User's Guide

Part II

Life Scope TR

Bedside Monitor

BSM-6301/BSM-6501/BSM-6701

BSM-6000 series
BSM-6301A
BSM-6301K
BSM-6501A
BSM-6501K
BSM-6701A
BSM-6701K

0614-901229Q

NIHON KOHDEN

In order to use this product safely and fully understand all its functions, read this manual before using the product.

Keep this manual near the instrument or in the reach of the operator and refer to it whenever the operation is unclear.

This product stores personal patient information. Manage the information appropriately.

Patient names on the screen shots and recording examples in this manual are fictional and any resemblance to any person living or dead is purely coincidental.

The contents of this manual are subject to change without notice.

If you have any comments or suggestions on this manual, please contact us at: www.nihonkohden.com

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Contents

Conventions Used in this Manual and Instrument

Warnings, Cautions and Notes

Warnings, cautions and notes are used in this manual to alert or signal the reader to specific information.

WARNING

A warning alerts the user to possible injury or death associated with the use or misuse of the instrument.

CAUTION

A caution alerts the user to possible injury or problems with the instrument associated with its use or misuse such as instrument malfunction, instrument failure, damage to the instrument, or damage to other property.

NOTE

A note provides specific information, in the form of recommendations, prerequirements, alternative methods or supplemental information.

Text Conventions

- Names of hard keys on the bedside monitor are enclosed in square brackets: [Menu]
- Messages that are displayed on the screen are enclosed in quotation marks: “CHECK ELECTRODES”
- Names of items that are displayed on the screen are enclosed in angle brackets: <SENSITIVITY>

Related Documentation

The BSM-6000 series Bedside Monitor comes with the following manuals in addition to the Operator’s Manual.

User’s Guide, Part I

Gives supplemental information on the operation of the bedside monitor.

User’s Guide, Part II

Describes the features and settings of the monitoring parameters.

Administrator’s Guide

Describes how to install the bedside monitor. It also explains about the password protected settings on the SYSTEM SETUP window and SYSTEM CONFIGURATION screen which only an administrator can change.

Service Manual

Describes information on servicing the bedside monitor. Only qualified service personnel can service the bedside monitor.

Safety Standards

The safety standard of this bedside monitor is classified as follows:

Type of protection against electrical shock: CLASS I EQUIPMENT (AC Powered)
Internally Powered EQUIPMENT (BATTERY Powered)

Degree of protection against electrical shock

Defibrillator-proof type CF applied part:

AY-631P, AY-633P, AY-651P, AY-653P, AY-661P, AY-663P, AY-671P and AY-673P: ECG, Respiration (impedance and thermistor method), IBP, Temperature, SpO_2, SpO_2-2, CO_2, O_2, NIBP, BIS, CCO (APCO)

AY-660P: ECG, Respiration (impedance method), IBP, Temperature, SpO_2, CO_2, NIBP

AA-672P, AA-674P, JA-694P: Respiration (thermistor method), IBP, Temperature, SpO_2-2, CO_2, O_2, BIS, CCO (APCO)

BSM-1700 series: ECG, Respiration (impedance method), IBP, Temperature, SpO_2, SpO_2-2, CO_2, NIBP, BIS

CF applied part:

AY-631P, AY-633P, AY-651P, AY-653P, AY-661P, AY-663P, AY-671P, AY-673P, AA-672P, AA-674P, JA-694P and BSM-1700 series: CO

Degree of protection against harmful ingress of water:
IPX0 (non-protected)

Degree of safety of application in the presence of FLAMMABLE ANAESTHETIC MIXTURE WITH AIR, OR WITH OXYGEN OR NITROUS OXIDE: Equipment not suitable for use in the presence of FLAMMABLE ANAESTHETIC MIXTURE WITH AIR, OR WITH OXYGEN OR NITROUS OXIDE

Mode of operation: CONTINUOUS OPERATION

Safety Information

This User's Guide only contains safety information related to monitoring parameters. Full information is in the BSM-6000A/K series Bedside Monitor Operator's Manual (code number: 0614-900685R).

WARNING

Do not diagnose a patient based on only part of the monitoring data on the bedside monitor or only on the data acquired by the bedside monitor. Overall judgement must be performed by a physician who understands the features, limitations and characteristics of the bedside monitor by reading this operator's manual thoroughly and by reading the biomedical signals acquired by other instruments.

Section 1 ECG Monitoring

General

To monitor ECG, attach disposable electrodes to the patient and connect them to the ECG/RESP socket on the input unit or BSM-1700 series bedside monitor. Up to 12 leads can be monitored with arrhythmia analysis and ST level measurement.

WARNING

The bioelectric impedance measurement sensor of a minute ventilation rate-adaptive implantable pacemaker may be affected by cardiac monitoring and diagnostic equipment which is connected to the same patient. If this occurs, the pacemaker may pace at its maximum rate and give incorrect data to the monitor or diagnostic equipment. In this case, set the <IMPEDANCE MEASUREMENT> on the RESP/CO_2 window to OFF on the bedside monitor. For a patient that requires the respiration monitoring, measure the respiration by thermistor method.

NOTE

- ECG monitoring using 10 electrodes is not available when an AY-660P input unit is used.
- When a line isolation monitor is used, noise from the line isolation monitor may resemble actual ECG waveforms on the bedside monitor and cause false heart rate alarms or no alarm at all.

Using the Output Signal from the ECG/BP OUT Socket

CAUTION

When using the output signal from the monitor as the synchronization signal for other equipment such as an IABP (intra-aortic balloon pump) or defibrillator:

- Set the timing of the IABP by checking the waveform on the IABP screen.
- Check the condition of the bedside monitor at all times. The output signal may become unstable.
- Check that the delay time of the output signal is within the range of the connected equipment.

CAUTION

Only a Nihon Kohden defibrillator can use the output signal from the monitor as a synchronization signal. Check that the delay time of the output signal (heart rate trigger 20 ms maximum) is within the range of the connected defibrillator.

NOTE

- Analog ECG, analog BP and heart rate trigger output are not available when an AY-660P input unit is used.
- The output signal from the ECG/BP OUT socket may become unstable in the following conditions.
  - Electrode is dry or detached.
  - Electrode lead is damaged or disconnected from the electrode.
  - Electrode lead is pulled.
  - AC interference or EMG noise superimposed.
  - Air bubbles or blood clog in the circuit for monitoring IBP.
  - Cord or cable is disconnected or damaged.
- All instruments which are to be connected to the ECG/BP OUTPUT socket must use a YJ-910P or YJ-920P ECG/BP output cable and comply with the IEC 60601-1 safety standard for medical equipment.

The following shows the delay time of the output signal.

Output Signal	Delay Time
ECG	20 ms
BP	40 ms
Heart rate trigger	20 ms

Preparing for ECG Monitoring

Preparation Flowchart

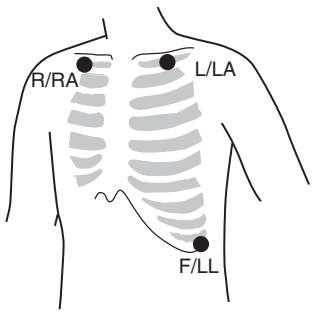
1. Select the electrode lead and electrodes.
2. Connect the electrode lead to the ECG connection cord and connect the ECG connection cord to the ECG/RESP socket on the input unit or BSM-1700 series bedside monitor.
3. Attach the disposable electrodes to the patient and attach the electrode lead to the electrodes.
4. Monitoring starts. Set necessary settings.

Number of Electrodes and Measuring Leads

The leads which can be monitored differ according to the type of electrode lead and number of electrodes used. This monitor automatically identifies the number of electrodes attached to the patient.

No. of Electrodes	Lead	Features
3	I, II, III	Can measure at the thoracic wall.
6	I, II, III, aVR, aVL, aVF, two leads from V1 to V6	Similar to the standard 12 lead.
10	I, II, III, aVR, aVL, aVF, V1 to V6	Standard 12 lead.

Electrode Position



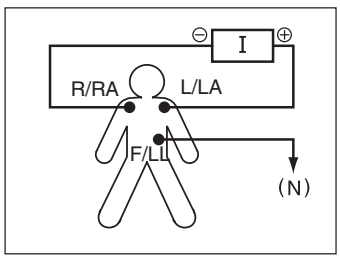
3 Electrode Leads

Electrode Position

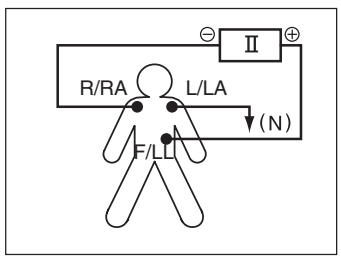
Symbol	Lead Color (Clip Color)	Electrode Position
R RA	Red (Red-beige) White (White-beige)	Right infraclavicular fossa
L LA	Yellow (Yellow-beige) Black (Black-beige)	Left infraclavicular fossa
F LL	Green (Green-beige) Red (Red-beige)	Lowest rib on the left anterior axillary line

Lead Connection

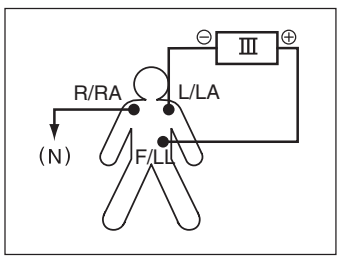
Lead I

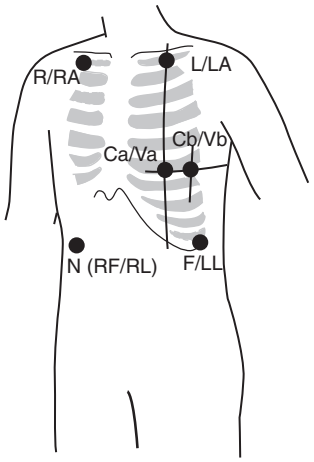


Lead II



Lead III





6 Electrode Leads

Electrode Position

The 5-electrode method with lead II and lead V5 is effective for monitoring myocardial ischemia. You can improve monitoring accuracy considerably by adding lead V4 to this combination. Ca and Cb (Va and Vb) can be at any position of the standard 12 leads C1 to C6 (V1 to V6), but C4 and C5 (V4 and V5) are most appropriate for myocardial ischemic monitoring.

For details on attaching the Ca or Cb electrode to C1, C2, C3 or C6, refer to the "Standard 12 Leads" section.

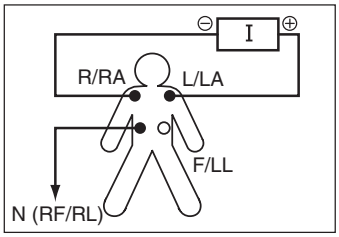
Symbol	Lead Color (Clip Color)	Electrode Position
R RA	Red (Red-beige) White (White-beige)	Right infraclavicular fossa
L LA	Yellow (Yellow-beige) Black (Black-beige)	Left infraclavicular fossa
F LL	Green (Green-beige) Red (Red-beige)	Lowest rib on the left anterior axillary line
N* (RF) N* (RL)	Black (Black-beige) Green (Green-beige)	Right anterior axillary line at the same level as F
Ca Va	White (Brown-white) Brown (Blue-brown)	Fifth intercostal space on the left midclavicular line (C4 position of standard 12 leads)
Cb Vb	White (Black-white) Brown (Orange-brown)	Left anterior axillary line at the same level as Ca (C5 position of standard 12 leads)

* N is the electrical reference point.

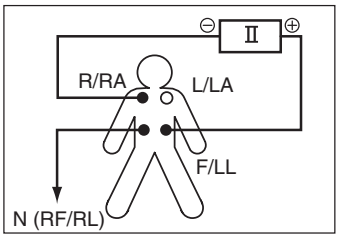
Lead Position

Standard limb leads

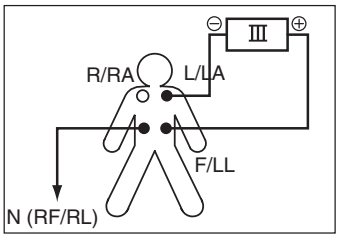
Lead I



Lead II

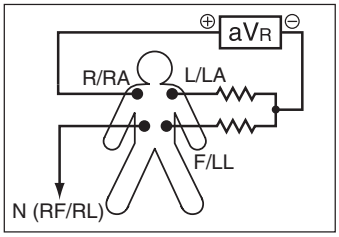


Lead III

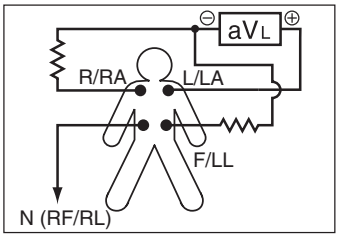


Monopolar limb leads

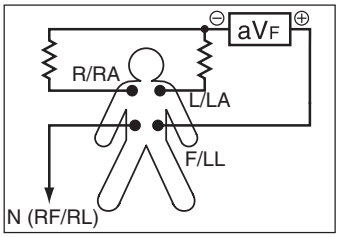
aV_R lead



aV_L lead

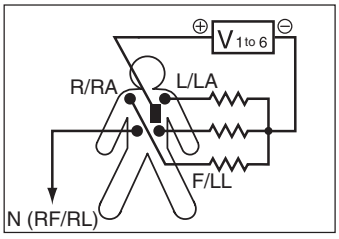


aV_F lead



Monopolar chest leads

V1 to V6 leads

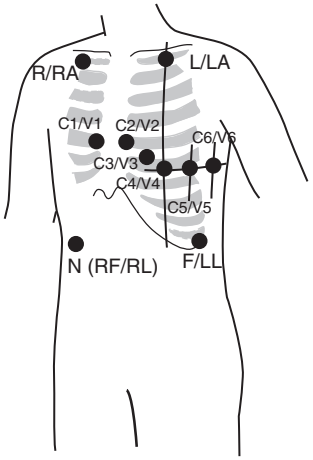


Mason-Likar Modification

WARNING

Do not use 12 lead ECG interpretation results and measured values from the Mason-Likar modification for diagnosis because the limb electrode placement is not the same as the standard 12 lead ECG. This may cause wrong diagnosis since 12 lead ECG interpretation of this monitor is based on the standard 12 lead ECG.

The Mason-Likar modification places the four limb electrodes close to the shoulders and lower abdomen. The six C (V) electrodes are placed on the chest in the same position as the standard 12 lead ECG electrode placement. The waveforms acquired from the Mason-Likar modification are different from those of the standard 12 lead.



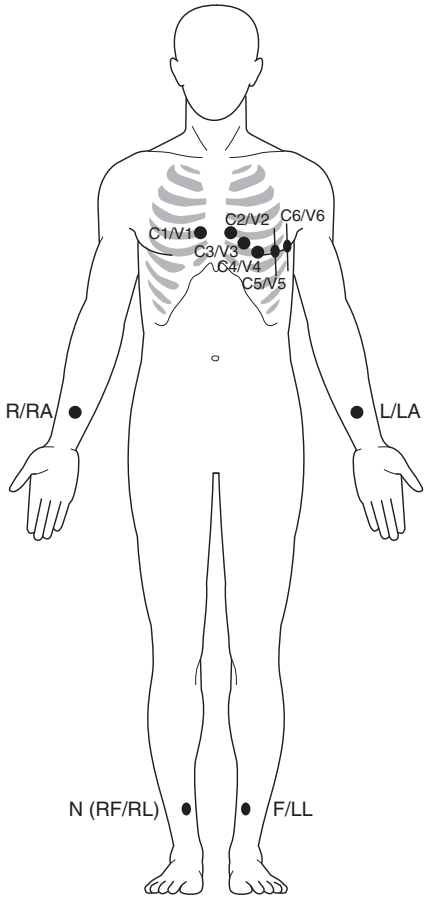
Electrode Position

Symbol	Lead Color (Clip Color)	Electrode Position
R RA	Red (Red-beige) White (White-beige)	Right infraclavicular fossa
L LA	Yellow (Yellow-beige) Black (Black-beige)	Left infraclavicular fossa
F LL	Green (Green-beige) Red (Red-beige)	Lowest rib on the left anterior axillary line
N* (RF) N* (RL)	Black (Black-beige) Green (Green-beige)	Right anterior axillary line at the same level as F
C1 V1	White (Red-white) Brown (Red-brown)	Fourth intercostal space at the right border of the sternum
C2 V2	White (Yellow-white) Brown (Yellow-brown)	Fourth intercostal space at the left border of the sternum
C3 V3	White (Green-white) Brown (Green-brown)	Halfway between C2 and C4
C4 V4	White (Brown-white) Brown (Blue-brown)	Fifth intercostal space on the left midclavicular line
C5 V5	White (Black-white) Brown (Orange-brown)	Left anterior axillary line at the same level as C4
C6 V6	White (Purple-white) Brown (Purple-brown)	Left midaxillary line at the same level as C4

* N is the electrical reference point.

Lead Connection

The lead connection is the same as the 6 electrode lead.



Standard 12 Leads

Electrode Position

Symbol	Lead Color (Clip Color)	Electrode Position
R RA	Red (Red-beige) White (White-beige)	Inside of right arm between the wrist and the elbow
L LA	Yellow (Yellow-beige) Black (Black-beige)	Inside of left arm between the wrist and the elbow
F LL	Green (Green-beige) Red (Red-beige)	Inside of the left calf between the knee and the ankle
N* (RF) N* (RL)	Black (Black-beige) Green (Green-beige)	Inside of the right calf between the knee and the ankle
C1 V1	White (Red-white) Brown (Red-brown)	Fourth intercostal space at the right border of the sternum
C2 V2	White (Yellow-white) Brown (Yellow-brown)	Fourth intercostal space at the left border of the sternum
C3 V3	White (Green-white) Brown (Green-brown)	Halfway between C2 and C4
C4 V4	White (Brown-white) Brown (Blue-brown)	Fifth intercostal space on the left midclavicular line
C5 V5	White (Black-white) Brown (Orange-brown)	Left anterior axillary line at the same level as C4
C6 V6	White (Purple-white) Brown (Purple-brown)	Left midaxillary line at the same level as C4

* N is the electrical reference point.

Lead Connection

The lead connection is the same as the 6 electrode lead.

Electrode Positions for Detecting the Pacemaker Pulse

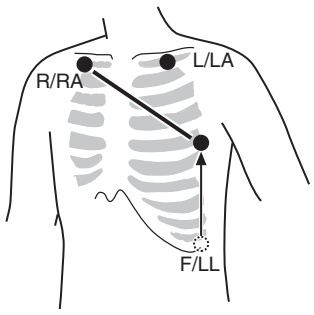
If the pacemaker pulse cannot be detected, change the electrode lead or electrode positions as follows.

Changing the Electrode Lead

If the pacemaker pulse cannot be detected with lead II, use lead I or lead III.

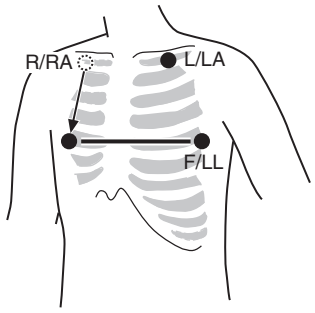
Changing the Electrode Positions

If the pacemaker pulse cannot be detected with lead I or lead III, change the electrode position as follows.



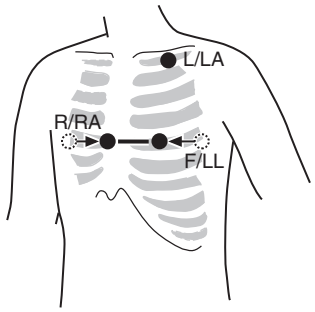
Lead II

1. With the lead II position, move the F/LL electrode up.



Lead II

2. If step 1 was not effective, move the R/RA electrode down.



Lead II

3. If step 2 was not effective, move the R/RA and F/LL electrodes closer together.

   If the pacemaker pulse is still not detected, the pacing pulse on the body surface may be too small. The sensitivity performance is limited.

Selecting Electrodes and Lead

Select the appropriate electrodes and lead according to the purpose.

WARNING

When using a defibrillator together with the monitor, use Ag/AgCl electrodes. Other types of electrodes, stainless steel in particular, will adversely affect the ECG waveform by slowing the baseline recovery on the monitor and result in no monitoring immediately following defibrillation.

CAUTION

Only use Nihon Kohden specified electrodes and electrode leads. When other type of electrodes or electrode leads are used, the “CHECK ELECTRODES” message may be displayed and ECG monitoring may stop.

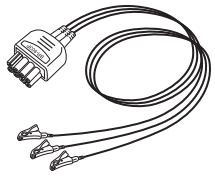
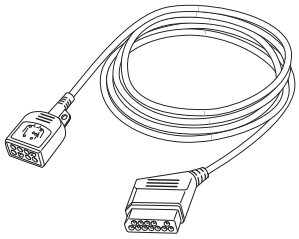
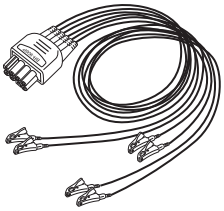
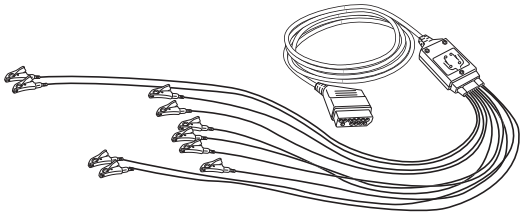
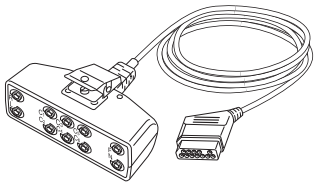
CAUTION

- When using the electrodes with DIN type lead, use only Vitrode V or N electrodes. If other electrodes are used, the electrode lead might not be properly connected and ECG monitoring may be unstable.
- Do not use electrodes of different metals. ECG monitoring may be unstable if electrodes of different metals are used.

NOTE

- Electrode leads other than Nihon Kohden’s might not be defibrillator-proof.
- Do not use different types of electrodes together. This might cause ECG monitoring to become unstable.

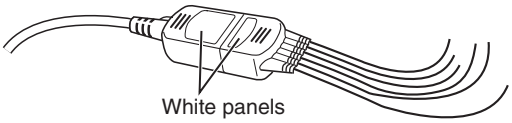
Types of Electrodes and Lead

<table>
<tr><th>No. of Electrodes</th><th>Disposable Electrodes</th><th>Electrode Lead</th><th>ECG Connection Cord</th></tr>
<tr><td rowspan="2">3
(I, II, III)</td><td>Vitrode F-150M, F-150S, L-150, L-150X</td><td>BR-903P (IEC)/BR-903PA (AHA) (Clip type, 0.8 m)
BR-963P (IEC) (Clip type: 0.8 m)
  </td><td rowspan="3">JC-906P (IEC)/JC-906PA (AHA), 3 m
JC-916P (IEC), 1.5 m
  </td></tr>
<tr><td colspan="2">Disposable Electrode with DIN type lead, Vitrode V-090M3, V-09IO3, V-120S3, N-03IS3</td></tr>
<tr><td rowspan="2">6
(I, II, III, aVR, aVL, aVF, 2 from V1 to V6)</td><td>Vitrode F-150M, F-150S, L-150, L-150X</td><td>BR-906P (IEC)/BR-906PA (AHA) (Clip type, 0.8 m)
  </td></tr>
<tr><td colspan="2">Disposable Electrode with DIN type lead, Vitrode V-060M6, V-06IO6</td></tr>
<tr><td rowspan="2">10
(I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6)</td><td>Vitrode F-150M, F-150S, L-150, L-150X</td><td colspan="2">ECG Patient Cable BJ-900P (IEC)/BJ-900PA (AHA)
  </td></tr>
<tr><td colspan="2">Disposable Electrode with DIN type lead, Vitrode V-040M4, V-04IO4, V-060M6, V-06IO6</td><td>JC-900P (IEC)/
JC-900PA (AHA)
  </td></tr>
</table>

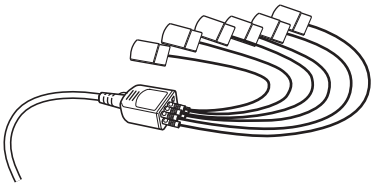
Connecting Cables and Attaching Disposable Electrodes

Connecting the Electrode Cable to the Input Unit

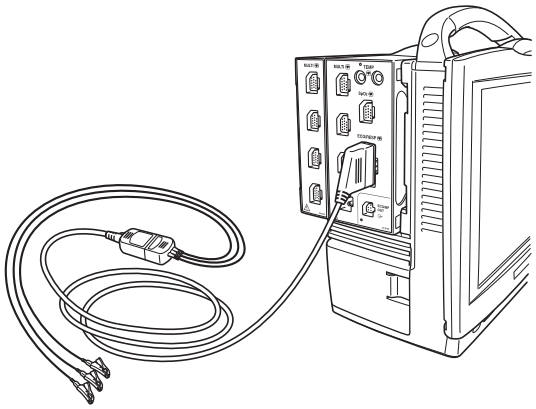
1. Connect the electrode lead and ECG connection cord so that their white panels face the same side.



When using the electrode with DIN type lead, connect the electrode lead of the electrode directly to the ECG connection cord according to the panel symbols.



2. Connect the ECG connection cord to the ECG/RESP socket.



When connecting the 3-electrode lead

When using more than 3 electrodes with DIN type lead with JC-906P or JC-906PA ECG connection cord, the number of electrodes must be set on the OTHER page of the ECG window. Refer to the “Changing the Number of Electrodes” section.

Connecting the Electrode Cable to the BSM-1700 series Bedside Monitor

Refer to the manuals of the BSM-1700 series bedside monitor for details.

Attaching Disposable Electrodes to the Patient

Attach the electrodes to the patient by referring to the manual provided with the electrodes.

WARNING

After attaching the electrode to the patient and connecting the cable to the monitor, check that electrodes are attached to the patient and check that the cable is connected to the monitor properly. When the electrodes are removed from the patient, do not touch the metal part of the electrode with bare hands or let the metal part of the electrode contact the metal part of the bed or any other conductive parts. Failure to follow this warning may cause electrical shock or injury to the patient by discharged energy.

CAUTION

Do not reuse disposable electrodes.

NOTE

- To maintain good contact between the electrode and skin, check that the paste of the disposable electrode is not dry.
- When contact of the disposable electrode becomes poor, replace the electrode with a new one immediately. Otherwise, contact impedance between the skin and electrode increases and the correct ECG cannot be obtained.

To obtain a stable ECG:

- Shave excess hair.
- Rub the patient's skin with a piece of cotton where the electrodes are to be attached.
- If the skin is dirty, clean with soap and water. Dry completely.

Monitoring ECG

When electrodes are attached to the patient and cables are connected properly, ECG and heart rate appear on the screen. The monitor automatically learns the patient's dominant ECG.

One lead appears on the home screen. Up to three leads can be displayed on the home screen when monitoring with six or ten leads. You can display eight leads on the 12 LEAD window when monitoring with six electrodes and twelve leads when monitoring with ten electrodes. To perform 12 lead ECG interpretation, ECG must be monitored with ten electrodes. For details about the 12 lead ECG interpretation, refer to the Operator's Manual or Section 7 of the User's Guide Part I.

The number of traces to be displayed on the home screen can be set on the DISPLAY window. Refer to Section 4 of the User's Guide Part I.

CAUTION

When the "CHECK ELECTRODES" message is displayed, ECG is not monitored properly and the ECG alarm does not function. Check the electrode, electrode leads and connection cord, and if necessary, replace with new ones.

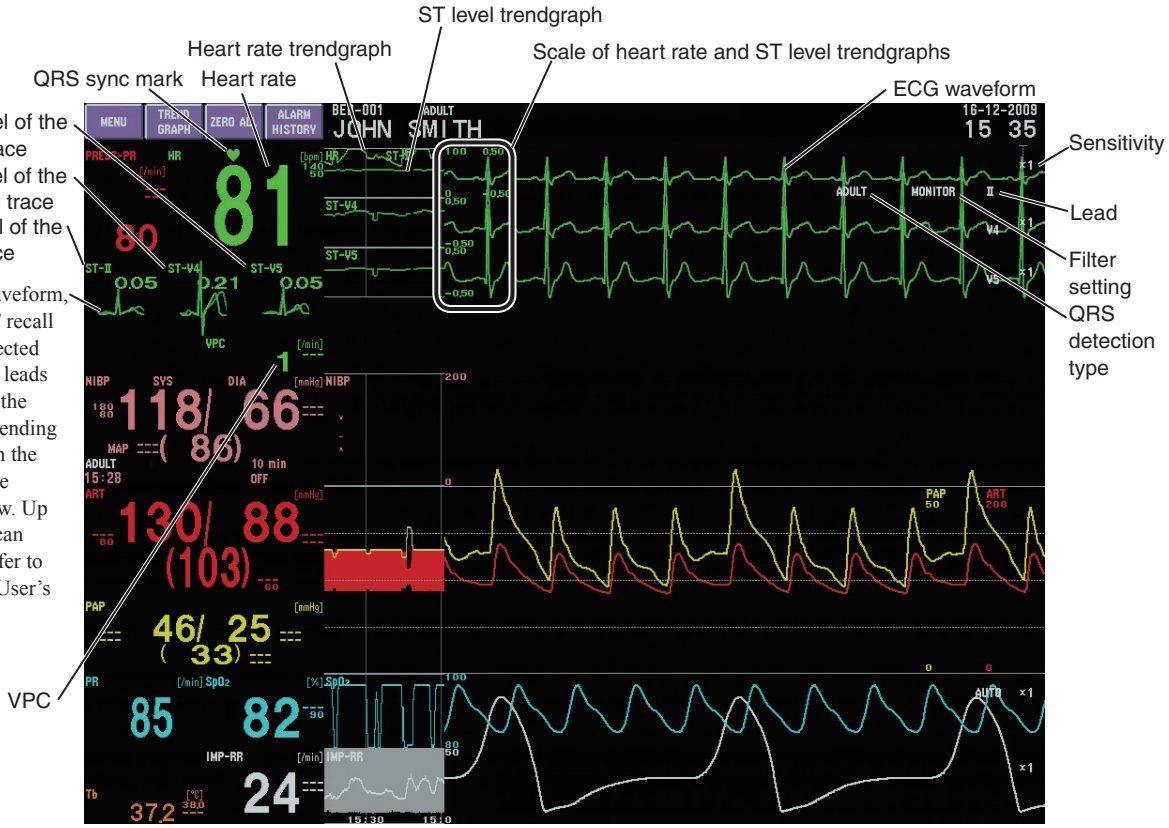
CAUTION

When the "NOISE" or "CANNOT ANALYZE" message is displayed, ECG data and alarm are not reliable. Remove the cause by checking the electrodes, electrode leads, patient's body movement, EMG and peripheral instruments grounding. Also make sure that an electric blanket is not used.

NOTE

- After adjusting the sensitivity of the ECG on the screen and changing necessary settings, check that the dominant QRS is appropriate.
- Before starting monitoring of a pacemaker patient, check that the pacing mark is displayed on the ECG.
- The maximum heart rate range is 300 beats/min. "300" is displayed on the screen even when the patient's heart rate is above 300.

ECG Information on the Home Screen



The ST recall waveform, and reference ST recall waveform of selected monitoring ECG leads are displayed on the home screen depending on the settings on the ST window of the REVIEW window. Up to 3 waveforms can be displayed. Refer to Section 6 of the User's Guide Part I.

ECG Data Display

The following ECG related data is acquired when ECG is monitored.

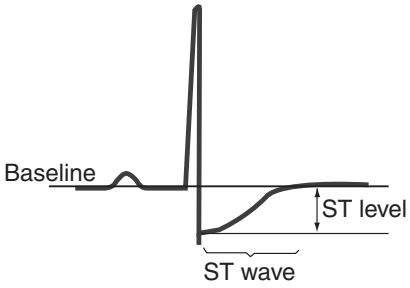
Screen/Window	Displayed Data	
	<ARRHYTHMIA ANALYSIS> is set to ON*1	**<ARRHYTHMIA ANALYSIS> is set to OFF***1
Home screen	Heart rate ST level Arrhythmia classification message Number of VPC per minute Arrhythmia alarm occurrence (when arrhythmia alarm is set to ON*2)	Heart rate ST level "ASYSTOLE" alarm occurrence
TREND window (Refer to the Operator's Manual or Section 6 of the User's Guide Part I)	Heart rate trendgraph ST level trendgraph Number of VPC trendgraph Heart rate list ST level list Number of VPC list	Heart rate trendgraph ST level trendgraph Heart rate list ST level list
ARRHYTHMIA RECALL window (Refer to the Operator's Manual or Section 6 of the User's Guide Part I)	Recall files of the arrhythmias set to be saved*3	"ASYSTOLE" recall files
ST RECALL window (Refer to the Operator's Manual or Section 6 of the User's Guide Part I)	ST recall files	ST recall files

*1 Arrhythmia analysis can be turned on or off on the ECG window → ARRHYTH ANALYSIS page.

*2 Alarm on/off and threshold can be set individually for certain arrhythmias on the ARRHYTH page on the ECG window or ARRHYTH ALARMS window.
When alarm recording is turned on, the data and waveform are recorded at the arrhythmia alarm occurrence.

*3 The arrhythmia waveforms to be saved as recall files are set on the RECALL window of the Review window.

Measuring ST Level



The ST level is the amplitude between the baseline and ST wave. The ECG waveform is averaged for 15 seconds to remove artifacts. The baseline and the ST wave are detected from the averaged ECG, and the ST level is measured.

NOTE

- If there are too many arrhythmias, there is noise on the ECG, or the heart rate is below 32, ST level might not be measured and ST level is not displayed on the screen.
- Although the ST algorithm has been tested for accuracy of the ST analysis result, the significance of the ST level changes need to be determined only by a physician.
- If there is baseline drift on the ECG, ST waves are distorted and the ST measurement may be impossible.

ST levels of up to 12 leads can be displayed on the ST window of the Review window. Refer to "ST Window" of the Operator's Manual or Section 6 of the User's Guide Part I.

You can change the ISO point, J point and ST point for ST level measurement on the ECG window → ST POINT page. Refer to the "Changing the ST Level Measurement Condition" section.

Detached Electrode Detection and Display

When an electrode or electrode lead is detached during ECG monitoring, a "CHECK ELECTRODES" alarm occurs.

When monitoring with 6 or 10 electrodes and <AUTO LEAD CHANGE> on the ECG window is set to ON, and the "CHECK ELECTRODES" message is displayed for more than 5 seconds, the lead for the first trace on the home screen is automatically changed to a stable lead.

Five seconds after the detached electrode or electrode lead is attached again, the lead of the first trace returns to the lead prior to auto lead change.

While the "CHECK ELECTRODES" message is displayed, the correct ECG waveform is not displayed. To prevent incorrect reading of ECG during an error condition, the ECG waveform is temporarily replaced with a square wave and flat line. Check the electrodes if this message appears. Refer to "Screen Messages" section of the Operator's Manual.

CAUTION

When the "CHECK ELECTRODES" message is displayed, ECG is not monitored properly and the ECG alarm does not function. Check the electrode, electrode leads and connection cord, and if necessary, replace with new ones.

When the “CHECK ELECTRODES” message appears, the ECG waveforms become square waves for 2 seconds, then change to flat lines above the baseline.

AC Interference and Display

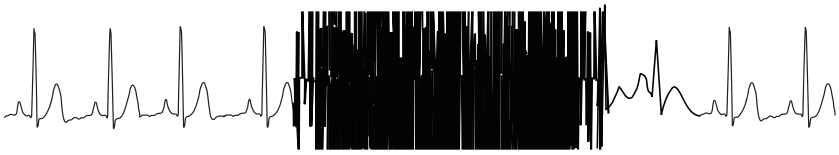
To prevent incorrect reading of ECG during an error condition, when there is a large AC interference (hum) on the waveform, the “CHECK ELECTRODES” message appears and the waveform appears as shown below, depending on the filter setting on the ECG window.

When the waveform looks like this, check that the bedside monitor is properly grounded.

Hum noises may interfere if the electrodes are dry. Replace the electrodes with new ones.

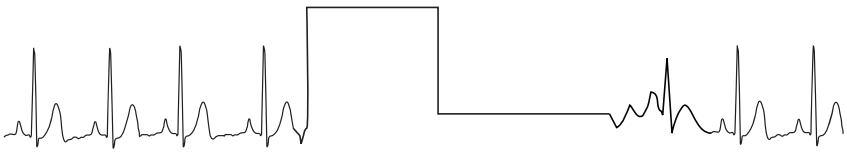
When <FILTERS> is set to DIAG

Noise superimposes on the waveform.



When <FILTERS> is set to MONITOR or MAXIMUM

When noise superimposes on the waveform and it is difficult to detect QRS waves, the ECG waveforms become square waves for 2 seconds, then change to flat lines above the baseline.



Monitoring Arrhythmia

General

The following functions are available for arrhythmia monitoring.

- Arrhythmia alarm indication (alarm sound, screen message and alarm indicator lamp). Refer to the Operator's Manual or Section 5 of the User's Guide Part I.
- Arrhythmia waveform storage (Arrhythmia recall files). Refer to the Operator's Manual or Section 6 of the User's Guide Part I.
- Arrhythmia waveform recording. Refer to the Operator's Manual or Section 10 of the User's Guide Part I.
- VPC display and trendgraph. Refer to the Operator's Manual or Section 4 and 6 of the User's Guide Part I.

WARNING

For arrhythmia monitoring, set <ARRHYTHMIA ANALYSIS> on the ECG window to ON. Otherwise, there is no sound or indication for arrhythmia alarms (except for ASYSTOLE).

When arrhythmia analysis is set to on, arrhythmia analysis starts as soon as the ECG monitoring starts. The monitor automatically detects and classifies arrhythmia by comparing each beat of the real-time ECG waveform to a reference ECG waveform (dominant QRS). If the following points of a QRS do not match the dominant QRS, that QRS is recognized as an arrhythmia.

- RR interval
- QRS width
- QRS amplitude
- QRS polarity

It is important to check the dominant QRS on the ECG window at the start of ECG monitoring for accurate arrhythmia monitoring.

CAUTION

At the start of ECG monitoring, check that the dominant QRS is appropriate. Otherwise arrhythmia monitoring may be inaccurate.

When the QRS wave or RR interval changes too frequently, it becomes difficult for the monitor to distinguish between the normal ECG and arrhythmia. To solve this problem, the monitor uses pattern matching and multi template matching for analyzing arrhythmia. However, when the patient's QRS changes rapidly, check that the appropriate dominant QRS is used for arrhythmia analysis.

Arrhythmia Analysis Data Display

When the monitor detects an arrhythmia, the arrhythmia alarm and data are indicated. The message display interval depends on the priority setting on the ALARM SETTINGS window. For details on this setting, refer to Section 3-2 of the Administrator's Guide.

The following arrhythmias are analyzed.

Arrhythmia Name	Description
ASYSTOLE	Longer than 3 to 10 seconds (selectable) with no QRS complex.
VF	Ventricular fibrillation longer than 4 seconds.
VT	Ventricular tachycardia. 3 to 9 (selectable*[1]) or more consecutive VPCs when heart rate exceeding the VT heart rate limit (16 to 300 beats/min selectable*[1]).
EXT TACHY*[1]	Extreme tachycardia exceeding the EXTREME TACHY limit.
EXT BRADY*[1]	Extreme bradycardia dropping below the EXTREME BRADY limit.
V BRADY*[1]	Ventricular bradycardia. 3 or more consecutive VPCs when heart rate drops below the V BRADY heart rate limit (15 to 299 beats/min selectable).
VPC RUN	VPC short run. 3 to 8 (selectable) consecutive VPCs when heart rate exceeds the VPC RUN heart rate limit (16 to 300 beats/min selectable*[1]). or The selected number*[4] of consecutive VPCs when heart rate drops below the VT heart rate limit.
SV TACHY*[1]	Supraventricular tachycardia. 3 to 9 (selectable) or more consecutive normal QRS of regular R-R interval when heart rate exceeding the SV TACHY heart rate limit (16 to 300 beats/min selectable).
TACHYCARDIA	Heart rate above the upper heart rate limit.
BRADYCARDIA	Heart rate below the lower heart rate limit.
PAUSE*[1]	1 to 3 seconds (selectable) with no QRS.
V RHYTHM*[1]	Ventricular rhythm. 3 or more consecutive VPCs.
COUPLET	VPC couplet (paired VPCs). 2 consecutive VPCs.
EARLY VPC	Early VPC including R-on-T type. VPC with a time interval from the preceding normal QRS complex of less than approximately one-third of the normal R-R interval, at heart rate dropping below 120*[2] beats/min.
MULTIFORM*[1]	Two different shaped VPCs within the last 3 minutes.
BIGEMINY	Ventricular bigeminy. 3 or more consecutive pairs of VPC and normal QRS. A dominant rhythm of N-V-N-V-N-V (N = normal beat, V = ventricular beat)
TRIGEMINY*[1]	Ventricular trigeminy. A dominant rhythm of N-N-V-N-N-V.
FREQ VPC	Frequent VPCs. VPC rate (VPCs/min) reaching or exceeding the preset limit of 1 to 99 VPCs/min (selectable).
VPC	Ventricular premature contraction.
IRREGULAR RR*[1]	Consistently irregular R-R intervals.
PROLONGED RR*[1]	R-R interval 1.75 times longer than the dominant R-R interval.
NO PACER PULSE*[1]*[3]	No QRS and pacing pulse within the bradycardia limit. Oversensing.
PACER NON-CAPTURE*[1]*[3]	No QRS from the preceding pacing pulse for the preset time interval (40 to 480 ms selectable). Non-capture.

*[1] These arrhythmias become available when "EXTENDED" is selected for <ARRHYTHMIA TYPE> on the SYSTEM SETUP screen. Refer to Section 3 of the Administrator's Guide.

*[2] 120 beats/min when <QRS DETECTION TYPE> is set to ADULT, 150 beats/min when <QRS DETECTION TYPE> is set to CHILD or NEONATE.

*[3] Available only when pacing detection is set to ON.

*[4] This number is set in the VT alarm setting.

NOTE

If arrhythmia type is changed to “EXTENDED” and the bedside monitor is connected via network to a central monitor that has old software, the “Lost communication with instruments in the network” message appears on the bedside monitor and the bedside monitor cannot be monitored on the central monitor.

The QRS is annotated as follows.

QRS Annotation	Description
N	Normal QRS complex
V	Ventricular premature contraction
P	Paced QRS
?	Impossible to classify or during learning
–	Noise

Changing Arrhythmia Monitoring Settings

Check the following settings for arrhythmia monitoring.

Turning Arrhythmia Analysis On or Off

WARNING

For arrhythmia monitoring, set <ARRHYTHMIA ANALYSIS> on the ECG window to ON. Otherwise, there is no sound or indication for arrhythmia alarms (except for ASYSTOLE).

When arrhythmia monitoring is necessary, select “ON”.

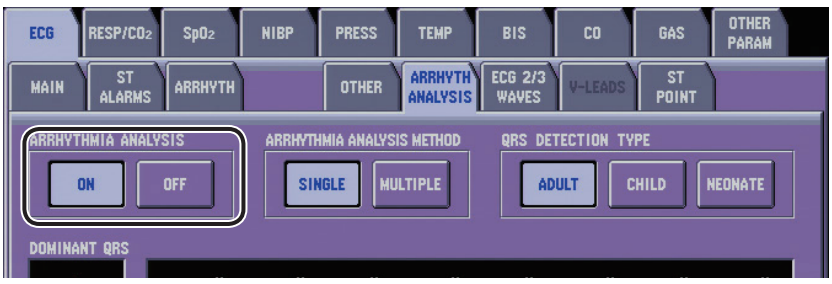
This arrhythmia analysis on/off setting returns to the master setting on the ARRHYTH page of the MASTER window when:

- The monitor power is off for more than 30 minutes and <SHOW ADMIT CONFIRMATION WINDOW> is turned off in the SYSTEM CONFIGURATION screen.
- The patient is admitted or discharged.

To change the master setting, refer to Section 3 of the Administrator’s Guide.

1. Display the ARRHYTH ANALYSIS page of the ECG window.
   Press the [Menu] key → ECG key → ARRHYTH ANALYSIS tab.

2. Select ON or OFF in the <ARRHYTHMIA ANALYSIS> box to turn arrhythmia analysis on or off.



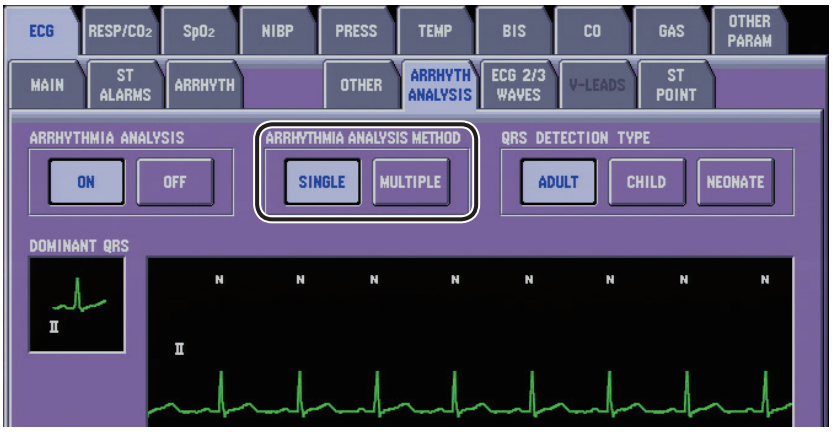
3. Press the [Home] key to return to the home screen.

Selecting Arrhythmia Analysis Leads

Select the leads for arrhythmia analysis.

1. Display the ARRHYTH ANALYSIS page of the ECG window.
   Press the [Menu] key → ECG key → ARRHYTH ANALYSIS tab.

2. Select SINGLE or MULTIPLE in the <ARRHYTHMIA ANALYSIS METHOD> box to select analyzing leads.
   SINGLE: The lead selected for the first trace is analyzed.
   MULTIPLE: The leads selected for the first and second traces are analyzed.



3. Press the [Home] key to return to the home screen.

Selecting the Patient Type for QRS Detection

CAUTION

At the start of ECG monitoring, check that the correct patient type is set for <QRS DETECTION TYPE> on the ARRHYTH ANALYSIS page of the ECG window. If an inappropriate patient type is set, heart rate cannot be counted accurately and noise or P waves may be counted as QRS and cardiac arrest may be overlooked.

Select the monitoring patient type. The selected patient type is displayed on the home screen.

This QRS detection type set on the ECG window returns to this master setting when:

- The monitor power is off for more than 30 minutes and <SHOW ADMIT CONFIRMATION WINDOW> is turned off in the SYSTEM CONFIGURATION screen.
- The patient is admitted or discharged.

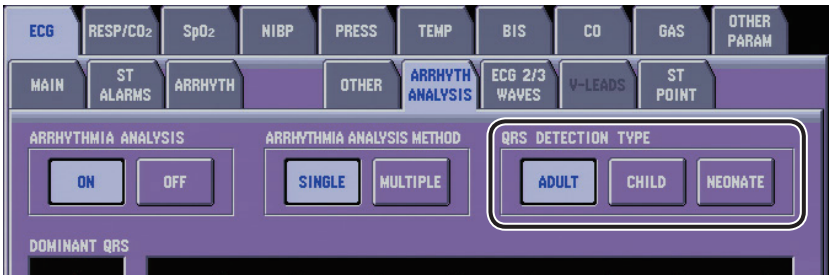
To change the master setting, refer to Section 3 of the Administrator's Guide.

The QRS settings depend on the patient type.

Items	QRS DETECTION TYPE Setting		
	ADULT	CHILD	NEONATE
Detect narrow QRS	Not available	Not available	Available
QRS detection sensitivity	Automatic sensitivity	Same as the <SENSITIVITY> setting	Automatic sensitivity
Default setting of ISO point	R – 80 ms	R – 56 ms	
Default setting of J point	R + 48 ms	Cannot be set	
Default setting of ST point	J + 60 ms	R + 60 ms	

1. Display the ARRHYTH ANALYSIS page of the ECG window.
   Press the [Menu] key → ECG key → ARRHYTH ANALYSIS tab.

2. Select the patient type in the <QRS DETECTION TYPE> box.



3. Press the [Home] key to return to the home screen.

Learning the ECG Waveform for Arrhythmia Detection (VPC Learning)

The monitor automatically detects and classifies arrhythmia waveforms when arrhythmia analysis is set to on. To do this, the monitor compares each beat of the real-time ECG waveform to a reference ECG waveform which is called dominant QRS.

The monitor automatically samples this dominant QRS in the following situations:

- When ECG monitoring begins
- When the monitoring lead is changed
- When the “CHECK ELECTRODES” alarm message is resolved
- When the waveform changes from ventricular rhythm to supraventricular rhythm and satisfies the conditions specified by Nihon Kohden.

Sampling the reference waveform is called “Learning”.

Learning takes a few seconds. During learning, a “LEARNING” message is displayed on the screen. After learning, the dominant QRS is replaced with the new one and the monitor resumes analyzing the ECG waveforms.

NOTE

- To make the monitor learn, <ARRHYTHMIA ANALYSIS> on the ARRHYTH ANALYSIS page of the ECG window must be set to ON.
- During learning, alarms other than “ASYSTOLE”, “VF”, “BRADYCARDIA” and “TACHYCARDIA” do not function.

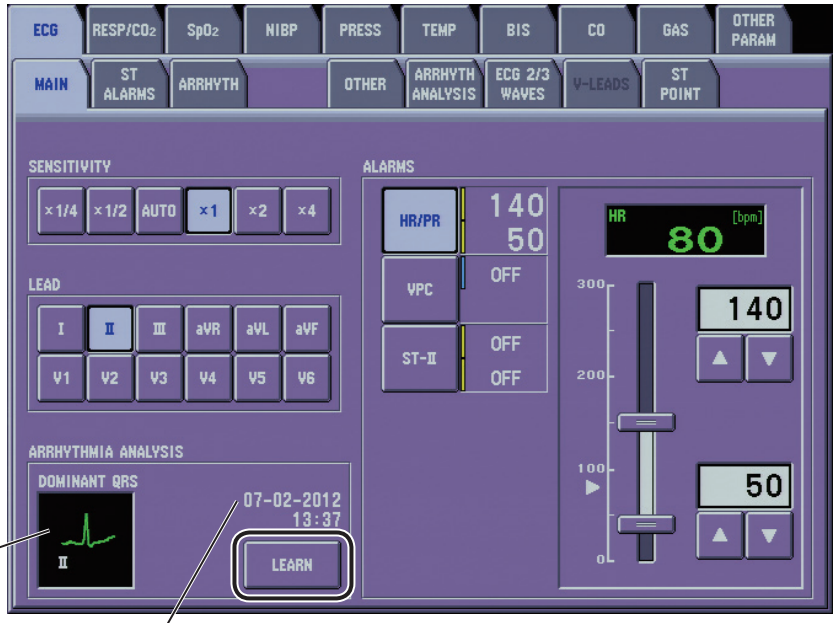
You can make the monitor “relearn” the reference ECG waveform at any time, for example, when the automatic VPC classification is questionable.

CAUTION

If there is any doubt about the arrhythmia analysis, make the monitor relearn the patient’s ECG and check that the dominant QRS is appropriate. Otherwise, an important arrhythmia may be overlooked.

1. Display the MAIN or ARRHYTH ANALYSIS page of the ECG window. Press the [Menu] key → ECG key → MAIN or ARRHYTH ANALYSIS tab.

2. Touch the LEARN key. The monitor learns the reference ECG waveform and the dominant QRS is refreshed.



3. Check that the dominant QRS is appropriate for arrhythmia analysis.

4. Press the [Home] key to return to the home screen.

Checking the Dominant QRS

The monitor detects QRS of the monitoring ECG and classifies them into templates. The monitor selects the most typical QRS, called dominant QRS, and uses it for analyzing arrhythmia. Whenever ECG is learned or relearned, the dominant QRS is refreshed.

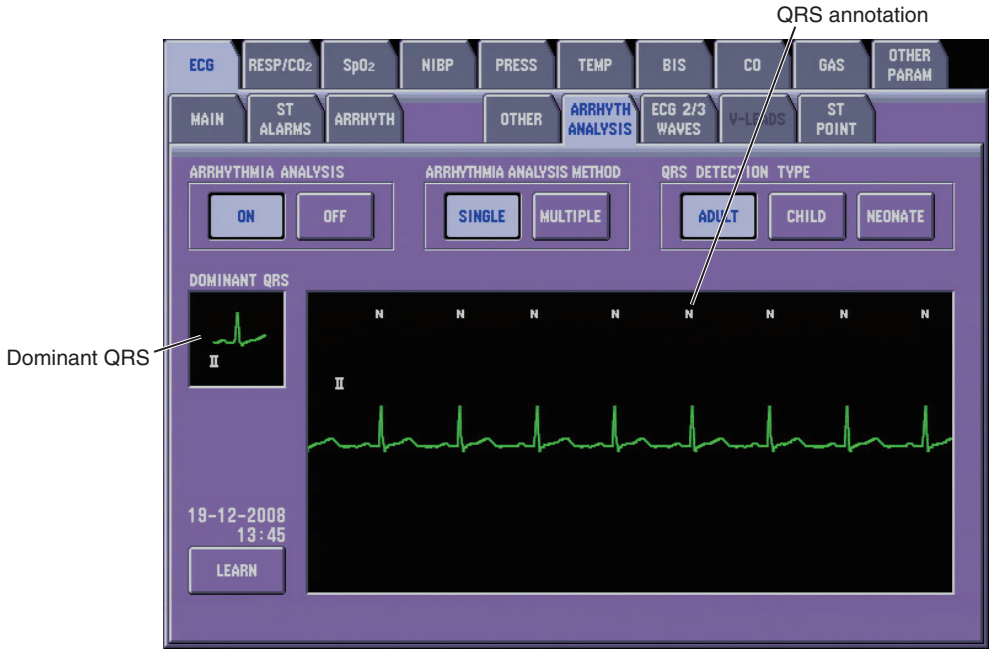
The ECG on the ARRHYTH ANALYSIS window are annotated by the following QRS classification.

QRS Annotation	Description
N	Normal QRS complex
V	Ventricular premature contraction
P	Paced QRS
?	Impossible to classify or during learning
–	Noise

If there is any doubt about the arrhythmia analysis, make the monitor relearn the patient's ECG and check the dominant QRS.

1. Display the ARRHYTH ANALYSIS page of the ECG window.
   Press the [Menu] key → ECG key → ARRHYTH ANALYSIS tab.

2. The dominant QRS and ECG of the first trace is displayed on the ARRHYTH ANALYSIS page.



NOTE

The ECG waveform on the ECG window is delayed 5 seconds.

3. Check that the dominant QRS is appropriate.

   To change the dominant QRS, touch the LEARN key to relearn the ECG. The dominant QRS is refreshed.

4. Press the [Home] key to return to the home screen.

Changing ECG Settings

Change settings on the ECG window. The following settings can be changed for ECG monitoring.

- ECG measurement on or off
- Monitoring lead and lead name
- ECG sensitivity
- Number of ECG traces on the home screen
- Learn ECG. Refer to the “Monitoring Arrhythmia” section.
- Heart rate, arrhythmia and ST alarm limits and setting
- Arrhythmia analysis on or off. Refer to the “Monitoring Arrhythmia” section.
- Arrhythmia analysis lead. Refer to the “Monitoring Arrhythmia” section.
- Check dominant QRS. Refer to the “Monitoring Arrhythmia” section.
- ST level settings
- Pacing settings
- Number of electrodes
- Auto lead change on or off when electrode is detached
- Heart rate display mode
- Filter mode
- Hum filter on or off
- Sync source
- Sync sound pitch
- Pulse rate display on or off
- QRS detection type

The following items can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator’s Guide.
- ECG electrode lead type (IEC or AHA)
- Heart rate sync sound pitch
- ECG display color
- Arrhythmia type (standard or extended)
- Cascade ECG waveform

The ST level unit (mV or mm) can be set on the SYSTEM CONFIGURATION screen. Refer to Section 2 of the Administrator’s Guide.

The scale of the heart rate and ST level trendgraphs on the home screen are the same scale as the trendgraphs of the Review window. Refer to the Operator’s Manual or Section 6 of the User’s Guide Part I.

ST waveform and reference ST recall waveform display on the home screen can be set to ON or OFF. Refer to Section 6 of the User’s Guide Part I.

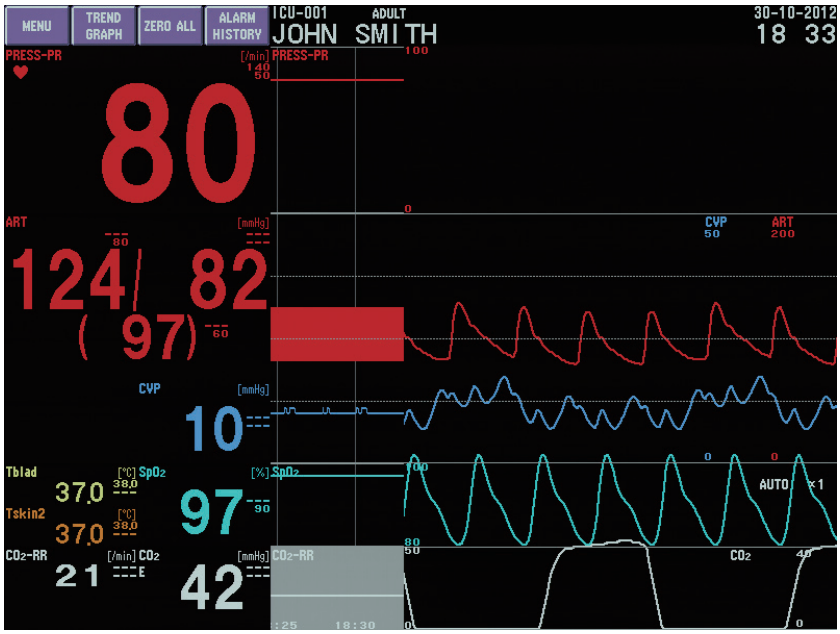
The ECG sweep speed is the speed set on the DISPLAY window. Refer to Section 3 of the User’s Guide Part I.

If the ECG CHECK ELECTRODES or CANNOT ANALYZE alarm occurs and no action is taken for a selected duration, the alarm level can be escalated. Refer to Section 3 of the Administrator’s Guide.

Turning ECG Measurement On or Off

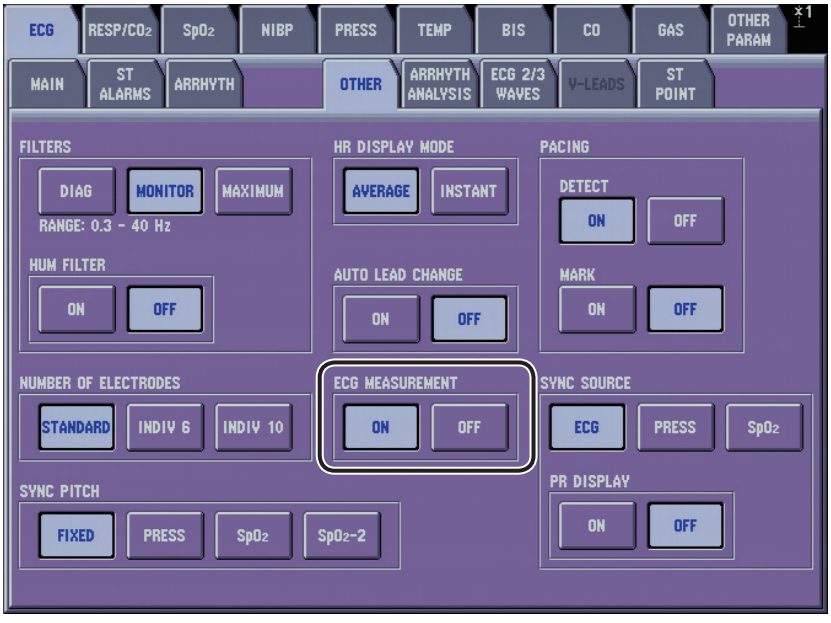
You can select ECG measurement on or off.

Home screen example when <ECG MEASUREMENT> is turned off



1. Display the OTHER page of the ECG window.
   Press the [Menu] key → ECG key → OTHER tab.

2. Select ON or OFF in the <ECG MEASUREMENT> box.
   ON: Measured value and waveform are displayed on the home screen. ECG related alarms are enabled.
   OFF: Measured value and waveform are not displayed. ECG related alarms are disabled.



3. Start ECG monitoring and check that the ECG waveform is displayed on the home screen.

NOTE

- The <ECG MEASUREMENT> setting cannot be changed to OFF while ECG is monitored.
- Even when the setting is set to OFF, the setting automatically changes to ON when ECG measurement is started. If the measured value and waveform are not displayed on the home screen within 10 seconds, change the setting to ON manually.
- After setting <ECG MEASUREMENT> to ON, check that the ECG waveform is displayed on the home screen.

Changing the Monitoring Lead

One lead can be monitored with 3 electrodes and three leads can be monitored with 6 or 10 electrodes on the home screen.

No. of Electrodes	Lead
3	I, II, III
6	I, II, III, aVR, aVL, aVF, two leads from V1 to V6
10	I, II, III, aVR, aVL, aVF, V1 to V6

When monitoring with 6 or 10 electrodes, the lead of the first trace can be automatically changed to a stable lead when there is an electrode detachment or the “CHECK ELECTRODES” message is displayed for more than 5 seconds. Refer to the “Auto Lead Change On or Off” section.

Optimum Lead

NOTE

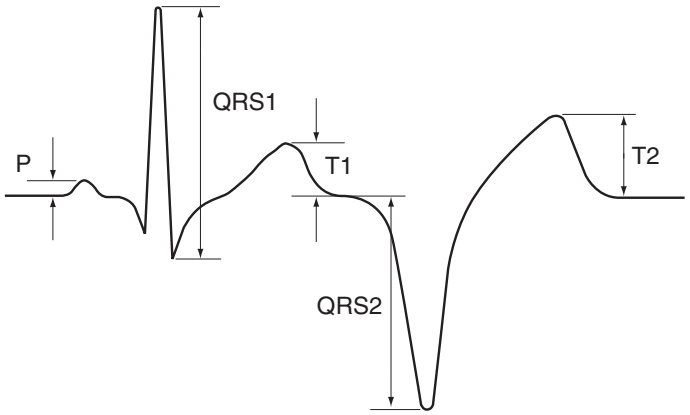
Follow the physician’s instructions for lead position when available.

It is generally considered that Lead II and Lead V1 are suitable for arrhythmia monitoring and that Lead V4 and Lead V5 are suitable for myocardial ischemia monitoring.

Some types of ECGs are difficult for automatic analysis, and heart rate or arrhythmia detection level is not accurate for some patients. In these cases, use the following procedure to find the appropriate lead for automatic analysis.

1. Measure the patient’s ECG with the standard 12 ECG leads using an ECG instrument.

2. Select the optimum lead according to the following guidelines:
   i) Select the lead with the highest QRS wave amplitude and least difference in amplitude compared with a VPC or pacing pulse.
   $0.5 \leq QRS1/QRS2 \leq 2$
   ii) Select the lead with less than 0.2 mV amplitude of the P-wave.
   $P \leq 0.2$ mV
   iii) Select the lead with a T-wave amplitude which is less than one-third of the QRS wave.
   $T1 \leq 1/3QRS1$, $T2 \leq 1/3QRS2$

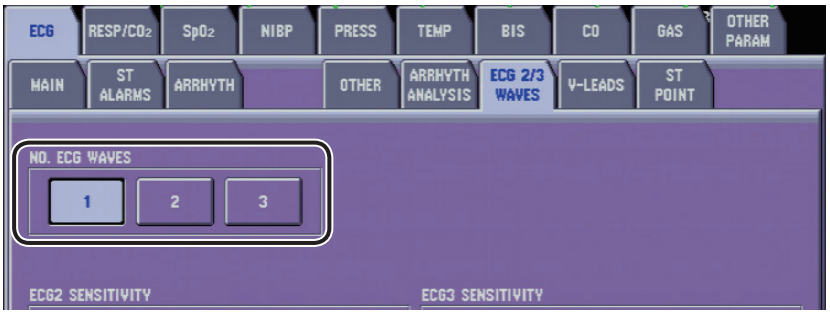


Selecting the Number of ECG Traces on the Home Screen

Select the number of ECG traces on the home screen. This setting can also be changed on the WAVES page of the DISPLAY window.

1. Display the ECG 2/3 WAVES page of the ECG window.
   Press the [Menu] key → ECG key → ECG 2/3 WAVES tab.

2. Select the number of ECG traces from the <NO. ECG WAVES> box.



3. Press the [Home] key to return to the home screen.

Changing a Lead

You can change the lead of traces on the home screen.

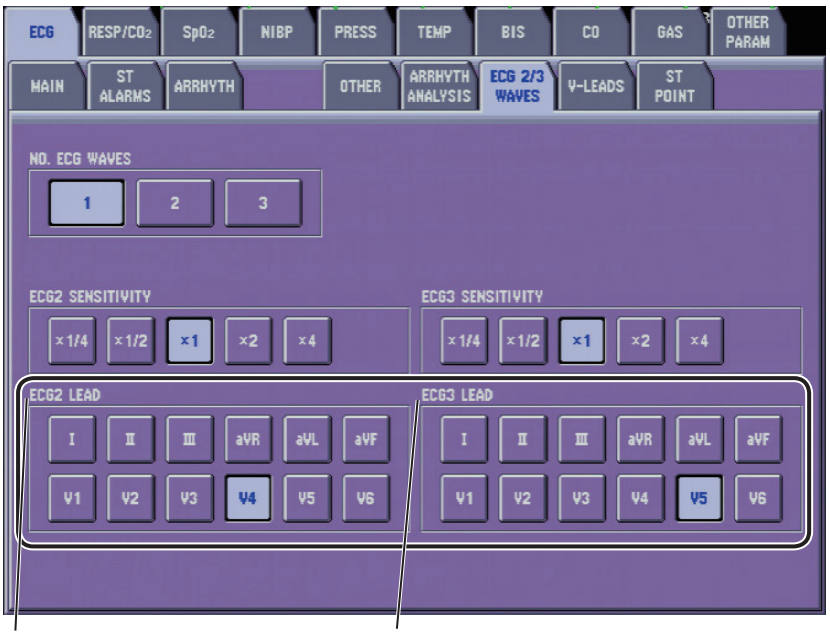
NOTE

- When the lead is changed on the MAIN window, the lead on the ARRHYTH ANALYSIS window also changes.
- When the <NUMBER OF ELECTRODES> setting on the OTHER window is changed, the lead setting automatically changes to II. Change the number of electrodes setting before changing the lead.

1. Display the MAIN page of the ECG window.
   Press the [Menu] key → ECG key → MAIN tab.

2. Select the lead from the <LEAD> box. The first trace changes to the selected lead.

To change the lead for the second and third traces on the home screen, touch the ECG2/3 WAVES tab and select the lead for each trace.



3. Press the [Home] key to return to the home screen.

Assigning Va and Vb (Ca and Cb) Leads when Monitoring with 6 Electrodes

You can assign the leads for Va and Vb when using 6 electrodes. After assigning the Va and Vb leads, select the monitoring lead.

1. Display the V-LEADS page of the ECG window.
   Press the [Menu] key → ECG key → V-LEADS tab.

2. Select the lead by touching the desired lead key. The selected lead becomes available to be selected on the ECG2/3 WAVES window.

If necessary, you can change the sensitivity for the second and third traces. Refer to the “Changing the ECG Sensitivity” section.

3. Press the [Home] key to return to the home screen.

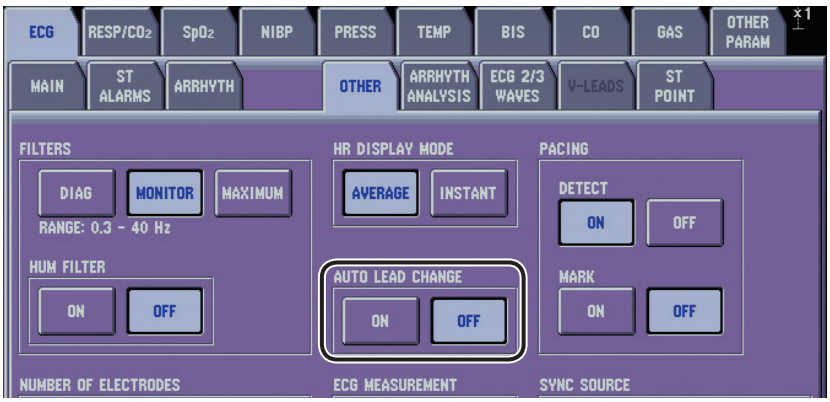
Auto Lead Change On or Off

When monitoring with 6 or 10 electrodes and <AUTO LEAD CHANGE> on the OTHER window is set to ON, the lead for the first trace on the home screen can be automatically changed to a stable lead when there is an electrode detachment or the “CHECK ELECTRODES” message is displayed for more than 5 seconds on the screen. While the “AUTO LEAD CHANGE” message is displayed, the “CHECK ELECTRODES” alarm message is not displayed.

Five seconds after the detached electrode or electrode lead is attached again, the lead of the first trace returns to the lead prior to auto lead change.

1. Display the OTHER page of the ECG window.
   Press the [Menu] key → ECG key → OTHER tab.

2. Select ON or OFF in the <AUTO LEAD CHANGE> box.



3. Press the [Home] key to return to the home screen.

Changing the ECG Sensitivity

The sensitivity determines the size of the waveform on both the screen and recording paper. For stable QRS detection, the QRS amplitude should be larger than 1 cm on the screen.

NOTE

When <QRS DETECTION TYPE> on the ARRHYTH ANALYSIS page is set to “ADULT” or “NEONATE”, the sensitivity is set automatically.

The sensitivity can be set manually or automatically. When you select auto sensitivity, the sensitivity is automatically determined according to the average QRS amplitude of the previous 16 beats. When sensitivity is set automatically, “AG” (auto gain) appears beside the sensitivity on the screen.

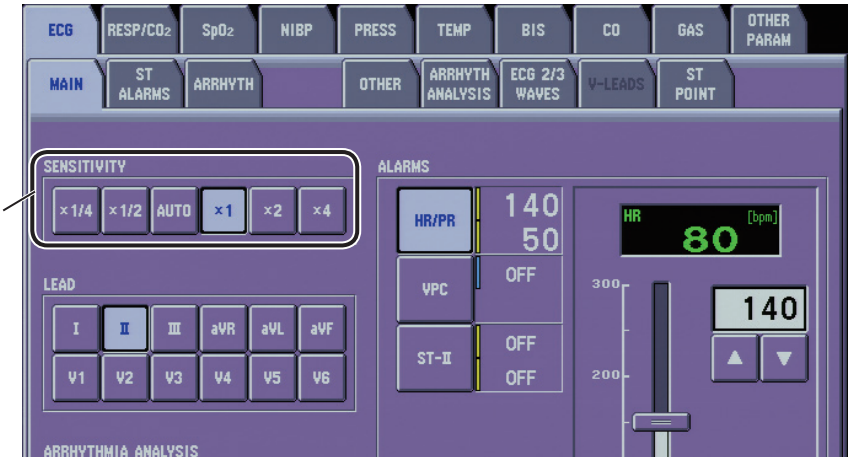
QRS Wave Amplitude	Auto Sensitivity
< 5 mm	× 4
< 10 mm	× 2
< 20 mm	× 1
< 30 mm	× 1/2
≥ 30 mm	× 1/4

NOTE

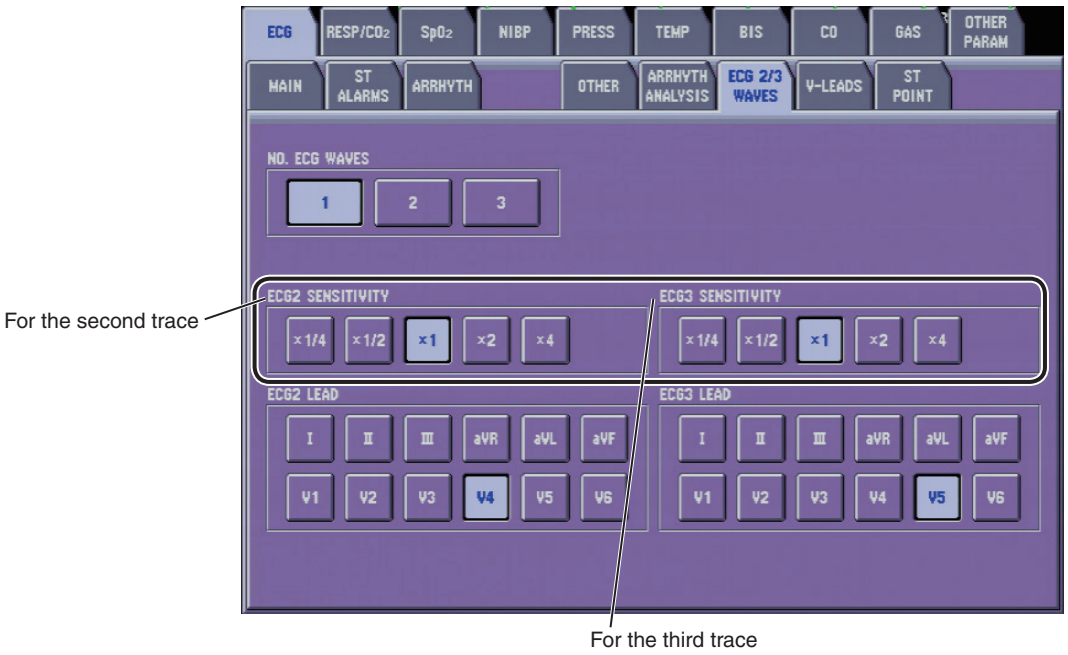
During learning or when there is noise, auto sensitivity is not possible.

1. Display the MAIN page of the ECG window.
   Press the [Menu] key → ECG key → MAIN tab.

2. Select the sensitivity from the <SENSITIVITY> box.



To change the sensitivity for the second and third traces, display the ECG2/3 WAVES page and select the sensitivity from the <ECG2 SENSITIVITY> box for the second trace and the <ECG3 SENSITIVITY> box for the third trace.



3. Press the [Home] key to return to the home screen.

Changing the Heart Rate/Pulse Rate, VPC and ST Alarm Limits

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

You can set the upper and lower heart rate/pulse rate, VPC and ST level of the first trace alarm limits on the ECG window. You can set all alarms, including the upper and lower heart rate alarm limits, on the ALARM LIMITS window (See the Operator's Manual or Section 5 of the User's Guide Part I).

Setting Range

NOTE

- VPC alarm limit can only be set when <ARRHYTHMIA ANALYSIS> on the ECG window is ON.
- If "EXT TACHY" or "EXT BRADY" are set to ON, the "ALARM CAP" setting for the "HR/PR" cannot be set. To apply the "ALARM CAP" setting for the "HR/PR", set "EXT TACHY" and "EXT BRADY" to OFF.

HR/PR: Upper limit: When <SYNC SOURCE> is set to ECG:
16 to 300 beats/min in 1 beat/min steps, OFF*1*2
When <SYNC SOURCE> is set to PRESS or SpO_2:
31 to 300 beats/min in 1 beat/min steps, OFF*1*2
When EXT TACHY alarm is set to ON:
16 to EXT TACHY alarm limit in 1 beat/min steps*1*2
(default setting: ADULT-140, CHILD-170, NEONATE-200)

Lower limit: When <SYNC SOURCE> is set to ECG:
OFF, 15 to 299 beats/min in 1 beat/min steps*1*2
When <SYNC SOURCE> is set to PRESS or SpO_2:
OFF, 30 to 299 beats/min in 1 beat/min steps*1*2
When EXT BRADY alarm is set to ON:
EXT BRADY alarm limit to 299 in 1 beat/min steps*1*2
(default setting: ADULT-50, CHILD-75, NEONATE-100)

*1 On BSM-6000A series, if <CRISIS VITAL ALARM MANAGEMENT> on the SYSTEM CONFIGURATION screen is turned on and "ALARM PRIORITY" on the SYSTEM SETUP window is set to CRISIS, the alarm setting is set to the alarm master setting.

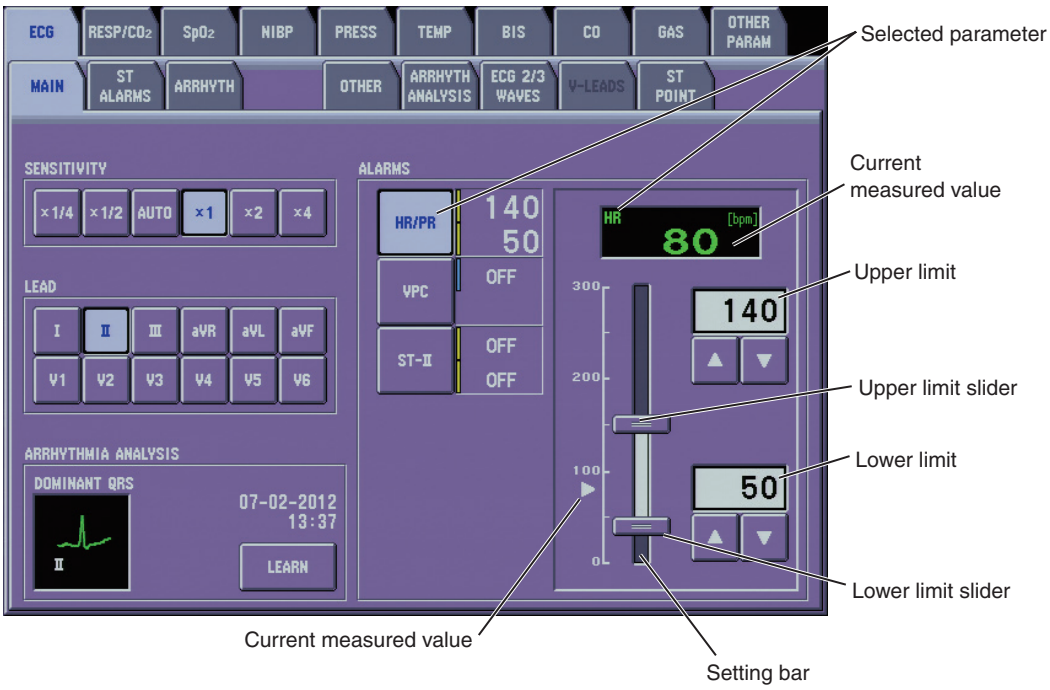
*2 On BSM-6000A series, if <ALARM CAP> on the SYSTEM CONFIGURATION screen is turned on, the alarm setting is affected by the "ALARM CAP" setting on the SYSTEM SETUP window.

VPC: Upper limit: 1 to 99 beats/min in 1 beats/min steps, OFF (default setting: OFF)

ST: Upper limit: –1.99 to +2.00 mV in 0.01 mV steps (–19.9 to +20.0 mm in 0.1 mm steps), OFF (default setting: OFF)
Lower limit: OFF, –2.00 to +1.99 mV in 0.01 mV steps (–20.0 to +19.9 mm in 0.1 mm steps) (default setting: OFF)

1. Display the MAIN page of the ECG window.
   Press the [Menu] key → ECG key → MAIN tab.

2. Touch the HR/PR key to change the heart rate/pulse rate alarm limits.
   Touch the VPC key to change the VPC alarm limit.
   Touch the ST key to change the ST level of the first trace alarm limits.



3. Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.

4. Press the [Home] key to return to the home screen.

Changing Arrhythmia Alarm Settings

WARNING

For arrhythmia monitoring, set <ARRHYTHMIA ANALYSIS> on the ECG window to ON. Otherwise, there is no sound or indication for arrhythmia alarms (except for ASYSTOLE).

CAUTION

When the alarm is turned OFF for an arrhythmia, there will be no alarm for that arrhythmia type. There is no message or mark to indicate that a certain arrhythmia alarm is turned off. Therefore, be careful when you turn off an arrhythmia alarm.

NOTE

When an arrhythmia alarm is turned OFF, there will be no alarm recording for that arrhythmia type even when alarm recording is set to ON on the RECORD window.

You can turn on or off the alarm for individual arrhythmias and set the threshold for some arrhythmias. The following table shows the setting for each arrhythmia.

Parameter	Detection Condition (Default Setting)	Alarm ON/OFF Setting (Default Setting)
ASYSTOLE	3 to 10 seconds (ADULT, CHILD: 5 s NEONATE: 3 s)	ON fixed
VF	—	ON fixed
VT	—	ON fixed
EXT TACHY*1*2	Upper heart rate alarm limit to 300 beats/min (ADULT: 160, CHILD 190, NEONATE: 220)	ON/OFF (OFF)
EXT BRADY*1*3	15 to lower heart rate alarm limit (ADULT: 40, CHILD 60, NEONATE: 80)	ON/OFF (OFF)
V BRADY*1	15 to 299 beats/min (ADULT, CHILD: 50 NEONATE: 60)	ON/OFF (ADULT OR: OFF, ICU/NICU: ON CHILD, NEONATE: OFF)
VPC RUN	3 to 8 VPCs (3)	ON/OFF (ADULT OR: OFF, ICU/NICU: ON CHILD, NEONATE: OFF)
	16 to 300 beats/min (ADULT, CHILD: 100 NEONATE: 140)*1	
SV TACHY*1	3 to 9 VPCs (6)	ON/OFF (OFF)
	16 to 300 beats/min (ADULT, CHILD: 170 NEONATE: 210)	ON/OFF (OFF)
PAUSE*1	1.0 to 3.0 s (ADULT, CHILD: 3.0 NEONATE: 1.5)	ON/OFF (ON)
V RHYTHM*1	—	ON/OFF (ADULT OR: OFF, ICU/NICU: ON CHILD, NEONATE: OFF)
COUPLET	—	ON/OFF (OFF)
EARLY VPC	—	ON/OFF (OFF)
MULTIFORM*1	—	ON/OFF (OFF)
BIGEMINY	—	ON/OFF (OFF)
TRIGEMINY*1	—	ON/OFF (OFF)
IRREGULAR RR*1	—	ON/OFF (OFF)

Parameter	Detection Condition (Default Setting)	Alarm ON/OFF Setting (Default Setting)
PROLONGED RR*1	—	ON/OFF (OFF)
NO PACER PULSE*1*3	—	ON/OFF (OFF)
PACER NON-CAPTURE*1*4	40 to 480 ms (400)	ON/OFF (OFF)

*1 These arrhythmias become available when “EXTENDED” is selected for <ARRHYTHMIA TYPE> on the SYSTEM SETUP screen. Refer to Section 3 of the Administrator’s Guide.

*2 When EXT TACHY alarm setting is OFF, HR setting range is 16 to 300 beat/min or OFF.

*3 When EXT BRADY alarm setting is OFF, HR setting range is 15 to 299 beat/min or OFF.

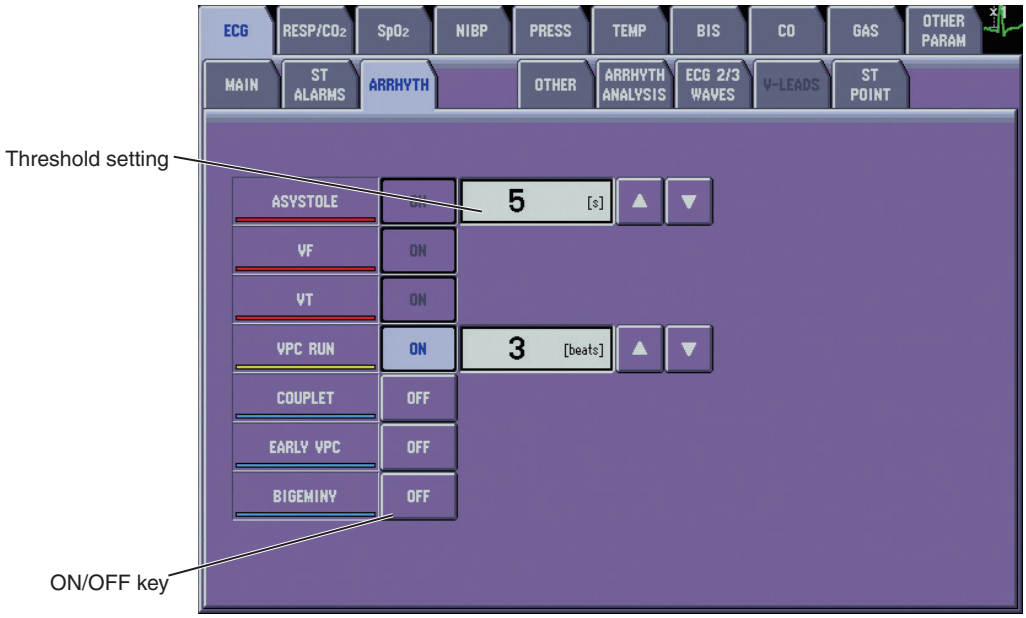
*4 Available only when pacing detection is set to ON.

You can also set arrhythmia alarm limits on the ARRHYTH ALARMS window (See the Operator’s Manual or Section 5 of the User’s Guide Part I).

NOTE

If arrhythmia type is changed to “EXTENDED” and the bedside monitor is connected via network to a central monitor that has old software, the “Lost communication with instruments in the network” message appears on the bedside monitor and the bedside monitor cannot be monitored on the central monitor.

1. Display the ARRHYTH page of the ECG window.
   Press the [Menu] key → ECG key → ARRHYTH tab.



2. To turn off an arrhythmia alarm, touch the ON key to turn it to OFF.

   To turn on an arrhythmia alarm, touch the OFF key to turn it to ON.

   To set the threshold, use the ▲ or ▼ key to adjust the setting.

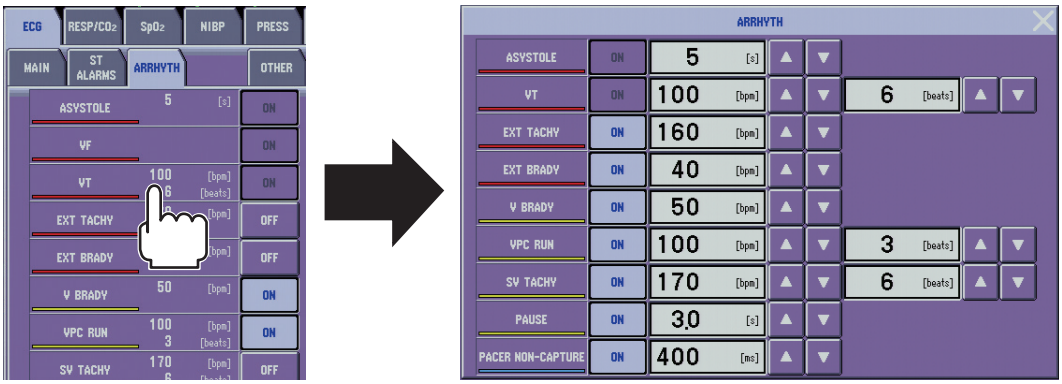
NOTE

For BSM-6000A series bedside monitors:

- Items can be turned on or off but thresholds are fixed and cannot be changed. The thresholds are set by the administrator on the MASTER window of the SYSTEM SETUP window.

- Arrhythmia alarm whose priority is set to CRISIS on the ALARM window of the SYSTEM SETUP window cannot be set to OFF. Refer to Section 3 of the Administrator's Guide.

When EXTENDED is selected for the arrhythmia type in the SYSTEM SETUP window, touch the threshold to display the ARRHYTH window and adjust the setting.



3. Press the [Home] key to return to the home screen.

Changing the ST Alarm Limits

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

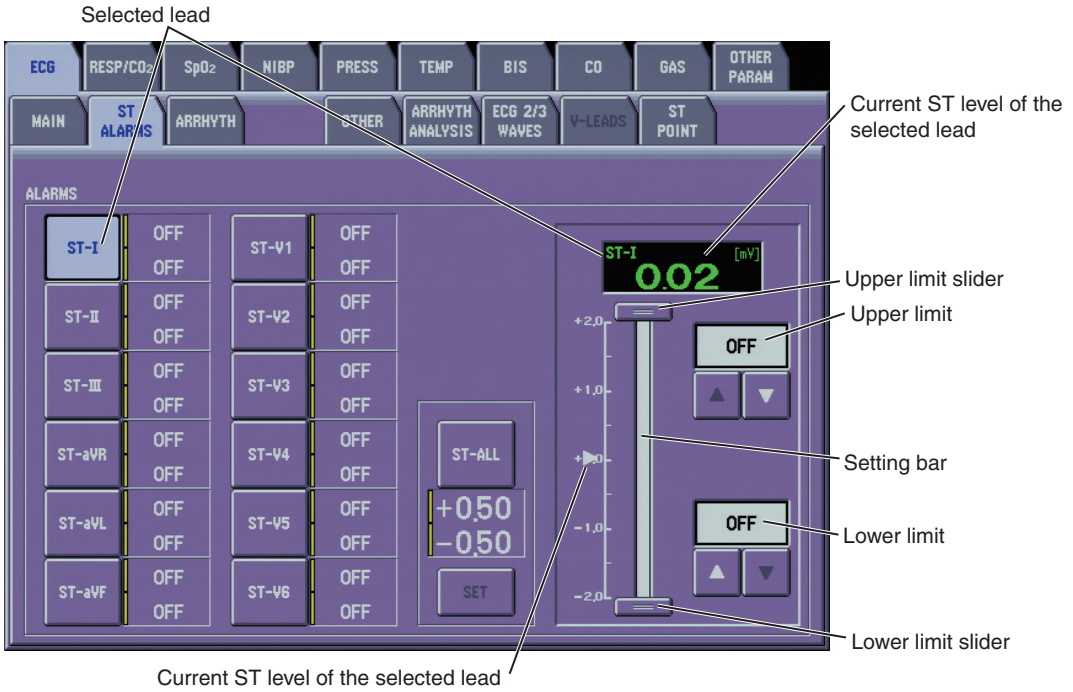
You can set the upper and lower ST alarm limits for each lead individually or altogether on the ECG window. You can set all alarms, including the upper and lower ST of all leads alarm limits, on the ALARM LIMITS window (See the Operator's Manual or Section 5 of the User's Guide Part I).

Setting Range

Upper limit: –1.99 to +2.00 mV in 0.01 mV steps (–19.9 to +20.0 mm in 0.1 mm steps), OFF (default setting: OFF)

Lower limit: OFF, –2.00 to +1.99 mV in 0.01 mV steps (–20.0 to +19.9 mm in 0.1 mm steps) (default setting: OFF)

1. Display the ST ALARMS page of the ECG window.
   Press the [Menu] key → ECG key → ST ALARMS tab.



2. To set the upper and lower alarm for a lead

   i) Select the lead.

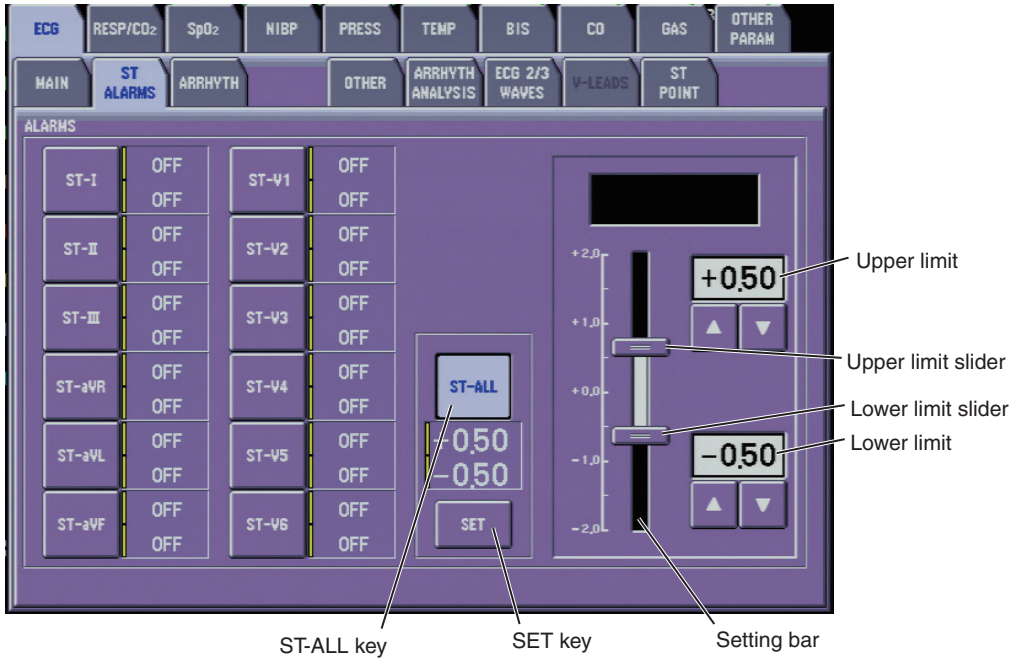
   ii) Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.
   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.

   To set alarms altogether for all leads according to the current ST value

   i) Touch the ST-ALL key.

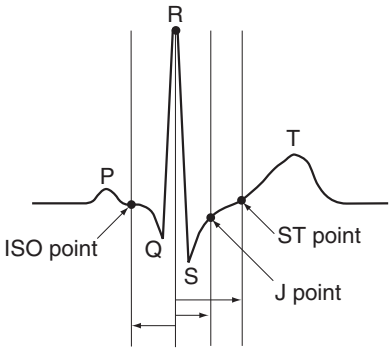
   ii) Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

   iii) Touch the SET key to set the upper and lower limits according to the current value of the ST value.



3. Press the [Home] key to return to the home screen.

Changing the ST Level Measurement Condition



In the ST level measurement, the ISO point determines the baseline and the ST point and J point determine the ST level from the baseline. You can change the ISO point, J point and ST point for ST level measurement.

NOTE

Although the ST algorithm has been tested for accuracy of the ST analysis result, the significance of the ST level changes need to be determined only by a physician.

Setting Range

ISO point: (R –) 0 to 248 ms in 4 ms steps
J point: (R +) 0 to 340 ms in 4 ms steps
ST point: (R +) R +: 0 to * ms in 4 ms steps
* When J point is set to R +: 340 ms, ST point is J + 0 ms.

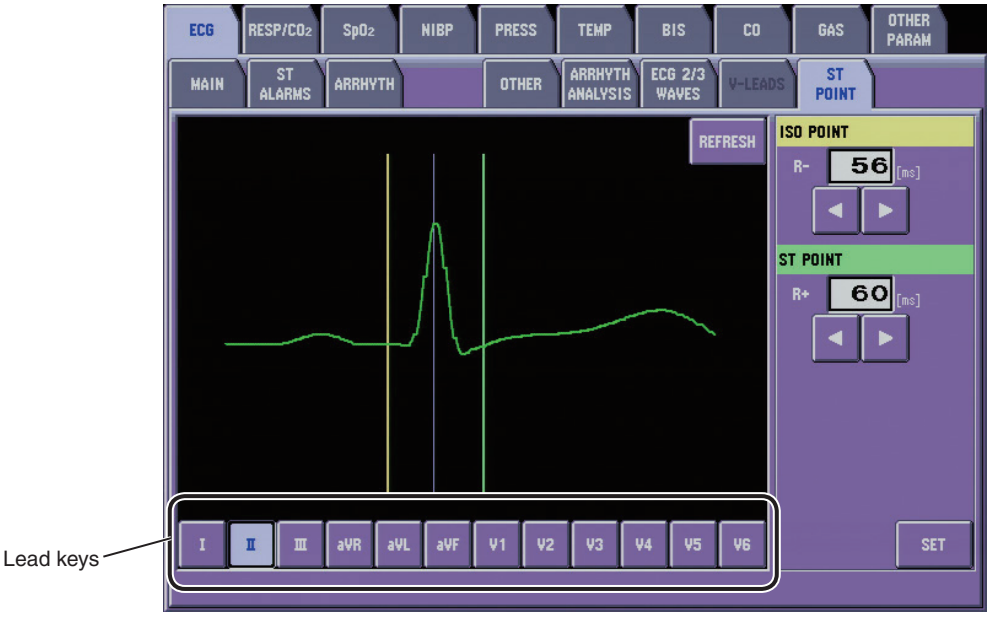
Default Setting

When <QRS DETECTION TYPE> is set to ADULT:
ISO point: R – 80
J point: R + 48
ST point: R + 60
When <QRS DETECTION TYPE> is set to CHILD or NEONATE:
ISO point: R – 56
ST point: R + 60

When QRS DETECTION TYPE is set to CHILD or NEONATE

1. Display the ST POINT page of the ECG window.
   Press the [Menu] key → ECG key → ST POINT tab.

2. Select the lead(s) by touching the lead key to be displayed on the ST POINT page. The QRS wave(s) of the selected lead(s) appears on the window.

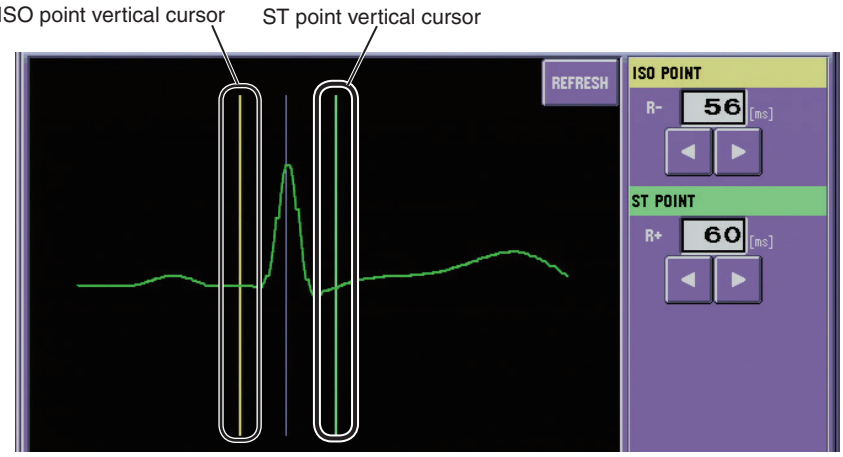


If the QRS wave does not appear on the window, close the window then open it again.

NOTE

R point vertical cursor is fixed.

3. To change the ISO point and ST point
   i) Touch the ISO point vertical cursor and ST point vertical cursor to move the vertical cursor left to right.
   ii) Touch the ◄ or ► key to move the vertical cursor left or right to adjust the setting. The cursor moves in 4 ms steps.



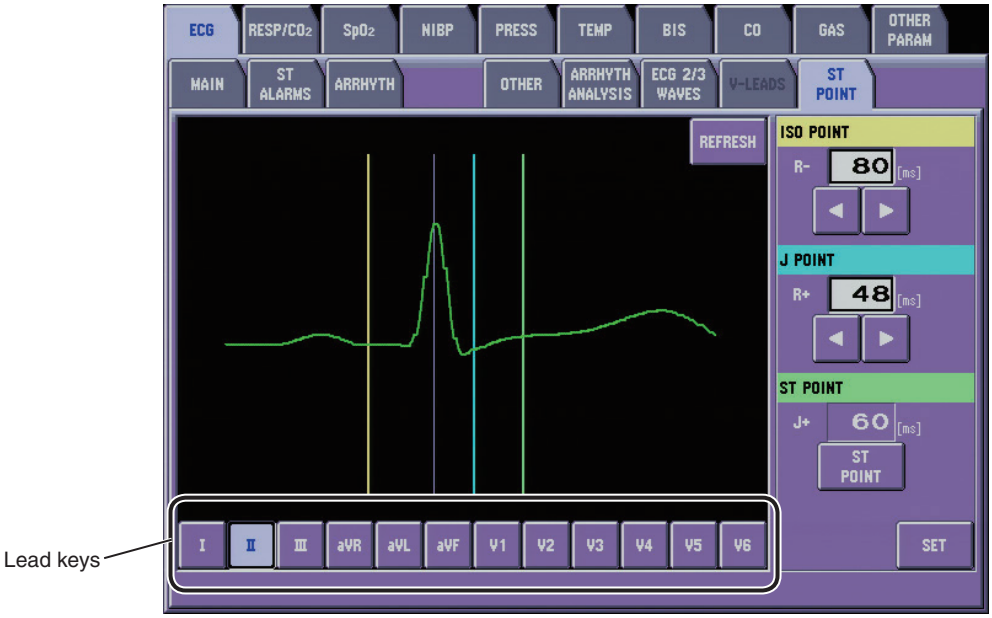
4. To register the ST level measurement condition settings, touch the SET key. The ST level is measured with the new measurement condition settings. To refresh the QRS waves on the ST POINT window, touch the REFRESH key.

5. Press the [Home] key to return to the home screen.

When QRS DETECTION TYPE is set to ADULT

1. Display the ST POINT page of the ECG window.
   Press the [Menu] key → ECG key → ST POINT tab.

2. Select the lead(s) by touching the lead key to be displayed on the ST POINT page. The QRS wave(s) of the selected lead(s) appears on the window.

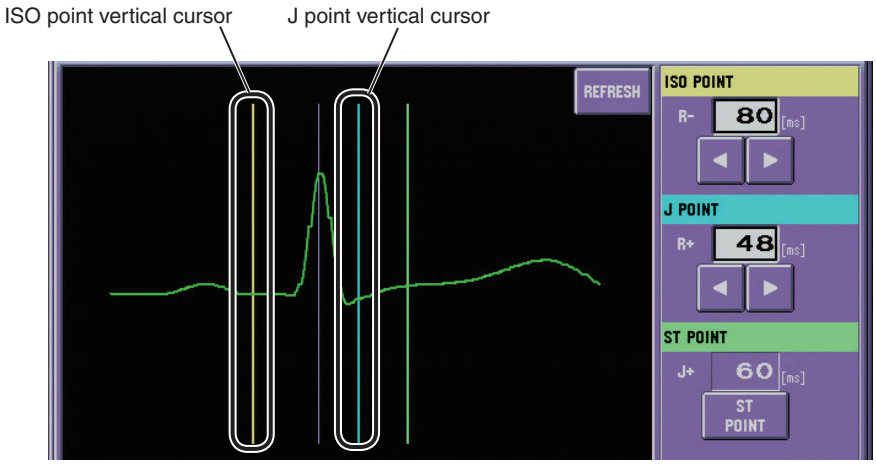


If the QRS wave does not appear on the window, close the window then open it again.

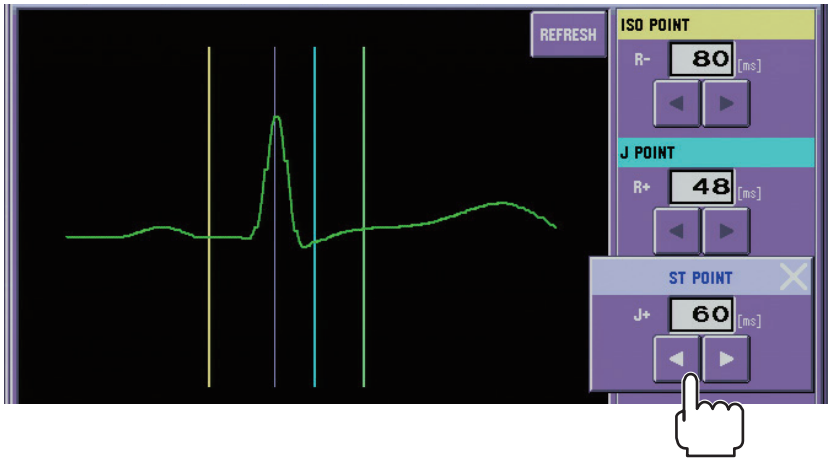
NOTE

- R point vertical cursor is fixed.
- When moves the J point vertical cursor, ST point vertical cursor also moves.

3. To change ISO and J points
   i) Touch the ISO point vertical cursor and J point vertical cursor to move the vertical cursor left to right.
   ii) Touch the ◄ or ► key to move the vertical cursor left or right to adjust the setting. The cursor moves in 4 ms steps.



To change the ST point
   i) Touch the ST POINT key to open the ST POINT dialog box.
   ii) Touch the ST point vertical cursor to move the vertical cursor.
   iii) Touch the ◄ or ► key to move the vertical cursor left or right. The cursor moves in 4 ms steps.



   iv) Touch the ☒ key to close the dialog box.

4. To register the ST level measurement condition settings, touch the SET key. The ST level is measured with the new measurement condition settings.

   To refresh the QRS waves on the ST POINT window, touch the REFRESH key.

5. Press the [Home] key to return to the home screen.

Changing Pacing Settings

Turning Pacing Spike Detection On or Off

When the patient has an implanted cardiac pacemaker, the pacing pulse may be counted as QRS and the heart rate may be miscounted. The pacing pulse is a very small wave which cannot be displayed on the monitor. When pacing spike detection is set to ON, the pacemaker spikes are rejected which allows correct heart rate counting. When pacing mark is set to ON, the pacing mark is displayed on the ECG. Refer to the "Displaying Pacing Mark" section.

The pacing spike detection is automatically turned on when <PACE MAKER> on the ADMIT page of the ADMIT DISCHARGE window is set to YES.

When pacing spike detection is set to OFF, the non-paced mark appears in the upper right of the screen.

WARNING

Turn the pacing pulse detection to ON when monitoring a pacemaker patient. Otherwise the pacemaker pulse is not rejected. However, even when the pacing pulse detection is set to ON, the pacemaker pulse might not be rejected. When the pacemaker pulse is not rejected, the pacemaker pulse is detected as QRS and false heart rate may be indicated or critical arrhythmia such as asystole may be overlooked. Keep pacemaker patients under close observation.

WARNING

Even when the pacing pulse detection is set to ON, the pacemaker pulse can be overlooked or detected as QRS. You cannot confirm the pacemaker operation only from the detected pacemaker pulse.

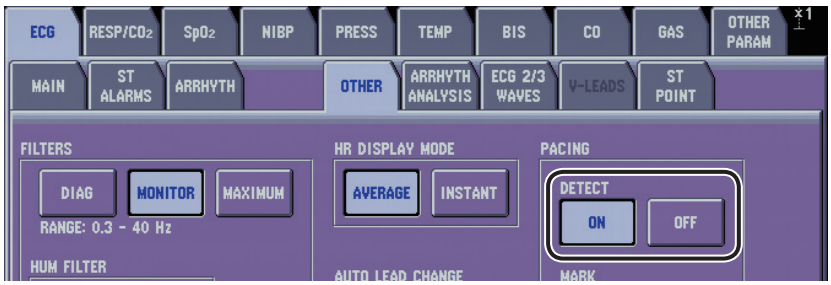
* For the pacemaker pulse rejection capability of BSM-6000 series bedside monitor, refer to the "Specifications - ECG" in the operator's manual.

NOTE

When you monitor a premature baby or infant and the monitor miscounts the narrow width QRS, set this to OFF.

1. Display the OTHER page of the ECG window.
   Press the [Menu] key → ECG key → OTHER tab.

2. Touch the ON or OFF key under <DETECT> in the <PACING> box to select on or off.

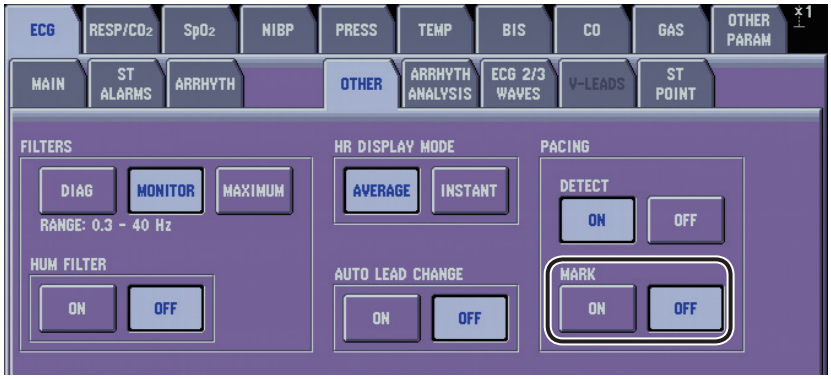


Displaying Pacing Mark

When the <PACING DETECT> is set to ON, the pacing mark can be displayed on the ECG waveform.

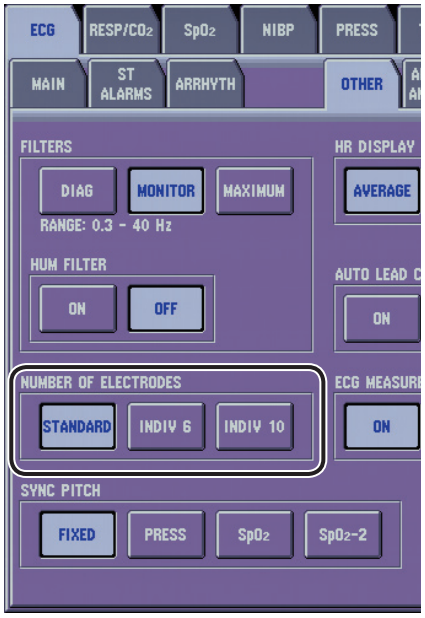
1. Display the OTHER page of the ECG window.
   Press the [Menu] key → ECG key → OTHER tab.

2. Touch the ON or OFF key under <MARK> in the <PACING> box to select on or off. When set to ON, the pacing mark is displayed on the ECG waveform.



3. Press the [Home] key to return to the home screen.

Changing the Number of Electrodes



Select the type and number of electrodes.

1. Display the OTHER page of the ECG window.
   Press the [Menu] key → ECG key → OTHER tab.

2. Select the type and number of electrodes in the <NUMBER OF ELECTRODES> box.
   STANDARD: Any electrodes other than DIN type. The number of electrodes (3, 6 or 10) is automatically recognized by the monitor.
   INDIV 6: Monitoring with 3 or 6 DIN type electrodes.
   INDIV 10: Monitoring with 10 DIN type electrodes. The RF/RL electrode must be attached.

3. Press the [Home] key to return to the home screen.

Selecting Mode for Updating the Heart Rate

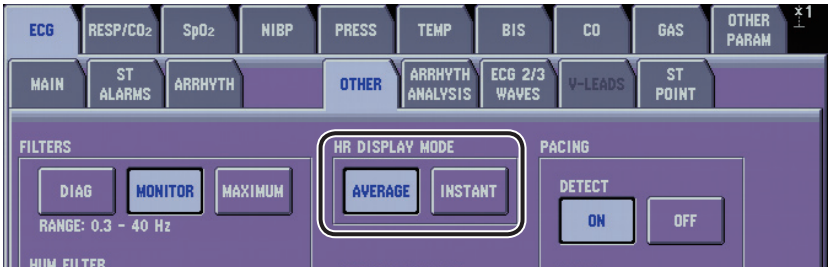
There are two calculation modes, “AVERAGE” and “INSTANT”.

AVERAGE: The heart rate is calculated by a moving average. The monitor detects 12 consecutive beats including VPC, averages the R-R intervals of the latest 12 beats and uses this average to calculate the current heart rate. When a new beat is detected, the heart rate is recalculated using the latest 12 beats. The heart rate display is updated every 3 seconds.

INSTANT: The heart rate is calculated every beat. The heart rate display is updated every 3 seconds.

1. Display the OTHER page of the ECG window.
   Press the [Menu] key → ECG key → OTHER tab.

2. Select AVERAGE or INSTANT in the <HR DISPLAY MODE> box.



3. Press the [Home] key to return to the home screen.

Selecting the Filter Type

There are following types for ECG filter.

DIAG: No filter. This mode is best for viewing the details of the waveform. It is similar to the real ECG. (0.05 to 150 Hz)

MONITOR: Low-cut and high-cut filter. (0.3 to 40 Hz)

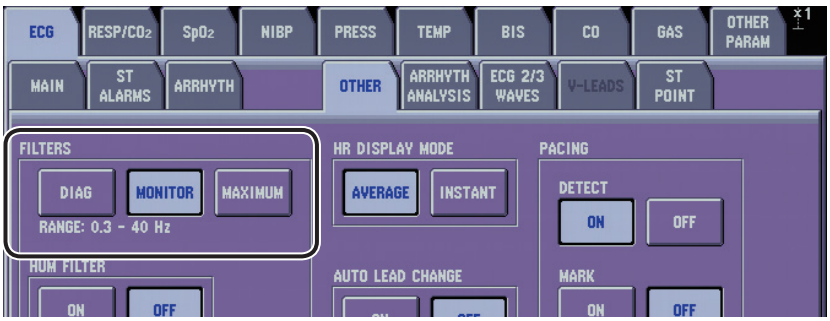
MAXIMUM: Baseline drift-free, hum (AC) and high-cut filter. Appropriate when there is noise from AC or ESU. (1 to 18 Hz)

NOTE

When performing defibrillation, set the <FILTERS> to MONITOR or MAXIMUM. The waveform recovery may become slow due to electrode polarization when DIAG is set.

1. Display the OTHER page of the ECG window.
   Press the [Menu] key → ECG key → OTHER tab.

2. Select filter type from the <FILTERS> box.



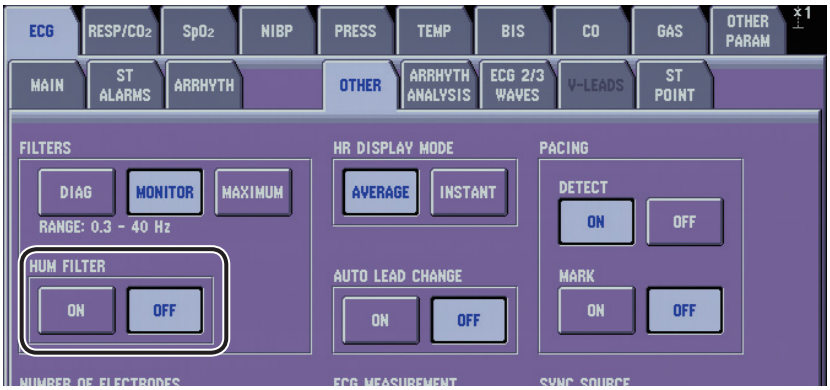
3. Press the [Home] key to return to the home screen.

Turning the Hum Filter On or Off

The hum filter type is set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

1. Display the OTHER page of the ECG window.
   Press the [Menu] key → ECG key → OTHER tab.

2. Touch the ON or OFF key under <HUM FILTER> in the <FILTERS> box to select on or off.



3. Press the [Home] key to return to the home screen.

Changing the Sync Sound Source

You can select ECG, SpO_2 pulse (SpO_2) or arterial blood pressure pulse (PRESS) as the sync sound source. When the arterial blood pressure pulse is selected, the blood pressure of the highest priority label is used. The sync source can also be changed on the SpO_2 and PRESS windows.

When pulse wave and pressure waveform are irregular because of an IABP, select ECG.

NOTE

- When heart rate is unstable because of an ESU, select SpO_2 or PRESS.

- When the connection cord of SpO_2 or IBP of the arterial blood pressure is disconnected from the monitor and an alarm occurs when the sync source is set to SpO_2 or PRESS, the sync source changes to ECG when the alarm is silenced by pressing the [Silence Alarms] key. The sync source returns to SpO_2 or PRESS when the SpO_2 or IBP is monitored again. When using PRESS as the sync source, adjust zero balance.
- When the sensor is detached from the patient and alarm occurs, and the sync source is set to SpO_2 or PRESS, the sync source does not change to ECG when the alarm is silenced, and "- - -" is displayed for PR.
- The SpO_2-2 cannot be set to the sync sound source.

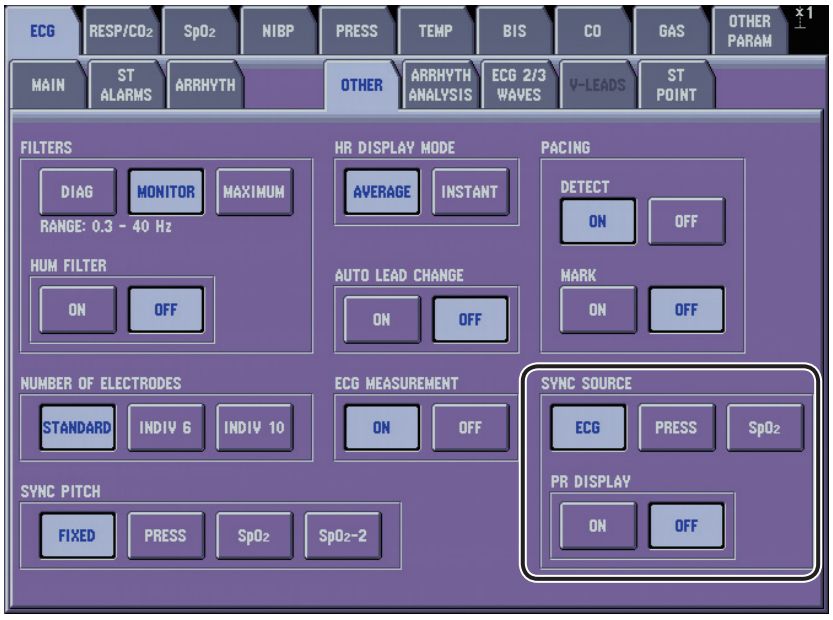
When the sync source is set to ECG and ECG is not measured, there is no sync sound.

When SpO_2 or PRESS is selected, the pulse rate is displayed to the left of the heart rate on the screen and the sync mark synchronizes with the pulse.

1. Display the OTHER page of the ECG window.
   Press the [Menu] key → ECG key → OTHER tab.

2. Select the sync source in the <SYNC SOURCE> box.
   ECG: QRS
   PRESS: Pulse wave of the highest priority arterial blood pressure
   SpO_2: SpO_2 pulse

   To display the pulse rate to the left of the heart rate on the home screen, select ON for <PR DISPLAY>. This setting is only available when <SYNC SOURCE> is set to ECG.



3. Press the [Home] key to return to the home screen.

Selecting Sync Sound Pitch

The sync sound can be variable pitch or fixed pitch pips. The fixed pitch is high pitch as the default, but medium or low pitch can also be set on the SYSTEM SETUP window (see Section 3 of the Administrator's Guide). When you select variable pitch, the pitch of the sync sound changes according to SpO_2 value or systolic BP value of the arterial blood pressure so that you can recognize the change on the patient from the pitch of the sync sound without looking at the monitor. The sync pitch can also be changed on the SpO_2 and PRESS windows.

* The AY-661P and AY-663P input unit and BSM-1763 bedside monitor are not available in the US.

When using an AY-661P*, AY-663P*, AY-671P or AY-673P input unit or BSM-1700 series bedside monitor*, the sync sound pitch can be set to change according to the SpO_2 value of the second SpO_2 (SpO_2-2) when monitoring dual SpO_2.

When the sync sound source is set to SpO_2 and the SpO_2 value is below 81%SpO_2, the low pitch is automatically selected.

When the sync sound source is set to SpO_2 and the "CHECK PROBE" or "DETECTING PULSE" message is displayed on the screen, the sync sound stops.

When the sync sound source is set to ECG or PRESS, the sync pitch is set to SpO_2 and the SpO_2 cannot be displayed on the screen, the low pitch is automatically selected.

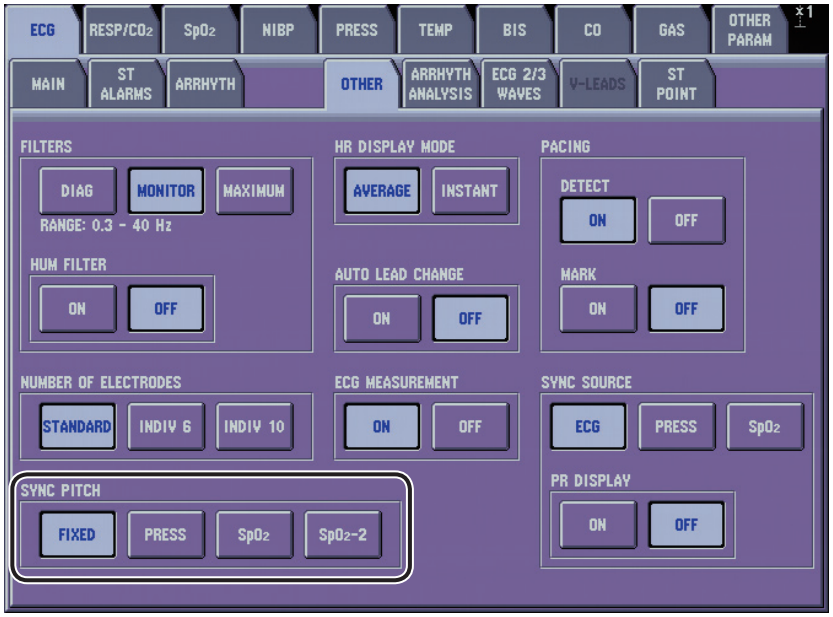
When the sync sound source is set to ECG or SpO_2, the sync pitch is set to PRESS and the IBP cannot be displayed on the screen, the low pitch is automatically selected.

When the sync sound source is set to ECG or SpO_2 and the IBP connection cord is disconnected, the low pitch is automatically selected. After connecting the IBP connection cord, adjust zero balance.

1. Display the OTHER page of the ECG window.
   Press the [Menu] key → ECG key → OTHER tab.

2. Select the sync sound pitch from the <SYNC PITCH> box.
   FIXED: The pitch is fixed to the pitch selected on the SYSTEM SETUP window.
   PRESS: The pitch is high when the BP value is above 120 mmHg. The pitch is low when the BP value is below 20 mmHg. The pitch changes from high to low in 20 steps for each 5 mmHg change between 120 and 20 mmHg BP value. The BP value of the highest priority arterial blood pressure is used.

SpO_2 and SpO_2-2: The pitch changes in 20 steps from high to low for each 1%SpO_2 change in SpO_2 value between 100%SpO_2 and 81%SpO_2.
When the SpO_2 is selected, the pitch changes according to the SpO_2 value acquired from the SpO_2 socket. When the SpO_2-2 is selected, the pitch changes according to the second SpO_2 (SpO_2-2) value acquired from the MULTI socket. (SpO_2-2 is only available when using an AY-661P, AY-663P, AY-671P or AY-673P input unit or BSM-1700 series bedside monitor.)



3. Press the [Home] key to return to the home screen.

Use with an Electrosurgical Unit

For use with an electrosurgical unit (ESU), this monitor has a circuit to protect the patient from skin burn and to reduce ESU interference on the ECG waveform. However, the effectiveness of this circuit depends on electrode position and monitor setup. With an ESU, pay attention to the following points.

WARNING

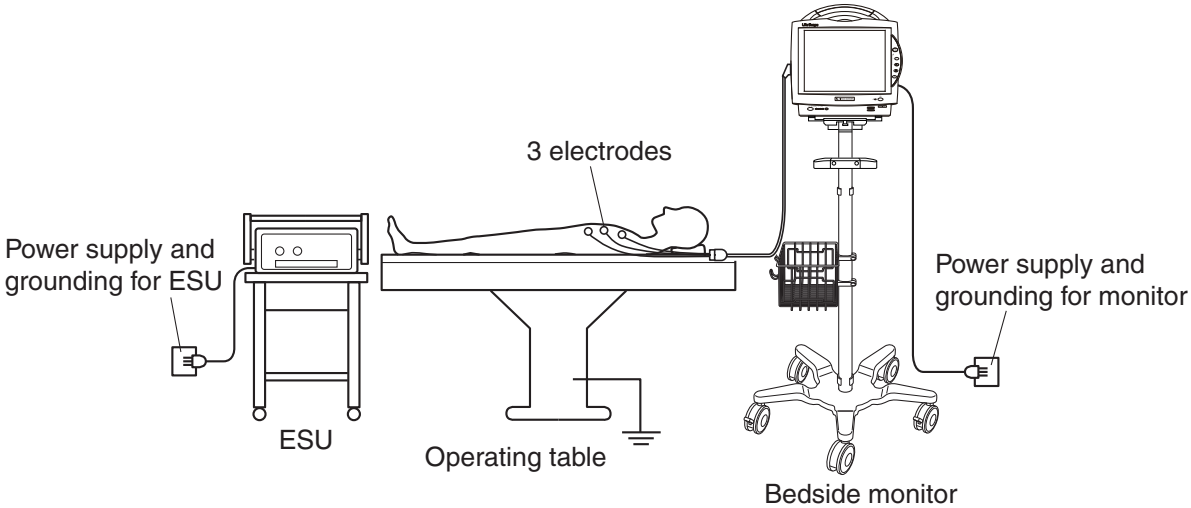
When the monitor is used with an electrosurgical unit (ESU), firmly attach the entire area of the ESU return plate. Otherwise, the current from the ESU flows into the electrodes of the monitor, causing electrical burn where the electrodes are attached. For details, refer to the ESU manual.

CAUTION

When using the monitor with an ESU, locate the monitor and ESU appropriately and ground instruments properly. Otherwise noise from the ESU may interfere with the ECG and the heart rate and arrhythmia analysis may be incorrect.

- Arrangement
  Install the monitor as far from the ESU as possible. If possible, locate them on opposite sides of the operating table.

- Power supply
  Noise from the ESU may interfere with the ECG signal through the AC power line. Supply power to the monitor and ESU from different outlets located as far from each other as possible. Do the equipotential grounding properly.



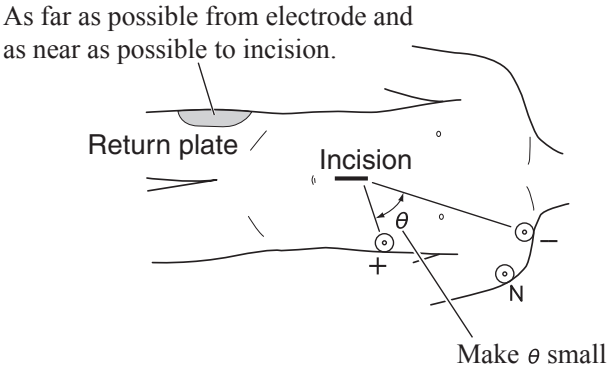
- Measure with 3-electrode lead
  Use the minimum number of electrodes. Use new electrodes.

- Minimize noise
  1. Select an ECG lead where the active ECG electrodes are located as far from the incision as possible.

  2. Position the + and – electrodes as close as possible.

  3. Select the leads where the angle (θ) between the active electrodes and the incision is as small as possible.

  4. Set the electrosurgical return plate as close to the incision as possible.



- Set the following items on the OTHER page of the ECG window.
  FILTERS: MAXIMUM
  SYNC SOURCE: SpO_2 or PRESS

- Monitor respiration by thermistor method or monitor CO_2
  Noise is superimposed on the waveform and the respiration rate cannot be monitored accurately in the impedance method. When monitoring respiration, turn respiration monitoring off or monitor the respiration by thermistor method or monitor CO_2.

Section 2 Respiration Monitoring

General

On this monitor, respiration can be measured by two methods: impedance method and thermistor method. When respiration is measured by both the impedance method and thermistor method, the values measured by the thermistor method is used.

Measurement Method

Impedance Method

In the impedance method, respiration is measured and monitored by attaching the ECG electrodes to the patient and connecting them to the ECG/RESP socket. This method measures changes in impedance between the R and F (RA and LL) or R and L (RA and LA) ECG electrodes.

WARNING

The bioelectric impedance measurement sensor of a minute ventilation rate-adaptive implantable pacemaker may be affected by cardiac monitoring and diagnostic equipment which is connected to the same patient. If this occurs, the pacemaker may pace at its maximum rate and give incorrect data to the monitor or diagnostic equipment. In this case, set the <IMPEDANCE MEASUREMENT> on the RESP/CO_2 window to OFF on the bedside monitor. For a patient that requires the respiration monitoring, measure the respiration by thermistor method.

Thermistor Method

In the thermistor method, respiration is measured and monitored by attaching the respiration pickup to the patient or connecting it to the respiration circuit, and connecting the respiration pickup to the MULTI socket.

This method measures and compares temperature changes caused by respiration and inspiration using the respiration pickup.

Use this method when using an ESU or if measurement by the impedance method is unavailable.

NOTE

The MULTI socket on the AY-660P input unit cannot be used for monitoring respiration in thermistor method.

Preparing for Respiration Monitoring in Impedance Method

Preparation Flowchart

The procedure is the same as for monitoring ECG.

1. Select the electrode lead.

2. Connect the electrode lead to the ECG connection cord and connect the ECG connection cord to the ECG/RESP socket.

3. Attach the disposable electrodes to the patient and attach the electrode lead to the electrodes. Attach R and F (RA and LL) or R and L (RA and LA) with the lungs between the electrodes.

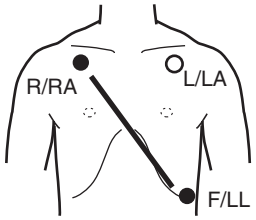
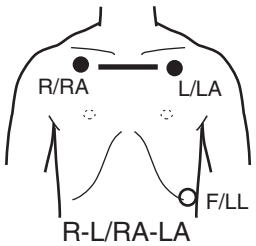
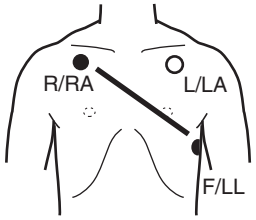
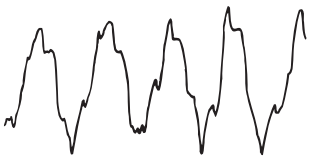
4. Monitoring starts. Set necessary settings.

Electrode Position and Waveform Examples

Respiration can be measured by the impedance method when the R (RA) and F (LL) or R (RA) and L (LA) electrodes are placed so that the lungs are between the electrodes.

The optimum electrode positions for ECG monitoring of a patient are not always optimum for respiration monitoring of the patient. Select the optimum positions for both ECG and respiration measurements or measure respiration by the thermistor method.

The amplitude of the respiration waveform differs according to the electrode position. The following shows different examples of respiration waveforms according to the electrode position when monitoring with the impedance method.

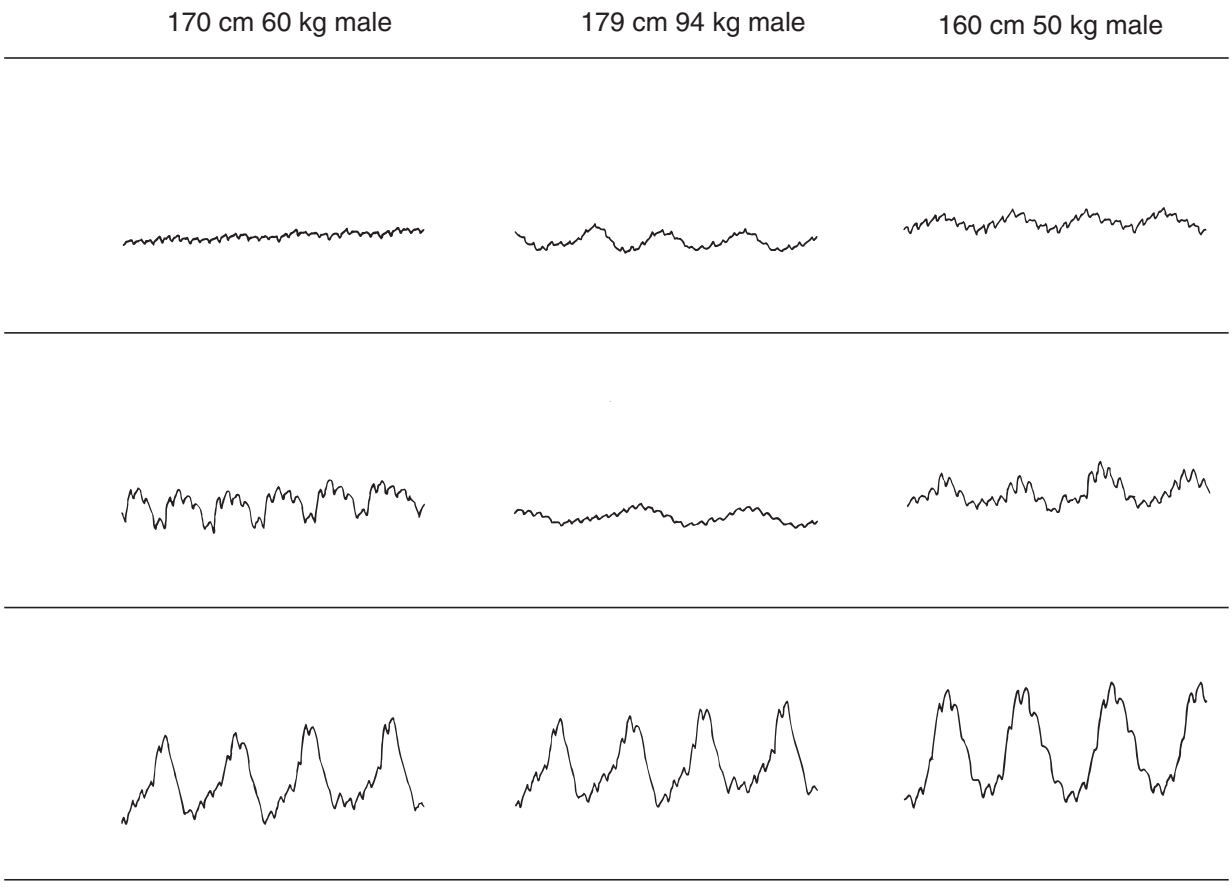
	Electrode lead and position	162 cm 47 kg female	153 cm 45 kg female
1	 Standard R-F/RA-LL		
2	 R-L/RA-LA		
3	 R-F/RA-LL with higher F/LL position		

Electrode Position

	R or RA	F or LL	L or LA
1	Right infraclavicular fossa	Lowest rib on the left anterior axillary line	—
2	Right infraclavicular fossa	—	Left infraclavicular fossa
3	Right infraclavicular fossa	Fifth intercostal space on the left midaxillary line	—

Amplitude

1	Respiration measurement is influenced by movement of the chest and abdomen. The amplitude of the waveform changes greatly according to slight change of the F (LL) electrode position. It also differs considerably between different patients.
2	Respiration measurement is influenced by movement of the chest. Detects thoracic respiration. There is a great difference in amplitude between different patients.
3	Respiration amplitude is large, and therefore, detection rate is good. The electrode position is similar to lead II of the ECG. This position is highly recommended.



Connecting Cables and Attaching Disposable Electrodes

Connecting cables and attaching disposable electrodes are the same as for the ECG monitoring. Refer to “Preparing for ECG Monitoring” in Section 1.

Preparing for Respiration Monitoring in Thermistor Method

Preparation Flowchart

1. Select the respiration pickup.
2. Connect the respiration pickup to the MULTI socket.
3. Attach the respiration pickup to the respiration circuit.
4. Monitoring starts. Set necessary settings.

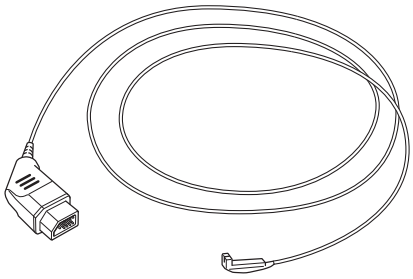
Respiration Pickups

CAUTION

Only use Nihon Kohden specified electrodes, probes, transducers, thermistors and catheters. Otherwise, the maximum performance from the monitor cannot be guaranteed.

Respiration pickup for nose TR-900P*

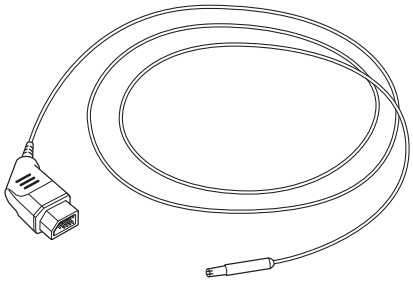
For measuring at nostrils.



* This part has not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

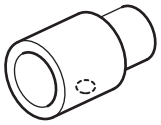
Respiration pickup for airway TR-910P

For measuring with trachea intubation.



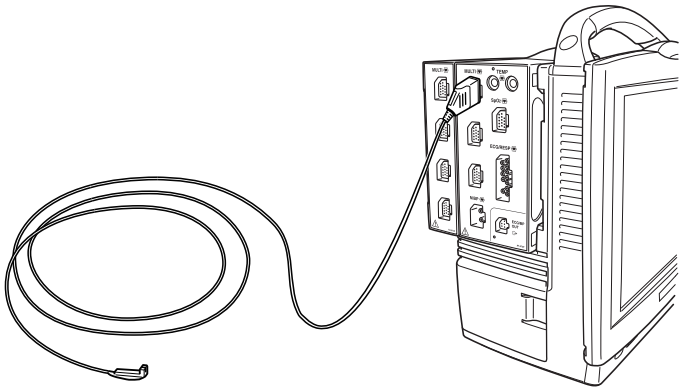
Airway adapter YG-001P

Use with the TR-910P respiration pickup.



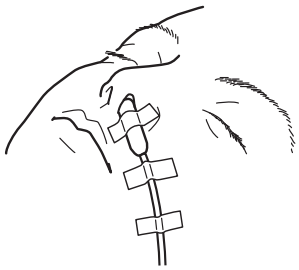
Connecting the Cable to the Unit

Connect the respiration pickup to the MULTI socket.



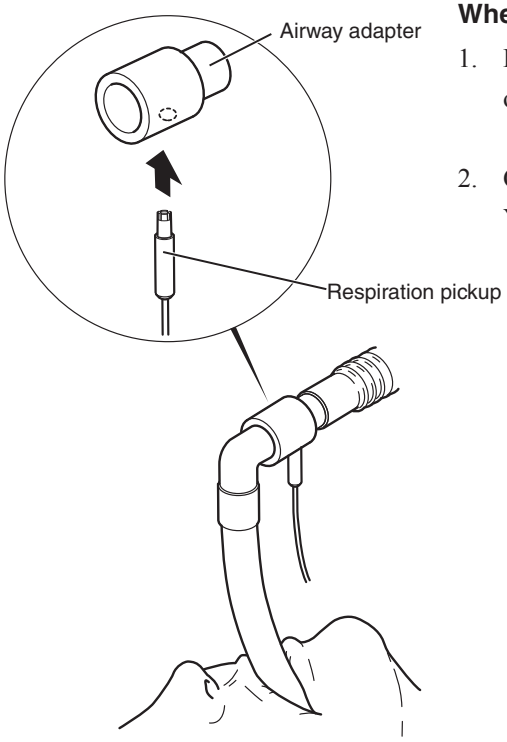
When connecting the TR-900P respiration pickup for nose

Attaching the Respiration Pickup



When Using Respiration Pickup for Nose

1. Place the tip of the respiration pickup at the front of the nostril.
2. Secure the lead wire and respiration pickup firmly to the cheek with surgical tape.



When Using Respiration Pickup for Airway

1. Firmly insert the tip of the respiration pickup for airway into the small hole on the airway adapter.
2. Connect the airway adapter to the airway tube (between the mouth and Y-shaped tube).

Monitoring Respiration

When preparation is done properly, the respiration waveform appears on the screen.

NOTE

Increase in the temperature of the inspired air during monitoring in thermistor method causes decrease in the temperature difference between inspiration and expiration, and the amplitude of the respiration waveform becomes small. When the inspiration temperature increases higher than the expiration temperature, the phases of expiration and inspiration may be reversed.

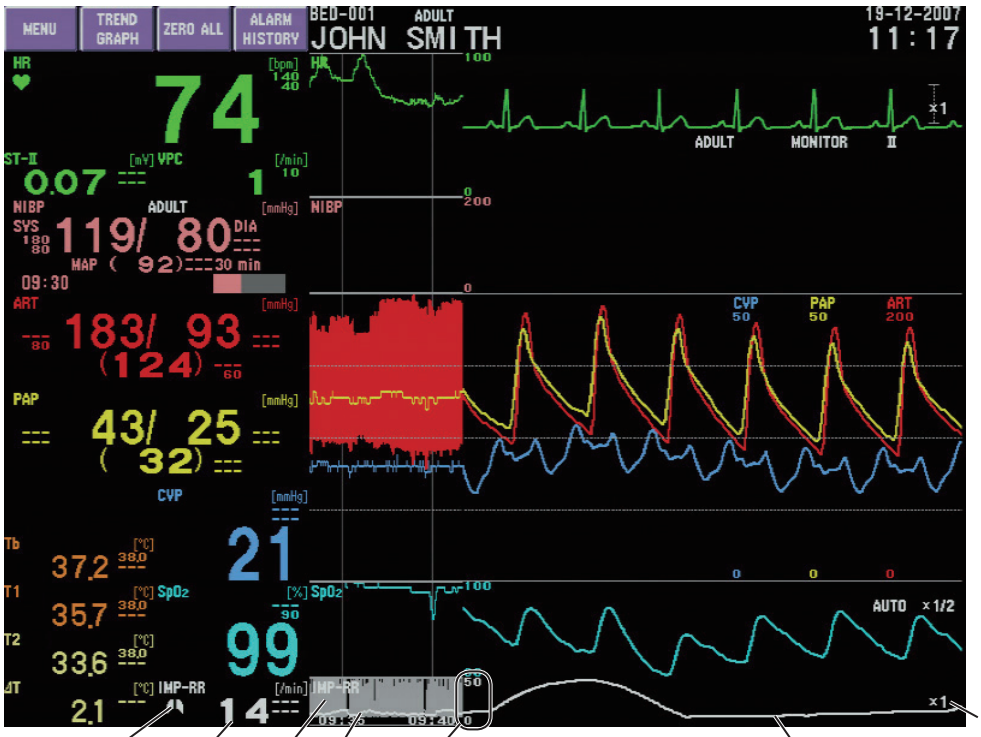
In impedance method, the respiration data do not appear on the screen when respiration monitoring in impedance method is set to OFF (the "RESP OFF" message appears). When using an ESU, noise is superimposed on the waveform and the respiration measurement cannot be monitored accurately. When respiration monitoring is necessary, use the thermistor method or monitor CO_2.

NOTE

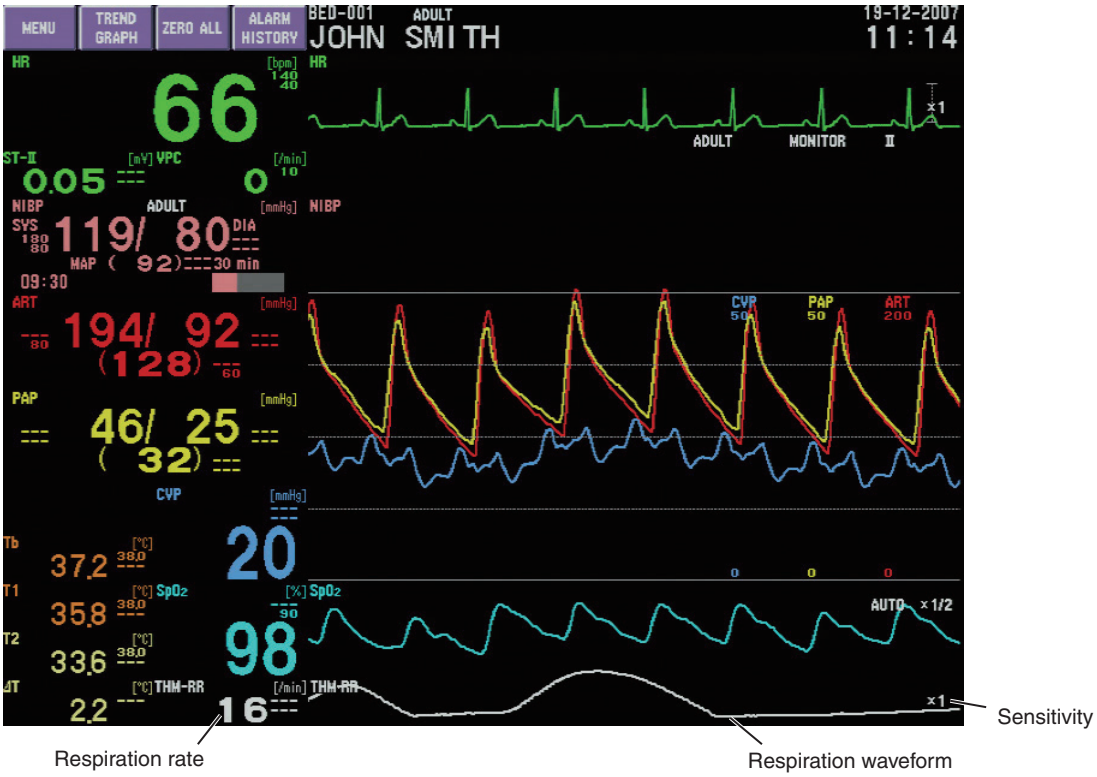
- The respiration rate can only be detected from one parameter. When CO_2, respiration and anesthetic gas are monitored at the same time, the respiration rate is detected in the following priority.
  Gas > FLOW > CO_2 > thermistor respiration > impedance respiration
- When ON is selected at <DISPLAY IMP-RR AS SECOND PARAMETER> on the OTHER page of the RESP/CO_2 window, the respiration rate is detected from two parameters. Refer to the "Displaying Impedance Method Respiration Rate as the Second Respiration Parameter" section.

Respiration Information on the Home Screen

In impedance method



In thermistor method



Changing Respiration Settings

Change settings on the RESP/CO_2 window. The following settings can be changed for respiration monitoring.

For impedance method

- Changing monitoring lead
- Turning respiration monitoring on or off
- Displaying respiration rate as the second parameter
- Respiration sensitivity
- Respiration rate and apnea alarm limits
- Respiration waveform sweep speed

For thermistor method

- Respiration sensitivity
- Respiration rate and apnea alarm limits
- Respiration waveform sweep speed

The noise reduction for impedance respiration monitoring can be turned on or off and the respiration data display color can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

The scale of the respiration rate trendgraph on the home screen is the same scale as the trendgraph of the Review window. Refer to the Operator's Manual or Section 6 of the User's Guide Part I.

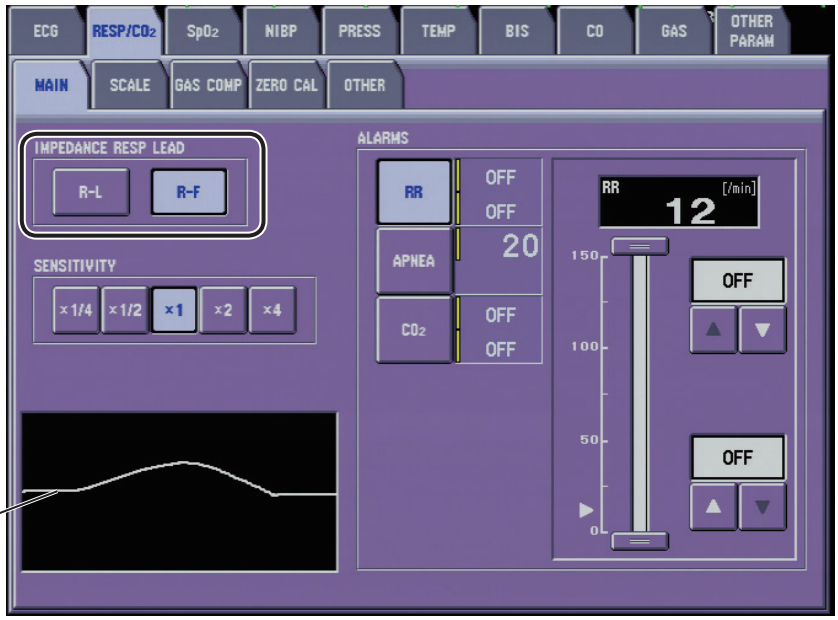
If the APNEA alarm occurs and no action is taken for a selected duration, the alarm level can be escalated. Refer to Section 3 of the Administrator's Guide.

Changing the Monitoring Lead in Impedance Method

The lead which can be monitored in the impedance method is R-F (RA-LL) or R-L (RA-LA). The selected lead appears on both the home screen and RESP/CO_2 window.

1. Display the MAIN page of the RESP/CO_2 window.
   Press the [Menu] key → RESP/CO_2 key → MAIN tab.

2. Select the lead in the <IMPEDANCE RESP LEAD> box. Select the lead with the larger respiration amplitude and smaller heart beat.



3. Press the [Home] key to return to the home screen.

Changing the Respiration Sensitivity

The sensitivity determines the size of the waveform on both the screen and recording paper.

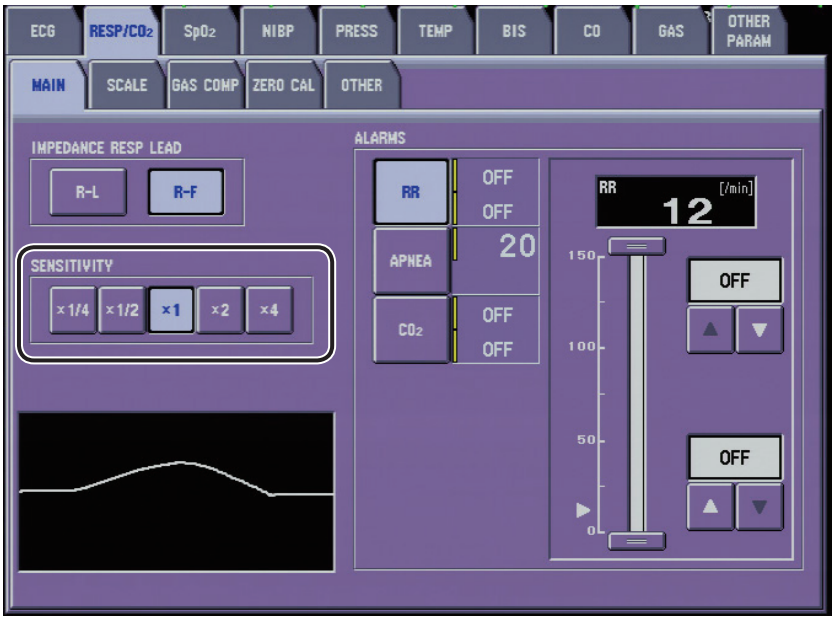
The respiration waveform amplitude differs according to the sensitivity and the NOISE REDUCTION ON IMPEDANCE RESP setting on the SYSTEM SETUP window. The following amplitudes for the respiration rate can be counted. Refer to Section 3 of the Administrator's Guide for the NOISE REDUCTION ON IMPEDANCE RESP setting.

NOISE REDUCTION ON IMPEDANCE RESP Setting	Sensitivity	Countable Amplitudes for the Respiration Rate
ON	× 1/4	Larger than 0.375 mm
	× 1/2	Larger than 0.75 mm
	× 1	Larger than 1.5 mm
	× 2	Larger than 3 mm
	× 4	Larger than 6 mm
OFF	All sensitivities	Larger than 10 mm

In thermistor method, countable amplitudes for the respiration rate is the same as when the NOISE REDUCTION ON IMPEDANCE RESP setting is set to ON.

1. Display the MAIN page of the RESP/CO_2 window.
   Press the [Menu] key → RESP/CO_2 key → MAIN tab.

2. Select the appropriate sensitivity from ×1/4, ×1/2, ×1, ×2 and ×4 in the <SENSITIVITY> box.



3. Press the [Home] key to return to the home screen.

Turning Respiration Measurement On or Off in Impedance Method

Even when respiration measurement is set up, you can turn respiration measurement off if you do not need it. When respiration is turned off, respiration waveform does not appear and the “RESP OFF” message appears on the home screen. When respiration is not available, no respiration data appears.

When monitoring respiration in thermistor method and not in impedance method, turn this setting to OFF.

NOTE

When using an ESU, noise is superimposed on the waveform and the respiration measurement cannot be monitored accurately. When respiration monitoring is necessary, use the thermistor method or monitor CO_2.

1. Display the OTHER page of the RESP/CO_2 window.
   Press the [Menu] key → RESP/CO_2 key → OTHER tab.

2. Select ON or OFF in the <IMPEDANCE MEASUREMENT> box to turn impedance measurement on or off.

3. Press the [Home] key to return to the home screen.

Changing the Respiration Rate and Apnea Alarm Limits

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

You can set the upper and lower respiration rate and apnea alarm limits on the RESP/CO_2 window. You can set all alarms, including the upper and lower respiration rate and apnea alarm limits, on the ALARM LIMITS window (See the Operator's Manual or Section 5 of the User's Guide Part I). You can also set the upper and lower respiration rate and apnea alarm limits on the CO_2, GAS and FLOW/Paw windows. (FLOW/Paw window is not available for BSM-6000A series.)

Setting Range

Respiration rate upper limit: 2 to 150 counts/min in 2 counts/min steps, OFF (default setting: OFF)*1*2

Respiration rate lower limit: OFF, 0 to 148 counts/min in 2 counts/min steps (default setting: OFF)*1*2

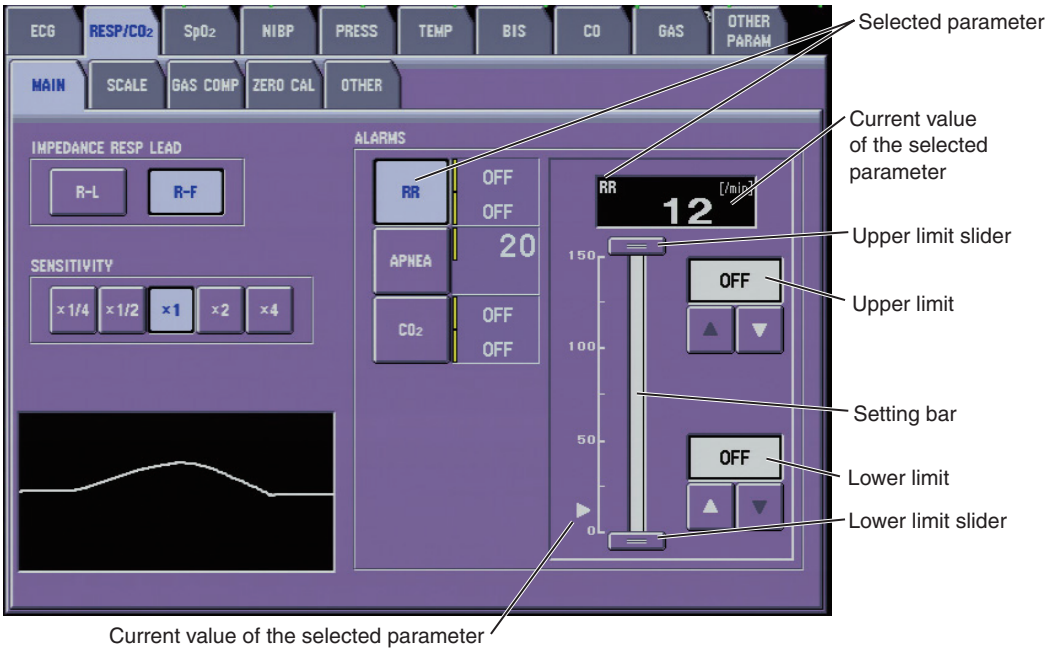
Apnea upper limit: 5 to 40 s in 5 s steps, OFF (default setting: 20)*1*2

*1 On BSM-6000A series, if <CRISIS VITAL ALARM MANAGEMENT> on the SYSTEM CONFIGURATION screen is turned on and "ALARM PRIORITY" on the SYSTEM SETUP window is set to CRISIS, the alarm setting is set to the alarm master setting.

*2 On BSM-6000A series, if <ALARM CAP> on the SYSTEM CONFIGURATION screen is turned on, the alarm setting is affected by the "ALARM CAP" setting on the SYSTEM SETUP window.

1. Display the MAIN page of the RESP/CO_2 window.
   Press the [Menu] key → RESP/CO_2 key → MAIN tab.

2. Touch the RR key to change the respiration rate alarm setting.
   Touch the APNEA key to change the apnea alarm setting.



3. Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.

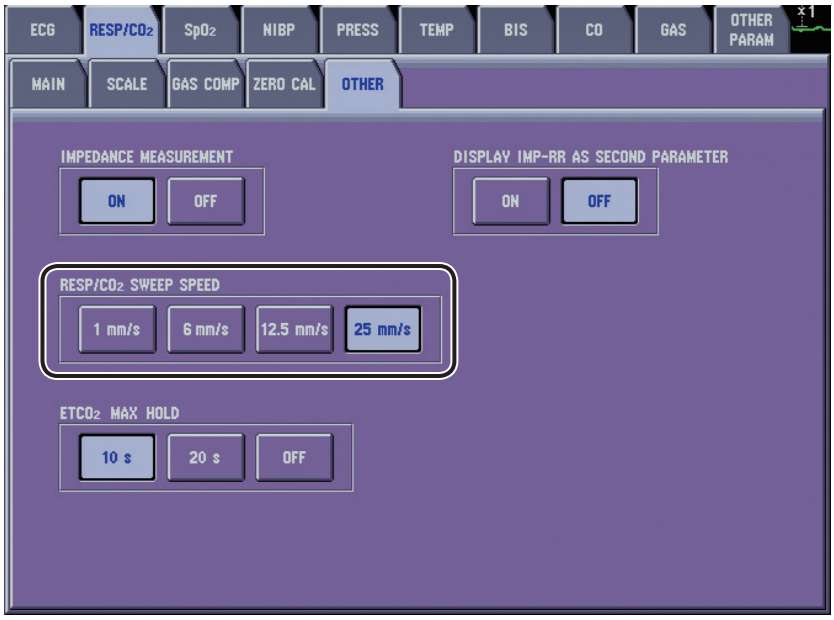
4. Press the [Home] key to return to the home screen.

Changing the Respiration Waveform Sweep Speed

The respiration waveform sweep speed on the screen can be selected. This setting can also be changed on the WAVES page of the DISPLAY window.

1. Display the OTHER page of the RESP/CO_2 window.
   Press the [Menu] key → RESP/CO_2 key → OTHER tab.

2. Select the sweep speed from the <RESP/CO_2 SWEEP SPEED> box.



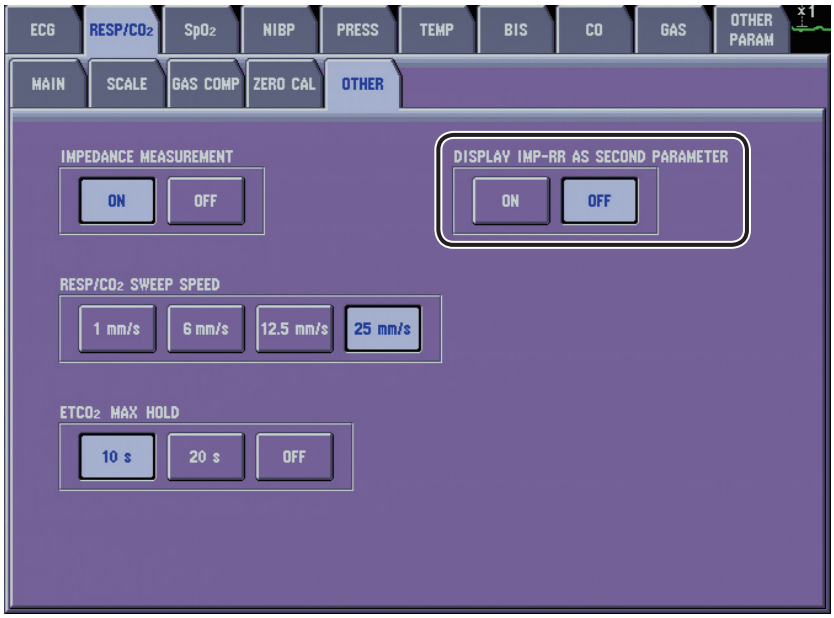
3. Press the [Home] key to return to the home screen.

Displaying Impedance Method Respiration Rate as the Second Respiration Parameter

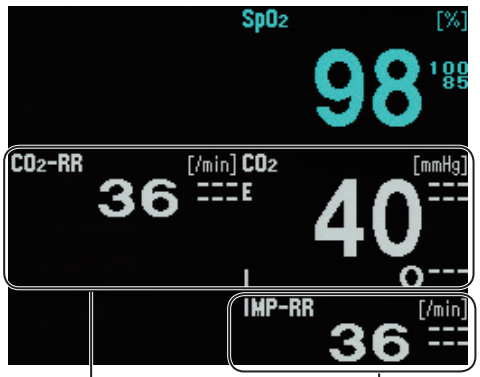
Respiration rate by impedance method can be displayed as a second respiration rate parameter together with the first respiration rate parameter. The method of the first respiration rate parameter is displayed in the following priority.
Gas > FLOW > CO_2 > thermistor respiration
Turn this setting on when displaying two measured values of respiration rate.

1. Display the OTHER page of the RESP/CO_2 window.
   Press the [Menu] key → RESP/CO_2 key → OTHER tab.

2. Select ON or OFF from the <DISPLAY IMP-RR AS SECOND PARAMETER> box.
   ON: Respiration rate by impedance method is displayed on the home screen.
   OFF: Respiration rate by impedance method is not displayed. Only the first respiration rate parameter is displayed on the home screen.



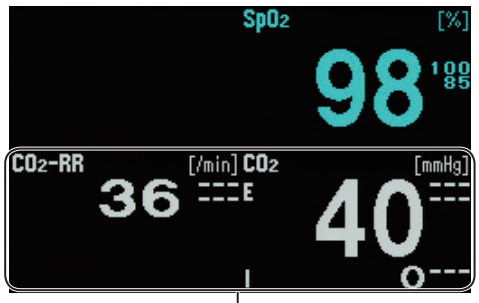
Display example for ON



First RR parameter

RR by impedance method

Display example for OFF



First RR parameter only

3. Press the [Home] key to return to the home screen.

Section 3 CO_2 Monitoring

General

On this monitor, CO_2 can be measured by either mainstream method or sidestream method.

To monitor CO_2 by the mainstream method, connect the TG-900P, TG-920P, TG-950P or TG-970P CO_2 sensor kit to the patient's respiration circuit or directly to the patient and connect the CO_2 sensor kit to the MULTI socket or PRESS CO_2 socket.

NOTE

The TG-950P CO_2 sensor kit is not available for BSM-6000A series.

To monitor CO_2 by the sidestream method, the optional AG-400R CO_2 unit, Oridion portable bedside monitor Microcap® or Covidien Microstream® Micropod™ capnography module is required.

To use the AG-400R CO_2 unit, the QF-905P interface is required. For details on the sidestream method, refer to the AG-400R CO_2 unit operator's manual.

To connect the Microcap® monitor, the QF-921P interface is required. Microcap is a registered trademark of Oridion Medical Ltd.

To connect the Micropod™ capnography module, the QF-801P interface is required. Micropod™ is a trademark of Covidien.

NOTE

- The AG-400R CO_2 unit is not available for BSM-6000A series.
- Oridion Microcap® portable bedside monitor is not available for BSM-6000K series.

Mainstream Method

In the mainstream method, the sensor is located directly in the respiration circuit. There are two types of sensors for different calculation methods.

Semi-quantitative method using the TG-900P or TG-920P CO_2 sensor kit
Measurements are based on the assumption of no CO_2 gas in the inspiration. The CO_2 concentration in the respiration is calculated by taking the CO_2 concentration in the inspiration as 0 mmHg (0 kPa).

Quantitative method using the TG-950P or TG-970P CO_2 sensor kit
The CO_2 partial pressure in both inspiration and expiration is measured.

The mainstream CO_2 measurement method has the following merits and limits compared to the sidestream method. Understand these points when performing measurements.

Merits

- No delay in the measurement time.
- Measurement is stable over a long period of time.
- Few measurement troubles due to mixture of water droplets.

Limits

- TG-900P, TG-950P or TG-970P CO_2 sensor kit cannot be used on non-intubated patients.
- Due to the weight of the TG-900P, TG-950P or TG-970P CO_2 sensor kit, load is easily imposed on the tracheal tube.
- The dead space volume is relatively large.

Sidestream Method

A small portion of the breath is continuously sampled from the respiratory circuit or directly from the patient's nostril. CO_2 molecules in the breath sample absorb infrared light at 4.3 μm. The absorption is proportional to the concentration of the CO_2 and the concentration can be determined by comparing the level of absorption to that of a known standard.

The sidestream CO_2 measurement method has the following merits and limits compared to the mainstream method. Understand these points when performing measurements.

NOTE

- The AG-400R CO_2 unit is not available for BSM-6000A series.
- Oridion Microcap® portable bedside monitor is not available for BSM-6000K series.

Merits

- CO_2 sensor adapter can be used on non-intubated patients.
- Lightweight adapter reduces risk of extubations.

Limits

- Delay in the measurement time.
- Sometimes CO_2 waveform is distorted.
- Long term measurement is difficult due to mixture of water droplets and secretions in the tube.

Measurement Error with the TG-900P or TG-920P CO_2 Sensor Kit

With the TG-900P or TG-920P CO_2 sensor kit, measurements are based on the assumption that the inspiration contains no CO_2 gas. If CO_2 gas mixes in the inspiration, measured values will be lower than normal.

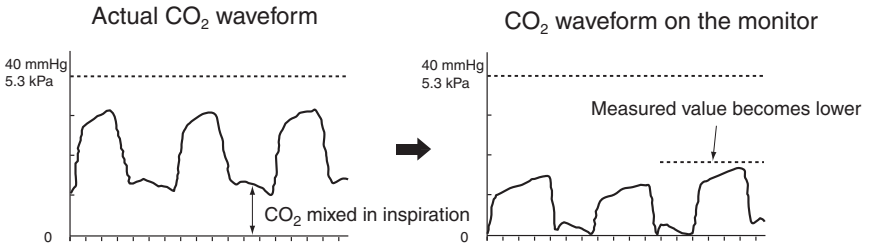
CAUTION

Supply adequate oxygen when measuring CO_2 partial pressure of a patient connected to a Jackson Rees, Mapleson D or any other respiration circuit where CO_2 gas may be present during inspiration. The semi-quantitative method measures CO_2 partial pressure based on the assumption of no CO_2 gas in the inspired air; it assumes CO_2 partial pressure 0 mmHg (0 kPa) in the inspiration of every respiration. If the inspired air contains CO_2 gas, the measured CO_2 value may be lower than the actual value.

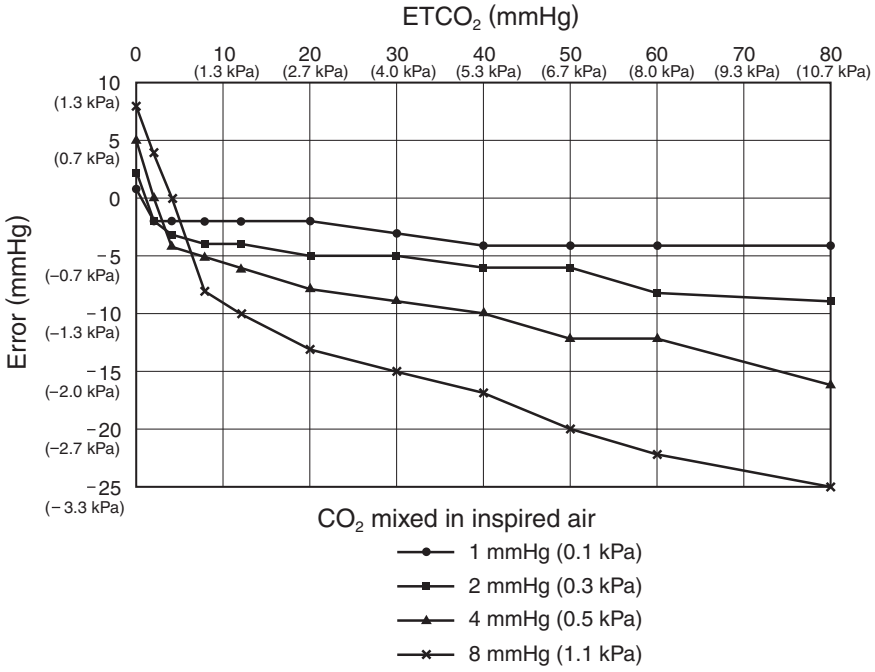
CAUTION

When measuring CO_2 partial pressure of a patient with an oxygen mask, set the oxygen supply to 5 L/min or more. If CO_2 gas remains in the oxygen mask and mixes with the inspired air, the measured value may be lower than the actual value.

When CO_2 is mixed in inspiration



Measurement Error when CO_2 is Mixed in the Inspired Air



CAUTION

The TG-900P and TG-920P CO_2 sensor kits do not adjust the measurement value to compensate for different atmospheric pressure. Be careful when reading the value when using the CO_2 sensor kit at high altitudes because the measurement value may be inaccurate.

The measurement value drops 0.13 kPa (1 mmHg) for 5.33 kPa (40 mmHg) CO_2 gas when an atmospheric pressure drops 3.3 kPa.

Use with Volatile Anesthetic Agents

CAUTION

When using an anesthetic instrument with a volatile anesthetic agent, the CO_2 measurement may be inaccurate.

Volatile anesthetic agents affect the CO_2 value. Be aware of this when using volatile anesthetic agent.

Example: At 1 atmospheric pressure and gas mixtures of 5% CO_2 (5.1 kPa (38 mmHg)) and balance N_2, dry gas

Anesthetic Gas	Concentration	Difference			
		TG-900P	TG-920P	TG-950P	TG-970P
Halothane	4%	+0.9 mmHg +0.12 kPa	+0.6 mmHg +0.08 kPa	+0.2 mmHg +0.03 kPa	+0.3 mmHg +0.04 kPa
Enflurane	5%	+1.5 mmHg +0.20 kPa	+1.5 mmHg +0.20 kPa	+0.4 mmHg +0.05 kPa	+0.9 mmHg +0.12 kPa
Isoflurane	5%	+1.8 mmHg +0.24 kPa	+1.7 mmHg +0.23 kPa	+0.8 mmHg +0.11 kPa	+1.7 mmHg +0.22 kPa
Sevoflurane	6%	+2.8 mmHg +0.37 kPa	+2.7 mmHg +0.36 kPa	+1.3 mmHg +0.17 kPa	+2.1 mmHg +0.28 kPa
Desflurane	24%	+7.0 mmHg +0.93 kPa	+6.6 mmHg +0.88 kPa	+3.2 mmHg +0.43 kPa	—
	15%	—	—	—	+2.9 mmHg +0.39 kPa

Preparing for CO_2 Monitoring

NOTE

- Only one MULTI socket can be used for monitoring CO_2. The sidestream and mainstream methods cannot be monitored at the same time.
- When the AG-920R, GF-110PA or GF-210R multigas unit or GF-120PA or GF-220R multigas/flow unit is connected to the monitor, turn off the AG-920R multigas unit power or disconnect the multi-link cable of the GF-110PA or GF-210R multigas unit or GF-120PA or GF-220R multigas/flow unit from the monitor while monitoring CO_2 by mainstream method. The CO_2 alarm from mainstream method cannot be indicated when the multigas unit or multigas/flow unit is turned on. (GF-120PA or GF-220R multigas/flow unit is not available for BSM-6000A series.)
- When using N_2O anesthetic gas (nitrous oxide), set the gas composition on the GAS COMP window. Refer to the “Setting the Inspiration Composition” section.

Preparation Flowchart

Mainstream Method

1. Select the CO_2 sensor kit and airway adapter/nasal adapter.
2. Connect the CO_2 sensor kit to the MULTI socket.
3. When using a TG-950P or TG-970P CO_2 sensor kit, perform zero calibration (TG-950P CO_2 sensor kit is not available for BSM-6000A series).
4. Connect the CO_2 sensor to the respiration circuit or attach the CO_2 sensor to the patient.
5. Start measurements and change necessary settings.

Sidestream Method

Using AG-400R CO_2 Unit

NOTE

The AG-400R CO_2 unit is not available for BSM-6000A series.

1. Prepare the CO_2 unit and connect the unit to the monitor with the QF-905P interface. Refer to the Administrator’s Guide and QF-905P interface operator’s manual.
2. Connect the patient and CO_2 unit with required sensor. Refer to the AG-400R CO_2 unit operator’s manual.
3. Start measurement and change necessary settings.

For details on the sidestream method, refer to the AG-400R CO_2 unit manual.

Using Oridion Portable Bedside Monitor Microcap® or Covidien Microstream® Micropod™ Capnography Module

NOTE

Oridion Microcap® portable bedside monitor is not available for BSM-6000K series.

1. Set up the external instrument and connect it to the BSM-6000A series bedside monitor. Refer to the interface operator's manual.

2. Connect the external instrument to the patient. Refer to the external instrument manual.

3. Start measurement and change necessary settings.

Types of CO_2 Sensor Kits for Mainstream Method

There are four types of CO_2 sensor kit for CO_2 mainstream monitoring.

Model	Method	Attachment
TG-900P	Semi-quantitative	Used on an intubated patient
TG-920P	Semi-quantitative	Attach to the patient nose or used on an intubated patient
TG-950P	Quantitative	Used on an intubated patient
TG-970P	Quantitative	Used on an intubated patient with YG-211T/213T/214T

WARNING

When using the airway adapter or nasal adapter on a patient with low ventilatory volume, the CO_2 may mix in the inspiration due to the airway adapter's dead space, resulting in inaccurate measured values or difficulty in detecting apnea. Perform ventilation taking into consideration the dead space of the adapters.

CAUTION

The CO_2 data may be inaccurate when monitoring a patient with an extremely high respiration rate or irregular respiration. Read the measured values carefully.

CAUTION

When monitoring CO_2, make sure that the gas composition is entered. Otherwise the measurement result may be inaccurate.

CAUTION

When using an anesthetic instrument with a volatile anesthetic agent, the CO_2 measurement may be inaccurate.

CAUTION

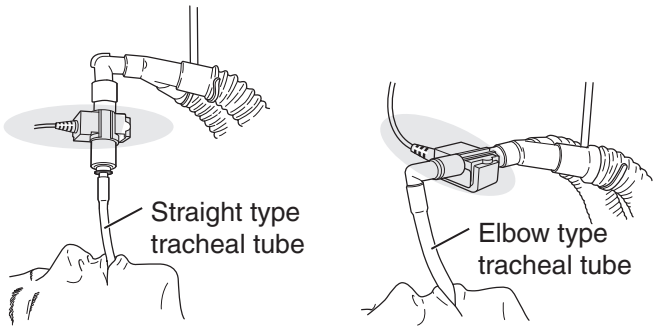
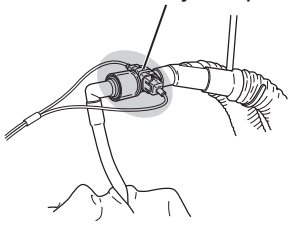
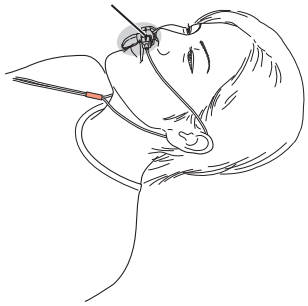
Select the airway adapter or nasal adapter taking into consideration the patient weight and ventilation volume. If an inappropriate airway adapter or nasal adapter is used, the resistance in the respiration circuit increases and it causes incorrect measurement value.

NOTE

The measurement may be inaccurate when monitored in the following conditions. Read the measured values carefully.

- When used in environments with high concentration nitrous oxide gas.
- When used in environments with sudden temperature changes.
- When used in environments with severe humidity.

Connection example

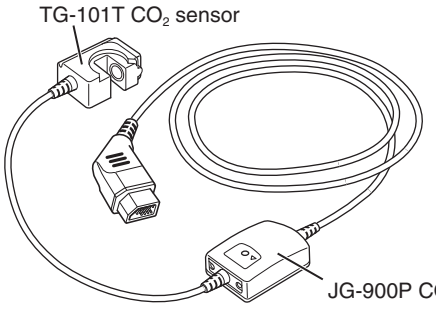
For intubated patients	For non-intubated patients
TG-900P/TG-950P/TG-970P  TG-920P YG-111T airway adapter 	TG-920P YG-121T nasal adapter 

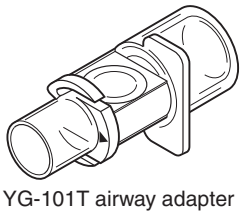
NOTE

- For intubated patients, connect the CO_2 sensor as in the following example so that the sensor does not touch the patient.
- The TG-950P CO_2 sensor kit is not available for BSM-6000A series.

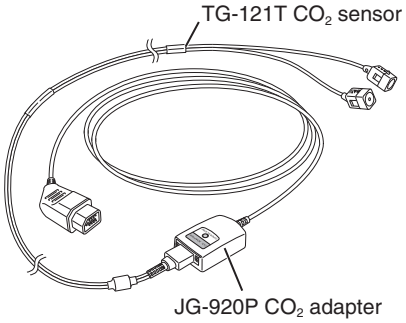
TG-900P CO_2 Sensor Kit

The TG-900P CO_2 sensor kit measures the partial pressure of the expired CO_2 of an intubated patient by the semi-quantitative method. It consists of a TG-101T CO_2 sensor and JG-900P CO_2 adapter. It requires a YG-101T airway adapter for monitoring CO_2.




YG-101T airway adapter

Model	Weight	Dead Space Volume	Supply Code
YG-101T	10 kg or more	5 cc	R801



TG-920P CO_2 Sensor Kit

The TG-920P CO_2 sensor kit measures the partial pressure of the expired CO_2 of a patient by the semi-quantitative method. This CO_2 sensor kit can be used on both intubated and not intubated patients. It consists of a TG-121T CO_2 sensor and JG-920P CO_2 adapter. It requires a YG-120T, YG-121T or YG-122T nasal adapter when attached on a patient who is not intubated or YG-111T airway adapter when attached on an intubated patient for monitoring CO_2.

Type of Adapter	Model	Weight	Dead Space Volume	Supply Code
Airway adapter	YG-111T	7 kg or more	4 mL	R804
Nasal adapter	YG-120T	10 kg or more	1.2 mL	V921
	YG-121T			V922
	YG-122T			V923

WARNING

The only oxygen cannula that can be used with YG-122T is manufactured by HUDSON RCI®. Do not use any other oxygen cannula. Other oxygen cannulas cannot be attached and oxygen cannot be delivered to the patient through the nostrils.

WARNING

Check that the oxygen cannula tube is not bent, broken, or blocked by the nasal tube. If the ends of the oxygen cannula tube turn too far up or down, it causes insufficient O_2 supply or the CO_2 value may be incorrect.

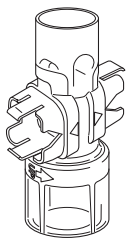
CAUTION

When using the YG-121T/YG-122T nasal adapter on a patient with bleeding disorder, poor general medical condition or malnutrition, observe the patient condition all the time. The mouth guide touches the mouth and may cause pressure sores.

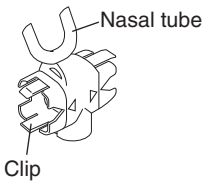
WARNING

- When you use YG-122T together with an oxygen cannula, check that the oxygen cannula is correctly attached on the patient by referring to other parameters and by observing the patient periodically.
- If arterial oxygen saturation does not increase, immediately stop using the oxygen cannula with the CO_2 sensor kit and select another way to supply oxygen.

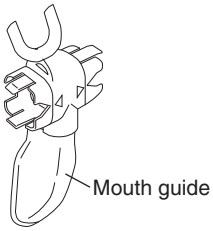
YG-111T airway adapter



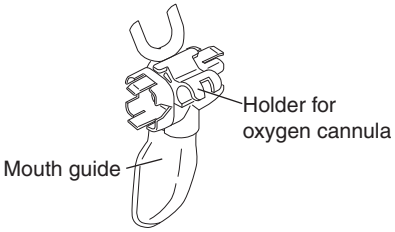
YG-120T
(for nasal breathing)



YG-121T
(for naso-oral)

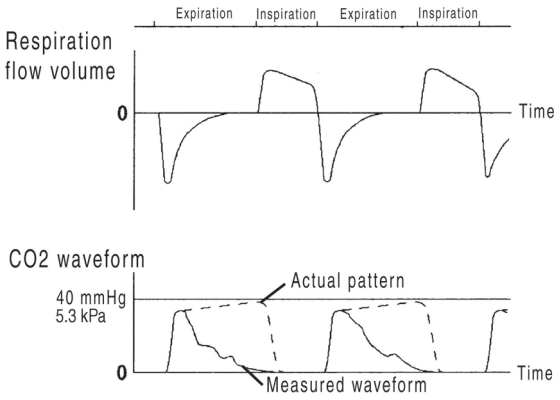


YG-122T
(for oxygen cannula)



When Using an Oxygen Cannula

As the graphs show, the expired volume is decreased at the end of expiration. If too much oxygen is supplied or oxygen is directly delivered to the nose, the oxygen flow affects the expired gas flow. Therefore, the actual CO_2 waveform will be inaccurate (the solid line in the graph) compared with the typical pattern (the dashed line).



TG-950P CO_2 Sensor Kit

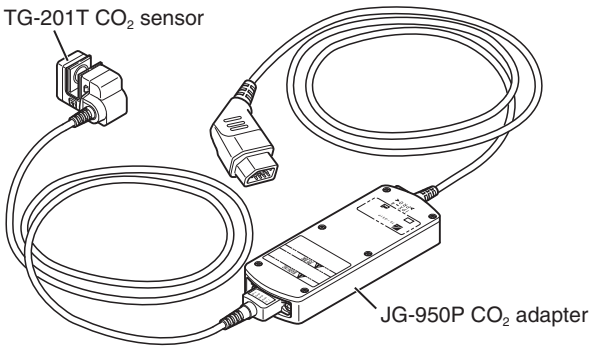
CAUTION

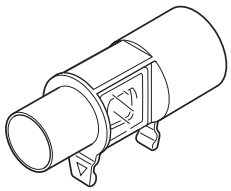
With the TG-950P/TG-970P CO_2 sensor kit, measured value may be incorrect when the operating temperature changes greatly. In this case, wait for about 30 minutes to acquire correct measurement.

The TG-950P CO_2 sensor kit measures the partial pressure of the expired CO_2 of an intubated patient by the quantitative method. It consists of a TG-201T CO_2 sensor and JG-950P CO_2 adapter. It requires a YG-201T or YG-202T airway adapter for monitoring CO_2.

NOTE

TG-950P CO_2 sensor kit and YG-201T/202T airway adapter are not available for BSM-6000A series.





YG-201T/YG-202T airway adapter

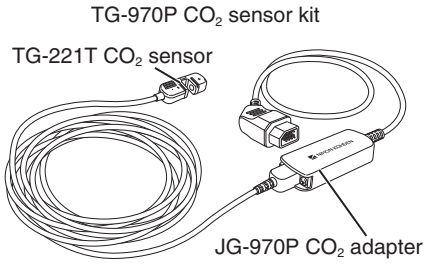
Model	Patient	Weight	Dead Space Volume	Supply Code
YG-201T	Adult/child	10 kg or more	5 mL	R802
YG-202T	Child/neonate	3 to 10 kg	2 mL	R803

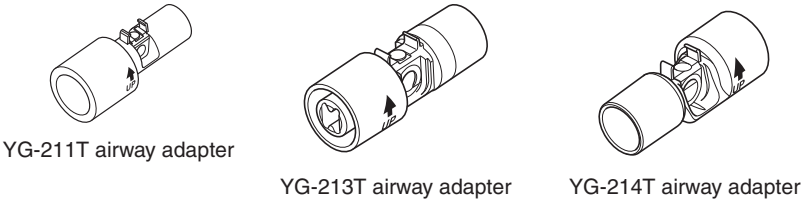
TG-970P CO_2 Sensor Kit

CAUTION

With the TG-950P/TG-970P CO_2 sensor kit, measured value may be incorrect when the operating temperature changes greatly. In this case, wait for about 30 minutes to acquire correct measurement.

The TG-970P CO_2 sensor kit measures the partial pressure of the expired CO_2 of an intubated patient by the quantitative method. It consists of a TG-221T CO_2 sensor and JG-970P CO_2 adapter. It requires an airway adapter for monitoring CO_2.





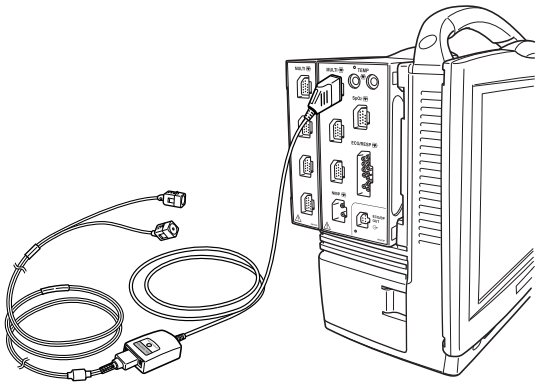
Model	Patient	Weight	Dead Space Volume	Supply Code
YG-211T	Adult/child	7 kg or more	4 mL	R805
YG-213T	Child/neonate	2 to 7 kg	0.5 mL	R806
YG-214T	Child/neonate	2.5 to 7 kg	1.8 mL	R807

Connecting the CO_2 Sensor Kit to the Unit

Connect the CO_2 sensor kit to the MULTI or PRESS CO_2 socket. Only one MULTI or PRESS CO_2 socket can be used for monitoring CO_2.

NOTE

- Only one MULTI socket or PRESS CO_2 socket can be used for monitoring CO_2. The sidestream and mainstream methods cannot be monitored at the same time.
- When the AG-920R, GF-110PA or GF-210R multigas unit or GF-120PA or GF-220R multigas/flow unit is connected to the monitor, turn off the AG-920R multigas unit power or disconnect the multi-link cable of the GF-110PA or GF-210R multigas unit or GF-120PA or GF-220R multigas/flow unit from the monitor while monitoring CO_2 by mainstream method. The CO_2 alarm from mainstream method cannot be indicated when the multigas unit or multigas/flow unit is turned on. (GF-120PA or GF-220R multigas/flow unit is not available for BSM-6000A series.)



When connecting the TG-920P CO_2 sensor kit

Connecting the CO_2 Sensor Kit to the Respiration Circuit

Connect the CO_2 sensor kit to the patient or respiration circuit by referring to the CO_2 sensor kit manual.

Performing Zero Calibration when Using a TG-950P or TG-970P CO_2 Sensor Kit

NOTE

TG-950P CO_2 sensor kit is not available for BSM-6000A series.

When using the TG-950P or TG-970P CO_2 sensor kit, perform zero calibration in the following conditions.

- When the airway adapter is replaced with a new one.
- When a different type of airway adapter is used.
- When the operating temperature changes.
- When the measurement room is changed.
- Whenever necessary.

Zero calibration can be performed in two ways: calibration with air and calibration with N_2 gas. Both methods are performed on the RESP/CO_2 window.

- Calibration with air
  Expose the airway adapter to air. Calibrates with about 0.2 mmHg (0.03 kPa) CO_2 in the air.
- Calibration with N_2 gas
  Flow N_2 gas into the airway adapter.

Calibrating by Air

1. Display the ZERO CAL page of the RESP/CO_2 window. The TG-950P CO_2 sensor kit must be connected to the monitor for the ZERO CAL page to be displayed.
   Press the [Menu] key → RESP/CO_2 key → ZERO CAL tab.

2. Select AIR CAL under <SELECT CALIBRATION METHOD>. The "EXPOSE SENSOR TO AIR" message appears.

3. Expose the airway adapter to air and touch the YES key to start calibration.

   When the "CALIBRATION COMPLETE" message is displayed, the calibration is complete. The calibrated date and time appears.

4. Reconnect the airway adapter to the respiration circuit. CO_2 can be monitored.

Calibrating with N_2 Gas

For handling the N_2 gas cylinder, refer to the N_2 gas manual.

1. Connect the airway adapter to the N_2 gas cylinder.

2. Display the ZERO CAL page of the RESP/CO_2 window. The TG-950P CO_2 sensor kit must be connected to the monitor for the ZERO CAL page to be displayed.
   Press the [Menu] key → RESP/CO_2 key → ZERO CAL tab.

3. Select N_2 CAL under <SELECT CALIBRATION METHOD>. The "FLOW N_2 GAS" message appears.

4. Open the N_2 gas cylinder so that the N_2 gas flows into the airway adapter and touch the YES key to start calibration.

   When the "CALIBRATION COMPLETE" message is displayed, the calibration is complete. The calibrated date and time appears.

5. Reconnect the airway adapter to the respiration circuit. CO_2 can be monitored.

Monitoring CO_2

After completing the preparation, CO_2 data and waveform appear on the screen.

CAUTION

When the "CO_2 CHANGE ADAPTER" or "CO_2 CHANGE SENSOR" message is displayed, check the CO_2 sensor kit and replace it if necessary. CO_2 cannot be monitored while the message is displayed.

CAUTION

When using an anesthetic instrument with a volatile anesthetic agent, the CO_2 measurement may be inaccurate.

NOTE

When the AG-920R, GF-110PA or GF-210R multigas unit or GF-120PA or GF-220R multigas/flow unit is connected to the monitor, turn off the AG-920R multigas unit power or disconnect the multi-link cable of the GF-110PA or GF-210R multigas unit or GF-120PA or GF-220R multigas/flow unit from the monitor while monitoring CO_2 by mainstream method. The CO_2 alarm from mainstream method cannot be indicated when the multigas unit or multigas/flow unit is turned on. (GF-120PA or GF-220R multigas/flow unit is not available for BSM-6000A series.)

CO_2 Information on the Home Screen

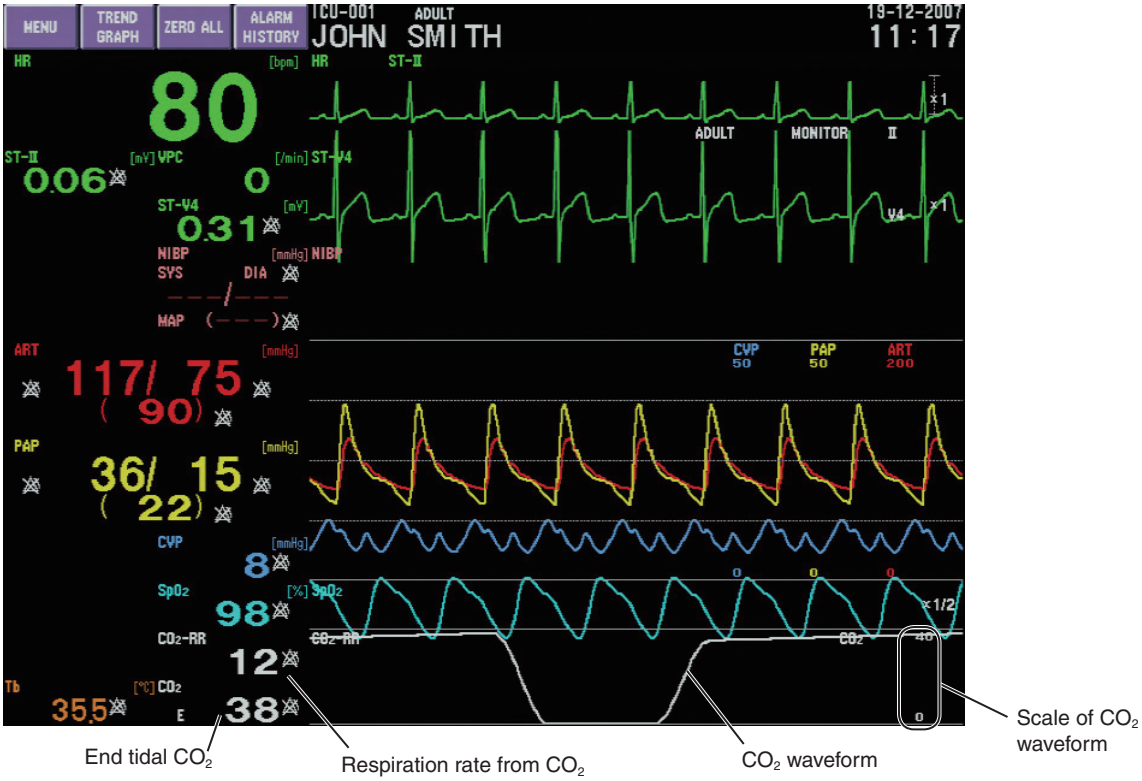
When Using a TG-900P or TG-920P CO_2 Sensor Kit

NOTE

This monitor performs calibration automatically at periodic interval and in the following conditions.

- At the monitor power on
- Patient's first respiration
- The airway adapter/nasal adapter is removed from the CO_2 sensor and connected again
- Respiration stopped for 20 seconds
- Signal changed rapidly due to temperature change

During calibration, the CO_2 waveform appears as the calibrated waveform, but the respiration rate and measured value are not affected.



When Using a TG-950P or TG-970P CO_2 Sensor Kit, AG-400R CO_2 Unit, Oridion Portable Bedside Monitor Microcap® or Covidien Microstream® Micropod™ Capnography Module

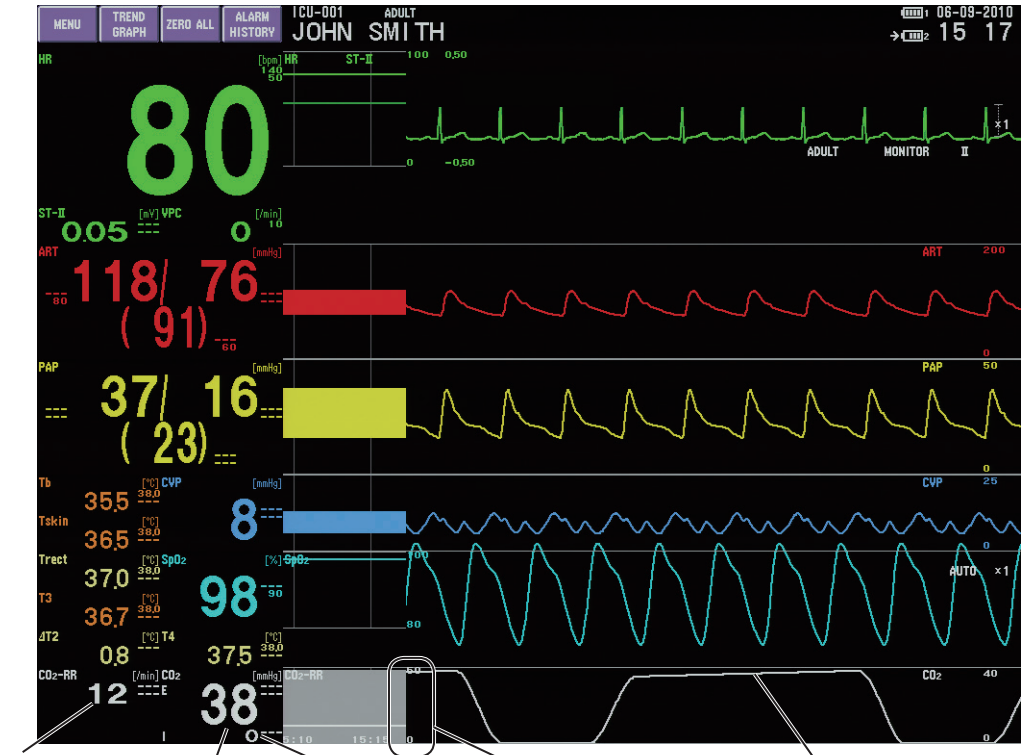
WARNING

Alarms are set on the bedside monitor and external instrument individually. When an alarm setting is changed on one instrument, the same setting change is not automatically applied to the other instrument.

NOTE

Perform calibration in the following conditions.

- When the airway adapter is replaced with a new one.
- When a different type of airway adapter is used.
- When the operating temperature changes.
- When the measurement room is changed.
- Whenever necessary.



Changing CO_2 Settings

Change the settings on the RESP/CO_2 window. The following settings can be changed for CO_2 monitoring.

- Scale
- Respiration rate, apnea and CO_2 alarm settings
- Inspiration composition
- CO_2 waveform sweep speed
- Duration for holding $ETCO_2$ maximum value

The CO_2 unit can be set to mmHg or kPa on the SYSTEM CONFIGURATION screen. Refer to Section 2 of the Administrator's Guide.

The CO_2 data display color and CO_2 waveform fill in or not can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

If the APNEA alarm occurs and no action is taken for a selected duration, the alarm level can be escalated. Refer to Section 3 of the Administrator's Guide.

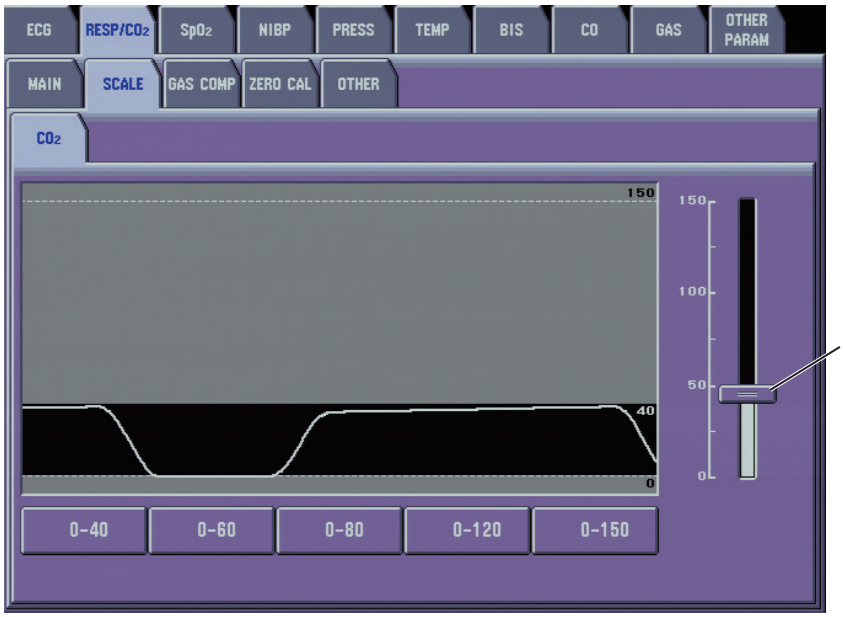
Changing the Scale

The scale can be changed for the CO_2 waveform. The same scale is used on both the home screen and RESP/CO_2 window.

The CO_2 scale can also be changed on the TREND GRAPH window.

1. Display the SCALE page of the RESP/CO_2 window.
   Press the [Menu] key → RESP/CO_2 key → SCALE tab.

2. Select the scale by touching the desired scale key. You can adjust the scale using the scale slider.



3. Press the [Home] key to return to the home screen.

Changing the CO_2, Respiration Rate and Apnea Alarm Limits

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

You can set the upper and lower $ETCO_2$, respiration rate and upper apnea and inspired CO_2 alarm limits on the RESP/CO_2 window. You can set all alarms, including the upper and lower $ETCO_2$, respiration rate and upper apnea and inspired CO_2 alarm limits on the ALARM LIMITS window (refer to the Operator's Manual or Section 5 of the User's Guide Part I). You can also set upper and lower CO_2, respiration rate and apnea alarm limits on the RESP, GAS and FLOW/Paw windows. (The FLOW/Paw window is not available for BSM-6000A series.) You can also set upper and lower $ETCO_2$ alarm limits and inspired CO_2 alarm limit on the GAS window.

Setting Range

CO_2(E) upper limit:	2 to 99 mmHg in 1 mmHg steps (0.2 to 13.0 kPa in 0.1 kPa steps), OFF (default setting: OFF)*1*2
CO_2(E) lower limit:	OFF, 1 to 98 mmHg in 1 mmHg steps (0.1 to 12.9 kPa in 0.1 kPa steps) (default setting: OFF)*1*2
CO_2(I) upper limit*3:	1 to 99 mmHg in 1 mmHg steps (0.1 to 13.0 kPa in 0.1 kPa steps), OFF (default setting: ADULT OR, CHILD-3 mmHg (0.4 kPa), ADULT ICU/NICU, NEONATE-OFF)
Respiration rate upper limit:	2 to 150 counts/min in 2 counts/min steps, OFF (default setting: OFF)*1*2
Respiration rate lower limit:	OFF, 0 to 148 counts/min in 2 counts/min steps (default setting: OFF)*1*2
Apnea upper limit:	5 to 40 s in 5 s steps, OFF (default setting: 20)*1*2

*1 On BSM-6000A series, if <CRISIS VITAL ALARM MANAGEMENT> on the SYSTEM CONFIGURATION screen is turned on and "ALARM PRIORITY" on the SYSTEM SETUP window is set to CRISIS, the alarm setting is set to the alarm master setting.

*2 On BSM-6000A series, if <ALARM CAP> on the SYSTEM CONFIGURATION screen is turned on, the alarm setting is affected by the "ALARM CAP" setting on the SYSTEM SETUP window.

*3 CO_2(I) alarm upper limit can be set when using a TG-950P and TG-970P CO_2 sensor kit or when monitoring CO_2 in sidestream method. TG-950P CO_2 sensor kit and AG-400R CO_2 unit are not available for BSM-6000A series.

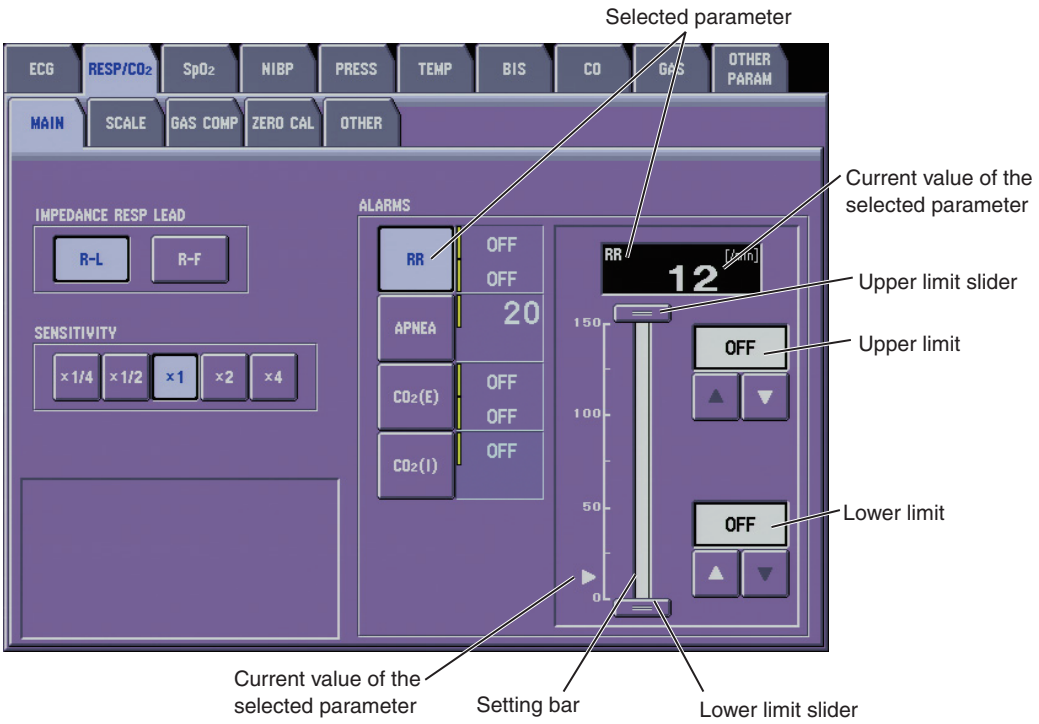
1. Display the MAIN page of the RESP/CO_2 window.
   Press the [Menu] key → RESP/CO_2 key → MAIN tab.

2. Touch the CO_2 key to change the end tidal CO_2 alarm setting.

   Touch the CO_2(I) key to change the inspired CO_2 alarm setting. This setting is only available when CO_2 is monitored with TG-950P CO_2 sensor kit or by sidestream method.

   Touch the RR key to change the respiration rate alarm setting.

Touch the APNEA key to change the apnea alarm setting.



3. Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.

4. Press the [Home] key to return to the home screen.

Setting the Inspiration Composition

When N_2O is mixed in the inspiration or when a high concentration of oxygen is inspired, sensitivity of CO_2 absorbing infrared ray is affected, and as a result measurements cannot be performed correctly. When using anesthetic gas or a respirator, set the inspiration composition. The monitor corrects the CO_2 concentration automatically according to the setting.

This setting is not required when monitoring in sidestream method.

CAUTION

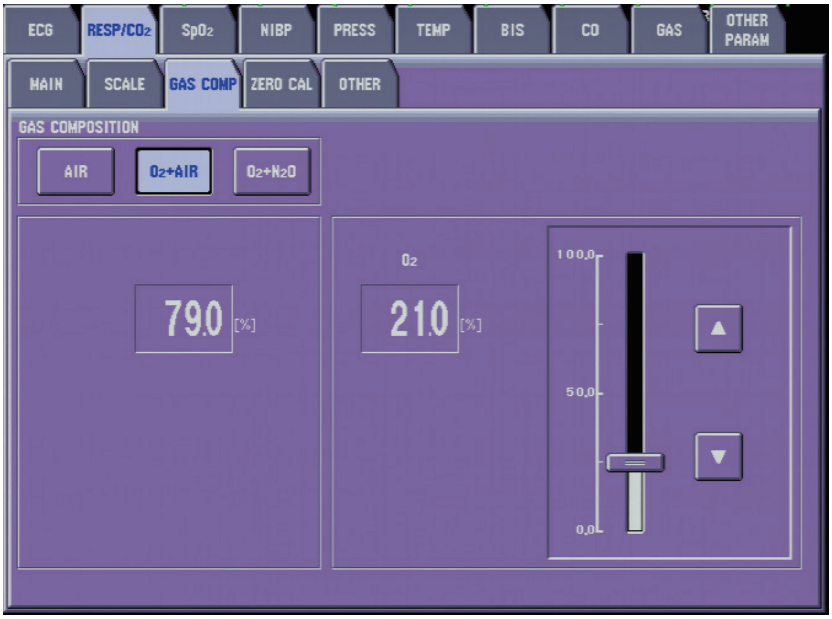
When monitoring CO_2, make sure that the gas composition is entered. Otherwise the measurement result may be inaccurate.

CAUTION

When using an anesthetic instrument with a volatile anesthetic agent, the CO_2 measurement may be inaccurate.

1. Display the GAS COMP page of the RESP/CO_2 window.
   Press the [Menu] key → RESP/CO_2 key → GAS COMP tab.

2. Set the composition of the inspired gas.
   - When not using gas that influences measurement
     → Select AIR.
   - When using a respirator or high concentration of oxygen
     → Select O_2+AIR and set the O_2 gas ratio on the O_2 setting bar.
   - When using anesthetic gas
     → Select O_2+N_2O and set the gas ratio on the O_2 and N_2 setting bar.



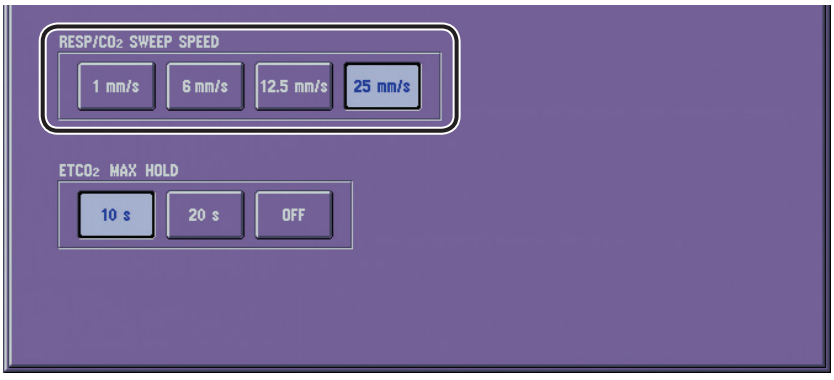
3. Press the [Home] key to return to the home screen.

Changing the CO_2 Waveform Sweep Speed

The CO_2 waveform sweep speed on the screen can be selected. This setting can also be changed on the WAVES page of the DISPLAY window.

1. Display the OTHER page of the RESP/CO_2 window.
   Press the [Menu] key → RESP/CO_2 key → OTHER tab.

2. Select the sweep speed from the <RESP/CO_2 SWEEP SPEED> box.



3. Press the [Home] key to return to the home screen.

Changing Duration for Holding $ETCO_2$ Maximum Value

Select the time for holding the maximum $ETCO_2$ value. This setting is available only when using the TG-950P* or TG-970P CO_2 sensor kit. When using the TG-900P or TG-920P CO_2 sensor kit, this item is automatically set to OFF.

* This function is not available in some versions.

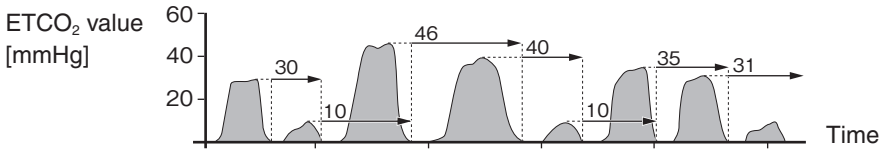
Settings

OFF: The maximum value is updated each breath (default setting)

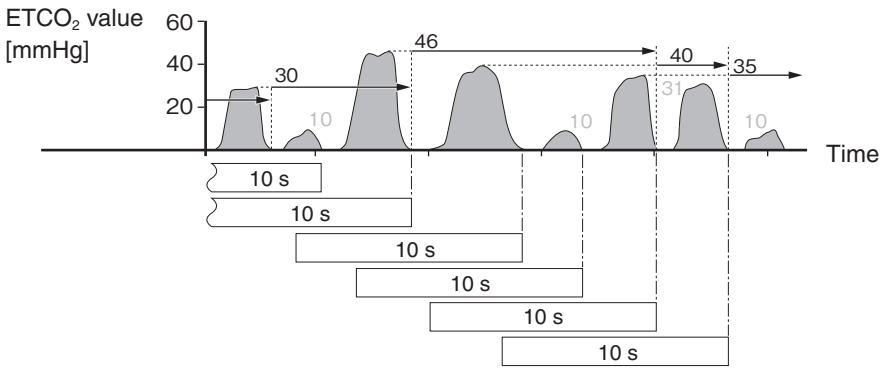
10 sec: The maximum value for latest 10 seconds

20 sec: The maximum value for latest 20 seconds

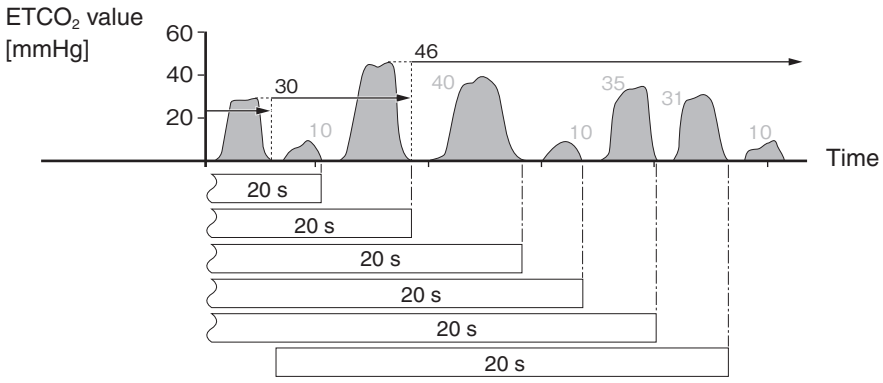
OFF



10 sec



20 sec



1. Display the OTHER page of the RESP/CO_2 window.
   Press the [Menu] key → RESP/CO_2 key → OTHER tab.

2. Select the time from the <$ETCO_2$ MAX HOLD> box.

3. Press the [Home] key to return to the home screen.

Inspection of Measuring Accuracy

Daily Inspection of Measuring Accuracy

Perform daily accuracy inspection using your own respiration.

Put the larger end of the airway adapter (side for connecting to the patient's mask and tracheal tube) into your mouth and after stabilizing breathing, breathe in the same way as in the resting state at a rate of 5 seconds per breath (12 breaths/min). Breathing too quickly or taking deep breaths will disable standard measurements.

The standard $ETCO_2$ concentration is 40 mmHg (5.3 kPa). Check that the CO_2 gas concentration display is from 35 to 45 mmHg (4.7 to 6.0 kPa).

Inspection of Measuring Accuracy (Precise Method)

Check the measurement accuracy every year and whenever you suspect the monitor is not reading correctly. This procedure does not calibrate the CO_2 sensor. It only checks the measurement accuracy. If the measurement accuracy is not appropriate, contact your Nihon Kohden representative.

For details, refer to Service Manual.

Section 4 SpO_2 Monitoring

For monitoring SpO_2, the manufacturer of the probes differs depending on the model of the AY series input unit and the BSM-1700 series bedside monitor.

AY-660P, AY-661P, AY-663P, AY-671P or AY-673P input unit, or BSM-1763 or BSM-1773 bedside monitor: Nihon Kohden (refer to Section 4-1)

AY-651P or AY-653P input unit, or BSM-1753 bedside monitor: Nellcor (refer to Section 4-2)

AY-631P or AY-633P input unit, or BSM-1733 bedside monitor: Masimo (refer to Section 4-3)

AY-660P, AY-661P and AY-663P input units and BSM-1763 bedside monitor are not available for BSM-6000A series.

Section 4-1 SpO_2 Monitoring with Nihon Kohden Probes

NOTE

The AY-660P, AY-661P and AY-663P input units and the BSM-1763 bedside monitor are not available for BSM-6000A series.

General

To monitor SpO_2, attach a probe to the patient and connect it to the SpO_2 socket.

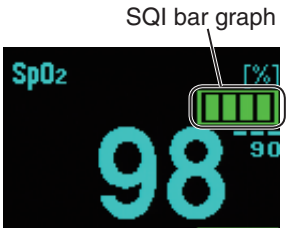
* The AY-660P, AY-661P and AY-663P input units, BSM-1763 bedside monitor and JL-500P2 SpO_2 adapter are not available in the US.

To monitor SpO_2 at two site (dual SpO_2), attach a probe to the patient and connect it to the SpO_2 socket on the AY-661P*, AY-663P*, AY-671P or AY-673P input unit or BSM-1763* or BSM-1773 bedside monitor and attach another probe to the patient and connect it to the MULTI socket on the AY-661P*, AY-663P*, AY-671P or AY-673P input unit, BSM-1763* or BSM-1773 bedside monitor, AA-672P or AA-674P smart expansion unit or JA-694PA data acquisition unit. The MULTI socket on the AY-660P input unit cannot be used.

To connect a Nihon Kohden probe to the MULTI socket, the JL-500P1 or JL-500P2* SpO_2 adapter is required. More than one JL-500P1 or JL-500P2* SpO_2 adapter cannot be connected to the monitor.

When using an AY-660P input unit* with a JA-694PA data acquisition unit, the SpO_2-2 cannot be monitored by the MULTI socket on the AY-660P input unit*, but can be monitored by the MULTI socket on the JA-694PA data acquisition unit.

When the Nihon Kohden probe is not connected to the SpO_2 socket, Nellcor or Masimo probe can be used with IF-919P or IF-925P communication cable. Refer to Section 4-2 or 4-3.



SQI bar graph

The SQI bar graph is only available when the following conditions are met. Check the version of the following items before use.

- Bedside monitor: Ver. 05-01 or later
- SpO_2 module: Ver. 02-01 or later
- AY-600P series input unit: Ver. 02-01 or later

The SQI bar graph shows the pulse waveform signal quality for SpO_2 measurement.

SQI Bar Graph		Signal Quality
	4 green bars	The signal quality is high.
	3 green bars	There may be some artifact.
	2 yellow bars*	The signal quality is reduced due to large artifact. If this state continues for a long time, check the patient and probe attachment.
	1 red bar*	The signal quality is very low. Check the patient and probe attachment.
	0 bars	The signal cannot be measured.

* If the SQI bar graph shows 1 or 2 bars, the “LOW QUALITY SIGNAL” message appears in the screen.

WARNING

SpO_2 measurement may be incorrect in the following cases.

- When the patient's carboxyhemoglobin or methemoglobin increases abnormally.
- When dye is injected in the blood.
- When using an electrosurgical unit.
- During CPR.
- When measuring at a site with venous pulse.
- When there is body movement.
- When the pulse wave is small (insufficient peripheral circulation).

WARNING

- When using the TL-201T finger probe, do not fasten the probe and cable to the finger by wrapping with tape. This may cause burn, congestion or pressure necrosis from poor blood circulation.
- When using probes other than the TL-201T finger probe, to avoid poor circulation, do not wrap the tape too tight. Check the blood circulation condition by observing the skin color and congestion at the skin peripheral to the probe attachment site. Even for short-term monitoring, there may be burn or pressure necrosis from poor blood circulation, especially on neonates or low birth weight infants whose skin is delicate. Accurate measurement cannot be performed on a site with poor peripheral circulation.

WARNING

Check the circulation condition by observing the skin color at the measurement site and pulse waveform. Change the measurement site every 8 hours for disposable probes and every 4 hours for reusable probes (every 8 hours for TL-631T3 probe). The skin temperature may increase at the attached site by 2 or 3°C (4 or 5°F) and cause a burn or pressure necrosis. When using the probe on the following patients, take extreme care and change the measurement site more frequently according to symptoms and degree.

- Patient with a fever
- Patient with insufficient peripheral circulation
- Neonate or low birth weight infant with delicate skin

WARNING

When not monitoring SpO_2, disconnect the SpO_2 connection cord from the input unit. Otherwise, noise from the probe sensor may interfere and incorrect data is displayed on the screen.

WARNING

When monitoring SpO_2 of a patient who is receiving photodynamic therapy, the light from the finger probe sensor may cause a burn. Photodynamic therapy uses a photosensitizing agent that has a side effect of photosensitivity.

The SpO_2 probe manufactured by Nihon Kohden have two wavelengths with peaks in the range of 650 and 950 nm. The maximum light intensity is less than 5.5 mW.

CAUTION

Turn off the power of mobile phones, small wireless devices and other devices which produce strong electromagnetic interference around a patient (except for devices allowed by the hospital administrator). Radio waves from devices such as mobile phones or small wireless devices may be mistaken as pulse waves and the displayed data may be incorrect.

CAUTION

Only use the specified probes. Otherwise, SpO_2 cannot be monitored.

CAUTION

Normal external light does not affect monitoring but strong light such as a surgical light or sunlight may affect monitoring. If affected, cover the measuring site with a blanket.

CAUTION

While a patient is on medication which causes vasodilation, the pulse waveform may change and in rare cases the SpO_2 value might not be displayed.

NOTE

Do not attach the probe to the same limb that is used for NIBP measurement or an IBP catheter. The SpO_2 measurement may be incorrect.

When Monitoring Dual SpO_2

CAUTION

When two probes are attached too close to each other, the light from the probes interferes with each other and SpO_2 cannot be monitored properly. Make sure that there is no light interference when attaching two probes.

NOTE

SpO_2-2 cannot be monitored by using the MULTI socket on the AY-660P input unit.

Dual SpO_2 Function (SpO_2 Measurement at Two Sites)

When there is a right → left shunt in a patent ductus arteriosus (PDA), there will be a difference in oxygen saturation between the right upper limb (pre-ductal) and lower limb (post-ductal).

By connecting two SpO_2 probes to the bedside monitor, SpO_2 can be monitored at the upper limb and lower limb, and the SpO_2 difference (ΔSpO_2) can be calculated. The ΔSpO_2 is calculated by subtracting the SpO_2 value from the probe connected to the MULTI socket (post-ductal) from the SpO_2 value from the probe connected to the SpO_2 socket (pre-ductal).

When there is a right → left shunt through the ductus arteriosus, the SpO_2 of the lower limb is lower than the SpO_2 of the right upper limb. Therefore, when the SpO_2 probe connected to the SpO_2 socket is attached to a right upper limb and the probe connected to the MULTI socket is attached to a lower limb, the ΔSpO_2 is indicated as a plus value.

PPHN (Persistent Pulmonary Hypertension of Newborn) and Dual SpO_2

PPHN (Persistent Pulmonary Hypertension of Newborn) is a critical disease where elevated pulmonary vascular resistance and serious pulmonary hypertension remain after birth and there is a large right → left shunt through the ductus arteriosus.

For PPHN from the right → left shunt in a patent ductus arteriosus (PDA), it is reported that monitoring the difference in SpO_2 between right upper limb (preductal) and lower limb (post-ductal) is useful to diagnose PPHN, decide the timing of starting/stopping treatment, and decide the operation schedule.

Preparing for SpO_2 Monitoring

Preparation Flowchart

1. Select the probe.
2. Connect the probe to the SpO_2 connection cord and connect the SpO_2 connection cord to the SpO_2 socket.

   For SpO_2 measurement at two sites, connect the probe to the SpO_2 adapter and connect the SpO_2 adapter to the MULTI socket.
3. Attach the probe to the patient.
4. Monitoring starts. Set necessary settings.

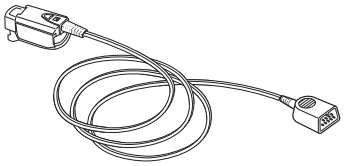
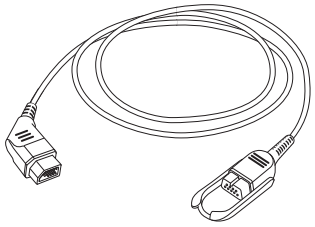
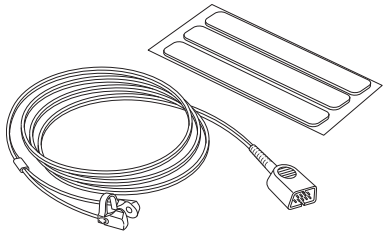
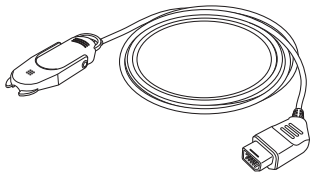
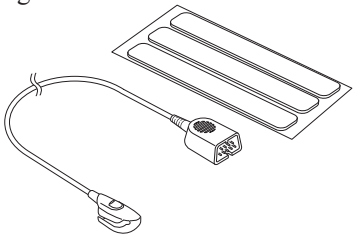
Selecting a Probe

Select the appropriate probe according to the purpose.

CAUTION

Only use Nihon Kohden specified electrodes, probes, transducers, thermistors and catheters. Otherwise, the maximum performance from the monitor cannot be guaranteed.

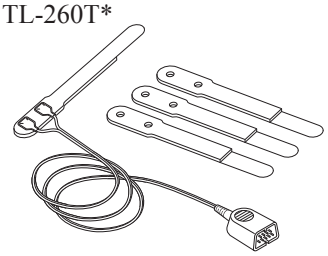
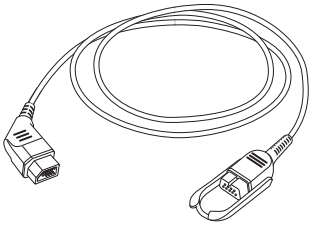
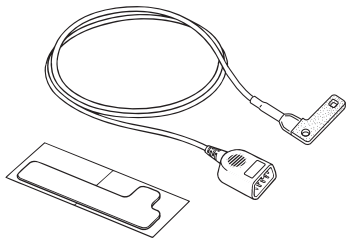
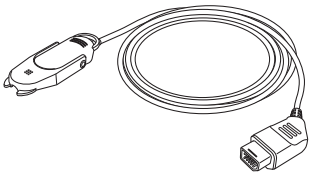
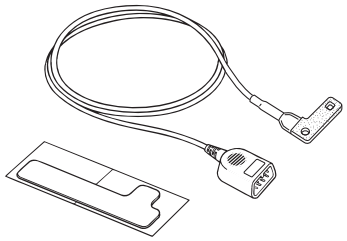
Nihon Kohden Reusable Probes

Model	Patient (Weight)	Attachment Site	SpO_2 Connection Cord/ SpO_2 Adapter
Finger Probe TL-201T 	Adults, children (Weight 20 kg or more)	Finger	SpO_2 Connection Cord JL-900P 
Multi-site Probe TL-220T 	Adults, infants (Weight 3 kg or more)	Finger or toe	
	Neonates (Weight 3 kg or less)	Instep and sole	SpO_2 Adapter JL-500P1/JL-500P2* 
Finger Probe TL-630T3*/TL-631T3 	Adults, children (TL-630T3: Weight 50 kg or more TL-631T3: Weight 20 kg or more)	Finger or toe	* TL-630T3 finger probe and JL-500P2 SpO_2 adapter are not available for BSM-6000A series.

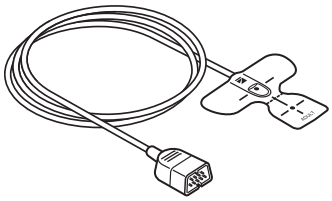
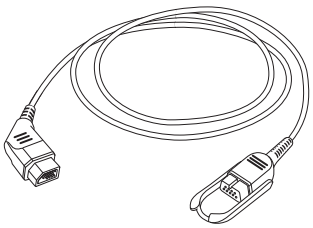
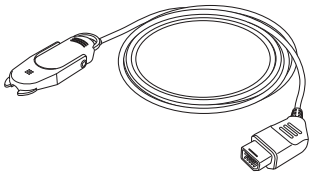
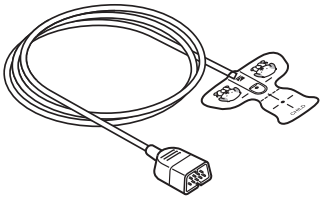
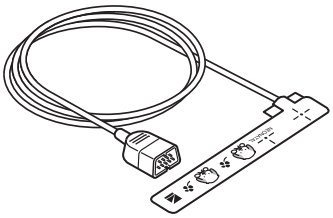
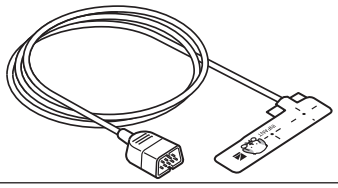
Nihon Kohden Disposable Probes

CAUTION

The disposable probe is not sterilized. Use the disposable probe only for a single patient. Never reuse the disposable probe for another patient because it causes cross infection.

Model	Patient (Weight)	Attachment Site		SpO_2 Connection Cord/ SpO_2 Adapter
TL-260T* 	Children, neonates (Weight 3 kg or more)	Finger or toe	Type S attachment tape	SpO_2 Connection Cord JL-900P 
	Low birth weight infants (Weight 1 kg or less)	Instep and sole		
	Neonates (Weight 3 kg or less)	Instep and sole	Type L attachment tape	
TL-051S/TL-052S  Cable length TL-051S: 80 cm TL-052S: 160 cm	Adults (Weight 50 kg or more)	Finger		SpO_2 Adapter JL-500P1/JL-500P2* 
	Neonates (Weight 3 kg or less)	Instep and sole		
TL-061S/TL-062S  Cable length TL-061S: 80 cm TL-062S: 160 cm	Adults, children (Weight from 15 to 50 kg)	Finger		
	Children, infants (Weight from 3 to 15 kg)	Toe		

* TL-260T multi-site Y probe and JL-500P2 SpO_2 adapter are not available for BSM-6000A series.

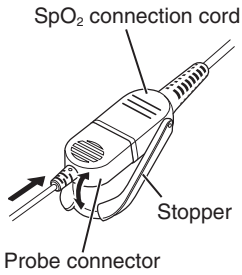
Model	Patient	Attachment Site	SpO_2 Connection Cord/ SpO_2 Adapter
TL-271T (80 cm)/TL-271T3 (160 cm) 	Adults (Weight 30 kg or more)	Finger or toe	SpO_2 Connection Cord JL-900P  SpO_2 Adapter JL-500P1/JL-500P2* 
TL-272T (80 cm)/TL-272T3 (160 cm) 	Children (Weight from 10 to 50 kg)		
TL-273T (80 cm)/TL-273T3 (160 cm) 	Adults (Weight 40 kg or more)	Finger or toe	
	Neonates (Weight 3 kg or less)	Instep and sole	
TL-274T (80 cm)/TL-274T3 (160 cm) 	Infants (Weight from 3 to 20 kg)	Finger or toe	

* JL-500P2 SpO_2 adapter is not available for BSM-6000A series.

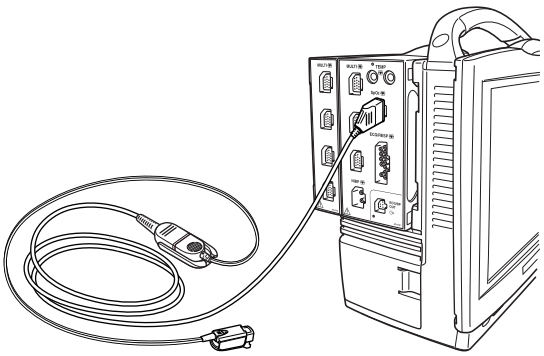
Connecting Cables and Attaching the Probes

Connecting Cable to the Unit

SpO_2 measurement at one site



1. Open the stopper of the SpO_2 connection cord and connect the probe connector firmly.
2. Close the stopper.
3. Connect the SpO_2 connection cord to the SpO_2 socket.

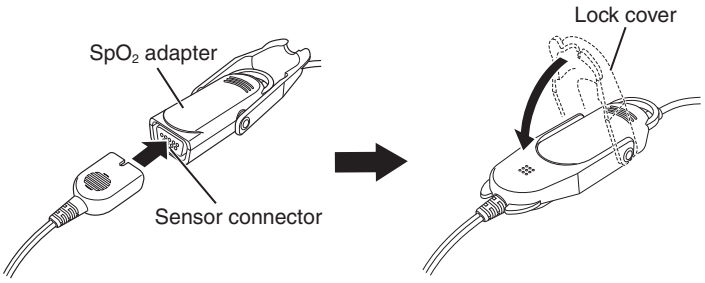


When connecting the TL-201T finger probe

SpO_2 measurement at two sites

1. Connect the probe to the SpO_2 connection cord and connect the SpO_2 connection cord to the SpO_2 socket.

2. Connect another SpO_2 probe to the sensor connector on the SpO_2 adapter.

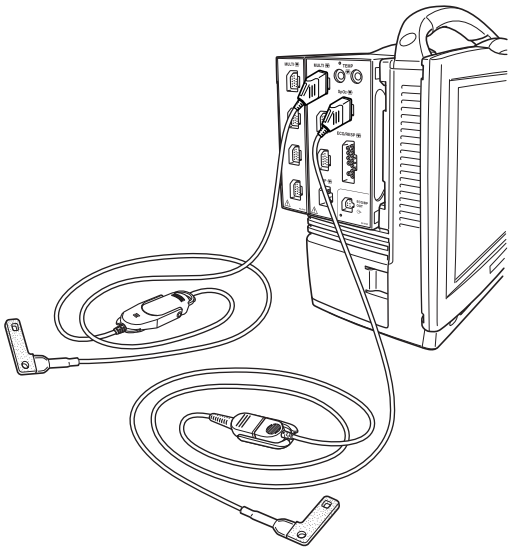


3. Close the lock cover.

4. Connect the SpO_2 adapter to the MULTI socket.

NOTE

The MULTI socket on the AY-660P input unit cannot be used.



When connecting the TL-051S/TL-052S probe

Connecting Cable to the BSM-1763/1773 Bedside Monitor

Refer to the manuals of the BSM-1763 or BSM-1773 bedside monitor for details. The BSM-1763 bedside monitor is not available in the US.

Attaching the Probe to the Patient

Refer to the probe manual.

Monitoring SpO_2

When the preparation is done properly, the SpO_2 value and pulse waveform appear on the screen.

The SpO_2 value acquired from the SpO_2 probe connected to the SpO_2 socket is displayed as "SpO_2" value and the SpO_2 value acquired from the SpO_2 probe connected to the MULTI socket is displayed as "SpO_2-2" value on the screen.

CAUTION

When the probe is attached on an appropriate site with sufficient circulation and an error message about probe attachment repeatedly appears, the probe may be deteriorated. Replace it with a new one.

CAUTION

If the attachment site is dirty with blood or bodily fluids, clean the attachment site before attaching the probe. If there is nail polish on the attachment site, remove the polish. Otherwise, the amount of transmitted light decreases, and measured value may be incorrect or measurement cannot be performed.

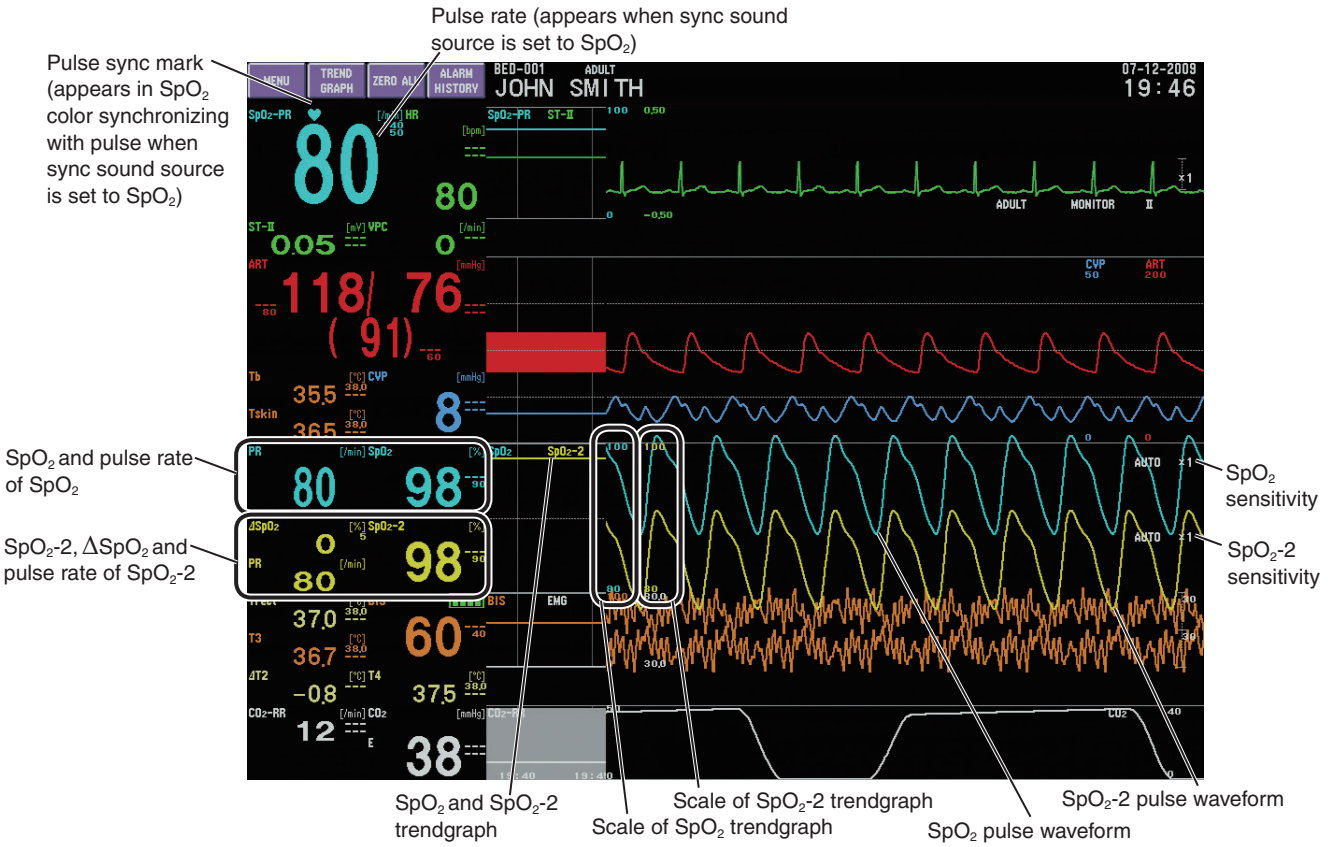
CAUTION

When a message indicates a faulty probe or faulty SpO_2 connection cord, stop monitoring and replace the probe or SpO_2 connection cord with a new one.

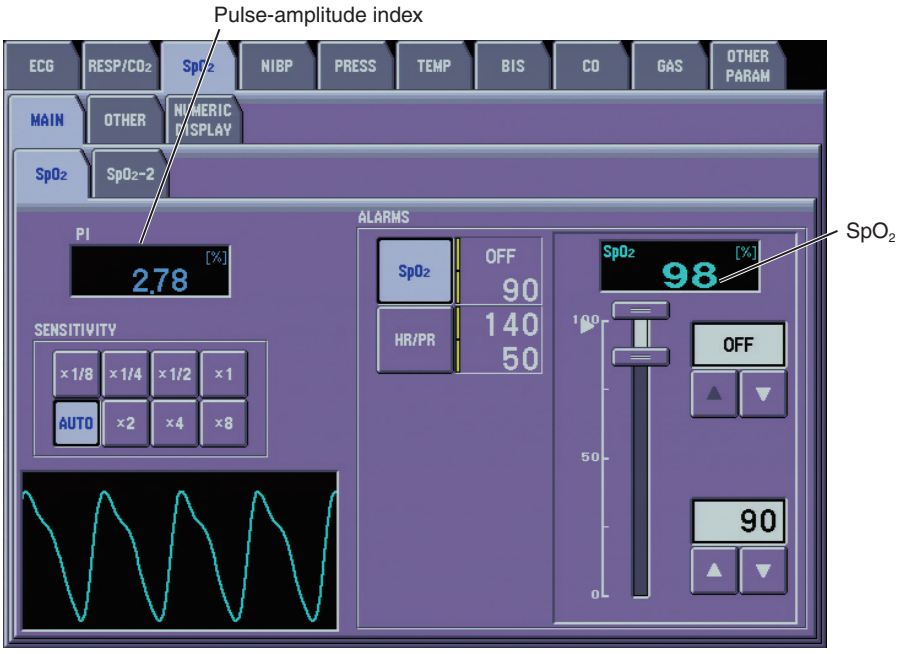
NOTE

In order to maintain sufficient blood circulation, keep the measurement site warm by covering with a blanket or something similar. Warming the site is effective, especially for a patient with a small pulse amplitude.

SpO_2 Information on the Home Screen



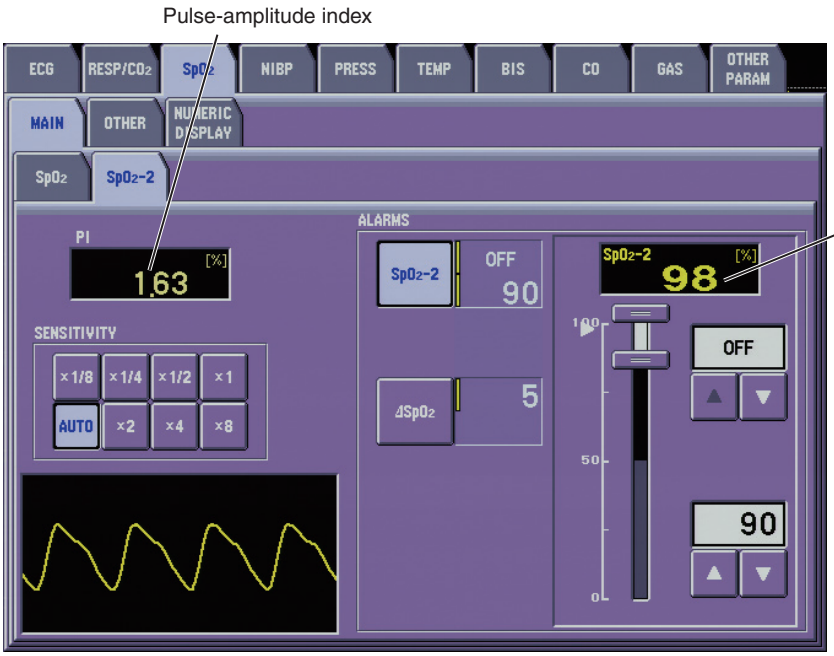
SpO_2 Information on the SpO_2 Window



PI (Pulse-amplitude Index)

The Pulse-amplitude Index indicates the percentage of pulsatile signal in the entire transmitted IR signal. This index may be affected by an artifact.

SpO_2 Information on the SpO_2-2 Window



Changing SpO_2 Settings

Change settings on the SpO_2 window. The following settings can be changed for SpO_2 monitoring.

The following settings can be changed on the SpO_2 tab.
- Pulse waveform sensitivity
- SpO_2 and pulse rate alarm limits
- Display pulse rate and/or PI in SpO_2 numeric data area on the home screen

The following settings can be changed on the SpO_2-2 tab for dual SpO_2 monitoring.
- Pulse waveform sensitivity
- SpO_2-2 and ΔSpO_2 alarm limits
- Display pulse rate, PI and/or ΔSpO_2 in SpO_2-2 numeric data area on the home screen
- Display SQI bar graph in SpO_2 numeric data area

The following settings are common settings for SpO_2 and SpO_2-2 tabs.
- Sync source
- Sync sound pitch
- Pulse rate display on or off
- Response mode
- Sensitivity mode (Available only when using the following units. The version can be confirmed on the INFO page of the SYSTEM SETUP window.
  - BSM-6000 series software version 03-01 or later
  - AY-600P series input unit software version 03-01 or later, AY-600P series input unit SpO_2 module version 01-11 or later, or BSM-1763*/1773 bedside monitor
  - JL-500P1/P2* version 01-11 or later)

* BSM-1763 bedside monitor and JL-500P2 SpO_2 adapter are not available for BSM-6000A series.

When monitoring dual SpO_2, display the SpO_2-2 page of the SpO_2 window to change the SpO_2-2 settings.

The SpO_2 and SpO_2-2 pulse waveform sweep speed and SpO_2 and SpO_2-2 waveform display on the home screen can be selected on the DISPLAY window. Refer to Section 3 of the User's Guide Part I.

SpO_2 data display color can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

The scale of the SpO_2 trendgraph on the home screen is the same scale as the trendgraph of the Review window. Refer to the Operator's Manual or Section 6 of the User's Guide Part I.

The SpO_2-2 page is only displayed when the JL-500P1 or JL-500P2* SpO_2 adapter is connected to the MULTI socket.

A second occurring SpO_2 alarm can be silenced when the [Silence Alarms] key is pressed. Refer to Section 3 of the Administrator's Guide. This function is only available for BSM-6000A series.

If an SpO_2 alarm occurs and no action is taken for a selected duration or the SpO_2 value drops below a set level for a selected duration, the alarm level can be escalated. Refer to Section 3 of the Administrator's Guide.

Changing the Sensitivity

The sensitivity determines the size of the pulse waveform on both the screen and recording paper.

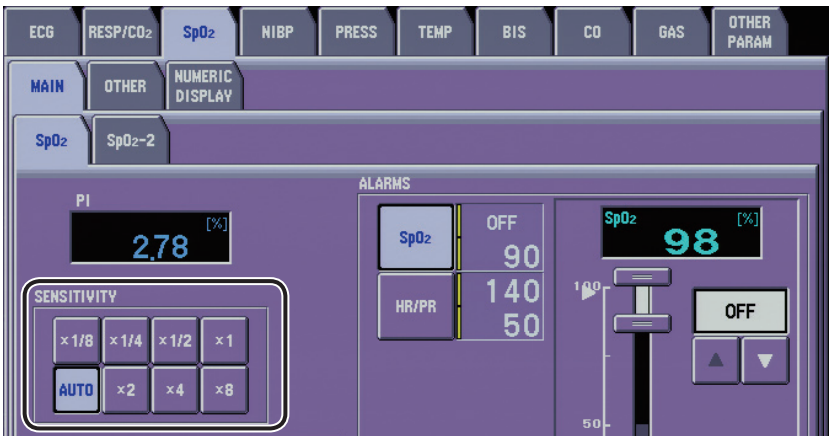
The sensitivity can be set manually or automatically. When you select auto sensitivity, the sensitivity is automatically determined according to the present SpO_2 pulse waveform. When sensitivity is set automatically, "AUTO" appears beside the sensitivity on the screen.

NOTE

The pulse wave amplitude varies according to the ratio of the pulsation component to the entire transmitted IR signal. When the pulsation component ratio is 1%, the pulse wave amplitude is about 10 mm at ×1 sensitivity on the display.

1. SpO_2: Display the SpO_2 tab of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → MAIN tab → SpO_2 tab.
   SpO_2-2: Display the SpO_2-2 tab of the SpO_2-2 window.
   Press the [Menu] key → SpO_2 key → MAIN tab → SpO_2-2 tab.

2. Select the sensitivity from ×1/8, ×1/4, ×1/2, ×1, ×2, ×4, ×8 or AUTO in the <SENSITIVITY> box.



3. Press the [Home] key to return to the home screen.

Changing the SpO_2 and Pulse Rate Alarm Limits

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

You can set the upper and lower SpO_2, SpO_2-2, heart rate/pulse rate alarm limits and ΔSpO_2 on the SpO_2 window. You can set all alarms including the upper and lower SpO_2, SpO_2-2, heart rate/pulse rate alarm limits and ΔSpO_2 on the ALARM LIMITS window (See the Operator's Manual or Section 5 of the User's Guide Part I). The heart rate/pulse rate alarm limits can also be changed on the ECG and PRESS window.

Setting Range

NOTE

If "EXT TACHY" or "EXT BRADY" are set to ON, the "ALARM CAP" setting for the "HR/PR" cannot be set. To apply the "ALARM CAP" setting for the "HR/PR", set "EXT TACHY" and "EXT BRADY" to OFF.

SpO_2 upper limit: 51 to 100%SpO_2 in 1%SpO_2 steps, OFF *1*2
(default setting: ADULT, CHILD-OFF, NEONATE-95)

SpO_2 lower limit: OFF, 50 to 99%SpO_2 in 1%SpO_2 steps *1*2
(default setting: ADULT, CHILD-90, NEONATE-85)

SpO_2-2 upper limit: 51 to 100%SpO_2 in 1%SpO_2 steps, OFF *1*2
(default setting: ADULT, CHILD-OFF, NEONATE-95)

SpO_2-2 lower limit: OFF, 50 to 99%SpO_2 in 1%SpO_2 steps *1*2
(default setting: ADULT, CHILD-90, NEONATE-85)

ΔSpO_2 upper limit: OFF, 1 to 50%SpO_2 in 1%SpO_2 steps
(default setting: 5)

HR/PR upper limit: When <SYNC SOURCE> is set to ECG:
16 to 300 beats/min in 1 beat/min steps, OFF*1*2
When <SYNC SOURCE> is set to PRESS or SpO_2:
31 to 300 beats/min in 1 beat/min steps, OFF*1*2
When EXT TACHY alarm is set to ON:
16 to EXT TACHY alarm limit in 1 beat/min steps*1*2
(default setting: ADULT-140, CHILD-170, NEONATE-200)

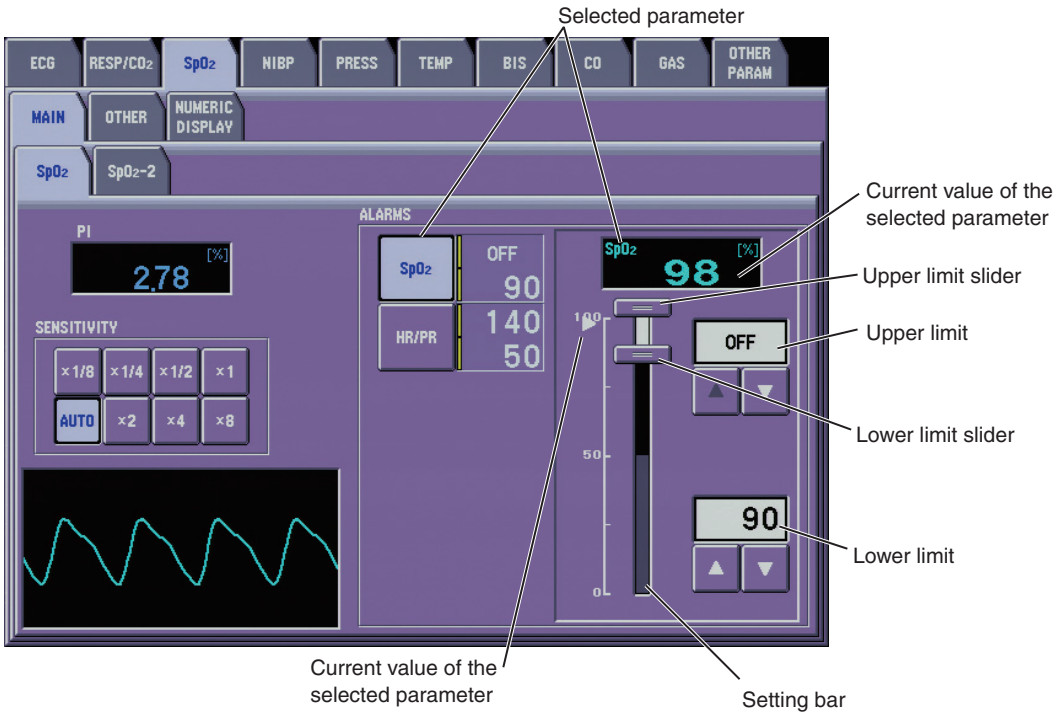
HR/PR lower limit: When <SYNC SOURCE> is set to ECG:
OFF, 15 to 299 beats/min in 1 beat/min steps*1*2
When <SYNC SOURCE> is set to PRESS or SpO_2:
OFF, 30 to 299 beats/min in 1 beat/min steps*1*2
When EXT BRADY alarm is set to ON:
EXT BRADY alarm limit to 299 in 1 beat/min steps*1*2
(default setting: ADULT-50, CHILD-75, NEONATE-100)

*1 On BSM-6000A series, if <CRISIS VITAL ALARM MANAGEMENT> on the SYSTEM CONFIGURATION screen is turned on and "ALARM PRIORITY" on the SYSTEM SETUP window is set to CRISIS, the alarm setting is set to the alarm master setting.

*2 On BSM-6000A series, if <ALARM CAP> on the SYSTEM CONFIGURATION screen is turned on, the alarm setting is affected by the "ALARM CAP" setting on the SYSTEM SETUP window.

1. SpO_2: Display the SpO_2 tab of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → MAIN tab → SpO_2 tab.
   SpO_2-2: Display the SpO_2-2 tab of the SpO_2-2 window.
   Press the [Menu] key → SpO_2 key → MAIN tab → SpO_2-2 tab.

2. Touch the SpO_2 key to change the SpO_2 alarm setting.
   Touch the HR/PR key to change the heart rate/pulse rate alarm setting.
   Touch the SpO_2-2 key on the SpO_2-2 tab to change the SpO_2-2 alarm setting.
   Touch the ΔSpO_2 key on the SpO_2-2 tab to change the ΔSpO_2 alarm setting.



3. Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.

4. Press the [Home] key to return to the home screen.

Changing the Sync Sound Source

You can select ECG, SpO_2 pulse (SpO_2) or arterial blood pressure pulse (PRESS) as the sync source. When the arterial blood pressure pulse is selected, the blood pressure of the highest priority label is used. The sync source can also be changed on the ECG and PRESS windows.

When pulse wave and pressure waveform are irregular because of an IABP, select ECG.

NOTE

- When heart rate is unstable because of an ESU, select SpO_2 or PRESS.

- When the connection cord of SpO_2 or IBP of the arterial blood pressure is disconnected from the monitor and an alarm occurs when the sync source is set to SpO_2 or PRESS, the sync source changes to ECG when the alarm is silenced by pressing the [Silence Alarms] key. The sync source returns to SpO_2 or PRESS when the SpO_2 or IBP is monitored again. When using PRESS as the sync source, adjust zero balance.
- When the sensor is detached from the patient and alarm occurs, and the sync source is set to SpO_2 or PRESS, the sync source does not change to ECG when the alarm is silenced, and "- - -" is displayed for PR.
- The SpO_2-2 cannot be set to the sync sound source.

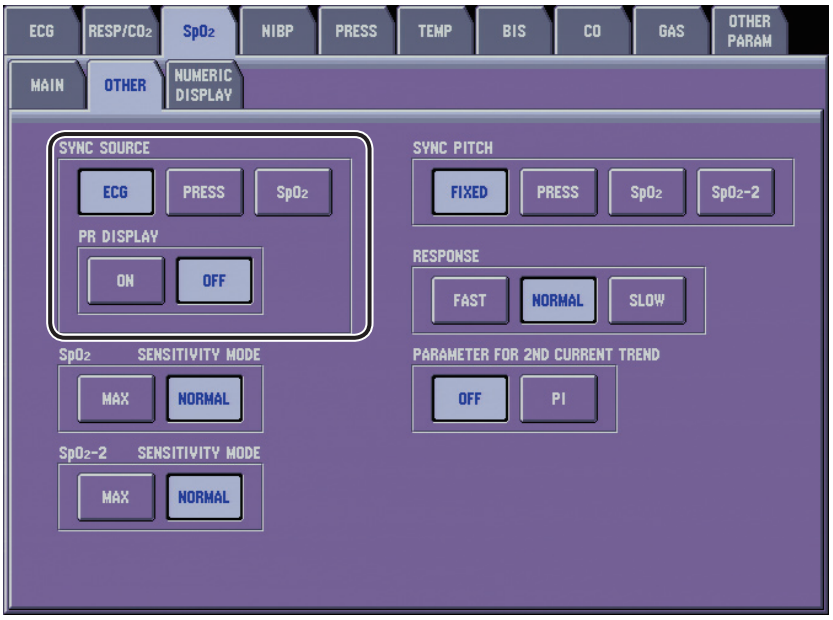
When the sync source is set to ECG and ECG is not measured, there is no sync sound.

When SpO_2 or PRESS is selected, the pulse rate can be displayed to the left of the heart rate on the screen and the sync mark synchronizes with the pulse.

1. Display the OTHER page of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → OTHER tab.

2. Select the sync source in the <SYNC SOURCE> box.
   ECG: QRS
   PRESS: Pulse wave of the highest priority arterial blood pressure
   SpO_2: SpO_2 pulse

   To display the pulse rate to the left of the heart rate on the home screen, select ON for <PR DISPLAY>. This setting is only available when <SYNC SOURCE> is set to ECG.



3. Press the [Home] key to return to the home screen.

Selecting Sync Sound Pitch

The sync sound can be variable pitch or fixed pitch pips. The fixed pitch is high pitch as the default, but medium or low pitch can also be set on the SYSTEM SETUP window. See Section 3 of the Administrator's Guide. When you select variable pitch, the pitch of the sync sound changes according to SpO_2 value or systolic BP value of the arterial blood pressure so that you can recognize the change on the patient from the pitch of the sync sound without looking at the monitor. The sync pitch can also be changed on the ECG and PRESS windows.

When using AY-661P, AY-663P, AY-671P or AY-673P input unit, the sync sound pitch can be set to change according to the SpO_2 value of the SpO_2-2 when monitoring dual SpO_2. (AY-661P or AY-663P input units are not available for BSM-6000A series.)

When the sync sound source is set to SpO_2 and the SpO_2 value is below 81%SpO_2 or 40%SpO_2, the low pitch is automatically selected.

When the sync sound source is set to SpO_2 and the "CHECK PROBE" or "DETECTING PULSE" message is displayed on the screen, the sync sound stops.

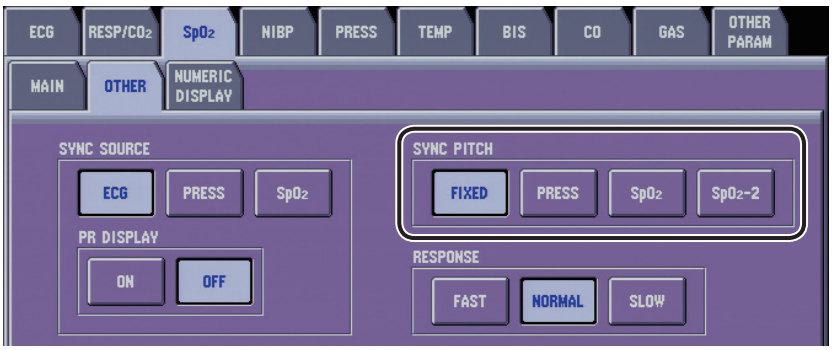
When the sync sound source is set to ECG or PRESS, the sync pitch is set to SpO_2 and the SpO_2 cannot be displayed on the screen, the low pitch is automatically selected.

When the sync sound source is set to ECG or SpO_2 the sync pitch is set to PRESS and the IBP cannot be displayed on the screen, the low pitch is automatically selected.

When the sync sound source is set to ECG or SpO_2 and the IBP connection cord is disconnected, the low pitch is automatically selected. After connecting the IBP connection cord, adjust zero balance.

1. Display the OTHER page of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → OTHER tab.

2. Select the sync sound pitch from the <SYNC PITCH> box.
   - FIXED: The pitch is fixed to the pitch selected on the SYSTEM SETUP window.
   - PRESS: The pitch is high when the BP value is above 120 mmHg. The pitch is low when the BP value is below 20 mmHg. The pitch changes from high to low in 20 steps for each 5 mmHg change between 120 and 20 mmHg BP value. The BP value of the highest priority arterial blood pressure is used.
   - SpO_2 and SpO_2-2: The pitch changes with each 1% change in SpO_2. You can select the SpO_2 range (81 to 100% or 40 to 100%) on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide. SpO_2-2 is only available when using the AY-661P, AY-663P, AY-671P or AY-673P input unit.



3. Press the [Home] key to return to the home screen.

Selecting the Response Mode

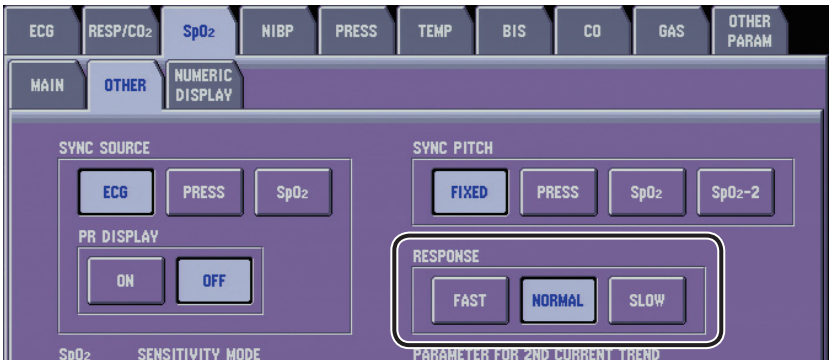
There are three response modes: FAST, NORMAL and SLOW. Each response mode uses a different time to enable accurate measurement depending on changes in SpO_2. For details on the response time, refer to the "Specifications - SpO_2" section in the Operator's Manual.

NOTE

When measurement condition is unstable due to strenuous movement of the patient, etc., response may become slower in all modes.

1. Display the OTHER page of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → OTHER tab.

2. Select the mode in the <RESPONSE> box.



3. Press the [Home] key to return to the home screen.

Selecting SpO_2 Sensitivity Mode

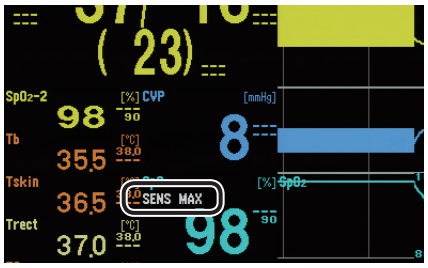
This setting is available only when using the following units. The version can be confirmed on the INFO page of the SYSTEM SETUP window.

- BSM-6000 series software version 03-01 or later
- AY-600P series input unit software version 03-01 or later, AY-600P series input unit SpO_2 module version 01-11 or later, or BSM-1763*/1773 bedside monitor
- JL-500P1/P2* version 01-11 or later

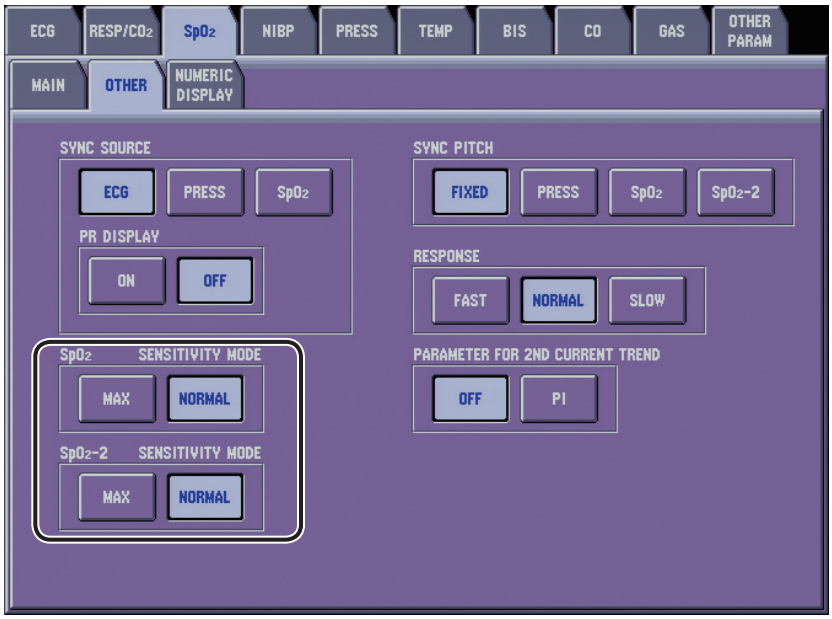
* BSM-1763 bedside monitor and JL-500P2 SpO_2 adapter are not available for BSM-6000A series.

Select the sensitivity mode for SpO_2 monitoring.

1. Display the OTHER page of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → OTHER tab.



2. Select the sensitivity mode in the <SpO_2 SENSITIVITY MODE> and/or <SpO_2-2 SENSITIVITY MODE> box.
   For normal monitoring, select NORMAL.
   Select MAX when it is difficult to detect pulse, such as when monitoring a patient with peripheral circulation insufficiency or when an IABP is used.
   When MAX is selected, "SENS MAX" appears in the SpO_2 value area on the home screen.



NOTE

When MAX is selected, a waveform and numeric value for SpO_2 may appear even when the probe is detached from the patient. When not monitoring SpO_2, disconnect the SpO_2 connection cord from the unit.

3. Press the [Home] key to return to the home screen.

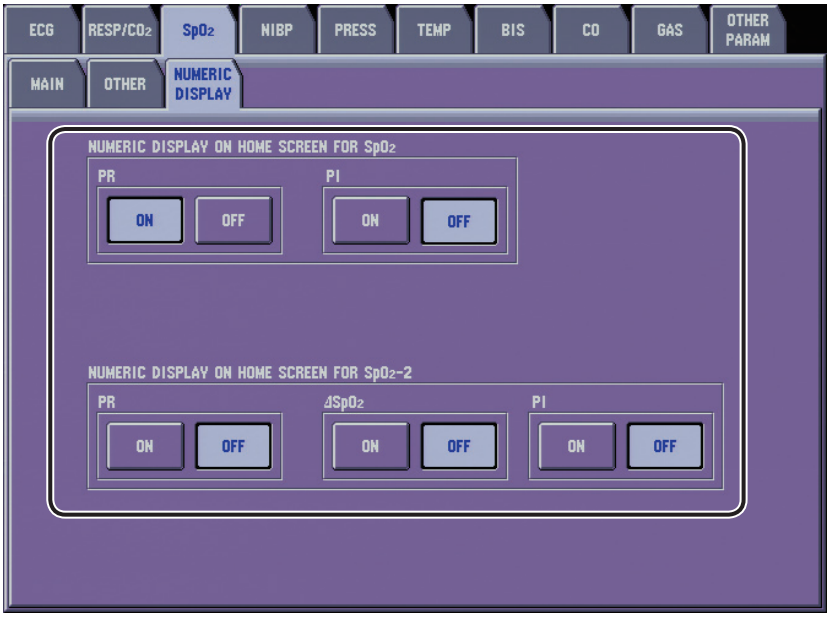
WARNING

When not monitoring SpO_2, disconnect the SpO_2 connection cord from the input unit. Otherwise, noise from the probe sensor may interfere and incorrect data is displayed on the screen.

Displaying Pulse Rate, ΔSpO_2 and PI on the Home Screen

The pulse rate and PI display in SpO_2 and SpO_2-2 area and the ΔSpO_2 display in SpO_2-2 area on the home screen can be set to on or off. For the numeric display in SpO_2-2 area, pulse rate and either ΔSpO_2 or PI can be displayed.

1. Display the NUMERIC DISPLAY page of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → NUMERIC DISPLAY tab.



2. Select ON or OFF for each parameter in the <NUMERIC DISPLAY ON HOME SCREEN FOR SpO_2> and/or <NUMERIC DISPLAY ON HOME SCREEN FOR SpO_2-2> box.

3. Press the [Home] key to return to the home screen.

Displaying the SQI Bar Graph on the Home Screen

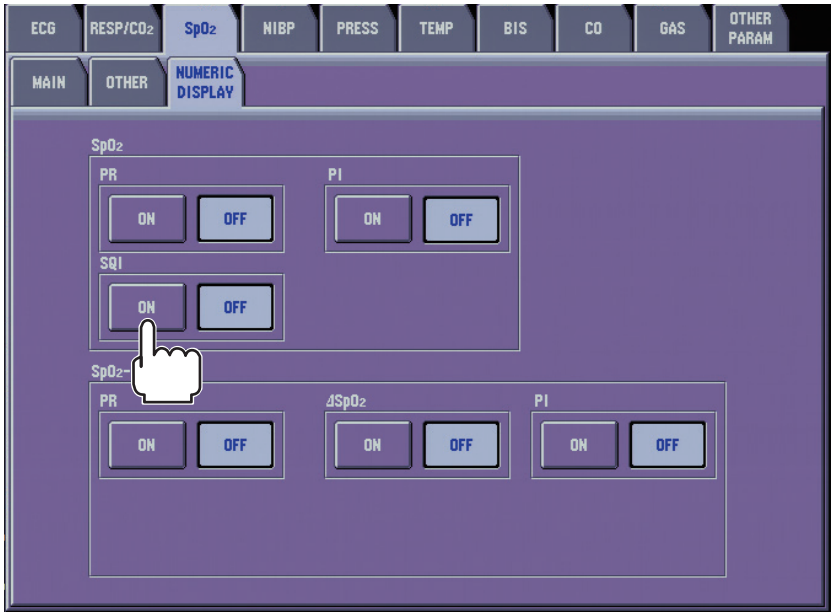
The SQI bar graph is only available when the component has the following required version.

- Bedside monitor software: 05-01 or later
- SpO_2 module: 02-01 or later
- AY-600P series input unit: 02-01 or later

To check the software version, touch SYSTEM key in the SETUP → INFO tab to display the INFO page of the SYSTEM SETUP window. If the unit does not have the required version, install the applicable software kit.

1. Display the NUMERIC DISPLAY page of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → NUMERIC DISPLAY tab.

2. Select ON for <SpO_2 SQI> to show the SQI bar graph on the home screen.



3. Press the [Home] key to return to the home screen.

NOTE

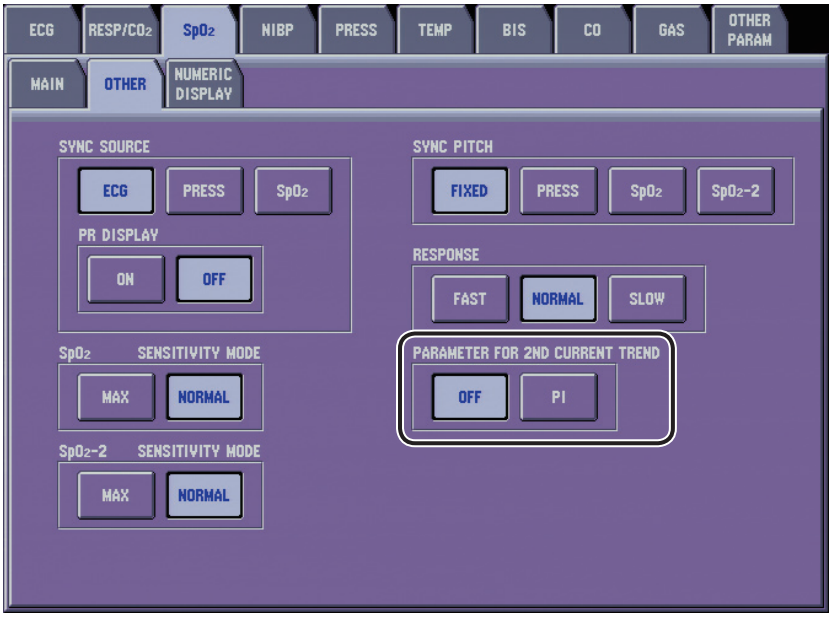
- If the ON and OFF keys of the <SQI> do not appear, the MU-631RA/K, MU-651RA/K or MU-671RA/K main unit is not the required version.
- If the ON and OFF keys of the <SQI> are gray and cannot be used, the SpO_2 module is not the required version.

Displaying PI Trendgraph on the Home Screen

SpO_2 PI and SpO_2-2 PI trendgraphs can be displayed on the home screen.

1. Display the OTHER page of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → OTHER tab.

2. Select PI to display the PI trendgraph on the home screen in the <PARAMETER FOR 2ND CURRENT TREND> box.



3. Press the [Home] key to return to the home screen.

Section 4-2 SpO_2 Monitoring with Nellcor Probes

General

Monitoring SpO_2 with Nellcor probes requires an AY-651P or AY-653P input unit, BSM-1753 bedside monitor or IF-919P communication cable.

To monitor SpO_2 using an AY-651P or AY-653P input unit or BSM-1753 bedside monitor, attach a probe to the patient and connect it to the SpO_2 socket.

To monitor SpO_2 using an IF-919P communication cable, attach a probe to the patient and connect it to the OxiMax™ N-600x™ pulse oximeter and connect the pulse oximeter to the multi-link socket on the bedside monitor with the IF-919P communication cable.

Dual SpO_2 Monitoring

To monitor dual SpO_2 using an AY-651P or AY-653P input unit or BSM-1753 bedside monitor, connect a Nellcor probe to the SpO_2 socket, another probe to the OxiMax™ N-600x™ pulse oximeter and connect the pulse oximeter to the multi-link socket on the bedside monitor or JA-690PA or JA-694PA data acquisition unit with the IF-919P communication cable.

To monitor dual SpO_2 using an IF-919P communication cable, two OxiMax™ N-600x™ pulse oximeters and two IF-919P communication cables are required. Connect a Nellcor probe to the OxiMax™ N-600x™ pulse oximeter and connect the pulse oximeter to the multi-link socket on the bedside monitor or JA-690PA or JA-694PA data acquisition unit with the IF-919P communication cable.

WARNING

SpO_2 measurement may be incorrect in the following cases.

- When the patient's carboxyhemoglobin or methemoglobin increases abnormally.
- When dye is injected in the blood.
- When using an electrosurgical unit.
- During CPR.
- When measuring at a site with venous pulse.
- When there is body movement.
- When the pulse wave is small (insufficient peripheral circulation).

WARNING

Check the circulation condition by observing the skin color at the measurement site and pulse waveform. Change the measurement site every 8 hours for disposable probes and every 4 hours for reusable probes. When using the probe on the following patients, take extreme care and change the measurement site more frequently according to symptoms and degree.

- Patient with a fever
- Patient with insufficient peripheral circulation
- Neonate or low birth weight infant with delicate skin

WARNING

When monitoring SpO_2 of a patient who is receiving photodynamic therapy, the light from the finger probe sensor may cause a burn. Photodynamic therapy uses a photosensitizing agent that has a side effect of photosensitivity.

WARNING

When not monitoring SpO_2, disconnect the SpO_2 connection cord from the input unit. Otherwise, noise from the probe sensor may interfere and incorrect data is displayed on the screen.

WARNING

To avoid poor circulation, do not wrap the tape too tight. Check the blood circulation condition by observing the skin color and congestion at the skin peripheral to the probe attachment site. Even for short-term monitoring, there may be burn or pressure necrosis from poor blood circulation, especially on neonates or low birth weight infants whose skin is delicate. Accurate measurement cannot be performed on a site with poor peripheral circulation.

CAUTION

Only use the specified probes. Otherwise, SpO_2 cannot be monitored.

CAUTION

Normal external light does not affect monitoring but strong light such as a surgical light or sunlight may affect monitoring. If affected, cover the measuring site with a blanket.

CAUTION

Turn off the power of mobile phones, small wireless devices and other devices which produce strong electromagnetic interference around a patient (except for devices allowed by the hospital administrator). Radio waves from devices such as mobile phones or small wireless devices may be mistaken as pulse waves and the displayed data may be incorrect.

CAUTION

While a patient is on medication which causes vasodilation, the pulse waveform may change and in rare cases the SpO_2 value might not be displayed.

NOTE

- Purchase of this instrument confers no express or implied license under any Nellcor Puritan Bennett patent to use this instrument with any oximetry sensor that is not manufactured or licensed by Nellcor Puritan Bennett.
- Do not attach the probe to the same limb that is used for NIBP measurement or an IBP catheter. The SpO_2 measurement may be incorrect.

When Monitoring Dual SpO_2

CAUTION

When using the Nellcor OxiMaxTM N-600x™ pulse oximeter, the “Sensor Message” on the pulse oximeter do not function on the bedside monitor. When the SpO_2 data on the bedside monitor is abnormal, check the data on the pulse oximeter.

CAUTION

When two probes are attached too close to each other, the light from the probes interferes with each other and SpO_2 cannot be monitored properly. Make sure that there is no light interference when attaching two probes.

NOTE

- If a parameter is not monitored on the pulse oximeter, it is not displayed on the bedside monitor.
- Some parameters cannot be displayed on the bedside monitor even if they are monitored on the pulse oximeter.
- Waveforms from the pulse oximeter are not synchronized with the waveforms measured on the bedside monitor.
- Depending on the software version or communication settings on the pulse oximeter, waveforms from the pulse oximeter may not be displayed on the bedside monitor. Refer to the communication cable operator's manual for details.

Dual SpO_2 Function (SpO_2 Measurement at Two Sites)

When there is a right → left shunt in a patent ductus arteriosus (PDA), there will be a difference in oxygen saturation between the right upper limb (pre-ductal) and lower limb (post-ductal).

By connecting two SpO_2 probes to the bedside monitor, SpO_2 can be monitored at the upper limb and lower limb, and the SpO_2 difference (ΔSpO_2) can be calculated. The ΔSpO_2 is calculated by subtracting the SpO_2 value from the probe connected to the MULTI socket (post-ductal) from the SpO_2 value from the probe connected to the SpO_2 socket (pre-ductal).

When there is a right → left shunt through the ductus arteriosus, the SpO_2 of the lower limb is lower than the SpO_2 of the right upper limb. Therefore, when the SpO_2 probe connected to the SpO_2 socket is attached to a right upper limb and the probe connected to the MULTI socket is attached to a lower limb, the ΔSpO_2 is indicated as a plus value.

PPHN (Persistent Pulmonary Hypertension of Newborn) and Dual SpO_2

PPHN (Persistent Pulmonary Hypertension of Newborn) is a critical disease where elevated pulmonary vascular resistance and serious pulmonary hypertension remain after birth and there is a large right → left shunt through the ductus arteriosus.

For PPHN from the right → left shunt in a patent ductus arteriosus (PDA), it is reported that monitoring the difference in SpO_2 between right upper limb (preductal) and lower limb (post-ductal) is useful to diagnose PPHN, decide the timing of starting/stopping treatment, and decide the operation schedule.

Preparing for SpO_2 Monitoring

Preparation Flowchart

1. Select the probe.

2. When using an AY-651P or AY-653P input unit or BSM-1753 bedside monitor, connect the probe to the SpO_2 connection cord and connect the SpO_2 connection cord to the SpO_2 socket.

   When using an IF-919P communication cable, connect the probe to the OxiMax™ N-600x™ pulse oximeter and connect the pulse oximeter to the multi-link socket on the bedside monitor or JA-690PA or JA-694PA data acquisition unit with the IF-919P communication cable. For details, refer to the OxiMax™ N-600x™ pulse oximeter and IF-919P communication cable manuals.

   When monitoring dual SpO_2:
   Connect the probe to the OxiMax™ N-600x™ pulse oximeter and connect the pulse oximeter to the multi-link socket on the bedside monitor or JA-690PA or JA-694PA data acquisition unit with the IF-919P communication cable. For details, refer to the OxiMax™ N-600x™ pulse oximeter and IF-919P communication cable manuals.

3. Attach the probe to the patient.

4. Monitoring starts. Set necessary settings.

Selecting a Probe

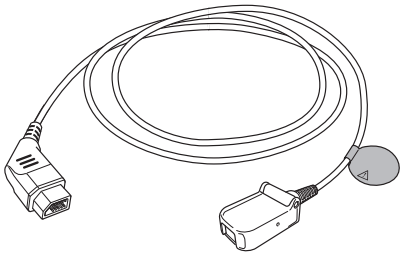
Select the appropriate probe according to the purpose.

CAUTION

Only use the OxiMAX™ series sensor probes on this monitor.

NOTE

When using Nellcor probes, read the instructions provided with the probe.



JL-650P SpO_2 connection cord

Nellcor SpO_2 Probes

For Nellcor probes, use OxiMax™ series sensor probes. To use Nellcor probes, the JL-650P SpO_2 connection cord (3.0 m) is required.

The Nellcor probes and cables are available direct from Nellcor Puritan Bennett or their suppliers.

The following Nellcor probes can be used with this bedside monitor.

OxiMax Adhesive Sensors: Single-page use

Description	Weight Range	Measuring Accuracy	Qty	Catalog #
MAX-FAST Adhesive Forehead Sensor	>10 kg	±2%SpO_2	Case of 24	MAXFAST
MAX-FAST Headband	—	—	Case of 12	10004954
MAX-A Adhesive Sensor, adult	>30 kg	±2%SpO_2	Case of 24	MAXA
MAX-AL Adhesive Sensor, adult (longer, 36 inch cable)	>30 kg	±2%SpO_2	Case of 24	MAXAL
MAX-N Adhesive Sensor, neonatal/adult	<3 kg or >40 kg	±2%SpO_2	Case of 24	MAXN
MAX-P Adhesive Sensor, pediatric	10 to 50 kg	±2%SpO_2	Case of 24	MAXP
MAX-I Adhesive Sensor, infant	3 to 20 kg	±2%SpO_2	Case of 24	MAXI
MAX-R Adhesive Sensor, adult nasal	>50 kg	±3.5%SpO_2	Case of 24	MAXR
MAX Sensor Assortment Pack (2 MAX-A and 2 MAX-N sensors)	—	±2%SpO_2	1	MAXPACI

OxiMax OxiCliq® Sensors: Reusable cable with adhesive sensor bandage

Description	Weight Range	Measuring Accuracy	Qty	Catalog #
OxiCliq Sensor Cable (3 ft)	—	—	1	OC-3
OxiCliq A, adult	>30 kg	±2.5%SpO_2	Case of 24	A
OxiCliq N, neonatal/adult	<3 kg or >40 kg	Neonate: ±3.5%SpO_2 Adult: ±2.5%SpO_2	Case of 24	N
OxiCliq P, pediatric	10 to 50 kg	±2.5%SpO_2	Case of 24	P
OxiCliq I, infant	3 to 20 kg	±2.5%SpO_2	Case of 24	I

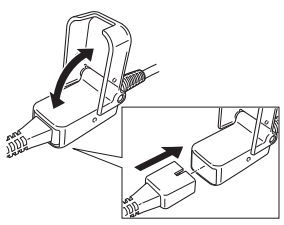
OxiMax Reusable Sensors

Description	Weight Range	Measuring Accuracy	Qty	Catalog #
Durasensor® DS-100A finger-clip sensor, adult	>40 kg	±3%SpO_2	1	DS100A
Oxiband® OXI-A/N adult/neonatal	<3 kg or >40 kg	Neonate: ±4%SpO_2 Adult: ±3%SpO_2	1	OXI-A/N
Oxiband OXI-P/I pediatric/infant	<3 kg or >40 kg	±3%SpO_2	1	OXI-P/I
Dura-Y® D-YS multisite sensor	>1 kg	Neonate: ±4%SpO_2 Infant/Adult: ±3%SpO_2	1	D-YS
D-YSE ear clip for Dura-Y sensor	>30 kg	±3.5%SpO_2	1	D-YSE
PediCheck™ D-YSPD pediatric spot-check sensor	<3 kg or >40 kg	±3.5%SpO_2	1	D-YSPD

Connecting Cables and Attaching the Probes

Connecting Cable to the Unit

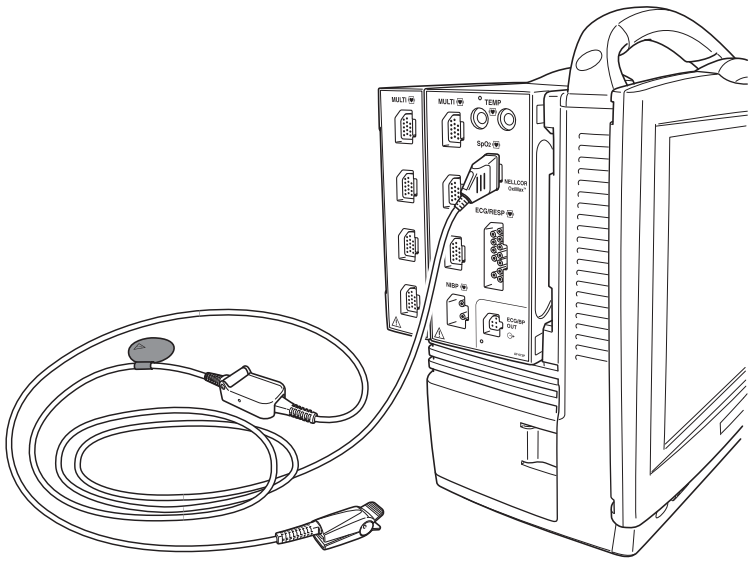
Using an AY-651P or AY-653P Input Unit or BSM-1753 Bedside Monitor



1. Open the stopper of the SpO_2 connection cord and connect the probe connector firmly.

2. Close the stopper. Check that it clicks and is firmly closed.

3. Connect the SpO_2 connection cord to the SpO_2 socket.



Using an IF-919P Communication Cable

1. Connect an SpO_2 probe to the OxiMax™ N-600x™ pulse oximeter. Refer to the pulse oximeter manual.

2. Connect the IF-919P communication cable to the pulse oximeter. Refer to the communication cable manual.

3. Connect the communication cable to the multi-link socket.

SpO_2 Measurement at Two Sites

Using an AY-651P or AY-653P Input Unit or BSM-1753 Bedside Monitor

1. Connect the probe to the SpO_2 connection cord and connect the SpO_2 connection cord to the SpO_2 socket.

2. Connect another SpO_2 probe to the OxiMax™ N-600x™ pulse oximeter. Refer to the pulse oximeter manual.

3. Connect the IF-919P communication cable to the pulse oximeter. Refer to the communication cable manual.

4. Connect the communication cable to the multi-link socket.

Using an IF-919P Communication Cable

Uses two OxiMax™ N-600x™ pulse oximeters. Connect an SpO_2 probe to each OxiMax™ N-600x™ pulse oximeter and connect the pulse oximeters to the multi-link sockets on the unit with the IF-919P communication cables.

Attaching the Probe to the Patient

Refer to the probe manual.

Monitoring SpO_2

When the preparation is done properly, the SpO_2 value and pulse waveform appear on the screen.

The SpO_2 value acquired from the SpO_2 probe connected to the SpO_2 socket is displayed as "SpO_2" value and the SpO_2 value acquired from the SpO_2 probe connected to the pulse oximeter is displayed as "SpO_2-2" value on the screen.

CAUTION

When the probe is attached on an appropriate site with sufficient circulation and an error message about probe attachment repeatedly appears, the probe may be deteriorated. Replace it with a new one.

CAUTION

If the attachment site is dirty with blood or bodily fluids, clean the attachment site before attaching the probe. If there is nail polish on the attachment site, remove the polish. Otherwise, the amount of transmitted light decreases, and measured value may be incorrect or measurement cannot be performed.

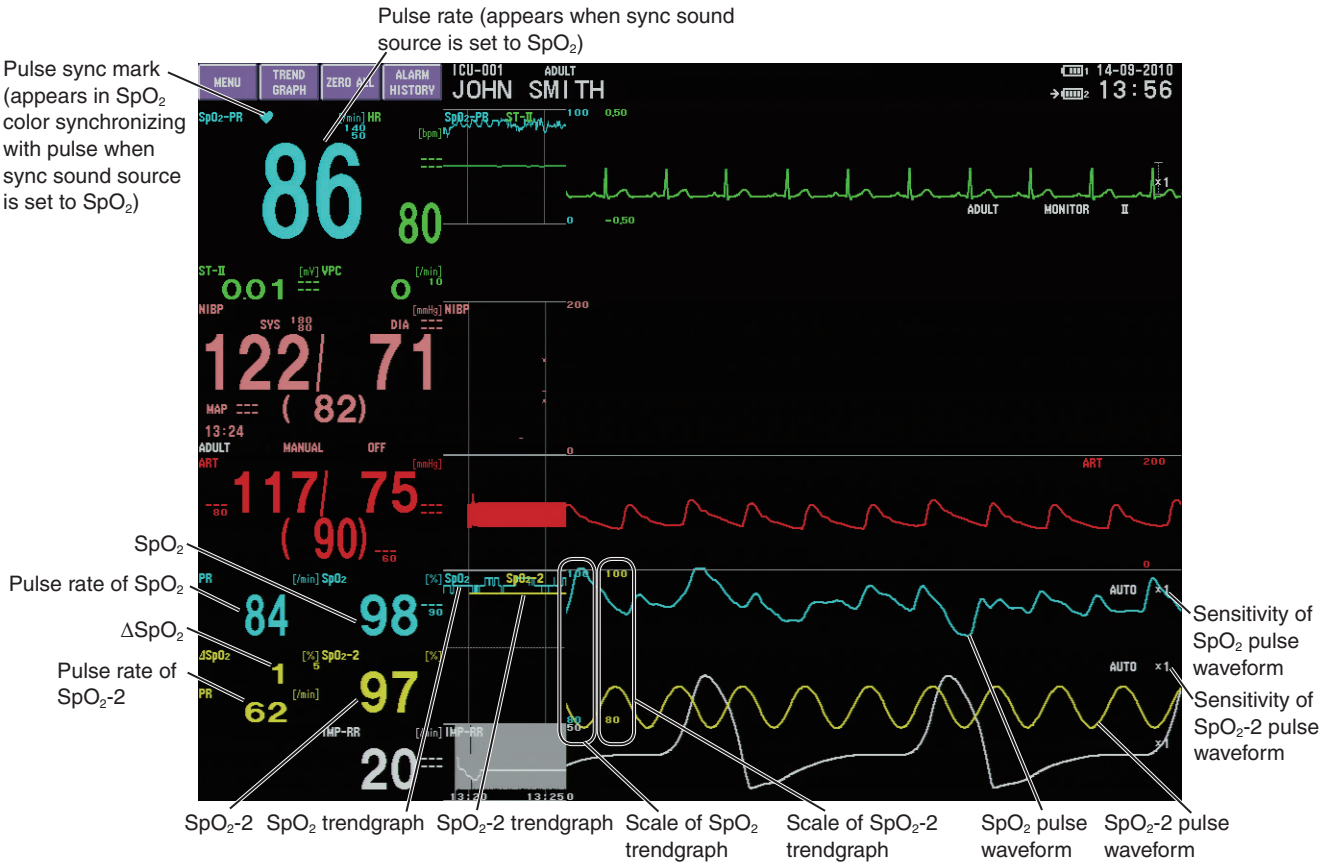
CAUTION

When a message indicates a faulty probe or faulty SpO_2 connection cord, stop monitoring and replace the probe or SpO_2 connection cord with a new one.

NOTE

In order to maintain sufficient blood circulation, keep the measurement site warm by covering with a blanket or something similar. Warming the site is effective, especially for a patient with a small pulse amplitude.

SpO_2 Information on the Home Screen



Changing SpO_2 Settings

Change settings on the SpO_2 window. The following settings can be changed for SpO_2 monitoring.

The following settings can be changed on the SpO_2 tab.
- Pulse waveform sensitivity
- SpO_2 and pulse rate alarm limits*
- Display pulse rate in SpO_2 numeric data area on the home screen

* SpO_2 and pulse rate alarm limits cannot be changed on the bedside monitor for SpO_2 monitored by a Nellcor pulse oximeter.

The following settings can be changed on the SpO_2-2 tab for dual SpO_2 monitoring.
- Pulse waveform sensitivity
- ΔSpO_2 alarm limits
- Display SpO_2-2 pulse rate and/or ΔSpO_2 in SpO_2-2 numeric data area on the home screen

The following settings are common settings for SpO_2 and SpO_2-2 tabs. These settings are not available for SpO_2 monitored by a Nellcor pulse oximeter.
- Sync source
- Sync sound pitch

The SpO_2 data display color can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

The scale of the SpO_2 trendgraph on the home screen is the same scale as the trendgraph of the Review window. Refer to the Operator's Manual or Section 6 of the User's Guide Part I.

The SpO_2 pulse waveform sweep speed and the waveform display on the home screen can be selected on the DISPLAY window. Refer to Section 3 of the User's Guide Part I.

A second occurring SpO_2 alarm can be silenced when the [Silence Alarms] key is pressed. Refer to Section 3 of the Administrator's Guide. This function is only available for BSM-6000A series.

If an SpO_2 alarm occurs and no action is taken for a selected duration or the SpO_2 value drops below a set level for a selected duration, the alarm level can be escalated. Refer to Section 3 of the Administrator's Guide.

Changing the Sensitivity

The sensitivity determines the size of the pulse waveform on both the screen and recording paper.

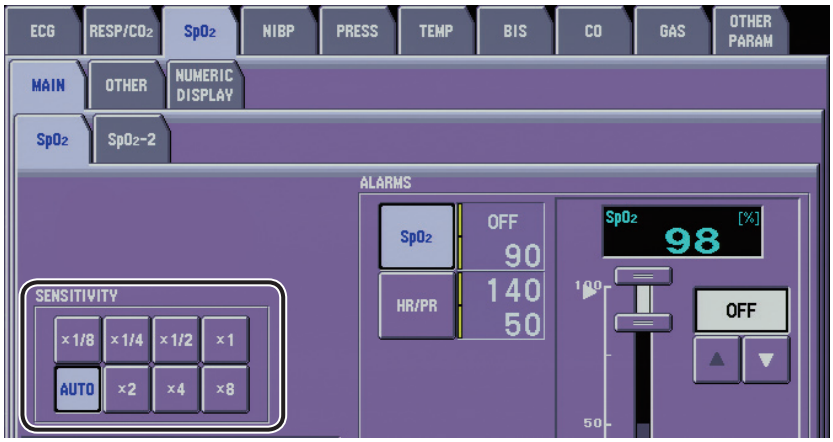
The sensitivity can be set manually or automatically. When you select auto sensitivity, the sensitivity is automatically determined according to the present SpO_2 pulse waveform. When sensitivity is set automatically, "AUTO" appears beside the sensitivity on the screen.
For the pulse waveform monitored by Nellcor pulse oximeter, the sensitivity cannot be set automatically.

NOTE

The pulse wave amplitude varies according to the ratio of the pulsation component to the entire transmitted IR signal. When the pulsation component ratio is 1%, the pulse wave amplitude is about 10 mm at ×1 sensitivity on the display.

1. SpO_2: Display the SpO_2 tab of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → MAIN tab → SpO_2 tab.
   SpO_2-2: Display the SpO_2-2 tab of the SpO_2-2 window.
   Press the [Menu] key → SpO_2 key → MAIN tab → SpO_2-2 tab.

2. Select the sensitivity from ×1/8, ×1/4, ×1/2, ×1, ×2, ×4, ×8 or AUTO in the <SENSITIVITY> box.



3. Press the [Home] key to return to the home screen.

Changing the SpO_2 and Pulse Rate Alarm Limits

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

You can set the upper and lower SpO_2, heart rate/pulse rate and ΔSpO_2 alarm limits on the SpO_2 window. You can set all alarms, including the upper and lower SpO_2 and pulse rate alarm limits, on the ALARM LIMITS window (See the Operator's Manual or Section 5 of the User's Guide Part I). The heart rate/pulse rate alarm limits can also be changed on the ECG and PRESS window.

Setting Range

NOTE

If “EXT TACHY” or “EXT BRADY” are set to ON, the “ALARM CAP” setting for the “HR/PR” cannot be set. To apply the “ALARM CAP” setting for the “HR/PR”, set “EXT TACHY” and “EXT BRADY” to OFF.

SpO_2 upper limit: 51 to 100%SpO_2 in 1%SpO_2 steps, OFF*1*2
(default setting: ADULT, CHILD-OFF, NEONATE-95)

SpO_2 lower limit: OFF, 50 to 99%SpO_2 in 1%SpO_2 steps*1*2
(default setting: ADULT, CHILD-90, NEONATE-85)

HR/PR upper limit: When <SYNC SOURCE> is set to ECG:
16 to 300 beats/min in 1 beat/min steps, OFF*1*2
When <SYNC SOURCE> is set to PRESS or SpO_2:
31 to 300 beats/min in 1 beat/min steps, OFF*1*2
When EXT TACHY alarm is set to ON:
16 to EXT TACHY alarm limit in 1 beat/min steps*1*2
(default setting: ADULT-140, CHILD-170, NEONATE-200)

HR/PR lower limit: When <SYNC SOURCE> is set to ECG:
OFF, 15 to 299 beats/min in 1 beat/min steps*1*2
When <SYNC SOURCE> is set to PRESS or SpO_2:
OFF, 30 to 299 beats/min in 1 beat/min steps*1*2
When EXT BRADY alarm is set to ON:
EXT BRADY alarm limit to 299 in 1 beat/min steps*1*2
(default setting: ADULT-50, CHILD-75, NEONATE-100)

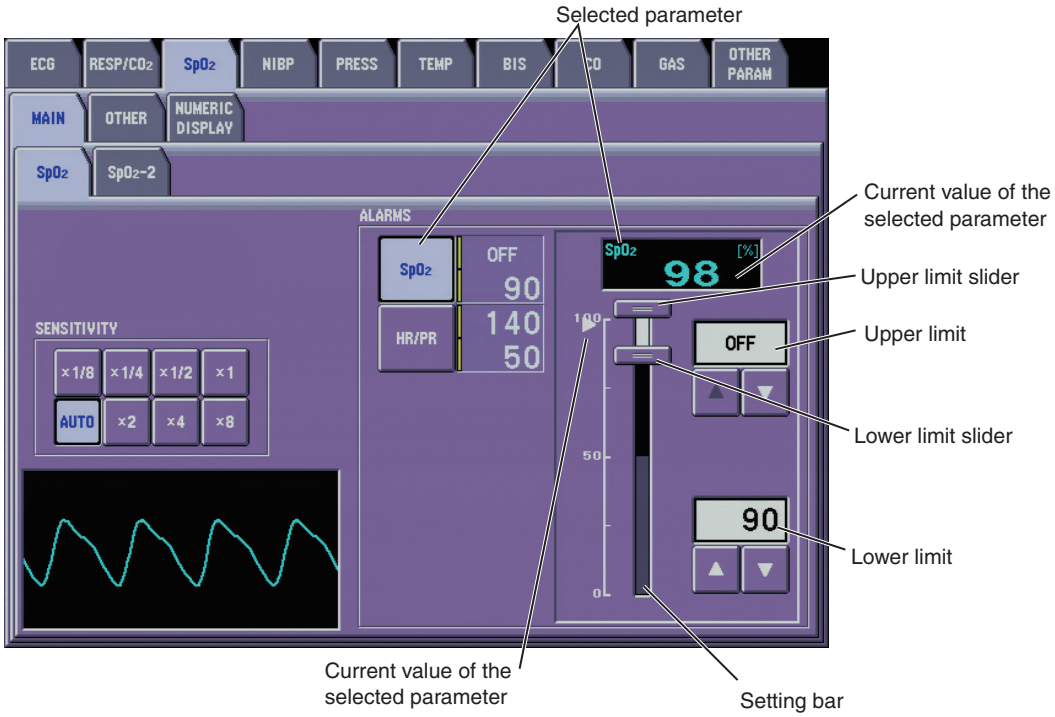
ΔSpO_2 upper limit: OFF, 1 to 50%SpO_2 in 1%SpO_2 steps
(default setting: 5)

*1 On BSM-6000A series, if <CRISIS VITAL ALARM MANAGEMENT> on the SYSTEM CONFIGURATION screen is turned on and “ALARM PRIORITY” on the SYSTEM SETUP window is set to CRISIS, the alarm setting is set to the alarm master setting.

*2 On BSM-6000A series, if <ALARM CAP> on the SYSTEM CONFIGURATION screen is turned on, the alarm setting is affected by the “ALARM CAP” setting on the SYSTEM SETUP window.

1. SpO_2: Display the SpO_2 tab of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → MAIN tab → SpO_2 tab.
   SpO_2-2: Display the SpO_2-2 tab of the SpO_2-2 window.
   Press the [Menu] key → SpO_2 key → MAIN tab → SpO_2-2 tab.

2. Touch the SpO_2 key to change the SpO_2 alarm setting.
   Touch the HR/PR key to change the heart rate/pulse rate alarm setting.
   Touch the ΔSpO_2 key on the SpO_2-2 tab to change the ΔSpO_2 alarm setting.



3. Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.

4. Press the [Home] key to return to the home screen.

Changing the Sync Sound Source

This setting is not available for SpO_2 monitored by a Nellcor pulse oximeter.

You can select ECG, SpO_2 pulse (SpO_2) or arterial blood pressure pulse (PRESS) as the sync source. When the arterial blood pressure pulse is selected, the blood pressure of the highest priority label is used. The sync source can also be changed on the ECG and PRESS windows.

When pulse wave and pressure waveform are irregular because of an IABP, select ECG.

NOTE

- When heart rate is unstable because of an ESU, select SpO_2 or PRESS.
- When the connection cord of SpO_2 or IBP of the arterial blood pressure is disconnected from the monitor and alarm occurs when the sync source is set to SpO_2 or PRESS, the sync source changes to ECG when the alarm is silenced by pressing the [Silence Alarms] key. The sync source returns to SpO_2 or PRESS when the SpO_2 or IBP is monitored again. When using PRESS as the sync source, adjust zero balance.

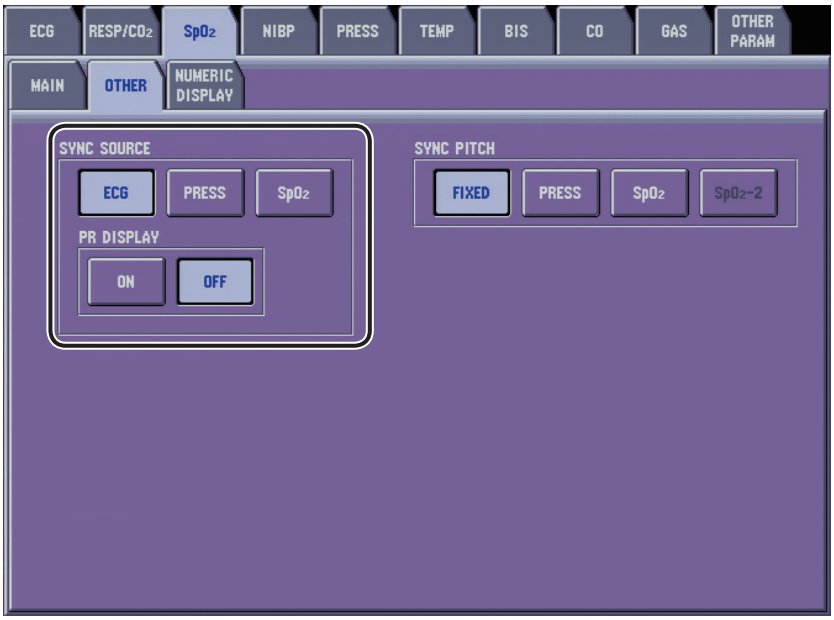
- When the sensor is detached from the patient and alarm occurs, and the sync source is set to SpO_2 or PRESS, the sync source does not change to ECG when the alarm is silenced and PR is displayed "- - -".

When the sync source is set to ECG and ECG is not measured, there is no sync sound.

When SpO_2 or PRESS is selected, the pulse rate can be displayed to the left of the heart rate on the screen and the sync mark synchronizes with the pulse.

1. Display the OTHER page of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → OTHER tab.

2. Select the sync source in the <SYNC SOURCE> box.
   ECG: QRS
   PRESS: Pulse wave of the highest priority arterial blood pressure
   SpO_2: SpO_2 pulse
   To display the pulse rate to the left of the heart rate on the home screen, select ON for <PR DISPLAY>. This setting is only available when <SYNC SOURCE> is set to ECG.



3. Press the [Home] key to return to the home screen.

Selecting Sync Sound Pitch

This setting is not available for SpO_2 monitored by a Nellcor pulse oximeter.

The sync sound can be variable pitch or fixed pitch pips. The fixed pitch is high pitch as the default, but medium or low pitch can also be set on the SYSTEM SETUP window. See Section 3 of the Administrator's Guide. When you select variable pitch, the pitch of the sync sound changes according to SpO_2 value or systolic BP value of the arterial blood pressure so that you can recognize the change on the patient from the pitch of the sync sound without looking at the monitor. The sync pitch can also be changed on the ECG and PRESS windows.

When the sync sound source is set to SpO_2 and the SpO_2 value is below 81%SpO_2 or 40%SpO_2, the low pitch is automatically selected.

When the sync sound source is set to SpO_2 and the "CHECK PROBE" or "DETECTING PULSE" message is displayed on the screen, the sync sound stops.

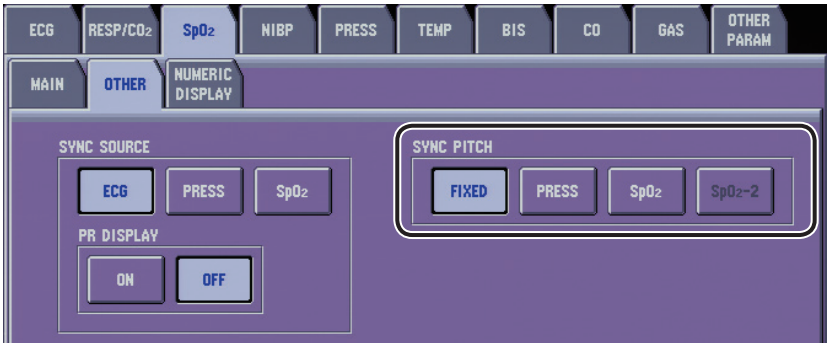
When the sync sound source is set to ECG or PRESS, the sync pitch is set to SpO_2 and the SpO_2 cannot be displayed on the screen, the low pitch is automatically selected.

When the sync sound source is set to ECG or SpO_2, the sync pitch is set to PRESS and the IBP cannot be displayed on the screen, the low pitch is automatically selected.

When the sync sound source is set to ECG or SpO_2 and the IBP connection cord is disconnected, the low pitch is automatically selected. After connecting the IBP connection cord, adjust zero balance.

1. Display the OTHER page of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → OTHER tab.

2. Select the sync sound pitch from the <SYNC PITCH> box.
   FIXED: The pitch is fixed to the pitch selected on the SYSTEM SETUP window.
   PRESS: The pitch is high when the BP value is above 120 mmHg. The pitch is low when the BP value is below 20 mmHg. The pitch changes from high to low in 20 steps for each 5 mmHg change between 120 and 20 mmHg BP value. The BP value of the highest priority arterial blood pressure is used.
   SpO_2: The pitch changes with each 1% change in SpO_2. You can select the SpO_2 range (81 to 100% or 40 to 100%) on the SYSTEM SETUP screen. Refer to Section 3 of the Administrator's Guide.

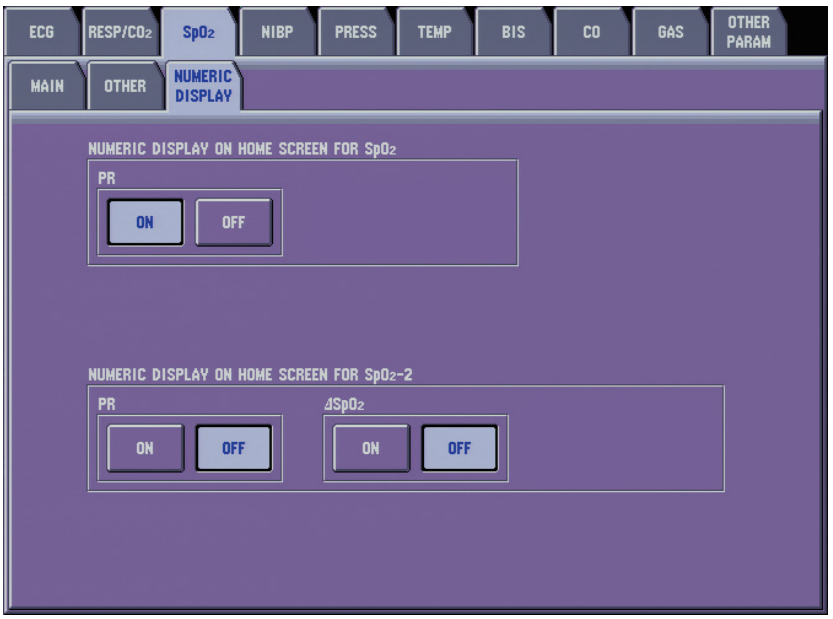


3. Press the [Home] key to return to the home screen.

Displaying Pulse Rate and ΔSpO_2 on the Home Screen

The pulse rate display in SpO_2 and SpO_2-2 area and the ΔSpO_2 display in SpO_2-2 area on the home screen can be set to on or off.

1. Display the NUMERIC DISPLAY page of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → NUMERIC DISPLAY tab.



2. Select ON or OFF for each parameter in the <NUMERIC DISPLAY ON HOME SCREEN FOR SpO_2> and/or <NUMERIC DISPLAY ON HOME SCREEN FOR SpO_2-2> box.

3. Press the [Home] key to return to the home screen.

Section 4-3 SpO_2 Monitoring with Masimo Probes

General

Monitoring SpO_2 with Masimo probes requires an AY-631P or AY-633P input unit, BSM-1733 bedside monitor or IF-925P communication cable.

To monitor SpO_2 using an AY-631P or AY-633P input unit or BSM-1733 bedside monitor, attach a probe to the patient and connect it to the SpO_2 socket.

To monitor SpO_2 using an IF-925P communication cable, attach a probe to the patient and connect it to the Radical™, Radical-7™ or Rad-8™ Masimo pulse oximeter and connect the pulse oximeter to the multi-link socket on the bedside montior with the IF-925P communication cable.

Dual SpO_2 Monitoring

To monitor dual SpO_2 using an AY-631P or AY-633P input unit or BSM-1733 bedside monitor, connect a Masimo probe to the SpO_2 socket, another probe to the Radical™, Radical-7™ or Rad-8™ Masimo pulse oximeter and connect the pulse oximeter to the multi-link socket on the bedside monitor or JA-690PA or JA-694PA data acquisition unit with the IF-925P communication cable.

To monitor dual SpO_2, two Masimo pulse oximeters Radical™, Radical-7™ or Rad-8™, and two IF-925P communication cables are required. Connect a Masimo probe to the Masimo pulse oximeter and connect the pulse oximeter to the multi-link socket on the bedside monitor or JA-690PA or JA-694PA data acquisition unit with the IF-925P communication cable.

WARNING

SpO_2 measurement may be incorrect in the following cases.

- When the patient's carboxyhemoglobin or methemoglobin increases abnormally.
- When dye is injected in the blood.
- When using an electrosurgical unit.
- During CPR.
- When measuring at a site with venous pulse.
- When there is body movement.
- When the pulse wave is small (insufficient peripheral circulation).

WARNING

Check the circulation condition by observing the skin color at the measurement site and pulse waveform. Change the measurement site every 8 hours for disposable probes and every 4 hours for reusable probes. When using the probe on the following patients, take extreme care and change the measurement site more frequently according to symptoms and degree.

- Patient with a fever
- Patient with insufficient peripheral circulation
- Neonate or low birth weight infant with delicate skin

WARNING

When monitoring SpO_2 of a patient who is receiving photodynamic therapy, the light from the finger probe sensor may cause a burn. Photodynamic therapy uses a photosensitizing agent that has a side effect of photosensitivity.

WARNING

When not monitoring SpO_2, disconnect the SpO_2 connection cord from the input unit. Otherwise, noise from the probe sensor may interfere and incorrect data is displayed on the screen.

WARNING

The following information are given by Masimo Corporation.

- A pulse oximeter should NOT be used as an apnea monitor.
- Pulse rate measurement is based on the optical detection of a peripheral flow pulse and therefore may not detect certain arrhythmias. The pulse oximeter should not be used as a replacement or substitute for ECG based arrhythmia analysis.
- A pulse oximeter is an early warning device. Use lab co-oximeter to completely understand the patient's condition.

CAUTION

Only use the specified probes. Otherwise, SpO_2 cannot be monitored.

CAUTION

Turn off the power of mobile phones, small wireless devices and other devices which produce strong electromagnetic interference around a patient (except for devices allowed by the hospital administrator). Radio waves from devices such as mobile phones or small wireless devices may be mistaken as pulse waves and the displayed data may be incorrect.

WARNING

To avoid poor circulation, do not wrap the tape too tight. Check the blood circulation condition by observing the skin color and congestion at the skin peripheral to the probe attachment site. Even for short-term monitoring, there may be burn or pressure necrosis from poor blood circulation, especially on neonates or low birth weight infants whose skin is delicate. Accurate measurement cannot be performed on a site with poor peripheral circulation.

CAUTION

Normal external light does not affect monitoring but strong light such as a surgical light or sunlight may affect monitoring. If affected, cover the measuring site with a blanket.

CAUTION

While a patient is on medication which causes vasodilation, the pulse waveform may change and in rare cases the SpO_2 value might not be displayed.

CAUTION

SpO_2 and pulse rate readings may be inaccurate for a short time after defibrillation when using Masimo probes.

NOTE

- Purchase of this instrument confers no express or implied license under any Masimo patent to use this instrument with any oximetry sensor that is not manufactured or licensed by Masimo Corporation.
- Do not attach the probe to the same limb that is used for NIBP measurement or an IBP catheter. The SpO_2 measurement may be incorrect.

When Monitoring Dual SpO_2

CAUTION

Some pulse oximeter alarms do not function on the bedside monitor when an pulse oximeter is connected. When the data is abnormal, check the alarm on the pulse oximeter.

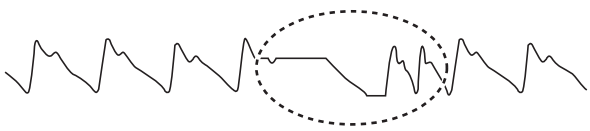
CAUTION

When two probes are attached too close to each other, the light from the probes interferes with each other and SpO_2 cannot be monitored properly. Make sure that there is no light interference when attaching two probes.

NOTE

- If a parameter is not monitored on the pulse oximeter, it is not displayed on the bedside monitor.
- Some parameters cannot be displayed on the bedside monitor even if they are monitored on the pulse oximeter.
- Waveforms from the pulse oximeter are not synchronized with the waveforms measured on the bedside monitor.
- When the pulse oximeter is operating in power save mode, the bedside monitor cannot receive data from the pulse oximeter. For details on the power save mode, refer to the pulse oximeter manual.
- The pulse waveform displayed on the bedside monitor is affected by the operation on the pulse oximeter. Depending on the status of the pulse oximeter, the pulse waveform displayed on the bedside monitor may differ from the actual waveform.

  e.g. The pulse waveform on the bedside monitor becomes flat while the trendgraph on the pulse oximeter is updated.



Dual SpO_2 Function (SpO_2 Measurement at Two Sites)
When there is a right → left shunt in a patent ductus arteriosus (PDA), there will be a difference in oxygen saturation between the right upper limb (pre-ductal) and lower limb (post-ductal).

By connecting two SpO_2 probes to the bedside monitor, SpO_2 can be monitored at the upper limb and lower limb, and the SpO_2 difference (ΔSpO_2) can be calculated. The ΔSpO_2 is calculated by subtracting the SpO_2 value from the probe connected to the pulse oximeter (post-ductal) from the SpO_2 value from the probe connected to the SpO_2 socket (pre-ductal).

When there is a right → left shunt through the ductus arteriosus, the SpO_2 of the lower limb is lower than the SpO_2 of the right upper limb. Therefore, when the SpO_2 probe connected to the SpO_2 socket is attached to a right upper limb and the probe connected to the pulse oximeter is attached to a lower limb, the ΔSpO_2 is indicated as a plus value.

PPHN (Persistent Pulmonary Hypertension of Newborn) and Dual SpO_2
PPHN (Persistent Pulmonary Hypertension of Newborn) is a critical disease where elevated pulmonary vascular resistance and serious pulmonary hypertension remain after birth and there is a large right → left shunt through the ductus arteriosus.

For PPHN from the right → left shunt in a patent ductus arteriosus (PDA), it is reported that monitoring the difference in SpO_2 between right upper limb (preductal) and lower limb (post-ductal) is useful to diagnose PPHN, decide the timing of starting/stopping treatment, and decide the operation schedule.

Preparing for SpO_2 Monitoring

Preparation Flowchart

1. Select the probe.
2. When using an AY-631P or AY-633P input unit or BSM-1733 bedside monitor, connect the probe to the SpO_2 connection cord and connect the SpO_2 connection cord to the SpO_2 socket.

   When using an IF-925P communication cable, connect the probe to the Masimo pulse oximeter and connect the pulse oximeter to the multi-link socket on the bedside monitor or JA-690PA or JA-694PA data acquisition unit with the IF-925P communication cable. For details, refer to the Masimo pulse oximeter and IF-925P communication cable manuals.

   When monitoring dual SpO_2:
   Connect the probe to the Masimo pulse oximeter and connect the pulse oximeter to the multi-link socket on the bedside monitor or JA-690PA or JA-694PA data acquisition unit with the IF-925P communication cable. For details, refer to the Masimo pulse oximeter and IF-925P communication cable manuals.
3. Attach the probe to the patient.
4. Monitoring starts. Set necessary settings.

Selecting a Probe and Patient Cable

Select the appropriate probe according to the purpose.

WARNING

Do not use additional tape to secure the probe to patient.

CAUTION

- Do not reuse adhesive probes for another patients because it causes cross infection.
- Do not use the probe over its stated lifetime. Otherwise the SpO_2 measurement accuracy cannot be guaranteed.
- Do not immerse the Masimo probe in water or any other solutions. The probe, cable and connectors are not waterproof.
- Do not sterilize the probe by irradiation, steam or ethylene oxide. Refer to the probe manual.

NOTE

When using a Masimo probe, read the instructions provided with the probe.

Masimo SpO_2 Probes

The following Masimo probes can be used with this bedside monitor. The Masimo probes are available direct from Masimo or their suppliers.

LNOP® Reusable Probes

Model	Patient	Weight Range	Measuring Accuracy		Application Site	Qty (/ box)
			No Motion	Motion		
LNOP DCI	Adult, pediatric	>30 kg	±2%SpO_2	±3%SpO_2	Finger	1
LNOP DCIP	Pediatric	10 to 50 kg	±2%SpO_2	±3%SpO_2	Finger	1
LNOP YI	Neonate, pediatric, adult	>1 kg	1 to 3 kg: ±3%SpO_2 >3 kg: ±2%SpO_2	1 to 3 kg: ±3%SpO_2 >3 kg: ±3%SpO_2	Multi-site	1
LNOP TC-I	Adult, pediatric	>30 kg	±3.5%SpO_2	N/A	Ear lobe	1
LNOP DC-195	Adult, pediatric	>30 kg	±2%SpO_2	±3%SpO_2	Finger	1
LNOP DCSC	Adult, pediatric	>30 kg	±2%SpO_2	±3%SpO_2	Finger	1
LNOP DC-12	Adult	>30 kg	±2%SpO_2	±3%SpO_2	Finger	1
LNOP TF-I	Adult	>30 kg	±2%SpO_2	N/A	Forehead	1

LNOP® Adhesive Probes

Model	Patient	Weight Range	Measuring Range		Application Site	Qty (/box)
			No Motion	Motion		
LNOP Adt	Adult	>30 kg	±2%SpO_2	±3%SpO_2	Finger	20
LNOP Pdt	Adult, pediatric	10 to 50 kg	±2%SpO_2	±3%SpO_2	Finger	20
LNOP Neo	Neonate	<10 kg	±3%SpO_2	±3%SpO_2	<3 kg: Foot >3 kg: Thumb or great toe	20
LNOP NeoPt	Neonate	<1 kg	±3%SpO_2	±3%SpO_2	Foot	20
LNOP Neo-L	Neonate, pediatric, adult	<3 kg >40 kg	<3 kg: ±3%SpO_2 >40 kg: ±2%SpO_2	<3 kg: ±3%SpO_2 >40 kg: ±3%SpO_2	<3 kg: Foot or toe >40 kg: Finger	20
LNOP NeoPt-L	Neonate	<1 kg	±3%SpO_2	±3%SpO_2	Foot	20
LNOP Inf-L	Neonate, pediatric	3 to 20 kg	±2%SpO_2	±3%SpO_2	Toe	20
LNOP Neo Bridge	Neonate	<10 kg	±3%SpO_2	±3%SpO_2	<3 kg: Foot >3 kg: Thumb or great toe	20
LNOP NeoPt Bridge	Neonate	<1 kg	±3%SpO_2	±3%SpO_2	Foot	20
LNOP Hi-Fi Trauma Neo/Adult	Adult, neonate	<3 kg >30 kg	<3 kg: ±3%SpO_2 >30 kg: ±2%SpO_2	<3 kg: ±3%SpO_2 >30 kg: ±3%SpO_2	<3 kg: Foot >30 kg: Finger	20
LNOP Hi-Fi Trauma Inf/ Ped	Infant, pediatric	3 to 30 kg	3 to 10 kg: ±3%SpO_2 10 to 30 kg: ±2%SpO_2	3 to 10 kg: ±3%SpO_2 10 to 30 kg: ±3%SpO_2	Finger or toe	20
LNOP Blue Inf	Neonate, pediatric	2.5 to 30 kg	±3 (for 80 to 100%SpO_2) ±4 (for 60 to 80%SpO_2)	N/A	Great toe	20
LNOP Adtx	Adult, pediatric	>30 kg	±2%SpO_2	±3%SpO_2	Finger	20
LNOP Pdtx	Pediatric	10 to 50 kg	±2%SpO_2	±3%SpO_2	Finger	20

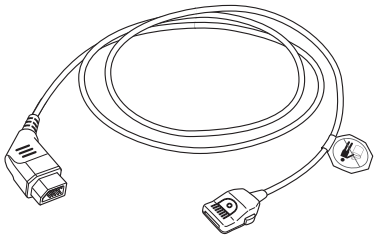
LNCS™ Reusable Probes

Model	Patient	Weight Range	Measuring Accuracy		Application Site	Qty (/box)
			No Motion	Motion		
LNCS DCI	Adult, pediatric	>30 kg	±2%SpO_2	±3%SpO_2	Finger	1
LNCS DCIP	Pediatric	10 to 50 kg	±2%SpO_2	±3%SpO_2	Finger	1
LNCS TC-I	Adult, pediatric	>30 kg	±3.5%SpO_2	N/A	Ear lobe	1
LNCS TF-I	Adult, pediatric	>30 kg	±2%SpO_2	N/A	Forehead	1

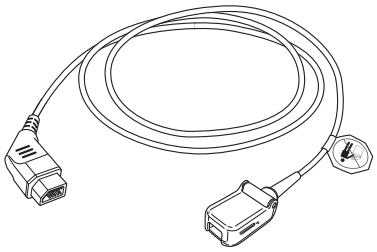
LNCS™ Adhesive Probes

Model	Patient	Weight Range	Measuring Accuracy		Application Site	Qty (/box)
			No Motion	Motion		
LNCS Adtx	Adult, pediatric	>30 kg	±2%SpO_2	±3%SpO_2	Finger	20
LNCS Pdtx	Adult, pediatric	10 to 50 kg	±2%SpO_2	±3%SpO_2	Finger	20
LNCS Inf-L	Neonate, pediatric	3 to 20 kg	±2%SpO_2	±3%SpO_2	Toe	20
LNCS Neo-L	Neonate, pediatric, adult	<3 kg >40 kg	±3%SpO_2 ±2%SpO_2	±3%SpO_2 ±3%SpO_2	<3 kg: Foot or toe >40 kg: Finger	20
LNCS NeoPt	Neonate	<1 kg	±3%SpO_2	±3%SpO_2	Foot	20

SpO_2 Connection Cords



Use the JL-630P SpO_2 connection cord (3.6 m) for the LNOP series probes.

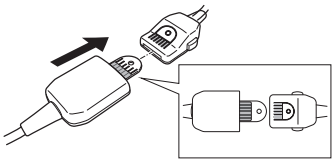


Use the JL-631P SpO_2 connection cord (3.0 m) for the LNCS series probes.

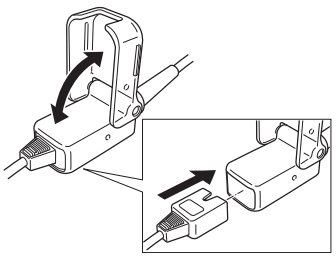
Connecting Cables and Attaching the Probes

Connecting Cable to the Unit

Using an AY-631P or AY-633P Input Unit or BSM-1733 Bedside Monitor

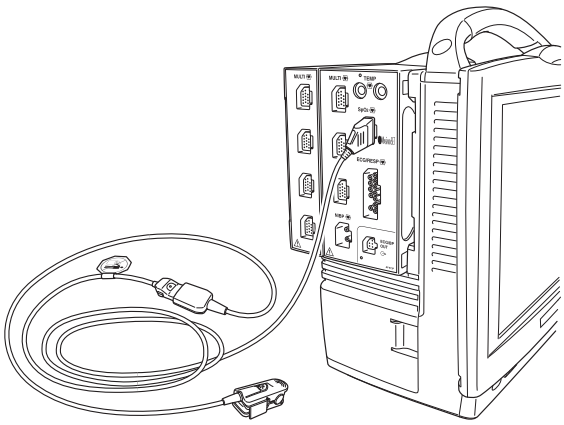


1. When using the LNOP series probes, insert the probe connector into the connector of the JL-630P SpO_2 connection cord.

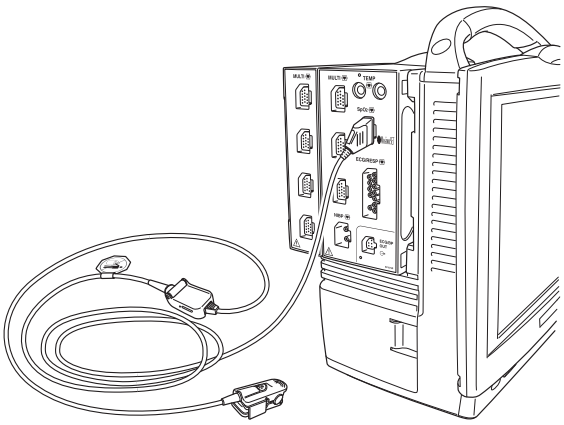


When using the LNCS series probes, open the stopper of the JL-631P SpO_2 connection cord, connect the probe connector firmly, then close the stopper. Check that the stopper clicks and is firmly closed.

2. Connect the SpO_2 connection cord to the SpO_2 socket.



When connecting the LNOP series probe



When connecting the LNCS series probe

Using an IF-925P Communication Cable

1. Connect an SpO_2 probe to the Masimo pulse oximeter. Refer to the pulse oximeter manual.

2. Connect the IF-925P communication cable to the pulse oximeter. Refer to the communication cable manual.

3. Connect the communication cable to the multi-link socket.

SpO_2 Measurement at Two Sites

Using an AY-631P or AY-633P Input Unit or BSM-1733 Bedside Monitor

1. Connect the probe to the SpO_2 connection cord and connect the SpO_2 connection cord to the SpO_2 socket.

2. Connect another SpO_2 probe to the Masimo pulse oximeter. Refer to the pulse oximeter manual.

3. Connect the IF-925P communication cable to the pulse oximeter. Refer to the communication cable manual.

4. Connect the communication cable to the multi-link socket.

Using an IF-925P Communication Cable

Uses two Masimo pulse oximeters. Connect an SpO_2 probe to each Masimo pulse oximeter and connect the pulse oximeters to the multi-link sockets with the IF-925P communication cables.

Attaching the Probe to the Patient

Refer to the probe manual.

Monitoring SpO_2

When the preparation is done properly, the SpO_2 value and pulse waveform appear on the screen.

The SpO_2 value acquired from the SpO_2 probe connected to the SpO_2 socket is displayed as "SpO_2" value and the SpO_2 value acquired from the SpO_2 probe connected to the pulse oximeter is displayed as "SpO_2-2" value on the screen.

CAUTION

When the probe is attached on an appropriate site with sufficient circulation and an error message about probe attachment repeatedly appears, the probe may be deteriorated. Replace it with a new one.

CAUTION

If the attachment site is dirty with blood or bodily fluids, clean the attachment site before attaching the probe. If there is nail polish on the attachment site, remove the polish. Otherwise, the amount of transmitted light decreases, and measured value may be incorrect or measurement cannot be performed.

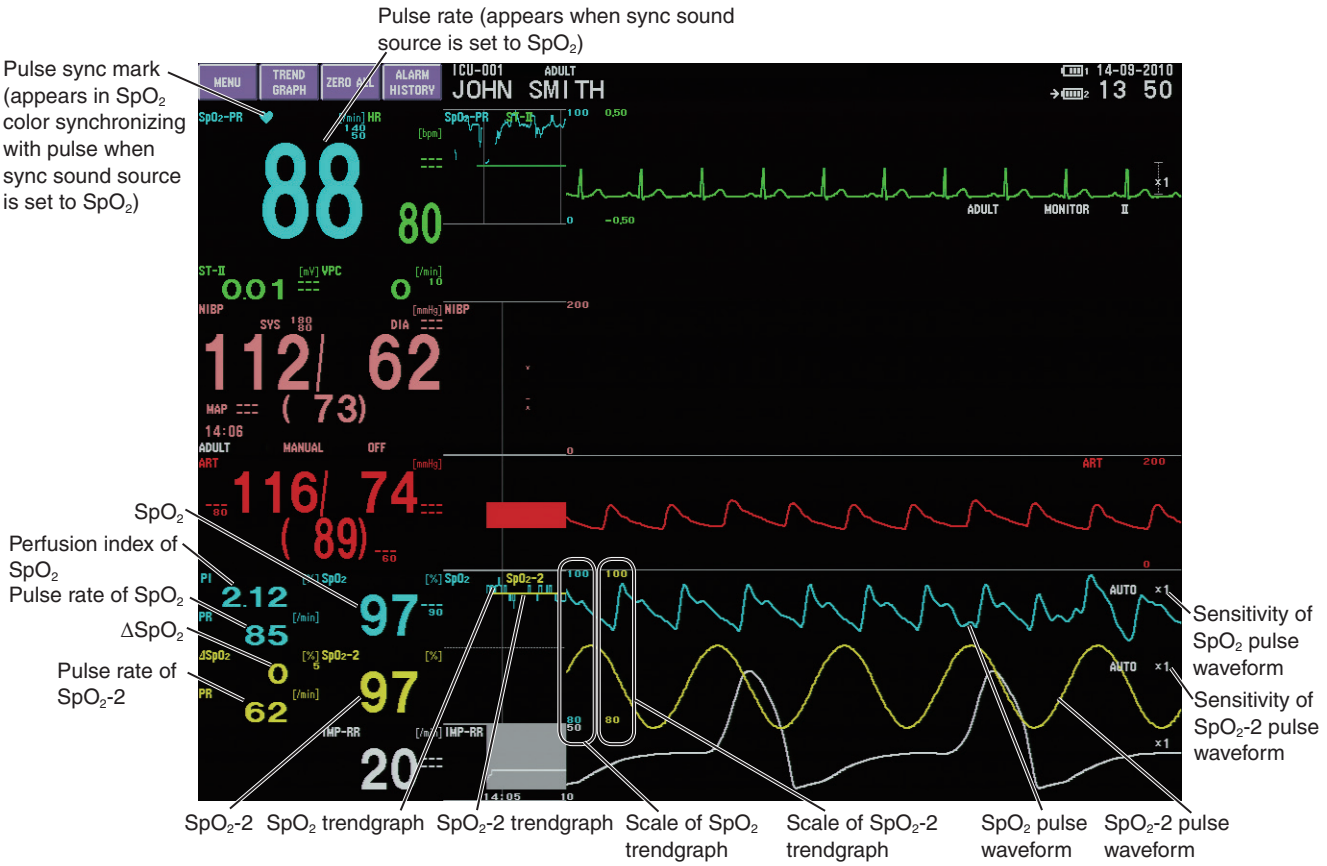
CAUTION

When a message indicates a faulty probe or faulty SpO_2 connection cord, stop monitoring and replace the probe or SpO_2 connection cord with a new one.

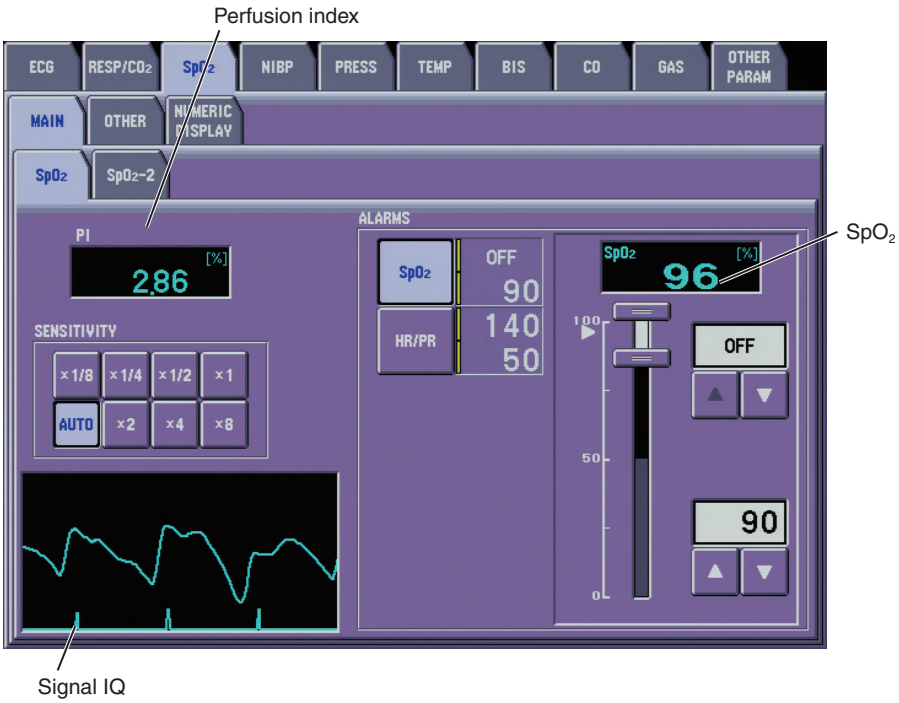
NOTE

In order to maintain sufficient blood circulation, keep the measurement site warm by covering with a blanket or something similar. Warming the site is effective, especially for a patient with a small pulse amplitude.

SpO_2 Information on the Home Screen



SpO_2 Information on the SpO_2 Window



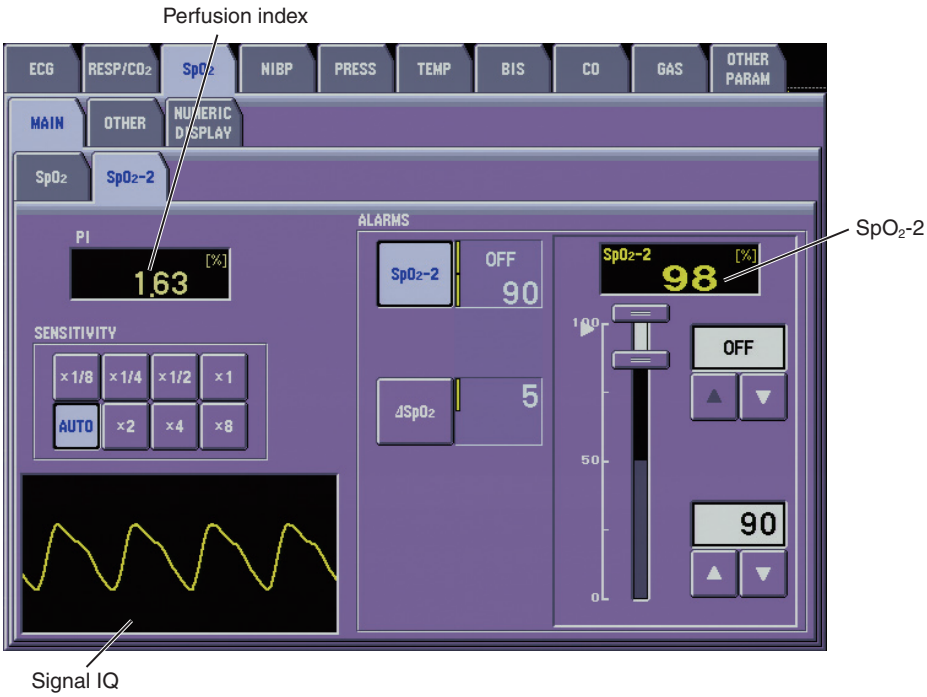
Signal IQ

Signal IQ is the signal quality indicator. Signal IQ can be used to identify the occurrence of a patient's pulse and the associated signal quality of the measurement. The pulse waveform is often distorted when there is motion and may be obscured by artifact. The Signal IQ, shown as a vertical line, coincides with the peak of an arterial pulsation. The height of the vertical line of the Signal IQ indicates the quality of the measured signal. The taller the height, the higher the signal quality. When the signal quality is very low, the height of the vertical line becomes low and an "M" mark is displayed beside the SpO_2 value.

PI (Perfusion Index)

The Perfusion Index indicates the percentage of pulsatile signal to non-pulsatile signal. The range of Perfusion Index is 0.02% (very weak pulse strength) to 20% (very strong pulse strength). The Perfusion Index allows clinicians to place sensors on optimal sites. Placing the sensor at the site with the highest Perfusion Index number improves performance during motion.

SpO_2 Information on the SpO_2-2 Window



Changing SpO_2 Settings

Change settings on the SpO_2 window. The following settings can be changed for SpO_2 monitoring.

The following settings can be changed on the SpO_2 tab.
- Pulse waveform sensitivity
- SpO_2 and pulse rate alarm limits*
- Averaging time*
- Sensitivity mode*
- FAST SAT mode on or off*
- Display pulse rate and/or perfusion index in SpO_2 numeric data area on the home screen

* These settings are not available for SpO_2 monitored by a Masimo pulse oximeter.

The following settings can be changed on the SpO_2-2 tab for dual SpO_2 monitoring.
- Pulse waveform sensitivity
- ΔSpO_2 alarm limit
- Display SpO_2-2 pulse rate, perfusion index and/or ΔSpO_2 in SpO_2-2 numeric data area on the home screen

The following settings are common settings for SpO_2 and SpO_2-2. These settings are not available for SpO_2 monitored by a Masimo pulse oximeter.
- Sync source
- Sync sound pitch

The SpO_2 data display color can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

The scale of the SpO_2 trendgraph on the home screen is the same scale as the trendgraph of the Review window. Refer to the Operator's Manual or Section 6 of the User's Guide Part I.

The SpO_2 pulse waveform sweep speed and the waveform display on the home screen can be selected on the DISPLAY window. Refer to Section 3 of the User's Guide Part I.

A second occurring SpO_2 alarm can be silenced when the [Silence Alarms] key is pressed. Refer to Section 3 of the Administrator's Guide. This function is only available for BSM-6000A series.

If an SpO_2 alarm occurs and no action is taken for a selected duration or the SpO_2 value drops below a set level for a selected duration, the alarm level can be escalated. Refer to Section 3 of the Administrator's Guide.

Changing the Sensitivity

The sensitivity determines the size of the pulse waveform on both the screen and recording paper.

The sensitivity can be set manually or automatically. When you select auto sensitivity, the sensitivity is automatically determined according to the present SpO_2 pulse waveform. When sensitivity is set automatically, "AUTO" appears beside the sensitivity on the screen.

For the pulse waveform monitored by Masimo pulse oximeter, the sensitivity cannot be set automatically.

NOTE

The pulse wave amplitude varies according to the ratio of the pulsation component to the entire transmitted IR signal. When the pulsation component ratio is 1%, the pulse wave amplitude is about 10 mm at ×1 sensitivity on the display.

1. SpO_2: Display the SpO_2 tab of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → MAIN tab → SpO_2 tab.
   SpO_2-2: Display the SpO_2-2 tab of the SpO_2-2 window.
   Press the [Menu] key → SpO_2 key → MAIN tab → SpO_2-2 tab.

2. Select the sensitivity from ×1/8, ×1/4, ×1/2, ×1, ×2, ×4, ×8 or AUTO in the <SENSITIVITY> box.

3. Press the [Home] key to return to the home screen.

Changing the SpO_2 and Pulse Rate Alarm Limits

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

You can set the upper and lower SpO_2 and heart rate/pulse rate alarm limits on the SpO_2 window. You can set all alarms, including the upper and lower SpO_2 and pulse rate alarm limits, on the ALARM LIMITS window (See the Operator's Manual or Section 5 of the User's Guide Part I). The heart rate/pulse rate alarm limits can also be changed on the ECG and PRESS window.

Setting Range

NOTE

If "EXT TACHY" or "EXT BRADY" are set to ON, the "ALARM CAP" setting for the "HR/PR" cannot be set. To apply the "ALARM CAP" setting for the "HR/PR", set "EXT TACHY" and "EXT BRADY" to OFF.

SpO_2 upper limit: 51 to 100%SpO_2 in 1%SpO_2 steps, OFF*1*2
(default setting: ADULT, CHILD-OFF, NEONATE-95)

SpO_2 lower limit: OFF, 50 to 99%SpO_2 in 1%SpO_2 steps*1*2
(default setting: ADULT, CHILD-90, NEONATE-85)

HR/PR upper limit: When <SYNC SOURCE> is set to ECG:
16 to 300 beats/min in 1 beat/min steps, OFF*1*2
When <SYNC SOURCE> is set to PRESS or SpO_2:
31 to 300 beats/min in 1 beat/min steps, OFF*1*2
When EXT TACHY alarm is set to ON:
16 to EXT TACHY alarm limit in 1 beat/min steps*1*2
(default setting: ADULT-140, CHILD-170, NEONATE-200)

HR/PR lower limit: When <SYNC SOURCE> is set to ECG:
OFF, 15 to 299 beats/min in 1 beat/min steps*1*2
When <SYNC SOURCE> is set to PRESS or SpO_2:
OFF, 30 to 299 beats/min in 1 beat/min steps*1*2
When EXT BRADY alarm is set to ON:
EXT BRADY alarm limit to 299 in 1 beat/min steps*1*2
(default setting: ADULT-50, CHILD-75, NEONATE-100)

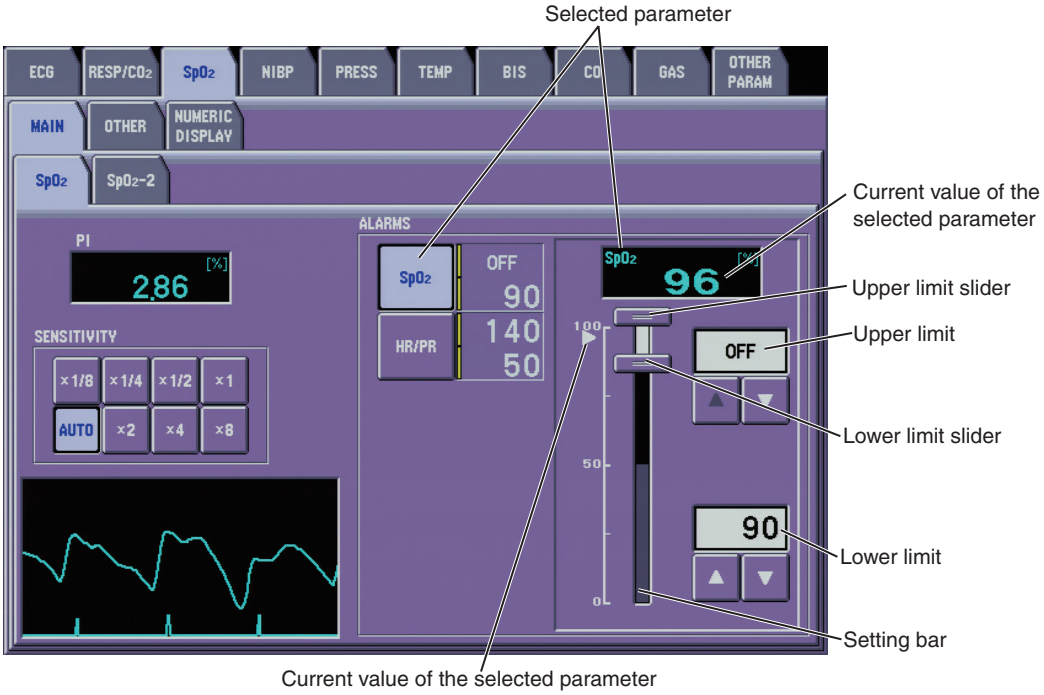
ΔSpO_2 upper limit: OFF, 1 to 50%SpO_2 in 1%SpO_2 steps
(default setting: 5)

*1 On BSM-6000A series, if <CRISIS VITAL ALARM MANAGEMENT> on the SYSTEM CONFIGURATION screen is turned on and "ALARM PRIORITY" on the SYSTEM SETUP window is set to CRISIS, the alarm setting is set to the alarm master setting.

*2 On BSM-6000A series, if <ALARM CAP> on the SYSTEM CONFIGURATION screen is turned on, the alarm setting is affected by the "ALARM CAP" setting on the SYSTEM SETUP window.

1. SpO_2: Display the SpO_2 tab of the SpO_2 window.
Press the [Menu] key → SpO_2 key → MAIN tab → SpO_2 tab.
SpO_2-2: Display the SpO_2-2 tab of the SpO_2-2 window.
Press the [Menu] key → SpO_2 key → MAIN tab → SpO_2-2 tab.

2. Touch the SpO_2 key to change the SpO_2 alarm setting.
   Touch the HR/PR key to change the heart rate/pulse rate alarm setting.
   Touch the ΔSpO_2 key on the SpO_2-2 tab to change the ΔSpO_2 alarm setting.



3. Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.
   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.

4. Press the [Home] key to return to the home screen.

Changing the Sync Sound Source

This setting is not available for SpO_2 monitored by a Masimo pulse oximeter.

You can select ECG, SpO_2 pulse (SpO_2) or arterial blood pressure pulse (PRESS) as the sync source. When the arterial blood pressure pulse is selected, the blood pressure of the highest priority label is used. The sync source can also be changed on the ECG and PRESS windows.

When pulse wave and pressure waveform are irregular because of an IABP, select ECG.

NOTE

- When heart rate is unstable because of an ESU, select SpO_2 or PRESS.
- When the connection cord of SpO_2 or IBP of the arterial blood pressure is disconnected from the monitor and alarm occurs when the sync source is set to SpO_2 or PRESS, the sync source changes to ECG when the alarm is silenced by pressing the [Silence Alarms] key. The sync source returns to SpO_2 or PRESS when the SpO_2 or IBP is monitored again. When using PRESS as the sync source, adjust zero balance.

- When the sensor is detached from the patient and alarm occurs, and the sync source is set to SpO_2 or PRESS, the sync source does not change to ECG when the alarm is silenced and PR is displayed "- - -".

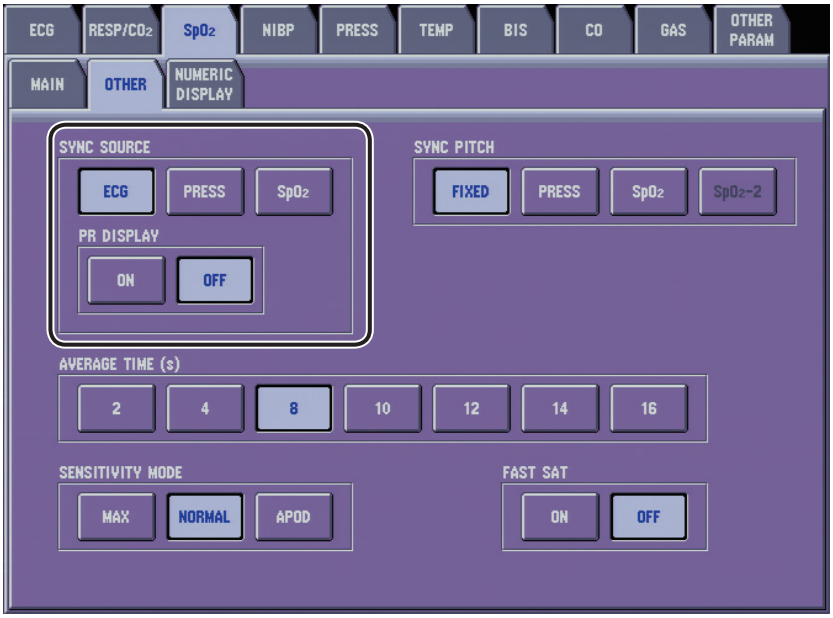
When the sync source is set to ECG and ECG is not measured, there is no sync sound.

When SpO_2 or PRESS is selected, the pulse rate can be displayed to the left of the heart rate on the screen and the sync mark synchronizes with the pulse.

1. Display the OTHER page of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → OTHER tab.

2. Select the sync source in the <SYNC SOURCE> box.
   ECG: QRS
   PRESS: Pulse wave of the highest priority arterial blood pressure
   SpO_2: SpO_2 pulse

   To display the pulse rate to the left of the heart rate on the home screen, select ON for <PR DISPLAY>. This setting is only available when <SYNC SOURCE> is set to ECG.



3. Press the [Home] key to return to the home screen.

Selecting Sync Sound Pitch

This setting is not available for SpO_2 monitored by a Masimo pulse oximeter.

The sync sound can be variable pitch or fixed pitch pips. The fixed pitch is high pitch as the default, but medium or low pitch can also be set on the SYSTEM SETUP window. See Section 3 of the Administrator's Guide. When you select variable pitch, the pitch of the sync sound changes according to SpO_2 value or systolic BP value of the arterial blood pressure so that you can recognize the change on the patient from the pitch of the sync sound without looking at the monitor. The sync pitch can also be changed on the ECG and PRESS windows.

When the sync sound source is set to SpO_2 and the SpO_2 value is below 81%SpO_2 or 40%SpO_2, the low pitch is automatically selected.

When the sync sound source is set to SpO_2 and the "CHECK PROBE" or "DETECTING PULSE" message is displayed on the screen, the sync sound stops.

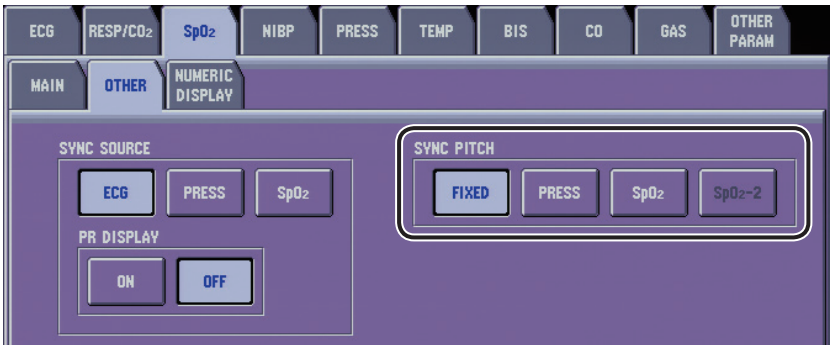
When the sync sound source is set to ECG or PRESS, the sync pitch is set to SpO_2 and the SpO_2 cannot be displayed on the screen, the low pitch is automatically selected.

When the sync sound source is set to ECG or SpO_2, the sync pitch is set to PRESS and the IBP cannot be displayed on the screen, the low pitch is automatically selected.

When the sync sound source is set to ECG or SpO_2 and the IBP connection cord is disconnected, the low pitch is automatically selected. After connecting the IBP connection cord, adjust zero balance.

1. Display the OTHER page of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → OTHER tab.

2. Select the sync sound pitch from the <SYNC PITCH> box.
   FIXED: The pitch is fixed to the pitch selected on the SYSTEM SETUP window.
   PRESS: The pitch is high when the BP value is above 120 mmHg. The pitch is low when the BP value is below 20 mmHg. The pitch changes from high to low in 20 steps for each 5 mmHg change between 120 and 20 mmHg BP value. The BP value of the highest priority arterial blood pressure is used.
   SpO_2: The pitch changes with each 1% change in SpO_2. You can select the SpO_2 range (81 to 100% or 40 to 100%) on the SYSTEM SETUP screen. Refer to Section 3 of the Administrator's Guide.



3. Press the [Home] key to return to the home screen.

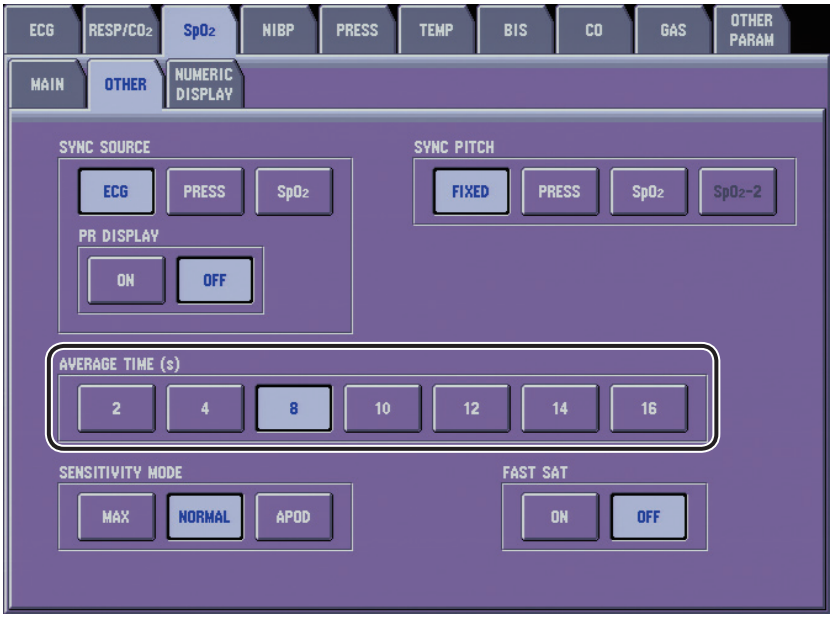
Selecting the Averaging Time

This setting is not available for SpO_2 monitored by a Masimo pulse oximeter.

Select the averaging time.

1. Display the OTHER page of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → OTHER tab.

2. Select the averaging time from the <AVERAGE TIME> box.



3. Press the [Home] key to return to the home screen.

Selecting the Sensitivity Mode

This setting does not apply to SpO_2 monitored by a Masimo pulse oximeter.

There are three sensitivity modes. Select the mode which gives most accurate measurement according to the patient condition.

MAX: This mode should be used for a critical patient where obtaining a reading is most difficult. MAX mode is designed to interpret and display data for even the weakest of signals. This mode is recommended during procedures and when clinician and patient contact is continuous.

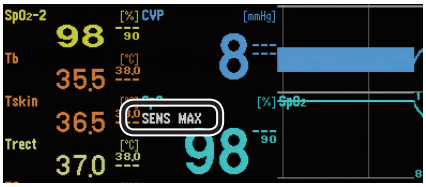
NORMAL: This mode provides the best combination of sensitivity and probe-off detection performance. This mode is recommended for most patients.

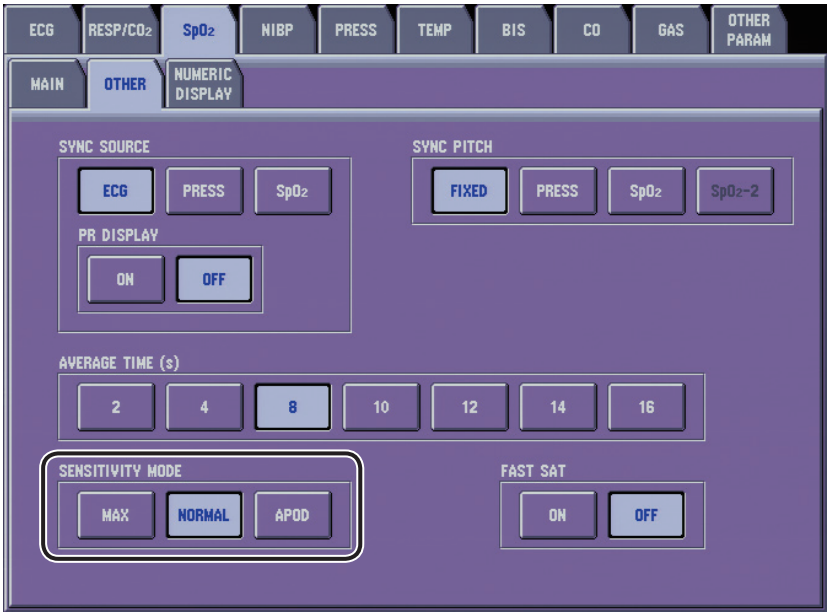
APOD: APOD (Adaptive Probe Off Detection) is the least sensitive in picking up a reading on patients with low perfusion but has the best detection of probe-off condition. This mode is useful for patients who are at risk of the sensor becoming detached (pediatric, body movement, etc.).

1. Display the OTHER page of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → OTHER tab.

2. Select the mode from the <SENSITIVITY MODE> box.
   When MAX or APOD is selected, "SENS MAX" or "APOD" appears in the SpO_2 value area on the home screen.

Example: MAX is selected





3. Press the [Home] key to return to the home screen.

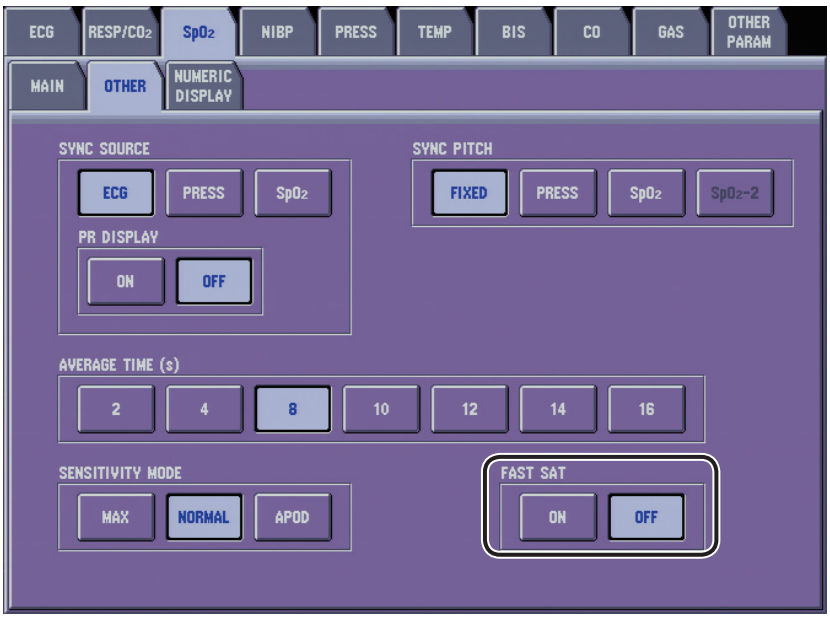
Turning FAST SAT Mode On or Off

This setting is not available for SpO_2 monitored by a Masimo pulse oximeter.

FAST SAT enables rapid tracking of arterial oxygen saturation changes by minimizing the averaging. This mode is clinically applicable during procedures when detecting rapid changes in oxygen saturation is most important such as induction, intubation and sleep studies.

1. Display the OTHER page of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → OTHER tab.

2. Select the ON or OFF in the <FAST SAT> box.



3. Press the [Home] key to return to the home screen.

Displaying Pulse Rate, ΔSpO_2 and Perfusion Index (PI) on the Home Screen

The pulse rate and perfusion index (PI) display in SpO_2 and SpO_2-2 area and the ΔSpO_2 display in SpO_2-2 area on the home screen can be set to on or off. For the numeric display in SpO_2-2 area, pulse rate and either ΔSpO_2 or PI can be displayed.

1. Display the NUMERIC DISPLAY page of the SpO_2 window.
   Press the [Menu] key → SpO_2 key → NUMERIC DISPLAY tab.

2. Select ON or OFF for each parameter in the <NUMERIC DISPLAY ON HOME SCREEN FOR SpO_2> and/or <NUMERIC DISPLAY ON HOME SCREEN FOR SpO_2-2> box.

3. Press the [Home] key to return to the home screen.

Section 5 NIBP Monitoring

The NIBP measurement is suitable for use in the presence of electrosurgery and during the discharge of a cardiac defibrillator. This monitor complies with IEC 60601-2-30: 1999.

General

Non-invasive blood pressure is measured by the oscillometric method in which the cuff is wrapped on the patient arm (or thigh) and connected to the NIBP socket on the input unit or BSM-1700 series bedside monitor.

Oscillometric method

The NIBP is measured from the change in amplitude pattern of pulsatile oscillation in cuff pressure as the cuff pressure is reduced from above systolic to below diastolic pressure. The occlusive-oscillometry method uses this to determine the systolic, diastolic, and mean arterial pressure.

The systolic pressure is the pressure at which the pulsatile oscillation suddenly increases, and the diastolic pressure is the pressure at which the pulsatile oscillation suddenly decreases. The mean arterial pressure is the point where maximum pulsatile oscillation occurs.

This monitor has four NIBP measurement modes.

- Manual measurement — Measurement is performed once.
- Automatic measurement — Measurement is performed automatically at preset time intervals. The time interval can be selected. Automatic measurement can also be performed with PWTT.
- STAT measurement — Measurement is performed for 10 minutes (maximum) continuously.
- SIM mode measurement — Measurement is performed in Staged Interval Mode (SIM). This mode is only available in OR site and when SIM is set to ON on the SYSTEM SETUP window. To change the site and SIM setting, refer to Section 3 of the Administrator's Guide.

WARNING

Be careful when measuring NIBP on a patient with known bleeding disorders or coagulation. After NIBP measurement, there may be dot hemorrhage, or circulatory disorder by thrombus where the cuff is attached.

WARNING

NIBP measurement may be incorrect in the following situations.

- When using an ESU
- Body movement
- Small pulse wave
- Too many arrhythmias
- Shaking from an external source
- Rapid blood pressure change
- During CPR
- Slow pulse
- Low blood pressure
- Cuff is too tight or too loose
- Cuff does not fit the arm
- Cuff is wrapped over thick clothing
- Cuff is deteriorated

When a BSM-1700 series bedside monitor is mounted on the BSM-6000K series, this monitor has two inflation methods: deflation mode and inflation mode. For details on the inflation method, refer to the BSM-1700 series bedside monitor operator's manual.

Preparing for NIBP Measurement

Preparation Flowchart

1. Select the cuff.
2. Connect the cuff to the air hose and connect the air hose to the NIBP socket.
3. Attach the cuff to the patient.
4. Set necessary settings, such as initial cuff inflation pressure.
5. Start measurements.

Selecting the Cuff

Select the appropriate cuff according to the purpose.

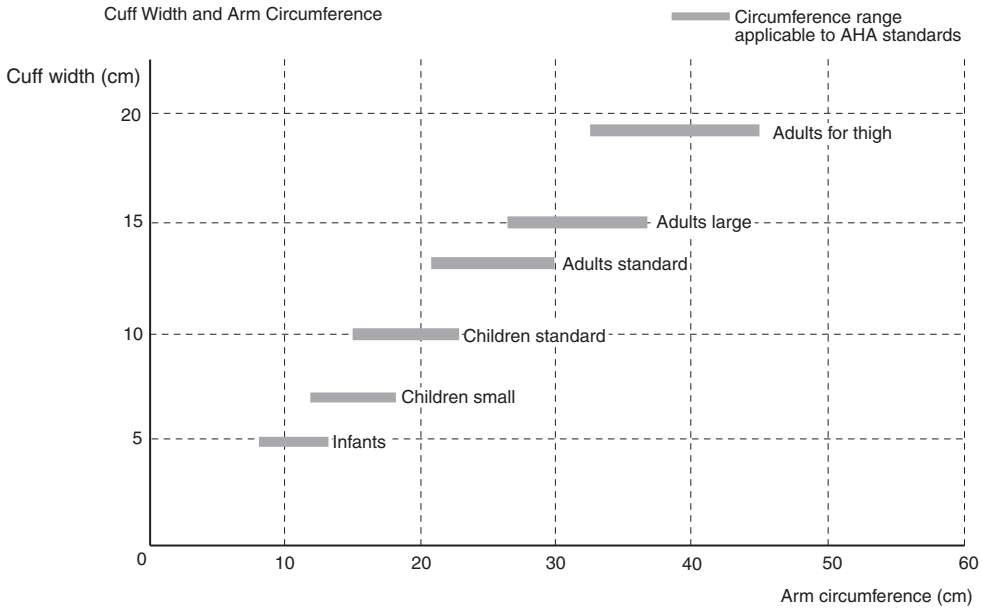
The AHA (American Heart Association) recommends that the cuff width be 40% of the circumference of the upper arm. Refer to the following graph and select the cuff which suits the patient's arm.

NOTE

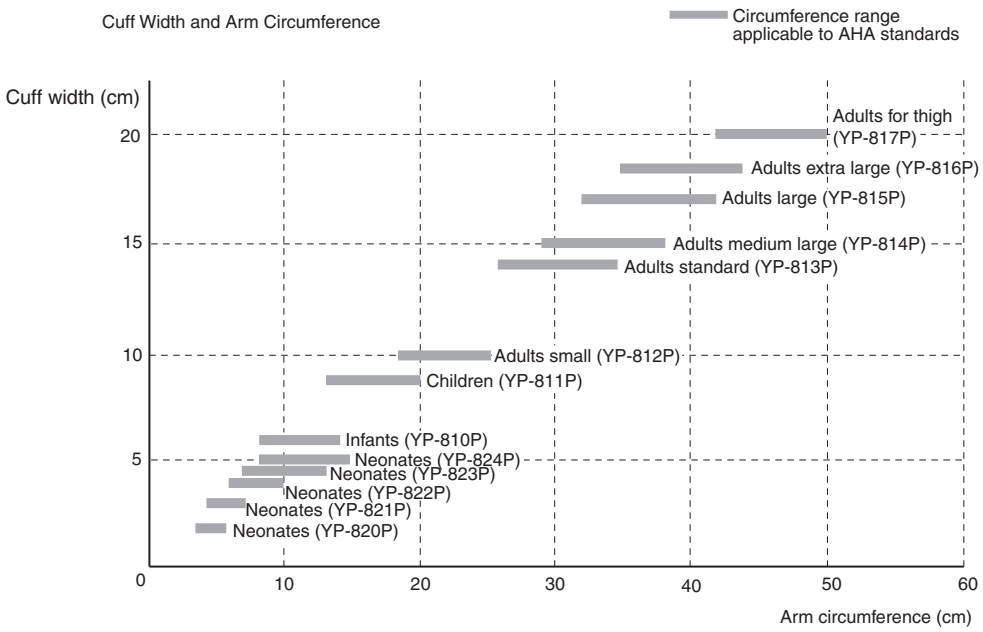
- If the range of arm circumference appropriate for the cuff is prescribed, use within that range.
- To obtain accurate measured values, select a wide cuff which can be attached to the upper arm or the thigh (calf in the case of neonates). Measuring with a very narrow cuff may result in measured values higher than the actual values.

Cuff Width and Arm Circumference

Reusable cuffs



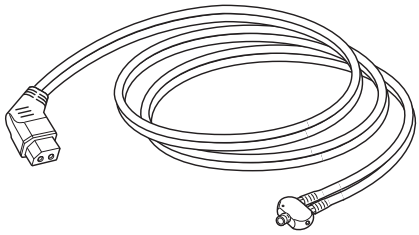
Disposable cuffs



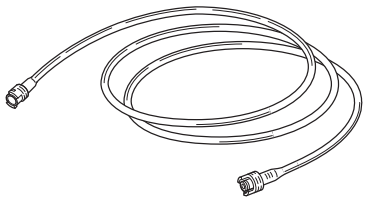
Types of Cuffs

Reusable Cuffs

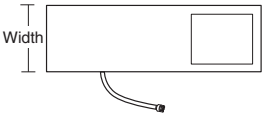
When using the following reusable cuffs, a YN-900P (1.5 m) or YN-901P (3.5 m) air hose is required. A YN-990P (1.5 m) extension hose is also available.

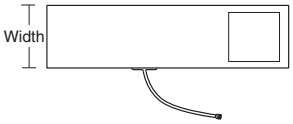


YN-900P air hose



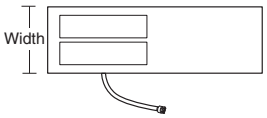
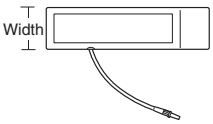
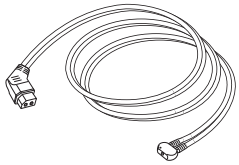
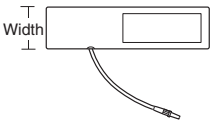
YN-990P extension hose

Cuff			Width (cm)	Applicable Circumference (cm)	Shape
For infants		YP-960T	5	8 to 13	
		YP-710T			
For children	Small	YP-961T	7	12 to 18	
		YP-711T		13 to 18	
	Standard	YP-702T	10	15 to 23	
		YP-962T			
For adults	Small	YP-712T*	10	18 to 23	
	Standard	YP-703T	13	21 to 30	
		YP-963T			
		YP-713T*		23 to 33	
	Large	YP-964T	15	26 to 36	
		YP-714T*	16	33 to 45	

Cuff		Width (cm)	Applicable Circumference (cm)	Shape
For thigh	YP-965T	19	33 to 45	
	YP-715T*		45 to 55	

* Can be used for inflation method measurement.

Disposable Cuffs

Cuff			Width (cm)	Applicable Circumference (cm)	Shape	Air Hose
Infants (Non-sterilized)		YP-810P	6	8 to 14		YN-900P (1.5 m) YN-901P (3.5 m)  Extension hose YN-990P (1.5 m) 
Children (Non-sterilized)		YP-811P	8	13 to 20		
Adults (Non-sterilized)	Small	YP-812P	10	18 to 26		
	Standard	YP-813P	14	26 to 35		
	Medium large	YP-814P	15	29 to 38		
	Large	YP-815P	17	32 to 42		
	Extra large	YP-816P	18	35 to 44		
For thigh		YP-817P	20	42 to 50		
Neonates (Non-sterilized)		YP-820P	2	3 to 6		YN-920P (1.5 m) YN-921P (3.5 m) 
		YP-821P	3	4 to 8		
		YP-822P	4	6 to 10		
		YP-823P	4.5	7 to 13		
		YP-824P	5	8 to 15		
Neonates (Sterilized)		No. 11*	3	5 to 7.5		
		No. 12*	4	7.5 to 10.5		
		No. 13*	5	8.5 to 13		

* These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

Connecting Cables and Attaching the Cuff to the Patient

Connecting Air Hose and Cuff to the Unit

CAUTION

Firmly connect the air hose to the NIBP socket on the monitor until it clicks. If not connected properly, the cuff type cannot be identified. At the start of NIBP measurement, check if the cuff type corresponds to the type displayed on the monitoring screen.

NOTE

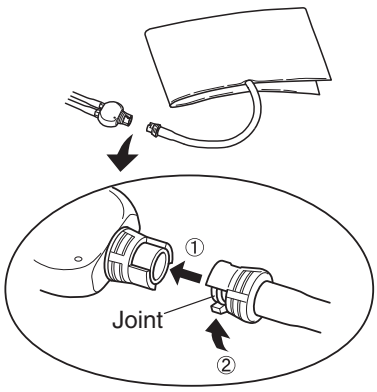
Firmly connect the air hose to the cuff and the unit. The air leakage will cause incorrect NIBP data or no data.

The monitor automatically identifies the type of air hose (adult, child or neonate) when the air hose is connected to the NIBP socket. The cuff inflation pressure is automatically changed according to the identified air hose type. The air hose type is displayed on the home screen.

NOTE

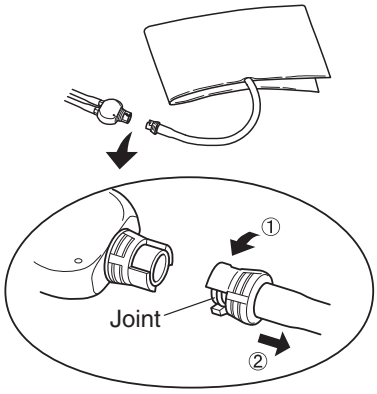
The alarm settings are not automatically changed according to the air hose type. The alarm settings which are appropriate for the patient must be manually set.

1. Connect the cuff to the air hose.



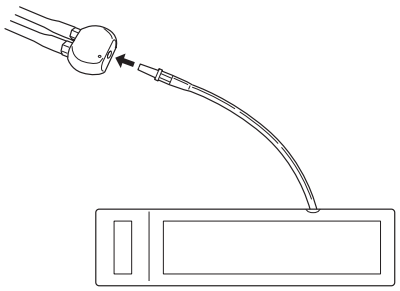
Connecting the Cuff for Adults and Children

Insert the cuff connector joint into the air hose and turn it clockwise to lock it.



Disconnecting the Cuff for Adults and Children

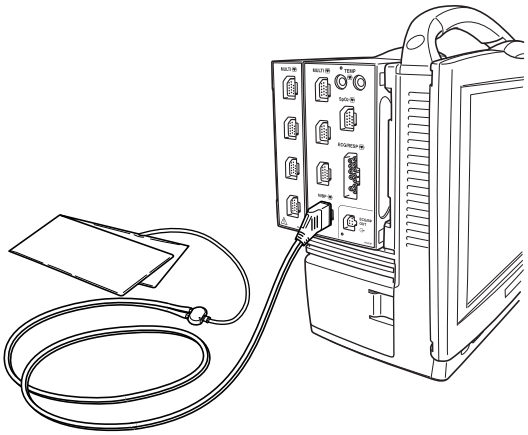
To disconnect the cuff from the air hose, turn the cuff connector joint counterclockwise to unlock it and remove it from the air hose.



Connecting the Cuff for Neonates

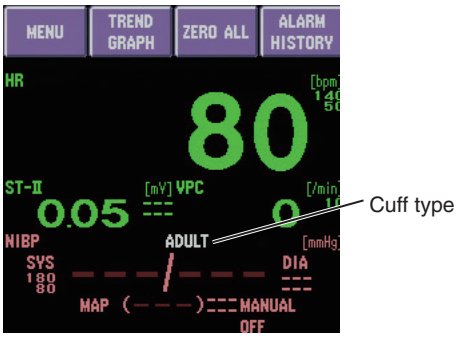
Insert the cuff connector into the air hose for neonate.

2. Connect the air hose to the NIBP socket. The monitor automatically identifies the type of the connected cuff (subject of measurement) and displays it on the home screen.



When connecting the YP-963P cuff for adults

3. Check that the home screen displays the correct cuff type.



Attaching the Cuff to the Patient

How to Wrap the Cuff

WARNING

Be careful when measuring NIBP on a patient with known bleeding disorders or coagulation. After NIBP measurement, there may be dot hemorrhage, or circulatory disorder by thrombus where the cuff is attached.

CAUTION

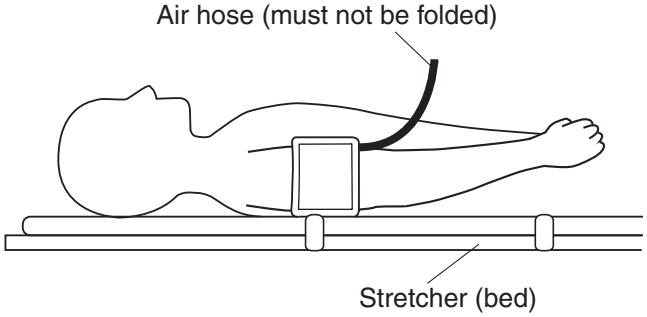
Do not wrap the cuff on an arm or thigh which is used for injection. NIBP measurement on an arm or thigh which is used for injection may cause reflux of blood and stop injection.

CAUTION

Do not wrap the cuff too tight. It may cause poor blood circulation and congestion. If the cuff is wrapped too loosely, the NIBP value may increase.

Wrap the cuff on the patient arm or thigh by referring to the manual provided with the cuff. When wrapping the cuff around the upper arm, observe the following points.

- The cuff must not wrap around the elbow.
- The cuff should just wrap around the upper arm, not too tightly or too loosely. A tightly wrapped cuff can cause discomfort to the patient and decreases the blood pressure reading, and a loosely wrapped cuff prolongs the measurement time and increases the blood pressure reading. If the cuff is too tight or too loose, the instrument may automatically stop inflating and stop the measuring procedure for patient safety.
- The air hose must not be folded.
- In principle, the cuff should be wrapped around a bare upper arm. Thick clothing can damp the pulsatile oscillation of the cuff pressure. It is still possible to obtain a measurement if the cuff is wrapped around thin clothing over the upper arm.



Cuff Hose and Air Hose

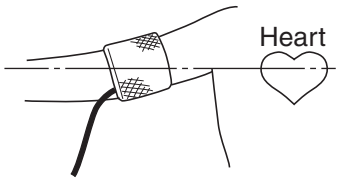
Confirm that the hoses are not folded or squeezed.

CAUTION

When too much pressure is applied to the cuff, or the hose is bent or squeezed, the "NIBP SAFETY CIRCUIT RUNNING" message appears on the screen and NIBP monitoring may be stopped. Remove the cause, wait 40 seconds, check that the message disappears, then measure again.

CAUTION

Only connect the air hose to the cuff and NIBP socket on the monitor. Do not connect the air hose, especially the air hose for neonate, to other parts, such as an infusion line. It may cause thrombus.



The air hose can be toward either the upper arm or forearm.

Cuff Position (Height of Cuff from Heart Level)

Place the cuffed upper arm (brachium) at the same height as the patient's heart. If the cuff is not at the same level as the heart, the weight of the blood affects the blood pressure reading. The pressure difference per unit height is 0.7 mmHg/cm. The blood pressure reading decreases when the arm is higher than the heart and increases when lower.

The best measuring condition is when the patient is lying on his/her back with arms and legs relaxed. If the cuff position cannot be on the same level as the heart, the displayed blood pressure reading must be mathematically adjusted.

Measuring and Monitoring NIBP

When the preparation is done properly, you can start non-invasive blood pressure measurement and monitoring.

The monitor automatically identifies the connected cuff type and sets the cuff inflation pressure.

WARNING

When performing long term measurement at intervals less than 2.5 minutes, perform measurements while observing the state of the patient, blood vessels and limb to ensure adequate circulation. Congestion may occur at the measurement site. When performing periodic measurement for a long time, periodically check the circulation condition.

CAUTION

When too much pressure is applied to the cuff, or the hose is bent or squeezed, the "NIBP SAFETY CIRCUIT RUNNING" message appears on the screen and NIBP monitoring may be stopped. Remove the cause, wait 40 seconds, check that the message disappears, then measure again.

CAUTION

Before starting STAT or SIM mode measurement, check the measurement setting (measurement intervals).

NOTE

- When measuring patients who are conscious, help the patient to relax. Measurement may not be accurate if the patient's arm is tense or if the patient talks.
- The data for measurement on the thigh tends to be higher than measurement on the arm.
- Do not apply pressure to the cuff or air hose. NIBP might not be measured correctly because of the noise or NIBP measurement may stop due to the NIBP safety circuit running.
- Do not measure NIBP on a patient on whom an IABP is used. Accurate NIBP measurement cannot be performed due to pulse waves from the IABP mixing with the patient's pulse waves.

Measurement Mode and Interval

There are four NIBP measurement modes: manual, auto (periodic), STAT (continuous) and SIM. The SIM mode is only available in OR site and when SIM is set to ON on the SYSTEM SETUP window. To change the site and SIM setting, refer to the Administrator's Guide.

Manual Measurement

NIBP is measured once whenever the [NIBP Start/Stop] key on the monitor is pressed. Manual measurement cannot be performed during the first stage of the STAT or SIM mode measurement.

Auto Measurement

The first NIBP measurement is performed when the [NIBP Start/Stop] key on the monitor is pressed and auto mode on the home screen is highlighted. The second measurement is performed when the current time (minutes) in the monitor reaches the nearest time interval selected.

The second periodic measurement time begins from the next even clock interval.
Example: When the interval is set to 5 minutes

8:02 First measurement (start measurement)
8:05 Second measurement
8:10 Third measurement

If the measurement interval is changed during auto measurement, the next measurement is performed at the next nearest selected interval. For example, when the auto measurement is performed at 5 minute intervals and if the interval is changed to 30 minutes, then the measurement will be performed as follows. 9:05 (5 minute interval measurement), 9:07 (interval changed to 30 minutes), 9:30 (30 minute interval measurement), 10:00 (30 minute interval measurement) and so on.

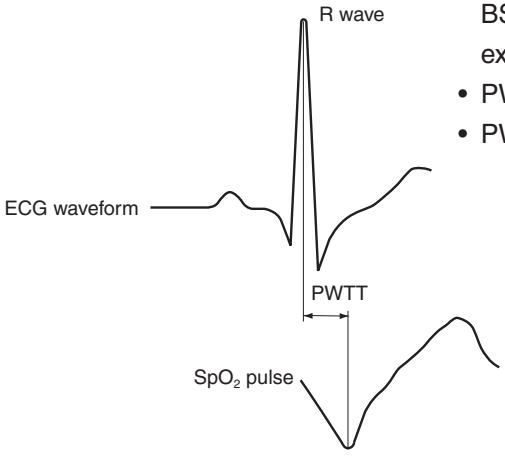
NOTE

The NIBP measurement time of the NIBP list on the TREND-NIBP window is the time the measurement is complete.

Auto Measurement with PWTT

NOTE

- Automatic measurement with PWTT is not available when using the AY-631P, AY-633P, AY-651P or AY-653P input unit or BSM-1733 or BSM-1753 bedside monitor. PWTT is only available when using Nihon Kohden probe for monitoring SpO_2.
- Automatic measurement with PWTT is not available when the SpO_2 measurement is performed with an SpO_2 probe connected to the MULTI socket on the AY-661P, AY-663P, AY-671P or AY-673P input unit, BSM-1763 or BSM-1773 bedside monitor, AA-672P or AA-674P smart expansion unit or JA-694PA data acquisition unit.
- PWTT is not available when site is NICU or the patient type is Neonate.
- PWTT is not available for BSM-6000A series.



PWTT (pulse wave transit time) is the interval between the R wave of the ECG and the onset of the SpO_2 pulse wave. The monitor can measure NIBP with PWTT trigger by using the PWTT change with circulation dynamics change. You can detect the NIBP change with circulation dynamics change which was over looked before, by using PWTT trigger NIBP measurement in combination with normal NIBP measurement.

To use PWTT in automatic NIBP measurement, you must set the PWTT to ON on the PWTT window of the NIBP window. Refer to the "Turning PWTT Trigger NIBP Measurement On or Off" section.

CAUTION

Do not rely only on the PWTT trigger NIBP measurement to monitor blood pressure changes. When it is necessary to monitor critical blood pressure change, set the appropriate interval for NIBP measurement.

CAUTION

In the following cases, PWTT may trigger too many or no NIBP measurements. Check the patient condition. If necessary, change the delta PWTT threshold or set the PWTT to OFF.

- Rapid blood pressure change with vasoreflex due to vasoactive drugs, such as phenylephrine and nicardipine
- Unstable pulse wave due to poor peripheral circulation
- Too many arrhythmias
- Patient movement
- Noise on ECG due to ESU
- SpO_2 measurement on foot of a child

NOTE

- When an air hose for neonates is connected, PWTT triggered NIBP measurement is not available.
- NIBP measurement with PWTT is performed when ECG and SpO_2 are monitored.
- If any of the following items are changed, PWTT changes discontinuously and estimated NIBP SYS might not be accurate. After changing any of these items, calibrate (measure NIBP) again.
  - "LEAD" setting on ECG window
  - Attachment place of the SpO_2 probe
- When using PWTT triggered NIBP measurement, set <AUTO LEAD CHANGE> on the ECG window to "OFF". If you set this to "ON", PWTT changes discontinuously and estimated NIBP SYS might not be accurate when the lead is changed.
- In the following cases, the PWTT mark disappears and PWTT triggered NIBP measurement is temporarily turned off. Remove the cause to turn on the PWTT triggered measurement.
  - Noise interference on ECG or SpO_2 and stable PWTT cannot be detected.
  - An ECG electrode or SpO_2 probe is detached and PWTT cannot be detected.
  - The ECG, SpO_2 or NIBP connector is disconnected.
  - Both the upper and lower NIBP SYS alarm limits are set to off.
- When using PWTT for NIBP measurement during operation, set arrhythmia analysis on the ECG window to ON. If set to OFF, the PWTT may be incorrect due to ESU. To change the ECG setting, refer to Section 1.
- When changing the ECG lead, the baseline of PWTT is reset and PWTT may be discontinuous.

STAT Measurement

Measurements are performed continuously according to the measurement program set for STAT measurement on the SYSTEM SETUP window. The program is divided into two stages. In the first stage, NIBP is measured continuously or at 1 minute intervals for 5 or 10 minutes. In the second stage, NIBP is measured at a different interval (manual or 1, 2, 2.5, 5, 10, 15 or 30 minutes, usually, longer interval than the first stage). Manual measurement cannot be performed during first stage measurement. The settings on the SYSTEM SETUP window can only be set by an administrator who has the password to enter the page.

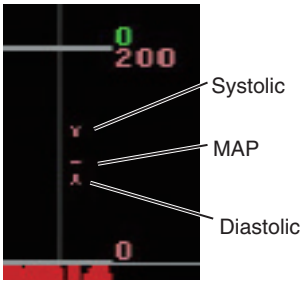
SIM Mode Measurement

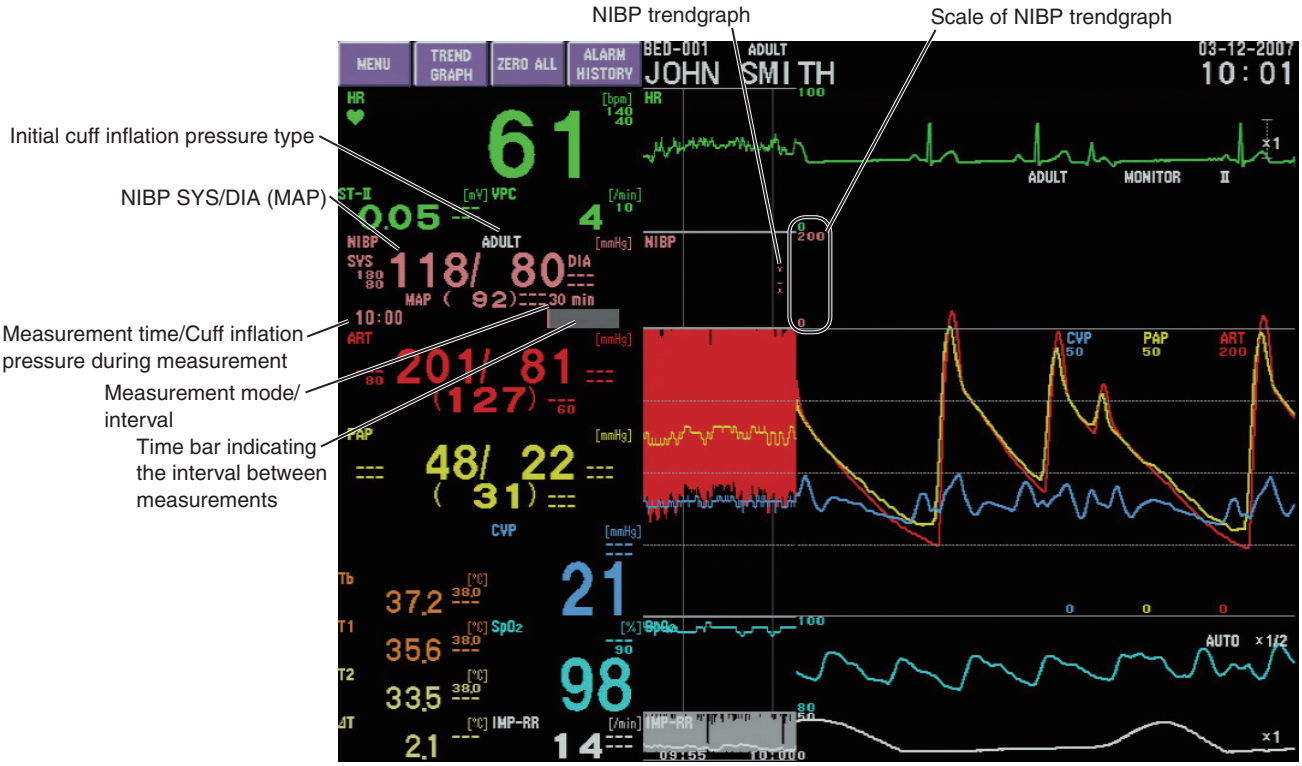
SIM mode program is for monitoring blood pressure during regional anesthesia, such as lumbar block, subarachnoid block and epidual anesthesia.

Measurements are performed continuously according to the measurement program set for SIM measurement on the SYSTEM SETUP window. The program is divided into two stages. In the first stage, NIBP is measured at 1, 2 or 2.5 minute intervals for 5, 10 or 15 minutes. In the second stage, NIBP is measured at a different interval (2, 2.5 or 5 minutes, usually a longer interval than the first stage). Manual measurement cannot be performed during first stage measurement. The settings on the SYSTEM SETUP window can only be set by an administrator who has the password to enter the page.

The SIM mode is only available in OR site and when SIM is set to ON on the SYSTEM SETUP window. To change the site and SIM setting, refer to the Administrator’s Guide.

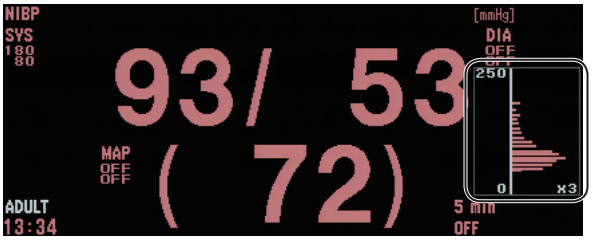
NIBP Information on the Home Screen





The NIBP oscillation graph is displayed when:

- NUMERIC PARAMETER AREA is set to LEFT SIDE or SIDE + LARGE BOTTOM on the SYSTEM SETUP screen
- DISPLAY OSCILLATION GRAPH is set to ON on the OTHER page of the NIBP window
- Only a few parameters are monitored



Dimming and Hiding the NIBP Data

The NIBP data on the home screen is dimmed or hidden at a preset time after the latest measurement. (This time is set at <TIME UNTIL DATA IS OLD> on the SYSTEM SETUP window.) Whether to dim or hide the old data can be selected at <OLD DATA DISPLAY> on the SYSTEM SETUP window. To change the SYSTEM SETUP settings, refer to Section 3 of the Administrator's Guide.

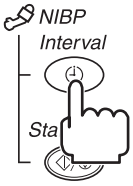
Setting: DIM

Setting: HIDE

Performing NIBP Measurement

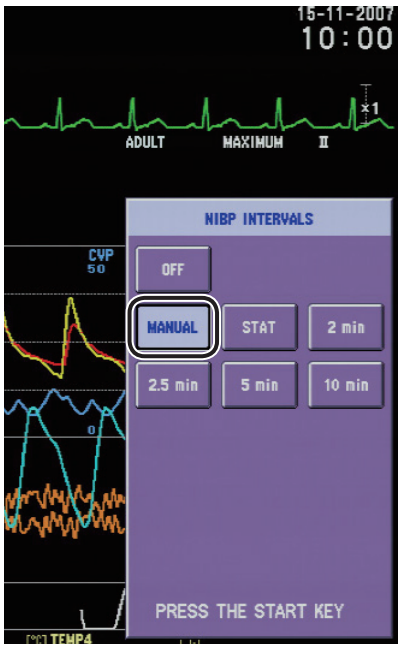
NOTE

- After NIBP measurement, the next measurement cannot start until the cuff pressure is less than 10 mmHg (2 mmHg in the Neonate mode) for more than 3 seconds.
- When NIBP START/STOP key is assigned to the function key, the NIBP measurement can also be performed with the function key. For details on the function keys, refer to Section 3 of the Administrator's Guide.

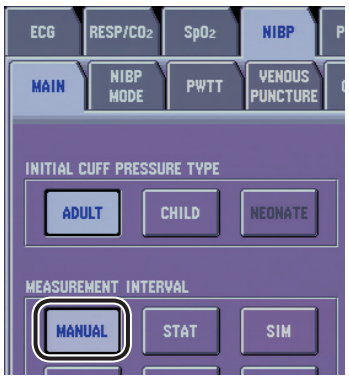


Manual Measurement

1. Press the [NIBP Interval] key to open the NIBP INTERVALS window to change the interval to "MANUAL".



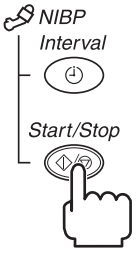
The measurement modes displayed on the NIBP INTERVALS window are selected on the SYSTEM SETUP window. Refer to the Administrator's Guide.



Or,

Touch the MANUAL key in the <MEASUREMENT INTERVAL> box on the MAIN page of the NIBP window.

Measurement mode "MANUAL"



2. Press the [NIBP Start/Stop] key to start measurement. During measurement, the cuff inflation pressure appears.

Cuff inflation pressure

When measurement is complete, the measured data appears on the screen.

When <COMPLETION SOUND> in the SYSTEM SETUP window is set to NK1 or NK2, a sound is generated when NIBP measurement is complete. For details on the completion sound, refer to Section 3 of the Administrator's Guide.

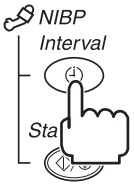
To stop measurement during measurement, press the [NIBP Start/Stop] key.

5

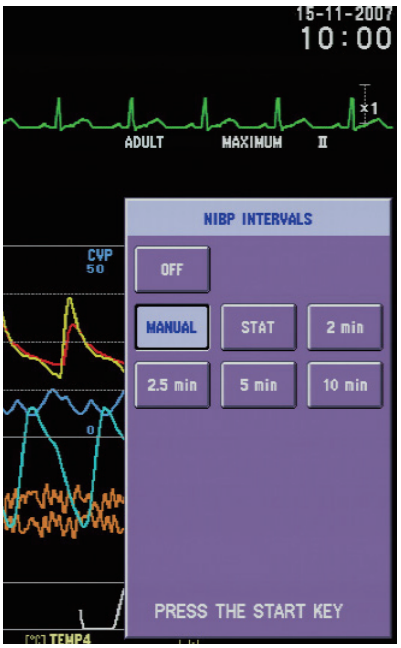
Auto Measurement

WARNING

When performing long term measurement at intervals less than 2.5 minutes, perform measurements while observing the state of the patient, blood vessels and limb to ensure adequate circulation. Congestion may occur at the measurement site. When performing periodic measurement for a long time, periodically check the circulation condition.

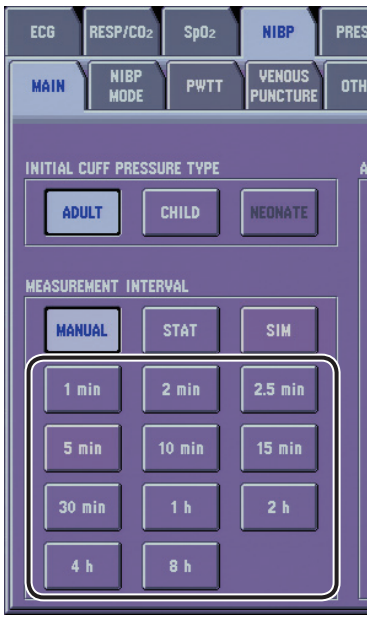


1. Press the [NIBP Interval] key to open the NIBP INTERVALS window to select the interval.



The measurement modes displayed on the NIBP INTERVALS window are selected on the SYSTEM SETUP window. Refer to the Administrator's Guide.

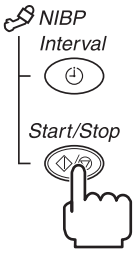
Or,



Select the interval from the <MEASUREMENT INTERVAL> box on the MAIN page of the NIBP window.

NOTE

When <NIBP INTERVAL KEY STARTS NIBP> on the SYSTEM SETUP window is set to ON, the first measurement starts when the interval is selected by pressing the [NIBP Interval] key on the monitor. To change the SYSTEM SETUP settings, refer to the Administrator's Guide.



2. Press the [NIBP Start/Stop] key to start measurement. During measurement, the cuff inflation pressure appears.

   If the auto mode is not highlighted on the home screen, it means that the auto measurement is not yet started.

   When measurement is complete, the measured data appears on the screen.

   When <COMPLETION SOUND> in the SYSTEM SETUP window is set to On, a "bong" sounds is generated when NIBP measurement is complete. For details on the completion sound, refer to Section 3 of the Administrator's Guide.

3. When the interval elapses, the second measurement automatically starts.

To stop one measurement in auto mode, press the [NIBP Start/Stop] key. To stop auto measurement, change the measurement mode to "MANUAL".

The periodic measurement can be stopped by pressing the [NIBP Interval] key to display the NIBP INTERVAL window and touching the OFF key on the NIBP INTERVAL window during measurement.

To perform a manual measurement in this mode, press the [NIBP Start/Stop] key between auto measurements.

If the measurement interval is changed during auto measurement, the next measurement is performed at the next nearest selected interval.

Auto Measurement with PWTT

PWTT is the pulse wave propagation time which is derived from ECG and SpO_2. On PWTT triggered measurement, PWTT and NIBP SYS are calibrated on each NIBP measurement and NIBP SYS between NIBP measurements is estimated. When the estimated NIBP SYS exceeds the alarm limit for eight seconds, NIBP is automatically measured.

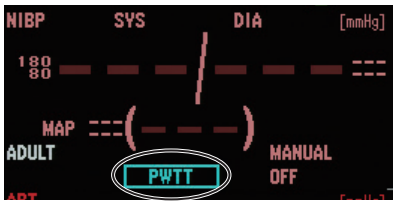
NOTE

- PWTT is not available for BSM-6000A series.
- Automatic measurement with PWTT is not available when using the AY-631P, AY-633P, AY-651P or AY-653P input unit or BSM-1733 or BSM-1753 bedside monitor. PWTT is only available when using Nihon Kohden probe for monitoring SpO_2.
- Automatic measurement with PWTT is not available when the SpO_2 measurement is performed with an SpO_2 probe connected to the MULTI socket on the AY-661P, AY-663P, AY-671P or AY-673P input unit, BSM-1763 or BSM-1773 bedside monitor, AA-672P or AA-674P smart expansion unit or JA-694PA data acquisition unit.
- PWTT is not available when site is NICU or the patient type is Neonate.
- When an air hose for neonates is connected, PWTT triggered NIBP measurement is not available.

1. Set <PWTT Trigger NIBP Measurement> to “On”. Refer to “Changing the PWTT Trigger NIBP Measurement On or Off” later in this section.

2. Set the NIBP SYS upper and lower alarm limit. Refer to “Changing the NIBP Alarm Limits” later in this section.

3. Monitor ECG and SpO_2. Refer to Section 1 “ECG Monitoring” and Section 4-1 “SpO_2 Monitoring on AY-660P/661P/663P/671P/673P Input Unit or BSM-1763/1773 Bedside Monitor”.



When stable PWTT is detected at least one minute after the start of ECG and SpO_2 monitoring, PWTT appears on the screen.

4. Measure NIBP once manually for calibration. Refer to “Manual Measurement” in this section.

After calibration, the PWTT mark changes to PWTT and PWTT triggered measurement is active.

NOTE

If the NIBP measurement is not finished normally, measure NIBP again.

When the estimated NIBP SYS exceeds the upper or lower alarm limit, the PWTT mark changes to PWTT.

NOTE

It takes a few seconds for the mark to change after the estimated NIBP SYS exceeds an alarm limit.

If the estimated NIBP SYS exceeds the alarm limit for eight seconds, NIBP is measured.

If the estimated NIBP SYS exceeds an alarm limit by ±20 mmHg, NIBP is measured again. PWTT triggered measurements are indicated with a “P” on the NIBP List window.

CAUTION

In the following cases, PWTT may trigger too many or no NIBP measurements. Check the patient condition. If necessary, change the delta PWTT threshold or set the PWTT to OFF.

- Rapid blood pressure change with vasoreflex due to vasoactive drugs, such as phenylephrine and nicardipine
- Unstable pulse wave due to poor peripheral circulation
- Too many arrhythmias
- Patient movement
- Noise on ECG due to ESU
- SpO_2 measurement on foot of a child

CAUTION

Do not rely only on the PWTT trigger NIBP measurement to monitor blood pressure changes. When it is necessary to monitor critical blood pressure change, set the appropriate interval for NIBP measurement.

NOTE

- NIBP measurement with PWTT is performed when ECG and SpO_2 are monitored. When ECG or SpO_2 is not monitored, PWTT appears blank on the home screen.
- To avoid too frequent NIBP measurement, PWTT does not trigger NIBP measurement within one minute of an NIBP measurement.
- If any of the following items are changed, PWTT changes discontinuously and estimated NIBP SYS might not be accurate. After changing any of these items, calibrate (measure NIBP) again.
  - “NUMBER OF ELECTRODES” setting on ECG window
  - Attachment place of the SpO_2 probe
- When using PWTT triggered NIBP measurement, set <AUTO LEAD CHANGE> on the ECG window to “OFF”. If you set this to “ON”, PWTT changes discontinuously and estimated NIBP SYS might not be accurate when the lead is changed.
- In the following cases, the PWTT mark disappears and PWTT triggered NIBP measurement is temporarily turned off. Remove the cause to turn on the PWTT triggered measurement.
  - Noise interference on ECG or SpO_2 and stable PWTT cannot be detected.
  - An ECG electrode or SpO_2 probe is detached and PWTT cannot be detected.
  - The ECG, SpO_2 or NIBP connector is disconnected.
  - Both the upper and lower NIBP SYS alarm limits are set to off.

STAT Measurement

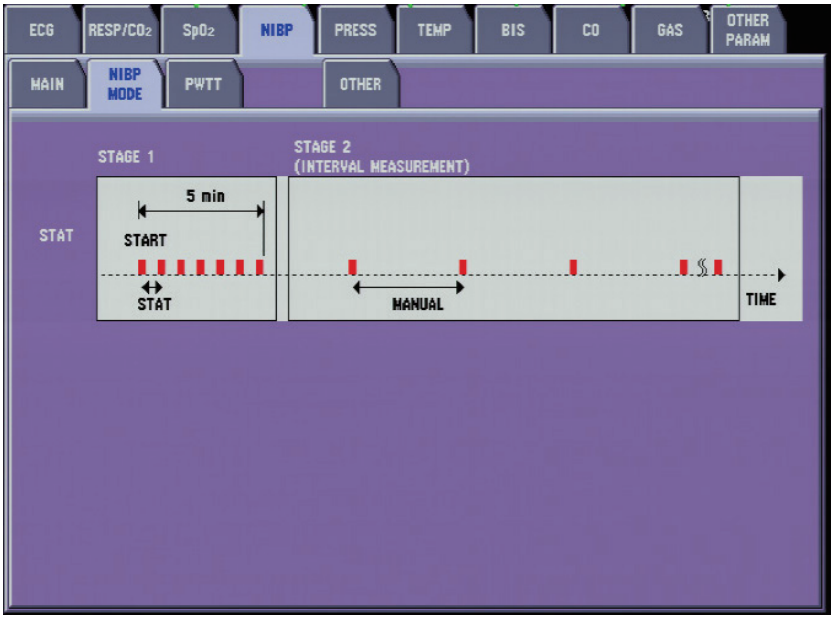
WARNING

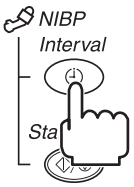
When performing long term measurement at intervals less than 2.5 minutes, perform measurements while observing the state of the patient, blood vessels and limb to ensure adequate circulation. Congestion may occur at the measurement site. When performing periodic measurement for a long time, periodically check the circulation condition.

CAUTION

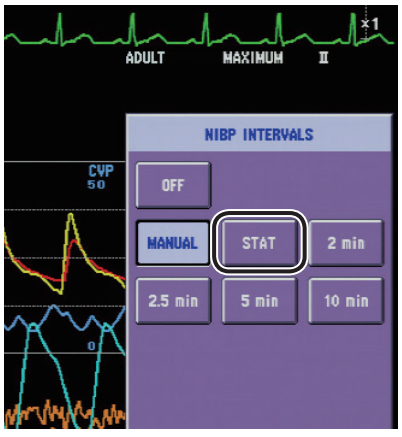
Before starting STAT or SIM mode measurement, check the measurement setting (measurement intervals).

1. Before STAT measurement, check the measurement setting on the NIBP MODE page of the NIBP window.
   Press the [Menu] key → NIBP key → NIBP MODE tab.

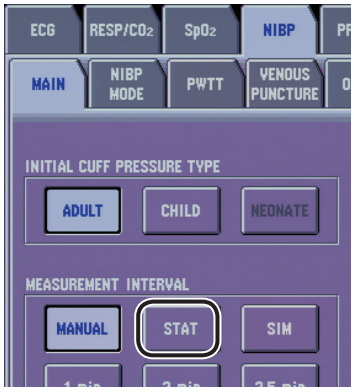




2. Press the [NIBP Interval] key to open the NIBP INTERVALS window to change the interval to “STAT”.

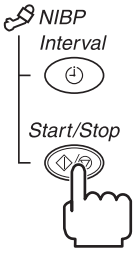


The measurement modes displayed on the NIBP INTERVALS window are selected on the SYSTEM SETUP window. Refer to the Administrator’s Guide.



Or,

Select STAT from the <MEASUREMENT INTERVAL> box on the MAIN page of the NIBP window.



3. Press the [NIBP Start/Stop] key to start measurement in the first stage. During measurement, the cuff inflation pressure appears.

   When measurement is complete, the measured data appears on the screen and another measurement starts.

   When <COMPLETION SOUND> in the SYSTEM SETUP window is set to NK1 or NK2, a sound is generated when NIBP measurement is complete. For details on the completion sound, refer to Section 3 of the Administrator’s Guide.

   Manual measurement is not available during the first stage of STAT measurement.

4. When the first stage is complete, measurement in the second stage starts.

To stop STAT measurement in the first stage, press the [NIBP Start/Stop] key.

To stop STAT measurement in the second stage, change the measurement mode to “MANUAL”.

The periodic measurement can be stopped by pressing the [NIBP Interval] key to display the NIBP INTERVAL window and touching the OFF key on the NIBP INTERVAL window during measurement.
To perform a manual measurement between auto measurements, press the [NIBP Start/Stop] key.

SIM Mode Measurement

WARNING

When performing long term measurement at intervals less than 2.5 minutes, perform measurements while observing the state of the patient, blood vessels and limb to ensure adequate circulation. Congestion may occur at the measurement site. When performing periodic measurement for a long time, periodically check the circulation condition.

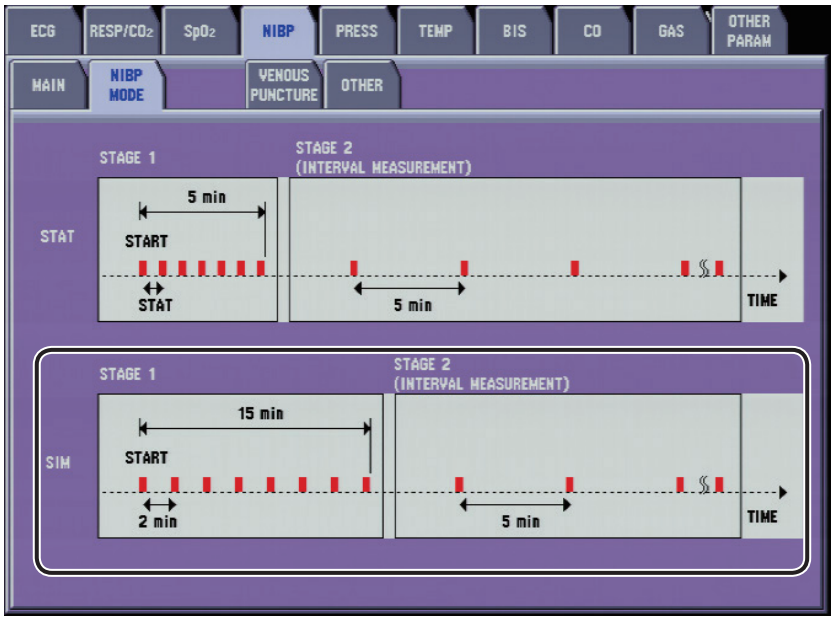
CAUTION

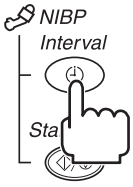
Before starting STAT or SIM mode measurement, check the measurement setting (measurement intervals).

NOTE

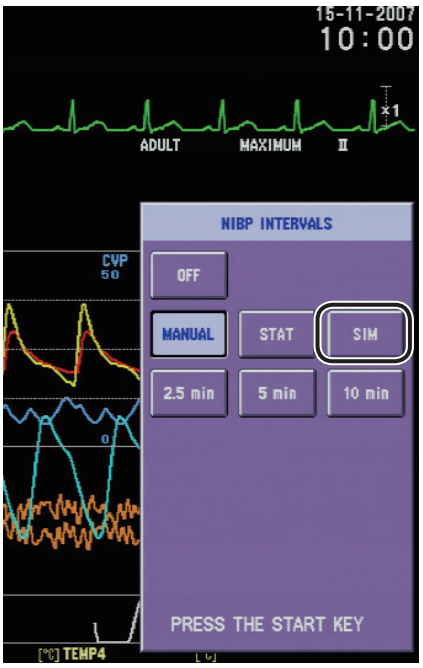
The SIM mode is only available in the OR site and when SIM is set to ON on the SYSTEM SETUP window. To change the site and SIM setting, refer to the Administrator's Guide.

1. Before SIM measurement, check the measurement setting on the NIBP MODE page of the NIBP window.
   Press the [Menu] key → NIBP key → NIBP MODE tab.

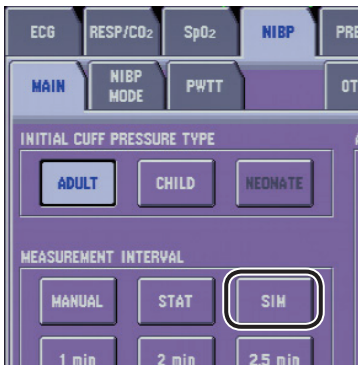




2. Press the [NIBP Interval] key to open the NIBP INTERVALS window to change the interval to "SIM".

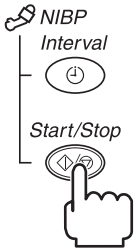


The measurement modes displayed on the NIBP INTERVALS window are selected on the SYSTEM SETUP window. Refer to the Administrator's Guide.



Or,

Select SIM from the <MEASUREMENT INTERVAL> box on the MAIN page of the NIBP window.



3. Press the [NIBP Start/Stop] key to start measurement in the first stage. During measurement, the cuff inflation pressure appears.

   When measurement is complete, the measured data appears on the screen and another measurement starts.

   When <COMPLETION SOUND> in the SYSTEM SETUP window is set to NK1 or NK2, a sound is generated when NIBP measurement is complete. For details on the completion sound, refer to Section 3 of the Administrator’s Guide.

   Manual measurement is not available during the first stage of SIM mode measurement.

4. When the first stage is complete, measurement in the second stage starts.

To stop SIM measurement in the first stage, press the [NIBP Start/Stop] key.

To stop SIM measurement in the second stage, change the measurement mode to “MANUAL”.

The periodic measurement can be stopped by pressing the [NIBP Interval] key to display the NIBP INTERVAL window and touching the OFF key on the NIBP INTERVAL window during measurement.

To perform a manual measurement between auto measurements, press the [NIBP Start/Stop] key.

Changing NIBP Settings

Change settings on the NIBP window. The following settings can be changed for monitoring NIBP.

- Initial cuff inflation pressure
- Measurement mode and interval
- NIBP alarm limits
- Automatic measurement with PWTT on/off
- Inflate mode on/off (Available only when the BSM-1700 series bedside monitor is mounted on the BSM-6000K series)

The following items can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

- Measurement end sound
- Starting NIBP auto measurement by pressing the [NIBP Interval] key
- SIM mode measurement on or off
- Measurement mode after the monitor power is off for more than 30 minutes (when <SHOW ADMIT CONFIRMATION WINDOW> is turned off in the SYSTEM CONFIGURATION screen) when the monitor is initialized or when a patient is admitted or discharged
- Dim or hide the old measurement data
- Time after NIBP measurement for the NIBP data to be dimmed or hidden
- Measurement program for STAT and SIM modes
- Measurement interval displayed on the NIBP INTERVALS window when the [NIBP Interval] key is pressed
- Venous puncture mode on or off and cuff inflation pressure for venous puncture
- NIBP data display color

The NIBP unit (mmHg or kPa) is the same as the pressure unit. The pressure unit is set on the SYSTEM CONFIGURATION screen. Refer to Section 2 of the Administrator's Guide.

The scale of the NIBP trendgraph on the home screen is the same scale as the trendgraph of the Review window. Refer to the Operator's Manual or Section 6 of the User's Guide Part I.

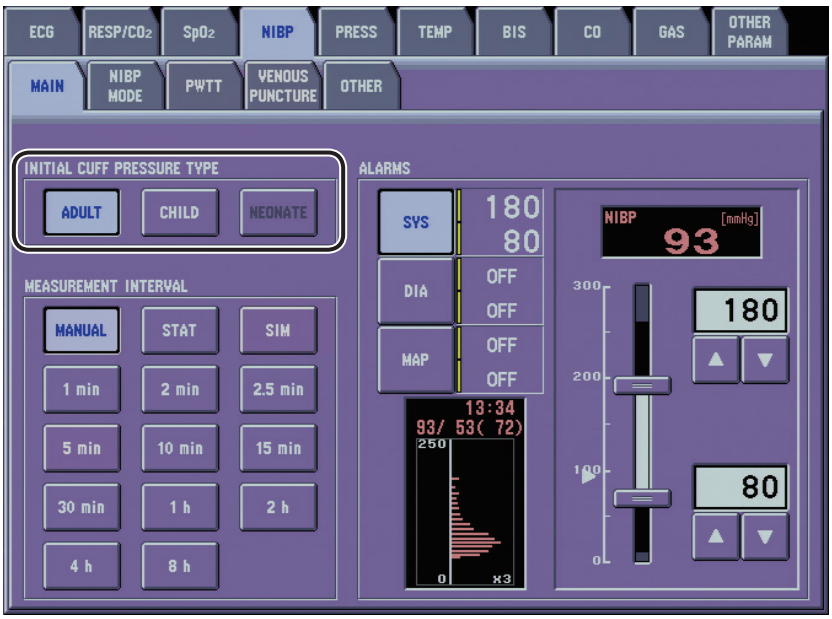
Selecting the Initial Cuff Inflation Pressure

Selecting the Initial Cuff Inflation Pressure Type

When the air hose for adult/child is connected to the NIBP socket, select the initial cuff inflation pressure type. When the air hose for neonate is connected, the initial cuff inflation pressure type is automatically set for neonate.

1. Display the MAIN page of the NIBP window.
   Press the [Menu] key → NIBP key → MAIN tab.

2. Select the patient type in the <INITIAL CUFF PRESSURE TYPE> box.



3. Press the [Home] key to return to the home screen.

Setting the Cuff Inflation Pressure

Select the cuff inflation pressure for the first measurement. After the first measurement, the cuff inflation pressure is the systolic value of the previous measurement plus 30 mmHg.

The initial cuff inflation pressure changes back to the master setting when:

- The monitor power is off for more than 30 minutes and <SHOW ADMIT CONFIRMATION WINDOW> is turned off in the SYSTEM CONFIGURATION screen.
- The patient is admitted or discharged.

To change the master setting, refer to Section 3 of the Administrator's Guide.

To change the initial cuff inflation pressure for neonate, the air hose for neonate must be connected to the NIBP socket.

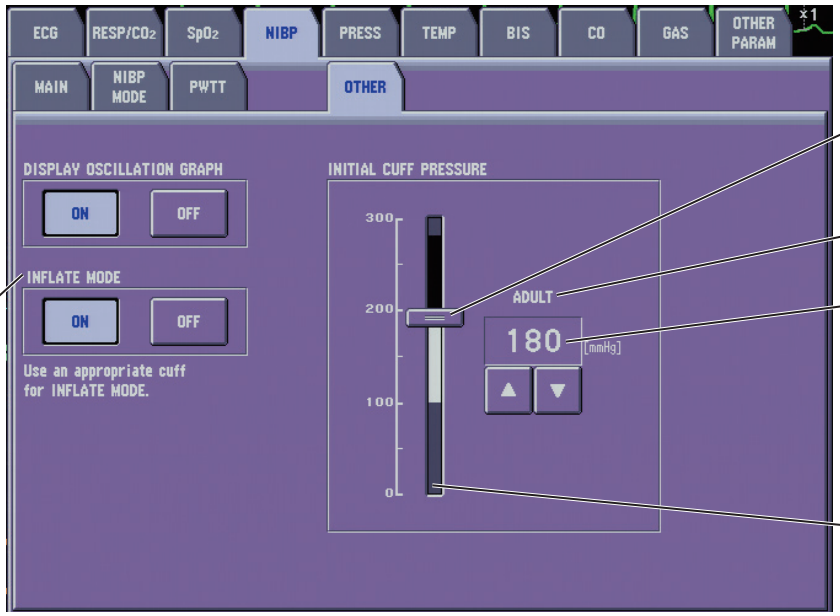
Patient Type	Setting Range (5 mmHg/step, 1 kPa/step)	Default Setting
ADULT	100 to 280 mmHg, 13.0 to 37.0 kPa	180 mmHg, 24.0 kPa
CHILD	100 to 280 mmHg, 13.0 to 37.0 kPa	140 mmHg, 19.0 kPa
NEONATE	70 to 145 mmHg, 9.0 to 19.0 kPa	100 mmHg, 13.0 kPa

NOTE

When the air hose for neonates (1.5 m) is connected to the monitor and the initial cuff pressure is set to 125 mmHg or more, the actual pressure may be less than the setting.

1. Select the patient type on the MAIN page. Refer to the previous procedure.

2. Display the OTHER page of the NIBP window.
   Press the [Menu] key → NIBP key → OTHER tab.



<INFLATE MODE> appears only when the BSM-1700 series bedside monitor is mounted on the BSM-6000K series.

3. Touch and drag the slider to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

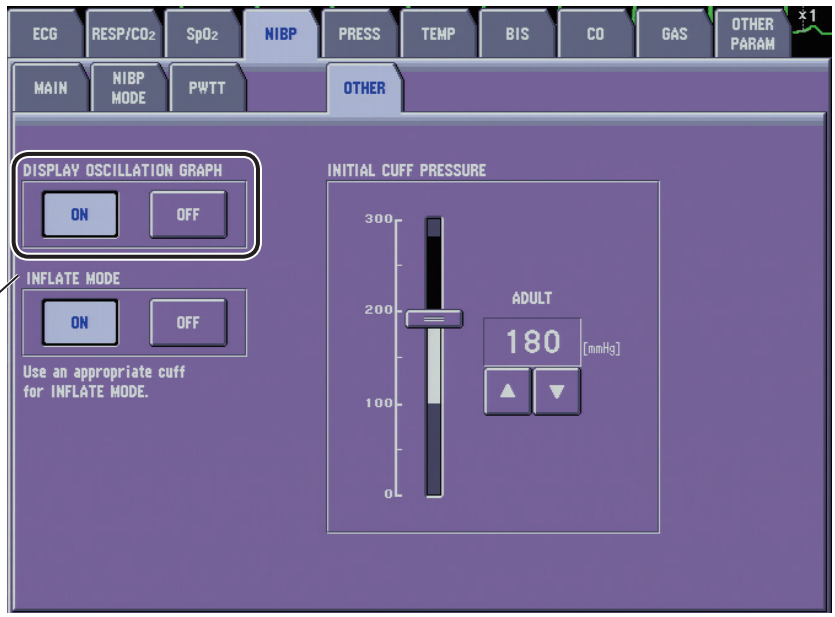
4. Press the [Home] key to return to the home screen.

Displaying the Oscillation Graph

You can display the oscillation graph when:

- NUMERIC PARAMETER AREA is set to LEFT SIDE or SIDE + LARGE BOTTOM on the SYSTEM SETUP screen
- DISPLAY OSCILLATION GRAPH is set to ON on the OTHER page of the NIBP window
- Only a few parameters are monitored

1. Display the OTHER page of the NIBP window.
   Press the [Menu] key → NIBP key → OTHER tab.



<INFLATE MODE> appears only when the BSM-1700 series bedside monitor is mounted on the BSM-6000K series.

2. Touch the ON or OFF key in the <DISPLAY OSCILLATION GRAPH> box to turn the oscillation graph display on or off.

3. Press the [Home] key to return to the home screen.

Turning Inflate Mode On or Off

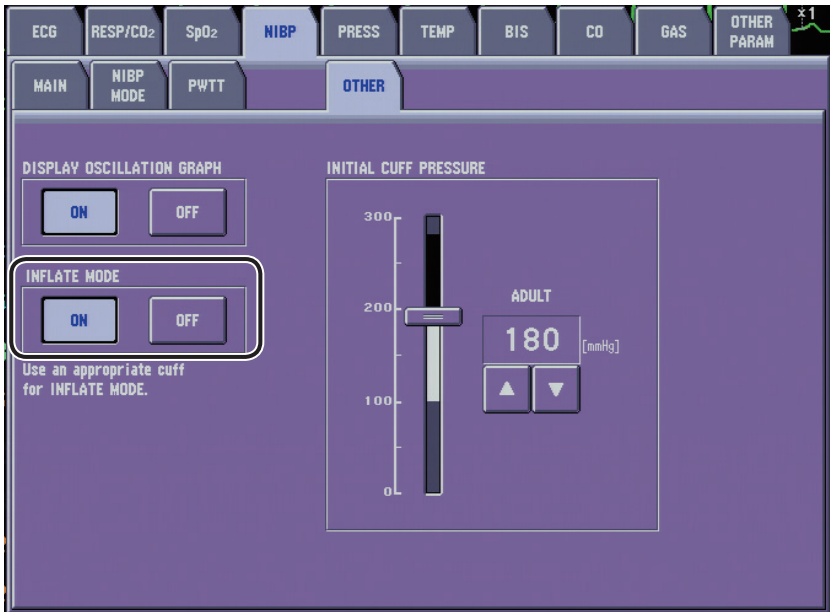
This setting is only available when a BSM-1700 series bedside monitor is mounted on the BSM-6000K series.

Select whether to perform NIBP measurement in inflate mode.

WARNING

When measuring NIBP in INFLATE MODE, use a cuff specified by Nihon Kohden. If an unspecified cuff is used, correct NIBP measurement might not be performed.

1. Display the OTHER page of the NIBP window.
   Press the [Menu] key → NIBP key → OTHER tab.



2. Touch the ON or OFF key in the <INFLATE MODE> box to turn the inflate mode on or off.

3. Press the [Home] key to return to the home screen.

Changing the NIBP Alarm Limits

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

You can set the upper and lower systolic, diastolic and MAP NIBP alarm limits on the NIBP window. You can set all alarms, including the upper and lower NIBP alarm limits, on the ALARM LIMITS window (See the Operator's Manual or Section 5 of the User's Guide Part I).

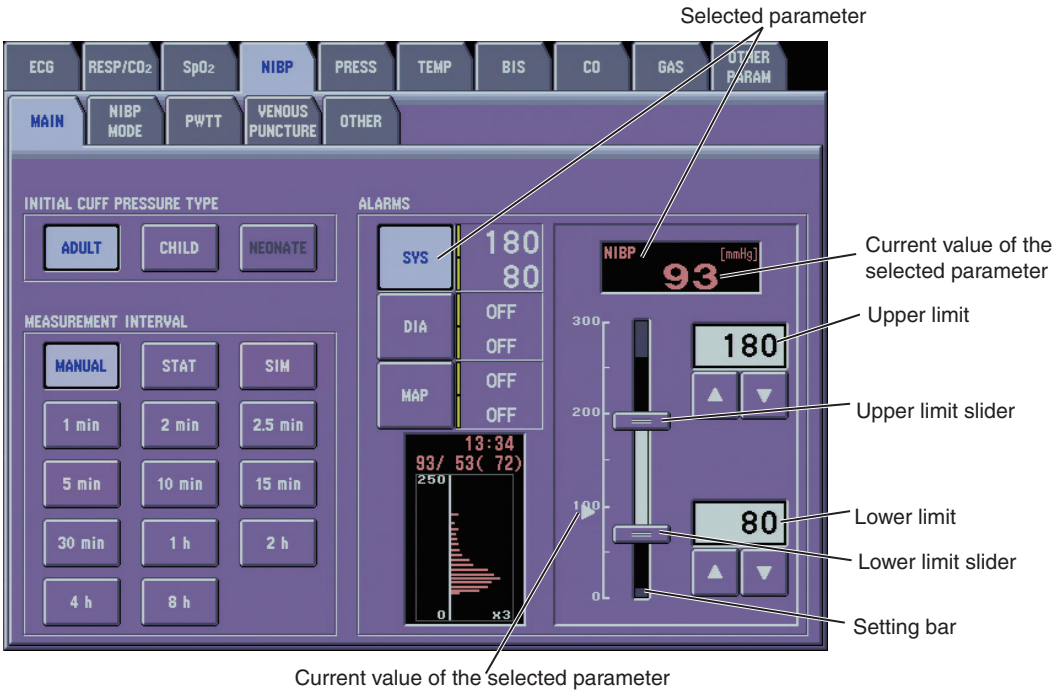
Setting Range

Upper limit: 15 to 260 mmHg in 5 mmHg steps (1.5 to 35.0 kPa in 0.5 kPa steps), OFF (default setting: Systolic: ADULT-180 mmHg (24.0 kPa), CHILD-140 mmHg (18.5 kPa), NEONATE-100 mmHg (13.5 kPa), Diastolic: OFF, MAP: OFF)

Lower limit: OFF, 10 to 255 in 5 mmHg steps (1.0 to 34.5 kPa in 0.5 kPa steps) (default setting: Systolic: ADULT-80 mmHg (10.5 kPa), CHILD-65 mmHg (8.5 kPa), NEONATE-50 mmHg (6.5 kPa), Diastolic: OFF, MAP: OFF)

1. Display the MAIN page of the NIBP window.
   Press the [Menu] key → NIBP key → MAIN tab.

2. Touch the SYS key to change the systolic alarm setting.
   Touch the DIA key to change the diastolic alarm setting.
   Touch the MAP key to change the mean alarm setting.



3. Touch and drag the slider to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.

4. Press the [Home] key to return to the home screen.

Turning PWTT Trigger NIBP Measurement On or Off

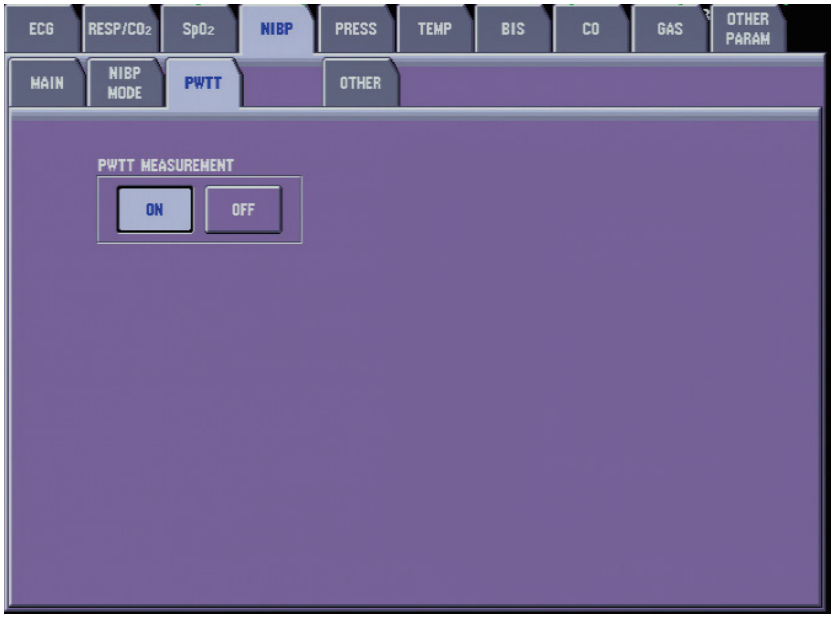
NOTE

- PWTT is not available for BSM-6000A series (the PWTT tab is not displayed).
- Connect an air hose for children or adults to turn the PWTT trigger NIBP measurement on or off.
- Automatic measurement with PWTT is not available when using the AY-631P, AY-633P, AY-651P or AY-653P input unit or BSM-1733 or BSM-1753 bedside monitor. PWTT is only available when using Nihon Kohden probe for monitoring SpO_2.
- Automatic measurement with PWTT is not available when the SpO_2 measurement is performed with an SpO_2 probe connected to the MULTI socket on the AY-661P, AY-663P, AY-671P or AY-673P input unit, BSM-1763 or BSM-1773 bedside monitor, AA-672P or AA-674P smart expansion unit or JA-694PA data acquisition unit.
- PWTT is not available when site is NICU or the patient type is Neonate.
- PWTT is not available when an air hose for neonates is connected.

You can select PWTT trigger NIBP measurement on or off.

1. Display the PWTT page of the NIBP window.
   Press the [Menu] key → NIBP key → PWTT tab.

2. Touch the ON or OFF key in the <PWTT MEASUREMENT> box to turn auto measurement with PWTT on or off.



3. Press the [Home] key to return to the home screen.

Using Venous Puncture Mode

In venous puncture mode, the cuff is inflated to a preset target pressure to constrict the flow of venous blood and distend the vein for venous puncture.

The cuff automatically deflates 2 minutes after inflation in ADULT/CHILD mode and 70 seconds after inflation in NEONATE mode. The cuff can also be deflated by the operator at any time.

To use venous puncture mode, venous puncture mode must be set to ON and the target cuff pressure must be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

CAUTION

Do not perform venous puncture on the same arm where NIBP is measured. This may cause infusion backflow or internal hemorrhage at the puncture.

NOTE

Venous puncture mode is available in the following modes:

- Manual measurement mode
- STAT (continuous) measurement mode (not available during measurement)
- Auto (periodic) measurement mode (not available during measurement and not available when waiting for next measurement)
- SIM measurement mode (Not available during measurement and not available when waiting for next measurement)

1. Display the VENOUS PUNCTURE page of the NIBP window.
   Press the [Menu] key → NIBP key → VENOUS PUNCTURE tab.

   Or,

   Touch the VENOUS PUNCTURE key if venous puncture assigned to function key. For details on function keys, refer to Section 3 of the Administrator's Guide.

2. Touch the START key on the VENOUS PUNCTURE window. The cuff starts inflating and the remaining time until cuff deflation is shown in the <REMAINING TIME> box.
   The cuff inflation can be stopped at any time by touching the STOP key on the VENOUS PUNCTURE window or by displaying another window.

3. Press the [Home] key to return to the home screen.

Section 6 IBP Monitoring

General

Invasive blood pressure and intracranial pressure (ICP) are measured and monitored by connecting the blood pressure measuring device to the units. Up to 7 channels can be measured (1 socket, 1 channel).

Using the Output Signal from the ECG/BP OUT Socket

CAUTION

When using the output signal from the monitor as the synchronization signal for other equipment such as an IABP (intra-aortic balloon pump) or defibrillator:

- Set the timing of the IABP by checking the waveform on the IABP screen.
- Check the condition of the bedside monitor at all times. The output signal may become unstable.
- Check that the delay time of the output signal is within the range of the connected equipment.

CAUTION

Only a Nihon Kohden defibrillator can use the output signal from the monitor as a synchronization signal. Check that the delay time of the output signal (heart rate trigger 20 ms maximum) is within the range of the connected defibrillator.

NOTE

- When using an IBP waveform as a synchronization signal for other equipment, connect the IBP line to the MULTI socket. The IBP waveform that is used for the synchronization signal depends on the "IBP ANALOG OUT" setting in the SYSTEM SETUP window.
  - When "IBP ANALOG OUT" is set to FIXED POSITION:
    The IBP line connected to the top MULTI socket is used.
  - When "IBP ANALOG OUT" is set to HIGHEST PRIORITY LABEL:
    When more than one IBP waveform is acquired, the IBP waveform of the highest priority label is used.
    IBP label priority:
    ART > ART2 > RAD > DORS > AO > FEM > UA > LVP > P1 > P2 > P3 > P4 > P5 > P6 > P7
- Analog ECG, analog BP and heart rate trigger output are not available when an AY-660P input unit is used.
- The output signal from the ECG/BP OUT socket may become unstable in the following conditions.
  - Electrode is dry or detached.
  - Electrode lead is damaged or disconnected from the electrode.
  - Electrode lead is pulled.
  - AC interference or EMG noise superimposed.
  - Air bubbles or blood clog in the circuit for monitoring IBP.
  - Cord or cable is disconnected or damaged.
- All instruments which are to be connected to the ECG/BP OUTPUT socket must use a YJ-910P or YJ-920P ECG/BP output cable and comply with the IEC 60601-1 safety standard for medical equipment.

The following shows the delay time of the output signal.

Output Signal	Delay Time
ECG	20 ms
BP	40 ms
Heart rate trigger	20 ms

Preparing for Blood Pressure Monitoring

Preparation Flowchart

NOTE

When using the JA-690PA or JA-694PA data acquisition unit, the MULTI sockets on the data acquisition unit cannot be used for IBP output. Use the MULTI sockets on the input unit, smart expansion unit or the BSM-1700 series bedside monitor.

1. Select the blood pressure measuring device.
2. Install the blood pressure measuring device, connect the blood pressure transducer to the IBP connection cord, and connect the IBP connection cord to the MULTI socket. For details, refer to the instruction manual provided with the blood pressure transducer and measuring kit.
3. Insert the catheter into the patient.
4. Perform zero balance adjustment.
5. Change necessary settings.
6. Start measurement (Start monitoring).
   After zero balance adjustment, you can start IBP measurement and monitoring.

Selecting the Blood Pressure Measuring Device

Select the appropriate blood pressure measuring device according to the purpose.

WARNING

All parts, except for transducers, must be non conductive. Otherwise, the discharged energy may cause electrical shock to the operator during defibrillation.

CAUTION

Do not reuse disposable parts and accessories.

Blood Pressure Transducers

Argon Medical Devices Reusable Blood Pressure Transducers

Pressure Transducer	IBP Connection Cord	Measuring Kit		Other Parts	Dome	Fixing Device
		Monitoring Kit	Pressure Tubing	Criti Flo		Transducer Holder
P23XL-1	JP-900P	SCK-520*	PT-06 PT-12 PT-24 PT-36 PT-48 PT-60	TA-4004 TA-4005*	TA-1011* TA-1011D* TA-1015T TA-1010ND	ZY-101U* + adapter 2
P10EZ-1	JP-900P	SCK-512* SCK-560			TA-1017M TA-1019M TA-1017 TA-1018* TA-1019*	G-TBG2 G-TMM G-UMM

Argon Medical Devices Disposable Blood Pressure Transducers (DX Series)

Monitoring Kit DX Series	IBP Connection Cord	Other Parts	Fixing Device
DX-100*	JP-900P	—	G-TBG2 G-TMM G-UMM
DX-200*			
DX-300*			
DX-312*			
DX-360*			
DX-360R*			
DX-360TT*			
DX-360SD*		Safe needle TA-BPN + arterial blood sampler QS-90	
SCKD-5005*		—	

Edwards Lifesciences (Baxter) Disposable Blood Pressure Transducers (TruWave)

Edwards Lifesciences (Baxter) blood pressure transducers are available direct from Edwards Lifesciences (Baxter) (www.edwards.com) or their suppliers.

Monitor Kit	IBP Connection Cord	Fixing Device
MN12030US (TW)*	JP-920P	59-UH4 59-DTS-C
MN12030UW (TW)*		
MN12030UT (TW)*		
MP-5100 (TW)*		
MP-5200 (TW)*		

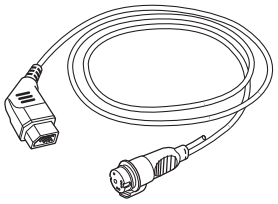
* These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

IBP Connection Cords

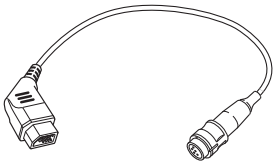
The IBP connection cord connector has a memory chip for saving site label and zero balance adjustment values. Attach the blood pressure site label of the saved site.

JP-900P: For Argon Medical Devices blood pressure transducers
JP-911P: For Integra NeuroSciences Camino® MPM-1 multi-parameter monitors
JP-920P: For Edwards Lifesciences (Baxter) blood pressure transducers
JP-960P: For Biosensor blood pressure transducers
JP-910P: For other blood pressure transducers

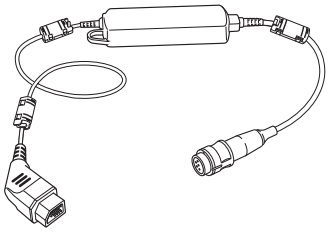
JP-900P



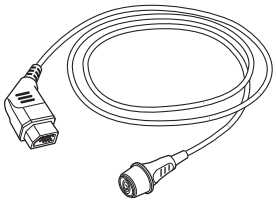
JP-910P

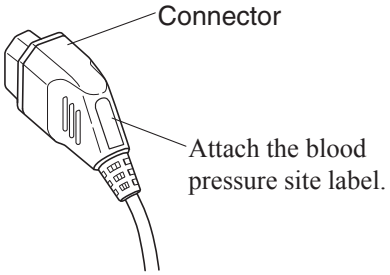


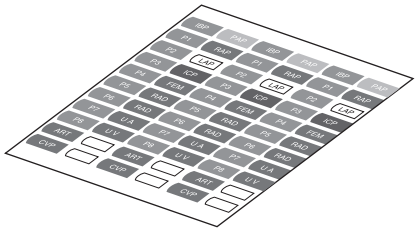
JP-911P



JP-920P



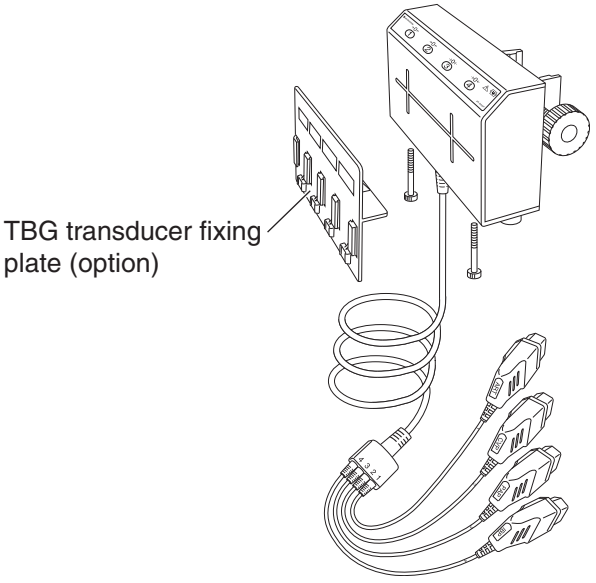




Blood pressure site label

JP-940P IBP Connection Box

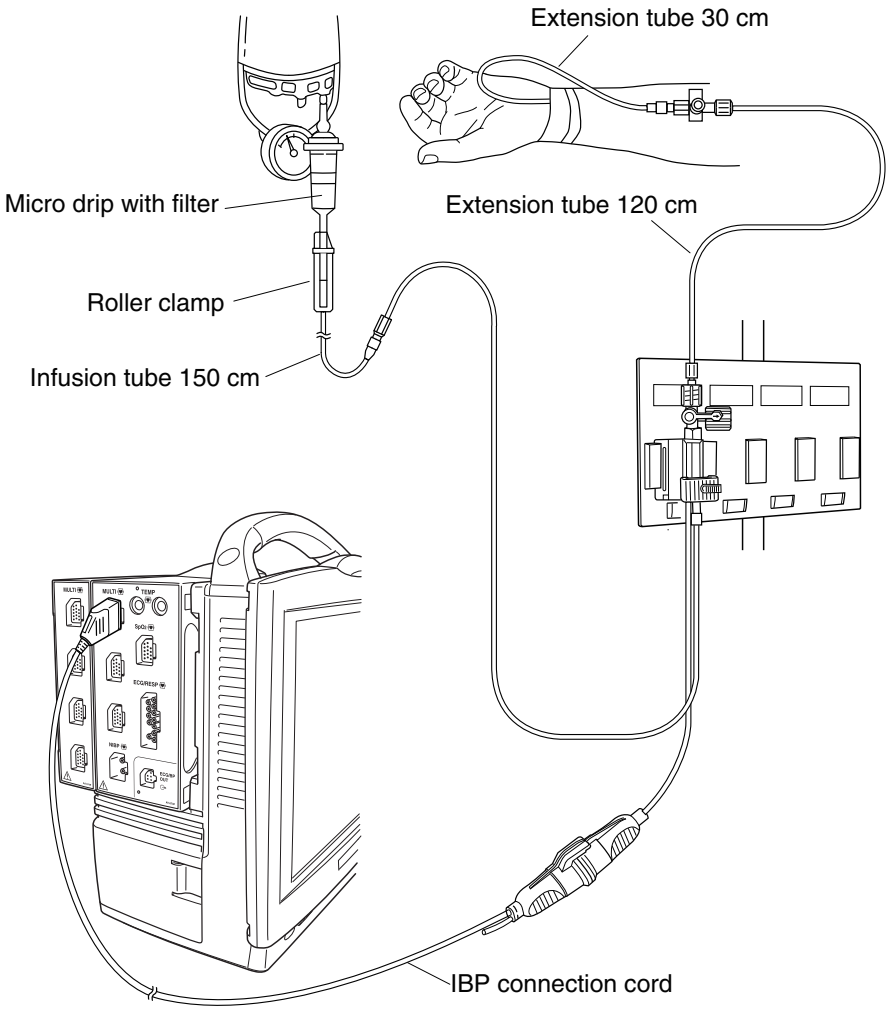
For connecting an Argon Medical Devices's Life Kit DX series disposable blood pressure transducer to the unit, an optional TBG transducer fixing plate is required.



Installing the Blood Pressure Measuring Device

The following describes installing the DX-360 Argon Medical Devices disposable blood pressure transducer. When using other blood pressure transducers and measuring kits, refer to the respective instruction manuals.

Typical Configuration Example



Connecting Cables to the Unit

1. Connect the blood pressure transducer to the IBP connection cord.

2. Connect the IBP connection cord to the MULTI socket.

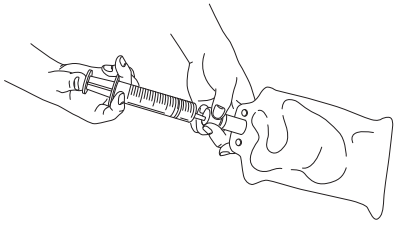
NOTE

When connecting the IBP connection cord to the unit after assembling the transducer and filling the tubes with saline solutions, make sure that the connector is not wet.

Assembling the Transducer

NOTE

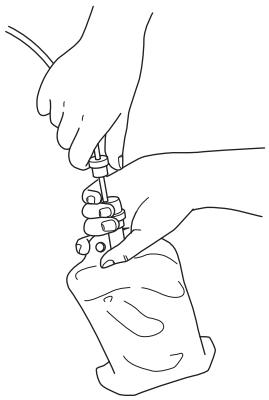
- For caution and usage of the transducer, refer to the manual of the transducer.
- The DX series disposable transducers are sterilized by EOG. Keep them clean after opening.
- Check that connectors and caps are firmly connected and the 3-way stopcock are directed to the correct way.
- The 3-way stopcocks and blood pressure tube openings are protected from contamination by the white aerated caps. Keep these white caps on until the solution is filled in completely. After filling the solution, replace the white caps with the yellow sealing caps which are in the separate bag.



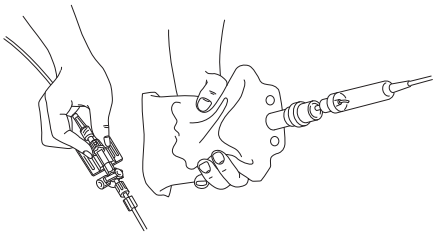
1. Inject 1 to 2 units of heparin into 1 mL sterilized physiological saline solution.

NOTE

Do not mix the solution yet.



2. Insert the needle at the tip of the micro-drip into the hole on the physiological saline pack.



3. Pressurize the physiological saline pack with your hand by pressing the flush cap to remove air from the pack.

4. When the solution in the micro-drip chamber is about 1/3 full (the stainless needle is in the solution), turn the physiological saline pack upside down and mix the physiological saline solution and heparin.

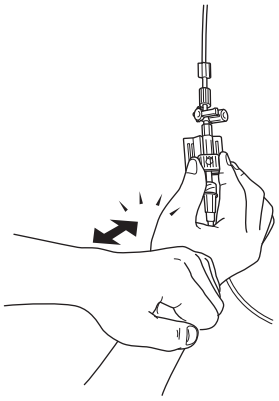
5. Place the saline pack in the pressure bag and hang the pressure bag on the stand.

6. Press the flush cap to completely fill the tube with saline solution.

NOTE

Tap the bottom part of the micro-drip to remove air bubbles from under the filter.

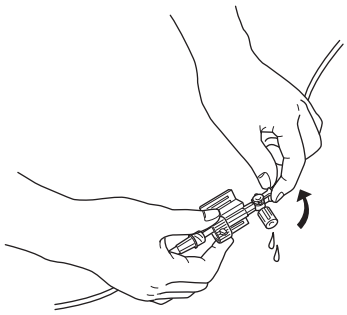
7. Fill in the transducer with the saline solution. Remove air bubbles by pressing the flush cap at above the saline pack, then bringing the flush cap down.



If the air bubbles cannot be removed from the transducer:

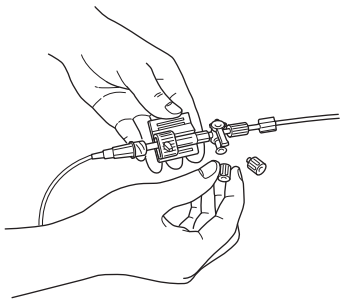
i) Hold the transducer higher than the saline pack to flow the saline solution back into the saline pack and fill the transducer again.

ii) Tap the transducer lightly and flush the transducer slowly. Do not tap too hard because the air bubbles may break into small bubbles which are difficult to remove.

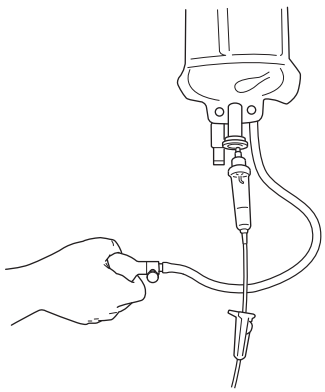


iii) Check that there are no air bubbles in the transducer, tubes and 3-way stopcocks.

8. Replace the white aerated caps with the yellow sealing caps.



9. Pressurize the pressure bag to 300 mmHg (40.0 kPa). The solution in the micro-chip chamber is about a third to half full.
At this pressure, the drip rate should be 2 to 4 drops/min.



10. Check all connections and that there is no leakage in the circuit.

11. After about 30 minutes, check the pressure of the pressure bag and drip rate. Also check that there is no leakage in the circuit.

Adjusting Zero Balance

NOTE

There is no alarm for 30 seconds after adjusting zero balance.

Adjust zero balance in the following cases. Zero balance adjustment is important for accurate IBP measurement.

- Before starting measurement.
- When the patient moved so that the height of the heart changed.
- When the height of the blood pressure transducer changes.
- When changes in the measured value are expected due to measurements over a long period of time or due to changes in the ambient temperature (check the pressure when exposed to air).
- IBP connection cord or transducer is changed.

When the zero balance is not adjusted, the "ZERO IMBALANCE" message is displayed beside each IBP value.

Zero Balance Mode

There are two modes for adjusting zero balance.

- **All zero**
  Zero balance of all blood pressure lines exposed to air, except for ICP, is performed at the same time.
  Touch the ZERO ALL key on the PRESS window. The zero all function can also be assigned to one of the function keys. For details on the function keys, refer to Section 3 of the Administrator's Guide.

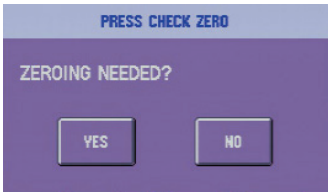
  Adjust zero balance separately for ICP (intracranial pressure).

- **Individual zero**
  The zero balance is adjusted individually for one pressure line.
  Touch the ZERO CAL key on the PRESS window of the IBP label (or ICP window for the ICP).

  When using the optional JP-940P IBP Connection Box, the zero balance keys on the box can be used for each line.

Adjusting Zero Balance

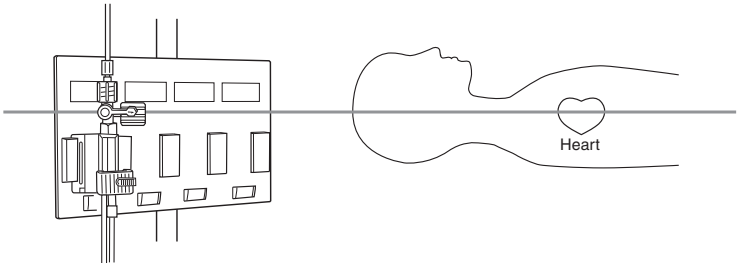
1. When zero balance is not adjusted, the following dialog box appears.



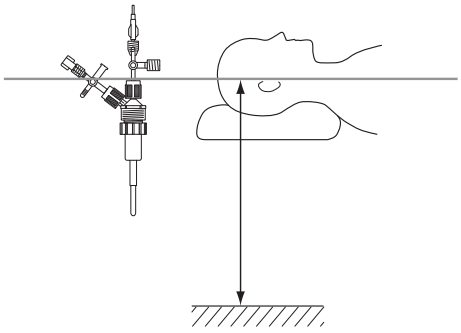
2. Touch the YES key to adjust zero balance. When the YES key is touched, the MAIN page of the PRESS window appears. Adjust zero balance by doing the following steps.

When the NO key is touched, the monitor starts monitoring IBP by using the zero balance value memorized in the connector of the IBP connection cord and the “ZERO IMBALANCE” messages disappear. The IBP values appear on the screen. If necessary, adjust zero balance by doing the following steps.

3. Move the dome up or down so that the 3-way stopcock on the transducer is at the level of the right atrium of the patient and open the air release opening of the 3-way stopcock to air.

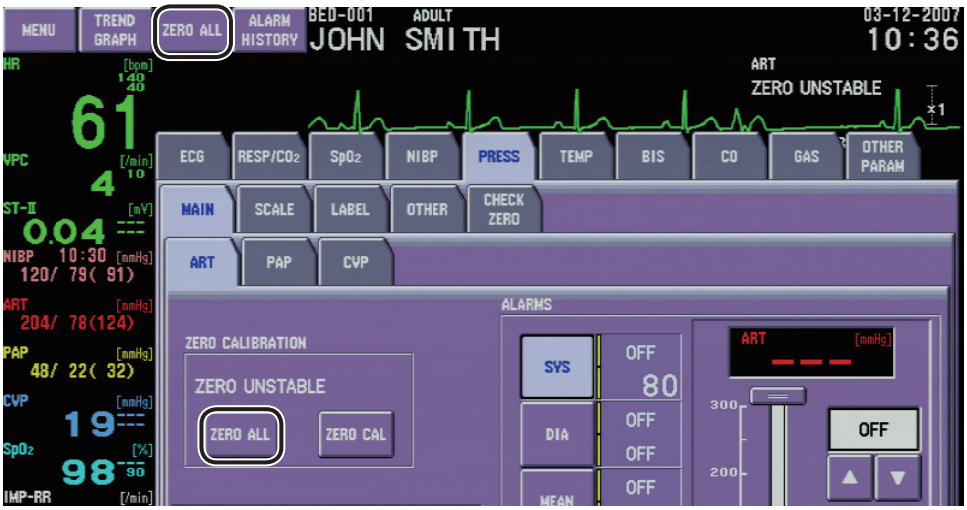


When measuring the intracranial pressure, adjust the 3-way stopcock of the catheter to the level of the ventricle and open the air release opening of the 3-way stopcock to air.

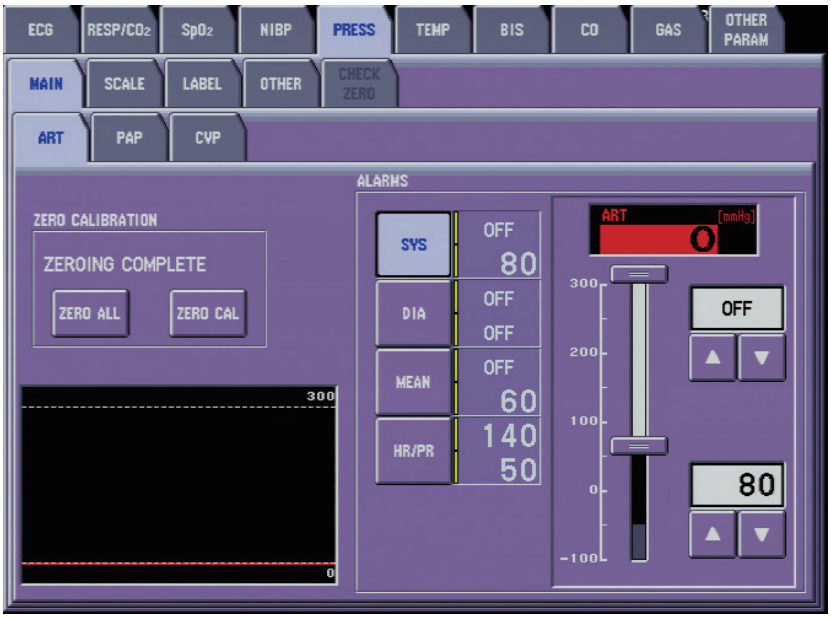


4. Perform zero balance adjustment.
   - All Zero

     Touch the ZERO ALL function key on the home screen or the ZERO ALL key on the MAIN page of the PRESS window. (Press the [Menu] key → PRESS key)



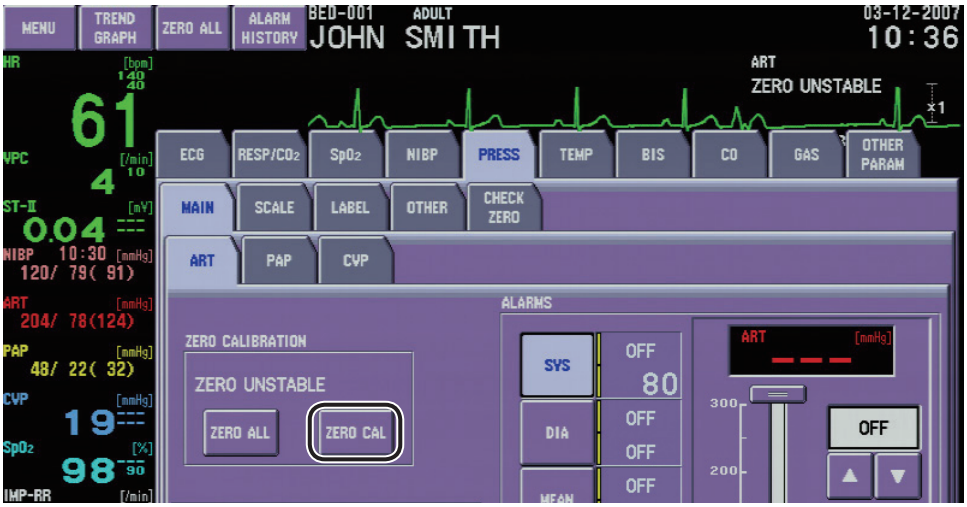
When the “ZEROING COMPLETE” message is displayed on the screen, zero balance adjustment is complete.



- Individual Zero

  i) Display the MAIN page of the desired label on the PRESS window. Press the [Menu] key → PRESS key → MAIN tab → label tab.

  ii) Touch the ZERO CAL key.



When the “ZEROING COMPLETE” message is displayed, zero balance adjustment is complete.

5. Close the 3-way stopcock.

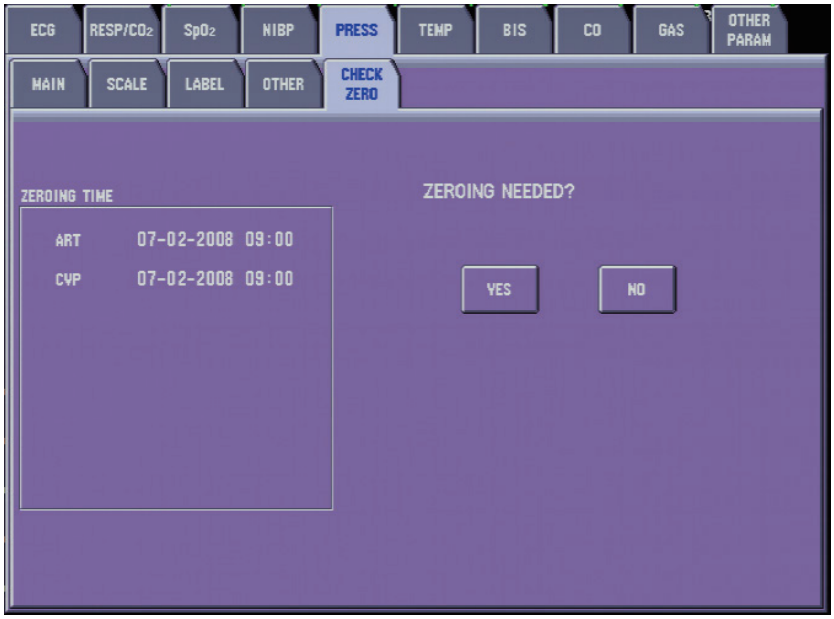
After adjusting zero balance and closing the 3-way stopcock, IBP is ready to be measured. The IBP value and blood pressure waveform appear on the screen.

Memorizing the Zero Balance Values

The zero values are saved in memory in the connector of the IBP connection cord when zero balance is performed. Therefore, you don't need to adjust the zero balance again when connecting the IBP connection cord to the different socket.

The CHECK ZERO Page

This page becomes active when zero balance is not adjusted. Zero balance can also be adjusted on the CHECK ZERO page.



Monitoring IBP

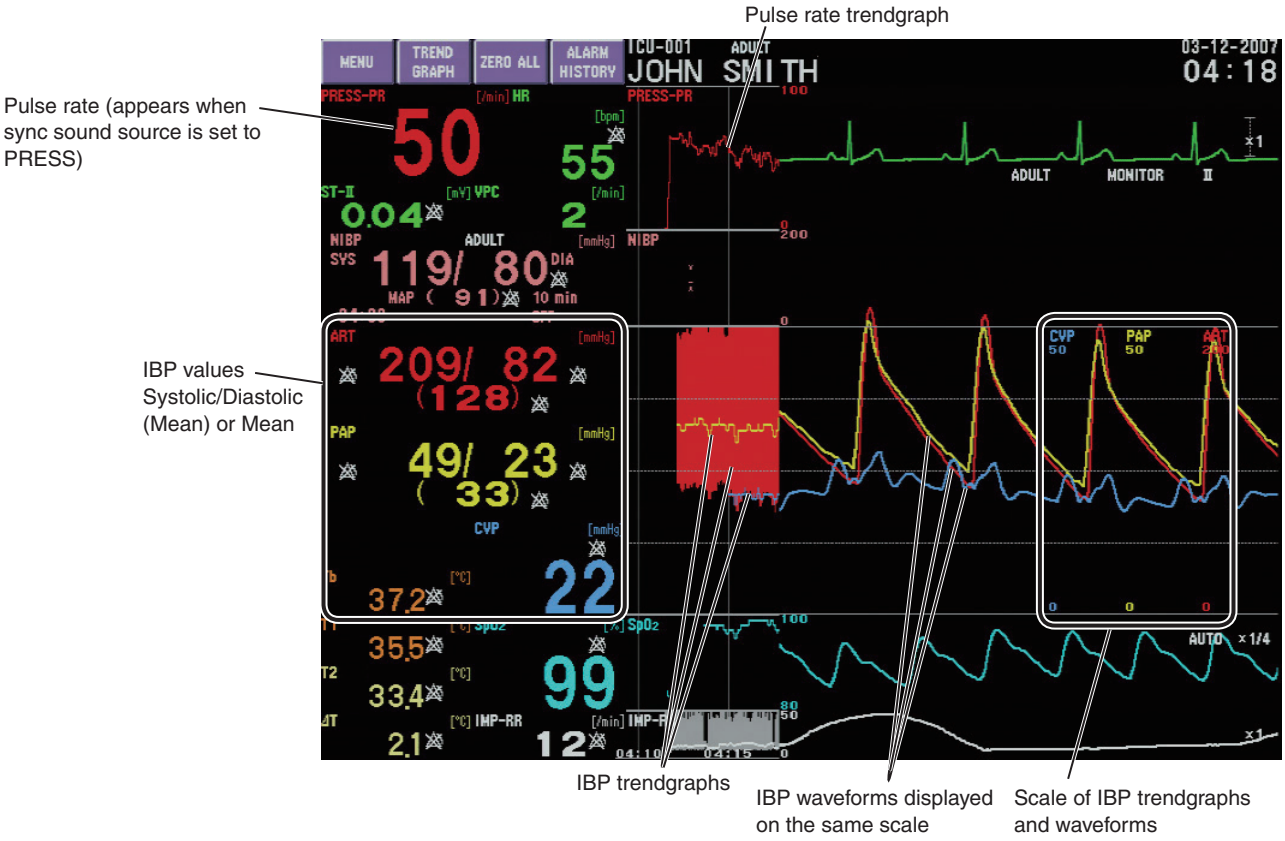
When the 3-way stopcock is closed after zero balance, you can start IBP monitoring.

IBP Information on the Home Screen

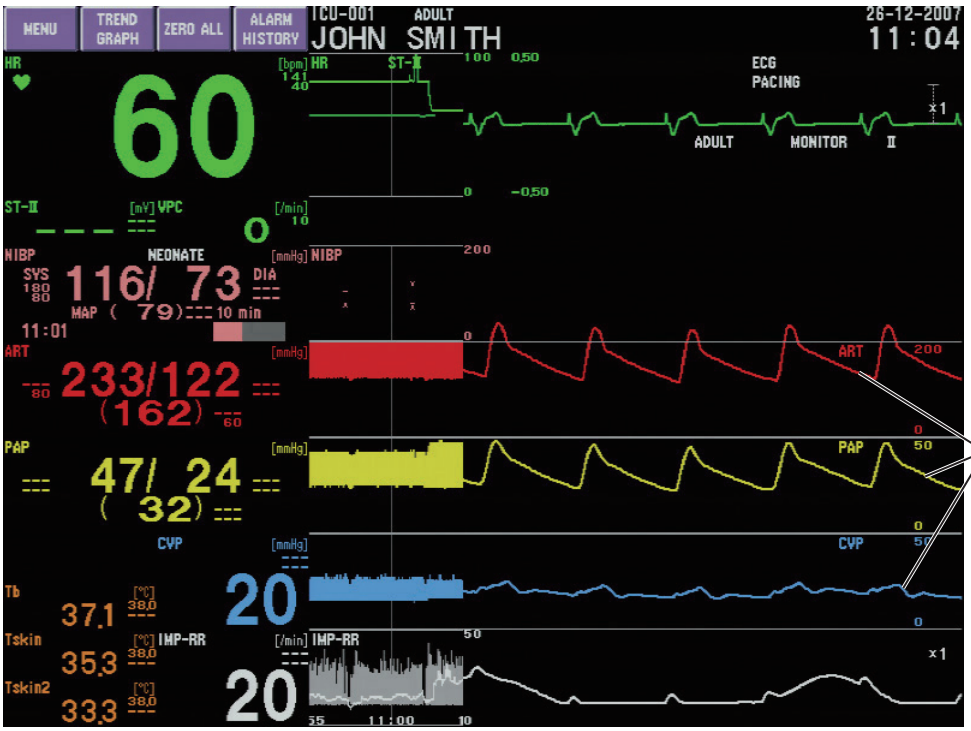
The blood pressure waveform and scale correspond to the color of the IBP values displayed.

There are three ways of displaying the IBP waveforms: common, separate or dual. The type of scale can be changed on the OTHER page of the PRESS window or WAVES page of the DISPLAY window. Refer to the “Selecting the IBP Waveform Display Mode” section.

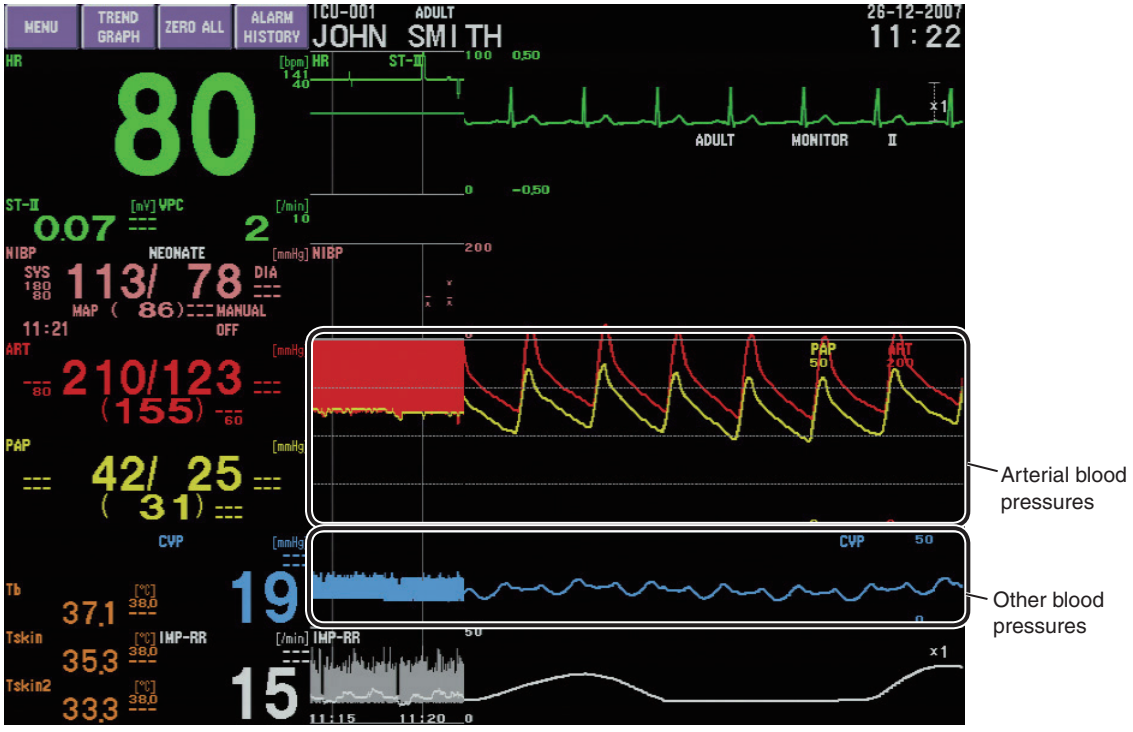
When Monitoring 3 Channels on Common Scale



When Monitoring 3 Channels on Separate Scale



When Monitoring 3 Channels on Dual Scale



Changing IBP Settings

Change settings on the IBP window. The following settings can be changed for monitoring IBP.

- Label
- Scale
- IBP alarm limits
- Adjust zero balance. Refer to the “Adjusting Zero Balance” section.
- IBP calculation mode
- Numeric data display mode
- CPP display on or off (on the ICP window only)
- Auto ET mode for CVP mean calculation on/off (on the CVP window only)
- Sync source
- Sync sound pitch
- Pulse rate display on or off
- Waveform display mode (scale mode)
- PPV/SPV display on or off
- PPV/SPV average time

The pressure unit (mmHg or kPa) can be set on the SYSTEM CONFIGURATION screen. Refer to Section 2 of the Administrator’s Guide.

The noise filter and IBP data display color can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator’s Guide.

The IBP waveform sweep speed and the displayed IBP parameters on the home screen can be selected on the DISPLAY window. Refer to Section 3 of the User’s Guide Part I.

Changing the Label

At shipment, the blood pressure lines are labeled as P1 to P7. You can use these labels, but it is recommended to label the site properly for proper processing of the waveform.

The labels are saved in memory in the connector of the IBP connection cord. Once the label is set, you don’t need to set the label again when the IBP connection cord is connected to a different socket.

If the IBP connection cord whose label is set by another monitor and which the label is not used on this monitor is connected to this monitor, the label appears from P1 to P7.

Setting labels is important for the following reasons.
- Prevents confusion of the blood pressure lines
- Measures the PCWP (Pulmonary Capillary Wedge Pressure) from the PAP (Pulmonary Artery Pressure)

- Lists the ART (Arterial Pressure), PAP (Pulmonary Artery Pressure), and CVP (Central Venous Pressure) values in the hemodynamics table
- Calculates CPP (Cerebral Perfusion Pressure) from the ICP (Intracranial Pressure) and the highest priority arterial blood pressure value when measuring the ICP

  Priority

  ART, ART2, RAD, DORS, AO and FEM
- The display area of the blood pressure line measured is determined by the priority of the labels.
- The pulse rate is counted according to the priority of the blood pressure labels.

Types of Labels

There are 15 labels. The labels are listed in the display priority.

ART:	Arterial Pressure
	Up to two blood pressure lines can be set (ART, ART2)
RAD:	Radial Artery Pressure
DORS:	Dorsal Artery Pressure
AO:	Aortic Pressure
FEM:	Femoral Artery Pressure
UA:	Umbilical Artery Pressure
LVP:	Left Ventricular Pressure
P1 to P7:	Up to 7 blood pressure lines can be set.
UV:	Umbilical Venous Pressure
PAP:	Pulmonary Artery Pressure
CVP:	Central Venous Pressure
RAP:	Right Atrial Pressure
RVP:	Right Ventricular Pressure
LAP:	Left Atrial Pressure
ICP, ICP2 to ICP4:	Intracranial Pressure
	Up to 4 pressure lines can be set.

Changing the Labels

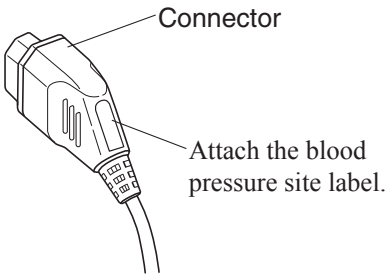
1. Display the LABEL page of the PRESS window.
   Press the [Menu] key → PRESS key → LABEL tab.

2. On the LABEL page, touch the MULTI socket key corresponding to the MULTI socket to which the IBP connection cord of the blood pressure line you want to label is connected.

3. Select the label appropriate for the blood pressure line from the <SELECTABLE ITEMS> box.

NOTE

The blood pressure label is fixed to ART when a JP-600P APCO/IBP processor is used.



4. Attach the blood pressure site label to the connector of the IBP connection cord.

5. To set the label of another blood pressure line, repeat steps 2 to 4.

6. Press the [Home] key to return to the home screen.

Changing the Scale

The scale can be individually changed for every blood pressure line for easy monitoring of the blood pressure waveform. The same scale is used on both the home screen and PRESS window (or ICP window).

1. Display the SCALE page of the IBP label on the PRESS window.
   Press the [Menu] key → PRESS key → SCALE tab → IBP label tab.

2. Select the scale by touching the desired scale key. Use the sliders to adjust the scale.

   Or, touch the AUTO ADJUST key to automatically select to the appropriate scale for the displayed waveform.

To change the scale of another blood pressure line, repeat steps 1 and 2.

3. Press the [Home] key to return to the home screen.

Changing the IBP and Pulse Rate Alarm Limits

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

You can set the upper and lower systolic, diastolic and mean IBP alarm limits of all monitoring labels and pulse rate alarm limits of the highest priority arterial blood pressure on the PRESS window. You can set all alarms, including the upper and lower IBP alarm limits and pulse rate alarm limits, on the ALARM LIMITS window (See the Operator's Manual or Section 5 of the User's Guide Part I). The pulse rate alarm limits can also be changed on the SpO_2 window.

For CVP, RAP, LAP and ICP lines, only the mean alarm limits can be set.

Setting Range

NOTE

If "EXT TACHY" or "EXT BRADY" are set to ON, the "ALARM CAP" setting for the "HR/PR" cannot be set. To apply the "ALARM CAP" setting for the "HR/PR", set "EXT TACHY" and "EXT BRADY" to OFF.

IBP upper limit: –48 to +300 mmHg in 2 mmHg steps (–6.0 to +40.0 kPa in 0.5 kPa steps), OFF*[1]
(default setting: SYS All labels: OFF
DIA All labels: OFF
MEAN All labels: OFF)

IBP lower limit: OFF, –50 to +298 mmHg in 2 mmHg steps (–6.5 to +39.5 kPa in 0.5 kPa steps)*1
(default setting: SYS ART/ART2/RAD/DORS/AO/FEM:
ADULT-80 mmHg (10.5 kPa),
CHILD-66 mmHg (8.5 kPa),
NEONATE-50 mmHg (6.5 kPa)
Other labels: OFF
DIA All labels: OFF
MEAN ART/ART2/RAD/DORS/AO/FEM:
ADULT-60 mmHg (8.0 kPa),
CHILD-46 mmHg (6.0 kPa),
NEONATE-30 mmHg (4.0 kPa)
Other labels: OFF)

HR/PR upper limit: When <SYNC SOURCE> is set to ECG:
16 to 300 beats/min in 1 beat/min steps, OFF*1*2
When <SYNC SOURCE> is set to PRESS or SpO_2:
31 to 300 beats/min in 1 beat/min steps, OFF*1*2
When EXT TACHY alarm is set to ON:
16 to EXT TACHY alarm limit in 1 beat/min steps*1*2
(default setting: ADULT-140, CHILD-170, NEONATE-200)

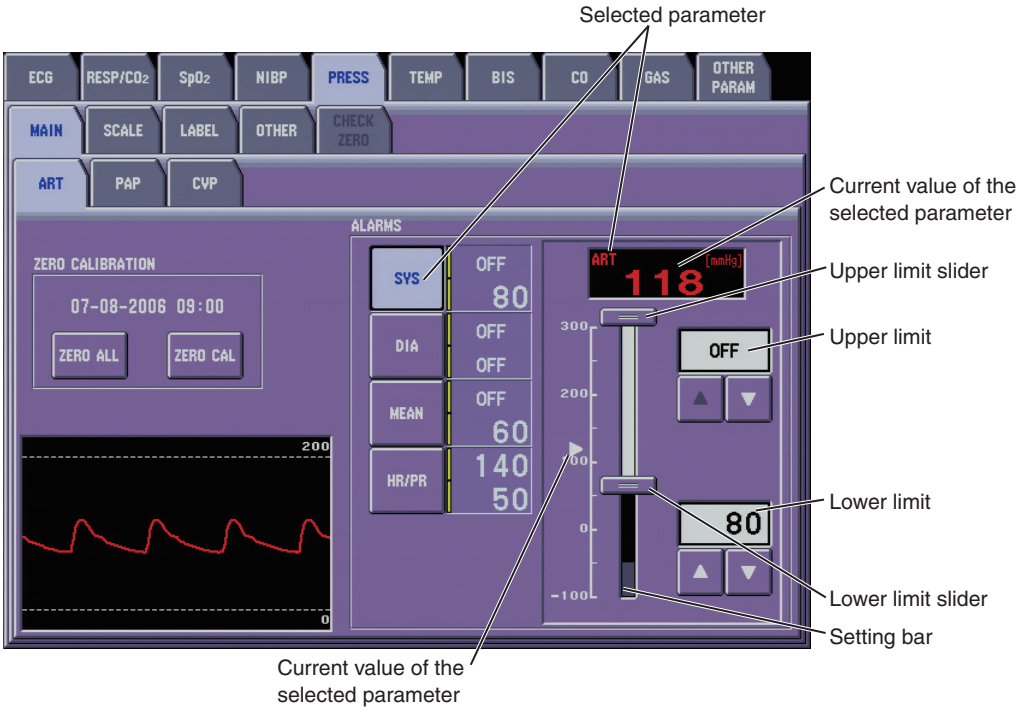
HR/PR lower limit: When <SYNC SOURCE> is set to ECG:
OFF, 15 to 299 beats/min in 1 beat/min steps*1*2
When <SYNC SOURCE> is set to PRESS or SpO_2:
OFF, 30 to 299 beats/min in 1 beat/min steps*1*2
When EXT BRADY alarm is set to ON:
EXT BRADY alarm limit to 299 in 1 beat/min steps*1*2
(default setting: ADULT-50, CHILD-75, NEONATE-100)

*1 On BSM-6000A series, if <ALARM CAP> on the SYSTEM CONFIGURATION screen is turned on, the alarm settings for IBP (ART, PAP and CVP) and HR/PR are affected by the "ALARM CAP" setting on the SYSTEM SETUP window.

*2 On BSM-6000A series, if <CRISIS VITAL ALARM MANAGEMENT> on the SYSTEM CONFIGURATION screen is turned on and "ALARM PRIORITY" on the SYSTEM SETUP window is set to CRISIS, the alarm setting is set to the alarm master setting.

1. Display the MAIN page of the IBP label on the PRESS window.
   Press the [Menu] key → PRESS key → MAIN tab → IBP label tab.

2. Touch the SYS key to change the systolic alarm setting.
   Touch the DIA key to change the diastolic alarm setting.
   Touch the MEAN key to change the mean alarm setting.
   Touch the HR/PR key to change the heart rate/pulse rate alarm setting.



3. Touch and drag the slider to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.

4. Press the [Home] key to return to the home screen.

Selecting the Mode for Calculating IBP

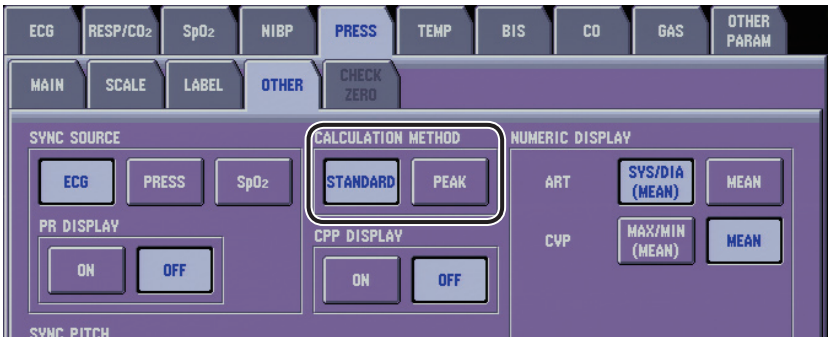
There are two calculation modes for displaying the IBP values.

STANDARD: The IBP values are calculated by moving average. The monitor averages the latest 8 consecutive pulses and displays this average as the IBP value. When a new pulse is detected, the IBP value is recalculated using the latest 8 pulses. The IBP value display is updated every 3 seconds.

PEAK: The systolic, diastolic and mean values of the highest pulse wave in the latest 8 consecutive pulses are displayed as the IBP values. The IBP value display is updated every 3 seconds.
When connected IABP causes the IBP values to vary greatly, use PEAK to improve measurement accuracy.

1. Display the OTHER page of the PRESS window.
   Press the [Menu] key → PRESS key → OTHER tab.

2. Select either STANDARD or PEAK in the <CALCULATION METHOD> box.



3. Press the [Home] key to return to the home screen.

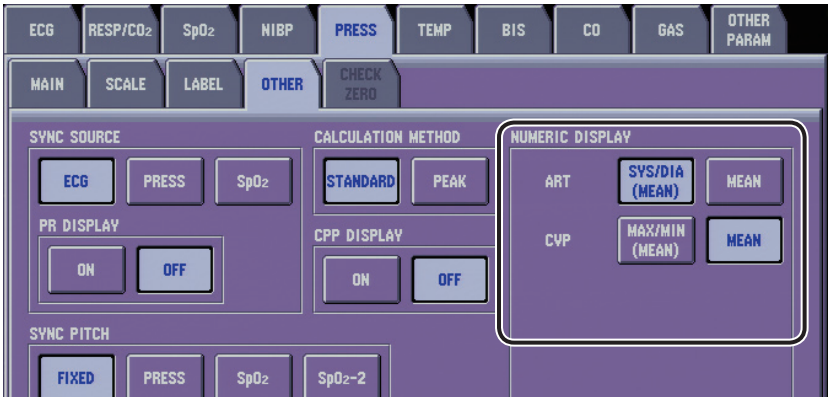
Selecting the Data Display Mode on the Home Screen

The displaying mode of the IBP/ICP values can be selected for the home screen. Select this display mode for every blood pressure line.

SYS/DIA/(MEAN): Displays the systolic blood pressure (SYS), diastolic blood pressure (DIA) and the averaged blood pressure (MEAN).
MEAN: Displays only the averaged blood pressure.

1. Display the OTHER page of the PRESS window.
   Press the [Menu] key → PRESS key → OTHER tab.

2. Select display mode for each label in the <NUMERIC DISPLAY> box.



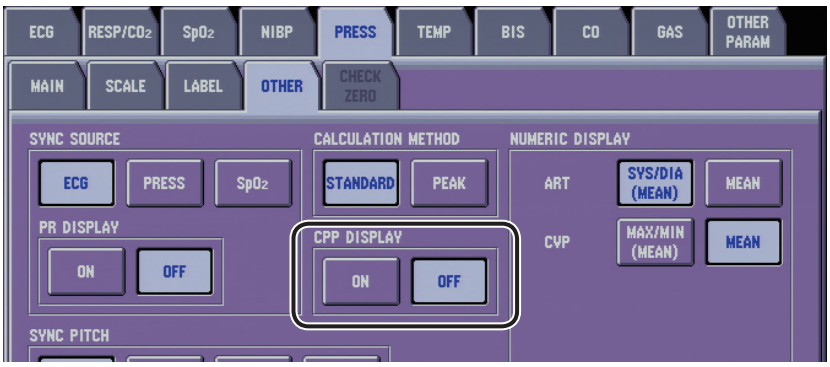
3. Press the [Home] key to return to the home screen.

Displaying CPP On or Off

When monitoring ICP, CPP (cerebral perfusion pressure) display on the home screen can be set to on or off.

1. Display the OTHER page of the PRESS window.
   Press the [Menu] key → PRESS key → OTHER tab.

2. Select ON or OFF in the <CPP DISPLAY> box to set CPP display on or off.



3. Press the [Home] key to return to the home screen.

Automatically Use ET Mode for Calculating Mean CVP

The ET mode mean calculation uses the CO_2 signal to calculate the end tidal mean CVP. In this mode, the mean CVP value is stable and less affected by respiration. When CO_2 is monitored in mainstream method with the TG-900P, TG-920P, TG-950P or TG-970P CO_2 sensor kit, you can set the monitor to use the ET mode for the CVP mean calculation.

On: Automatically uses the ET mode to calculate the mean CVP. When CO_2 is not monitored in mainstream method with the TG-900P, TG-920P, TG-950P or TG-970P CO_2 sensor kit, the mean CVP is calculated in normal mode. When the ET mode is used, “CVP_ET” appears for the CVP value on the home screen.

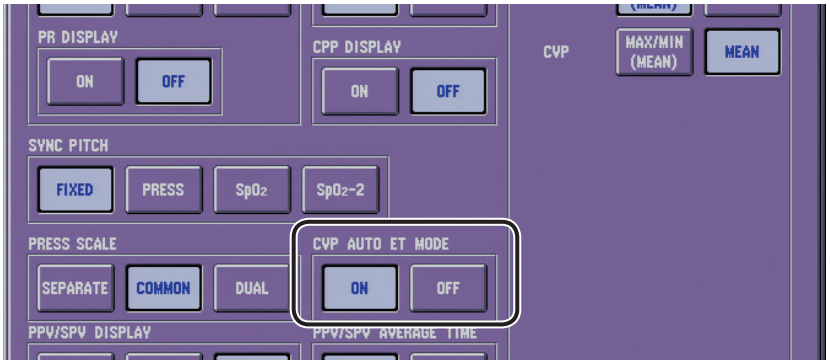
Off: The mean CVP is calculated in normal mode every 3 seconds.

NOTE

- To use the ET mode, CO_2 must be monitored with the TG-900P, TG-920P, TG-950P or TG-970P CO_2 sensor kit.
- In the following cases, the mode automatically changes from ET to normal mode:
  - Cannot detect changes from expiration to inspiration for more than 20 seconds.
  - The CO_2 sensor connector is not connected or disconnected from the socket.
  - CO_2 cannot be monitored due to CO_2 sensor failure
  - CO_2 is not monitored with a TG-900P, TG-920P, TG-950P or TG-970P CO_2 sensor kit.
- When the ET mode is used, the mean CVP might not be calculated at the appropriate end-tidal point due to the CO_2 sensor attachment or patient’s respiration state. When using the ET mode, check that the CVP value is appropriate by reading the CVP waveform on the screen.
- The mean CVP value obtained by the ET mode might not be accurate due to patient movement or unstable respiration.
- When “NUMERIC DISPLAY” is set to SYS/DIA (MEAN), the ET mode is used for the calculation, but “CVP” appears instead of “CVP_ET” for the CVP value on the home screen.

1. Display the OTHER page of the PRESS window.
   Press the [Menu] key → PRESS key → OTHER tab.

2. Select ON or OFF in the <CVP AUTO ET MODE> box to set auto ET mode for CVP on or off.



3. Press the [Home] key to return to the home screen.

Changing the Sync Sound Source

You can select ECG, SpO_2 pulse (SpO_2) or arterial blood pressure pulse (PRESS) as the sync source. When the arterial blood pressure pulse is selected, the blood pressure of the highest priority label is used. The sync source can also be changed on the ECG and SpO_2 windows.
When pulse wave and pressure waveform are irregular because of an IABP, select ECG.

NOTE

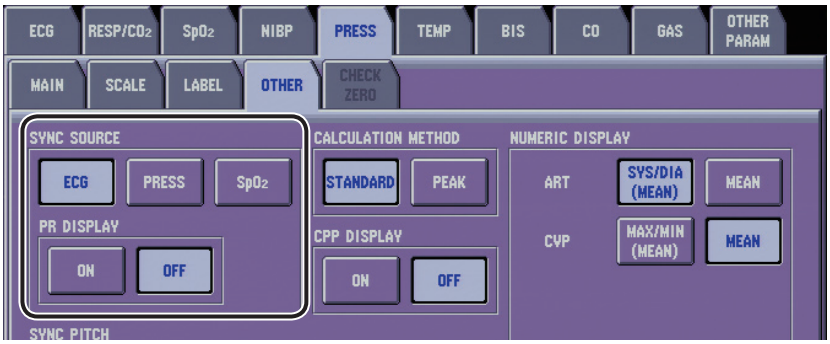
- When heart rate is unstable because of an ESU, select SpO_2 or PRESS.
- When the connection cord of SpO_2 or IBP of the arterial blood pressure is disconnected from the monitor and an alarm occurs when the sync source is set to SpO_2 or PRESS, the sync source changes to ECG. The sync source returns to SpO_2 or PRESS when the SpO_2 or IBP is monitored again. When using PRESS as the sync source, adjust zero balance.
- When the sensor is detached from the patient and alarm occurs, and the sync source is set to SpO_2 or PRESS, the sync source does not change to ECG when the alarm is silenced, and "- - -" is displayed for PR.
- When PRESS is selected while monitoring low blood pressure, the pulse rate becomes small and might not be displayed correctly.
- The SpO_2-2 cannot be set to the sync sound source.

When the sync source is set to ECG and ECG is not measured, there is no sync sound.

When SpO_2 or PRESS is selected, the pulse rate is displayed to the left of the heart rate on the screen and the sync mark synchronizes with the pulse.

1. Display the OTHER page of the PRESS window.
   Press the [Menu] key → PRESS key → OTHER tab.

2. Select the sync source in the <SYNC SOURCE> box.
   ECG: QRS
   PRESS: Pulse wave of the highest priority arterial blood pressure
   SpO_2: SpO_2 pulse



   To display the pulse rate to the left of the heart rate on the home screen, select ON for <PR DISPLAY>. This setting is only available when <SYNC SOURCE> is set to ECG.

3. Press the [Home] key to return to the home screen.

Selecting Sync Sound Pitch

The sync sound can be variable pitch or fixed pitch pips. The fixed pitch is high pitch as the default, but medium or low pitch can also be set on the SYSTEM SETUP window (see Section 3 of the Administrator's Guide). When you select variable pitch, the pitch of the sync sound changes according to SpO_2 value or systolic BP value of the arterial blood pressure so that you can recognize the change on the patient from the pitch of the sync sound without looking at the monitor. The sync pitch can also be changed on the ECG and SpO_2 windows.

When using AY-661P, AY-663P, AY-671P or AY-673P input unit or BSM-1763 or BSM-1773 bedside monitor, the sync sound pitch can be set to change according to the SpO_2 value of the second SpO_2 (SpO_2-2) when monitoring dual SpO_2. (AY-661P and AY-663P input units and BSM-1763 bedside monitor are not available for BSM-6000A series.)

When the sync sound source is set to SpO_2 and the SpO_2 value is below 81%SpO_2, the low pitch is automatically selected.

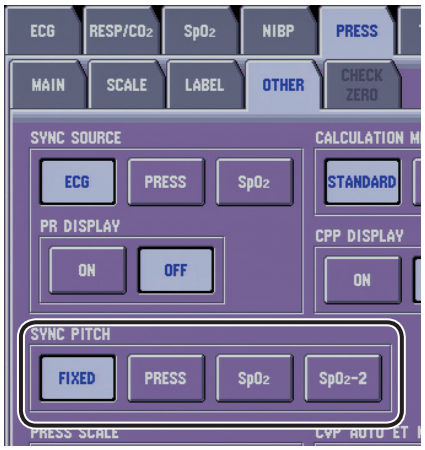
When the sync sound source is set to SpO_2 and the "CHECK PROBE" or "DETECTING PULSE" message is displayed on the screen, the sync sound stops.

When the sync sound source is set to ECG or PRESS, the sync pitch is set to SpO_2 and the SpO_2 cannot be displayed on the screen, the low pitch is automatically selected.

When the sync sound source is set to ECG or SpO_2, the sync pitch is set to PRESS and the IBP cannot be displayed on the screen, the low pitch is automatically selected.

When the sync sound source is set to ECG or SpO_2 and the IBP connection cord is disconnected, the low pitch is automatically selected. After connecting the IBP connection cord, adjust zero balance.

1. Display the OTHER page of the PRESS window.
   Press the [Menu] key → PRESS key → OTHER tab.



2. Select the sync sound pitch from the <SYNC PITCH> box.
   - FIXED: The pitch is fixed to the pitch selected on the SYSTEM SETUP window.
   - PRESS: The pitch is high when the BP value is above 120 mmHg. The pitch is low when the BP value is below 20 mmHg. The pitch changes from high to low in 20 steps for each 5 mmHg change between 120 and 20 mmHg BP value. The BP value of the highest priority arterial blood pressure is used.
   - SpO_2 and SpO_2-2: The pitch changes in 20 steps from high to low for each 1%SpO_2 change in SpO_2 value between 100%SpO_2 and 81%SpO_2. SpO_2-2 is only available when using AY-661P, AY-663P, AY-671P or AY-673P input unit or BSM-1763 or BSM-1773 bedside monitor. (AY-661P and AY-663P input units and BSM-1763 bedside monitor are not available for BSM-6000A series.)

3. Press the [Home] key to return to the home screen.

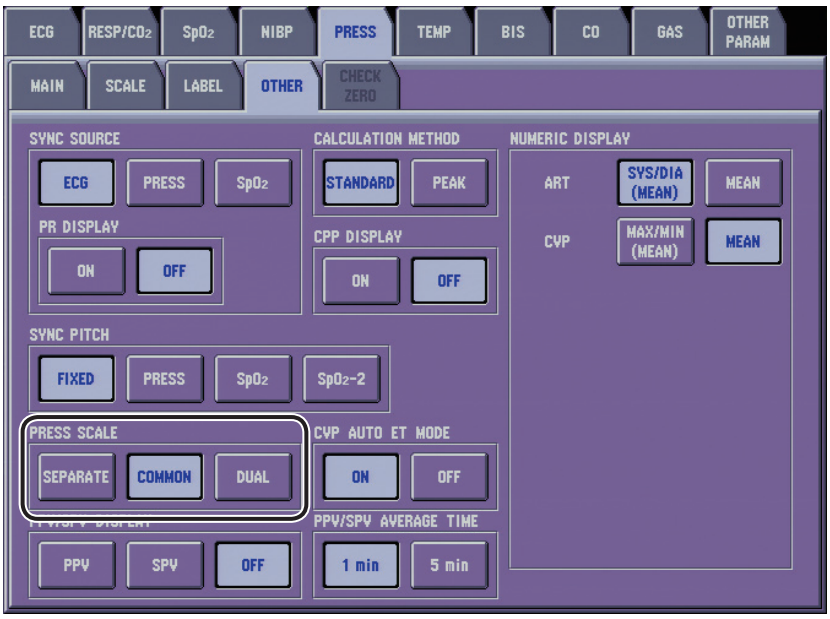
Selecting the IBP Waveform Display Mode

There are three ways of displaying IBP waveforms. This setting can also be changed on the WAVES page of the DISPLAY window. Refer to the Operator's Manual or Section 4 of the User's Guide Part I.

- COMMON: All IBP waveforms are displayed on the same scale.
- SEPARATE: IBP waveforms are displayed separately on different scales.
- DUAL: IBP waveforms are separated into arterial blood pressures and other type of blood pressures. The arterial blood pressures are labeled ART, ART-2, RAD, DORS, AO, FEM, UA, LVP and PRESS (P1 to P7).

1. Display the OTHER page of the PRESS window.
   Press the [Menu] key → PRESS key → OTHER tab.

2. Select the scale mode from the <PRESS SCALE> box.



3. Press the [Home] key to return to the home screen.

Displaying PPV or SPV on the Home Screen

NOTE

This setting is common for all IBP labels. It only needs to be set on one label window.

Selecting PPV or SPV Display on the Home Screen

PPV (pulse pressure variability) or SPV (systolic pressure variability) of the IBP with the highest priority label of arterial blood pressure (ART, ART2, RAD, DORS, AO or FEM) can be displayed on the home screen.

PPV indicates the variability of the difference between systolic and diastolic pressure in one beat in the respiration cycle. PPV is calculated from the following equation.

$$PPV = \frac{PPmax - PPmin}{(PPmax + PPmin) / 2}$$

PP: instantaneous systolic pressure in one beat – instantaneous diastolic pressure in one beat
PPmax: maximum PP in one respiration cycle
PPmin: minimum PP in one respiration cycle

SPV indicates the variability of systolic pressure in the respiration cycle. SPV is calculated from the following equation.

$$SPV = \frac{SPmax - SPmin}{(SPmax + SPmin) / 2}$$

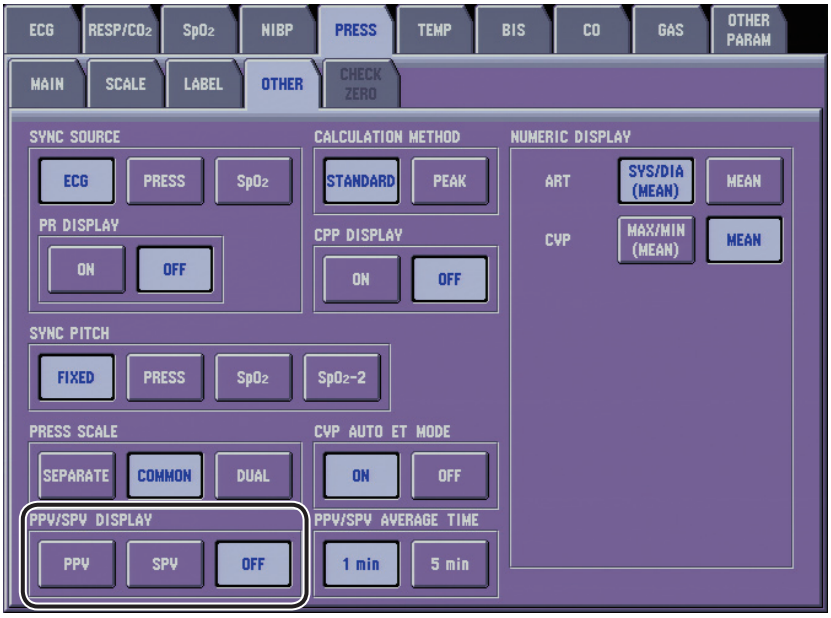
SP: instantaneous systolic pressure in one beat
SPmax: maximum SP in one respiration cycle
SPmin: minimum SP in one respiration cycle

NOTE

- PPV or SPV of IBP with the highest priority label of arterial blood pressure (ART, ART2, RAD, DORS, AO or FEM) is displayed. If the connection cord of IBP whose PPV or SPV is monitored is disconnected from the monitor, PPV or SPV of the blood pressure with the second priority label is monitored. If the disconnected IBP is connected again, PPV or SPV of the highest priority label is monitored again. In such a case, adjust zero balance.
- PPV or SPV is accurately measured when the patient is using a ventilator and when there is no patient movement and no arrhythmias. In the following cases, PPV or SPV is not accurate or cannot be measured.
  - Patient movement
  - Spontaneous respiration
  - Arrhythmia
  - Respiration rate less than 6 counts/min
  - Ventilation volume less than 8 mL/kg
  - Acute right heart failure

1. Display the OTHER page of the PRESS window.
   Press the [Menu] key → PRESS key → OTHER tab.

2. Select PPV, SPV or OFF in the <PPV/SPV DISPLAY> box.



3. Press the [Home] key to return to the home screen.

Changing PPV or SPV Average Time

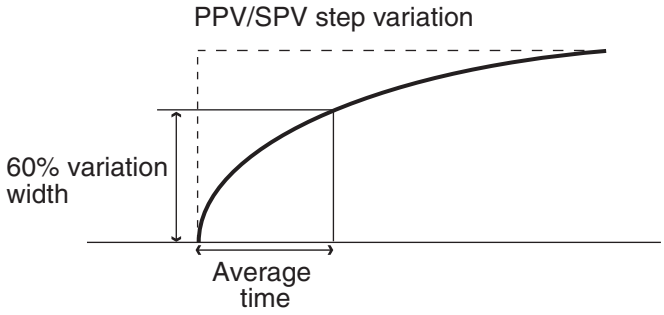
You can select the averaging time for PPV or SPV display. Five minutes is appropriate for monitoring variation for long term (more than an hour) with less noise interference.

NOTE

This setting is only available when “PPV” or “SPV” is selected for the “PPV/SPV DISPLAY” setting.

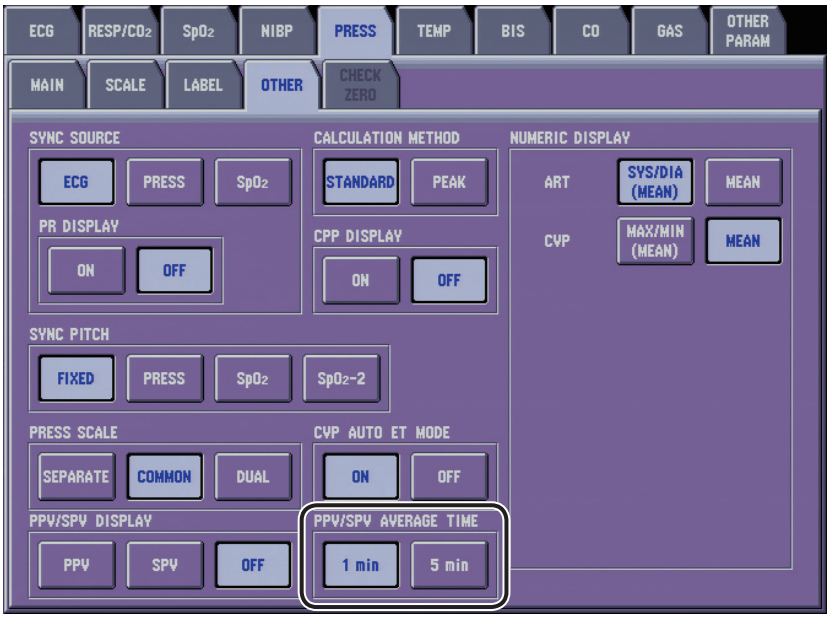
When the average time is longer, noise interference decreases but the response becomes slower. Normally, one minute is recommended.

The average time is the time when variation width reaches 60% when PPV or SPV is hypothetically varied in steps.



1. Display the OTHER page of the PRESS window.
   Press the [Menu] key → PRESS key → OTHER tab.

2. Select the average time in the <PPV/SPV AVERAGE TIME> box.



3. Press the [Home] key to return to the home screen.

Section 7 Temperature Monitoring

General

To monitor temperature, attach the probe to the patient and connect the probe to the TEMP socket or MULTI socket.

Two probes can be connected to the TEMP sockets without using the temperature connection cord. Two probes can be connected to one temperature connection cord to measure 2 channels. Up to 4 channels can be measured.

By using the CO connection cord and catheter, the blood temperature of one channel can be measured. (Refer to Section 9.)

NOTE

- The monitor simulates the temperature signal of 27°C and 37°C inside the monitor. Monitoring this simulated signal periodically, the monitor self-diagnoses the temperature signal processor part of the monitor. When the monitor could not cover the 0 to 45°C measurement range, a “MPU MODULE ERROR” message is displayed.
- The MULTI socket on the AY-660P input unit and BSM-1700 series bedside monitor cannot be used for monitoring temperature. Only the TEMP socket can be used.

Preparing for Temperature Monitoring

Preparation Flowchart

1. Select the probe.
2. Connect the probe to the TEMP socketor to the temperature connection cord. Connect the temperature connection cord to the MULTI socket.
3. Attach the probe to the patient.
4. Start monitoring and change necessary settings.

Selecting the Probe

Select the appropriate probe according to the purpose.

CAUTION

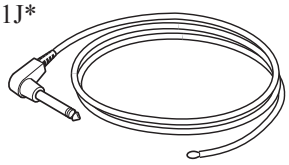
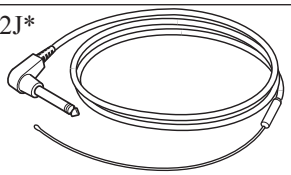
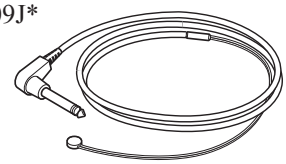
Select the appropriate probe for the patient. Using adult probes on premature infants and children may injure the mucous membrane.

CAUTION

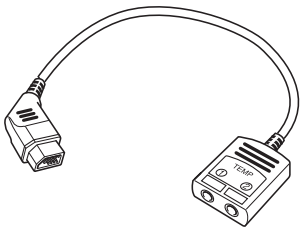
The insulation pad may irritate the skin. In long term monitoring, change the attachment site to prevent irritation.

Reusable Probes

When connecting the temperature probe to the MULTI socket, the JT-900P temperature connection cord is required.

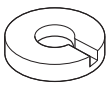
Thermistor Probe	Purpose
401J* 	For adult rectum/ esophagus
402J* 	For child rectum/ esophagus
409J* 	For body surface

* These thermistor probes are available direct from YSI, Yellow Springs Instrument Inc., Yellow Springs Ohio 45387, USA; Phone +1 937-767-7241.



JT-900P temperature connection cord

401J comes with a probe cover**



409J comes with an insulation pad**

** These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

Disposable Probes

The following probes can be used on this monitor. To use the disposable probes, the 5-15801 extension cable is required. When connecting these probes to the MULTI socket, the JT-900P temperature connection cord is also required.

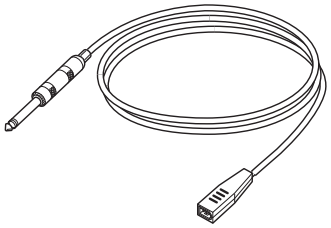
The disposable probes and the extension cable are available direct from Kendall Healthcare Products Company (www.kendallhq.com) or their suppliers.

CAUTION

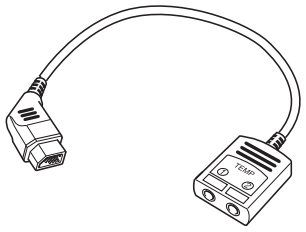
Do not reuse disposable probes on other patients.

Disposable Probe		Thickness	Purpose
Sonatemp	5-13212*	12F	For esophagus
	5-13218*	18F	
	5-13224*	24F	
Sheritemp	5-15610*	18F	For esophagus/rectum
	5-26101*	—	For tympanic membrane
Foley catheter	5-18808*	8F	For bladder
	5-18810*	10F	
	5-18812*	12F	
	5-18814*	14F	
	5-18816*	16F	
	5-18818*	18F	

* These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.



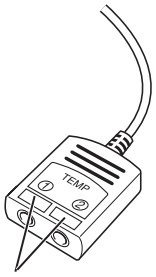
5-15801 extension cable



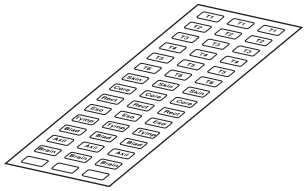
JT-900P temperature connection cord

Temperature Connection Cord

The temperature connection cord connector has a memory chip for saving the site label. Attach the temperature site label of the saved site.



Attach the label here



Temperature site label

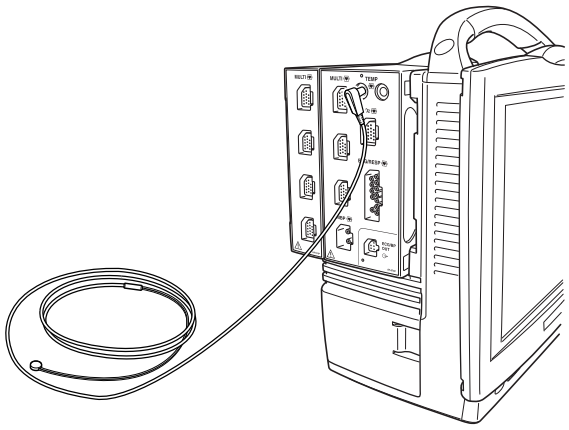
Connecting Cables and Attaching the Probe

Connecting Cable to the Unit

When Using the TEMP Socket

Connect the probe to the TEMP socket.

When using the disposable probe, connect the extension cable between the probe and TEMP socket.



When connecting the 409J reusable probe for the body surface

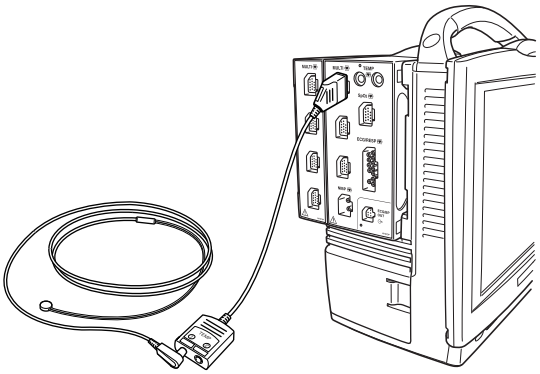
When Using the MULTI Socket

NOTE

The MULTI socket on the AY-660P input unit and BSM-1700 series bedside monitor cannot be used for monitoring temperature.

Connect the probe to the temperature connection cord and connect the temperature connection cord to the MULTI socket.

When using the disposable probe, connect the extension cable between the probe and temperature connection cord.



When connecting the disposable probe (Sheritemp body surface: 5-16201)

Attaching the Probe to the Patient

Attach the probe to the patient by referring to the manual provided with the probe.

CAUTION

Select the appropriate probe for the patient. Using adult probes on premature infants and children may injure the mucous membrane.

CAUTION

After changing the temperature label, do not reconnect the probe to another jack. This may cause an incorrect label display and lead to misjudgment.

NOTE

When the measuring site is exposed directly to air, the temperature may be lower than normal. It takes about 20 to 30 minutes to reach the equilibrium temperature after attaching the sensor.

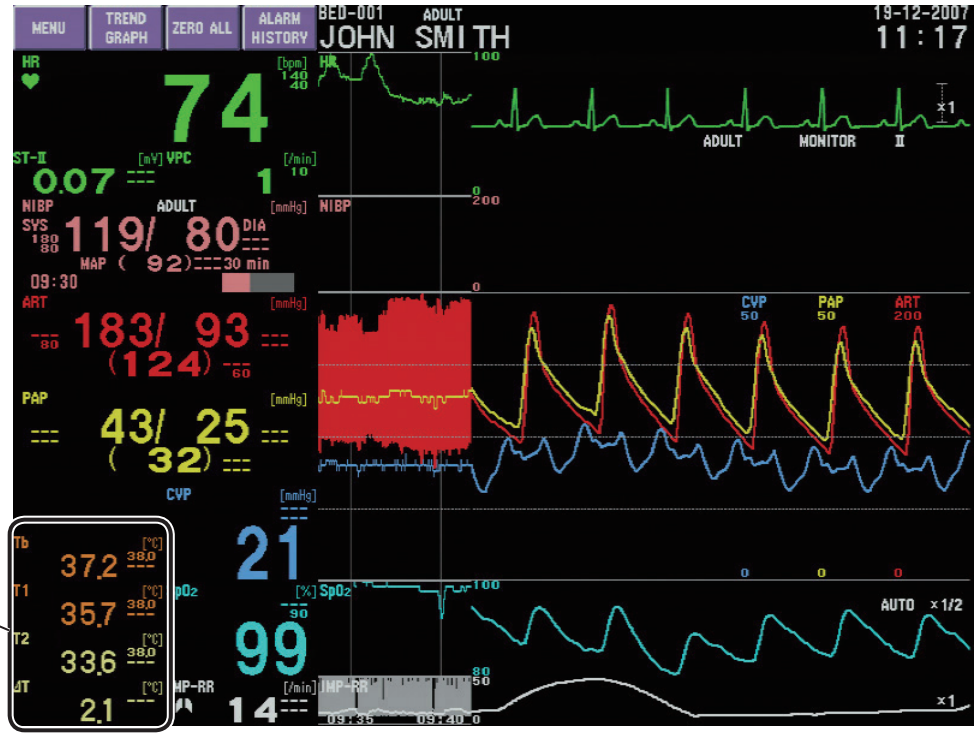
Using the Insulation Pad

The pad prevents the environmental temperature from affecting the sensor temperature and also prevents internal body heat from escaping at the attached site so that a stable temperature is obtained.

Monitoring Temperature

After completing the preparation, temperature data appears on the screen.

Temperature Information on the Home Screen



Temperature
The temperature values are displayed in the display priority of the label.

Changing Temperature Settings

Change settings on the TEMP window. The following settings can be changed for monitoring temperature.

- Label
- Temperature alarm limits
- Delta temperature equation setting

The temperature unit can be set to °C or °F on the SYSTEM CONFIGURATION screen. Refer to Section 2 of the Administrator's Guide.

The temperature data display color can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

Changing the Label

At shipment, the sites are labeled as T1 to T4. You can use these labels, but it is recommended to apply more descriptive labels for the sites to be measured, such as Tskin or Tcore.

When the temperature probe is connected to the TEMP socket, the labels are saved in monitor memory. Once the label is set, do not reconnect the temperature probe to the other TEMP socket.

When the temperature probe is connected to the MULTI socket with the temperature connection cord, the labels are saved in memory in the connector of the temperature connection cord. Once the label is set, you do not need to set the label again when the temperature connection cord is connected to a different socket.

If the temperature connection cord whose label is set by another monitor and which the label is not used on this monitor is connected to this monitor, the label appears from T1 to T4.

Types of Labels

There are 9 types of labels. The labels are listed in the display priority.

Tskin: Skin temperature
Up to 3 sites can be set. (Tskin, Tskin2, Tskin3)
Trect: Rectum temperature
Tcore: Core temperature
Tnaso: Nasal cavity temperature
Teso: Esophagus temperature
Ttymp: Tympanic membrane temperature
Tblad: Bladder temperature
Taxil: Axillary temperature
T1 to T4: Up to 4 sites can be set.

Types of Labels for Blood Temperature Measured Regions

When blood temperature is measured with a catheter and CO connection cord or when CCO is measured by a CCO monitor, the label is Tb.

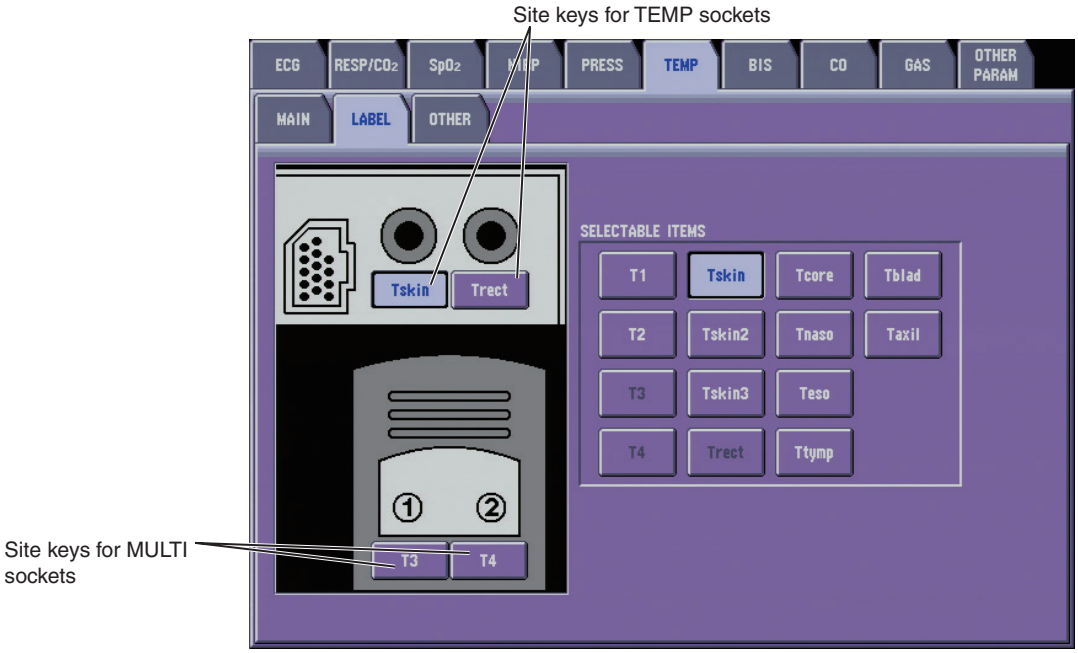
Changing the Label

CAUTION

After changing the temperature label, do not reconnect the probe to another jack. This may cause an incorrect label display and lead to misjudgment.

1. Display the LABEL page of the TEMP window.
   Press the [Menu] key → TEMP key → LABEL tab.

2. Select the label appropriate for the measurement site.
   i) Select the site to be labeled.



   ii) Select the label from the <SELECTABLE ITEMS> box.

3. Press the [Home] key to return to the home screen.

When using the temperature connection cord, attach the temperature site label to the temperature connection cord connector.

Setting the Site for Calculating Temperature Difference

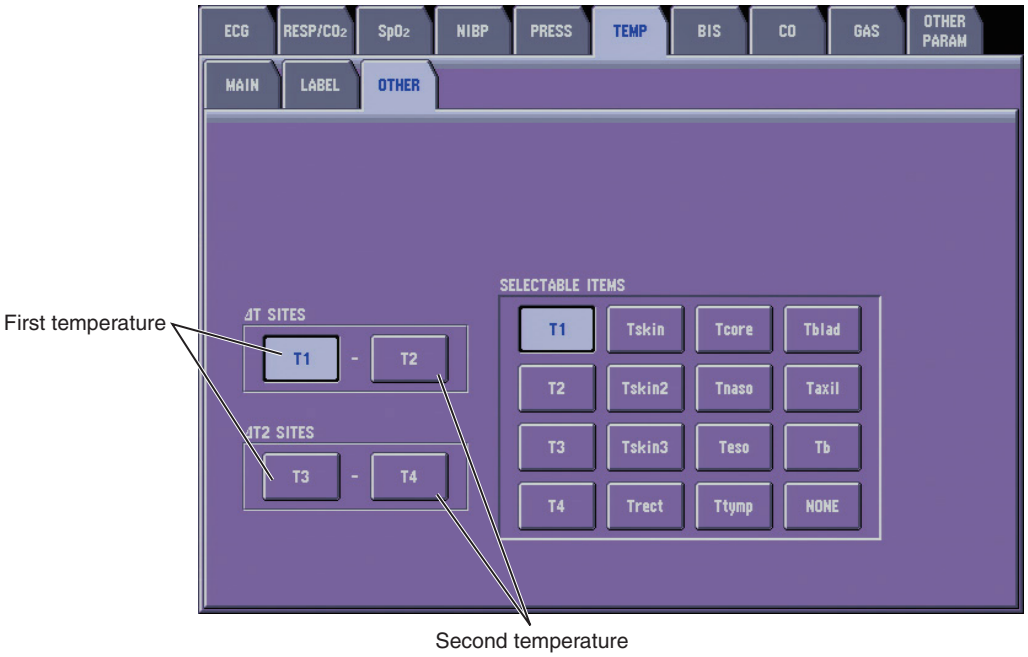
Temperature difference for two pairs of temperatures can be measured.

1. Display the OTHER page of the TEMP window.
   Press the [Menu] key → TEMP key → OTHER tab.

2. Select the temperatures in the <ΔT SITES> and <ΔT2 SITES> boxes.
   i) Touch the first temperature in the <ΔT SITES> or <ΔT2 SITES> box and select a temperature from the <SELECTABLE ITEMS> box.
   ii) Touch the second temperature in the <ΔT SITES> or <ΔT2 SITES> box and select a temperature from the <SELECTABLE ITEMS> box.

   If you do not need to monitor temperature difference, select NONE in the <ΔT SITES> or <ΔT2 SITES> box.

   The difference between the temperatures is calculated and appears in the home screen.



3. Press the [Home] key to return to the home screen.

Changing the Temperature Alarm Limits

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

You can set the upper and lower temperature alarm limits on the TEMP window. You can set all alarms, including the upper and lower temperature alarm limits, on the ALARM LIMITS window (See the Operator's Manual or Section 5 of the User's Guide Part I).

Setting Range

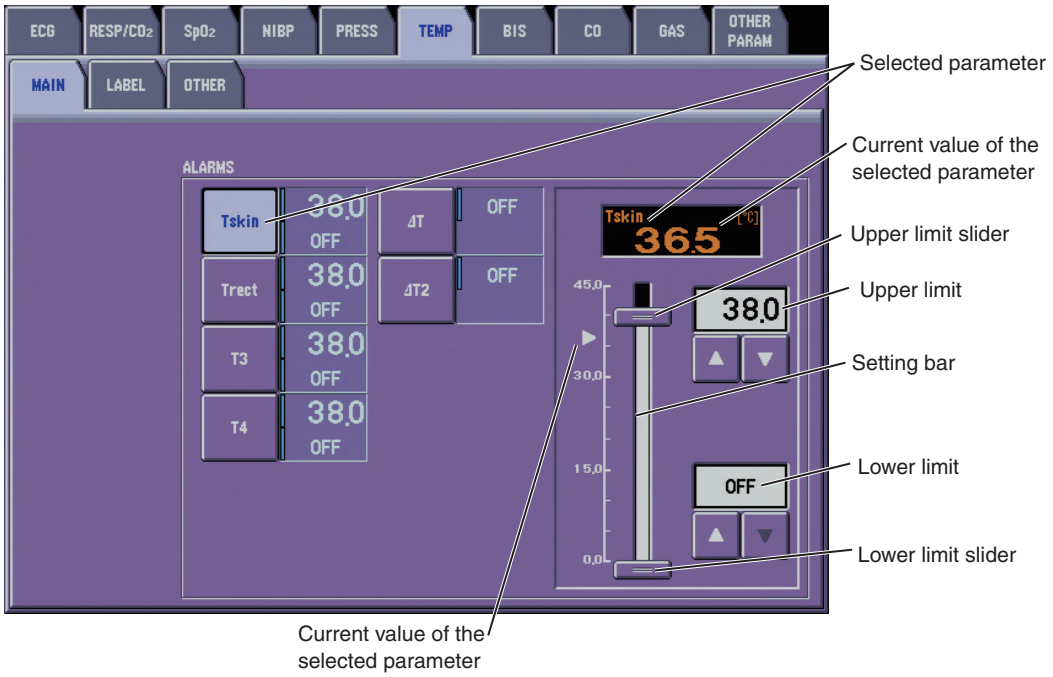
Temperature upper limit: 0.1 to 45.0°C in 0.1°C steps (33 to 113°F in 1°F steps), OFF (default setting: ADULT: 38.0°C (100°F), CHILD: 38.5°C (101°F), NEONATE: 39.0°C (102°F))

Temperature lower limit: OFF, 0.0 to 44.9 in 0.1°C steps (32 to 112°F in 1°F steps) (default setting: OFF)

ΔTemperature upper limit: 0.1 to 45.0°C in 0.1°C steps (1.0 to 113°F in 1°F steps), OFF (default setting: OFF)

1. Display the MAIN page of the TEMP window.
   Press the [Menu] key → TEMP key → MAIN tab.

2. Touch the parameter key for the alarm limit to be set.



3. Touch and drag the slider to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.

4. Press the [Home] key to return to the home screen.

Section 8 BIS Monitoring

General

BIS monitoring can be performed by using the BISx processor or BIS monitor manufactured by Covidien.

The BISx processor is also available from Nihon Kohden as the QE-910P BIS processor.

NOTE

QE-910P BIS processor is not available in USA.

To use the QE-910P BIS processor (or BISx processor), the YJ-671P BISx connection cable is required. The BISx connection cable can only be connected to the MULTI socket on the AY-600P series input unit, the BSM-1700 series bedside monitor, AA-672P/AA-674P smart expansion unit or JA-694PA data acquisition unit.

To connect the BIS monitor to the bedside monitor, the QF-902P interface is required.

NOTE

BIS cannot be monitored by connecting the BISx connection cable to the MULTI socket on the AY-660P input unit.

List of Terms

Term	Description	Measuring Range
BIS	Bispectral index Indicates the effects of anesthetic agents on the brain.	0 to 100 (1 steps)
EMG	Electromyogram Indicates the effects of EMG on the EEG signal. This shows the high frequency artifact in the input signal.	30.0 to 55.0 dB
SEF	95% spectral edge frequency Shows the level of hypnosis. (The frequency below which the power spectrum contains 95% of the total power in the EEG.)	0.5 to 30.0 Hz (0.5 Hz steps)
SQI	Signal quality index Shows the level of the EEG signal quality. This is the percentage of interval with no artifact in the EEG signal.	0 to 100%
SR	Suppression ratio The percentage of epochs in the past 63 seconds in which the EEG signal is considered to be suppressed for more than 0.5 second.	0 to 100%
BCOUNT*	Burst count The number of EEG bursts in the last minute. Blanked if SR is less than 5. Activated by connection of an Extend sensor.	0 to 30
EEG	A visual representation of the rhythmic fluctuations of electric potential between parts of the brain (brain waves).	—

* This parameter in only available when using BIS processor or BISx proccessor.

Preparing for BIS Monitoring

CAUTION
Only use the specified BIS sensor.

CAUTION
Do not use an expired BIS sensor.

CAUTION
- The BIS sensor is single use only. Do not reuse it.
- Do not reuse the BIS sensor for another patient. There are a lot of fine projections on the BIS sensor. Reusing the BIS sensor for another patient may cause infection to another patient by bacteria adhering to the BIS sensor.
- Do not use the BIS sensor for more than 24 hours. It affects monitoring accuracy.

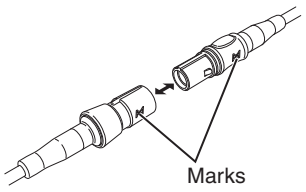
CAUTION
When attaching the BIS sensor to the patient, press each electrode on the sensor for 5 seconds to reduce impedance between the electrode and skin.

CAUTION
To minimize the risk of patient strangulation, the PIC Plus patient interface cable must be carefully placed and secured.

CAUTION
The BIS processor cannot be sterilized. Sterilizing the BIS processor may damage it.

Preparation Flowchart for Using the BIS Processor

1. Connect the BSM connector of the BIS processor or BISx processor to the BISx connection cable by aligning the marks on each connector until you hear a click.



2. Connect the BISx connection cable to the MULTI socket.
3. Connect the BIS sensor to the PIC Plus patient interface cable and connect the interface cable to the BIS processor.
4. Attach the BIS sensor to the patient.
5. Start measurement and change necessary settings.

For steps 3 and 4, refer to the BIS processor operator's manual.

Preparation Flowchart for Using the BIS Monitor

1. Set up the BIS monitor and connect it to the bedside monitor. Refer to the QF-902P interface operator's manual.

2. Connect the BIS monitor to the patient. Refer to the BIS monitor manual.

3. Start measurement and change necessary settings.

Monitoring BIS

After completing the preparation, BIS data and the EEG waveform appear on the screen.

General Safety Information for Using BIS Processor

WARNING

Do not perform defibrillation with the BIS sensor placed between the defibrillator pads.

WARNING

The conductive parts of electrodes or sensor and connectors, including the neutral electrode, should not contact other conductive parts, including earth.

WARNING

Reliance on the BIS alone for intraoperative anesthetic management is not recommended. Clinical judgement (patient face color, patient reaction, heart rate, blood pressure and other vital sign data) should always be used. BIS has been studied with the anesthetic agents listed in the “Drugs that have been Studied for Use with the BIS” section in the BIS reference guide, but the studied data are relative values and do not indicate the absolute value of the hypnotic level.

WARNING

Do not place the BIS monitor or BIS processor above the patient. When installing the BIS monitor, use the pole clamp to firmly attach the BIS monitor to a secure pole (1.0 to 3.8 cm in diameter). Periodically check that the pole clamp knob is not loose. Use the clip on the back of the BIS processor to attach the BIS processor to the bed rail or pole. If the BIS monitor or BIS processor is not attached to a rail or pole, install it where it cannot fall or tip over. Otherwise, it may cause injury to the patient or operator.

WARNING

The hypnotic state of a patient undergoing surgery is influenced by the intensity of stimulation that is applied. During the course of a surgical procedure, the balance between the intensity of stimulation and sensory suppression may be constantly changing. Read the BIS value carefully.

WARNING

It is reported that BIS monitoring is not appropriate when an analgesic anesthetic agent, such as ketamin, fentanyl, morphine, or only a muscle relaxant is used.

WARNING

Due to limited clinical experience in the following applications, BIS values should be interpreted cautiously in patients with known neurological disorders such as epilepsy, patients taking other psychoactive medications, patients with cerebral infarction and in children below the age of 18.

CAUTION

Turn off the automatic impedance check if the impedance check signal (1 nA, 128 Hz) interferes with other equipment.

CAUTION

Do not let the BIS processor continuously contact the patient's body. The BIS processor heats up during operation and it may cause low temperature burn to the patient.

CAUTION

When performing electroconvulsive therapy (ETC), attach the BIS sensor as far as possible from the electrodes that are used for electrical shock. Otherwise noise from the electrodes may interfere and incorrect data is displayed on the screen.

CAUTION

When the "BIS CONNECTOR OFF" message is displayed, check that the BIS processor is firmly connected to the connection cable and connection cable is firmly connected to the monitor. The BIS cannot be monitored and the alarm does not function while this message is displayed.

CAUTION

- The following physiological factors and external factors must be considered in BIS monitoring.
  1. Ischemia or hypoxia, when severe enough to cause global EEG slowing or outright suppression, results in a decrease in the BIS value. It is important to bear in mind that the frontal montage used for BIS monitoring usually will not detect episodes of focal ischemia caused by embolic events.
  2. Hypothermia will generally result in a corresponding decrease in BIS levels as brain processes slow. More profound hypothermia used during cardiac bypass procedures will cause suppression of the EEG and, consequently, a very low BIS.
  3. Artifacts and signal of poor quality cause the BIS to be unreliable. Such artifacts are caused by poor contact of sensor to skin, muscle activity or rigidity, head or body movement, eye movement, inappropriate sensor attachment and other electrical interference. Some examples are given below.
     a) Hum noise: Usually there is no hum interference, but when the hum filter is turned off and a signal larger than 100 µV is superimposed on the EEG waveform on the screen, BIS may increase.
     b) ESU (unipolar):The noise generated by unipolar ESU is so large that it saturates the EEG signal so that EEG waveforms cannot be acquired. BIS value first blinks (SQI decreases) and then disappears. After stopping the use of the ESU, BIS value is displayed again.
     c) ESU (bipolar): Bipolar ESU causes low amplitude high frequency wave signals which may be mistaken as EEG and thus cause an increase in BIS value. If there is unexpected increase in BIS, monitor EEG carefully and read the BIS value carefully.
     d) ECG: The BIS processor has a filter for detecting ECG, but large ECG may be mistaken as EEG. If ECG artifact is seen on the EEG, read the BIS value carefully.
     e) Pulse wave: There may be an interference caused by the pulse wave when the BIS sensor is attached near an artery. Reattach the BIS sensor to the appropriate site.
     f) Pacemaker: If pacing spikes can be seen on the EEG, the BIS may be affected. Read the BIS value carefully.
     g) EMG: EMG is a signal of high frequency wave of more than 500 µV (generally more than 30 Hz). There is an increase in EMG as the patient is emerging from anesthesia. Muscle activity is seen during surgery. The BIS processor has a filter for detecting EMG, but the increase in EMG causes an increase in the BIS value. Shivering in a patient who is emerging from anesthesia may increase EMG and artifact on EEG, resulting in an increase in BIS value.
- Check the BIS sensor attachment when there is an unexpected EMG increase and SQI decrease. If EMG still increases after having checked the sensor attachment, there may be an electromagnetic interference. Check the surrounding equipment and power supply.

NOTE

Connect the BIS connector of the BIS processor or BISx processor until it clicks.

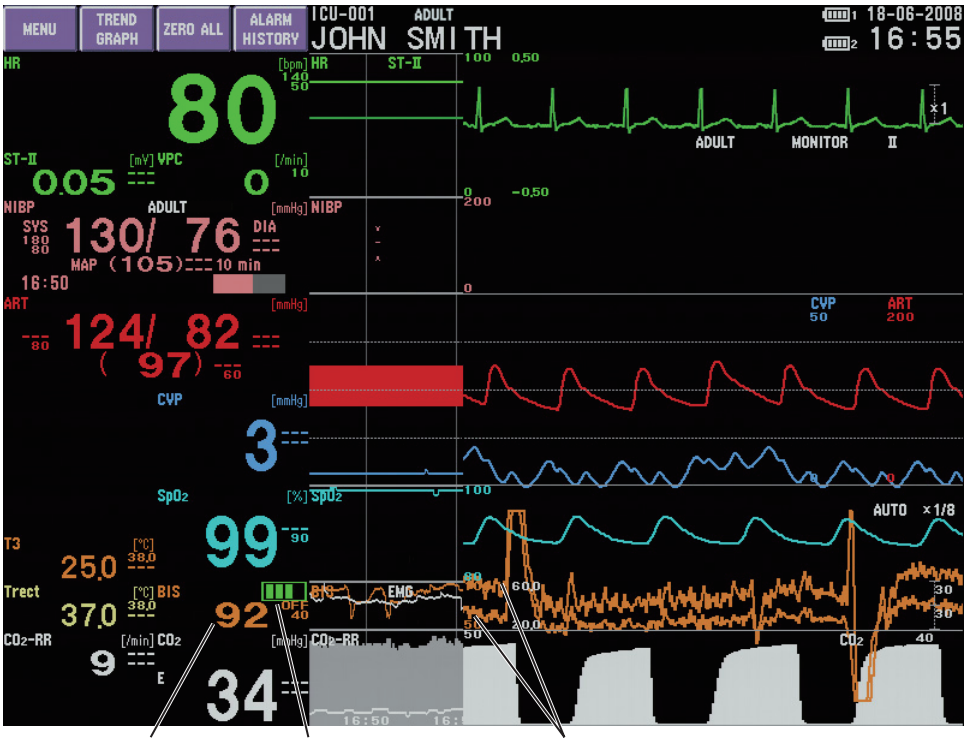
Safety Information for Using BIS Monitor

WARNING

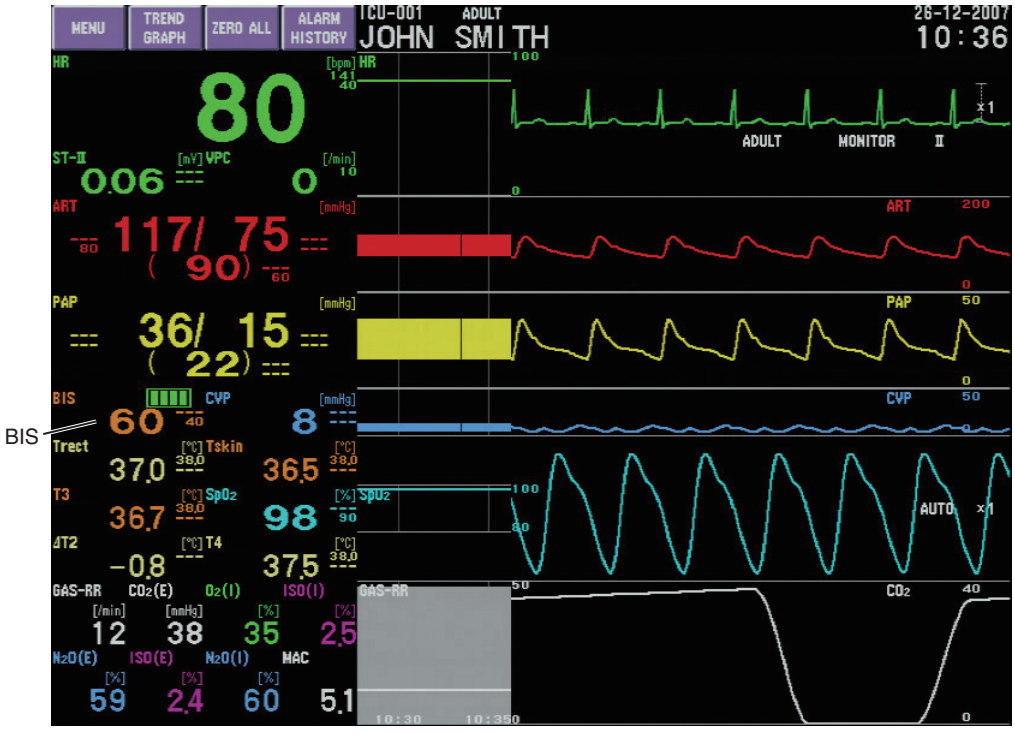
The BIS monitor alarms do not function on the bedside monitor. When the BIS data on the bedside monitor is abnormal, check the alarm on the BIS monitor.

BIS Information on the Home Screen

Using the BIS Processor

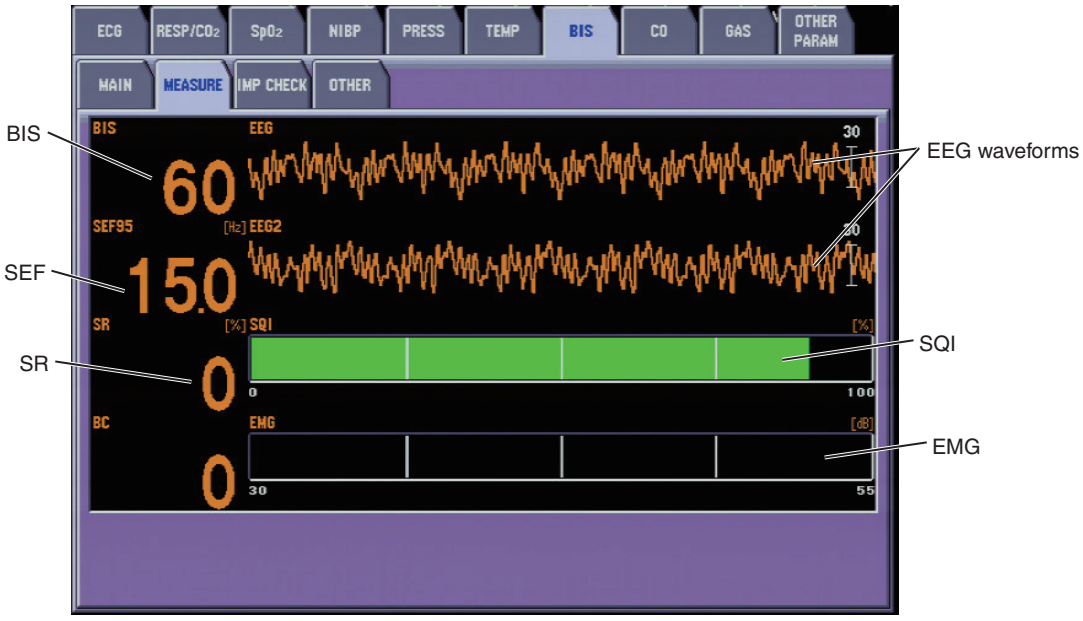


Using the BIS Monitor

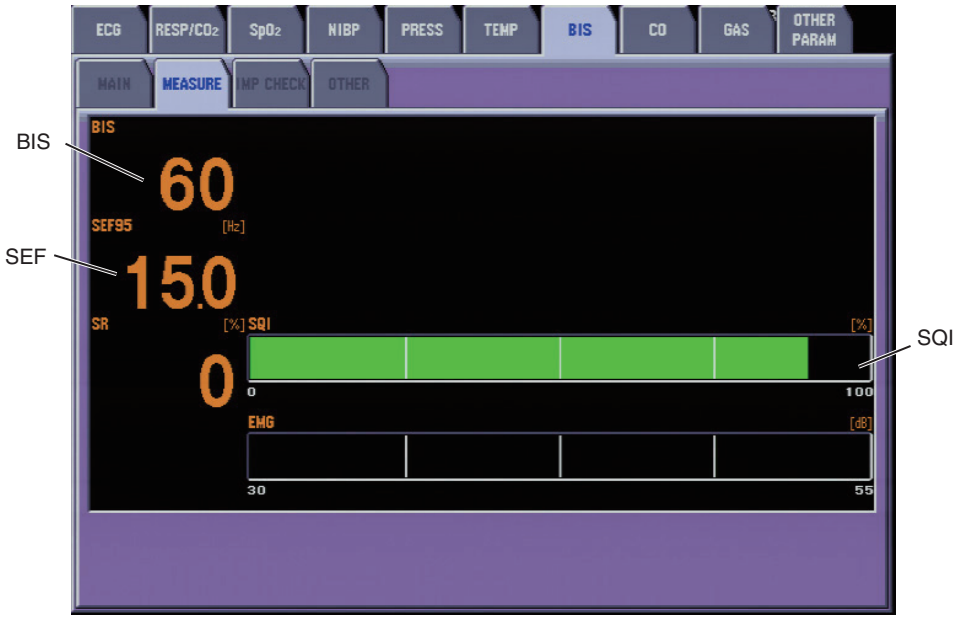


BIS Information on the BIS Window

Using the BIS Processor



Using the BIS Monitor



Changing the BIS Settings

When using the BIS processor, the following settings can be changed for BIS monitoring. Change the settings on the BIS window.

- BIS alarm limits
- BIS waveform sensitivity
- Check impedance and auto impedance check on or off
- Filter on or off
- Smoothing rate
- BIS waveform sweep speed
- Parameter for second current trendgraph

The display color for BIS can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

When using the BIS monitor, only the measured values are displayed on the bedside monitor screen.

The waveform display of the EEG and EEG2 on the home screen can be selected on the DISPLAY window. Refer to Section 3 of the User's Guide Part I.

Checking the Impedance of the BIS Sensor

This setting is not available when using the BIS monitor.

Check the impedance between the BIS sensor and skin. If the check result is not "PASS", remove the cause and repeat the impedance check until the result becomes "PASS".

The impedance check can be performed automatically and manually.

PASS: The impedance check is OK.
The impedance is 7.5 kΩ or less. However, the result of the #2 ground electrode becomes "PASS" when the impedance is 30 kΩ or less.

HIGH: The impedance is above 7.5 kΩ. As long as the sum of the impedance of all electrodes except for the ground electrode is 15 kΩ or less, the check result becomes "PASS". If the check result is over 15 kΩ, clean the skin where the BIS sensor will be attached.

NOISE: The signal from the electrode exceeds the measurable range. Check the BIS sensor attachment. Replace the BIS sensor with a new one if necessary.

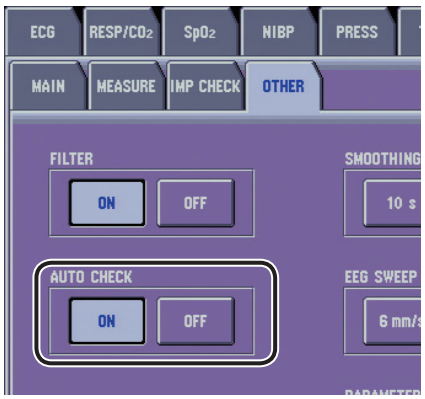
LDOFF: Connector connection is loose or disconnected. Check the connection from the BIS sensor to the bedside monitor. If necessary, replace the BIS sensor or PIC Plus patient interface cable with a new one.

Automatically Checking Impedance

When auto check is turned ON, the impedance is checked every 10 minutes.

CAUTION

Turn off the automatic impedance check if the impedance check signal (1 nA, 128 Hz) interferes with other equipment.



If the result is not “PASS”, the “CHECK SENSOR” message appears on the screen.

1. Display the OTHER page on the BIS window.
   Press the [Menu] key → BIS key → OTHER tab.

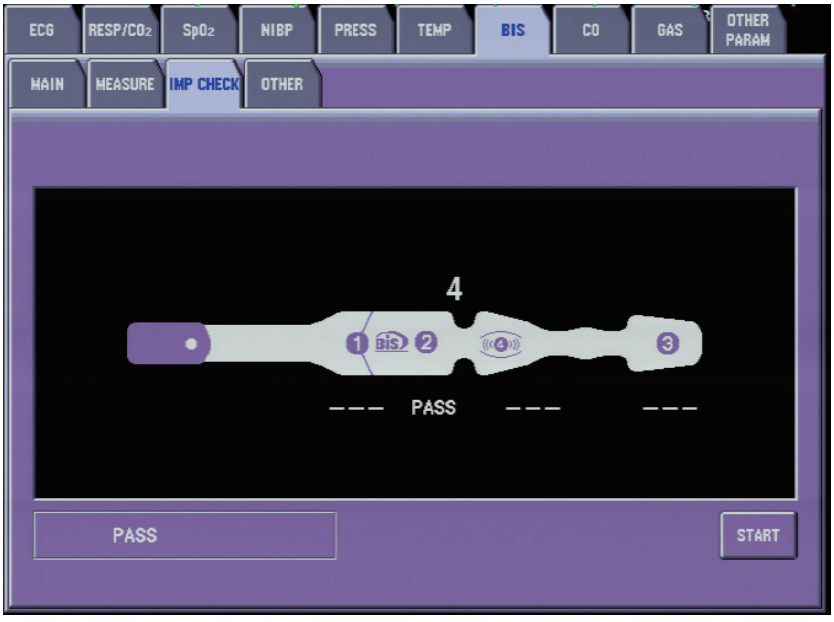
2. Touch the ON key in the <AUTO CHECK> box.

3. Press the [Home] key to return to the home screen.

Manually Checking Impedance

1. Display the IMP CHECK page on the BIS window.
   Press the [Menu] key → BIS key → IMP CHECK tab.

2. Touch the START key.



   The check result appears.

3. Press the [Home] key to return to the home screen.

Changing the BIS Alarm Limits

This setting is not available when using the BIS monitor.

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

You can set the upper and lower BIS alarm limits on the BIS window. You can set all alarms, including the upper and lower BIS alarm limits, on the ALARM LIMITS window (See the Operator's Manual or Section 5 of the User's Guide Part I).

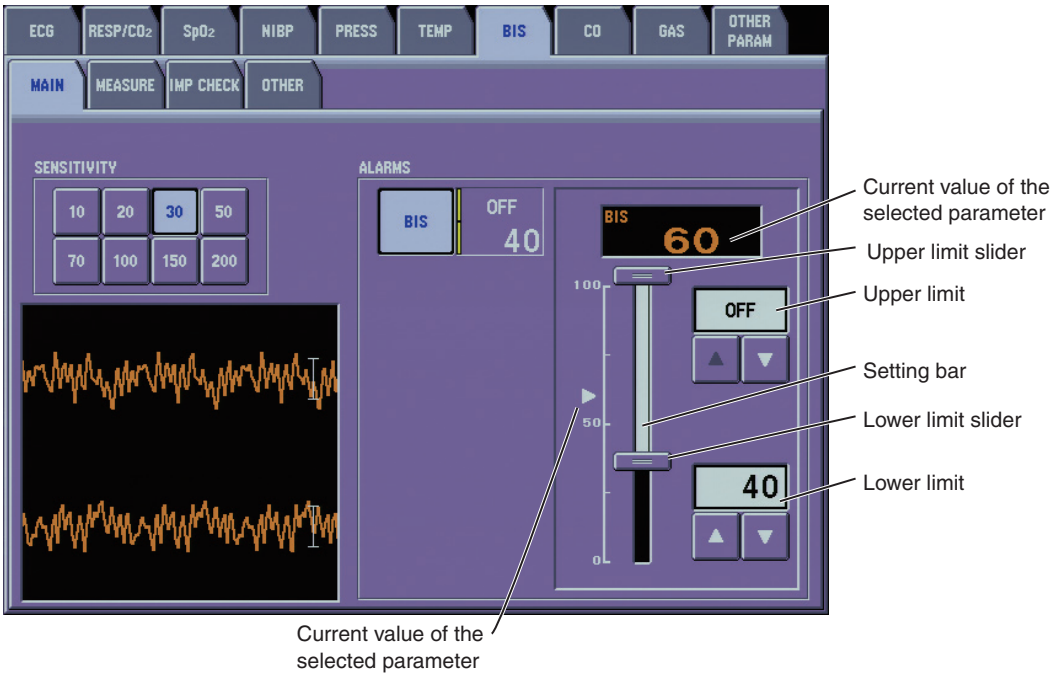
Setting Range

BIS upper limit: 1 to 100 in 1 steps, OFF (default setting: OFF)
BIS lower limit: OFF, 0 to 99 in 1 steps (default setting: 40)

1. Display the MAIN page on the BIS window.
   Press the [Menu] key → BIS key → MAIN tab.

2. Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.



3. Press the [Home] key to return to the home screen.

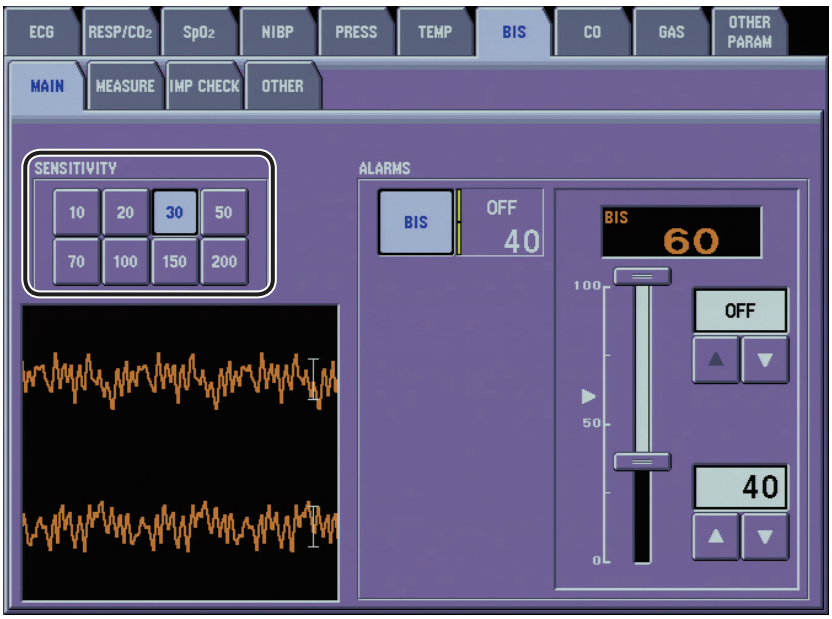
Changing the Sensitivity

This setting is not available when using the BIS monitor.

The sensitivity determines the size of the BIS waveform on both the screen and recording paper.

1. Display the MAIN page on the BIS window.
   Press the [Menu] key → BIS key → MAIN tab.

2. Select the sensitivity from the <SENSITIVITY> box (unit: µV/div).



3. Press the [Home] key to return to the home screen.

Turning the Filter On or Off

This setting is not available when using the BIS monitor.

Turn the high-cut filter, low-cut filter and AC filter on or off. This setting is applied on both the home screen and BIS window.

1. Display the OTHER page on the BIS window.
   Press the [Menu] key → BIS key → OTHER tab.

2. Select ON or OFF in the <FILTER> box.

3. Press the [Home] key to return to the home screen.

Selecting the BIS Average Time (Smoothing Rate)

This setting is not available when using the BIS monitor.

Select the BIS smoothing rate over which the BIS value is averaged.

1. Display the OTHER page on the BIS window.
   Press the [Menu] key → BIS key → OTHER tab.

2. Select the smoothing rate in the <SMOOTHING RATE> box.

3. Press the [Home] key to return to the home screen.

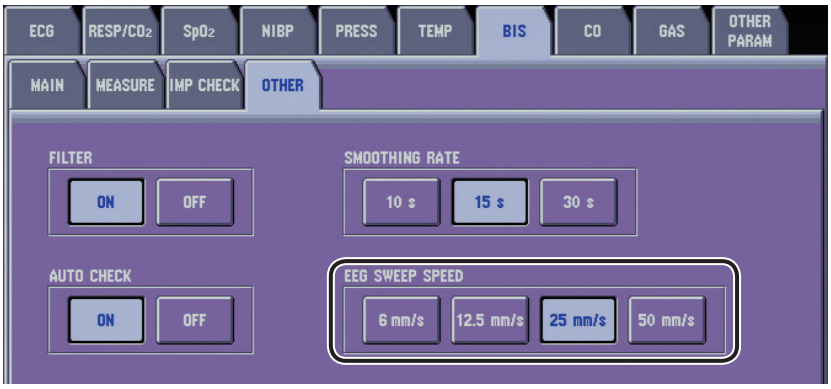
Changing the EEG Waveform Sweep Speed

This setting is not available when using the BIS monitor.

The sweep speed of the EEG waveform on the home screen can be changed.

1. Display the OTHER page on the BIS window.
   Press the [Menu] key → BIS key → OTHER tab.

2. Select the appropriate speed in the <EEG SWEEP SPEED> box.



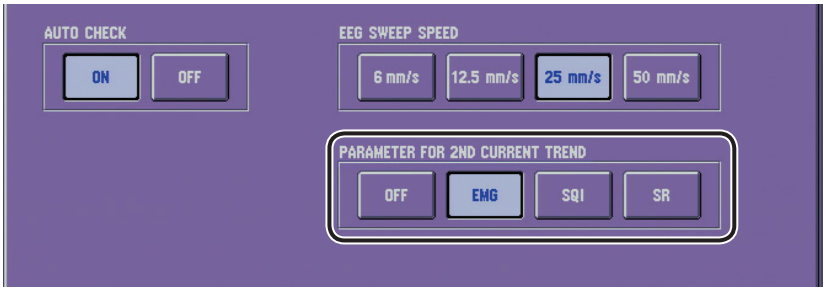
3. Press the [Home] key to return to the home screen.

Selecting the Second Current Trendgraph

Select the second parameter to be displayed as a trendgraph on the home screen. The second trendgraph is displayed in white.

1. Display the OTHER page on the BIS window.
   Press the [Menu] key → BIS key → OTHER tab.

2. Select the parameter in the <PARAMETER FOR 2ND CURRENT TREND> box. Select OFF when the second trendgraph is not needed.



3. Press the [Home] key to return to the home screen.

Section 9 Cardiac Output Monitoring

General

CO (Cardiac Output) measurement is performed by connecting the measuring system to the MULTI socket. This monitor uses the thermodilution method.

NOTE

CO cannot be monitored by using the MULTI socket on the AY-660P input unit.

Thermodilution method

This method is performed by injecting cold water into the right atrium, measuring the temperature changes of the blood after mixing of the injected cold water in the right ventricle using the thermistor at the tip of a catheter, and drawing the temperature change curve (thermal dilution curve). The cardiac output is calculated from the area below this curve.

WARNING

When performing defibrillation during cardiac output monitoring, never touch the CO connection cord. The discharged energy may cause electrical shock or injury.

NOTE

CO monitoring using the MULTI socket does not comply with the Defibrillator proof type CF.

Preparing for Cardiac Output Monitoring

Preparation Flowchart

1. Select the thermodilution catheter.
2. Prepare the injectate.
3. Connect the catheter to the CO connection cord, connect the CO connection cord to the MULTI socket, and assemble the measuring system. For details, refer to the instruction manuals provided with the catheter and measuring system.
4. Insert the catheter into the patient.
5. Measure the pulmonary capillary wedge pressure. Determine the position for retaining the catheter.
6. Check the setting for measuring CO.
7. Start monitoring CO.

Selecting the Catheter

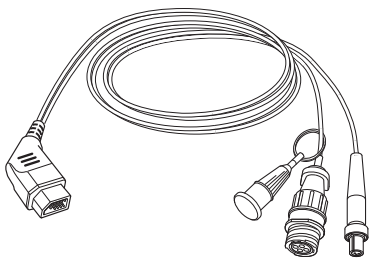
Select the appropriate catheter according to the purpose.

CAUTION

Do not reuse disposable parts and accessories.

Types of Catheter

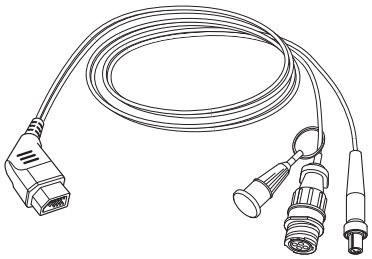
Argon Medical Devices Thermodilution Catheter

Catheter	Specifications	Thickness (F)	Lumen	CO Connection Cord
TC-504*	—	5	4	JT-950P 
TC-664MP*	Made of polyurethane	6		
TC-704*	—	7		
TC-704M*				
TC-704MU*	Made of polyurethane			
TC-7042*	For inline sensor method			
TC-755*	—	7.5	5	
TC-774MP*	Made of polyurethane	7	4	

* These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

Edwards Lifesciences (Baxter) Swan-Ganz (Thermodilution) Catheter

Edwards Lifesciences (Baxter) catheters are available direct from Edwards Lifesciences (Baxter) (www.edwards.com) or their suppliers.

Catheter	Specifications	Thickness (F)	Lumen	CO Connection Cord
131H-7F*1	Standard	7	4	JT-950P 
141H-7F*1	Hard			
151H-7F*1	For femoral vein			
93A-161H-7F*1*2	Hard tapered			
93A-171H-7F*1*2	Torque support			
93C-172H-7F*1*2	Made of polyurethane			
096-6F*1*2	For adult small blood vessel	6		
132-5F*1*2	For children	5		
93A-831H-7.5F*1*2	With side hole for infusion	7.5	5	
93A-931H-7.5F*1*2	With RV pace port side hole			
93A-991H-8F*1*2	With AV pace port side hole	8	6	
93A-200H-7F*1	RA, RV pacing electrode	7	4	
93A-205H-7F*1				
93A-741H-7.5F*1	$S\bar{v}O_2$ measurement possible.*3	7.5	5	

*1 These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

*2 In this monitor, the computation constant required for calculating CO value is automatically calculated, but not for the catheters marked with *2. When using these catheters, enter the computation constant labeled on the package of the catheter.

*3 $S\bar{v}O_2$ cannot be monitored on this bedside monitor.

Preparing the Injectate

Usable Injectate

Use sterilized 5% glucose solution for the injectate. Physiological saline can also be used, but the CO value is about 2% lower than when glucose is used.

Injectate Temperature and Volume

When the injectate temperature is high or the injectate volume is small, the thermodilution curve becomes low and the measuring range is limited. Use a large volume (10 cc) of low temperature (0°C, 32°F) injectate if it does not cause any problems to the patient.

The appropriate injectate temperature and volume differs according to the catheter used. Refer to the instruction manual for the catheter used.

NOTE

When room temperature injectate is used, the change in blood temperature becomes small and the measurement results cannot be used on patients with low cardiac output.

Measuring the Injectate Temperature

Types of Measuring Methods

Measure the injectate temperature using one of the following two methods.

Measuring Type	Measuring Method
Inline sensor method	Directly measures the injectate temperature at injection. The measuring accuracy is high because the temperature is measured directly.
Bath probe method	Measures the injectate temperature before injection and uses this temperature as the injectate temperature.

For BSM-6000K series, if the measurement of the injectate temperature is omitted, the monitor assumes the temperature to be 0°C and "0.0°C" is displayed for Ti on the screen. In this case, use injectate that has been cooled down to 0°C.

For BSM-6000A series, if the measurement of the injectate temperature is omitted, "---" is displayed for Ti on the screen and a "CO CHECK Ti TEMP" message appears and CO measurement is not performed. Measure the injectate temperature to monitor CO.

NOTE

When drawing injectate into the syringe using the close injection kit or extension tube, always use the inline sensor. If the inline sensor is not used, the injectate temperature rises about 5 to 10°C (41 to 50°F) when passing through the extension tube and the temperature difference between the injectate in the bottle and injected injectate becomes large and the CO result may be higher than the actual value.

Preparing the Injectate

Prepare the injectate according to the following table.

Preparations	Injectate Temperature Measuring Method	Accuracy	Ease of Use	Sterilization	Running Cost
Use a closed injection kit	Inline sensor method	excellent	excellent	excellent	fair
Syringes iced in the container	Inline sensor method	excellent	good	good	fair
	Bath probe method	good	fair	fair	good
	None*	fair	good	good	good
Transfers injectate from iced injectate bottle to syringe	Inline sensor method	excellent	good	good	fair
	None*	good	excellent	good	good

* When the injectate is cooled down to 0°C (32°F).

Inline Sensor Method

When using the inline sensor method, prepare the injectate using one of the following methods.

- Using the close injection kit
  This method is easy and allows the monitor to determine the temperature of the injectate accurately. Use a close injection kit with a temperature sensor, close the circuit and inject the injectate.

Features

- Sterilization rate is very high because it is disposable and closed
- Measurements are accurate
- Easy to use (Can measure several times using one syringe)
- Both cooled injectate and room temperature injectate can be used and cooling time is short

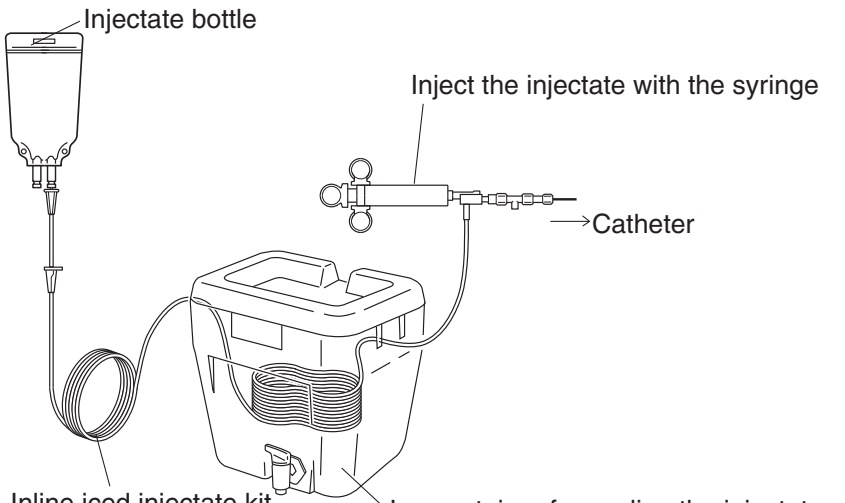
Example

When using the Argon Medical Devices catheter:

Inline iced injectate kit (SP-4500)

When using the Edwards Lifesciences (Baxter) catheter:

Injectate supply system (93-600, 93-610)



- Drawing directly from the injectate bottle or the container of the injectate
  As shown in the following diagram, draw the injectate directly from its bottle or the container containing the injectate, and inject into the circuit installing the temperature sensor. When drawing injectate from the container, wait about 15 minutes for the temperature of the injectate to reach equilibrium before injecting into the circuit.

  The temperature sensor detects the injectate temperature, and sends the data to the monitor.

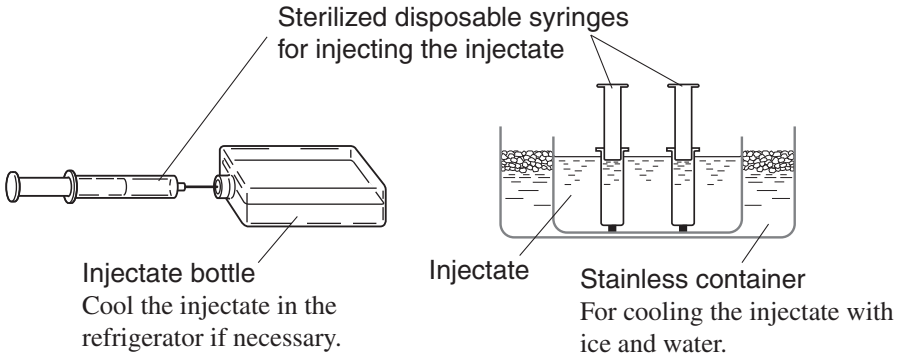
  Example

  When using the Argon Medical Devices catheter:

  Inline sensor (SP-5045)

  When using the Edwards Lifesciences (Baxter) catheter:

  Flow through injectate housing (93-505)



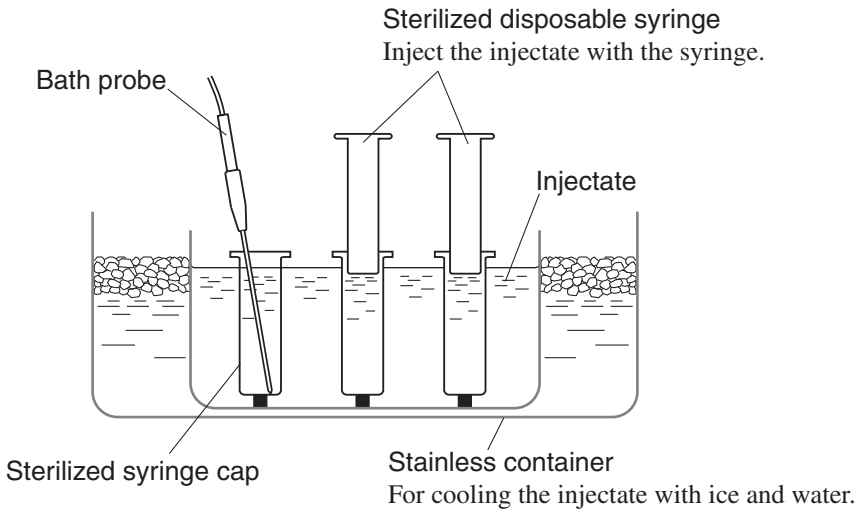
Bath Probe Method

When using the bath probe method, prepare the injectate as follows.

- Drawing the injectate from its container

  As shown in the following diagram, draw the injectate from its container and wait about 15 minutes for the injectate temperature to reach equilibrium before injecting it into the circuit.

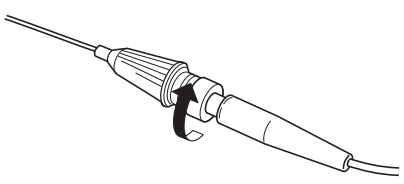
  Place the thermistor probe (SP-5030) installed in the circuit in the container, and have the monitor determine the injectate temperature.



Assembling the Measuring System

Connecting Cables to the Unit

1. Connect the thermistor connector of the catheter to the CO connection cord and secure it firmly with the ring.



2. Connect the CO connection cord to the MULTI socket.

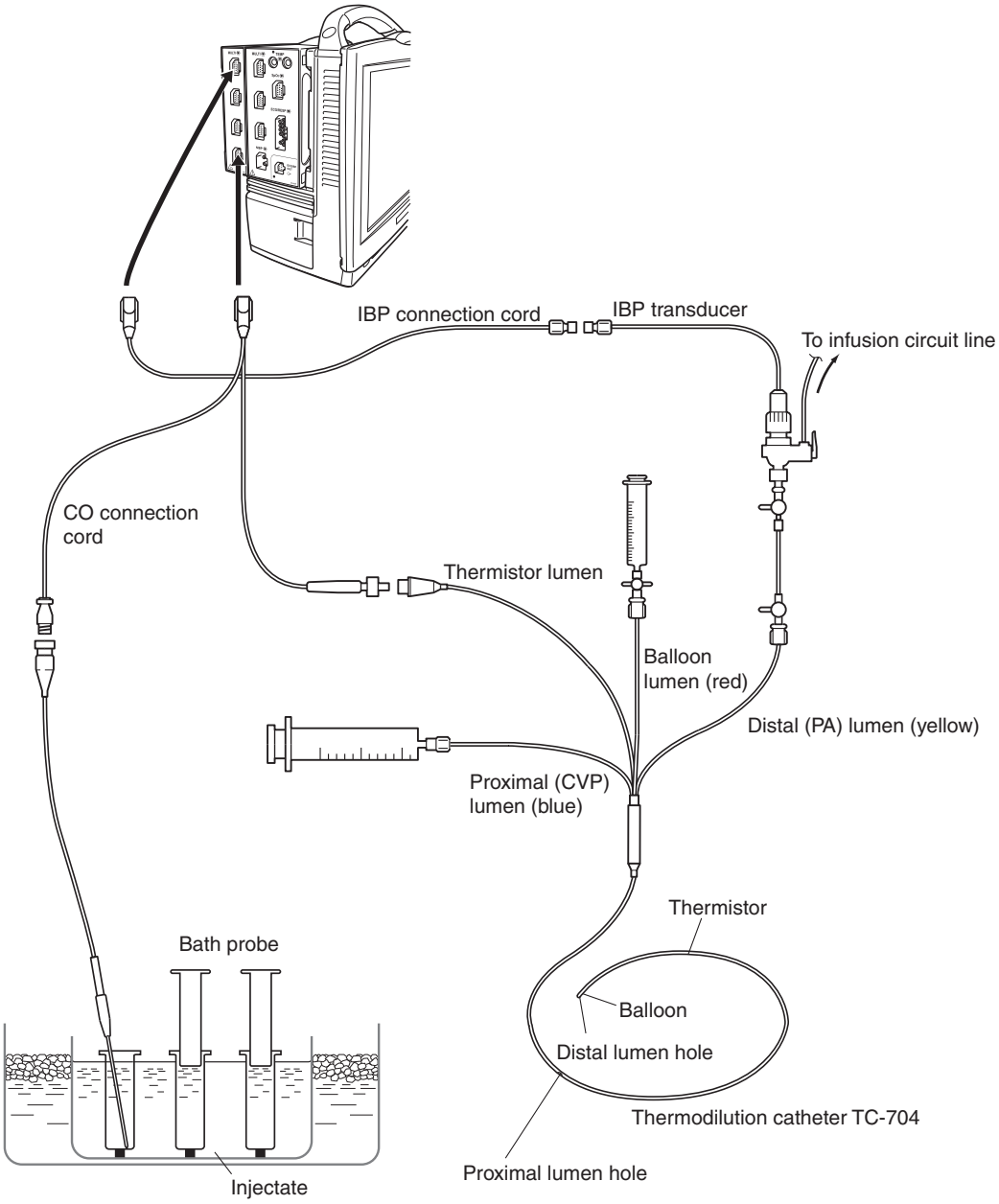
NOTE

CO cannot be monitored by using the MULTI socket on the AY-660P input unit.

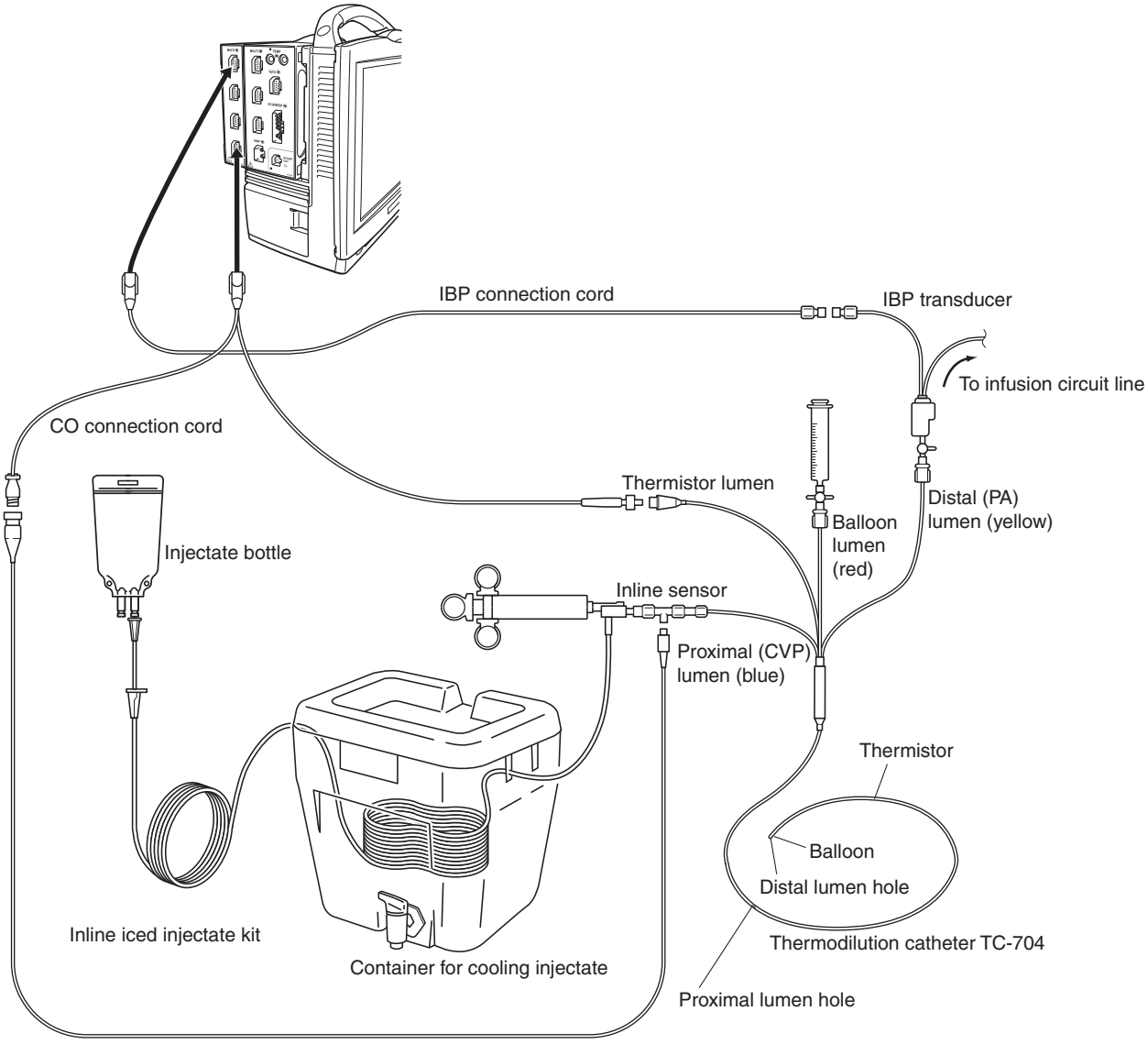
3. Connect the IBP connection cord to the MULTI socket.

Measuring System Setup Examples

When using the Argon Medical Devices Catheter TC-704 and measuring with the bath probe method



When using the Argon Medical Devices Catheter TC-704 and measuring with the inline sensor method



Changing Settings for CO Measurement

Before measurements, the coefficient value of the catheter and patient height and weight must be entered. Settings can be changed on the CO window.

NOTE

The settings, such as injectate volume and catheter size are necessary for calculating CO. These settings cannot be changed after measurement.

Setting the Coefficient Value

This monitor automatically calculates the coefficient value from five types of information: the manufacturer of catheter, catheter size, injectate volume, injectate temperature, and method of measuring the injectate temperature.

When using an Argon Medical Devices or Edwards Lifesciences (Baxter) catheter, the injectate temperature is automatically measured by this monitor. Enter the manufacturer of catheter, catheter size, injectate volume as follows. For an Argon Medical Devices catheter, the coefficient values are not specified by the manufacturer for the injectate temperature 5 to 18°C (41.0 to 64.4°F).

NOTE

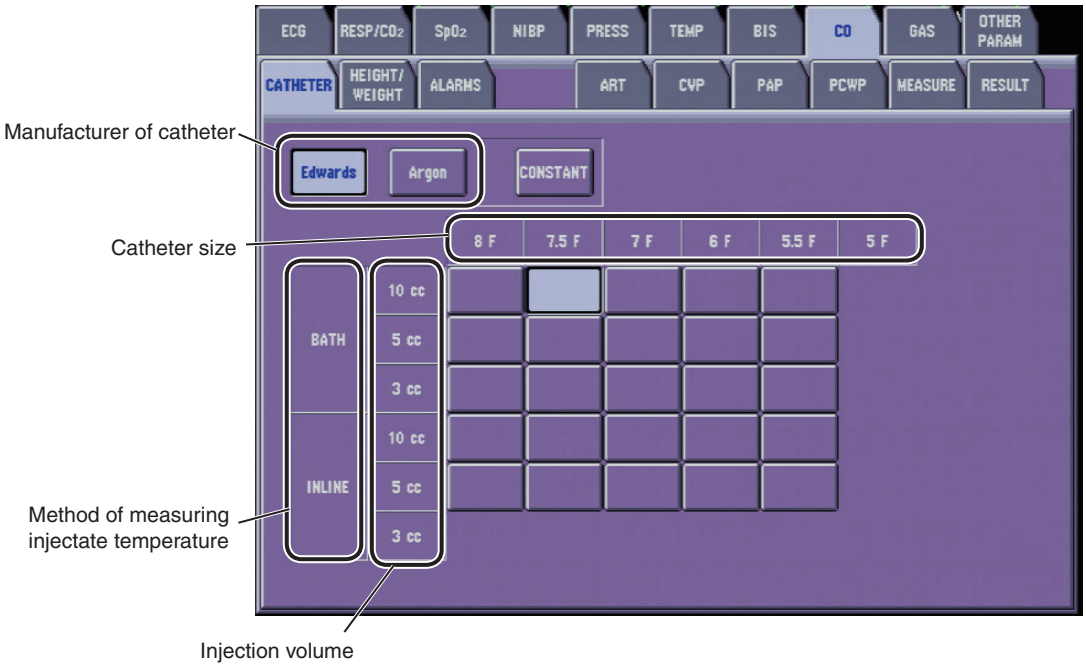
- The computation constant (coefficient value of the catheter) is necessary for calculating cardiac output. Before measurement, check that the computation constant for the catheter in the catheter manual. If the change is necessary, change the value before measurement.
- The computation constant on this monitor is a representative value. Before the setting, check the value in the catheter manual. If the value is different from the representative value or you are using a catheter which does not allow automatically calculating the computation constant, select “CONSTANT” and enter the computation constant manually.
- When using a catheter other than bath probe or inline sensor and not setting the injectate temperature on the monitor, select the coefficient value from the bath probe table. In this case, “– – –” is displayed for Ti on the screen.

Procedure

1. Display the CATHETER page of the CO window.
   Press the [Menu] key → CO key → CATHETER tab.

2. Select the manufacturer of the catheter (Argon or Edwards).

3. Select the areas corresponding to catheter size, method of measuring injectate temperature, and injectate volume.



To manually enter coefficient value:

i) Touch the CONSTANT key.

ii) Enter the computation constant with the numeric keys.

iii) Touch the ENT key to register the value. The entered value appears in the box.

NOTE

If the other window is displayed without touching the ENT key, the entered value is deleted.

The Preset Coefficient Value Settings

Edwards Lifesciences catheters

Injectate temperature 22.5 to 27°C, 70.5 to 80.6°F

Edwards		8F	7.5F	7F	6F	5.5F
Bath probe	10 cc	0.612	0.594	0.595	0.607	0.616
	5 cc	0.301	0.283	0.287	0.304	0.304
	3 cc	0.177	0.159	0.165	0.180	0.180
Inline sensor	10 cc	0.601	0.599	0.616	0.616	0.624
	5 cc	0.294	0.301	0.311	0.307	0.310
	3 cc	—	—	—	—	—

Injectate temperature 18 to 22.5°C, 64.4 to 70.5°F

Edwards		8F	7.5F	7F	6F	5.5F
Bath probe	10 cc	0.588	0.582	0.578	0.597	0.606
	5 cc	0.283	0.277	0.274	0.297	0.298
	3 cc	0.158	0.156	0.154	0.174	0.175
Inline sensor	10 cc	0.593	0.593	0.603	0.602	0.612
	5 cc	0.288	0.297	0.295	0.298	0.304
	3 cc	—	—	—	—	—

Injectate temperature 5 to 18°C, 41 to 64.4°F

Edwards		8F	7.5F	7F	6F	5.5F
Bath probe	10 cc	0.563	0.575	0.562	0.573	0.581
	5 cc	0.267	0.267	0.262	0.278	0.281
	3 cc	0.148	0.150	0.144	0.159	0.161
Inline sensor	10 cc	0.578	0.578	0.570	0.568	0.581
	5 cc	0.272	0.286	0.257	0.276	0.288
	3 cc	—	—	—	—	—

Injectate temperature 0 to 5°C, 32 to 41°F

Edwards		8F	7.5F	7F	6F	5.5F
Bath probe	10 cc	0.564	0.564	0.542	0.547	0.555
	5 cc	0.262	0.257	0.247	0.259	0.264
	3 cc	0.139	0.143	0.132	0.144	0.148
Inline sensor	10 cc	0.562	0.563	0.537	0.533	0.549
	5 cc	0.267	0.276	0.217	0.253	0.272
	3 cc	—	—	—	—	—

Argon Medical Devices catheters

Injectate temperature 23 to 25°C, 73.4 to 77°F

Argon Medical Devices		7.5F	7F	6F	5F
Bath probe	10 cc	0.628	0.628	—	—
	5 cc	0.309	0.309	0.309	0.316
	3 cc	0.181	0.181	0.181	0.188
Inline sensor	10 cc	0.628	0.628	—	—
	5 cc	0.309	0.309	0.309	0.316
	3 cc	0.181	0.181	0.181	0.188

Injectate temperature 18 to 23°C, 64.4 to 73.4°F

Argon Medical Devices		7.5F	7F	6F	5F
Bath probe	10 cc	0.628	0.628	—	—
	5 cc	0.309	0.309	0.312	0.312
	3 cc	0.181	0.181	0.184	0.184
Inline sensor	10 cc	0.628	0.628	—	—
	5 cc	0.309	0.309	0.312	0.312
	3 cc	0.181	0.181	0.184	0.184

Injectate temperature 0 to 5°C, 32 to 41°F

Argon Medical Devices		7.5F	7F	6F	5F
Bath probe	10 cc	0.566	0.566	—	—
	5 cc	0.270	0.270	0.270	0.279
	3 cc	0.151	0.151	0.151	0.160
Inline sensor	10 cc	0.579	0.579	—	—
	5 cc	0.281	0.281	0.281	0.291
	3 cc	0.160	0.160	0.160	0.170

Changing the Height and Weight

The height and weight data displayed on the CO window are the values entered for the patient information on the ADMIT page of the ADMIT DISCHARGE window. Because this data is used in the calculation of hemodynamics after CO measurement as BSA, check that it is correct before performing CO measurement.

When these values are changed, the settings on the ADMIT page of the ADMIT DISCHARGE window also change.

The units for height (cm or inch) and weight (kg or lbs) can be set on the SYSTEM CONFIGURATION screen. Refer to Section 2 of the Administrator's Guide.

1. Display the HEIGHT/WEIGHT page of the CO window.
   Press the [Menu] key → CO key → HEIGHT/WEIGHT tab.

2. Touch the HEIGHT key to change the height.
   Touch the WEIGHT key to change the weight.

3. Enter the value with the numeric keys.

4. Touch the ENT key to register the value. BSA is automatically calculated.

NOTE

If another window is opened before pressing the ENT key, the entered value is deleted.

Changing the Blood Temperature Alarm Setting

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

You can set the upper and lower blood temperature (Tb) alarm limits on the CO window. You can set all alarms, including the upper and lower Tb alarm limits, on the ALARM LIMITS window (See the Operator's Manual or Section 5 of the User's Guide Part I).

Setting Range

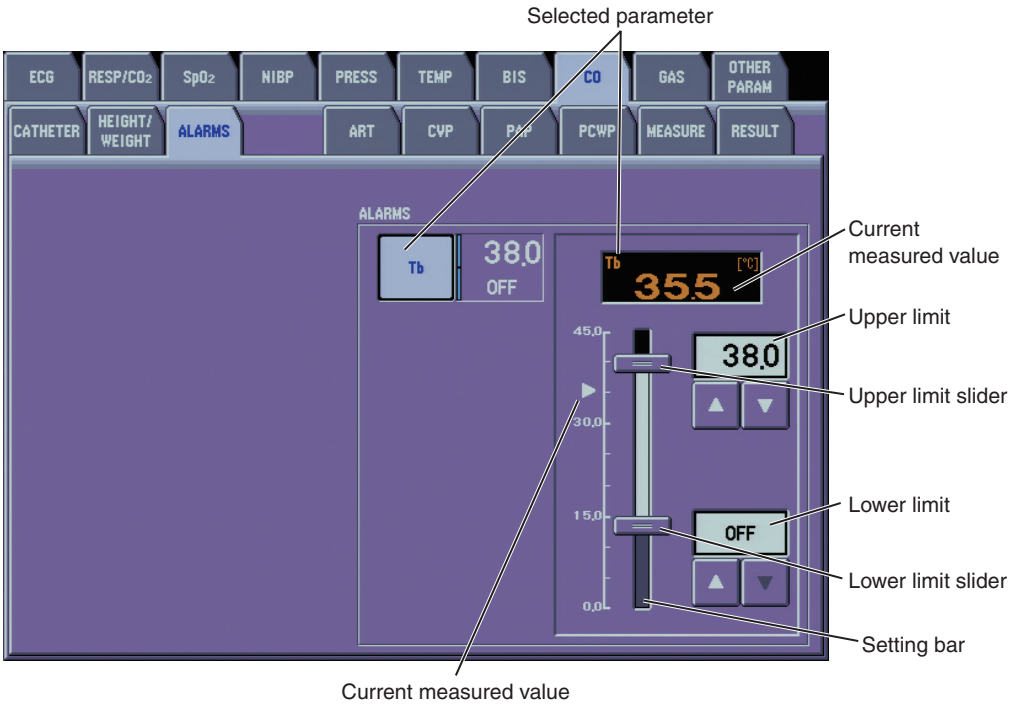
Tb upper limit: 15.1 to 45.0°C in 0.1°C steps (51 to 113°F in 1°F steps), OFF (default setting: ADULT: 38.0°C (100°F), CHILD: 38.5°C (101°F), NEONATE: 39.0°C (102°F))

Tb lower limit: OFF, 15.0 to 44.9°C in 0.1°C steps (50 to 112°F in 1°F steps) (default setting: OFF)

1. Display the ALARMS page of the CO window.
   Press the [Menu] key → CO key → ALARMS tab.

2. Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.



3. Press the [Home] key to return to the home screen.

Measuring the Pulmonary Capillary Wedge Pressure

Inserting and Retaining the Catheter in the Patient

For details and precautions on the methods of inserting the catheter, refer to relevant literature and manuals.

Inserting Position and Inserting Method

- Inserting position
  Elbow veins, basilic veins, external jugular veins, subclavian veins, femoral veins, and saphenous veins.
  Generally the upper limb arteries are used.

- Inserting method
  Arterial incision and Seldinger method.

Inserting the Catheter into the Patient and Monitoring Blood Pressure

WARNING

- Insert or remove the catheter from the pulmonary artery as quickly as possible. If it takes longer than about 10 seconds, pulmonary infarction, pulmonary hemorrhage or pulmonary artery perforation may occur.
- When inserting or removing the catheter, check the blood pressure waveform on the monitor, X-ray unit images, and other equipment. Do not depend on the insertion or removal messages displayed on the monitor.

NOTE

- Set the label to PAP to monitor the blood pressure for checking the catheter position.
- When inserting the catheter into the patient, monitor the blood pressure waveform and check the position of the catheter at all times.
- If inserting the catheter takes a long time, the catheter may soften from body heat or there may be spasm in the vein which makes inserting the catheter more difficult.
- Be careful not to burst the balloon. It may cause embolization. To inflate the balloon, use carbon dioxide and not air. Inflate the balloon slowly while observing the blood pressure waveform on the monitor.
- Arrhythmia may occur when the catheter is inserted through cardiac ventricle. Monitor ECG.

1. Insert the catheter to the right atrium quickly and inflate the balloon.

2. While checking the position of the catheter from the pressure waveform on the screen, push it slowly to the pulmonary artery in the direction of the blood flow.

3. After inserting the catheter to the position where the pulmonary capillary wedge pressure (PCWP) waveform can be obtained, deflate the balloon promptly, and check that the pulmonary artery pressure (PAP) waveform is obtained.

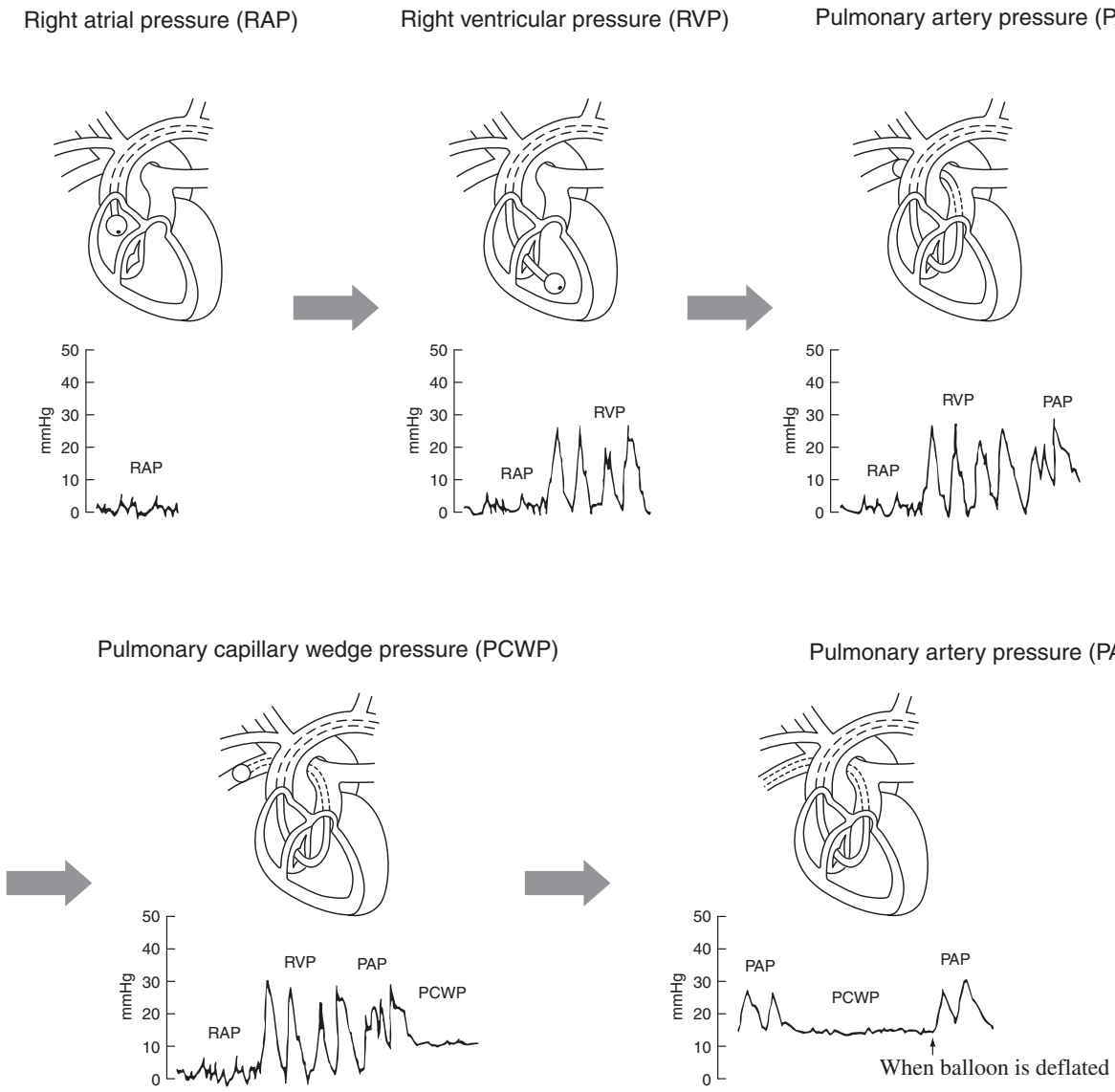
4. After determining the position at which the PCWP waveform is obtained when the balloon is inflated and the PAP waveform is obtained when deflated, retain the catheter in the pulmonary artery.

NOTE

Monitor the pulmonary artery pressure (PAP) waveform while retaining the catheter and check at all times that the tip of the catheter is at the main branches of the pulmonary artery and not wedging into a peripheral artery.

Measure the PCWP before CO measurement. Refer to the "Entering the Pulmonary Capillary Wedge Pressure and Other IBP Values" section.

Changes in Blood Pressure Waveform When Inserting Catheter (Example)

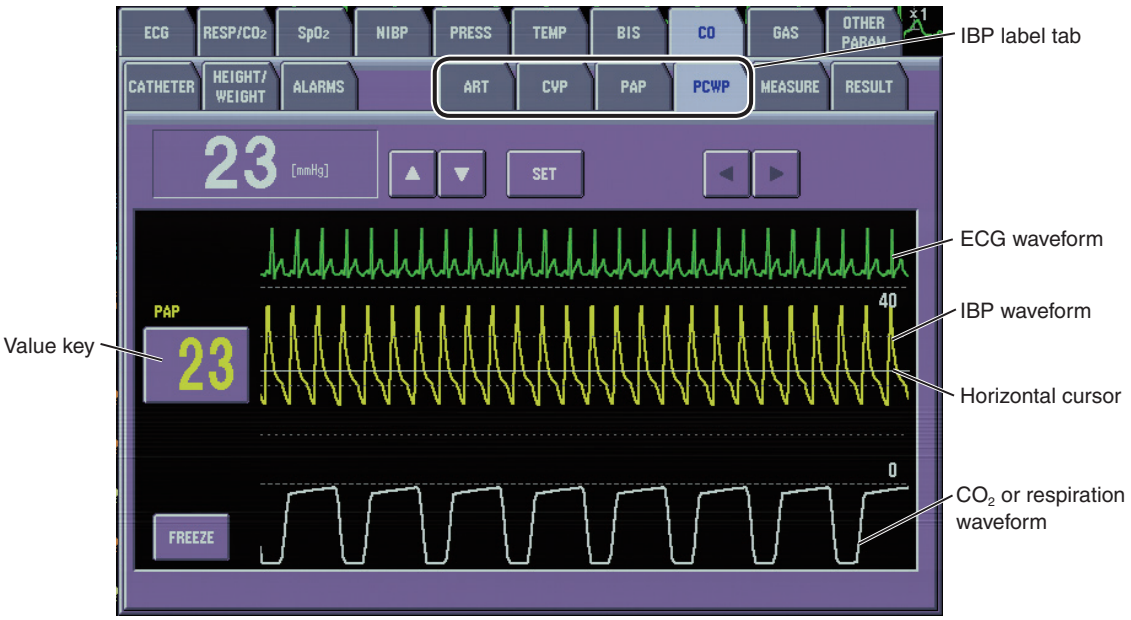


Entering the Pulmonary Capillary Wedge Pressure and Other IBP Values

Enter the PCWP and IBP values required for calculating CO. When the IBP lines are labeled correctly, these values are automatically entered.

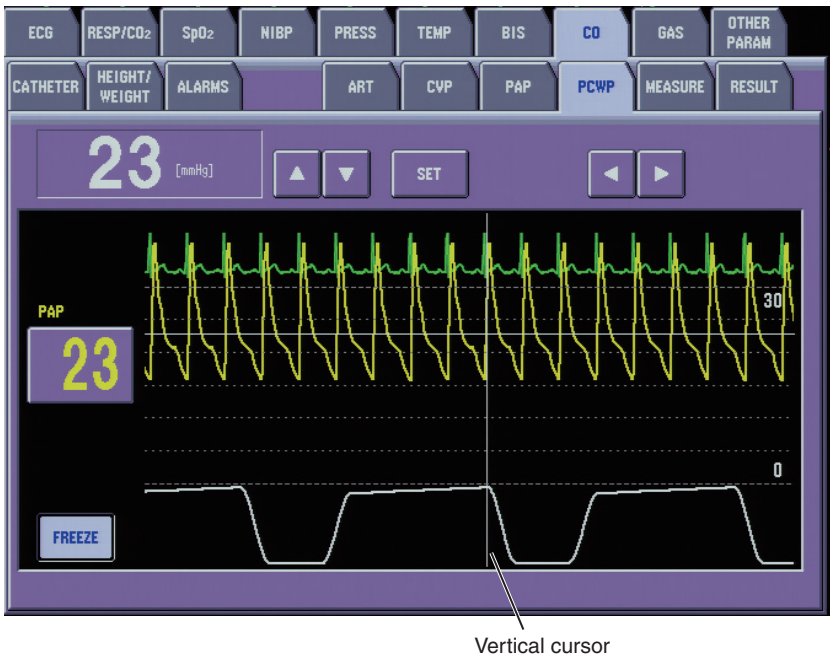
1. Display the IBP page of the CO window.
   Press the [Menu] key → CO key → IBP label tab.

   The value at the horizontal cursor appears in the value key beside the IBP waveform.



You can change the value by moving the horizontal cursor with your finger or the ▲ or ▼ keys.

You can freeze the waveforms by touching the FREEZE key. When the waveforms are frozen, a vertical cursor appears. You can scroll the waveforms by moving the vertical cursor with your finger or the ◄ or ► keys. To unfreeze the waveforms, touch the FREEZE key again.



2. Touch the SET key to enter the value in the table on the RESULT page.

NOTE

To add the PCWP and IBP values to the hemodynamics table, refer to the “Registering Acquired Data to the Hemodynamics Table on the TREND Window” section.

Measuring CO

Before Measurement

Do the following before measurement.

1. Completely fill the blood pressure transducer, dome and tubes with physiological saline with heparin to eliminate air completely.

2. Inject physiological saline with heparin in the CVP lumen of the catheter using a syringe and check that liquid flows out from the tip of the CVP lumen.

3. Fill the PA lumen with physiological saline with heparin.

Check the following before measurement.

1. Check the injectate temperature (Ti) on the home screen or the CO window.

NOTE

When the injectate temperature is not appropriate, the “OUT OF RANGE” message appears on the screen and CO cannot be measured.

2. Check that the injectate temperature measurement lines (thermistor probe and inline sensor) are connected correctly.

NOTE

For BSM-6000K series, if these lines are disconnected, the monitor assumes the injectate temperature to be 0°C. For BSM-6000A series, if these lines are disconnected, “---” is displayed for Ti, a “CHECK Ti TEMP” message appears and CO measurement is not performed.

3. Check the catheter settings on the CATHETER page of the CO window.

NOTE

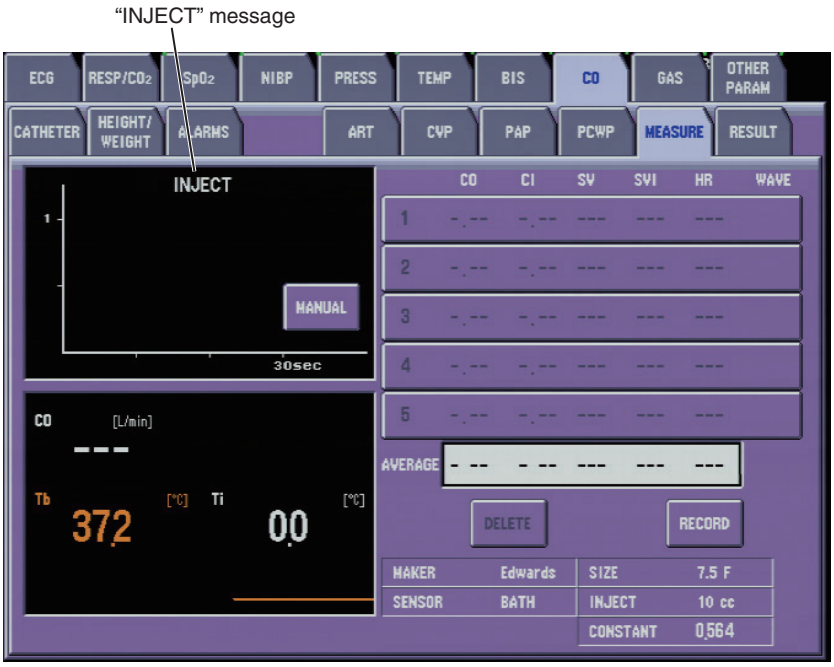
The settings, such as injectate volume and catheter size are necessary for calculating CO. These settings cannot be changed after measurement.

Measuring CO

CAUTION

Do not measure the cardiac output repeatedly at short intervals. Frequently injecting the injectate affects the measuring accuracy.

1. Display the MEASURE page of the CO window.
   Press the [Menu] key → CO key → MEASURE tab.



2. Check that the "INJECT" message is displayed on the CO window and inject the injectate quickly within 4 minutes. CO measurement starts.

NOTE

- If the injectate is not injected within 4 minutes, the "INJECTION TIME OUT" message appears. In this case, touch the MANUAL key on the MEASURE window and inject the injectate within 30 seconds.
- Inject the injectate as quickly and steadily as possible. Measurement cannot be performed correctly if injected slowly.

3. Check that the "MEASURING CO" message is displayed on the CO window.

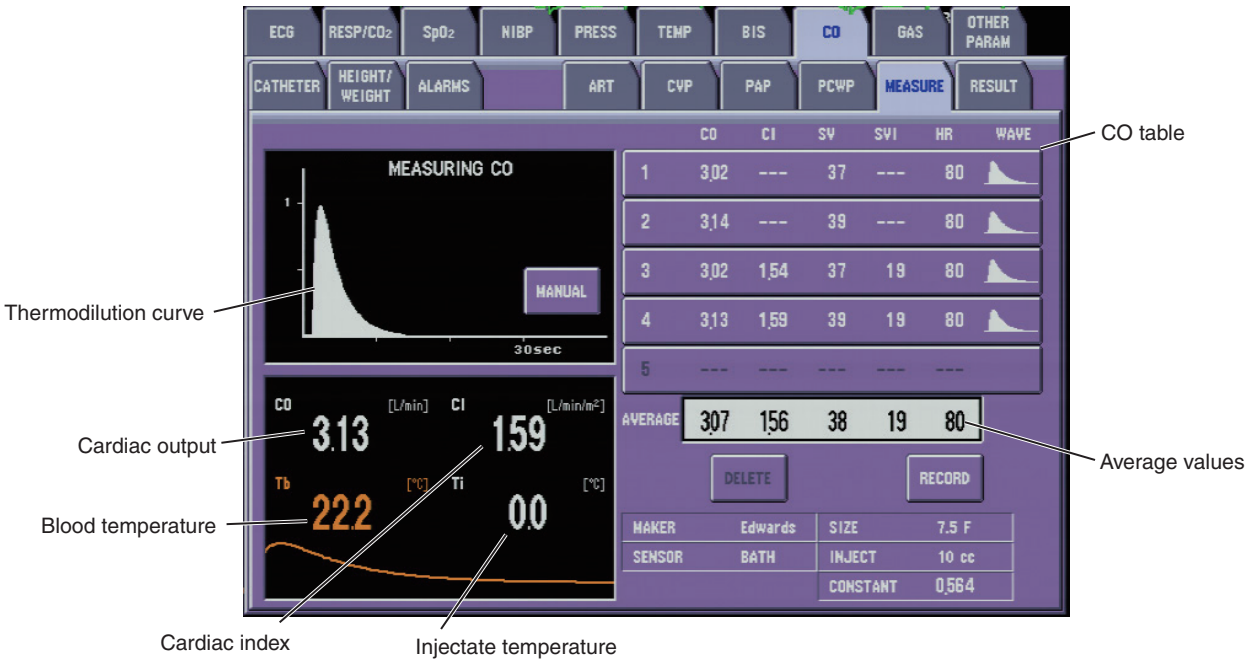
NOTE

The monitor has not acknowledged the injection if the "MEASURING CO" message is not displayed on the CO window within about 10 seconds after the injectate has been injected. If this happens, inject the injectate again.

When the CO value is calculated, the measurement results are displayed in the CO table on the CO window.

NOTE

Do not close the CO window before the measurement result is displayed in the CO table. Otherwise, the measured data will be lost.



When the “INJECT” message is displayed on the MEASURE window again, the injectate can be injected again.

Up to five measurement data can be stored in memory and displayed in the CO table. If more than five measurements are performed, the oldest data is deleted.

Current average CO and PCWP values and the measured time are displayed on the home screen. The data dims after 15 minutes and disappears from the home screen after 24 hours. When data is added to the hemodynamics trend table in the HEMO TREND page of the TREND window, the data disappears from the home screen.

NOTE

To register the CO data to the hemodynamics trend table, refer to the “Registering Acquired Data to the Hemodynamics Table on the TREND Window” section.

When Measurements Cannot be Performed Correctly

In some cases, measurements cannot be performed correctly because the baseline moves due to noise or conditions of the patient, such as physiological changes. In such cases, touch the MANUAL key on the MEASURE window and inject the injectate within 30 seconds. The point when the MANUAL key is pressed is the start of measurement.

NOTE

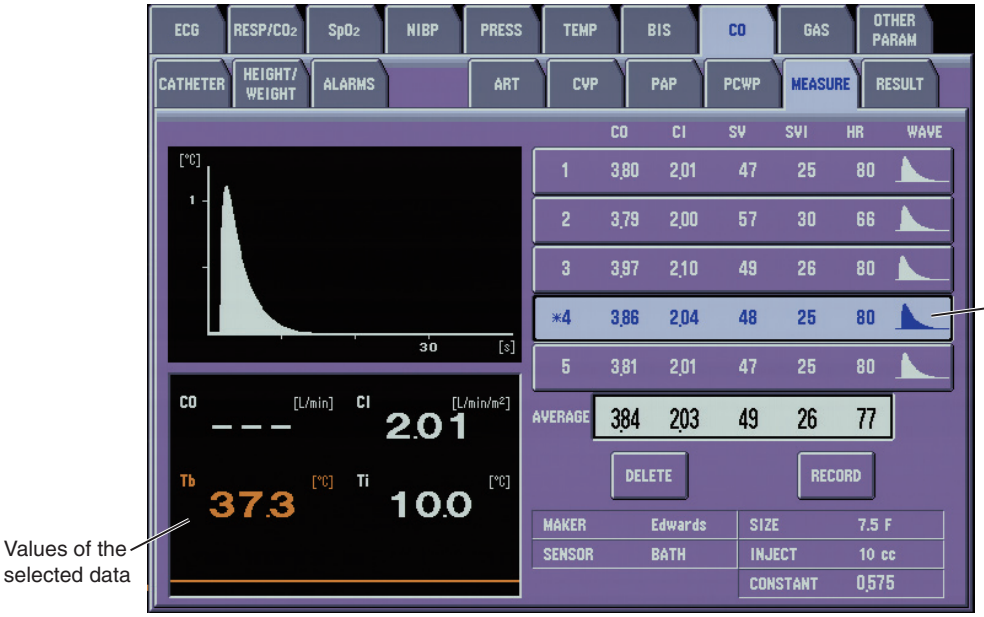
If the injectate is not injected within 30 seconds, the “INJECTION TIME OUT” message appears.

Deleting the Data from the CO Table

Up to five measurement data can be stored and displayed in the CO table on the CO window. Stored data can be deleted from the list.

1. Display the MEASURE page of the CO window.
   Press the [Menu] key → CO key → MEASURE tab.

2. Select the data to be deleted from the CO table. The thermodilution curve and measured values of the selected data appear on the left part of the CO window.



3. Touch the DELETE key to delete data. The average is calculated again.

Recording Hemodynamics Data

Up to 5 hemodynamics data and thermodilution curves on the CO window can be recorded on the optional recorder.

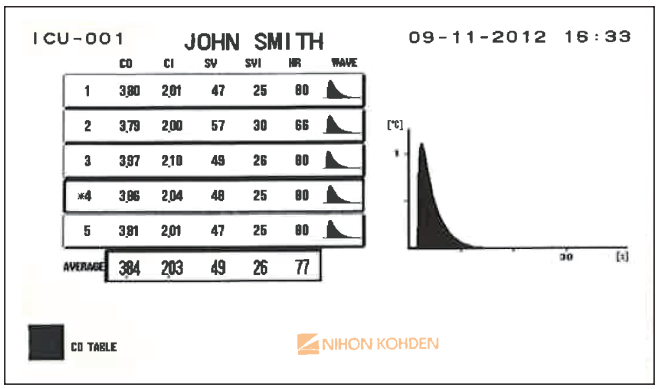
1. Display the MEASURE page of the CO window.
   Press the [Menu] key → CO key → MEASURE tab.

2. Touch the RECORD key on the MEASURE window.

   To stop recording, press the [Record] key.

3. Press the [Home] key to return to the home screen.

Recording example



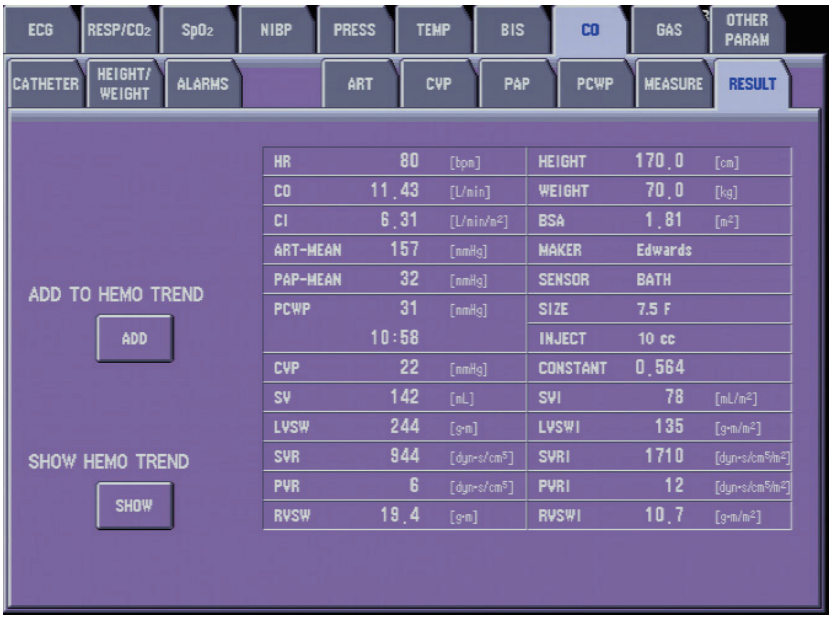
Adding Acquired Data to the Hemodynamics Table on the TREND Window

The acquired CO data can be added to the hemodynamics table on the HEMO TREND page of the TREND window. When data is added to the HEMO TREND page, the data disappears from the home screen and CO window. "- - -" appears on the CO data display area on the screen.

1. Display the RESULT page of the CO window.
   Press the [Menu] key → CO key → RESULT tab.

2. Touch the ADD key under the ADD TO HEMO TREND. The data on the RESULT window is added on the HEMO TREND page.

3. Touch the SHOW key under the SHOW HEMO TREND to display the HEMO TREND page. The added CO data is displayed on the HEMO TREND page. For details, refer to Section 6 of the User's Guide Part I.



Explanation of Hemodynamics Data

Label	Name	Unit	Explanation and Equation
HR	Heart rate	bpm	Heart rate at the time the CO is measured.
CO	Cardiac output	L/min	—
CI	Cardiac index	L/min/m^2	CI = CO/BSA*1
CCO	Continuous cardiac output	L/min	—
CCI	Continuous cardiac output index	L/min/m^2	CCI = CCO/BSA*1
PCCO*5	Pulse contour cardiac output	L/min	—
PCCI*5	Pulse contour cardiac output index	L/min/m^2	—
ART-MEAN	Arterial mean pressure	mmHg*2	Values registered at the time the CO is measured.
PAP-MEAN	Pulmonary arterial mean pressure		
PCWP	Pulmonary capillary wedge pressure		
PCWP TIME	PCWP time is measured	hr:min	
CVP	Central venous mean pressure	mmHg*2	
SV	Stroke volume	mL	SV = (CO × 1000)/HR
SVI	Stroke volume index	mL/m^2	SVI = (CI × 1000)/HR
SVR	Systemic vascular resistance	dyn•s/cm^5*3	SVR = {(ART-MEAN – CVP) × 80}/CO
SVRI	Systemic vascular resistance index	dyn•s•m^2/cm^5*4	SVRI = {(ART-MEAN – CVP) × 80}/CI
SVV	Stroke volume variation	%	—
PPV	Pulse pressure variation	%	—
PVR	Pulmonary vascular resistance	dyn•s/cm^5*3	PVR = {(PAP-MEAN – PCWP) × 80}/CO
PVRI	Pulmonary vascular resistance index	dyn•s•m^2/cm^5*4	PVRI = {(PAP-MEAN – PCWP) × 80}/CI
LVSW	Left ventricular stroke work	g•m	LVSW = {SV × (ART-MEAN – PCWP)} × 0.0136
LVSWI	Left ventricular stroke work index	g•m/m^2	LVSWI = {SVI × (ART-MEAN – PCWP)} × 0.0136
RVSW	Right ventricular stroke work	g•m	RVSW = {SV × (PAP-MEAN – CVP MEAN)} × 0.0136
RVSWI	Right ventricular stroke work index	g•m/m^2	RVSWI = {SVI × (PAP-MEAN – CVP MEAN)} × 0.0136
EDV	End diastolic volume	mL	—
EDVI	End diastolic volume index	mL/m^2	EDVI = EDV/BSA*1
GEDV*5	Global end-diastolic volume	mL	—
GEDVI*5	Global end-diastolic volume index	mL/m^2	—
ESV	End systolic volume	mL	—
ESVI	End systolic volume index	mL/m^2	ESVI = ESV/BSA*1
EF	Ejection fraction	%	—
GEF*5	Global ejection fraction	%	—
ITBV*5	Intrathoracic blood volume	mL	—
ITBVI*5	Intrathoracic blood volume index	mL/m^2	—
EVLW*5	Extravascular lung water	mL	—
EVLWI*5	Extravascular lung water index	mL/kg	—
CFI*5	Cardiac function index	/min	—
PVPI*5	Pulmonary vascular permeability index	—	—
dPmax*5	Left ventricular contractility index	mmHg*2/s	—

*1 BSA = 0.007184 × Weight$^{0.425}$ × Height$^{0.725}$ (m^2) (DuBois equation)

*2 The blood pressure unit can be changed to kPa on the can be changed on the SYSTEM CONFIGURATION screen of the bedside monitor.

*3 When the blood pressure unit is kPa, this unit becomes kPa•s/L.

*4 When the blood pressure unit is kPa, this unit becomes kPa•s•m^2/L.

*5 These parameters are monitored when a PiCCO monitor is used.

CO Value Calculation Equation/Coefficient Value Calculation Value

In this monitor, the CO value is calculated using the following equation.

$$CO = \frac{(1.08)Ct(60)V(Tb-Ti)}{1000\int_0^\infty \Delta Tbdt}$$

$$1.08 = \frac{\rho Cp \text{ in the injectate}}{\rho Cp \text{ in the blood}}$$

ρ : density
Cp: specific heat

Ct = Compensated coefficient (determined by the catheter manufacturer, size, V and Ti)
60 = seconds in a minute
V = Injectate volume (mL)
Tb = Blood temperature (℃)
Ti = Injectate temperature (℃)
$\int_0^\infty \Delta Tbdt$ = Integrated value of the thermodilution curve

$$\frac{(1.08)Ct(60)V}{1000} = \text{Coefficient value}$$

Section 10 Gas Monitoring

General

The concentration of gases administered to and respired by the patient during anesthesia can be monitored by connecting the AG-920R multigas unit, GF-110PA or GF-210R multigas unit or GF-120PA or GF-220R multigas/flow unit to the multi-link socket on the monitor. To connect the AG-920R multigas unit to the monitor, the QF-904P interface is required.

NOTE

- The GF-120PA or GF-220R multigas/flow unit is not available for BSM-6000A series.
- When an anesthetic machine is used with the AG-920R, GF-110PA/GF-210R multigas unit or GF-120PA/GF-220R multigas/flow unit:
  - The GAS window displays the parameters that are monitored on the multigas or multigas/flow unit.
  - The VENT window displays the parameters of the anesthetic machine.

Carbon dioxide (CO_2), nitrous oxide (N_2O), oxygen (O_2), and any of five anesthetic agents (Halothane, Isoflurane, Enflurane, Sevoflurane and Desflurane) are monitored on a real-time, breath-by-breath basis. The inspiration and expiration phases are detected from the instantaneous CO_2 concentration and the respiration rate is counted from these phases. The measured data are displayed on the home screen and can be viewed with reference to other vital sign data.

Measuring Parameters

Terms		Meaning	Unit	Measurement Method
RR		Respiration rate	Counts/min	—
O_2		Oxygen	%	Paramagnetic
CO_2		Carbon dioxide	mmHg	Non-dispersive infrared ray absorption
N_2O		Nitrous oxide	%	Non-dispersive infrared ray absorption
Agent	HAL	Halothane	%	Non-dispersive infrared ray absorption
	ISO	Isoflurane		
	ENF	Enflurane		
	SEV	Sevoflurane		
	DES	Desflurane		
MAC*		Minimum alveolar concentration	—	Calculated from the monitored gas

* MAC is only available when using the GF-110PA or GF-210R multigas unit or GF-120PA or GF-220R multigas/flow unit. Only uncorrected-MAC is available on BSM-6000A series.

Preparing for Gas Monitoring

1. Set up the multigas unit and connect the unit to the patient. Refer to the operator's manual of the AG-920R multigas unit, GF-110PA or GF-210R multigas unit or GF-120PA or GF-220R multigas/flow unit.

2. Perform calibration.

3. Select the sampling rate and change necessary settings when using an AG-920R or GF-110PA multigas unit or GF-120PA multigas/flow unit.

4. Start monitoring.

Monitoring Gas

After completing the preparation, gas data and waveforms appear on the screen.

Using AG-920R or GF-110PA Multigas Unit or GF-120PA Multigas/Flow Unit

NOTE

- The gas monitoring starts about 45 seconds after the [MEASURE] lamp on the multigas unit lights. The measurement accuracy is guaranteed for about 10 minutes after the [MEASURE] lamp lights.
- Inspired and expired values are not accurate soon after starting monitoring. These values stabilize after the respiration rate appears on the screen.

Auto Calibration

The monitor periodically performs the zero calibration with air at the following intervals. Manually perform the zero calibration when inappropriate measurement data appears and before performing gas calibration. It takes about 5 seconds for the zero calibration to complete. Refer to the “Performing Zero Calibration” section.

Using GF-210R Multigas Unit or GF-220R Multigas/Flow Unit

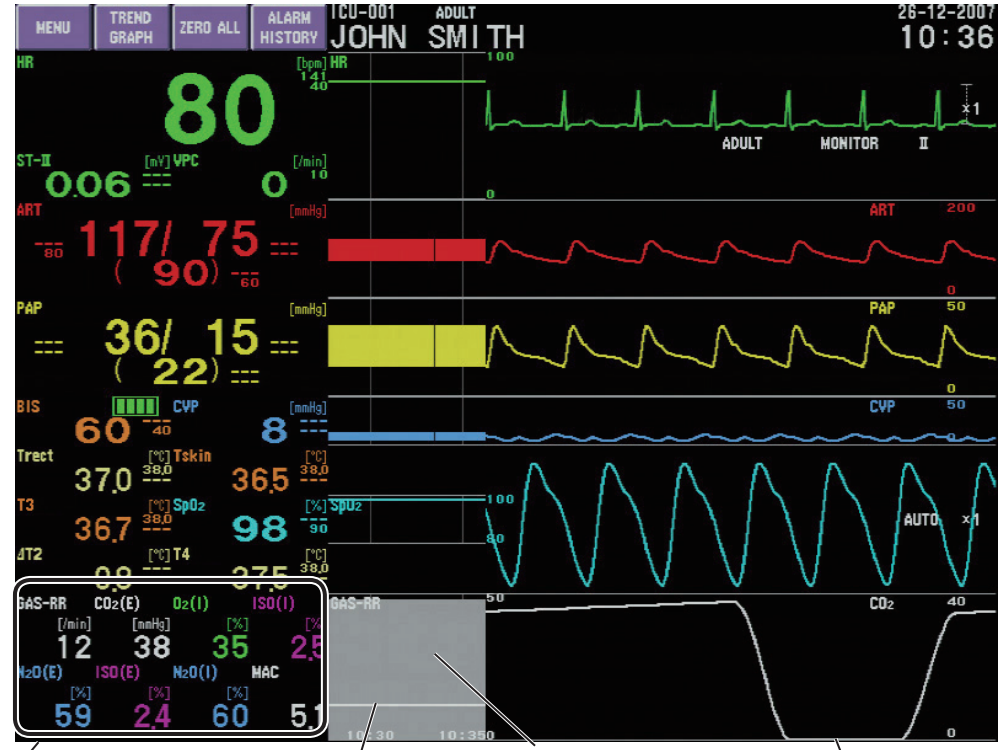
NOTE

- The gas monitoring starts about 1 minute after the [MEASURE] lamp on the multigas unit lights. The measurement accuracy is guaranteed for about 6 minutes after the [MEASURE] lamp lights.
- Inspired and expired values are not accurate soon after starting monitoring. These values stabilize after the respiration rate appears on the screen.

Auto Calibration

The monitor performs the zero calibration with air every 2 hours when the multigas unit is in the steady state. Manually perform the zero calibration when inappropriate measurement data appears. It takes about 1 minute for the zero calibration to complete. Refer to the “Performing Zero Calibration” section.

Gas Information on the Home Screen

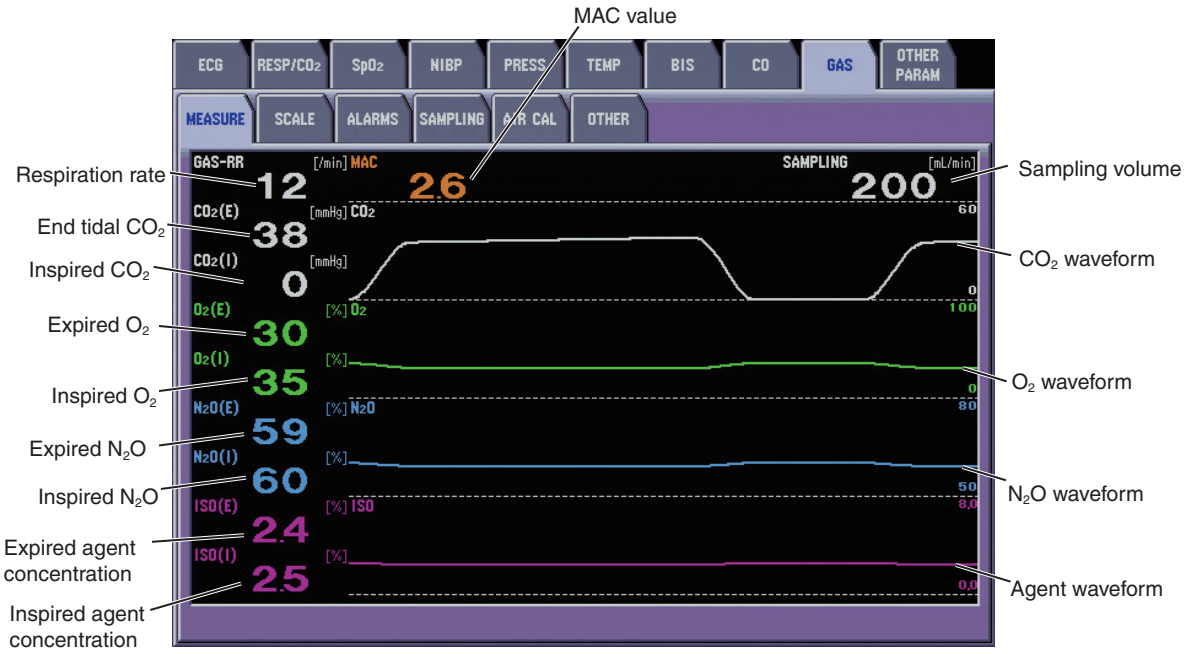


Up to 8 gas parameters selected on the OTHER page of the GAS window are displayed on the home screen. To change the displaying parameters, refer to the "Selecting Parameters to be Displayed on the Home Screen" section.

When an alarm occurs for a parameter which is not displayed on the screen, the displayed parameter changes to the alarmed parameter and is highlighted.

The type of MAC on the home screen depends on the MAC setting on the GAS page of the PARAMETERS window in the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

Gas Information on the GAS Window



Changing Gas Settings

Change the settings on the GAS window. The following settings can be changed for gas monitoring.

- Respiration rate, apnea, CO_2, O_2, N_2O and agent alarm settings
- Scale for CO_2, O_2, N_2O and agent waveforms
- Sampling rate (when using AG-920R or GF-110PA multigas unit or GF-120PA multigas/flow unit)
- Perform zero calibration
- Displaying gas parameters on the home screen
- Gas measurement on or off (when using GF-110PA or GF-210R multigas unit or GF-120PA or GF-220R multigas/flow unit)

The CO_2 unit can be set to mmHg or kPa on the SYSTEM CONFIGURATION screen. Refer to Section 2 of the Administrator's Guide.

The following settings can be set on the PARAMETERS window of the SYSTEM SETUP window when using GF-110PA or GF-210R multigas unit or GF-120PA or GF-220R multigas/flow unit. Refer to Section 3 of the Administrator's Guide.

- Set the time to delete anesthetic agent data from the home screen after the end of gas monitoring.
- Set the time to display spontaneous value instead of Fi/ET values for gas values when there is apnea.
- Select the temperature and humidity for compensating the CO_2 measurement values.
- Select the type of MAC to be displayed.
- Select whether or not to compensate the sampled gas rate when monitoring FLOW/Paw.

The display color for each gas can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

If the APNEA alarm occurs and no action is taken for a selected duration, the alarm level can be escalated. Refer to Section 3 of the Administrator's Guide.

Changing the Respiration Rate, Apnea and Gas Alarm Limits

WARNING

Change the anesthetic alarm settings by referring to anesthetic agent reference information.

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

You can set the upper and lower CO_2, O_2, N_2O, anesthetic agent, respiration rate and apnea alarm limits on the GAS window. You can set all alarms, including the upper and lower CO_2, O_2, N_2O, anesthetic agent, respiration rate and apnea alarm limits, on the ALARM LIMITS window (See the Operator's Manual or Section 5 of the User's Guide Part I). You can also set upper and lower respiration rate and apnea alarm limits on the RESP, CO_2 and FLOW/Paw windows. (FLOW/Paw window is not available for BSM-6000A series.) You can also set upper and lower CO_2 alarm limits on the CO_2 window. You can also set upper and lower O_2 alarm limits on the O_2 window.

Setting Range

$ETCO_2$ upper limit:	2 to 99 mmHg in 1 mmHg steps (0.2 to 13.5 kPa in 0.1 kPa steps), OFF (default setting: OFF)
$ETCO_2$ lower limit:	OFF, 1 to 98 mmHg in 1 mmHg steps (0.1 to 13.0 kPa in 0.1 kPa steps) (default setting: OFF)
CO_2 (I) upper limit:	1 to 99 mmHg in 1 mmHg steps (0.1 to 13.0 kPa in 0.1 kPa steps), OFF (default setting: ADULT OR, CHILD-3 mmHg (0.4 kPa), ADULT ICU/NICU, NEONATE-OFF)
O_2 (E) upper limit:	11 to 100% in 1% steps, OFF (default setting: OFF)
O_2 (E) lower limit:	OFF, 10 to 99% in 1% steps (default setting: OFF)
O_2 (I) upper limit:	19 to 100% in 1% steps, OFF (default setting: OFF)
O_2 (I) lower limit:	18 to 99% in 1% steps (default setting: 18%)
N_2O (E), N_2O (I) upper limit:	1 to 100% in 1% steps, OFF (default setting: N_2O (E) OFF, N_2O (I) 80%)
N_2O (E), N_2O (I) lower limit:	OFF, 0 to 99% in 1% steps (default setting: OFF)
HAL (E), HAL (I) upper limit:	0.1 to 7.0% in 0.1% steps, Off (default setting: HAL (E) OFF, HAL (I) 4.0%)
HAL (E), HAL (I) lower limit:	OFF, 0.0 to 6.9% in 0.1% steps (default setting: OFF)
ISO (E), ISO (I) upper limit:	0.1 to 7.0% in 0.1% steps, OFF (default setting: ISO (E) OFF, ISO (I) 5.0%)
ISO (E), ISO (I) lower limit:	OFF, 0.0 to 6.9% in 0.1% steps (default setting: OFF)

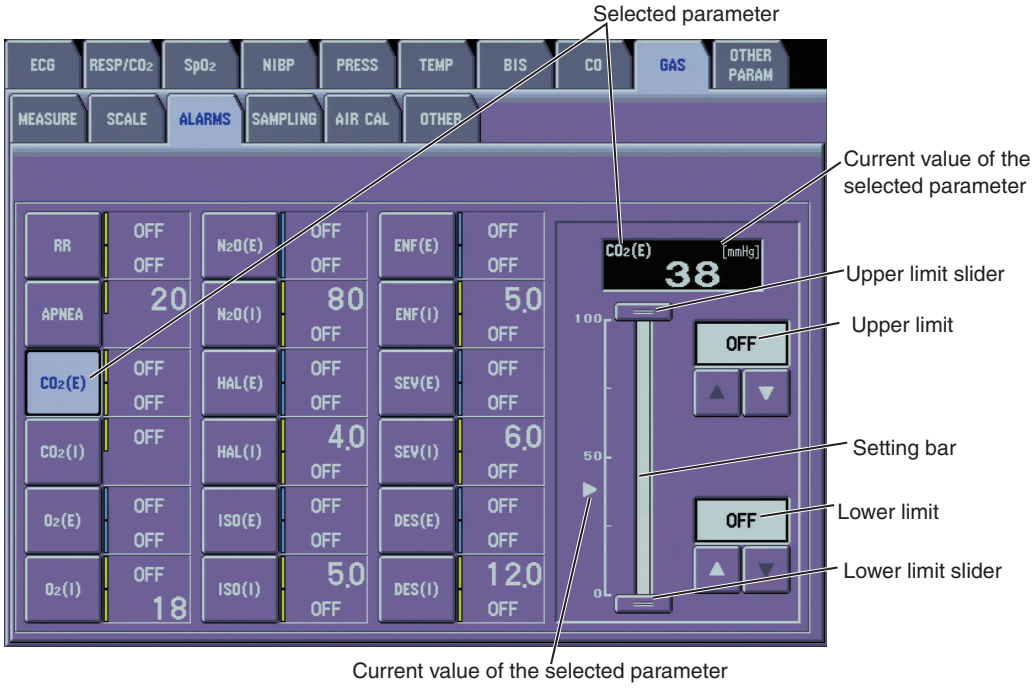
ENF (E), ENF (I) upper limit: 0.1 to 7.0% in 0.1% steps, OFF (default setting: ENF (E) OFF, ENF (I) 5.0%)
ENF (E), ENF (I) lower limit: OFF, 0.0 to 6.9% in 0.1% steps (default setting: OFF)
SEV (E), SEV (I) upper limit: 0.1 to 7.0% in 0.1% steps, OFF (default setting: SEV (E) OFF, SEV (I) 6.0%)
SEV (E), SEV (I) lower limit: OFF, 0.0 to 6.9% in 0.1% steps (default setting: OFF)
DES (E), DES (I) upper limit: 0.1 to 20.0% in 0.1% steps, OFF (default setting: DES (E) OFF, DES (I) 12%)
DES (E), DES (I) lower limit: OFF, 0.0 to 19.9% in 0.1% steps (default setting: OFF)
Respiration rate upper limit: 2 to 150 counts/min in 2 counts/min steps, OFF (default setting: OFF)*1*2
Respiration rate lower limit: OFF, 0 to 148 counts/min in 2 counts/min steps (default setting: OFF)*1*2
Apnea upper limit: 5 to 40 s in 5 s steps, OFF (default setting: 20)*1*2

*1 On BSM-6000A series, if <CRISIS VITAL ALARM MANAGEMENT> on the SYSTEM CONFIGURATION screen is turned on and "ALARM PRIORITY" on the SYSTEM SETUP window is set to CRISIS, the alarm setting is set to the alarm master setting.

*2 On BSM-6000A series, if <ALARM CAP> on the SYSTEM CONFIGURATION screen is turned on, the alarm setting is affected by the "ALARM CAP" setting on the SYSTEM SETUP window.

1. Display the ALARMS page of the GAS window.
   Press the [Menu] key → GAS key → ALARMS tab.

2. Touch the parameter key to change the alarm setting.



3. Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.
   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.

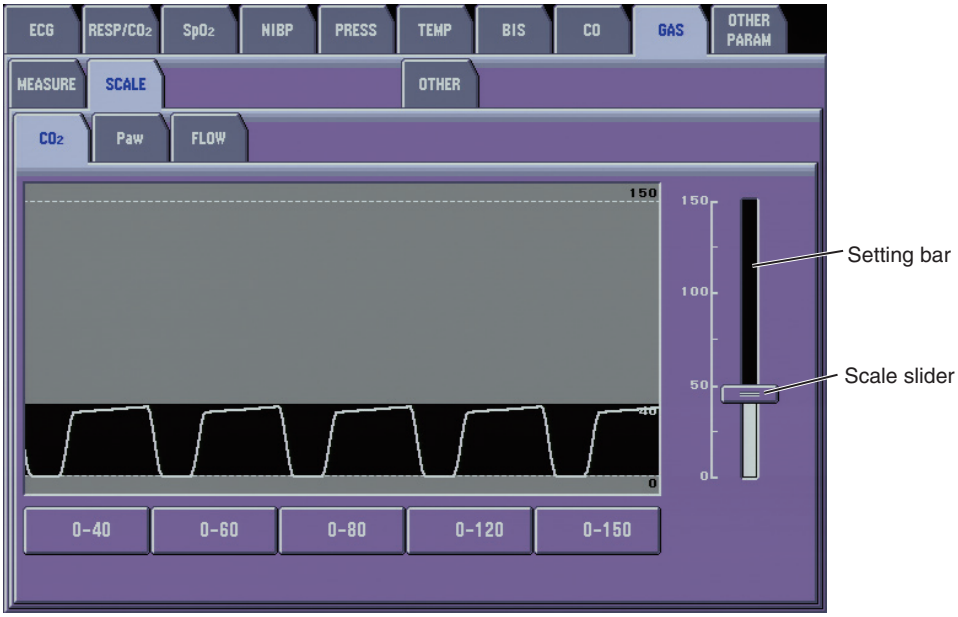
4. Press the [Home] key to return to the home screen.

Changing the Waveform Scale

The scale can be changed for the CO_2, O_2, N_2O and agent waveforms. The same scale is used on both the home screen and GAS window.

1. Display the SCALE page of the desired parameter on the GAS window.
   Press the [Menu] key → GAS key → SCALE tab → parameter tab.

2. Select the appropriate scale for the parameter. You can adjust the scale using the scale slider.



3. Press the [Home] key to return to the home screen.

Changing the Sampling Rate

This setting is not available when using a GF-210R multigas unit or GF-220R multigas/flow unit.

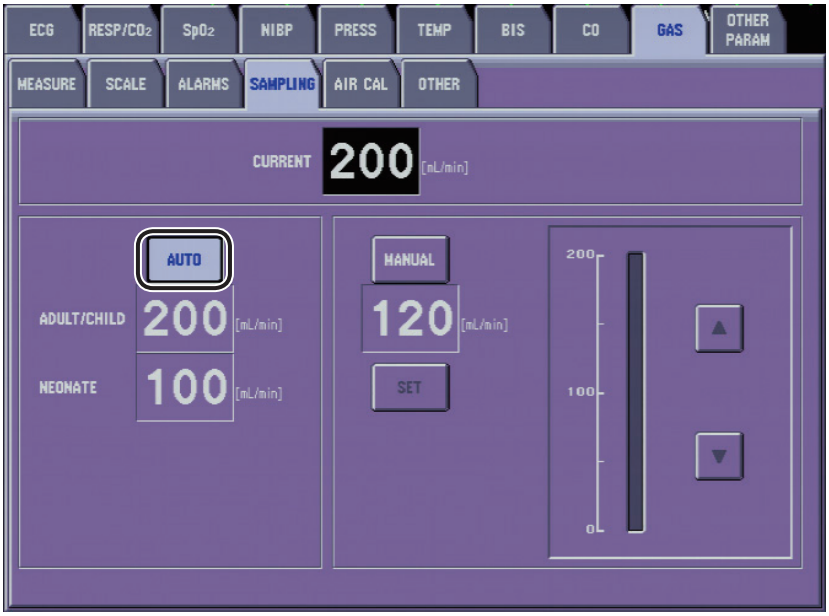
There is AUTO mode and MANUAL mode for the sampling rate. The default setting is AUTO.

AUTO mode: Sampling rate is 200 mL/min when a water trap for adult is connected to the multigas unit.
Sampling rate is 100 mL/min when a water trap for neonate is connected to the multigas unit.

MANUAL mode: You can select from 120 to 200 mL/min in 5 mL/min steps when a water trap for adult is connected to the multigas unit.
You can select from 70 to 120 mL/min in 5 mL/min steps when a water trap for neonate is connected to the multigas unit.
If a value outside this range is set, the mode changes to AUTO.

1. Display the SAMPLING page of the GAS window.
   Press the [Menu] key → GAS key → SAMPLING tab.

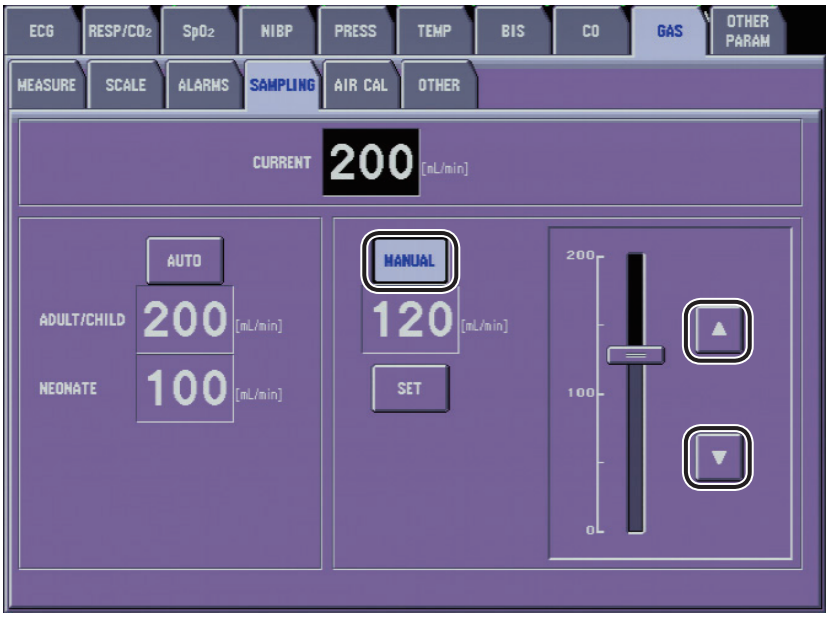
2. In Auto mode:
   Touch the AUTO key.



   In Manual mode:

   i) Touch the MANUAL key.

   ii) Touch or drag the slider to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.



   iii) Touch the SET key.

3. Press the [Home] key to return to the home screen.

Performing Zero Calibration

The monitor periodically performs the zero calibration with air.

When using a AG-920R or GF-110PA multigas unit or GF-120PA multigas/flow unit, manually perform the zero calibration when inappropriate measurement data appears and before performing gas calibration. It takes about 5 seconds for the zero calibration to complete.

When using a GF-210R multigas unit or GF-220R multigas/flow unit, manually perform the zero calibration when inappropriate measurement data appears. It takes about 1 minute for the zero calibration to complete.

1. Display the AIR CAL page of the GAS window.
   Press the [Menu] key → GAS key → AIR CAL tab.

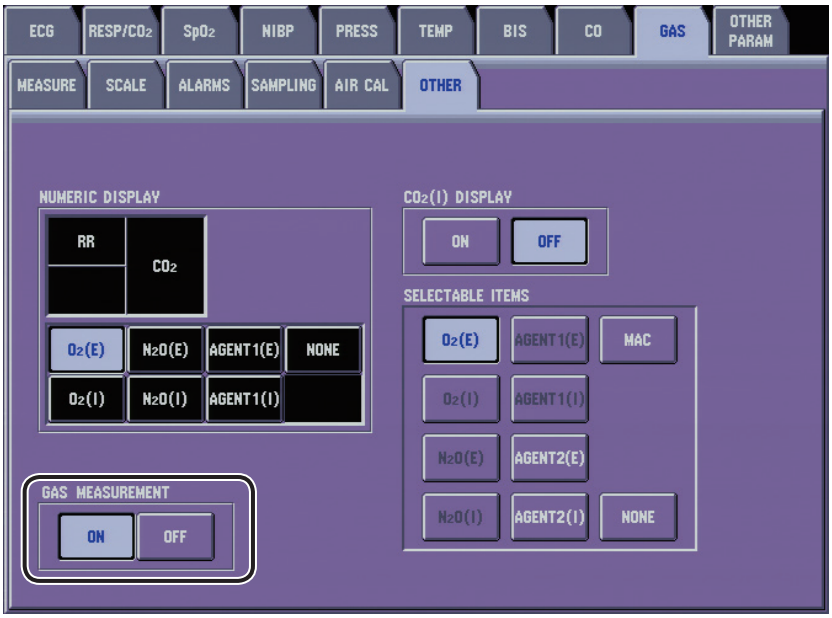
2. Touch the CAL key. Calibration is complete when the “CALIBRATING” message appears.

3. Press the [Home] key to return to the home screen.

Turning Gas Measurement On or Off

Gas measurement can be turned off only when using a GF-110PA or GF-210R multigas unit or GF-120PA or GF-220R multigas/flow unit.

1. Display the OTHER page of the GAS window.
   Press the [Menu] key → GAS key → OTHER tab.



2. Select ON or OFF in the <GAS MEASUREMENT> box to turn gas measurement on or off.

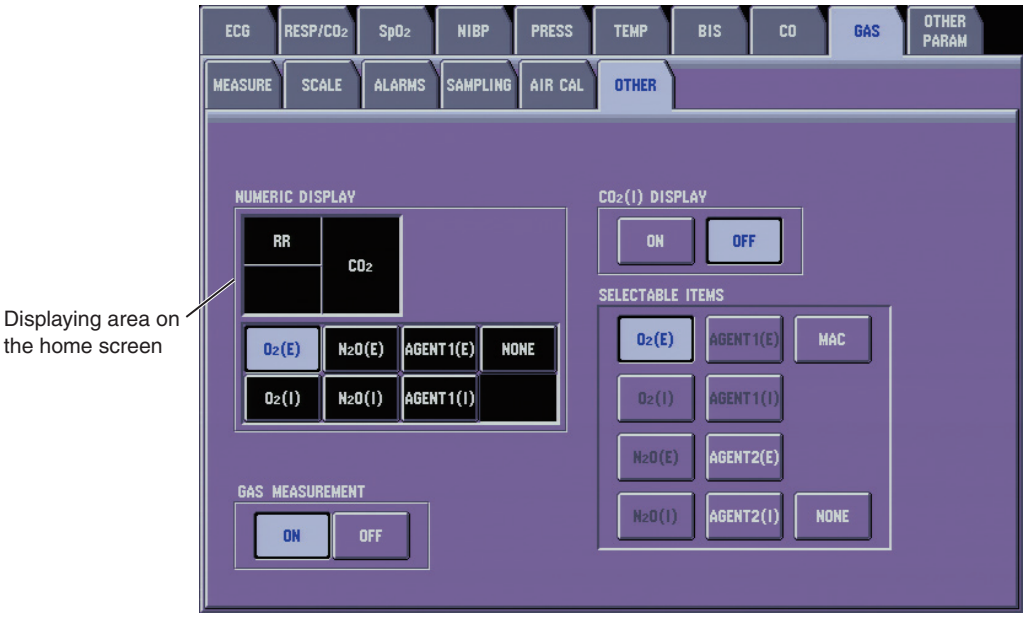
3. Press the [Home] key to return to the home screen.

Selecting the Parameters to be Displayed on the Home Screen

Up to 8 parameters can be displayed on the home screen. RR and CO_2(E) are always displayed. CO_2(I) display can be turned off independently of other items.

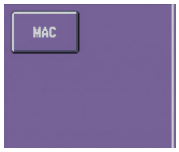
1. Display the OTHER page of the GAS window.
   Press the [Menu] key → GAS key → OTHER tab.

2. Select the parameters to be displayed from the <SELECTABLE ITEMS> box.



This screen example is when the “NUMERIC PARAMETER AREA” setting on the LAYOUT page of the SYSTEM window in the SYSTEM SETUP window is set to SIDE + SMALL BOTTOM or SIDE + LARGE BOTTOM. The screen layout depends on the NUMERIC PARAMETER AREA setting. Refer to Section 3 of the Administrator’s Guide.

When connecting the GF-110PA or GF-210R multigas unit or GF-120PA or GF-220R multigas/flow unit, the selectable items depend on the MAC setting on the GAS page of the PARAMETERS window in the SYSTEM SETUP window. Refer to Section 3, Administrator’s Guide. Only uncorrected-MAC is available on BSM-6000A series.

MAC setting		
UNCORRECTED	AMBIENT PRESSURE CORRECTED	ENHANCED
		

3. Press the [Home] key to return to the home screen.

Performing Gas Calibration

CAUTION

When the monitoring value is not appropriate, perform gas calibration. Perform gas calibration once a year for stable measuring accuracy.

For stable measurement accuracy, perform gas calibration every year and whenever you suspect the monitor is not reading correctly when using an AG-920R or GF-110PA multigas unit or GF-120PA multigas/flow unit. For details, refer to the Service Manual.

Section 11 O_2 Monitoring

General

To monitor O_2 (inspired oxygen concentration), attach the oxygen sensor (074705) to the patient's inspiration circuit and connect it to the MULTI socket.

The inspired oxygen concentration of the patient is continuously measured.

NOTE

The MULTI socket on the AY-660P input unit and BSM-1700 series bedside monitor cannot be used for monitoring O_2.

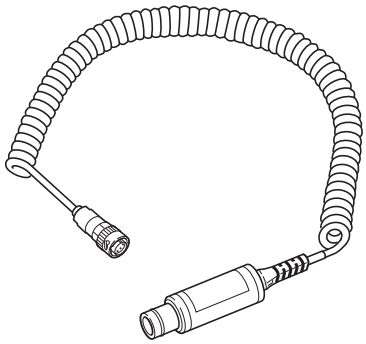
Preparing for O_2 Monitoring

Preparation Flowchart

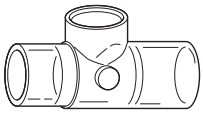
1. Connect the oxygen sensor to the FiO_2 connection cord and connect the FiO_2 connection cord to the MULTI socket.
2. Calibrate the oxygen sensor.
3. Connect the oxygen sensor to the inspiration circuit of the patient.
4. Start measurement (Start monitoring).

Oxygen Sensor and Connection Cord

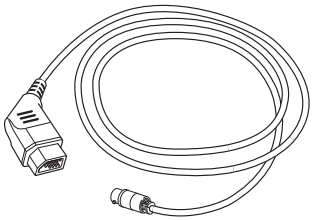
Oxygen sensor 074705



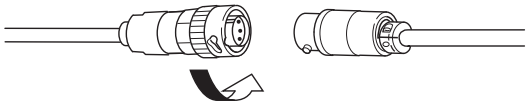
T-shaped adapter 110774



JO-900P FiO_2 connection cord



Connecting the Oxygen Sensor to the Unit

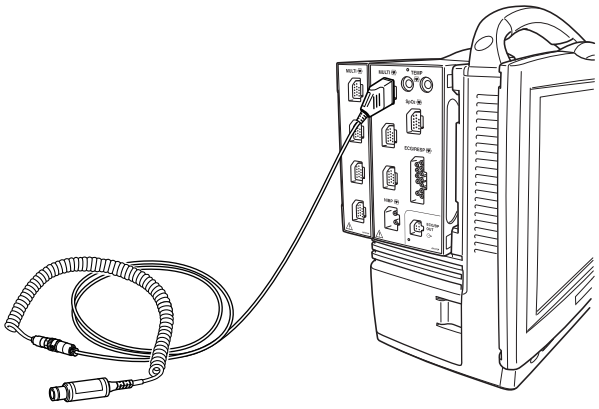


1. Connect the oxygen sensor to the FiO_2 connection cord.

NOTE

Rotate the ring until it clicks to lock it properly.

2. Connect the FiO_2 connection cord to the MULTI socket.



NOTE

The MULTI socket on the AY-660P input unit and BSM-1700 series bedside monitor cannot be used for monitoring O_2.

Calibrating the O_2 Sensor

Perform calibration in the following cases.

- When starting measurement.
- When more than 24 hours have passed since the last calibration.
- When the oxygen sensor is disconnected from the FiO_2 connection cord and connected again.
- When the measured value seems to be incorrect.

CAUTION

The oxygen sensor must be stored with the detector facing down. If the oxygen sensor is not stored with the detector facing down, the oxygen sensor must be left with the detector facing down for a few minutes before calibration. If the calibration is performed right after the oxygen sensor has been stored with the detector not facing down, calibration cannot be performed properly.

Calibration can be performed in two ways: air calibration and 100% O_2 calibration. Both methods are performed on the O_2 window.

- Calibration with air (simple method)
  Calibrates with air (21% O_2).
  The error margin of the measured value is 3%.
- Calibration with 100% O_2 (precise method)
  Calibrates with 100% O_2.
  The error margin of the measured value is 2%.

NOTE

The calibrated value is saved in memory in the connector of the FiO_2 connection cord. Once calibrated, you don't need to calibrate again when connecting the FiO_2 connection cord to the socket of a different unit.

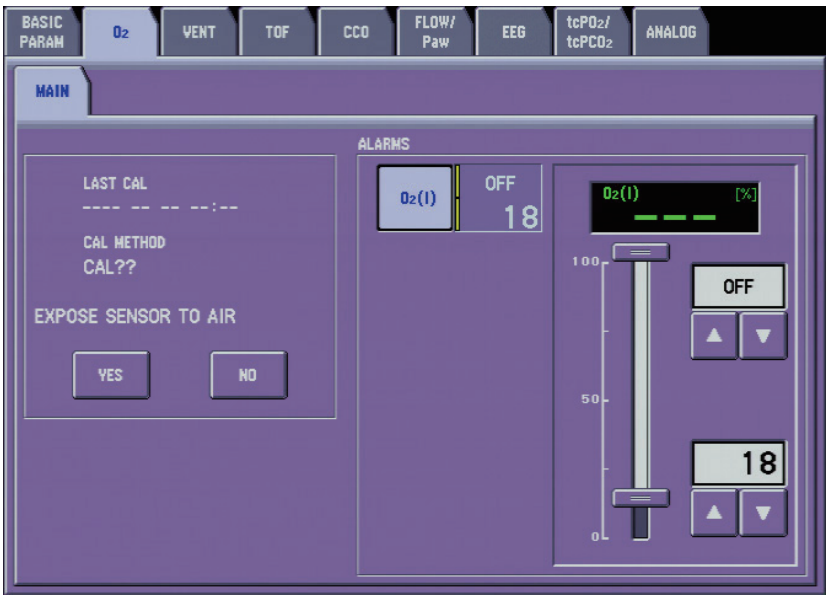
Calibration with Air (Simple Method)

1. Leave the oxygen sensor in the atmosphere for more than 1 minute.

2. Display the MAIN page of the O_2 window.
   Press the [Menu] key → O_2 key → MAIN tab.

3. Touch the AIR CAL key.

4. When the “EXPOSE SENSOR TO AIR” message is displayed, touch the YES key to start calibration.



When calibration is complete, the calibration date and time, and the O_2 value ‘21’ are displayed on the O_2 window.

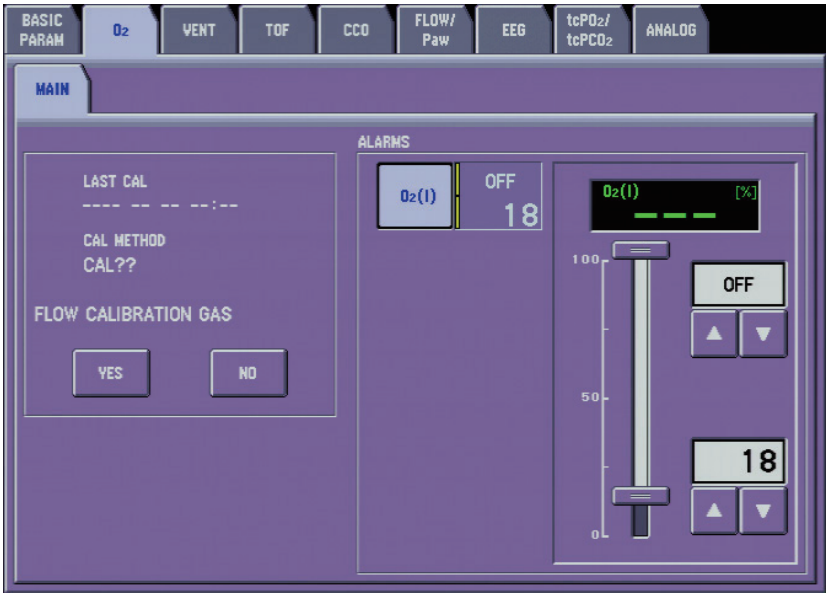
Calibration with 100% O_2 (Precise Method)

1. Apply 100% O_2 flow to the oxygen sensor for more than 1 minute.

2. Display the MAIN page of the O_2 window.
   Press the [Menu] key → O_2 key → MAIN tab.

3. Touch the O_2 CAL key.

4. When the "FLOW CALIBRATION GAS" message is displayed, touch the YES key to start calibration.



When calibration is complete, the calibration date and time, and the O_2 value '100' are displayed on the O_2 window.

Connecting the Oxygen Sensor to the Inspiration Circuit and Starting Measurement

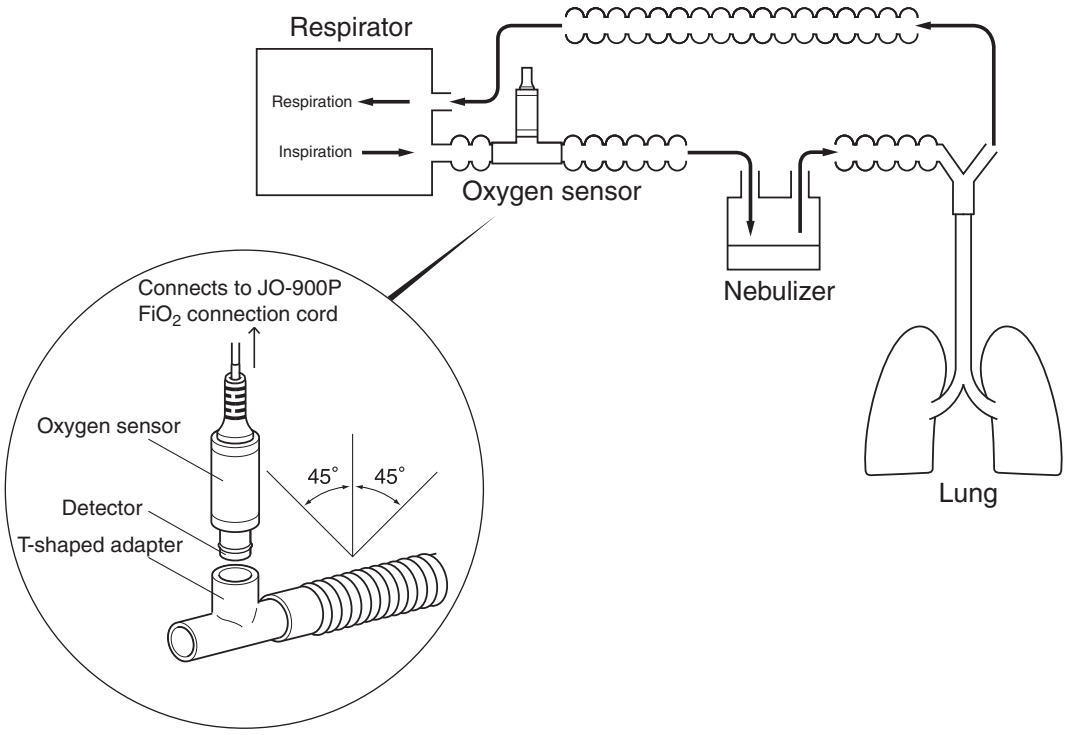
1. Connect the oxygen sensor to the T-shaped adapter.

2. Connect the T-shaped adapter properly to the inspiration circuit of the respirator, with the detector of the oxygen sensor facing down and the oxygen sensor at an inclination angle within 45° from the respirator vertically.

NOTE

- Connect the detector of the oxygen sensor facing down. Otherwise, the oxygen sensor function deteriorates and considerable errors in the measured value may occur.
- Do not connect the oxygen sensor where inspiration and expiration gas mix. The oxygen sensor cannot respond to each respiration.

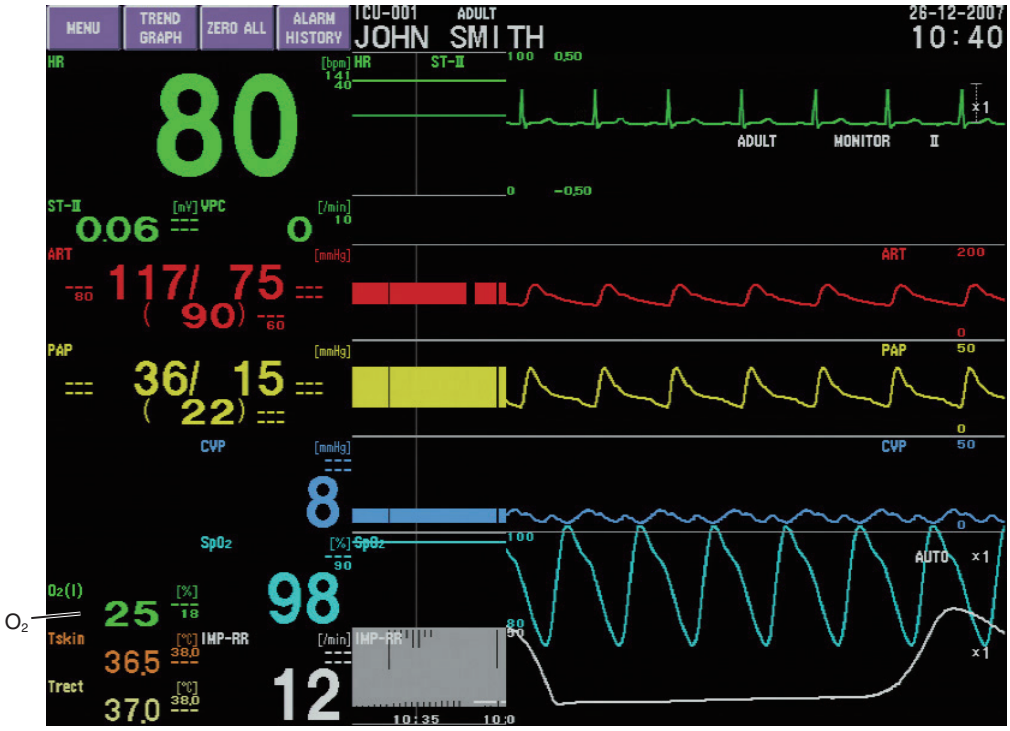
3. After connecting the oxygen sensor, you can start the O_2 monitoring.



Monitoring O_2

After completing the preparation, O_2 can be monitored.

O_2 Information on the Home Screen



Changing O_2 Settings

Change O_2 alarm settings on the O_2 window. The O_2 data display color can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

Changing the O_2 Alarm Limits

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

You can set the upper and lower O_2 alarm limits on the O_2 window. You can set all alarms, including the upper and lower O_2 alarm limits, on the ALARM LIMITS window (See the Operator's Manual or Section 5 of the User's Guide Part I). You can also set upper and lower O_2 alarm limits on the GAS window.

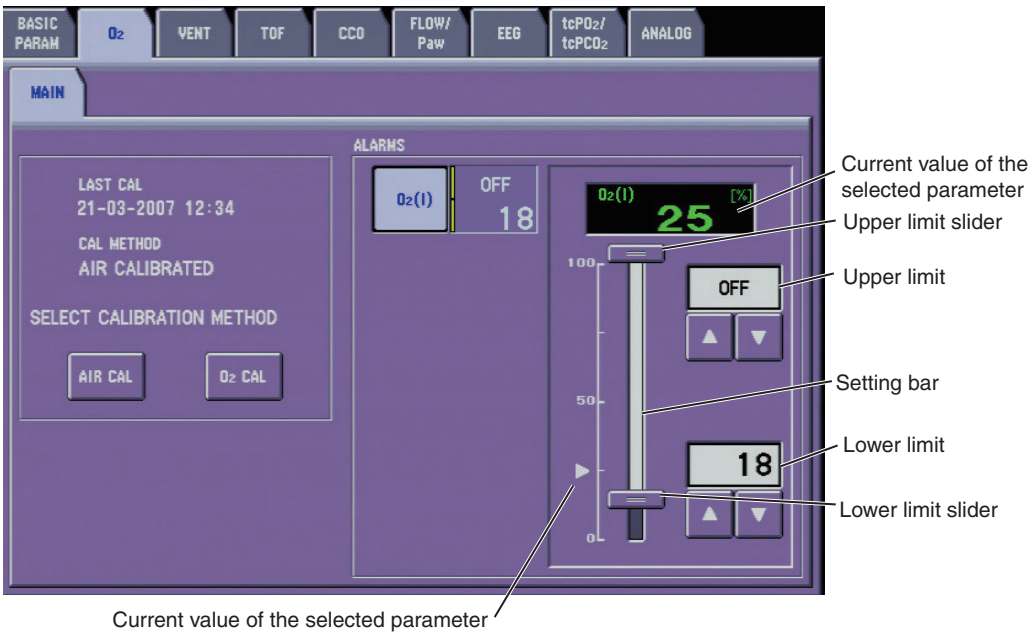
Setting Range

Upper limit: 19 to 100% in 1% steps, OFF (default setting: OFF)
Lower limit: 18 to 99% in 1% steps (default setting: 18%)

1. Display the MAIN page of the O_2 window.
   Press the [Menu] key → O_2 key → MAIN tab.

2. Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.

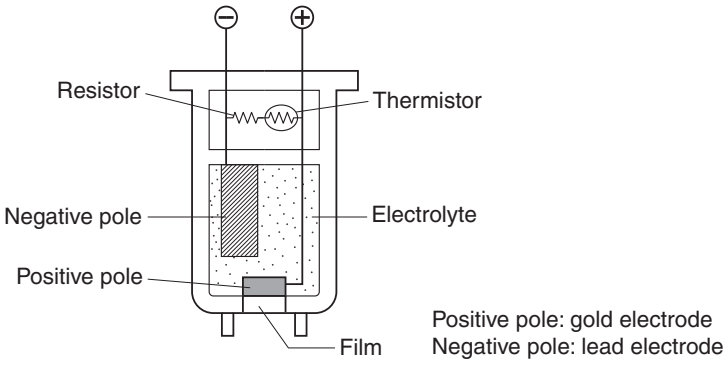


3. Press the [Home] key to return to the home screen.

Principle and Structure of Oxygen Sensor

Structure of Oxygen Sensor

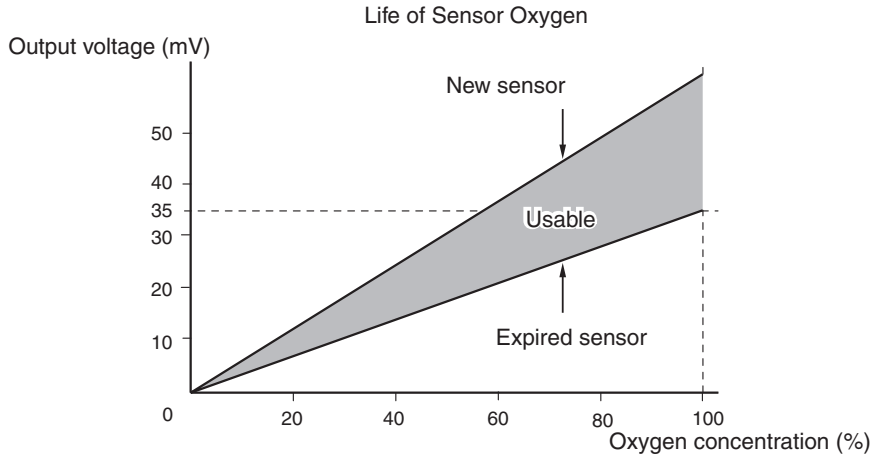
As shown below, the oxygen sensor is composed of an oxygen lead battery using special acidic electrolyte with the oxygen electrode (gold electrode) as the positive pole and the lead electrode as the negative pole. The oxygen in the measured air which passes through the non-multiparous fluorine-containing resin film and scatters, is electrolytically reduced at the gold electrode. A current proportional to the oxygen concentration in the atmosphere flows between the two electrodes. This current is detected as the terminal voltage of the resistor and thermistor for temperature compensation, and the oxygen concentration can be measured from the change in the output voltage. (See the graph below.)



Life Span of Oxygen Sensor

The oxygen sensor wears out after a certain period of time because it is an oxygen battery which generates voltage in reaction to the oxygen in the atmosphere. Its life span depends on the oxygen concentration of the measured atmosphere, and will be shorter when used in places with high oxygen concentration, and longer in places with low oxygen concentration. Since the oxygen sensor outputs voltage proportionate to the oxygen concentration, it has reached the end of its life span when the output voltage can no longer be obtained.

As shown in the below graph, as it nears the end of its life, the output voltage becomes smaller. When the output voltage of the sensor during 100% O_2 calibration is below 35 mV, it is determined to have reached the end of its life.

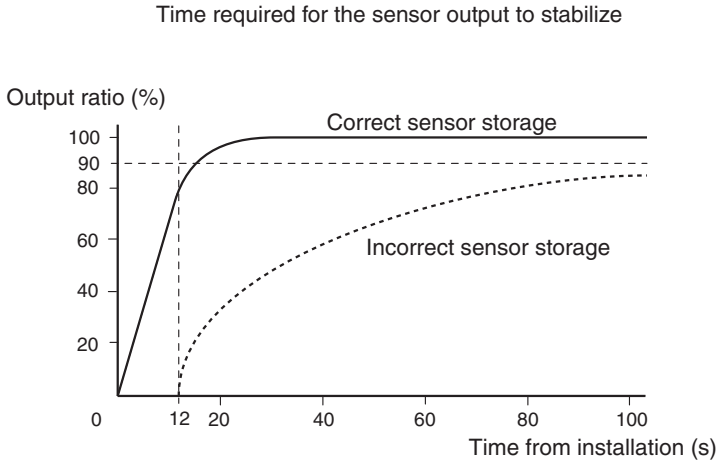


Precautions when Using the Oxygen Sensor

The electrolyte in the oxygen sensor contains air bubbles to protect the film and internal sensor parts from changes in the external voltage of the sensor (changes in atmospheric pressure). It serves as the buffer against pressure. For this reason, if the detector is not face down in use, these air bubbles will adhere to the film and electrodes and interfere with electrolytic response in the sensor, disabling correct measurement. Therefore, the detector of the oxygen sensor must be face down and at an inclination of within 45° vertically in use and storage. Leaving the detector face up will disable correct measurements for several minutes after the start of measurements.

When using an oxygen sensor not stored with the detector face down, face the detector down, leave it for several minutes to 12 hours, then perform calibration after the sensor output stabilizes.

The time for the sensor output to stabilize depends on the storage conditions. Refer to the graph below.



Section 12 Ventilator Monitoring

General

The measured data acquired by a ventilator can be displayed on the bedside monitor when the ventilator is connected to the monitor with the QF series interface or IF series communication cable. The measured values, waveforms, settings on the ventilator and alarm can be displayed on the bedside monitor screen.

NOTE

An anesthetic machine cannot be used together with a ventilator.

Monitoring Parameters and Settings

The parameters and settings that can be displayed on the monitor screen depend on the ventilator type as shown below.

Yes: displayed No: not displayed

QF-901P, QF-907P and QF-908P interfaces and IF-917P, IF-923P and IF-944P communication cables

Terms	Description	Unit	Cable and Ventilator Types					
			QF-901P Dräger	QF-907P Covidien Puritan Bennett	IF-923P Covidien Puritan Bennett 7200	QF-908P MAQUET	IF-917P HAMILTON	IF-944P HAMILTON-C1 HAMILTON-T1
FLOW	Respiratory flow rate	L/min	Yes	No	No	Yes	Yes	Yes
Paw	Airway pressure	cmH_2O*	Yes	No	No	Yes	Yes	Yes
Mode	Ventilation mode	—	Yes	Yes	Yes	Yes	Yes	Yes
Ppeak	Peak airway pressure	cmH_2O*	Yes	Yes	Yes	Yes	Yes	Yes
Pplat	Plateau pressure	cmH_2O*	Yes	Yes	Yes	Yes	Yes	Yes
Pmean	Mean airway pressure	cmH_2O*	Yes	Yes	Yes	Yes	Yes	Yes
PEEP	Positive end expiratory pressure	cmH_2O*	Yes	No	No	Yes	Yes	Yes
Pmin	Minimum airway pressure	cmH_2O*	Yes	No	No	No	Yes	No
CO_2(E)	End tidal CO_2 partial pressure	mmHg*	Yes	No	No	No	No	Yes
O_2(I)	Inspired oxygen	%	Yes	No	No	Yes	Yes	Yes
TEMP	Airway temperature	°C*	Yes	No	No	No	No	No
C	Compliance	mL/cmH_2O*	Yes	No	No	No	Yes	Yes
R	Resistance	cmH_2O*/L/s	Yes	No	No	No	Yes	No
RR	Respiration rate	/min	Yes	Yes	Yes	Yes	Yes	Yes
RRspo	Spontaneous respiration rate	/min	Yes	No	No	No	Yes	Yes
MV	Expiratory minute volume	L/min	Yes	Yes	Yes	Yes	Yes	Yes
MVspo	Spontaneous expiratory minute volume	L/min	Yes	Yes	Yes	No	No	No
TV	Tidal volume	L	Yes	Yes	Yes	Yes	Yes	Yes
I/E	Inspiration expiration ratio	—	No	Yes	No	No	No	No
Ppeak alarm limit	Peak airway pressure alarm setting	cmH_2O*	Yes	Yes	Yes	Yes	Yes	Yes
set PEEP	Positive end expiratory pressure setting	cmH_2O*	Yes	Yes	Yes	Yes	Yes	Yes
set FLOW(I)	Respiratory flow rate setting	L/min	Yes	Yes	Yes	No	Yes	No
CO_2(E) upper limit	End tidal CO_2 partial pressure upper alarm limit	mmHg*	Yes	No	No	No	No	No
CO_2(E) lower limit	End tidal CO_2 partial pressure lower alarm setting	mmHg*	Yes	No	No	No	No	No
set O_2(I)	Inspired oxygen setting	%	Yes	Yes	Yes	Yes	Yes	Yes
RR alarm limit	Respiration rate alarm setting	/min	Yes	Yes	Yes	No	Yes	Yes
MV upper limit	Expiratory minute volume upper alarm setting	L/min	Yes	No	No	Yes	Yes	Yes
MV lower limit	Expiratory minute volume lower alarm setting	L/min	Yes	Yes	Yes	Yes	Yes	Yes
set TV	Tidal volume setting	mL	Yes	Yes	Yes	No	Yes	Yes
set I/E	Inspiration expiration ratio setting	—	Yes	Yes	No	No	Yes	Yes

* The temperature unit (°C or °F), CO_2 unit (mmHg or kPa) and respiration unit (cmH_2O or hPa) can be changed on the SYSTEM CONFIGURATION screen on the bedside monitor.

IF-927P, IF-933P, IF-934P, IF-935P, IF-936P, IF-939P and IF-942P communication cables

Terms	Description	Unit	Cable and Ventilator Types						
			IF-927P CareFusion AVEA® or VELA®	IF-933P Resmed Elisee	IF-934P AirLiquid Monnal T75	IF-935P GE Helthcare Engstrom	IF-936P Heinen+Lowenstein Elisa	IF-939P GE Healthcare Centiva	IF-942P Dräger Evita Infinity V500
FLOW	Respiratory flow rate	L/min	Yes	Yes	No	Yes	Yes	Yes	Yes
Paw	Airway pressure	cmH_2O*	Yes	Yes	No	Yes	Yes	Yes	Yes
Mode	Ventilation mode	—	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ppeak	Peak airway pressure	cmH_2O*	Yes	No	Yes	Yes	Yes	Yes	Yes
Pplat	Plateau pressure	cmH_2O*	Yes	No	Yes	Yes	Yes	Yes	Yes
Pmean	Mean airway pressure	cmH_2O*	Yes	No	Yes	Yes	Yes	Yes	Yes
PEEP	Positive end expiratory pressure	cmH_2O*	Yes	No	Yes	Yes	Yes	Yes	Yes
Pmin	Minimum airway pressure	cmH_2O*	No	No	No	No	No	No	Yes
CO_2(E)	End tidal CO_2 partial pressure	mmHg*	Yes	No	No	Yes	No	No	Yes
O_2(I)	Inspired oxygen	%	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TEMP	Airway temperature	°C*	No	No	No	No	No	No	No
C	Compliance	mL/ cmH_2O*	Yes	No	No	Yes	Yes	Yes	Yes
R	Resistance	cmH_2O*/L/s	Yes	No	No	Yes	Yes	Yes	Yes
RR	Respiration rate	/min	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RRspo	Spontaneous respiration rate	/min	Yes	No	No	Yes	Yes	Yes	Yes
MV	Expiratory minute volume	L/min	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MVspo	Spontaneous expiratory minute volume	L/min	Yes	No	No	Yes	Yes	Yes	Yes
TV	Tidal volume	L	Yes	Yes	Yes	Yes	Yes	Yes	Yes
I/E	Inspiration expiration ratio	—	Yes	No	No	No	No	No	No
Ppeak alarm limit	Peak airway pressure alarm setting	cmH_2O*	Yes	No	Yes	Yes	No	No	Yes
set PEEP	Positive end expiratory pressure setting	cmH_2O*	Yes	Yes	Yes	Yes	Yes	Yes	Yes
set FLOW(I)	Respiratory flow rate setting	L/min	Yes	Yes	No	Yes	No	No	Yes
CO_2(E) upper limit	End tidal CO_2 partial pressure upper alarm limit	mmHg*	Yes	No	No	No	No	No	Yes
CO_2(E) lower limit	End tidal CO_2 partial pressure lower alarm setting	mmHg*	Yes	No	No	No	No	No	Yes
set O_2(I)	Inspired oxygen setting	%	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RR alarm limit	Respiration rate alarm setting	/min	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MV upper limit	Expiratory minute volume upper alarm setting	L/min	Yes	Yes	Yes	Yes	Yes	Yes	No
MV lower limit	Expiratory minute volume lower alarm setting	L/min	Yes	Yes	Yes	Yes	Yes	Yes	No
set TV	Tidal volume setting	mL	Yes	Yes	Yes	Yes	Yes	Yes	Yes
set I/E	Inspiration expiration ratio setting	—	No	No	No	Yes	Yes	Yes	Yes

IF-928P, IF-938P and IF-943P communication cables

Terms	Description	Unit	Cable and Ventilator Types						
			IF-928P Dräger	IF-938P Metran				IF-943P Dräger	
			Babylog 8000 plus	R100		Caliope α		Babylog VN500	
				HFO	Others	HFO	Others	HFO	Others
FLOW	Respiratory flow rate	L/min	Yes	No	Yes	No	No	No	Yes
Paw	Airway pressure	cmH_2O*	Yes	No	Yes	No	Yes	No	Yes
VOL	Respiratory volume	mL	No	No	Yes	No	No	No	Yes
Mode	Ventilation mode	—	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R	Resistance	cmH_2O*/L/s	Yes	No	No	No	No	Yes	Yes
Pmean	Mean airway pressure	cmH_2O*	Yes	No	Yes	No	Yes	No	Yes
Pplat	Plateau pressure	cmH_2O*	No	No	Yes	No	No	No	No
PEEP	Positive end expiratory pressure	cmH_2O*	Yes	No	Yes	No	Yes	Yes	Yes
Ppeak	Peak airway pressure	cmH_2O*	Yes	No	Yes	No	Yes	Yes	Yes
RRspo	Spontaneous respiration rate	/min	No	No	Yes	No	No	Yes	Yes
RR	Respiration rate	/min	Yes	No	Yes	No	No	Yes	Yes
C20/C	Dynamic compliance during the last 20% of the inspiratory phase in relationship to the total dynamic compliance	—	Yes	No	No	No	No	Yes	Yes
I:E	Inspiration expiration ratio	—	No	No	Yes	No	No	Yes	Yes
C	Compliance	mL/cmH_2O*	Yes	No	No	No	No	Yes	Yes
MVspo	Spontaneous expiratory minute volume	L/min	No	No	Yes	No	No	No	No
MV	Expiratory minute volume	L/min	Yes	No	Yes	No	No	Yes	Yes
TVe	Expiratory tidal volume	mL	Yes	No	Yes	No	No	Yes	Yes
O_2	Oxygen	%	Yes	Yes	Yes	No	No	Yes	Yes
Tc	Time Constant	ms	Yes	No	No	No	No	Yes	Yes
r	Correlation Coefficient	—	Yes	No	No	No	No	No	No
RVR	Rate - Volume Ratio	/min, mL	Yes	No	No	No	No	No	No
Tispo	Spontaneous Inspiration Time	s	Yes	No	No	No	No	Yes	Yes
DCO_2	Gas Transport Coefficient	mL^2/s	Yes	No	No	No	No	Yes	Yes
TVim	Inspiratory Mandatory Tidal Volume	mL	Yes	No	No	No	No	Yes	Yes
TVHf	High Frequenct Tidal Volume	mL	Yes	No	No	No	No	Yes	Yes
%Leak	Leakage	%	Yes	No	No	No	No	Yes	Yes
%Spont	Spontaneous Fraction Minute Volume	%	Yes	No	No	No	No	Yes	Yes
MVim	Inspiratory Mandatory Minute Volume	L/min	Yes	No	No	No	No	No	No
MAP	Mean airway pressure	cmH_2O*	No	Yes	No	Yes	No	Yes	No
AMP	HFO Amplitude	cmH_2O*	No	Yes	No	Yes	No	Yes	Yes
setFLOW(I)	Respiratory flow rate setting	L/min	Yes	Yes	Yes	Yes	Yes	Yes	Yes
setFLOW(E)	Respiratory flow rate setting	L/min	Yes	No	No	No	No	No	No
setTi	Inspiratory time setting	s	Yes	Yes	Yes	Yes	Yes	Yes	Yes
setTe	Expiratory time setting	s	Yes	No	No	No	No	Yes	Yes
setRR	Respiration rate setting	/min	Yes	Yes	Yes	Yes	Yes	Yes	Yes
setPEEP	Positive end expiratory pressure setting	cmH_2O*	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Terms	Description	Unit	Cable and Ventilator Types						
			IF-928P Dräger	IF-938P Metran				IF-943P Dräger	
			Babylog 8000 plus	R100		Caliope α		Babylog VN500	
				HFO	Others	HFO	Others	HFO	Others
setTRIGGER (PRESS)	Press trigger level setting	cmH_2O*	No	Yes	Yes	Yes	Yes	No	No
setTRIGGER (FLOW)	Flow trigger level setting	L/min	No	Yes	Yes	No	No	Yes	Yes
setETS	Expiratory trigger sensitivity setting	%	No	Yes	Yes	No	No	No	No
setRISE	Rise time setting	s	No	Yes	Yes	No	No	Yes	Yes
setO_2(I)	Inspiratory O_2 setting	%	Yes	Yes	Yes	Yes	Yes	Yes	Yes
setI:E	Inspiration expiration ratio setting	—	Yes	No	No	No	No	Yes	Yes
set TVi	Inspiratory tidal volume setting	mL	Yes	Yes	Yes	No	No	Yes	Yes
set FlowWave	Flow rate waveform setting	—	No	Yes	Yes	No	No	No	No
set Freq	Frequency setting	Hz	Yes	Yes	Yes	No	No	Yes	Yes
set AMP	Amplitude setting	%	Yes	No	No	No	No	No	No
set BaseFlow	HFO base flow setting	mL/s	No	Yes	Yes	No	No	No	No
set Ppeak	Peak airway pressure setting	cmH_2O*	Yes	Yes	Yes	Yes	Yes	Yes	Yes
set Vtrig	Trigger volume setting	—	Yes	No	No	No	No	No	No
set PSV	PSV pressure setting	cmH_2O*	No	Yes	Yes	Yes	Yes	No	No
set Plat	Plateau setting	s	No	Yes	Yes	No	No	No	No
set MAP	Mean airway pressure setting	cmH_2O*	No	Yes	Yes	Yes	Yes	Yes	No
set SV	Stroke volume setting	mL	No	Yes	Yes	Yes	Yes	No	No
set SI	Deep respiration pressure setting	cmH_2O*	No	Yes	Yes	No	No	No	No

Preparing for Ventilator Parameter Monitoring

1. Connect the ventilator to the bedside monitor. Refer to the QF series interface or IF series communication cable manual.

2. Connect the ventilator to the patient. Refer to the ventilator manual.

3. Monitoring starts. Set necessary settings.

Monitoring Ventilator Parameters

After completing the preparation, ventilator data and waveforms appear on the screen.

WARNING

When connecting an external instrument using an interface or communication cable to the monitor, some alarms and messages from the external instrument might not be displayed on the monitor. When the waveform or data is abnormal, check the alarm and message on the external instrument.

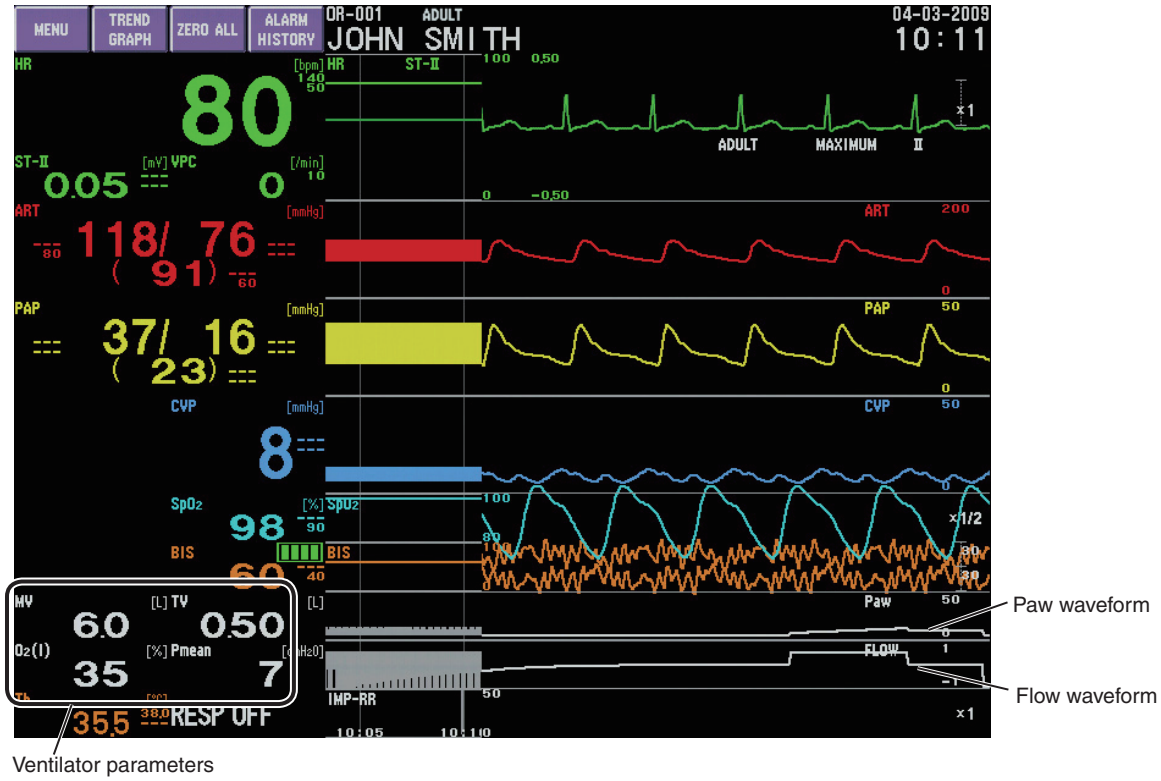
When using the following ventilator, no ventilator alarms are displayed on the bedside monitor.

- MAQUET ventilator
- Dräger Babylog 8000 plus ventilator
- CareFusion ventilator

NOTE

- If a ventilator parameter is not monitored on the ventilator, it is not displayed on the bedside monitor.
- Some ventilator parameters cannot be displayed on the bedside monitor even if they are monitored on the ventilator.

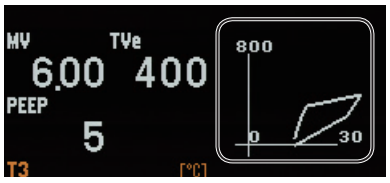
Ventilator Information on the Home Screen



Up to 4 ventilator parameters selected on the OTHER page of the VENT window are displayed on the home screen. To change the displaying parameters, refer to the “Selecting Parameters to be Displayed on the Home Screen” section.

When using following interfaces or communication cables, the alarm silence icon appears and ventilator alarms are not displayed on the home screen if the alarms are canceled on the ventilator.

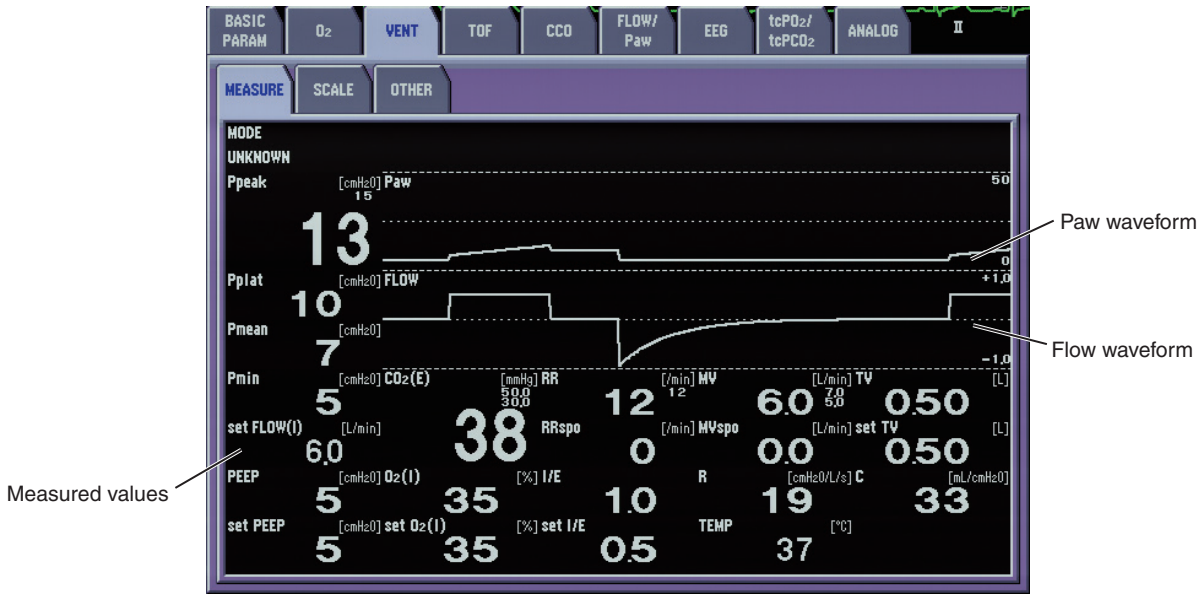
- Interface: QF-901P, QF-907P
- Communication cable: IF-917P, IF-923P, IF-927P, IF-933P, IF-935P, IF-936P, IF-939P, IF-944P



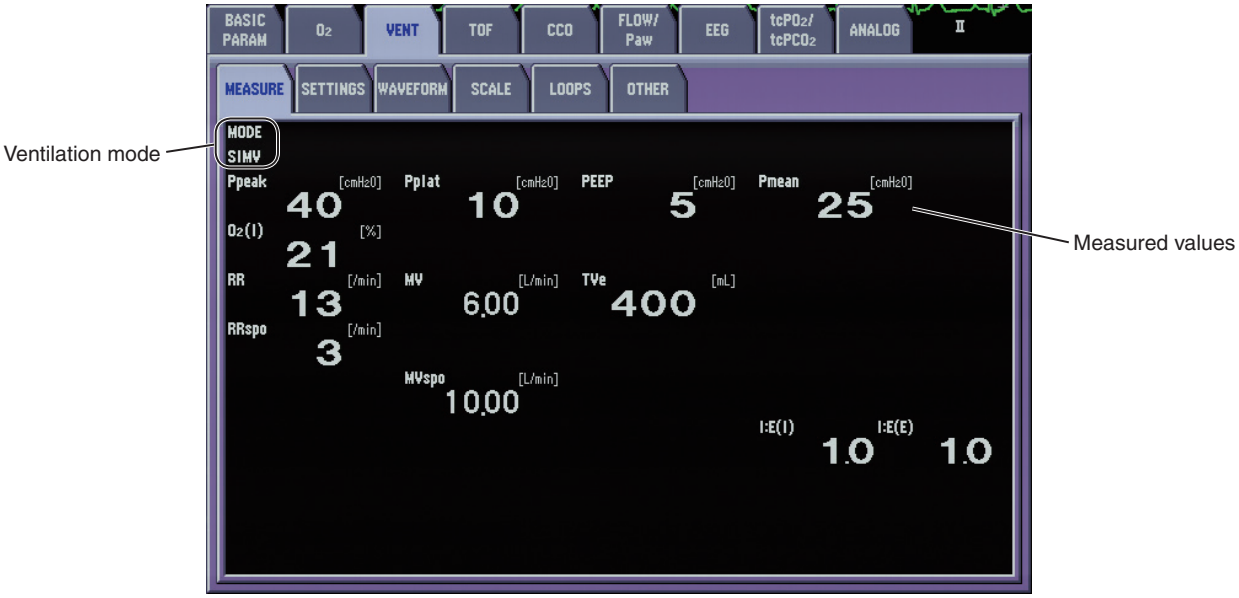
When using an IF-938P or IF-943P communication cable, the loop graph is displayed on the home screen.

Ventilator Information on the MEASURE Window

QF-901P, QF-907P or QF-908P interface and IF-917P, IF-923P, IF-927P, IF-933P, IF-934P, IF-935P, IF-936P, IF-939P, IF-942P or IF-944P communication cable



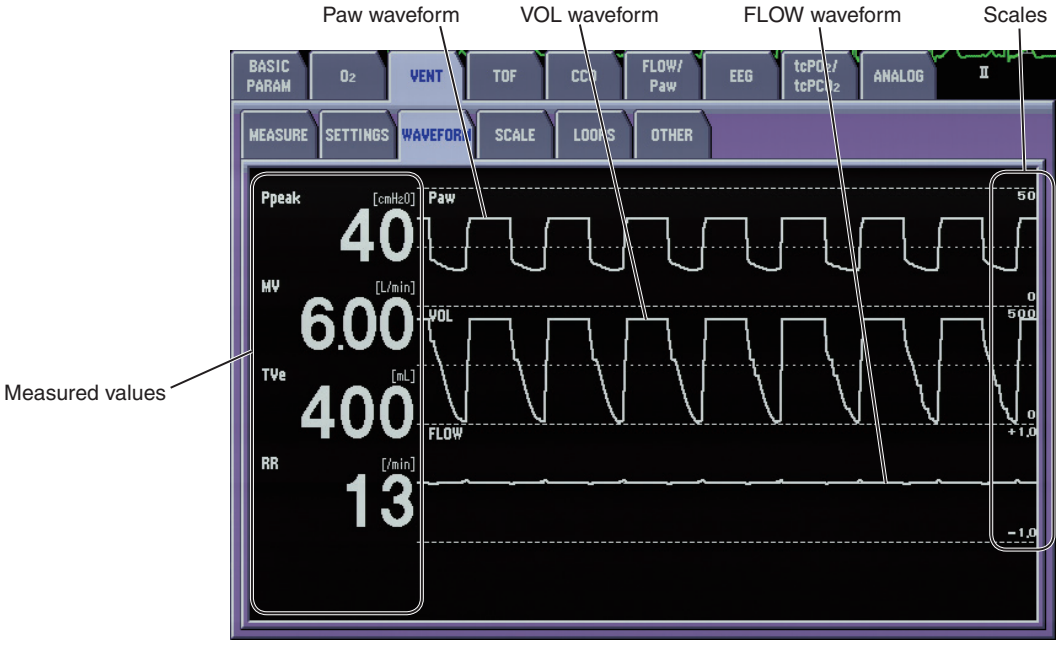
IF-928P, IF-938P and IF-943P communication cables



Ventilator Information on the SETTINGS and WAVEFORM Windows (IF-928P, IF-938P and IF-943P only)

SETTINGS window

WAVEFORM window



Changing Ventilator Settings

The following settings can be checked or set for ventilator parameter monitoring.

- Check settings on the ventilator
- Scale for FLOW, Paw and VOL* waveforms
- Displaying ventilator parameters on the home screen

* The VOL waveform is available only when using the IF-938P or IF-943P communication cable.

The display color for ventilator parameters can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

Checking the Ventilator Settings

1. Display the MEASURE page of the VENT window.
   Press the [Menu] key → VENT key → MEASURE (or SETTINGS) tab.

2. Check the settings. You can refer to the tables in the "Monitoring Parameters and Settings" section for the items on the window.

   Example

3. Press the [Home] key to return to the home screen.

Changing the FLOW, Paw or VOL Scale

The scale can be changed for the FLOW, Paw and VOL waveforms. The same scale is used on both the home screen and VENT window.

The VOL waveform is available only when using the IF-938P or IF-943P communication cable.

1. Display the SCALE page of the VENT window.
   Press the [Menu] key → VENT key → SCALE tab.

2. Touch the Paw tab to change the scale for the airway pressure waveform.
   Touch the FLOW tab to change the scale for the respiratory flow rate waveform.
   Touch the VOL tab to change the scale for the respiratory volume waveform.

3. Select the scale. Adjust the scale with the sliders on the setting bar.

4. Press the [Home] key to return to the home screen.

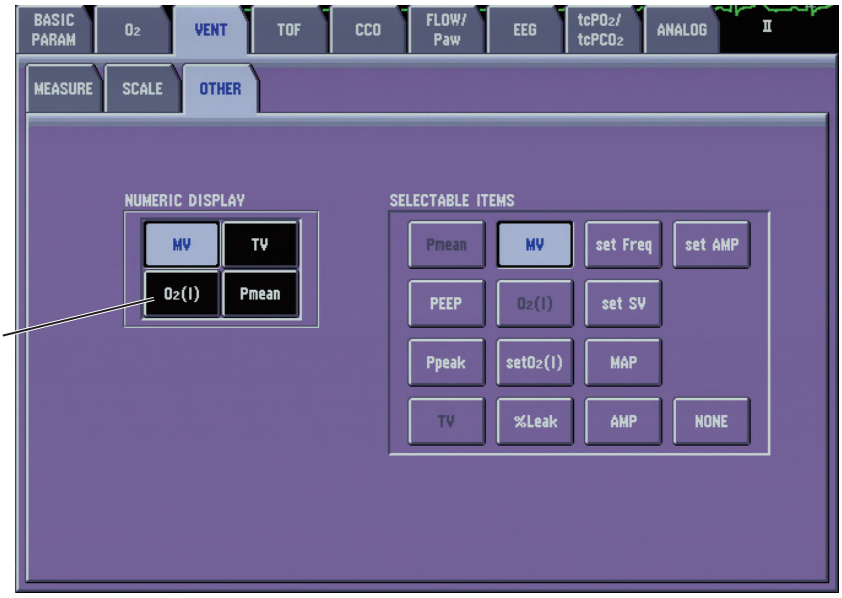
Selecting the Ventilator Parameters to be Displayed on the Home Screen

Up to 4 ventilator parameters can be displayed on the home screen.

1. Display the OTHER window of the VENT window.
   Press the [Menu] key → VENT key → OTHER tab.

2. Select the area on the home screen where the parameter is to be displayed in the <NUMERIC DISPLAY> box.

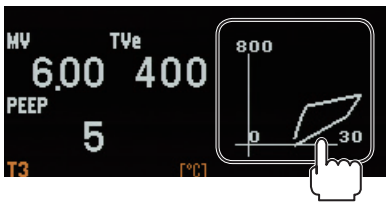
3. Select the parameter to be displayed in the selected area from the <SELECTABLE ITEMS> box.



4. Press the [Home] key to return to the home screen.

Viewing the Loop Graph (IF-938P and IF-943P only)

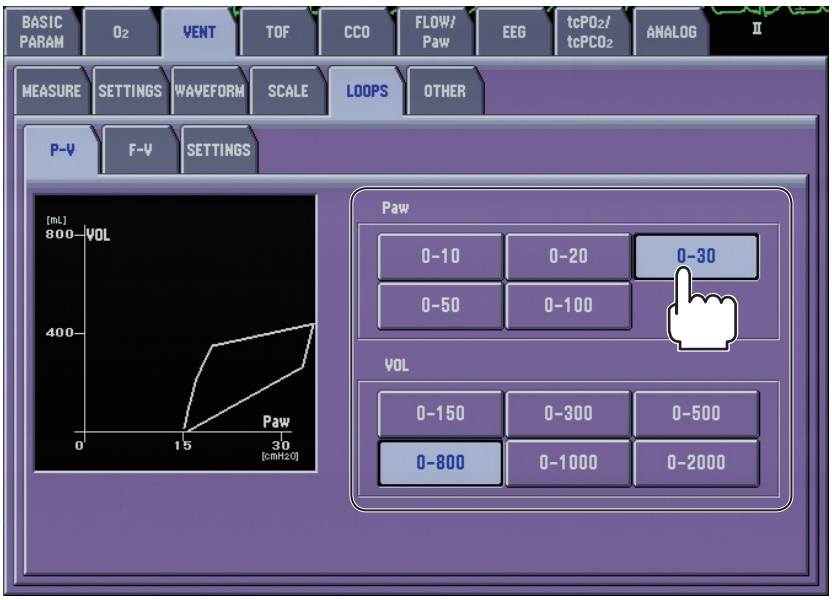
There are P-V loops and F-V loops for ventilator monitoring only when using the IF-938P or IF-943P communication cable.



Changing the Loop Graph Scale

1. Display the loop window for the desired loop type.
   Press the [Menu] key → VENT key → LOOPS tab → P-V tab or F-V tab.
   Or, touch the loop graph on the home screen.

2. Select a scale for each parameter.
   Example: P-V loop



3. Press the [Home] key to return to the home screen.

Changing the Settings for the Loop Graph

1. Display the SETTINGS window for the loop graph.
   Press the [Menu] key → VENT key → LOOPS tab → SETTINGS tab.

2. Select P-V or F-V to show the loop graph on the home screen. Selecting OFF does not display the loop graph on the home screen.

3. Press the [Home] key to return to the home screen.

Section 13 TOF Monitoring

General

TOF monitoring is performed by connecting the Merck & Co., Inc./MSD TOF-Watch® SX neuromuscular transmission monitor to the bedside monitor. To connect the TOF-Watch® SX, the QF-909P interface is required.

TOF-Watch SX is a registered trademark of Merck & Co., Inc./MSD.

List of Terms

Item	Description	Unit
TOF rat	TOF ratio	%
TOF cnt	TOF counts	Times
PTC*	Twitch counts	Times
Temp	Body surface temperature	°C
Stim	Stimulation current	mA
Cal	Calibration current	mA
T	Pulse width	µs
Alarm	TOF alarm setting	% or times
Sens	Sensitivity of the transducer	—
TW1	Twitch height 1	%
TW2	Twitch height 2	%
TW3	Twitch height 3	%
TW4	Twitch height 4	%

* PTC is only displayed in PTC mode.

Preparing for TOF Monitoring

1. Connect the TOF-Watch® SX to the bedside monitor. Refer to the QF-909P interface operator's manual.

2. Connect the TOF-Watch® SX to the patient. Refer to the TOF-Watch® SX manual.

3. Start monitoring.

4. If necessary, change settings on the TOF-Watch® SX. Refer to the TOF-Watch® SX manual.

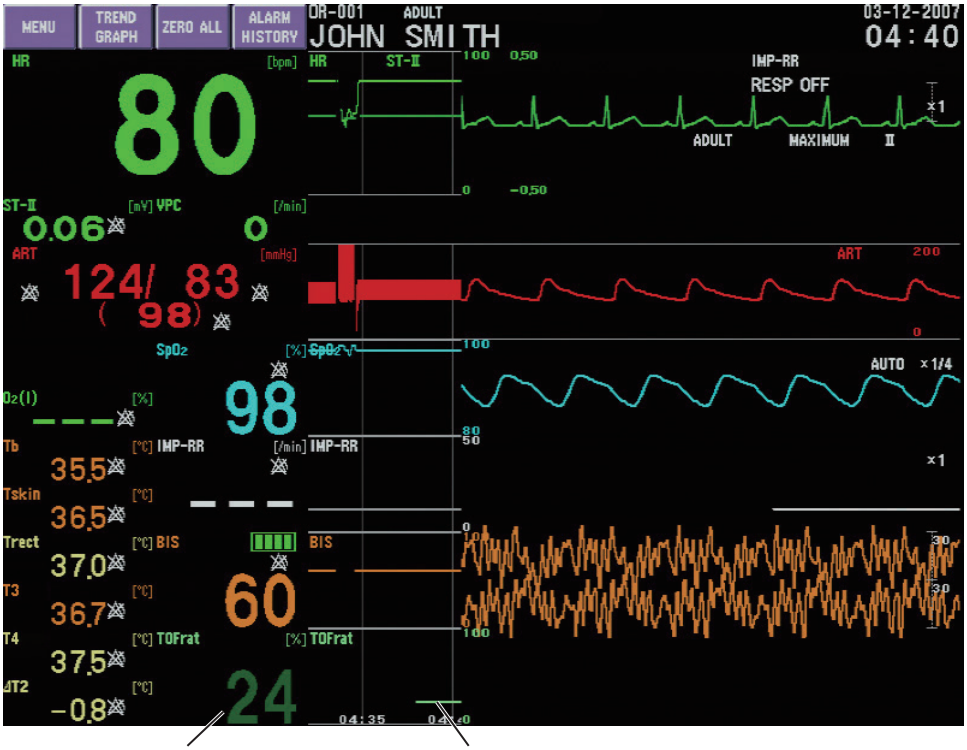
Monitoring TOF

After completing the preparation, TOF data appear on the screen.

WARNING

The TOF rat and TOF cnt alarms do not function on the bedside monitor when the TOF-Watch® SX is connected. When the TOF data on the bedside monitor is abnormal, check the alarm on the TOF-Watch® SX.

TOF Information on the Home Screen



Opening the TOF Window

To open the TOF window:
Press the [Menu] key → TOF key → MEASURE tab.

The contents of the TOF window depend on the operation mode on the TOF-Watch® SX.

TOF Information on the TOF Window

Recording the TOF Data

TOF data on the TOF window can be recorded on the optional recorder.

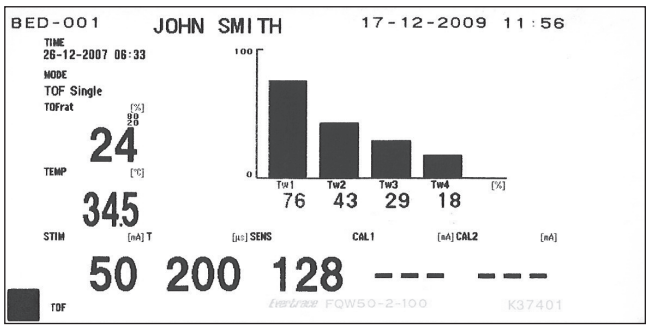
1. Display the TOF window.
   Press the [Menu] key → TOF key.

2. Touch the RECORD key. Recording starts.

   To stop recording, press the [Record] key.

3. Press the [Home] key to return to the home screen.

Recording example



Section 14 CCO Monitoring

CCO Monitoring by APCO/IBP Processor

NOTE

The JP-600P APCO/IBP processor is not available for BSM-6000A series.

General

The JP-600P APCO/IBP processor can only be connected to the MULTI socket on an AY-600P series input unit, BSM-1700 series bedside monitor, AA-672P or AA-674P smart expansion unit, or JA-694PA data acquisition unit.

NOTE

The MULTI socket on the AY-660P input unit cannot be used for monitoring CCO.

List of Terms

Label	Name	Unit
CCO	Continuous cardiac output	L/min
CCI	Continuous cardiac output index	L/min/m^2
SVV	Stroke volume variation	%
PR	Pulse rate	bpm
AP-MEAN	Arterial mean pressure	mmHg*1
SV	Stroke volume	mL
SVI	Stroke volume index	mL/m^2
SVR	Systemic vascular resistance	dyn•s/cm^5*2
SVRI	Systemic vascular resistance index	dyn•s•m^2/cm^5*3

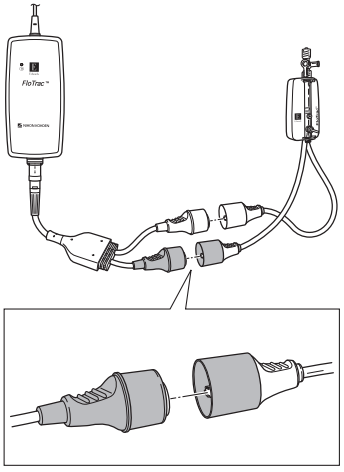
*1 The blood pressure units (mmHg or kPa) can be changed on the SYSTEM CONFIGURATION screen of the bedside monitor.

*2 When the blood pressure unit is kPa, this unit becomes kPa•s/L.

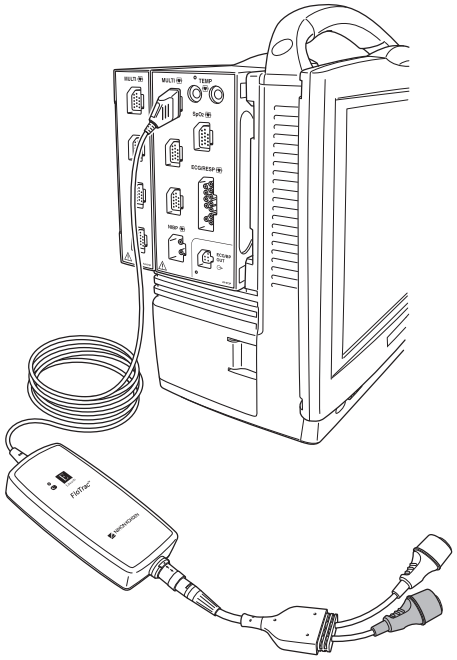
*3 When the blood pressure unit is kPa, this unit becomes kPa•s•m^2/L.

Preparation Flowchart for Using the APCO/IBP Processor

1. Connect the FloTrac sensor to the APCO/IBP processor.



2. Connect the APCO/IBP processor to the MULTI socket.



3. Display the PATIENT INFO page on the CCO window and check that the age, gender and BSA are correct. To correct the age, gender or BSA, refer to "Entering the Patient's Date of Birth, Gender, Height and Weight" section.

4. Attach the FloTrac sensor to the patient.

5. Perform zero balance adjustment.

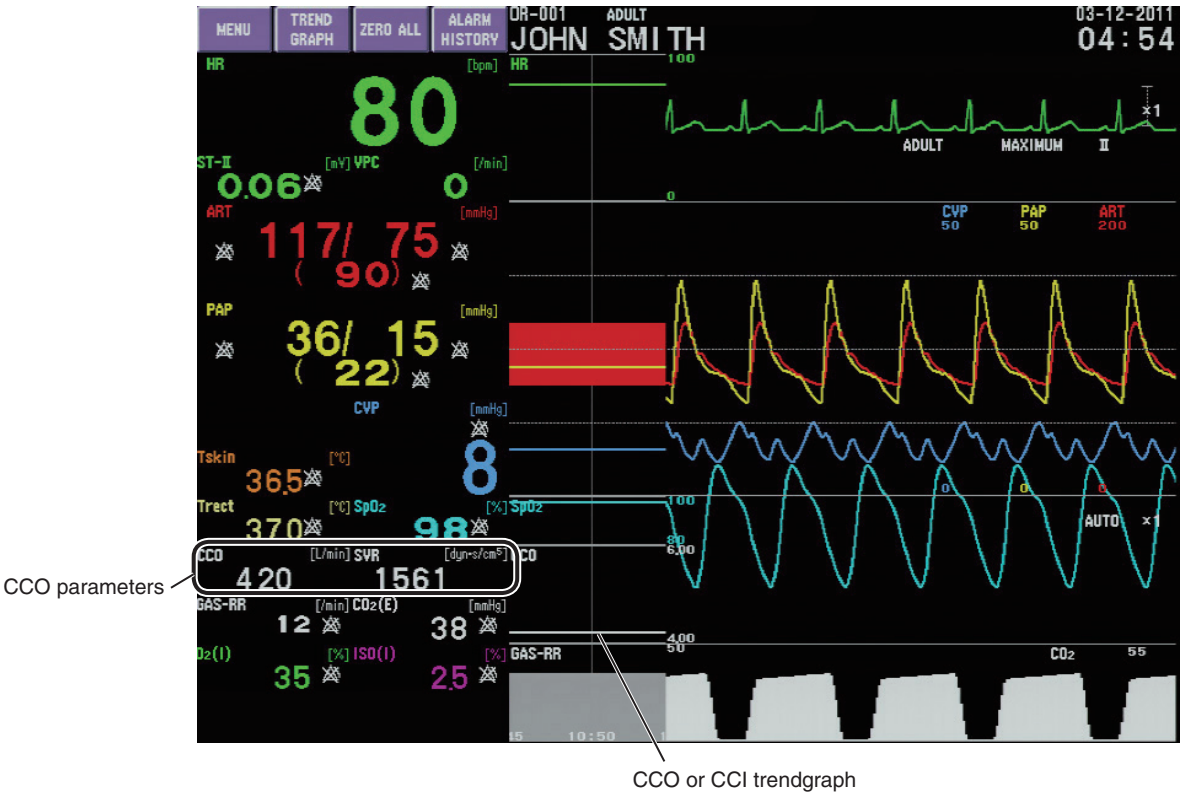
6. Start measurement (Start monitoring).
   After zero balance adjustment, you can start CCO measurement and monitoring.

Monitoring CCO

After completing the preparation, CCO data appears on the screen.

CCO Information on the Home Screen

CCO, SVV: Data monitored on the APCO/IBP processor.
CCI, SV, SVI, SVR, SVRI: Data monitored on the bedside monitor.



Up to 4 CCO parameters selected on the OTHER page of the CCO window are displayed on the home screen. To change the parameters, refer to the “Selecting the CCO Parameters to be Displayed on the Home Screen” section.

CCO Information on the CCO Window

CCO, SVV, PR, AP-MEAN: Data monitored on the APCO/IBP processor.
CCI, SV, SVI, SVR, SVRI: Data monitored on the bedside monitor.

Displaying the CCO Window

To display the CCO window:
Press the [Menu] key → CCO key → MEASURE tab.

Hemodynamics Table on the HEMO TREND Page of the TREND Window

When cardiac output is monitored by the APCO/IBP processor, the CCO data is listed on the HEMO TREND page of the TREND window. For details on the HEMO TREND page, refer to Section 6 of the User's Guide Part I.

PR, CCO, CCI, ART-MEAN, PAP-MEAN, CVP, SV, SVI, SVR, SVRI, RVSW, RVSWI, PCWP, PCWP TIME, PVR, PVRI, LVSW, LVSWI are listed on the HEMO TREND page of the TREND window.

CCO, CCI, SVV, SV, SVI, SVR, SVRI are listed on the TABLE page of the TREND window.

CCO, CCI, SVV, SV, SVI, SVR, SVRI are listed on the GRAPH page of the TREND window.

Changing the CCO Settings

When using the APCO/IBP processor, the following settings can be changed for CCO monitoring. Change the settings on the CCO window.

- Enter the patient's date of birth, gender, height and weight
- Perform zero calibration
- CCO and CCI alarm limits
- Scale for AP waveform
- Displaying CCO parameters on the home screen
- CCO/CCI average time
- Displaying CCO or CCI for current trendgraph on the home screen

The display color for CCO can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

NOTE

The blood pressure label is fixed to ART when a JP-600P APCO/IBP processor is used.

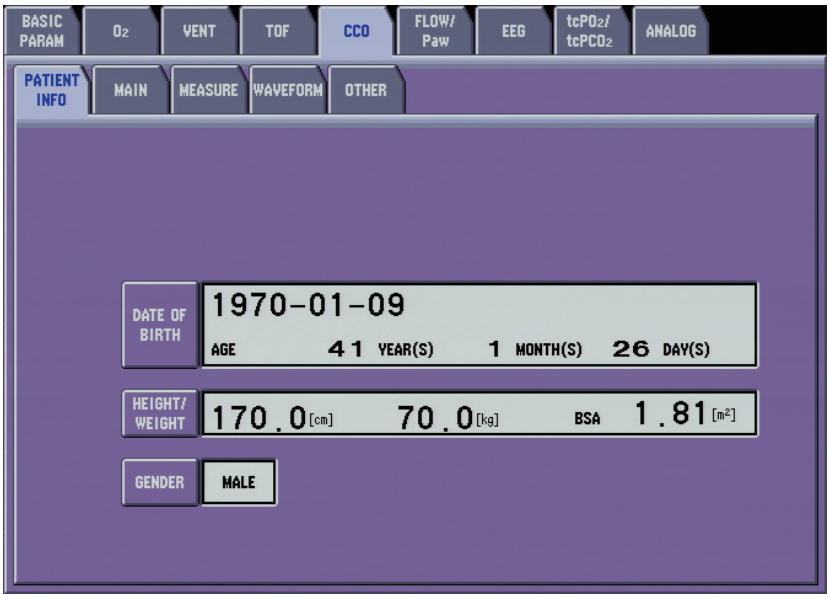
Entering the Patient's Date of Birth, Gender, Height and Weight

NOTE

- When the date of birth, gender, height and weight are not entered, CCO monitoring cannot be performed.
- When the BSA is outside the range of 0.08 to 5.02 m^2 and the age is outside the range of 2 to 120 years old, CCO monitoring is not available.

Displaying the PATIENT INFO Page

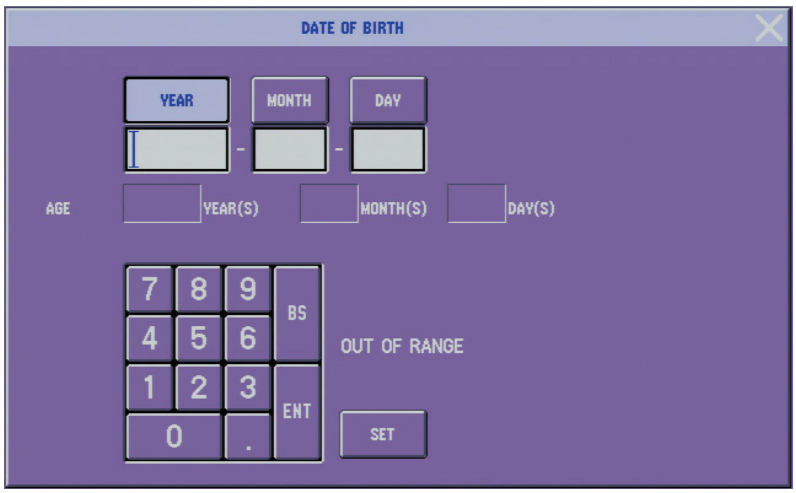
1. Display the PATIENT INFO page of the CCO window.
   Press the [Menu] key → CCO key → PATIENT INFO tab.



2. Touch the ☒ key to close the window.

Entering the Date of Birth

1. Touch the DATE OF BIRTH key to display the DATE OF BIRTH window.



2. Touch the YEAR, MONTH or DAY key or touch the box under the YEAR, MONTH or DAY key to enter the year, month and day.

3. Enter the numbers by using the number keys.

4. Touch the ENT key. The number is entered under the YEAR, MONTH or DAY box.

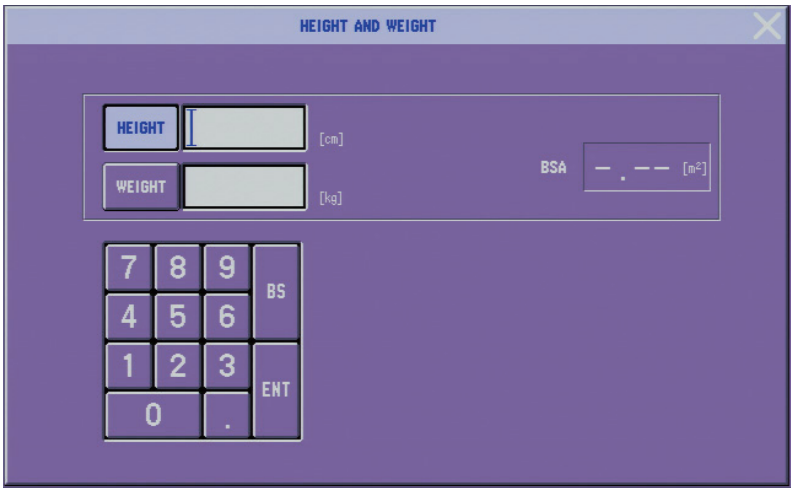
5. Touch the SET key. When the year, month and day are entered, age is automatically calculated and appears in the AGE area on the DATE OF BIRTH window.

6. Touch the ☒ key to close the DATE OF BIRTH window.

Entering the Height and Weight

The height and weight units can be changed on the SYSTEM CONFIGURATION screen. Refer to Section 2 of the Administrator's Guide.

1. Touch the HEIGHT/WEIGHT key to display the HEIGHT AND WEIGHT window.



2. Touch the HEIGHT or WEIGHT key or the box beside the HEIGHT or WEIGHT key to enter height and weight.

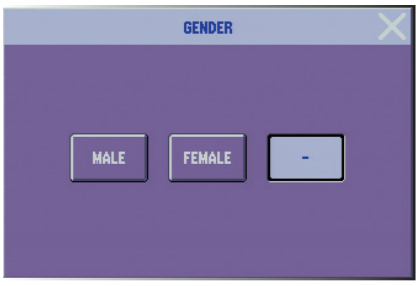
3. Enter the numbers by using the number keys.

4. Touch the ENT key. When the height and weight are entered, BSA is automatically calculated and appears in the BSA area on the HEIGHT AND WEIGHT window.

5. Touch the ☒ key to close the HEIGHT AND WEIGHT window.

Entering the Gender

1. Touch the GENDER key to display the GENDER window.



2. Touch the MALE or FEMALE key. Touch the "-" key when the patient gender is unknown.

3. Touch the ☒ key to close the GENDER window.

Closing the PATIENT INFO Page

Press the [Home] key to return to the home screen.

Adjusting Zero Balance

NOTE

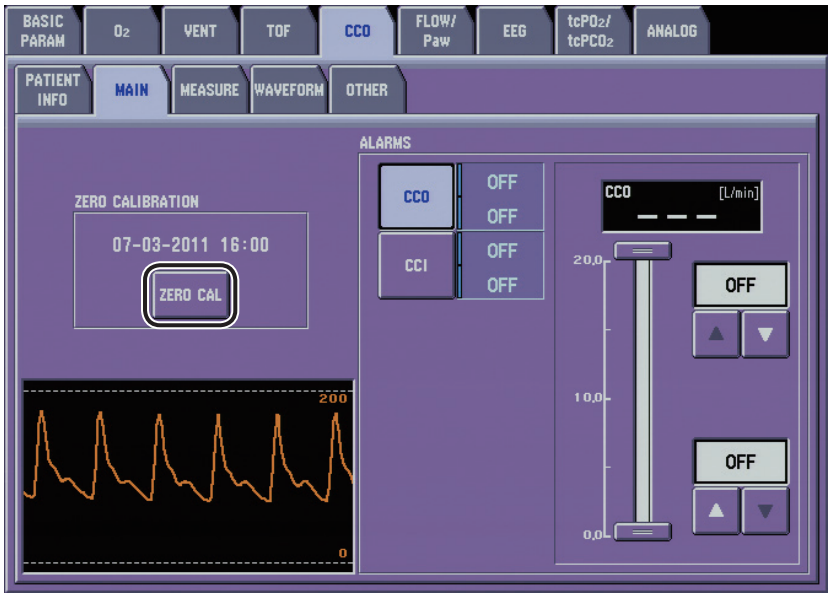
- Zero balance adjustment is required for the CCO monitoring.
- When zero balance is adjusted on the PRESS window, zero balance on the CCO window is also performed. When zero balance is adjusted on the CCO window, zero balance on the PRESS window is also performed.

Adjusting Zero Balance

1. Refer to the FloTrac sensor manual and prepare for zero balance.

2. Perform zero balance adjustment.
   i) Display the MAIN page of the CCO window.
   Press the [Menu] key → CCO key → MAIN tab.

   ii) Touch the ZERO CAL key.



When the “ZEROING COMPLETE” message is displayed, zero balance adjustment is complete.

CCO is ready to be measured. The CCO value and AP waveform appear on the screen.

3. Press the [Home] key to return to the home screen.

Changing the CCO and CCI Alarm Limits

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

You can set the upper and lower CCO and CCI alarm limits on the CCO window. You can set all alarms, including the upper and lower CCO and CCI alarm limits, on the ALARM LIMITS window (See the Operator's Manual or Section 5 of the User's Guide Part I).

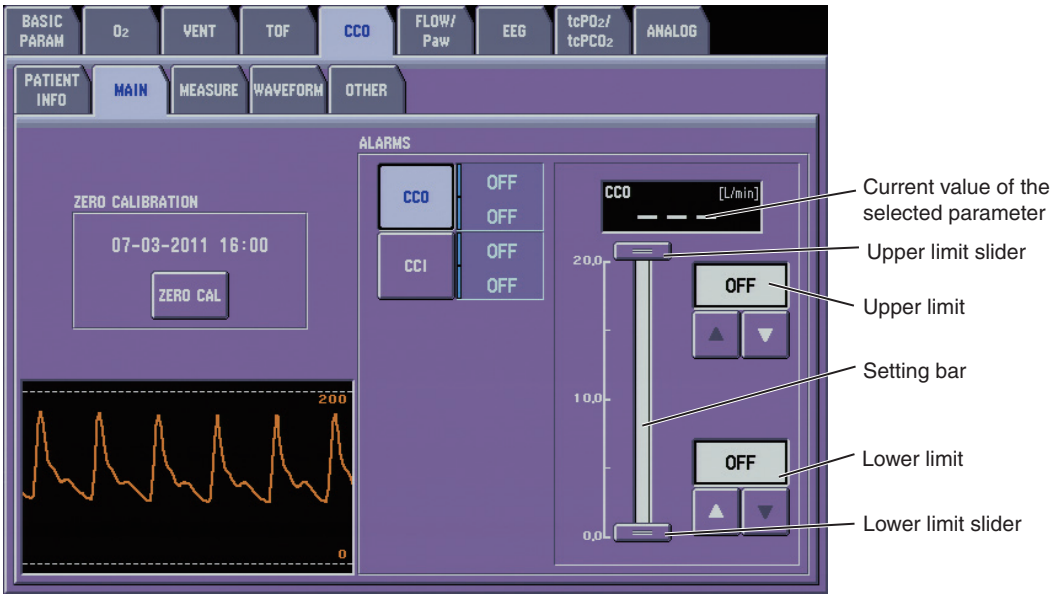
Setting Range

CCO upper limit: 1.1 to 20.0 in 0.1 steps, OFF (default setting: OFF)
CCO lower limit: OFF, 1.0 to 19.9 in 0.1 steps (default setting: OFF)
CCI upper limit: 1.1 to 20.0 in 0.1 steps, OFF (default setting: OFF)
CCI lower limit: OFF, 1.0 to 19.9 in 0.1 steps (default setting: OFF)

1. Display the MAIN page on the CCO window.
   Press the [Menu] key → CCO key → MAIN tab.

2. Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.



3. Press the [Home] key to return to the home screen.

Changing the Scale

The scale of the AP waveform on the CCO window can be changed.

1. Display the WAVEFORM page of the CCO window.
   Press the [Menu] key → CCO key → WAVEFORM tab.

2. Select the scale by touching the desired scale key.

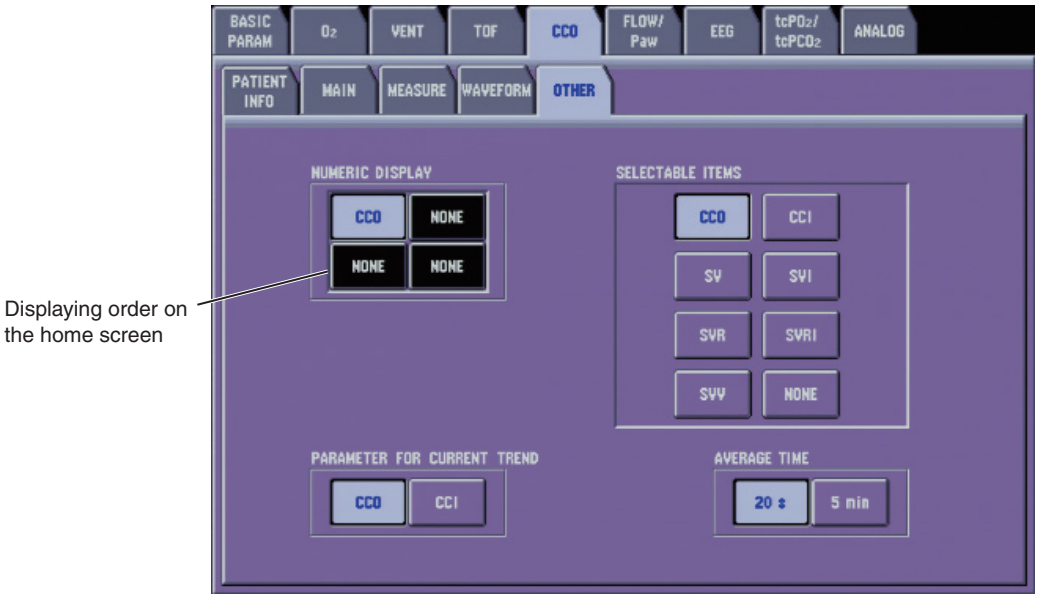
3. Press the [Home] key to return to the home screen.

Selecting the CCO Parameters to be Displayed on the Home Screen

1. Display the OTHER page of the CCO window.
   Press the [Menu] key → CCO key → OTHER tab.

2. Select the area for the parameter to be displayed on the home screen in the <NUMERIC DISPLAY> box.

3. Select the parameter to be displayed in the selected area from the <SELECTABLE ITEMS> box.



4. Press the [Home] key to return to the home screen.

Selecting the CCO/CCI Average Time

Select the averaging time.

1. Display the OTHER page on the CCO window.
   Press the [Menu] key → CCO key → OTHER tab.

2. Select the averaging time from the <AVERAGE TIME> box.

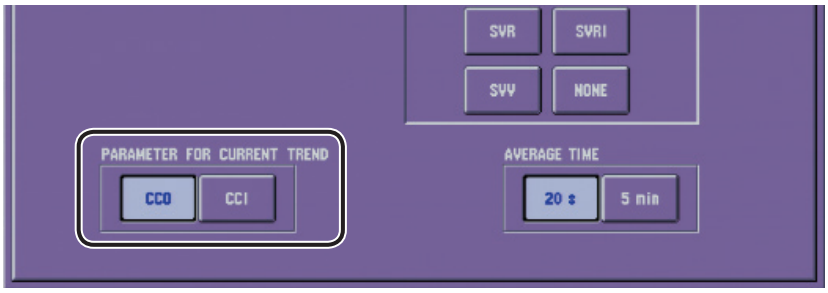
3. Press the [Home] key to return to the home screen.

Selecting the Current Trendgraph

Select the parameter to be displayed as a trendgraph on the home screen.

1. Display the OTHER page on the CCO window.
   Press the [Menu] key → CCO key → OTHER tab.

2. Select the parameter in the <PARAMETER FOR CURRENT TREND> box.



3. Press the [Home] key to return to the home screen.

Recording the CCO Data on the WAVEFORM Page of CCO Window

AP waveform and CCO data on the WAVEFORM page of the CCO window can be recorded.

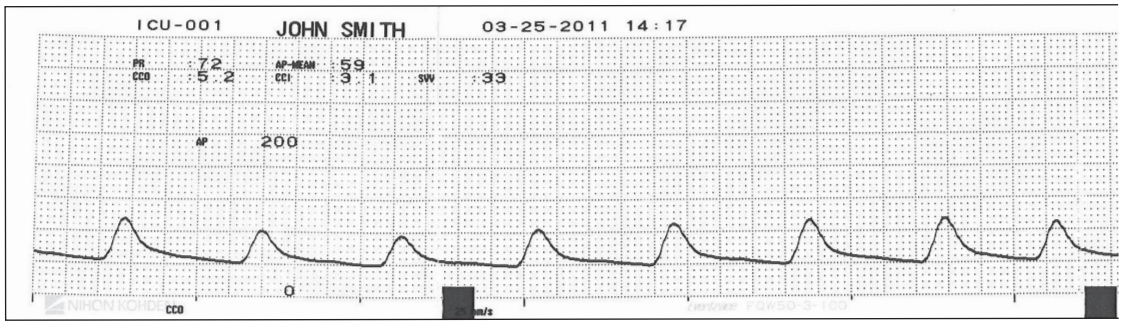
1. Display the WAVEFORM page of the CCO window.
   Press the [Menu] key → CCO key → WAVEFORM tab.

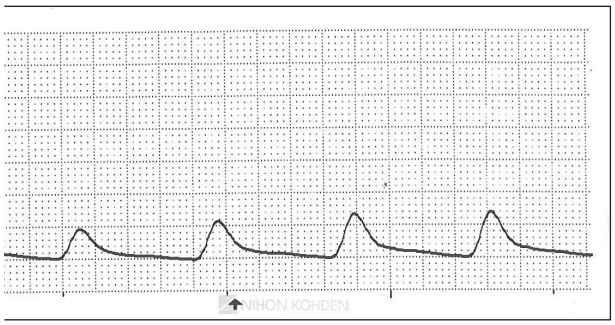
2. Touch the RECORD WAVE key. Recording starts.

To stop recording, press the [Record] key.

3. Press the [Home] key to return to the home screen.

Recording example





CCO Monitoring by CCO Monitor

General

Continuous cardiac output data acquired by a CCO monitor can be displayed on the bedside monitor when a CCO monitor is connected to the monitor with the QF-903P interface or IF-946P or IF-948P communication cable. The measured values, waveforms and settings on the CCO monitor can be displayed on the bedside monitor screen.

- An Edwards Lifesciences Vigilance, Vigilance II or Vigileo oximeter/ continuous cardiac output measuring device can be connected with the QF-903P interface.
- An Edwards Lifesciences clinical platform EV1000 can be connected with the IF-948P communication cable.
- A LiDCOrapid or LiDCOplus hemodynamic monitor can be connected with the IF-946P communication cable.

WARNING

The alarm does not function on the bedside monitor when a LiDCOrapid or LiDCOplus hemodynamic monitor is connected. When the data is abnormal, check the alarm on the LiDCOrapid or LiDCOplus hemodynamic monitor.

Monitoring Parameters and Settings

The parameters and settings that can be displayed on the monitor screen depend on the CCO monitor type as shown below.

Yes: displayed
No: not displayed
Monitor: Data monitored on the bedside monitor
Calc: Calculated from the data monitored on the CCO monitor and bedside monitor

Label	Description	Unit	Cable and CCO Monitor Types					
			QF-903P			IF-948P	IF-946P	
			Edwards Lifesciences				LiDCO	
			Vigilance	Vigilance II	Vigileo	EV1000	LiDCOrapid	LiDCOplus
CCO	Continuous cardiac output	L/min	Yes	Yes	Yes	Yes	Yes	Yes
CCI	Continuous cardiac output index	L/min/m^2	Calc	Calc	Calc	Calc	Calc	Calc
$S\bar{v}O_2$*1	Mixed venous oxygen saturation	%	Yes	Yes	Yes	Yes	No	No
$ScvO_2$*1	Central venous oxygen saturation	%	No	Yes	Yes	Yes	No	No
Tb	Blood temperature	°C or °F*2	Yes	Yes	No	Yes	No	No
SV	Stroke volume	mL	Calc	Calc	Calc	Calc	Calc	Calc
SVI	Stroke volume index	mL/m^2	Calc	Calc	Calc	Calc	Calc	Calc

Label	Description	Unit	Cable and CCO Monitor Types					
			QF-903P			IF-948P	IF-946P	
			Edwards Lifesciences				LiDCO	
			Vigilance	Vigilance II	Vigileo	EV1000	LiDCOrapid	LiDCOplus
SVV	Stroke volume variation	%	No	No	Yes	Yes	Yes	Yes
HR	Heart rate	bpm	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
HRV	Heart rate variation	%	No	No	No	No	Yes	Yes
CF	Calibration factor	—	No	No	No	No	Yes	Yes
SVR	Systemic vascular resistance	dyn•s/cm^5*3	Calc	Calc	Calc	Calc	Calc	Calc
SVRI	Systemic vascular resistance index	dyn•s•m^2/cm^5*4	Calc	Calc	Calc	Calc	Calc	Calc
ART	Arterial pressure	mmHg*2	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
CVP	Central venous mean pressure	mmHg*2	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
EDV	End diastolic volume	mL	Yes	Yes	No	No	No	No
EDVI	End diastolic volume index	mL/m^2	Calc	Calc	No	No	No	No
ESV	End systolic volume	mL	Yes	Yes	No	No	No	No
ESVI	End systolic volume index	mL/m^2	Calc	Calc	No	No	No	No
EF	Ejection fraction	%	Yes	Yes	No	No	No	No
DO_2	Oxygen delivery	mL/min	Yes	Yes	No	No	No	Yes
DO_2I	Oxygen delivery index	mL/min/m^2	Calc	Calc	No	No	No	Calc
VO_2	Oxygen consumption	mL/min	Yes	Yes	No	No	No	No
O_2EI	Oxygen extraction index	%	Yes	Yes	No	No	No	No
SaO_2	Arterial oxygen saturation	%	Yes	Yes	No	No	No	No
SQI	Signal quality index	—	Yes	Yes	Yes	Yes	No	No

*1 $ScvO_2$ is displayed instead of $S\bar{v}O_2$ when it is monitored on the Vigilance II, Vigileo or EV1000 monitor.

*2 The temperature units (°C or °F) and blood pressure units (mmHg or kPa) can be changed on the SYSTEM CONFIGURATION screen of the bedside monitor.

*3 When the blood pressure unit is kPa, this unit becomes kPa•s/L.

*4 When the blood pressure unit is kPa, this unit becomes kPa•s•m^2/L.

Preparing for CCO Monitoring

1. Set up the CCO monitor and connect it to the bedside monitor. Refer to the QF-903P interface or IF-946P or IF-948P communication cable operator's manual.

2. Connect the CCO monitor to the patient. Refer to the CCO monitor manual.

3. Start measurement and change necessary settings.

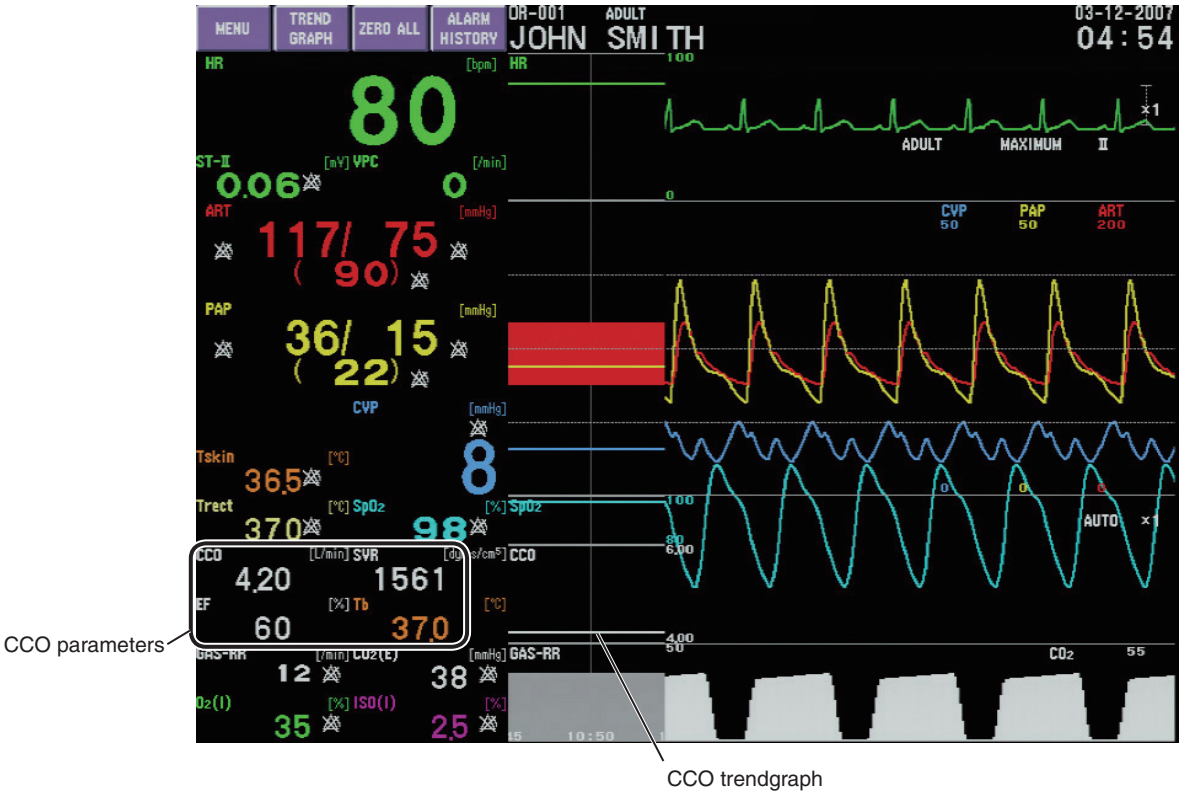
Monitoring CCO

After completing the preparation, CCO data appears on the screen.

CCO Information on the Home Screen

EF, Tb (Ext), CCO, $S\bar{v}O_2$ ($ScvO_2$), EDV, SVV, HRV:
Data monitored on the CCO monitor.

EDVI, SVR, SVRI, CCI: Calculated from the data monitored on the CCO monitor and bedside monitor.



Up to 4 CCO parameters selected on the OTHER page of the CCO window are displayed on the home screen. To change the parameters, refer to the “Selecting CCO Parameters to be Displayed on the Home Screen” section.

CCO Information on the CCO Window

CCO, $S\bar{v}O_2$ ($ScvO_2$), Tb, SQI, SVV, HRV, CF, EDV, ESV, EF, DO_2, VO_2, O_2EI, SaO_2: Data monitored on the CCO monitor.

HR, ART, CVP: Data monitored on the bedside monitor.

CCI, SV, SVI, SVR, SVRI, EDVI, ESVI, DO_2I: Calculated from the data monitored on the CCO monitor and bedside monitor.

SQI bar graph

$S\bar{v}O_2$ ($ScvO_2$) SQI is indicated in 4 levels.

Good

Medium

Poor

Invalid

Displays the hemodynamics table on the HEMO TREND page of the TREND window

Opening the CCO Window

To open the CCO window:

Press the [Menu] key → CCO key → MEASURE 1 or MEASURE 2 tab.

Hemodynamics Table on the HEMO TREND Page of the TREND Window

When cardiac output is monitored by the CCO monitor, the CO data is listed on the HEMO TREND page of the TREND window. When CO is monitored, the CO and CI are also added to this list. For details on the HEMO TREND page, refer to Section 6 of the User's Guide Part I.

CO: Data monitored on the CCO monitor.

CI: Calculated from the data monitored on the CCO monitor and bedside monitor.

CCO parameters (TABLE page): CCO, CCI, SVR, SVRI, SV, SVI, CF, SVV, HRV, $S\bar{v}O_2$, $ScvO_2$, EDV, EDVI, ESV, ESVI, EF

CCO parameters (GRAPH page): CCO, CCI, SVR, SVRI, SV, SVI, CF, SVV, HRV, $S\bar{v}O_2$, $ScvO_2$, EDV

Changing the CCO Settings

Displaying CCO parameters on the home screen can be set on the CCO window.

The display color for CCO can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

Selecting the CCO Parameters to be Displayed on the Home Screen

Up to 4 CCO parameters can be displayed on the home screen.

1. Display the OTHER page of the CCO window.
   Press the [Menu] key → CCO key → OTHER tab.

2. Select the area for the parameter to be displayed on the home screen in the <NUMERIC DISPLAY> box.

3. Select the parameter to be displayed in the selected area from the <SELECTABLE ITEMS> box.

4. Press the [Home] key to return to the home screen.

PCCO Monitoring by PiCCO Monitor

General

Pulse contour cardiac output monitoring can be performed by connecting a Pulsion Medical Systems PiCCO *plus* or $PiCCO_2$ monitor (PiCCO monitor) to the bedside monitor. To connect the PiCCO monitor to the bedside monitor, a QF-911P interface is required.

CAUTION

Connect the PiCCO monitor to the BSM-6000 series bedside monitor using only the QF-911P interface. Do not connect the instruments using any other interface or cable. Otherwise, the measurement accuracy becomes out of range.

NOTE

- Only the PiCCO *plus* monitor with protocol version SP 7.0 or later and $PiCCO_2$ monitor with protocol version V3.0 or V1.0 is compatible with the BSM-6000 series bedside monitors.
- If a PiCCO parameter is not monitored on the PiCCO monitor, it is not displayed on the bedside monitor.
- Some PiCCO parameters cannot be displayed on the bedside monitor even if they are monitored on the PiCCO monitor.

List of Terms

Label	Name	Unit
PCCO	Pulse contour cardiac output	L/min
PCCI	Pulse contour cardiac output index	L/min/m^2
SV	Stroke volume	mL
SVI	Stroke volume index	mL/m^2
SVR	Systemic vascular resistance	dyn•s/cm^5*1
SVRI	Systemic vascular resistance index	dyn•s•m^2/cm^5*2
SVV	Stroke volume variation	%
PPV	Pulse pressure variation	%
dPmax*3	Left ventricular contractility index	mmHg*4/s
Tb	Blood temperature	°C or °F*4
PR	Pulse rate	bpm
AP	Arterial pressure (systolic/diastolic (mean))	mmHg*4
CO	Cardiac output	L/min
CI	Cardiac output index	L/min/m^2
GEDV	Global end diastolic volume	mL
GEDVI	Global end diastolic volume index	mL/m^2
ITBV	Intrathoracic blood volume	mL
ITBVI	Intrathoracic blood volume index	mL/m^2
GEF*3	Global ejection fraction	%
CFI	Cardiac function index	/min
EVLW	Extravascular lung water	mL
EVLWI	Extravascular lung water index	mL/kg
PVPI*3	Pulmonary vascular permeability index	—
Time	Measurement time	—
Height*5	Height	cm
Weight*5	Weight	kg
$ScvO_2$*3*6	Central venous oxygen saturation	%
DO_2*3*6	Oxygen delivery	mL/min
DO_2I*3*6	Oxygen delivery index	mL/min/m^2
VO_2*3*6	Oxygen consumption	mL/min
VO_2I*3*6	Oxygen consumption index	mL/min/m^2
CPO*3*6	Cardiac power output	W
CPI*3*6	Cardiac power index	W/m^2
SpO_2*3*6	Arterial oxygenation saturation (pleth)	%
PDR*3*6	Plasma disappearance rate	%/min
R15*3*6	Retention rate of ICG	%

*1 When the blood pressure unit is kPa, this unit becomes kPa•s/L.

*2 When the blood pressure unit is kPa, this unit becomes kPa•s•m^2/L.

*3 These parameters are not available on BSM-6000A series.

*4 The temperature units (°C or °F) and blood pressure units (mmHg or kPa) can be changed on the SYSTEM CONFIGURATION screen.

*5 These values are set on the PiCCO monitor.

*6 These parameters are not available when the QF-911P interface version is 01-01.

Monitoring Parameters and Settings

The parameters and settings that can be displayed on the bedside monitor screen depend on the PiCCO monitor type and bedside monitor setting as shown below.

Yes: displayed No: not displayed

When the <NUMERIC DISPLAY> on the OTHER Page is Set to ABSOLUTE

Label	PiCCO Monitor Type			
	PiCCO *plus*	SP 7.0	V1.0	V3.0
PCCO	Yes	Yes	Yes	Yes
GEDV	Yes	Yes	Yes	Yes
ITBV	Yes	Yes	Yes	Yes
SVR	Yes	Yes	Yes	Yes
SV	Yes	Yes	Yes	Yes
CO	Yes	Yes	Yes	Yes
SVV	Yes	Yes	Yes	Yes
PPV	Yes	Yes	Yes	Yes
GEF*1	Yes	Yes	Yes	Yes
dPmax*1	Yes	Yes	Yes	Yes
CFI	Yes	Yes	Yes	Yes
EVLW	Yes	Yes	Yes	Yes
$ScvO_2$*1*2	No	No	Yes	Yes
SpO_2*1*2	No	No	No	Yes
PVPI*1	No	Yes	Yes	Yes
CPO*1*2	No	No	Yes	Yes
PDR*1*2	No	No	No	Yes
R15*1*2	No	No	No	Yes
DO_2*1*2	No	No	Yes	Yes
VO_2*1*2	No	No	Yes	Yes
Height	Yes	Yes	Yes	Yes
Weight	Yes	Yes	Yes	Yes

When the <NUMERIC DISPLAY> on the OTHER Page is Set to INDEX

Label	PiCCO Monitor Type			
	PiCCO *plus*	SP 7.0	V1.0	V3.0
PCCI	No	Yes	Yes	Yes
GEDVI	No	Yes	Yes	Yes
ITBVI	No	Yes	Yes	Yes
SVRI	No	Yes	Yes	Yes
SVI	No	Yes	Yes	Yes
CI	No	Yes	Yes	Yes
SVV	Yes	Yes	Yes	Yes
PPV	Yes	Yes	Yes	Yes
GEF*1	Yes	Yes	Yes	Yes
dPmax*1	Yes	Yes	Yes	Yes
CFI	Yes	Yes	Yes	Yes
EVLWI	No	Yes	Yes	Yes
$ScvO_2$*1*2	No	No	Yes	Yes
SpO_2*1*2	No	No	No	Yes
PVPI*1	No	Yes	Yes	Yes
CPI*1*2	No	No	Yes	Yes
PDR*1*2	No	No	No	Yes
R15*1*2	No	No	No	Yes
DO_2I*1*2	No	No	Yes	Yes
VO_2I*1*2	No	No	Yes	Yes
Height	Yes	Yes	Yes	Yes
Weight	Yes	Yes	Yes	Yes

*1 These parameters are not available on BSM-6000A series.

*2 These parameters are not available when the QF-911P interface version is 01-01.

Preparing for PiCCO Monitoring

1. Set up the PiCCO monitor and connect it to the bedside monitor. Refer to the QF-911P interface operator's manual.
2. Connect the PiCCO monitor to the patient. Refer to the PiCCO monitor manual.
3. Start measurement and change necessary settings.

Monitoring PiCCO

After completing the preparation, PiCCO data appears on the screen.

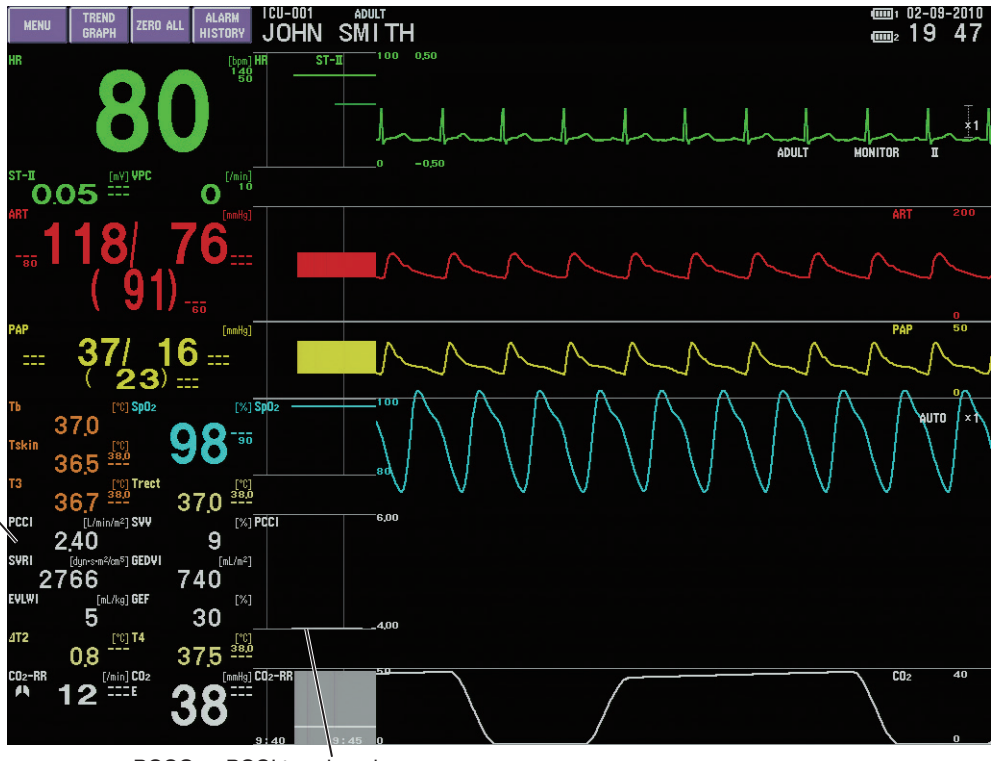
WARNING

The PiCCO alarms do not function on the bedside monitor. When the PiCCO data on the bedside monitor is abnormal, check the alarm on the PiCCO monitor.

PiCCO Information on the Home Screen

When the RS-232C setting on the PiCCO monitor is PiCCO *plus*:
BSM-6000A series: PCCO, SVV, SVR, GEDV, EVLW, Tb
BSM-6000K series: PCCO, SVV, SVR, GEDV, EVLW, GEF, Tb

When the RS-232C setting on PiCCO monitor version is SP 7.0/V1.0/V3.0:
BSM-6000A series: PCCO/PCCI, SVV, SVR/SVRI, GEDV/GEDVI, EVLW/EVLWI, Tb
BSM-6000K series: PCCO/PCCI, SVV, SVR/SVRI, GEDV/GEDVI, EVLW/EVLWI, GEF, Tb



PCCO parameters (Depend on the NUMERIC DISPLAY setting on the OTHER page)

PCCO or PCCI trendgraph
(Depends on the NUMERIC DISPLAY setting on the OTHER page)

PiCCO Information on the MEASURE page of CCO Window

Screen examples are when the RS-232C setting on PiCCO monitor version is V3.0.

When the <NUMERIC DISPLAY> on the OTHER Page is Set to ABSOLUTE

Displays the hemodynamics table on the HEMO TREND page of the TREND window

When the <NUMERIC DISPLAY> on the OTHER Page is Set to INDEX

Displays the hemodynamics table on the HEMO TREND page of the TREND window

Recording the PiCCO Data on the WAVEFORM Page of CCO Window

AP waveform and PiCCO data on the WAVEFORM page of the CCO window can be recorded.

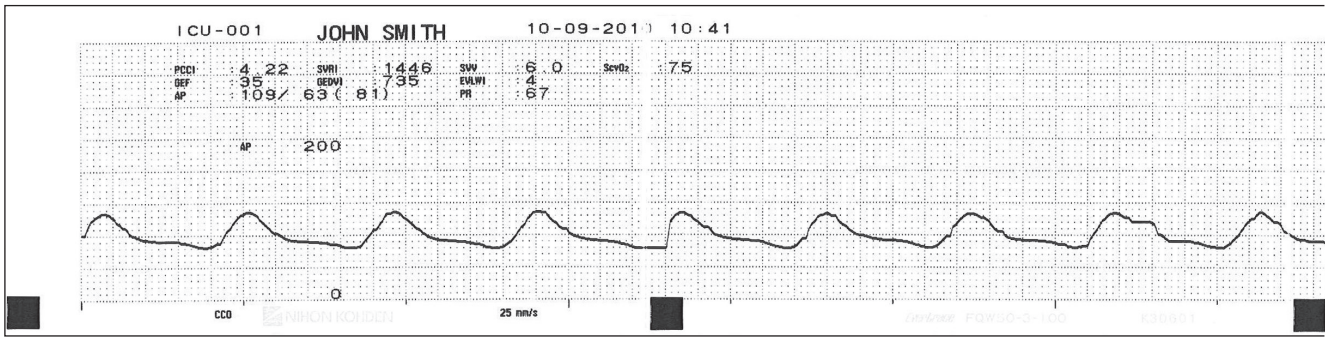
1. Display the WAVEFORM page of the CCO window.
   Press the [Menu] key → CCO key → WAVEFORM tab.

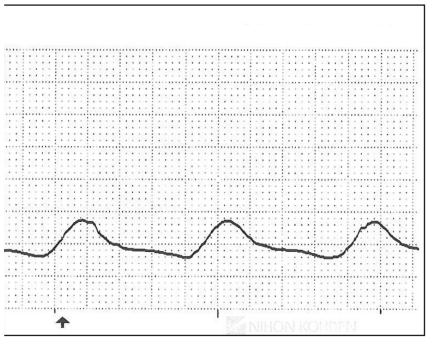
2. Touch the RECORD WAVE key. Recording starts.

   To stop recording, press the [Record] key.

3. Press the [Home] key to return to the home screen.

Recording example





Hemodynamics Table on the HEMO TREND Page of the TREND Window

When cardiac output is monitored by the PiCCO monitor, the CO data is listed on the HEMO TREND page of the TREND window. When CO is monitored, CO and CI are also added to this list. For details on the HEMO TREND page, refer to Section 6 of the User's Guide Part I.

Changing the PiCCO Setting

Change the settings on the CCO window. The following settings can be changed.

- Scale for AP waveform on the WAVEFORM page of the CCO window
- Absolute or index numeric display on the home screen and MEASURE page of the CCO window

The display color for CCO can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

Changing the Scale of the AP Waveform on the WAVEFORM Page of the CCO Window

The scale of the AP waveform on the CCO window can be changed.

1. Display the WAVEFORM page of the CCO window.
   Press the [Menu] key → CCO key → WAVEFORM tab.

2. Select the scale by touching the desired scale key.

3. Press the [Home] key to return to the home screen.

Selecting the Absolute or Index Value to be Displayed

Either absolute or index value can be displayed on the home screen and MEASURE page of the CCO window.

1. Display the OTHER page of the CCO window.
   Press the [Menu] key → CCO key → OTHER tab.

2. Select either ABSOLUTE or INDEX in the <NUMERIC DISPLAY> box.

3. Press the [Home] key to return to the home screen.

CCO/$S\bar{v}O_2$ Monitoring by SO_2/CCO Monitor

General

Oxygen saturation and continuous cardiac output monitoring can be performed by connecting an ICU Medical oxygen saturation and continuous cardiac output monitor, Q-VUE/Q2/Q2 plus computer (SO_2/CCO monitor) to the bedside monitor. To connect the SO_2/CCO monitor to the bedside monitor, the IF-922P communication cable is required.

WARNING

The alarm does not function on the bedside monitor when a SO_2/CCO monitor is connected. When the data is abnormal, check the alarm on the SO_2/CCO monitor.

NOTE

- If a SO_2/CCO monitor parameter is not monitored on the SO_2/CCO monitor, it is not displayed on the bedside monitor.
- Some SO_2/CCO monitor parameters cannot be displayed on the bedside monitor even if they are monitored on the SO_2/CCO monitor.

List of Terms

Label	Name	Unit
HR	Heart rate	beat/min
CCO	Continuous cardiac output	L/min
CCI*1	Continuous cardiac index	L/min/m^2
Tb*2	Blood temperature	°C or °F*3
$S\bar{v}O_2$*2	Oxygen saturation	%
ART	Arterial pressure	mmHg or kPa*3
CVP	Central venous pressure	mmHg or kPa*3
SV	Stroke volume	mL
SVI	Stroke volume index	mL/m^2
SVR	Systemic vascular resistance	dyn·s/cm^5*4
SVRI*1	Systemic vascular resistance index	dyn•s•m^2/cm^5*5

*1 Enter the height and weight on the ADMIT page of the ADMIT DISCHARGE window. Otherwise they cannot be displayed.

*2 Replace the following parameters on the SO_2/CCO monitor.
Tb: BT, CO: ICO mean, $S\bar{v}O_2$: SO_2

*3 The temperature units (°C or °F) and blood pressure units (mmHg or kPa) can be set on the SYSTEM CONFIGURATION screen of the bedside monitor.

*4 When the blood pressure unit is kPa, this unit becomes kPa•s/L.

*5 When the blood pressure unit is kPa, this unit becomes kPa•s•m^2/L.

Preparing for CCO/S$\bar{v}O_2$ Monitoring

1. Set up the SO_2/CCO monitor and connect it to the bedside monitor. Refer to the IF-922P communication cable manual.

2. Connect the SO_2/CCO monitor to the patient. Refer to the SO_2/CCO monitor manual.

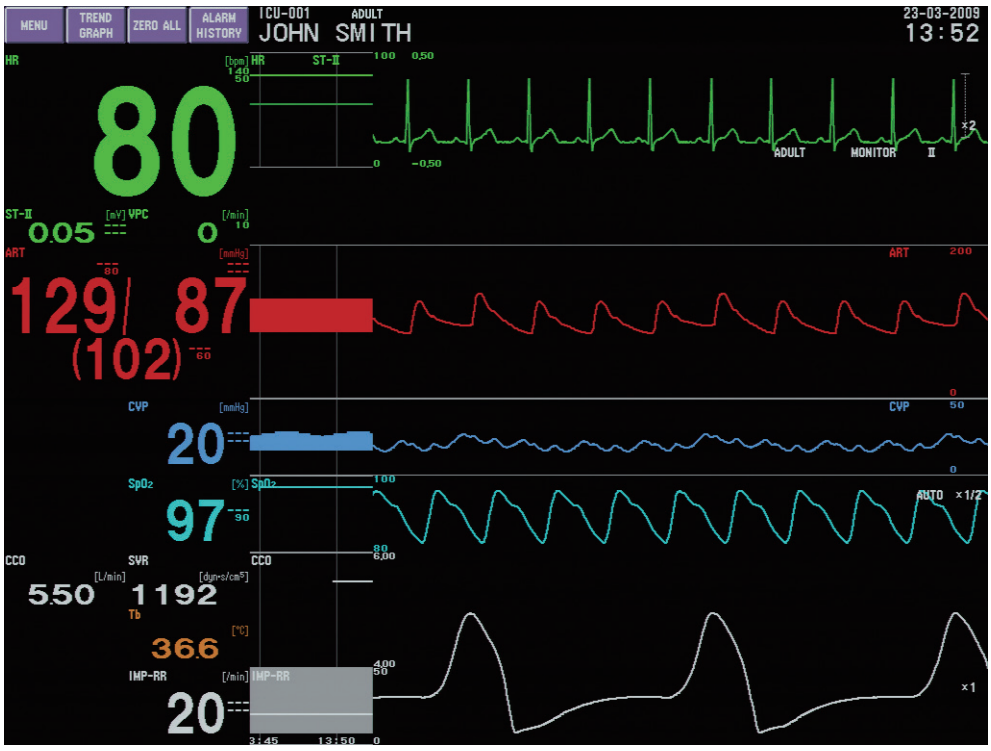
3. Start measurement and change necessary settings.

Monitoring CCO/S$\bar{v}O_2$

After completing the preparation, CCO/S$\bar{v}O_2$ data appears on the screen.

CCO Information on the Home Screen

CCO: Data monitored on the SO_2/CCO monitor.



When you are connecting an SO_2/CCO monitor to the bedside monitor, only CCO is displayed.

CCO/$S\bar{v}O_2$ Information on the CCO Window

CCO, $S\bar{v}O_2$, Tb: Data monitored on the SO_2/CCO monitor.
HR, ART, CVP: Data monitored on the bedside monitor.
CCI, SVR, SVRI, SV, SVI: Calculated from the data monitored on the SO_2/CCO monitor and bedside monitor.

Displays the hemodynamics table on the HEMO TREND page of the TREND window

Opening the CCO Window

To open the CCO window:
Press the [Menu] key → CCO key → MEASURE 1 tab.

Hemodynamics Table on the HEMO TREND Page of the TREND Window

When cardiac output is monitored by the SO_2/CCO monitor, the CO data is listed on the HEMO TREND page of the TREND window. When CO is monitored, the CO and CI are also added to this list. For details on the HEMO TREND page, refer to Section 6 of the User's Guide Part I.

CO: Data monitored on the SO_2/CCO monitor.
CI: Calculated from the data monitored on the SO_2/CCO monitor and bedside monitor.

The CCO parameters (TABLE page): CCO, CCI, $S\bar{v}O_2$, SVR, SVRI, SV, SVI
The CCO parameters (GRAPH page): CCO, CCI, $S\bar{v}O_2$, SVR, SVRI, SV, SVI

Changing the CCO/S$\bar{v}O_2$ Settings

Displaying CCO parameters on the home screen can be set on the CCO window.

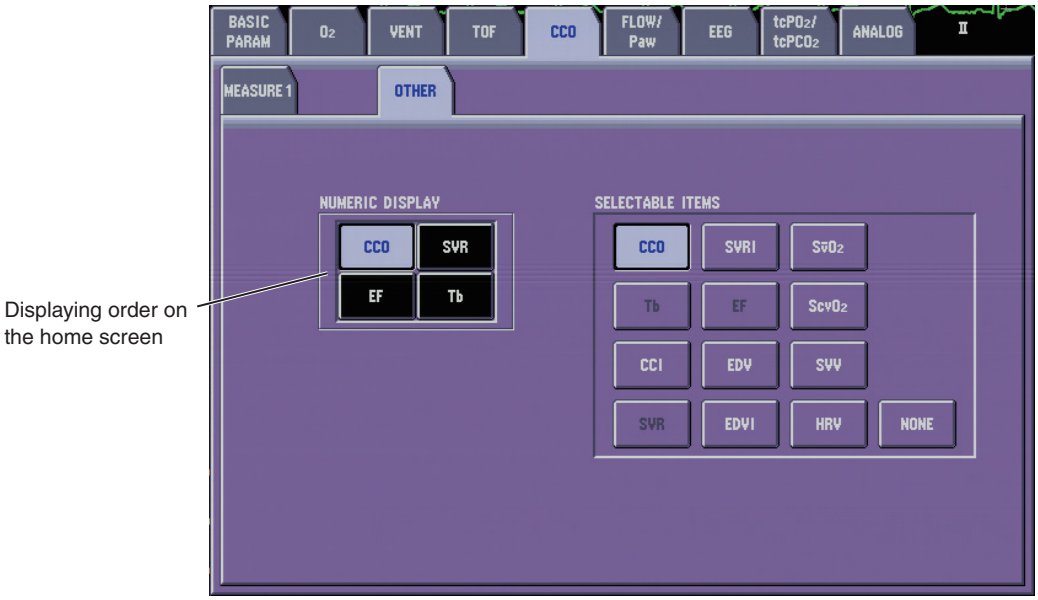
The display color for CCO can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

Selecting the CCO/S$\bar{v}O_2$ Parameters to be Displayed on the Home Screen

1. Display the OTHER page of the CCO window.
   Press the [Menu] key → CCO key → OTHER tab.

2. Select the area for the parameter to be displayed on the home screen in the <NUMERIC DISPLAY> box.

3. Select the parameter to be displayed in the selected area from the <SELECTABLE ITEMS> box.



4. Press the [Home] key to return to the home screen.

Explanation of Hemodynamics Data

Label	Name	Unit	Explanation and Equation
HR/PR	Heart rate/pulse rate	bpm	Heart rate at the time the CO is measured.
CO	Cardiac output	L/min	—
CI	Cardiac index	L/min/m^2	CI = CO/BSA*1
CCO	Continuous cardiac output	L/min	—
CCI	Continuous cardiac output index	L/min/m^2	CCI = CCO/BSA*1
PCCO*2	Pulse contour cardiac output	L/min	—
PCCI*2	Pulse contour cardiac output index	L/min/m^2	—
ART-MEAN	Arterial mean pressure	mmHg*3	Values registered at the time the CO is measured.
PAP-MEAN	Pulmonary arterial mean pressure		
PCWP	Pulmonary capillary wedge pressure		
PCWP TIME	PCWP time is measured	hr:min	
CVP	Central venous mean pressure	mmHg*3	
SV	Stroke volume	mL	SV = (CO × 1000)/HR
SVI	Stroke volume index	mL/m^2	SVI = (CI × 1000)/HR
SVR	Systemic vascular resistance	dyn•s/cm^5*4	SVR = {(ART-MEAN – CVP) × 80}/CO
SVRI	Systemic vascular resistance index	dyn•s•m^2/cm^5*4	SVRI = {(ART-MEAN – CVP) × 80}/CI
SVV	Stroke volume variation	%	—
PPV	Pulse pressure variation	%	—
PVR	Pulmonary vascular resistance	dyn•s/cm^5*4	PVR = {(PAP-MEAN – PCWP) × 80}/CO
PVRI	Pulmonary vascular resistance index	dyn•s•m^2/cm^5*5	PVRI = {(PAP-MEAN – PCWP) × 80}/CI
LVSW	Left ventricular stroke work	g•m	LVSW = {SV × (ART-MEAN – PCWP)} × 0.0136
LVSWI	Left ventricular stroke work index	g•m/m^2	LVSWI = {SVI × (ART-MEAN – PCWP)} × 0.0136
RVSW	Right ventricular stroke work	g•m	RVSW = {SV × (PAP-MEAN – CVP)} × 0.0136
RVSWI	Right ventricular stroke work index	g•m/m^2	RVSWI = {SVI × (PAP-MEAN – CVP)} × 0.0136
EDV	End diastolic volume	mL	—
EDVI	End diastolic volume index	mL/m^2	EDVI = EDV/BSA*1
GEDV*2	Global end-diastolic volume	mL	—
GEDVI*2	Global end-diastolic volume index	mL/m^2	—
ESV	End systolic volume	mL	—
ESVI	End systolic volume index	mL/m^2	ESVI = ESV/BSA*1
EF	Ejection fraction	%	—
GEF*2	Global ejection fraction	%	—
ITBV*2	Intrathoracic blood volume	mL	—
ITBVI*2	Intrathoracic blood volume index	mL/m^2	—
EVLW*2	Extravascular lung water	mL	—
EVLWI*2	Extravascular lung water index	mL/kg	—
CFI*2	Cardiac function index	/min	—
PVPI*2	Pulmonary vascular permeability index	—	—
dPmax*2	Left ventricular contractility index	mmHg*3/s	—

*1 BSA = 0.007184 × Weight$^{0.425}$ × Height$^{0.725}$ (m^2) (DuBois equation)

*2 These parameters are monitored when a PiCCO monitor is used.

*3 The blood pressure unit can be changed to kPa on the can be changed on the SYSTEM CONFIGURATION screen of the bedside monitor.

*4 When the blood pressure unit is kPa, this unit becomes kPa•s/L.

*5 When the blood pressure unit is kPa, this unit becomes kPa•s•m^2/L.

Section 15 FLOW/Paw Monitoring

NOTE

FLOW/Paw monitoring is not available for BSM-6000A series.

General

To monitor overall respiratory condition of a patient, use the GF-120PA or GF-220R multigas/flow unit.

List of Terms

Terms	Meaning	Unit
FLOW	Respiratory flow rate	L/s
Paw	Airway pressure	cmH_2O or hPa*
VOL	Respiratory volume	mL
Ppeak	Peak airway pressure	cmH_2O or hPa*
PEEP	Positive end expiratory pressure	cmH_2O or hPa*
Pmean	Mean airway pressure	cmH_2O or hPa*
FLOW-RR	Respiration rate from flow waveform	Counts/min
MV	Minute volume	L/min
TVe	Expiratory tidal volume	mL
TVi	Inspiratory tidal volume	mL
C	Compliance	mL/cmH_2O or hPa*
R	Airway resistance	cmH_2O or hPa*/L/s
Re	Expiratory airway resistance	cmH_2O or hPa*/L/s
Ri	Inspiratory airway resistance	cmH_2O or hPa*/L/s
I:E	Inspiration expiration ratio	—

* The respiration unit (cmH2O or hPa) can be set on the SYSTEM CONFIGURATION screen. Refer to Section 2 of the Administrator's Guide.

Preparing for FLOW/Paw Monitoring

Preparation Flowchart

1. Set up the GF-120PA or GF-220R multigas/flow unit and connect the multi-link cable of the unit to the bedside monitor.

2. Connect the flow adapter to the respiration circuit of the patient.

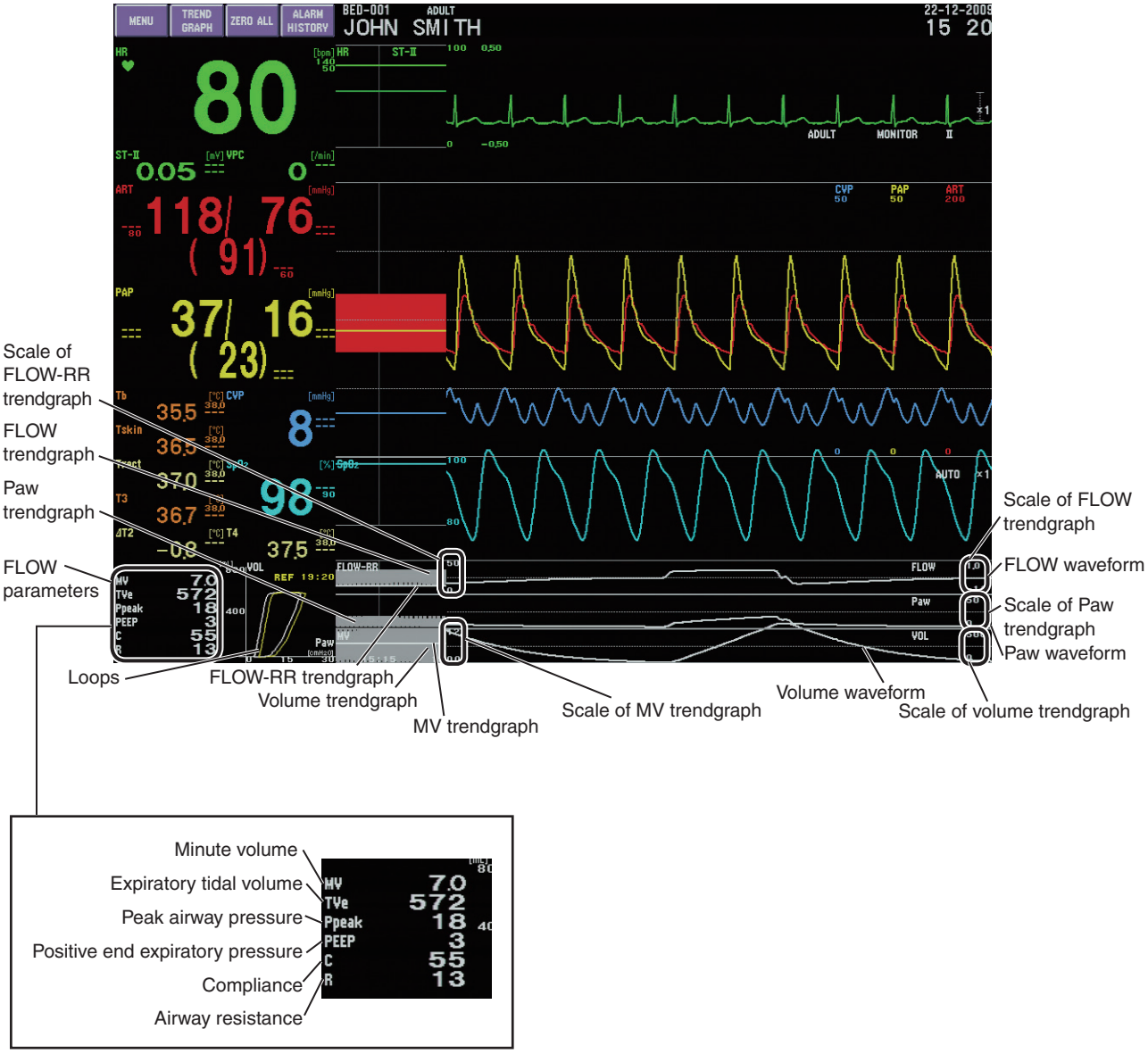
3. Start measurement and change necessary settings.

For steps 1 and 2, refer to the GF-120PA or GF-220R multigas/flow unit operator's manual.

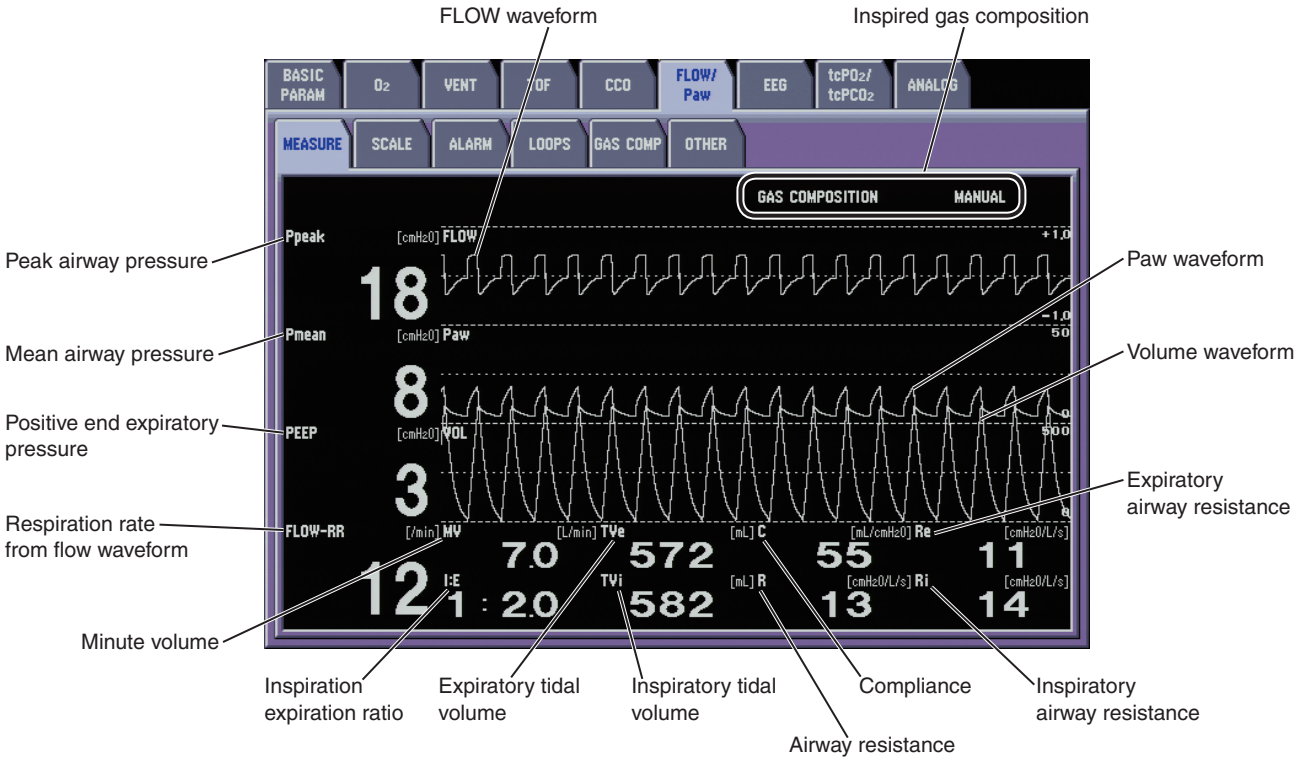
Monitoring FLOW/Paw

After completing the preparation, FLOW/Paw data and waveforms appear on the screen.

FLOW/Paw Information on the Home Screen



FLOW/Paw Information on the FLOW/Paw Window



Changing FLOW/Paw Settings

Change the settings on the FLOW/Paw window. The following settings can be changed for FLOW/Paw monitoring.

- MV, Ppeak, PEEP, respiration rate and apnea alarm settings
- Scale for FLOW, Paw and volume waveforms
- Various settings for loops (scale, reference loop, number of loops)
- Inspiration gas composition, temperature and humidity
- Displaying FLOW/Paw parameters on the home screen
- FLOW and Paw measurement on or off

The respiration unit (cmH_2O or hPa) can be set on the SYSTEM CONFIGURATION screen. Refer to Section 2 of the Administrator's Guide.

The FLOW and Paw display color can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

The waveform display of the FLOW, Paw and MV on the home screen can be selected on the DISPLAY window. Refer to Section 3 of the User's Guide Part I.

If the APNEA alarm occurs and no action is taken for a selected duration, the alarm level can be escalated. Refer to Section 3 of the Administrator's Guide.

Changing the MV, Ppeak, PEEP, Respiration Rate and Apnea Alarm Limits

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

You can set the upper and lower MV, Ppeak, PEEP, respiration rate and apnea alarm limits on the FLOW/Paw window. You can set all alarms, including the upper and lower MV, Ppeak, PEEP, respiration rate and apnea alarm limits on the ALARM LIMITS window (See the Operator's Manual or Section 5 of the User's Guide Part I). You can also set upper and lower respiration rate and apnea alarm limits on the RESP, CO_2, and GAS windows.

Setting Range

MV upper limit:	0.1 to 30.0 L/min in 0.1 L/min steps, OFF (default setting: ADULT-10.0 L/min, CHILD-6.0 L/min, NEONATE-OFF)
MV lower limit:	OFF, 0.0 to 29.9 L/min in 0.1 L/min steps (default setting: ADULT, CHILD-2.0 L/min, NEONATE-OFF)
Ppeak upper limit:	1 to 100 cmH_2O in 1 cmH_2O steps (1 to 100 hPa in 1 hPa steps), OFF (default setting: ADULT, CHILD-40 cmH_2O (40 hPa), NEONATE-OFF)

Ppeak lower limit:	OFF, 0 to 99 cmH_2O in 1 cmH_2O steps (0 to 99 hPa in 1 hPa steps) (default setting: ADULT, NEONATE-OFF, CHILD-8 cmH_2O (8 hPa))
PEEP upper limit:	1 to 50 cmH_2O in 1 cmH_2O steps (1 to 50 hPa in 1 hPa steps), OFF (default setting: ADULT, CHILD-10 cmH_2O (10 hPa), NEONATE-OFF)
PEEP lower limit:	OFF, 0 to 49 cmH_2O in 1 cmH_2O steps (0 to 49 hPa in 1 hPa steps) (default setting: ADULT, NEONATE-OFF, CHILD-2 cmH_2O (2 hPa))
Respiration rate upper limit:	2 to 150 counts/min in 2 counts/min steps, OFF (default setting: OFF)*1*2
Respiration rate lower limit:	OFF, 0 to 148 counts/min in 2 counts/min steps (default setting: OFF)*1*2
Apnea upper limit:	5 to 40 s in 5 s steps, OFF (default setting: 20)*1*2

*1 On BSM-6000A series, if <CRISIS VITAL ALARM MANAGEMENT> on the SYSTEM CONFIGURATION screen is turned on and "ALARM PRIORITY" on the SYSTEM SETUP window is set to CRISIS, the alarm setting is set to the alarm master setting.

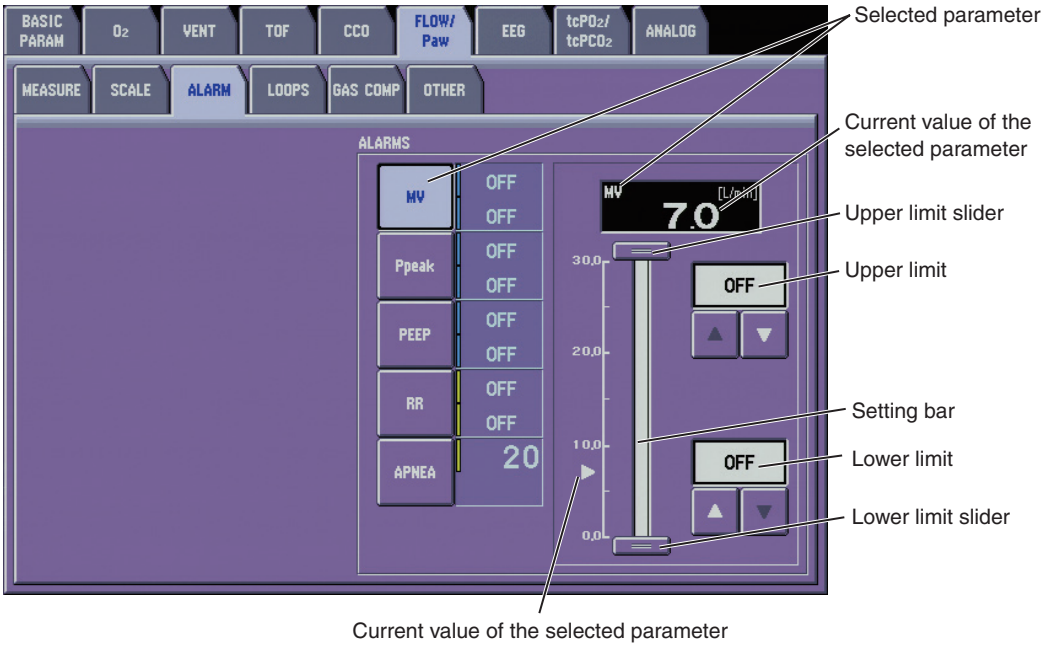
*2 On BSM-6000A series, if <ALARM CAP> on the SYSTEM CONFIGURATION screen is turned on, the alarm setting is affected by the "ALARM CAP" setting on the SYSTEM SETUP window.

1. Display the ALARM page of the FLOW/Paw window.
   Press the [Menu] key → FLOW/Paw key → ALARM tab.

2. Touch the MV key to change the MV alarm setting.
   Touch the Ppeak key to change the Ppeak alarm setting.
   Touch the PEEP key to change the PEEP alarm setting.
   Touch the RR key to change the respiration rate alarm setting.
   Touch the APNEA key to change the apnea alarm setting.

3. Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.



15

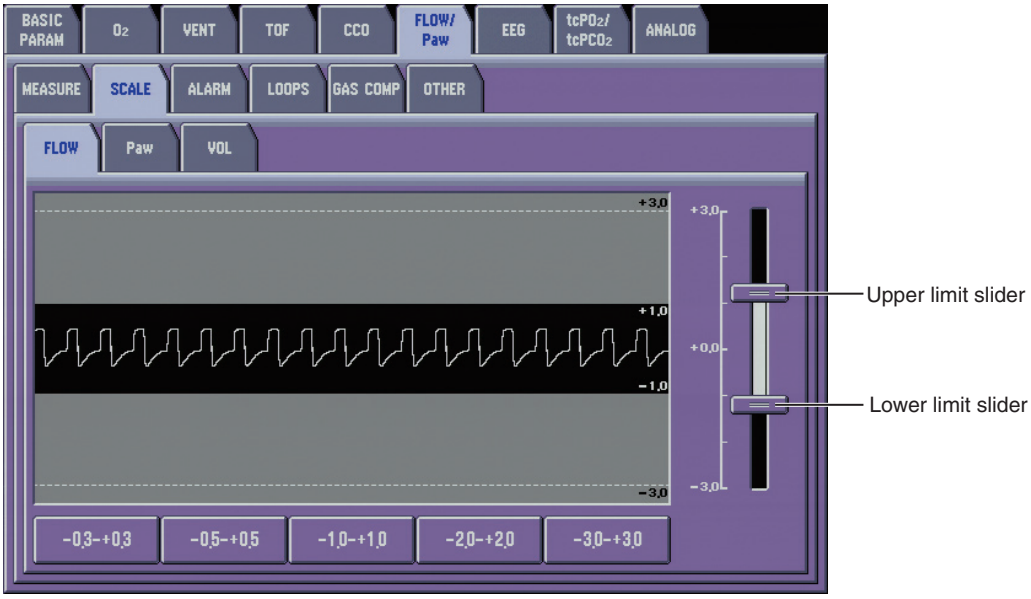
4. Press the [Home] key to return to the home screen.

Changing the Scale

The scale can be changed for the FLOW, Paw and volume waveforms. The same scale is used on both the home screen and FLOW/Paw window.

1. Display the SCALE page of the FLOW/Paw window.
   Press the [Menu] key → FLOW/Paw key → SCALE tab.

2. Select the appropriate scale for each parameter. Touch and drag the sliders to the desired level on the setting bar.



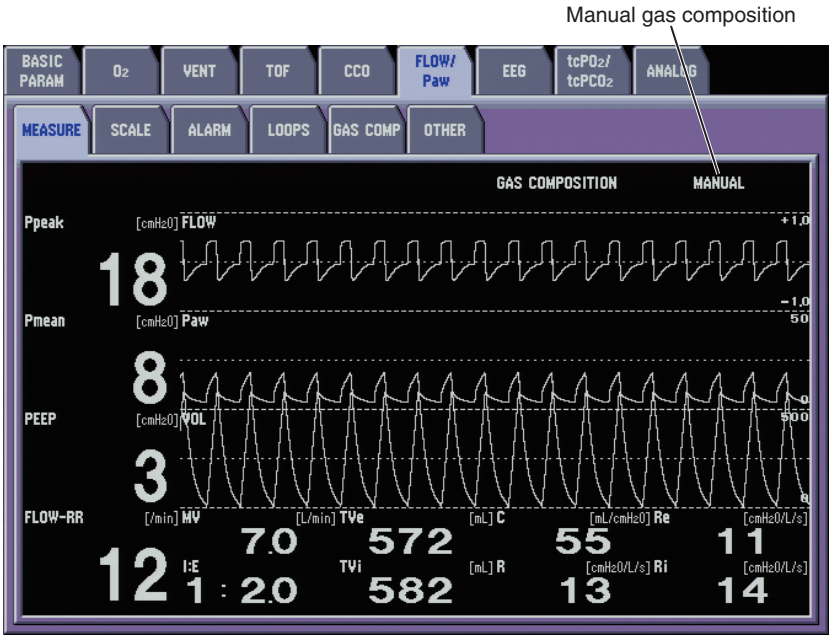
3. Press the [Home] key to return to the home screen.

Setting the Inspired Gas Composition

The measured FLOW values are affected by the gas composition due to the measurement principle of the FLOW sensor.

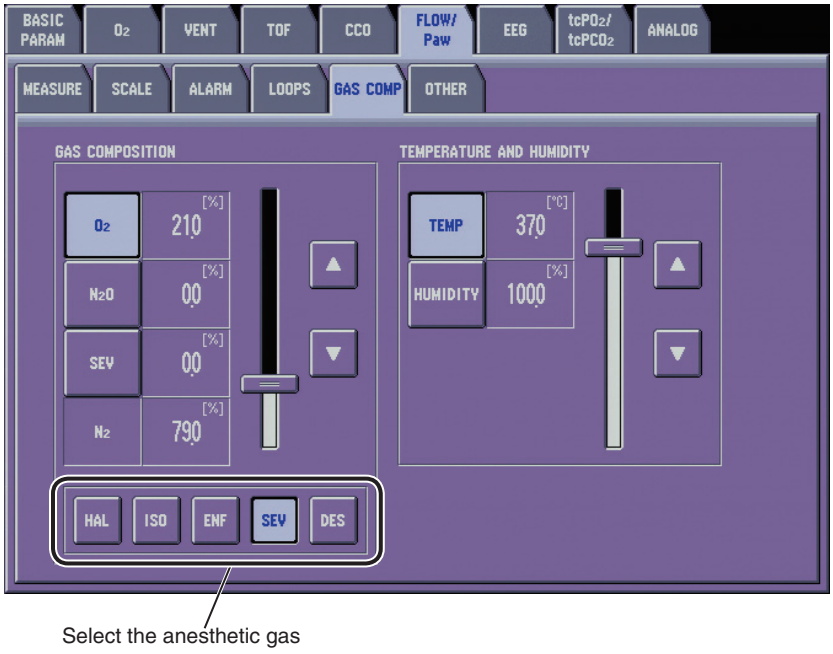
When the GF-120PA or GF-220R multigas/flow unit is used, the gas composition is automatically set. If “MANUAL” is displayed for the gas composition, it means that the gas is not monitored properly by the multigas unit. Check the settings, connection and monitoring condition of the multigas unit.

When another gas monitor or ventilator is used or when <GAS MEASUREMENT> on the OTHER page of the GAS window is set to OFF, set the gas composition manually.



1. Display the GAS COMP page of the FLOW/Paw window.
   Press the [Menu] key → FLOW/Paw key → GAS COMP tab.

2. Touch the O_2 key to set the oxygen percentage.
   Touch the N_2O key to set the N_2O anesthetic gas percentage.
   Touch the agent key to set the agent percentage when using a volatile anesthetic gas. You can select the type of agent from the five keys at the bottom of the page.
   The N_2 percentage is automatically calculated from the equation below.



Setting Range

O_2: 0 to 100% in 0.1 steps (default setting: 21%)
N_2O: 0 to 100% in 0.1 steps 0 to 100% in 0.1 steps (default setting: 0%)
AGENT: 0 to 100% in 0.1 steps (default setting: 0%)
N_2*: 0 to 100% in 0.1 steps
* N_2 (%) = 100 – O_2 – N_2O – agent

3. Set the appropriate percentage. Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

4. Press the [Home] key to return to the home screen.

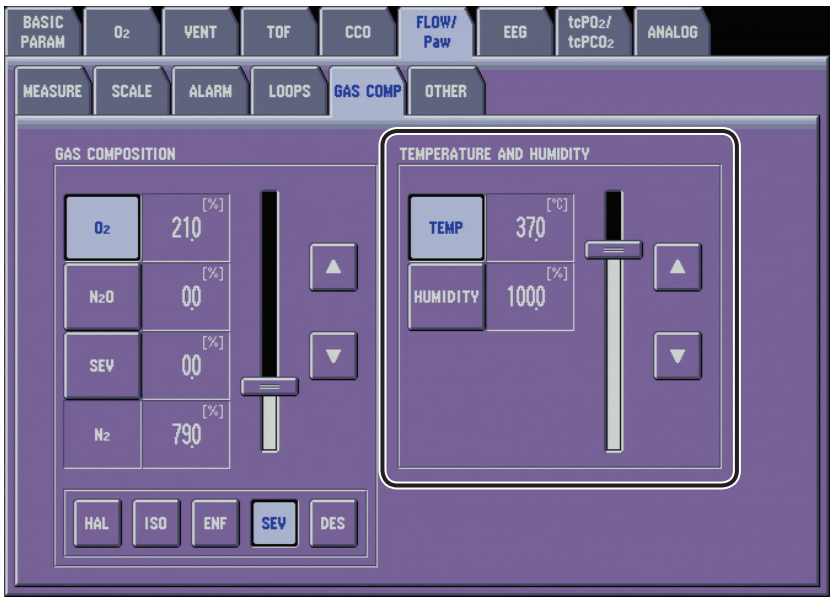
Setting the Temperature and Humidity of the Inspired Gas

When FLOW and Paw are measured at the patient's mouth, usually there is no need to set the temperature and humidity of the inspired gas because FLOW is measured at 37°C (98.6°F) temperature and 100% humidity.

To use the FLOW sensor at high precision, change the temperature and humidity of the gas to be measured.

1. Display the GAS COMP page of the FLOW/Paw window.
   Press the [Menu] key → FLOW/Paw key → GAS COMP tab.

2. Touch the TEMP key to set the temperature of the gas.
   Touch the HUMIDITY key to set the humidity of the gas.



3. Set the temperature and humidity of the gas. Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

4. Press the [Home] key to return to the home screen.

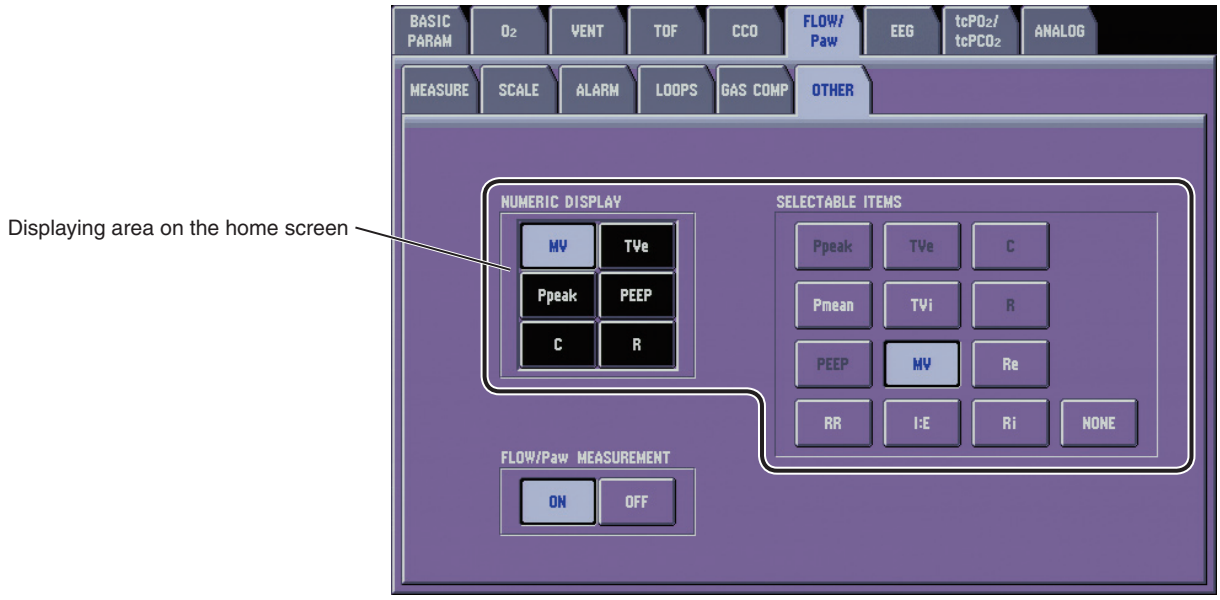
Selecting the FLOW/Paw Parameters to be Displayed on the Home Screen

Up to 6 FLOW/Paw parameters can be displayed on the home screen.

1. Display the OTHER page of the FLOW/Paw window.
   Press the [Menu] key → FLOW/Paw key → OTHER tab.

2. Select the area on the home screen where the parameter is to be displayed in the <NUMERIC DISPLAY> box.

3. Select the parameter to be displayed from the <SELECTABLE ITEMS> box.



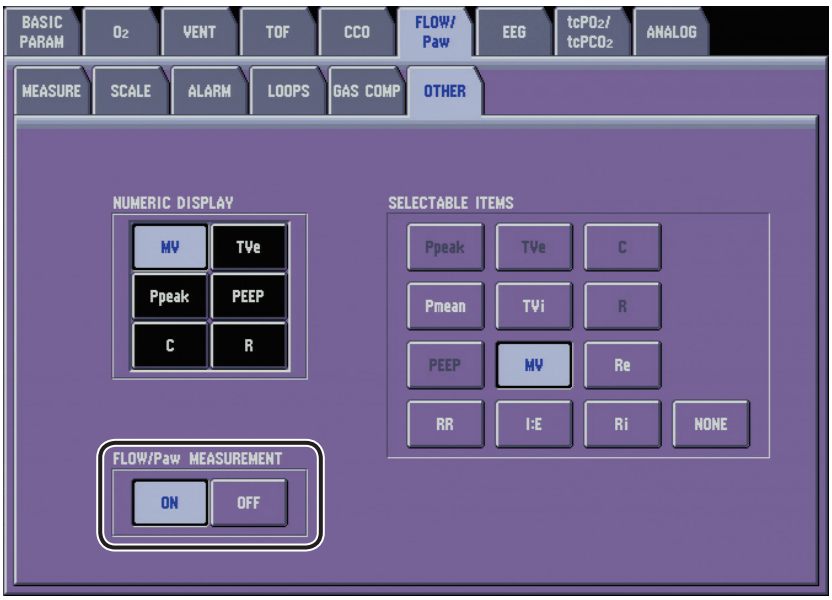
4. Press the [Home] key to return to the home screen.

Turning FLOW/Paw Measurement On or Off

FLOW/Paw measurement can be turned off.

1. Display the OTHER page of the FLOW/Paw window.
   Press the [Menu] key → FLOW/Paw key → OTHER tab.

2. Select ON or OFF in the <FLOW/Paw MEASUREMENT> box to turn FLOW/Paw measurement on or off.



3. Press the [Home] key to return to the home screen.

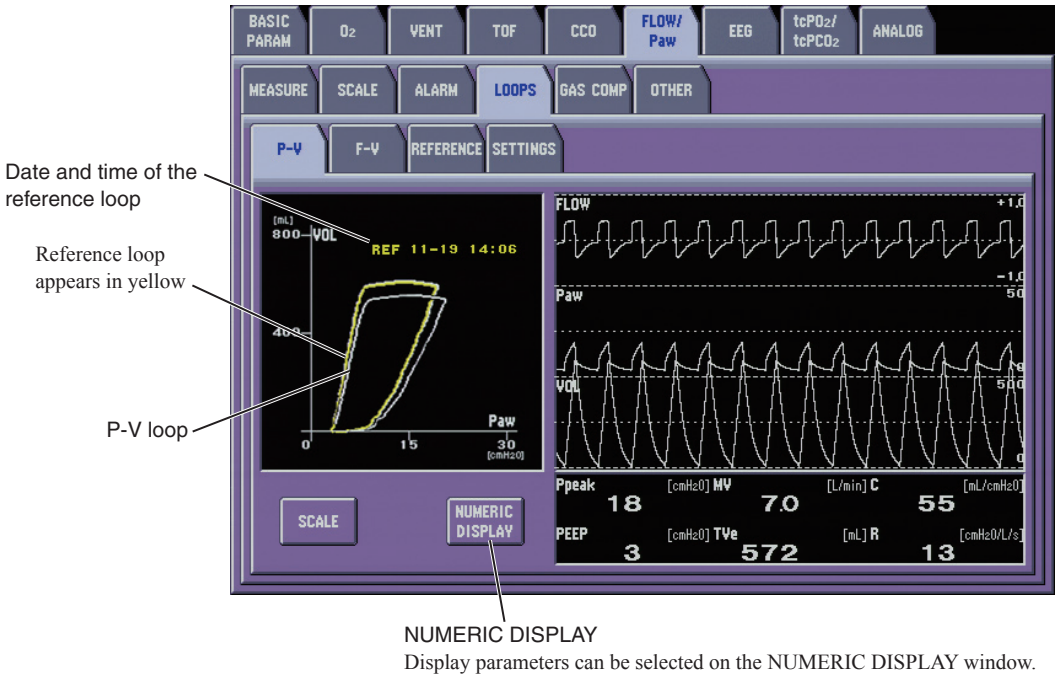
Viewing the Loops

There are P-V loops and F-V loops for FLOW/Paw monitoring.

Displaying the Loop Window

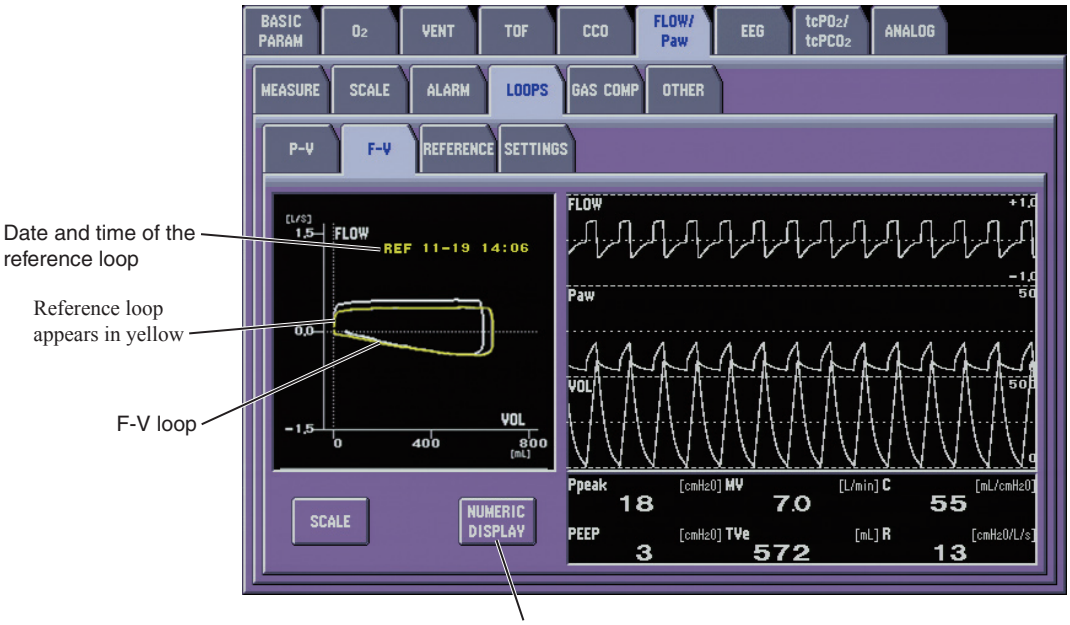
There are separate windows for P-V loops and F-V loops.

1. Display the loop window for the desired loop type.
   P-V loop: Press the [Home] key → FLOW/Paw key → LOOPS tab → P-V tab.



NUMERIC DISPLAY
Display parameters can be selected on the NUMERIC DISPLAY window.

   F-V loop: Press the [Home] key → FLOW/Paw key → LOOPS tab → F-V tab.



NUMERIC DISPLAY
Display parameters can be selected on the NUMERIC DISPLAY window.

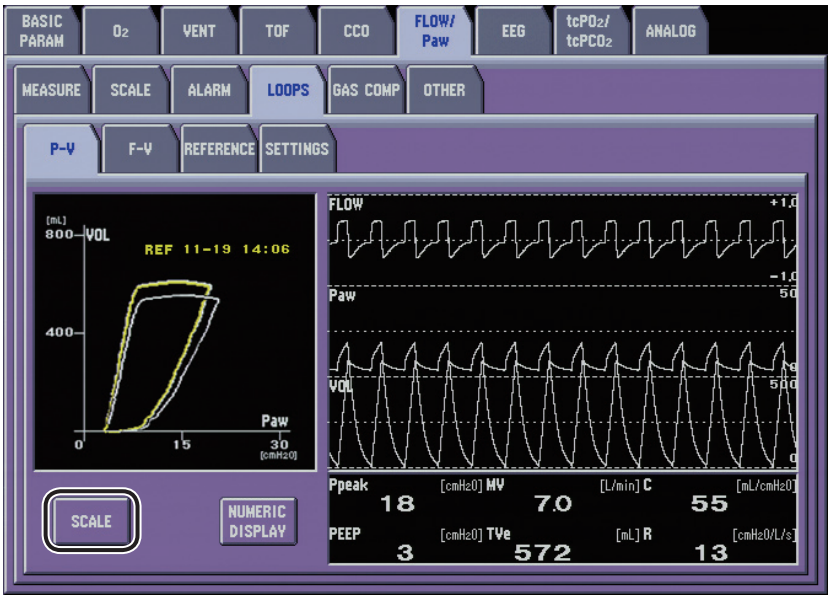
2. Press the [Home] key to return to the home screen.

Changing the Loop Graph Scale

The scale can be changed for the FLOW, Paw and volume. The same scale is used on both the home screen and FLOW/Paw window.

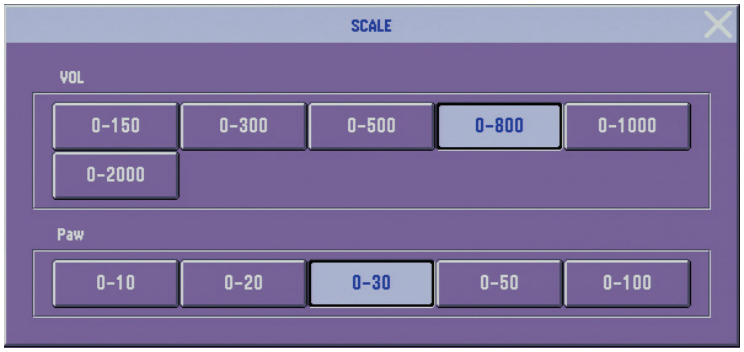
1. Display the LOOPS page for the desired loop type.
   P-V loop: Press the [Home] key → FLOW/Paw key → LOOPS tab → P-V tab
   F-V loop: Press the [Home] key → FLOW/Paw key → LOOPS tab → F-V tab

2. Touch the SCALE key to change the graph scale.



3. Select the appropriate scale for each parameter.
   Paw: 0-10, 0-20, 0-30, 0-50, 0-100 (cmH_2O)
   VOL: 0-150, 0-300, 0-500, 0-800, 0-1000, 0-2000 (mL)
   FLOW: ±0.3, ±0.5, ±1.0, ±1.5, ±3.0 (L/s)

   i) Select the scale by touching the desired scale key.



   ii) Touch the ☒ key to close the window.

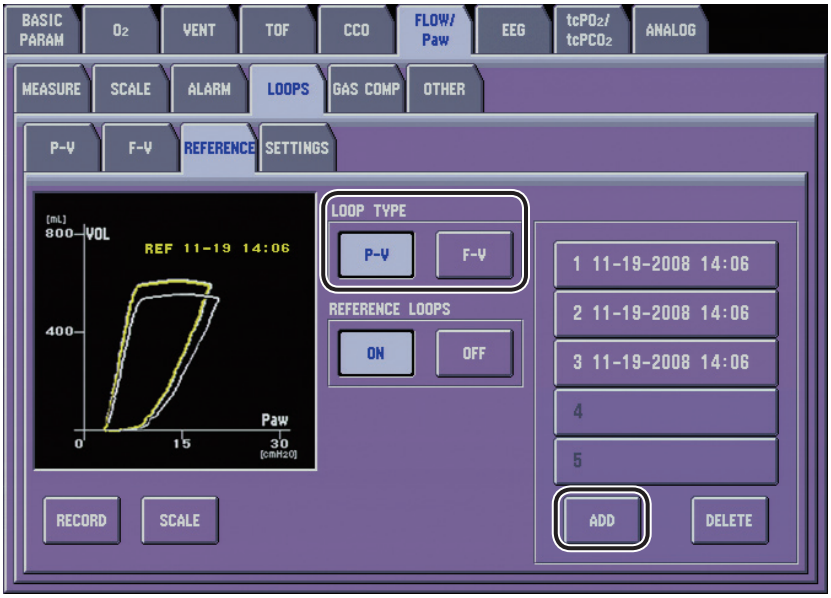
4. Press the [Home] key to return to the home screen.

Registering Reference Loops

Up to 5 P-V loops and 5 F-V loops can be registered as reference loops.

1. Display the REFERENCE page of the FLOW/Paw window.
   Press the [Menu] key → FLOW/Paw key → LOOPS tab → REFERENCE tab.

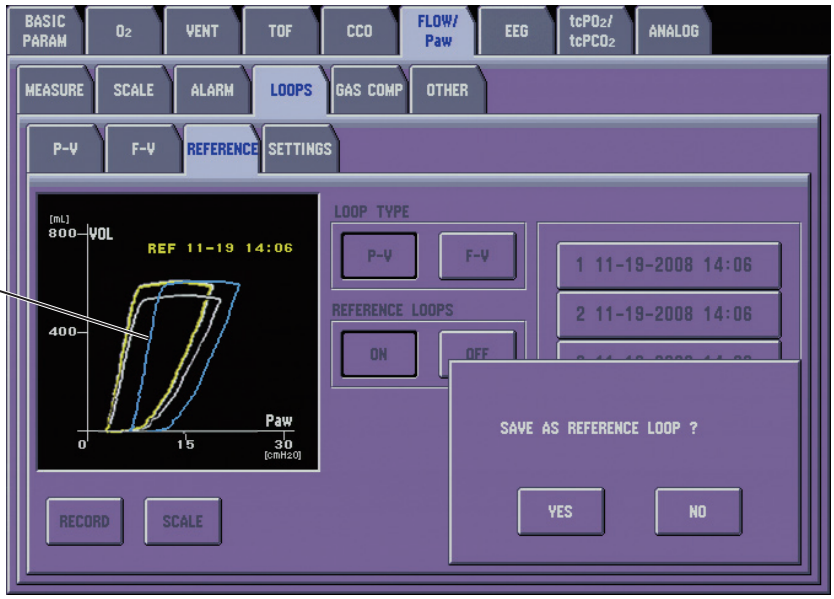
2. Select the loop type in the <LOOP TYPE> box.



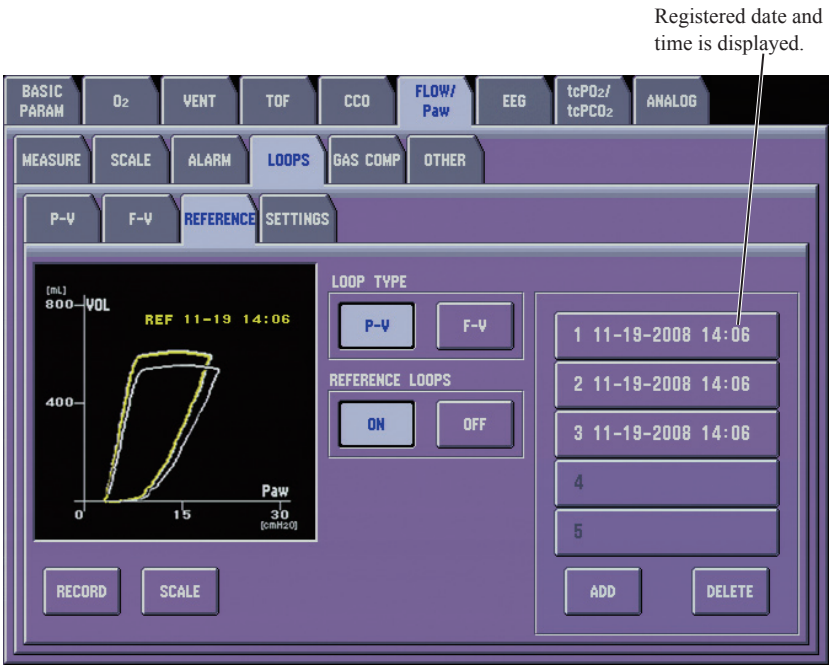
3. When the desired loop is displayed on the window, touch the ADD key. The confirmation message appears. The loop to be registered appears in blue.

4. Touch YES to register the loop as a reference loop.
   Touch NO to cancel registration.

Loop to be registered appears in blue.

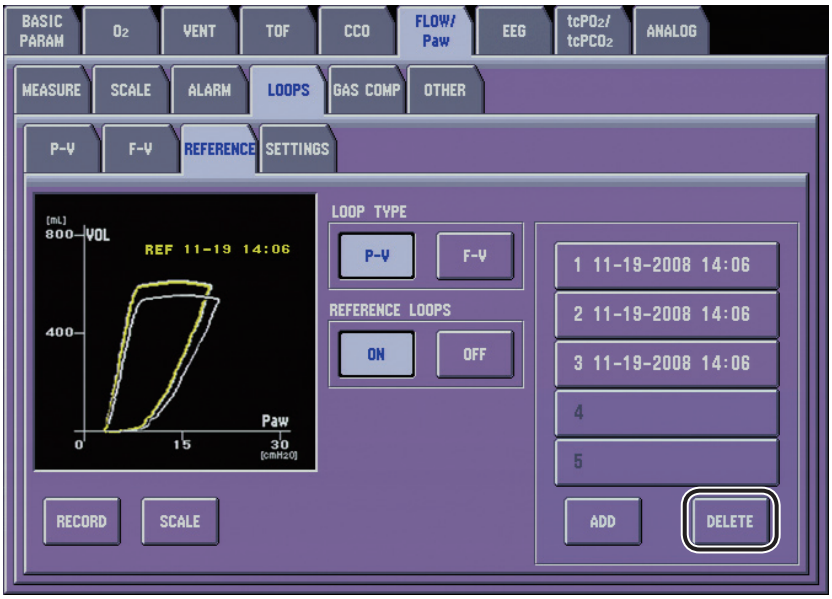


A new loop cannot be registered as a reference loop when 5 loops are already registered. To register another reference loop when there are already 5 reference loops, delete one reference loop.



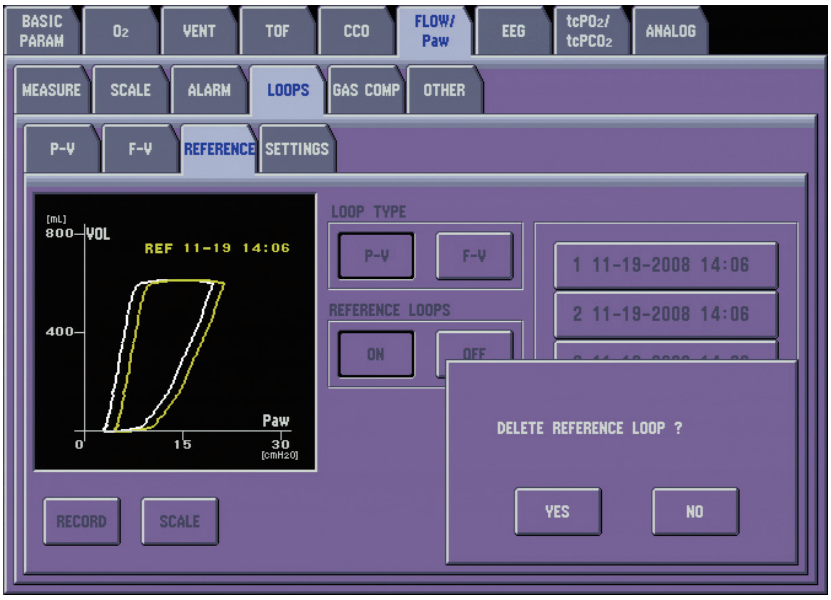
To delete a reference loop

i) Touch the key of the reference loop to be deleted.



ii) Touch the DELETE key. The confirmation message appears.

iii) Touch YES to delete the selected loop.
Touch NO to cancel deletion.



5. Press the [Home] key to return to the home screen.

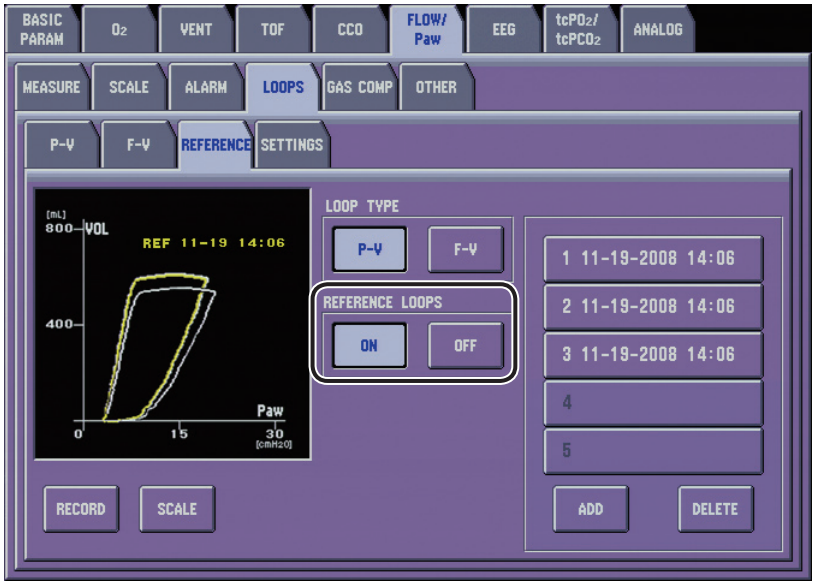
Turning Reference Loop Display On or Off

Select the reference loop display on the home screen and P-V tab or F-V tab of the LOOPS page.

1. Display the REFERENCE tab of the FLOW/Paw window.
   Press the [Menu] key → FLOW/Paw key → LOOPS tab → REFERENCE tab.

2. Select ON or OFF in the <REFERENCE LOOP> box to set reference loop display on or off.

3. When <REFERENCE LOOPS> is set to ON, select the loop type and the reference loop from the registered reference loops.



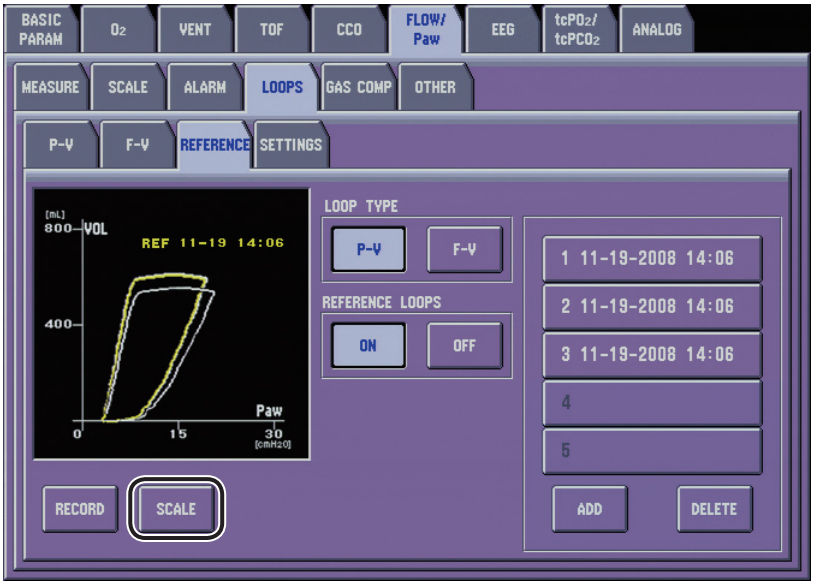
4. Press the [Home] key to return to the home screen.

Changing the Loop Graph Scale on the REFERENCE Tab

The scale can be changed for the FLOW, Paw and volume waveforms. The same scale is used on both the home screen and FLOW/Paw window.

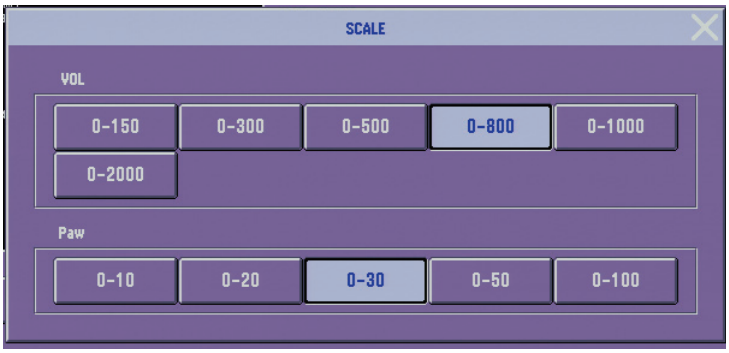
1. Display the REFERENCE tab of the FLOW/Paw window.
   Press the [Menu] key → FLOW/Paw key → LOOPS tab → REFERENCE tab.

2. Touch the SCALE key to change the graph scale.



3. Select the appropriate scale for each parameter.
   Paw: 0-10, 0-20, 0-30, 0-50, 0-100 (cmH_2O)
   VOL: 0-150, 0-300, 0-500, 0-800, 0-1000, 0-2000 (mL)
   FLOW: ±0.3, ±0.5, ±1.0, ±1.5, ±3.0 (L/s)

   i) Select the scale by touching the desired scale key.



   ii) Touch the ☒ key to close the window.

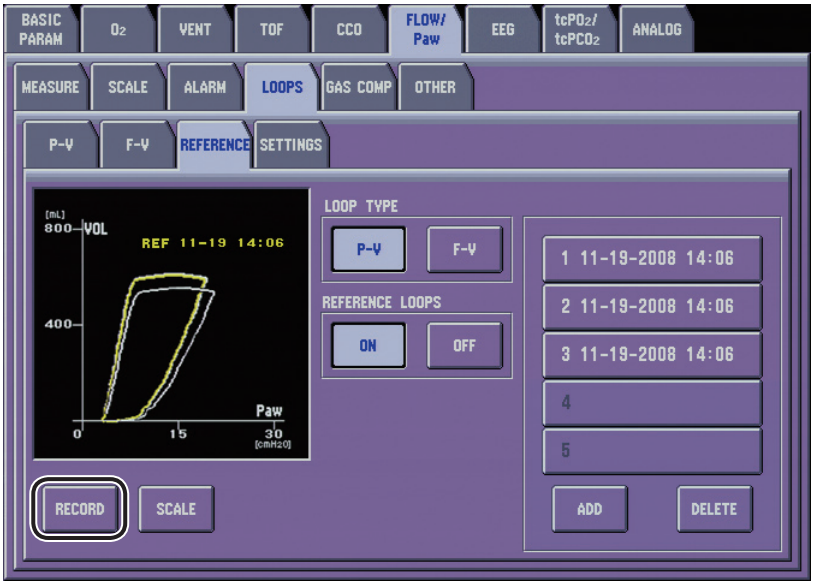
4. Press the [Home] key to return to the home screen.

Recording the Loops on the FLOW/Paw Window

The loops displayed on the FLOW/Paw window can be recorded with the numeric values on the optional recorder.

1. Display the REFERENCE tab of the FLOW/Paw window.
   Press the [Menu] key → FLOW/Paw key → LOOPS tab → REFERENCE tab.

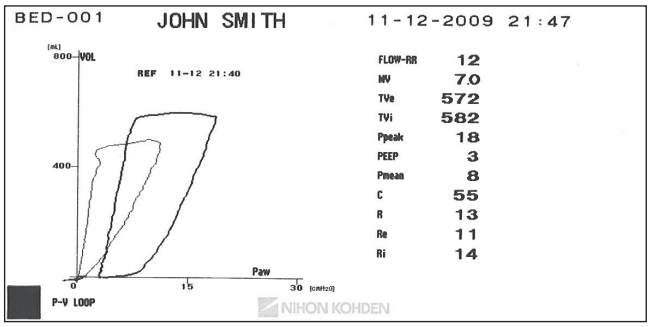
2. Touch the RECORD key. Recording starts.



   To stop recording, press the [Record] key.

3. Press the [Home] key to return to the home screen.

Recording example

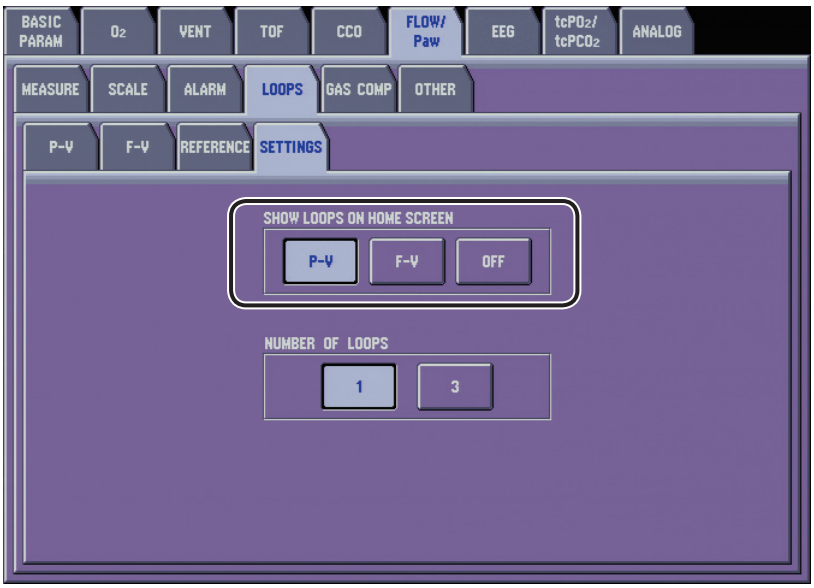


Changing the Loop Settings

Selecting the Loop Types to Display on the Home Screen

1. Display the SETTINGS tab of the LOOPS page of the FLOW/Paw window.
   Press the [Menu] key → FLOW/Paw key → LOOP tab → SETTINGS tab.

2. Select the item from the <SHOW LOOPS ON HOME SCREEN> box.
   P-V: Displays P-V loop
   F-V: Displays F-V loop
   OFF: Displays only the numeric values



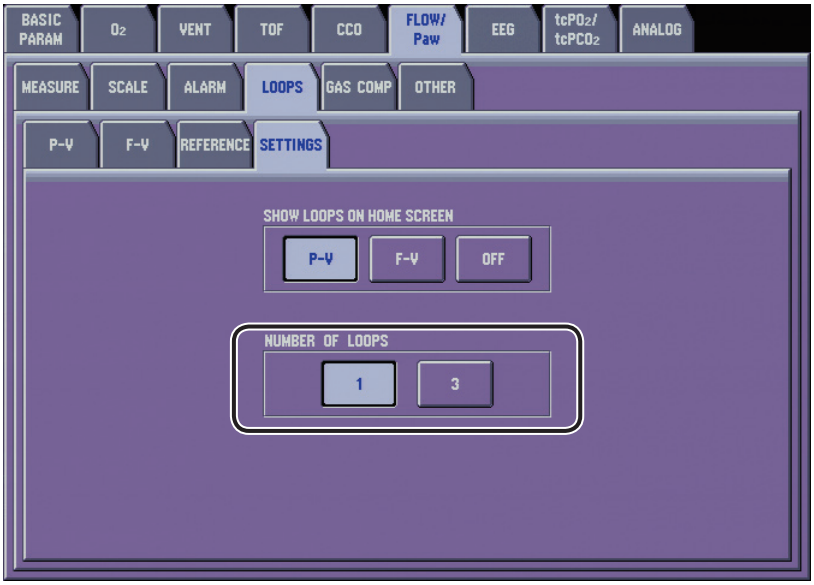
3. Press the [Home] key to return to the home screen.

Selecting the Number of Displayed Loops

Select 1 or 3 for the number of display loops. When the set number of loops are displayed, the loops are cleared from the screen when a new loop is drawn.

1. Display the SETTINGS tab of the LOOPS page of the FLOW/Paw window. Press the [Menu] key → FLOW/Paw key → LOOP tab → SETTINGS tab.

2. Select either 1 or 3 from the <NUMBER OF LOOPS> box.



3. Press the [Home] key to return to the home screen.

Section 16 EEG Monitoring

General

EEG monitoring can be performed by using the AE-918P neuro unit. Up to 8 channels can be monitored.

When EEG is monitored with the AE-918P neuro unit with the software version 02-01 or later, aEEG can be displayed on the aEEG window. For details, refer to Section 6 “Review Windows” in User’s Guide Part I.

List of Terms

Item	Description	Measuring Range
SEF	Spectral edge frequency The frequency below which the power spectrum contains 90 or 95% of the total power in the EEG.	0.0 to 62.5 Hz
MDF	Median frequency The frequency below which the power spectrum contains 50% of the total power in the EEG.	0.0 to 62.5 Hz
PPF	Peak power frequency The frequency of the highest power spectrum in the EEG.	0.0 to 62.5 Hz
TP	Total power	0 to 9.99 nW
%Delta	Power ratio of about 0.5 to 4 Hz* (delta wave)	0 to 100.0%
%Theta	Power ratio of about 4 to 8 Hz* (theta wave)	0 to 100.0%
%Alpha	Power ratio of about 8 to 13 Hz* (alpha wave)	0 to 100.0%
%Beta	Power ratio of about 13 to 30 Hz* (beta wave)	0 to 100.0%
%Gamma	Power ratio of about 30 to 60 Hz* (gamma wave)	0 to 100.0%
Abs Delta	Power of about 0.5 to 4 Hz* (delta wave)	0 to 9999 pW
Abs Theta	Power of about 4 to 8 Hz* (theta wave)	0 to 9999 pW
Abs Alpha	Power of about 8 to 13 Hz* (alpha wave)	0 to 9999 pW
Abs Beta	Power of about 13 to 30 Hz* (beta wave)	0 to 9999 pW
Abs Gamma	Power of about 30 to 60 Hz* (gamma wave)	0 to 9999 pW

* These values are the default settings. These values can be changed on the SYSTEM SETUP window. For details, refer to the Administrator’s Guide.

Preparing for EEG Monitoring

1. Connect the neuro unit and bedside monitor.
2. Connect the EEG electrode leads to the EEG connection cord.
3. Connect the EEG connection cord to the neuro unit.
4. Attach the EEG electrodes to the patient.
5. Start measurement and change necessary settings.

For steps 1 to 4, refer to the AE-918P neuro unit operator's manual.

WARNING

When using the JE-905P EEG connection cord, bundle all unused electrode leads. When using the JE-906P EEG connection cord, disconnect all unused electrode from the EEG connection cord. If the unused electrode or electrode lead touches a metal object or any other conductive parts, the patient may receive electrical shock.

WARNING

When using the JE-906P EEG connection cord and the bedside monitor is connected to a central monitor network, EEG values and waveforms are not output to the central monitor from the bedside monitor. No data or alarm regarding the EEG data from the neuro unit are displayed on the central monitor. Be careful on EEG monitoring when the bedside monitor is connected to a central monitor network.

Monitoring EEG

After completing the preparation, EEG data and waveforms appear on the screen.

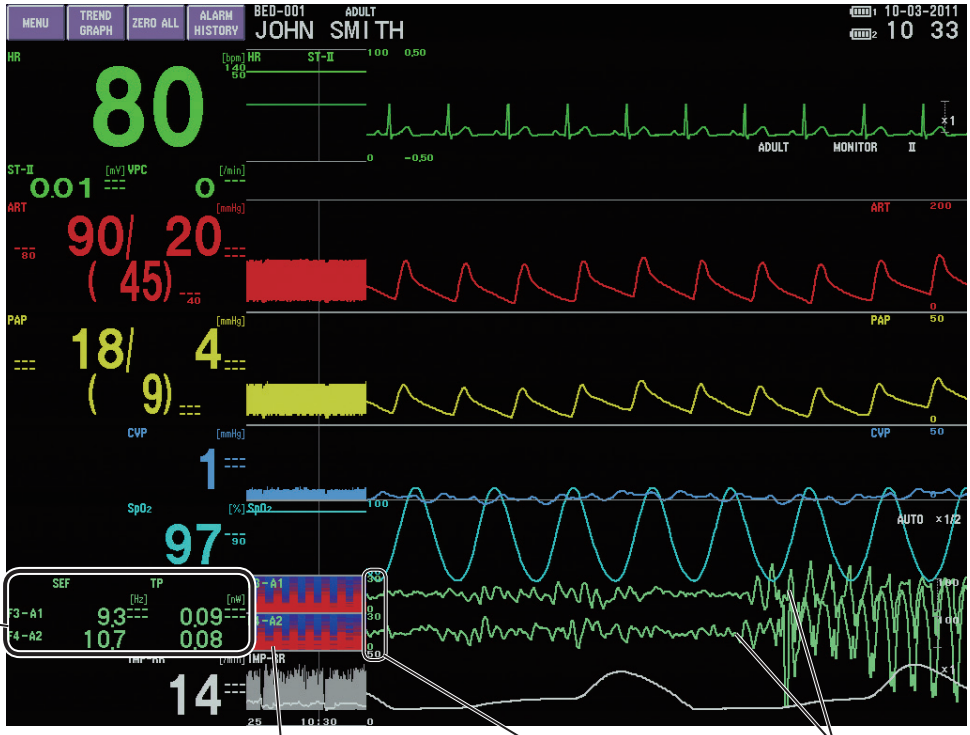
WARNING

When abnormal waveforms appear (flat waveform or a lot of AC interference), remove all electrodes from the patient and stop using the neuro unit.

CAUTION

Do not use the needle electrodes for more than one hour as a measurement electrode for the EEG. When measuring the EEG for over one hour, use the EEG disk electrode.

EEG Information on the Home Screen



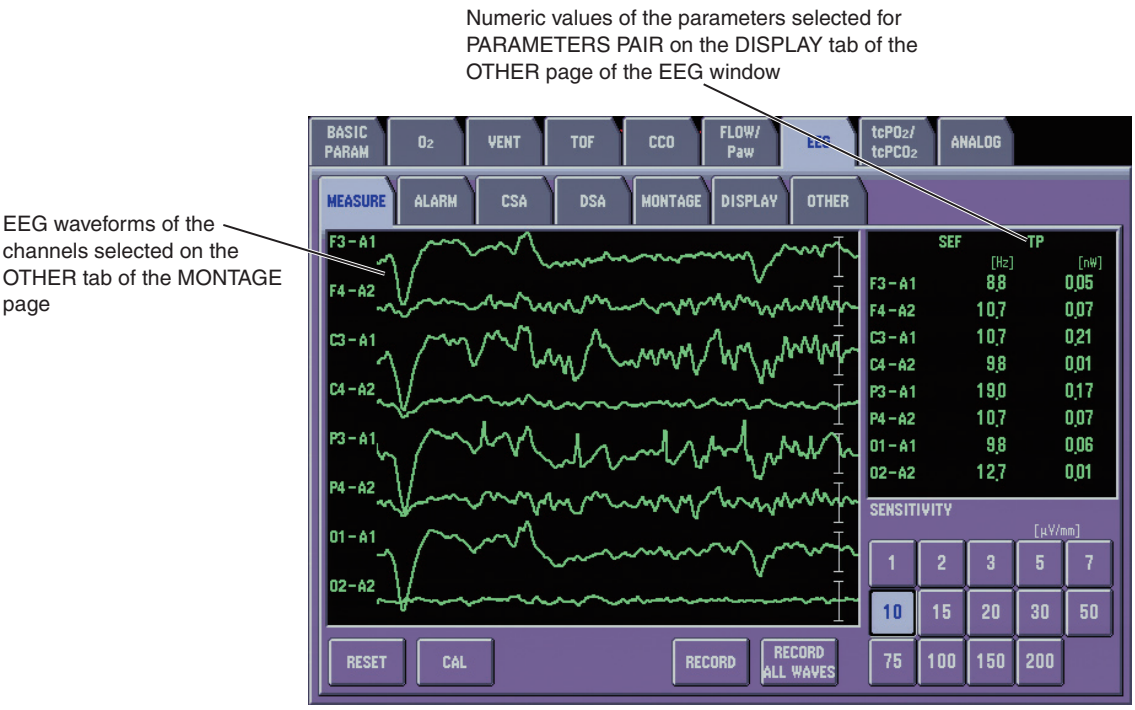
EEG values
Two parameters selected on the DISPLAY tab of the OTHER page of the EEG window appear.

DSA trendgraph
Gradation type can be changed on the DSA page of the EEG window.

Frequency selected on the DSA page of the EEG window

EEG waveforms

EEG Information on the EEG Window



Returning EEG Waveforms to the Baseline

Touch the RESET key to return all EEG waveforms to the baseline position when artifacts are on the waveforms or the baseline is wandering.

Displaying the Calibration Waveforms

Touch the CAL key to display the calibration waveforms.

Changing the EEG Settings

Change the settings on the EEG window. The following settings can be changed for EEG monitoring.

- SEF and TP alarm limits
- EEG waveform sensitivity
- Montage
- Check impedance
- CSA and DSA settings (spectrum, frequency, DSA color)
- SEF (spectral edge frequency)
- Filters
- Parameters for the home screen
- Amplitude limiting

NOTE

If the high cut filter, low cut filter or CSA/DSA update interval are changed, monitored CSA and DSA data are deleted.
If the montage or channel pair settings are changed, monitored CSA, DSA and aEEG data are deleted.

Automatic impedance check on or off and frequency band settings for EEG are set on the SYSTEM SETUP window. For details, refer to Section 3 of the Administrator's Guide.

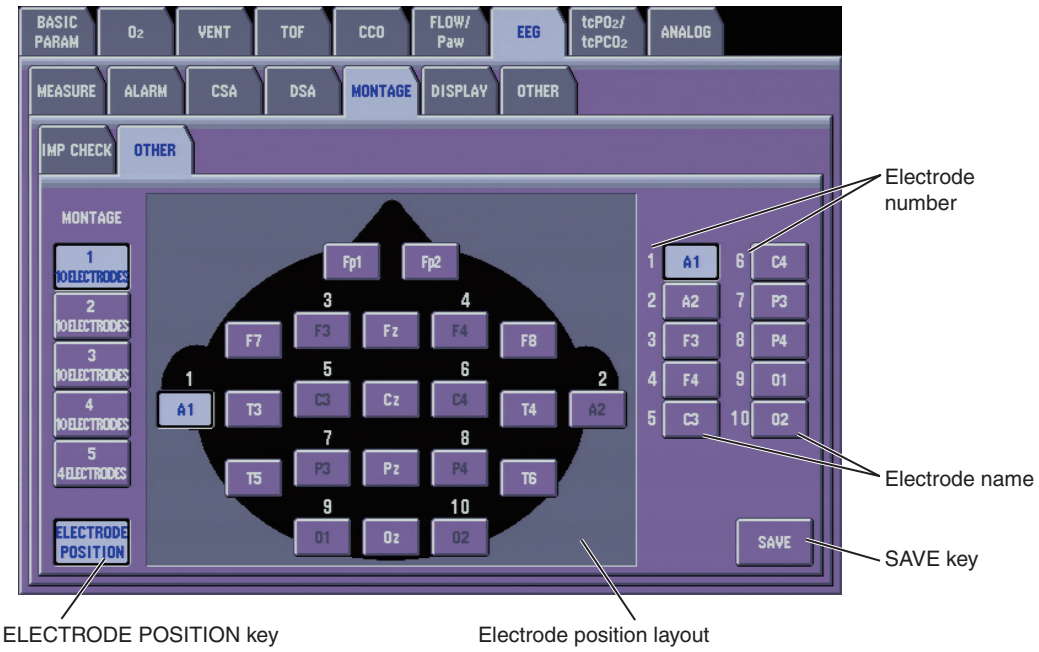
The EEG data display color can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

Setting Montage

Set the electrode position and montage on the MONTAGE page.

1. Display the OTHER tab of the MONTAGE page on the EEG window.
   Press the [Menu] key → EEG key → MONTAGE tab → OTHER tab.

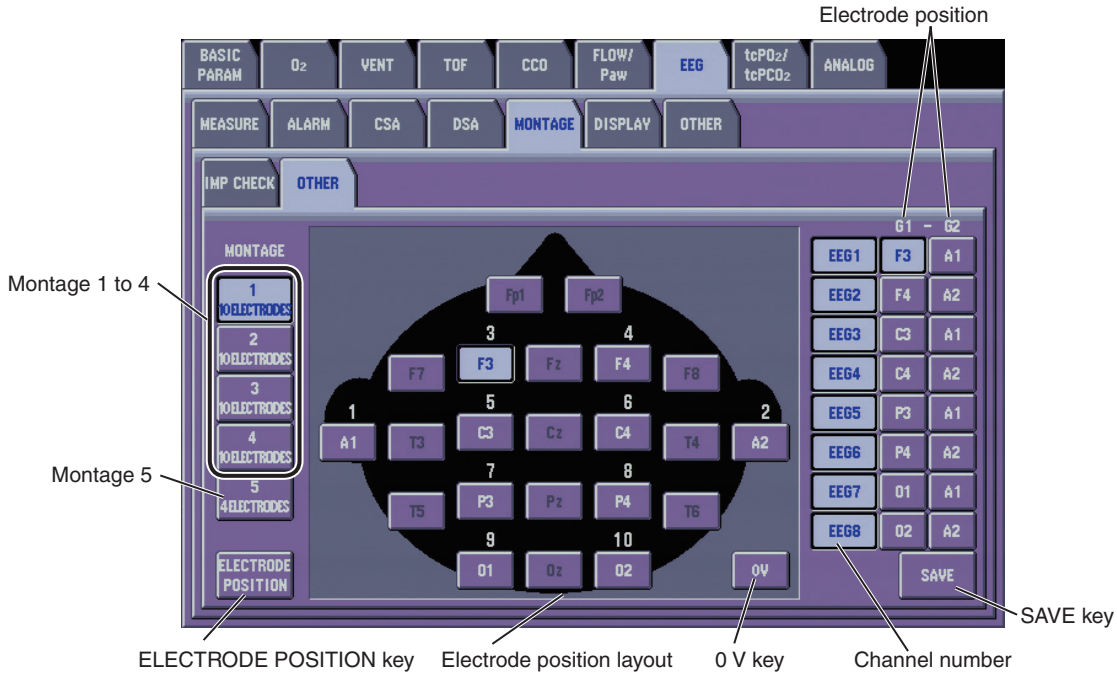
2. Change the electrode positions if necessary.
   i) Touch the ELECTRODE POSITION key.
   ii) Assign the electrode position to each electrode by touching the electrode name key for the electrode number and selecting the position from the electrode position layout.



iii) To save the changed electrode positions, touch the SAVE key.

iv) Touch the ELECTRODE POSITION key again to display the montage.

3. Select a montage from 1 to 4 when using 10 electrodes.
   Select montage 5 when using 4 electrodes.



4. If necessary, change the montage. If Montage 5 (for 4 electrodes) is selected, the montage cannot be changed.

   i) Touch the electrode position of the channel you want to change the combination.

   ii) Select the electrode position from the electrode position layout.
   Use the 0 V key to display the original electrode potential.

   iii) To save the montage settings, touch the SAVE key.

5. Press the [Home] key to return to the home screen.

Checking the Electrode Impedance

CAUTION

Never check the skin-electrode impedance with the needle electrode inserted in the patient. Failure to follow this caution causes electrical burn where electrodes are inserted.

Check the impedance between the electrodes and skin. Always check the impedance after attaching electrodes on the patient.

The impedance check result according to the set threshold appears every time the impedance is checked. If the check result is not “PASS”, remove the cause and repeat the impedance check until the result becomes “PASS”.

The impedance check can be performed automatically or manually. Impedance auto check on or off is set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator’s Guide.

Auto check: When auto check is turned On, the measurement signals of two types of frequencies higher than the EEG frequency band are applied to check impedance while measuring EEG. If the result is not “PASS”, the “CHECK ELECTRODES” or “HIGH IMPEDANCE” message appears on the screen.
The impedance for the Z electrode cannot be automatically checked. Check impedance for the Z electrode manually.

Manual check: Impedance for all electrodes are checked while the START key for <MANUAL CHECK> is pressed. The measurement signal of the frequency within the EEG frequency band are applied to check impedance of all electrodes including the Z electrode.

NOTE

It is recommended to use auto impedance check function so that an electrode off, lead disconnection and high impedance of an electrode can be automatically detected. However, noise from the automatic impedance check may affect other devices. In such a case, set the automatic impedance check to OFF.

Automatically Checking Impedance

When auto check is turned On, impedance is automatically checked while measuring EEG. If the result is not “PASS”, the “CHECK ELECTRODES” or “HIGH IMPEDANCE” message appears on the screen.

The impedance for the Z electrode cannot be automatically checked. Check impedance for the Z electrode manually.

Manually Checking Impedance

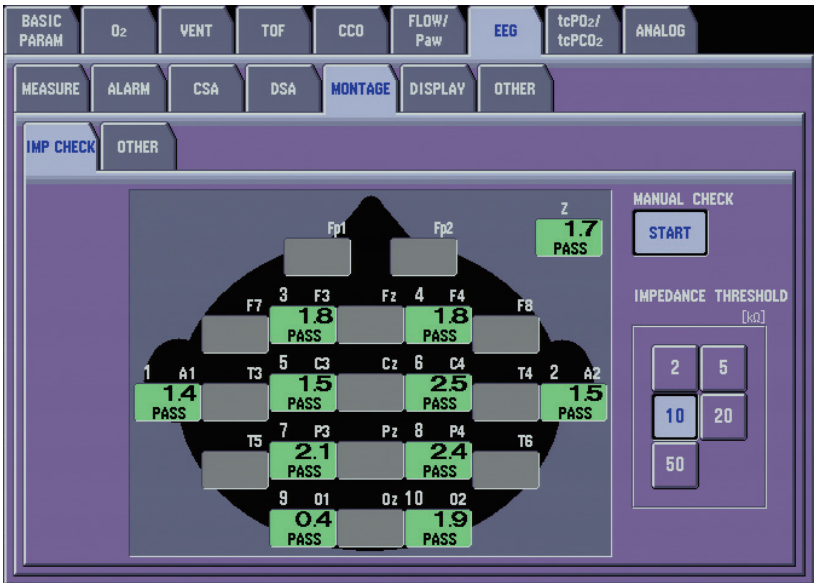
Check the impedance manually whenever necessary. Data is not acquired during manual impedance check.

1. Display the IMP CHECK tab of the MONTAGE page on the EEG window.
   Press the [Menu] key → EEG key → MONTAGE tab → IMP CHECK tab.

2. Select the threshold in the <IMPEDANCE THRESHOLD> box.

3. Touch the START key in the <MANUAL CHECK> box.
   To cancel impedance check, touch the START key again.

   The check result appears.



PASS:	The impedance check is OK.
HIGH:	The impedance is high. Clean the electrode attachment site with alcohol and attach the electrode again.
LEAD OFF or – – –:	Electrode is detached or the lead is loose or disconnected. Check the electrode attachment and lead connection. If the “LEAD OFF” message still appears, clean the electrode attachment site with alcohol.

4. Press the [Home] key to return to the home screen.

Changing the SEF and TP Alarm Limits

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit. Be careful when you set the alarm limit to OFF.

You can set the upper and lower SEF and TP alarm limits on the EEG window. You can set all alarms, including the upper and lower SEF and TP alarm limits, on the ALARM LIMITS window (See the Operator's Manual or Section 5 of the User's Guide Part I).

Setting Range

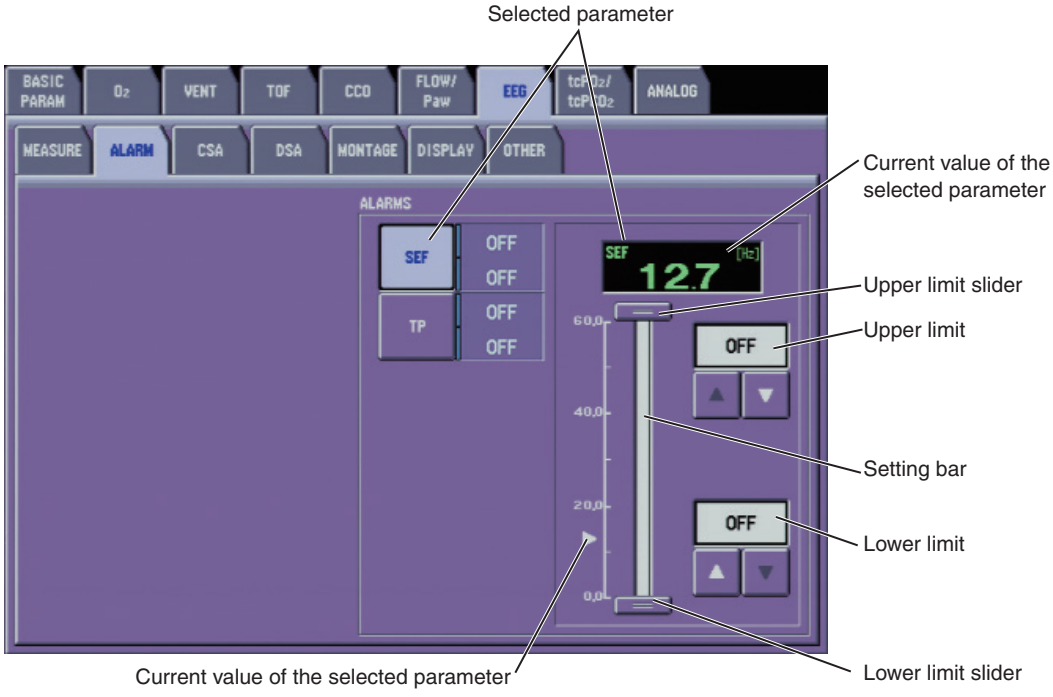
SEF upper limit: 1.0 to 60.0 Hz in 0.5 Hz steps, OFF (default setting: OFF)
SEF lower limit: OFF, 0.5 to 59.5 Hz in 0.5 Hz steps (default setting: OFF)
TP upper limit: 0.02 to 9.99 nW in 0.01 nW steps, OFF (default setting: OFF)
TP lower limit: OFF, 0.01 to 9.98 nW in 0.01 nW steps (default setting: OFF)

1. Display the ALARM page on the EEG window.
   Press the [Menu] key → EEG key → ALARM tab.

2. Touch the SEF key to change the SEF alarm setting.
   Touch the TP key to change the TP alarm setting.

3. Touch and drag the sliders to the desired level on the setting bar. Use the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum, the upper limit alarm is set to OFF. If the lower limit is set to a value below the minimum, the lower limit alarm is set to OFF.



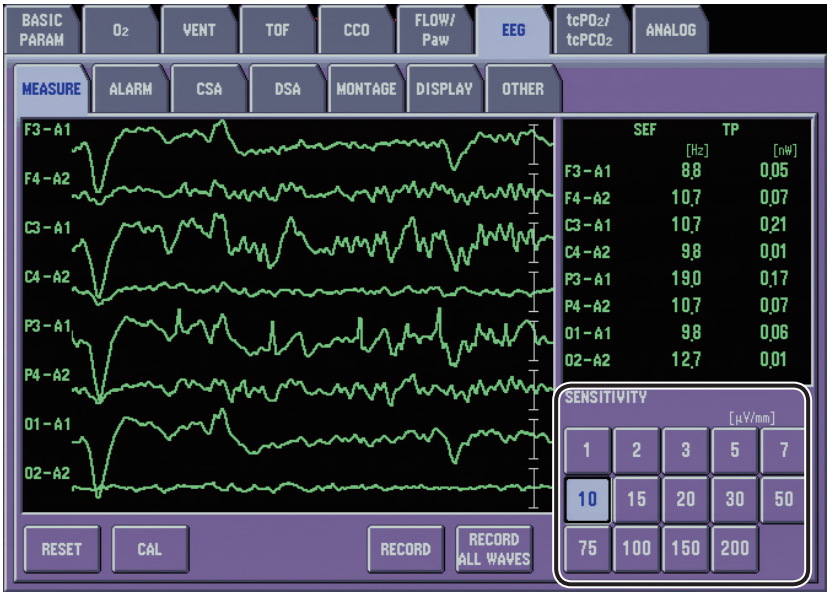
4. Press the [Home] key to return to the home screen.

Changing the EEG Sensitivity

The sensitivity determines the amplitude of the EEG waveform on both the screen and recording paper.

1. Display the MEASURE page on the EEG window.
   Press the [Menu] key → EEG key → MEASURE tab.

2. Select the sensitivity from the <SENSITIVITY> box.



3. Press the [Home] key to return to the home screen.

Selecting the Edge Frequency for SEF

Select the edge frequency for the SEF display.

1. Display the OTHER page of the EEG window.
   Press the [Menu] key → EEG key → OTHER tab.

2. Select 90 or 95 in the <SEF> box.

3. Press the [Home] key to return to the home screen.

Changing the Filter Settings

Select the high-cut filter and low-cut filter and turn AC filter on or off. These settings are applied on both the home screen and EEG window.

1. Display the OTHER page of the EEG window.
   Press the [Menu] key → EEG key → OTHER tab.

2. Select the low-cut filter from the <LOW CUT FILTER> box.
   Select the high-cut filter from the <HIGH CUT FILTER> box.
   Turn the AC filter on or off in the <AC FILTER> box.

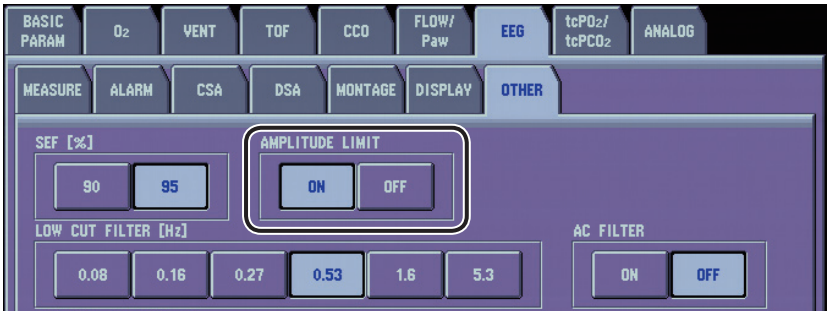
3. Press the [Home] key to return to the home screen.

Limiting the EEG Amplitude

When the EEG amplitude on the home screen is large and EEG overlaps other waveforms, limit the EEG amplitude.

1. Display the OTHER page of the EEG window.
   Press the [Menu] key → EEG key → OTHER tab.

2. Select ON or OFF in the <AMPLITUDE LIMIT> box.



3. Press the [Home] key to return to the home screen.

Selecting Channels and Parameters to Display on the Home Screen

Select the channels and parameters to display in the numeric display area on the home screen. Up to 2 channels and 2 parameters can be selected.

1. Display the DISPLAY tab of the EEG window.
   Press the [Menu] key → EEG key → DISPLAY tab.

2. Select two channels in the <CHANNELS PAIR> box.

3. Select two parameters in the <PARAMETERS PAIR> box.

4. Press the [Home] key to return to the home screen.

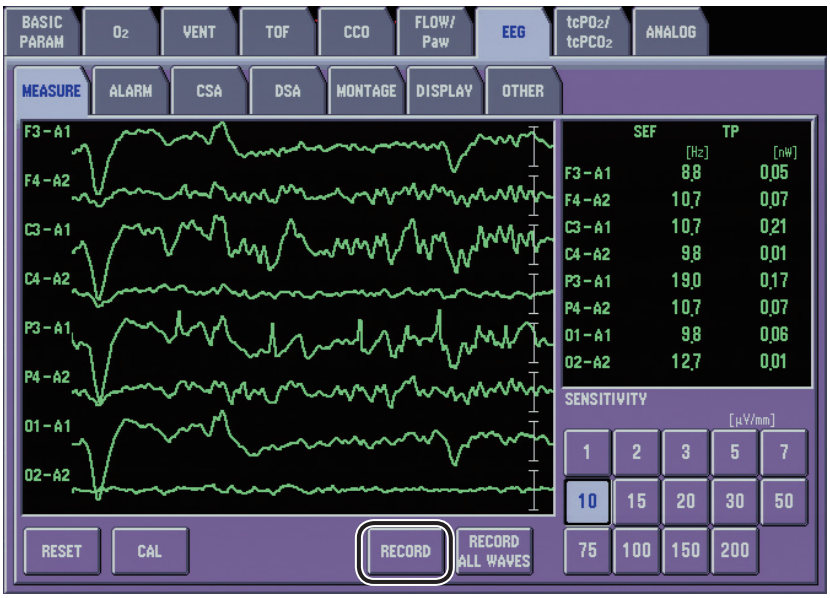
Recording the EEG Waveforms on the EEG Window

Recording the EEG Waveforms on the EEG Window

The EEG waveforms displayed on the EEG window can be recorded with the numeric values on the optional recorder.

1. Display the MEASURE page on the EEG window.
   Press the [Menu] key → EEG key → MEASURE tab.

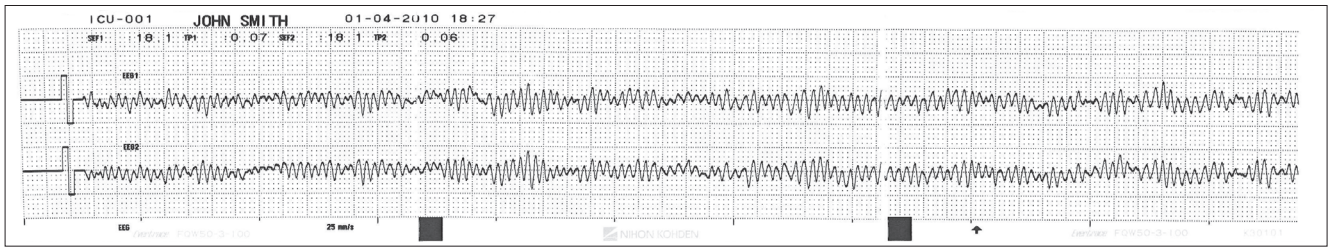
2. Touch the RECORD key. Recording starts.



To stop recording, press the [Record] key.

3. Press the [Home] key to return to the home screen.

Recording example

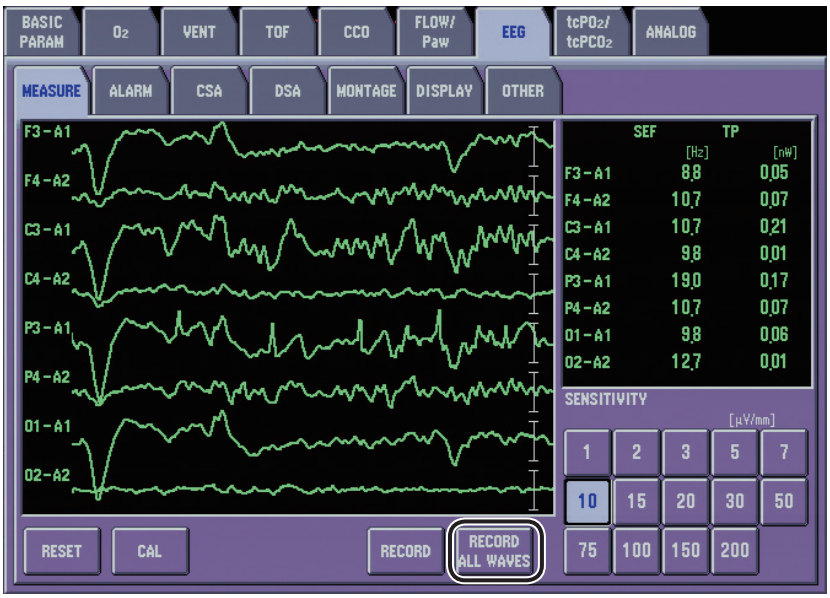


Recording All EEG Waveforms

10 seconds of EEG waveforms with numeric values for each channel can be recorded on the optional recorder.

1. Display the MEASURE page on the EEG window.
   Press the [Menu] key → EEG key → MEASURE tab.

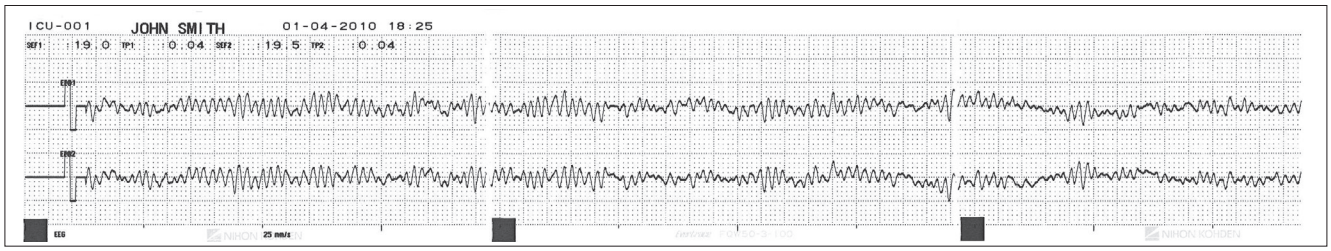
2. Touch the RECORD ALL WAVES key. Recording starts.

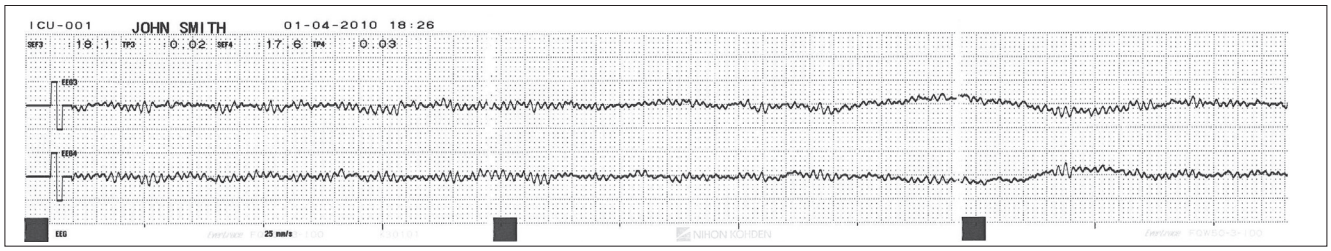


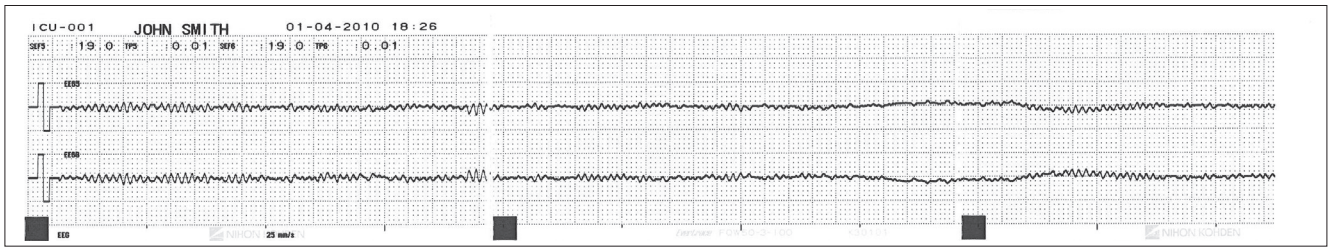
To stop recording, press the [Record] key.

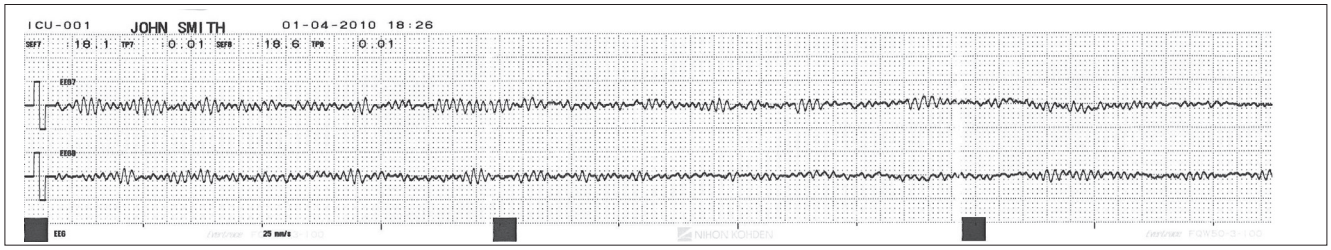
3. Press the [Home] key to return to the home screen.

Recording example









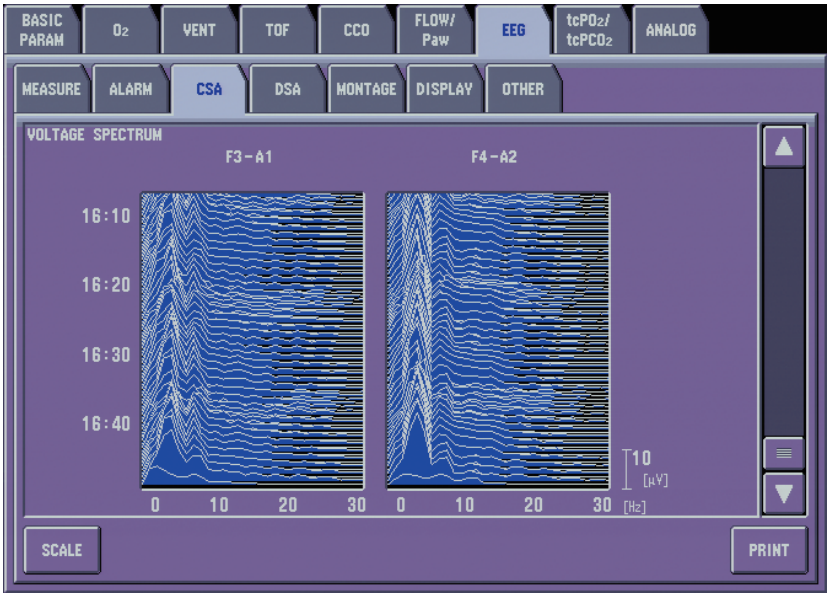
Viewing the CSA and DSA

NOTE

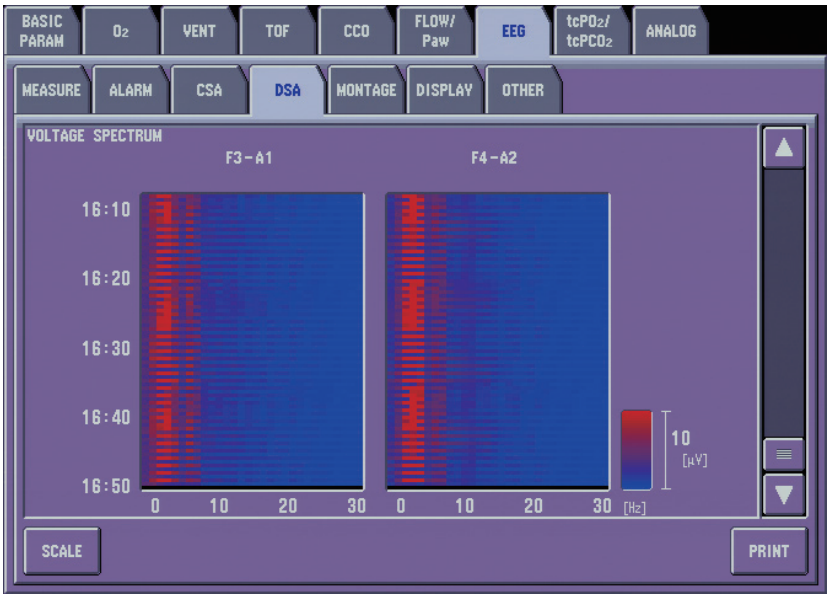
CSA and DSA are not available for BSM-6301A/K.

Displaying the CSA and DSA Page

1. To display the CSA page:
   Press the [Menu] key → EEG key → CSA tab.



   To display the DSA page:
   Press the [Menu] key → EEG key → DSA tab.



2. Press the [Home] key to return to the home screen.

Changing the CSA/DSA Settings

Selecting the CSA/DSA Amplitude Type

Select the amplitude type for the y axis on the CSA or DSA window.

1. Display the OTHER page of the EEG window.
   Press the [Menu] key → EEG key → OTHER tab.

2. Select VOLTAGE or POWER in the <PARAMETER> box.

3. Press the [Home] key to return to the home screen.

Selecting the CSA/DSA Updating Interval

Select the interval for updating the CSA and DSA.

1. Display the OTHER page of the EEG window.
   Press the [Menu] key → EEG key → OTHER tab.

2. Select the interval in the <CSA/DSA UPDATE INTERVAL[S]> box.

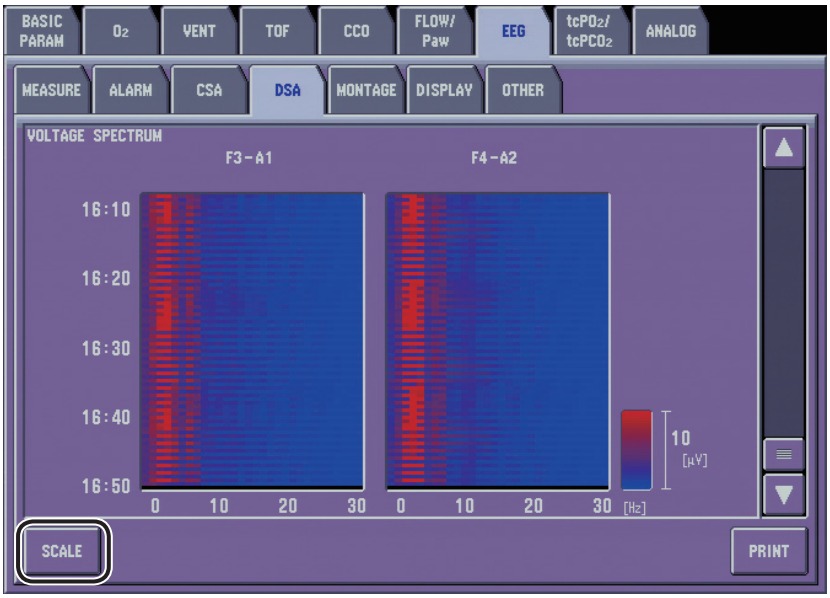
3. Press the [Home] key to return to the home screen.

Selecting the DSA Color Gradation

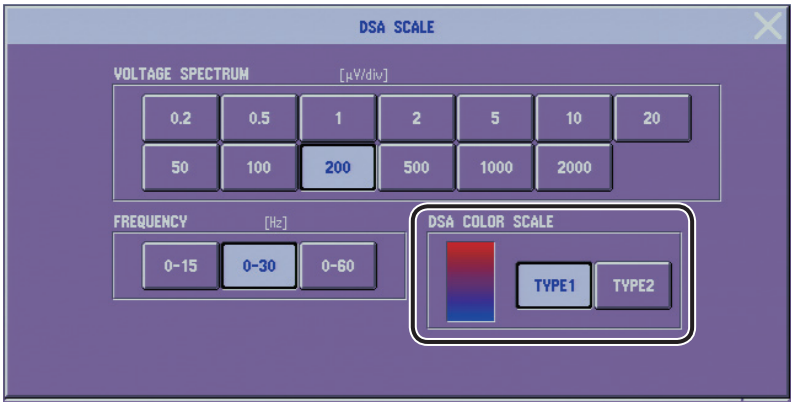
Select the color gradation type for DSA.

1. Display the DSA page of the EEG window.
   Press the [Menu] key → EEG key → DSA tab.

2. Touch the SCALE key.



3. On the DSA SCALE window, select the gradation type from the <DSA COLOR SCALE> box.



4. Touch the close button ( ) to close the DSA SCALE window.

5. Press the [Home] key to return to the home screen.

Selecting the CSA/DSA Display Sensitivity

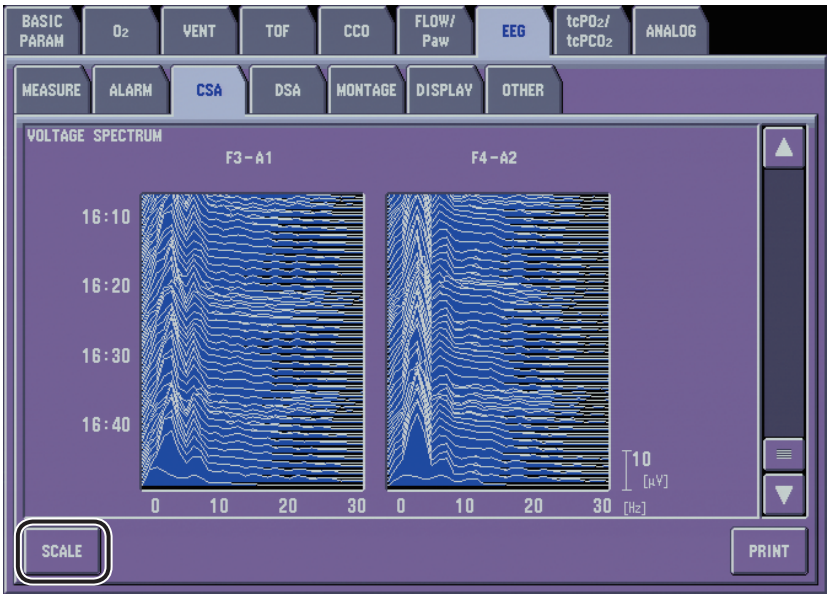
The setting range depends on the CSA/DSA amplitude type.

When the amplitude is VOLTAGE: 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000 µV/div

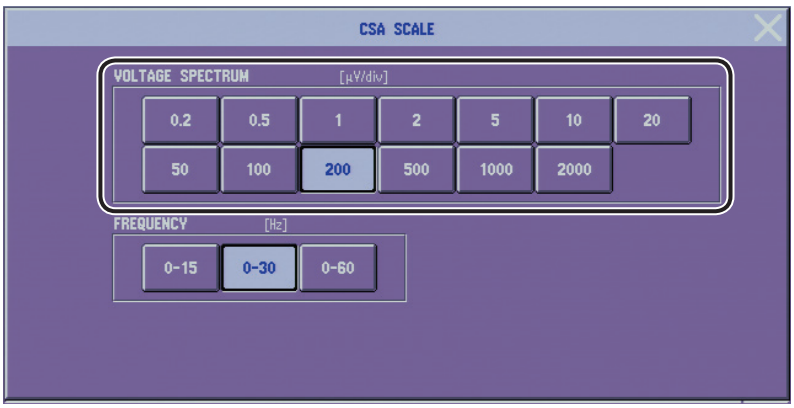
When the amplitude is POWER: 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000 pW

1. Display the CSA page or DSA page of the EEG window.
   Press the [Menu] key → EEG key → CSA tab or DSA tab.

2. Touch the SCALE key.



3. On the CSA SCALE or DSA SCALE window, select the sensitivity from the <VOLTAGE SPECTRUM> or <POWER SPECTRUM> box.



4. Touch the close button (☒) to close the CSA SCALE or DSA SCALE window.

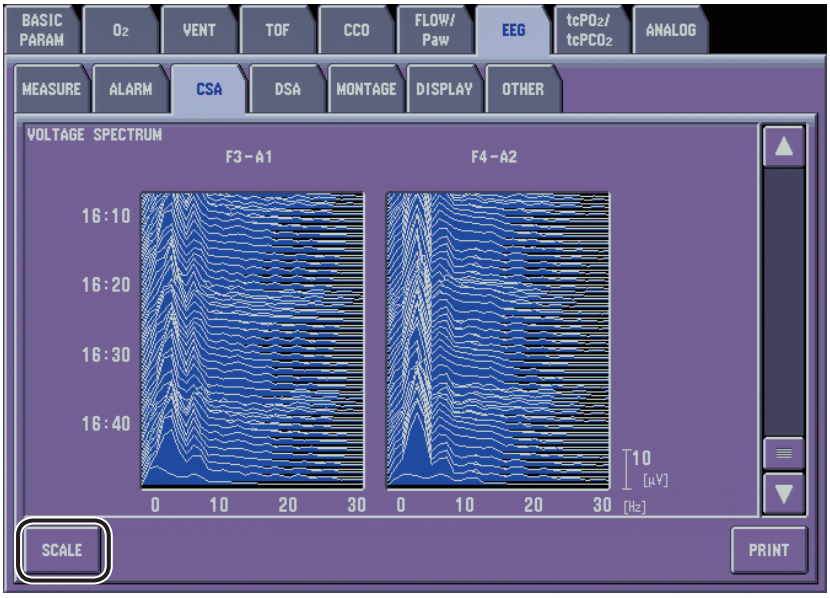
5. Press the [Home] key to return to the home screen.

Selecting the CSA/DSA Frequency

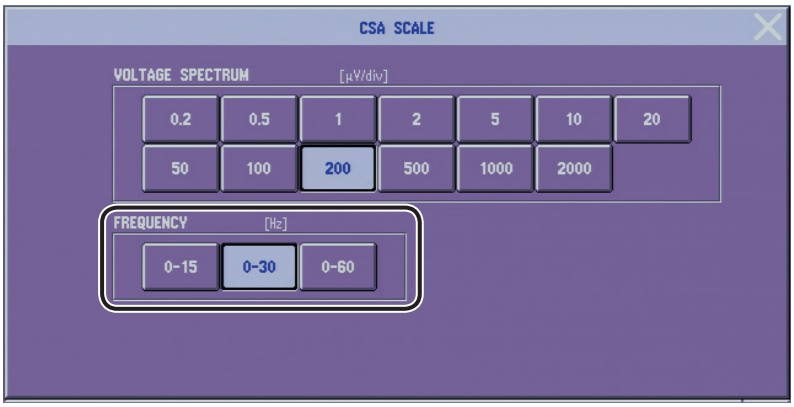
Select the frequency for the x axis of CSA or DSA. The frequency selected on the CSA or DSA window becomes the scale of the current trendgraph on the home screen.

1. Display the CSA page or DSA page of the EEG window.
   Press the [Menu] key → EEG key → CSA tab or DSA tab.

2. Touch the SCALE key.



3. On the CSA SCALE or DSA SCALE window, select the frequency from the <FREQUENCY> box.



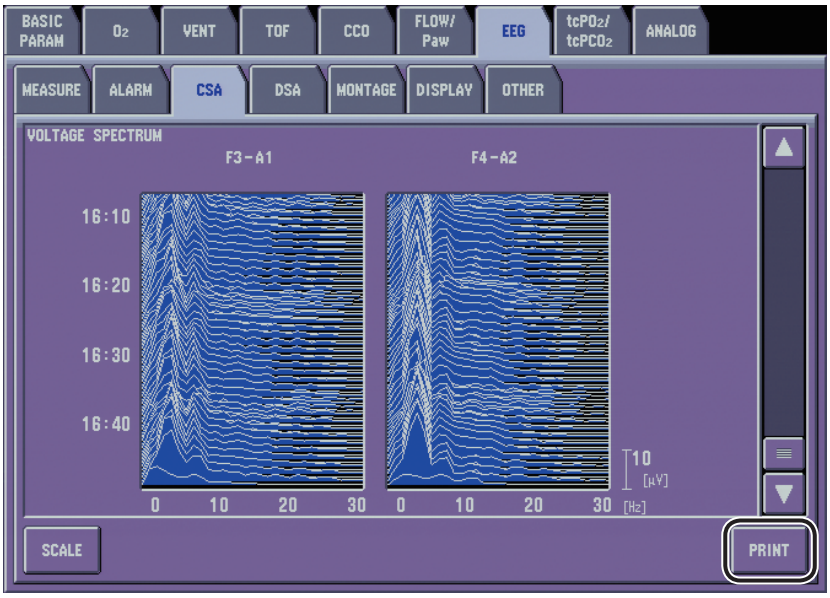
4. Touch the ☒ key to close the CSA SCALE or DSA SCALE window.

5. Press the [Home] key to return to the home screen.

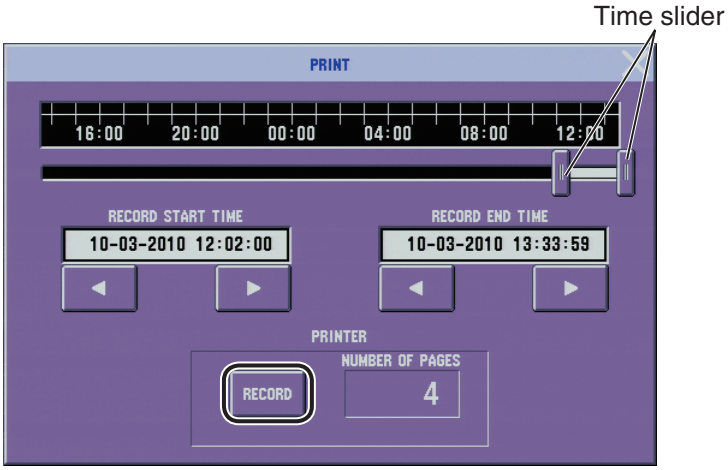
Printing CSA/DSA

CSA and DSA can be printed when the bedside monitor is connected to a network which has a network printer.

1. Display the CSA page to print CSA or DSA page to print DSA on the EEG window.
   Press the [Menu] key → EEG key → CSA tab or DSA tab.



2. Touch the PRINT key. The PRINT window appears.



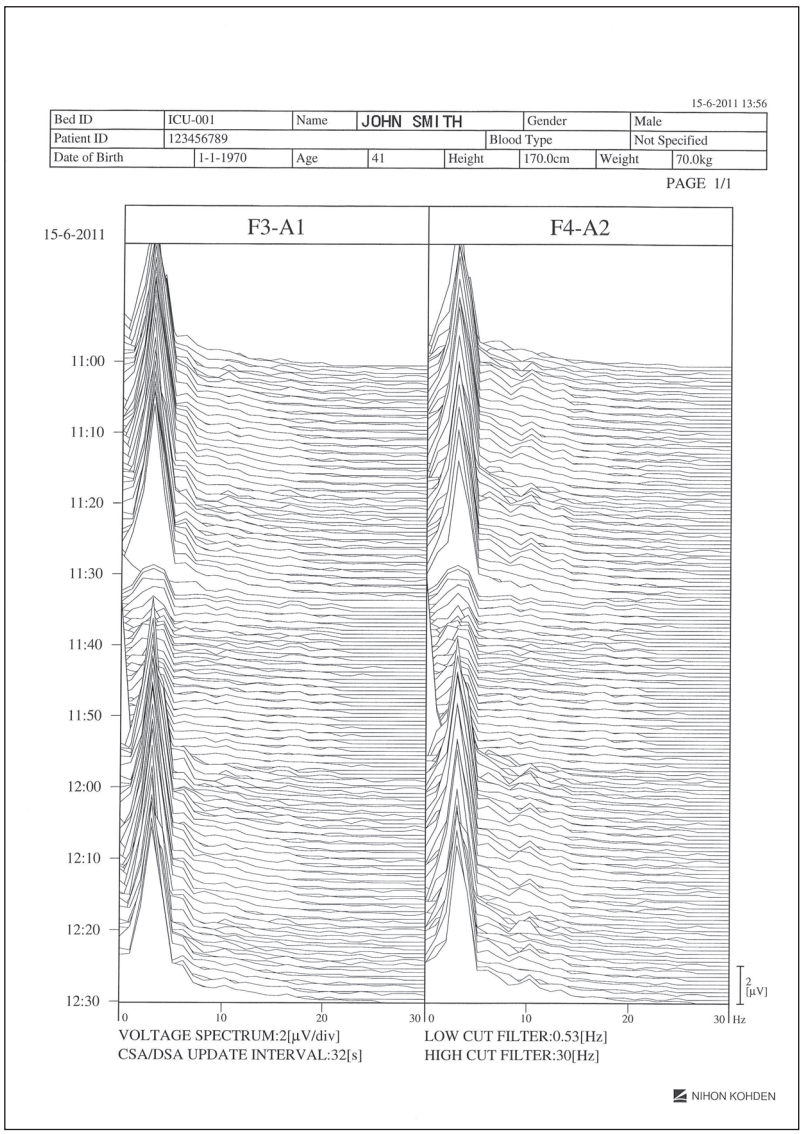
3. Set the RECORD START TIME and RECORD END TIME with the ◄ or ► key or time slider.

4. Check the number of pages and touch the RECORD key in <PRINTER> box.

5. Touch the ☒ key to close the window.

6. Press the [Home] key to return to the home screen.

Printing example



Section 17 $tcPO_2$/$tcPCO_2$ Monitoring

General

Transcutaneous blood gas monitoring can be performed by connecting a Radiometer transcutaneous monitor to the bedside monitor. To connect the transcutaneous monitor to the bedside monitor, the IF-913P or IF-914P communication cable is required.

IF-913P: For connecting MicroGas 7650 *rapid* transcutaneous monitor
IF-914P: For connecting TCM4 or TCM40 transcutaneous monitor

List of Terms

Label	Name	Unit
$tcPO_2$	Transcutaneous oxygen partial pressure	mmHg or kPa*
$tcPCO_2$	Transcutaneous carbon dioxide partial pressure	mmHg or kPa*
TEMP	Sensor temperature	°C or °F*
POWER	Electrode heating power	mW

* The temperature unit (°C or °F) and $tcPO_2$/PCO_2 pressure unit (mmHg or kPa) can be changed on the SYSTEM CONFIGURATION screen of the bedside monitor.

Preparing for $tcPO_2$/$tcPCO_2$ Monitoring

1. Set up the transcutaneous monitor and connect it to the bedside monitor. Refer to the IF-913P or IF-914P communication cable operator's manual.

2. Connect the transcutaneous monitor to the patient. Refer to the transcutaneous monitor manual.

3. Start measurement and change necessary settings.

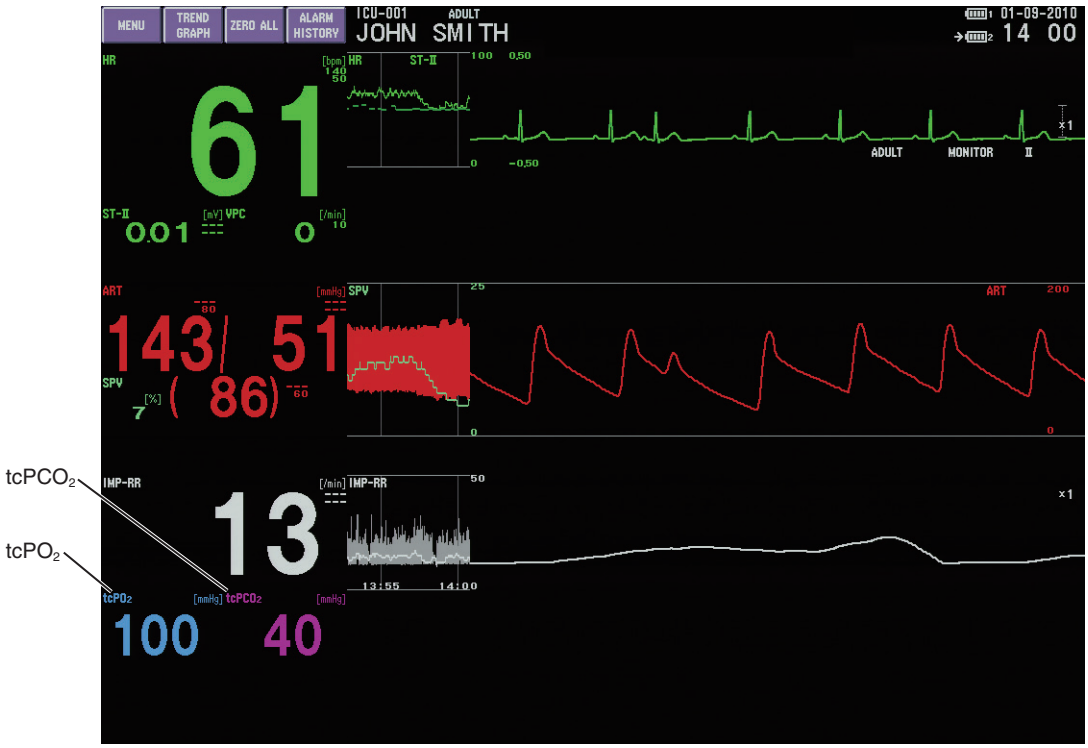
Monitoring $tcPO_2$/$tcPCO_2$

After completing the preparation, $tcPO_2$/$tcPCO_2$ data appear on the screen.

WARNING

When using the transcutaneous monitor, some transcutaneous alarms do not function on the bedside monitor. When the transcutaneous data on the bedside monitor is abnormal or the transcutaneous monitor is giving an alarm, check the messages and data on the transcutaneous monitor.

$tcPO_2$/$tcPCO_2$ Information on the Home Screen



$tcPO_2$/$tcPCO_2$ Information on the $tcPO_2$/$tcPCO_2$ Window

Measured values
POWER is displayed only when TCM4 or TCM40 transcutaneous monitor is connected.

Section 18 Analog Input Monitoring

General

The analog waveforms acquired by an external device which outputs analog voltage signal, such as Transonic Systems HT series flowmeters, can be displayed on the BSM-6000 series bedside monitor when the external device is connected to the monitor with the IF-912P communication cable. Up to 2 analog waveforms can be displayed on the monitor screen.

Preparing for Analog Input Monitoring

1. Connect the external device to the bedside monitor. Refer to the IF-912P communication cable manual.

2. Connect the external device to the patient. Refer to the external device manual.

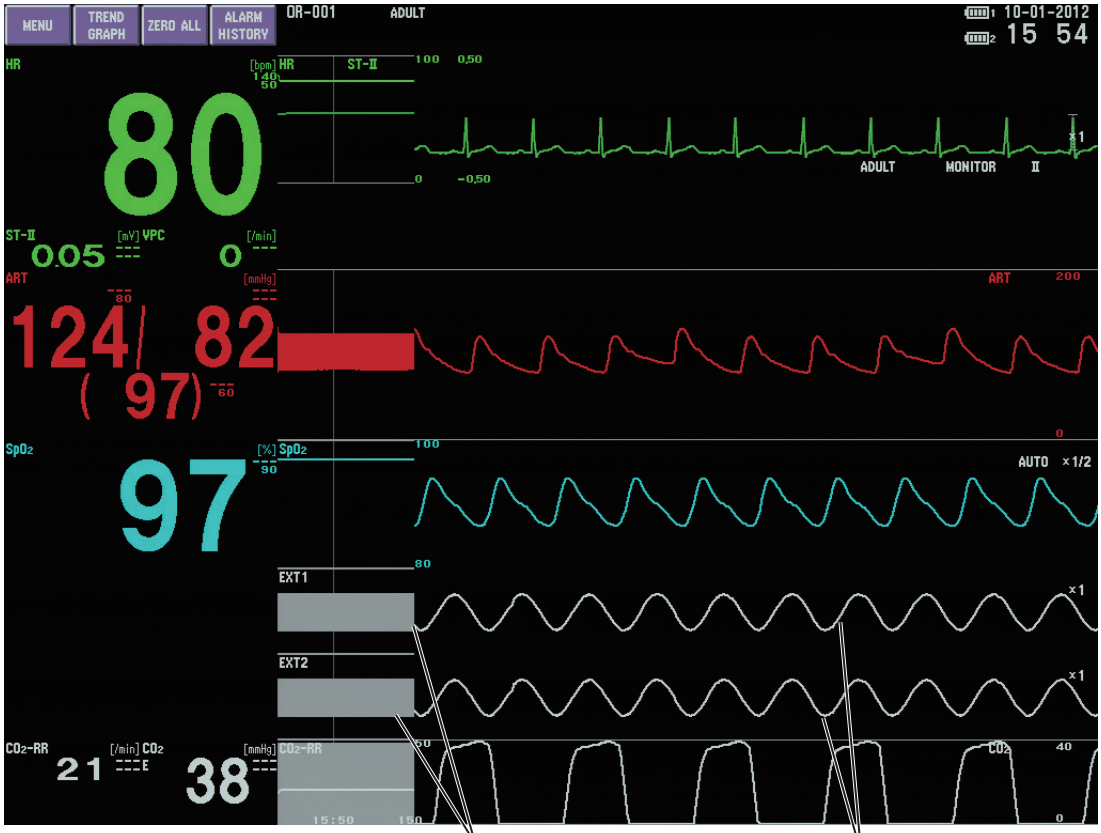
3. Monitoring starts. Set necessary settings.

Monitoring Analog Waveforms

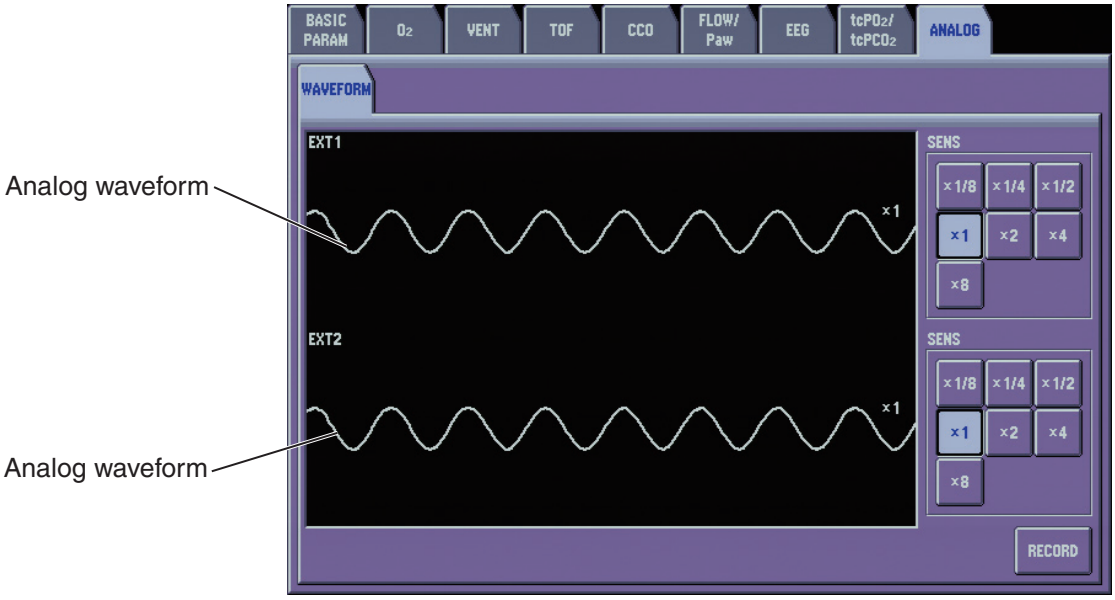
After completing the preparation, the analog waveforms appear on the screen.

Up to 2 waveforms can be displayed on the monitor screen.

Analog Input Information on the Home Screen



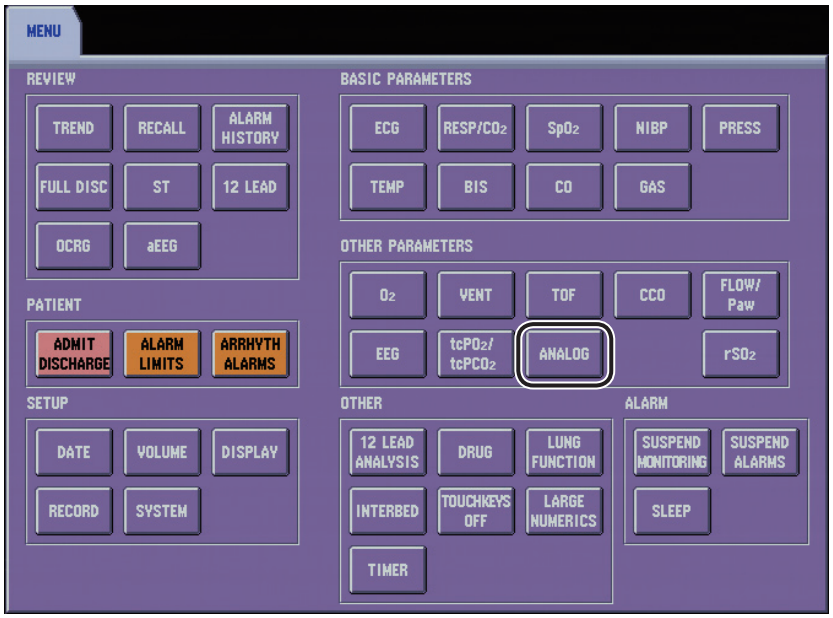
Analog Waveforms on the ANALOG INPUT Window



Opening the ANALOG INPUT Window

To open the ANALOG INPUT window:

Press the [Menu] key → ANALOG key.



Changing Analog Input Monitoring Settings

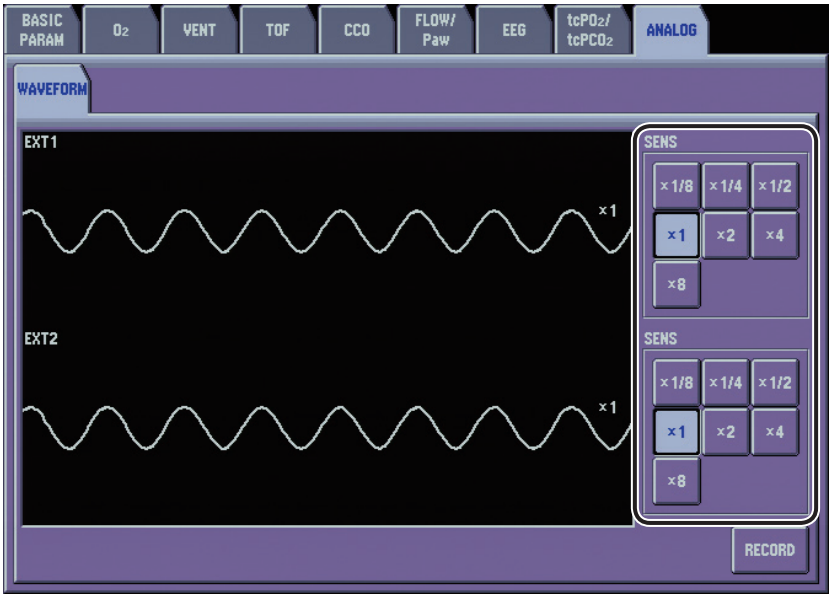
The waveform sensitivity can be changed for analog input monitoring.

Changing the Analog Waveform Sensitivity

The sensitivity determines the size of the waveforms on both the screen and recording paper.

1. Display the ANALOG window.
   Press the [Menu] key → ANALOG key.

2. Select the sensitivity in the <SENS> box.



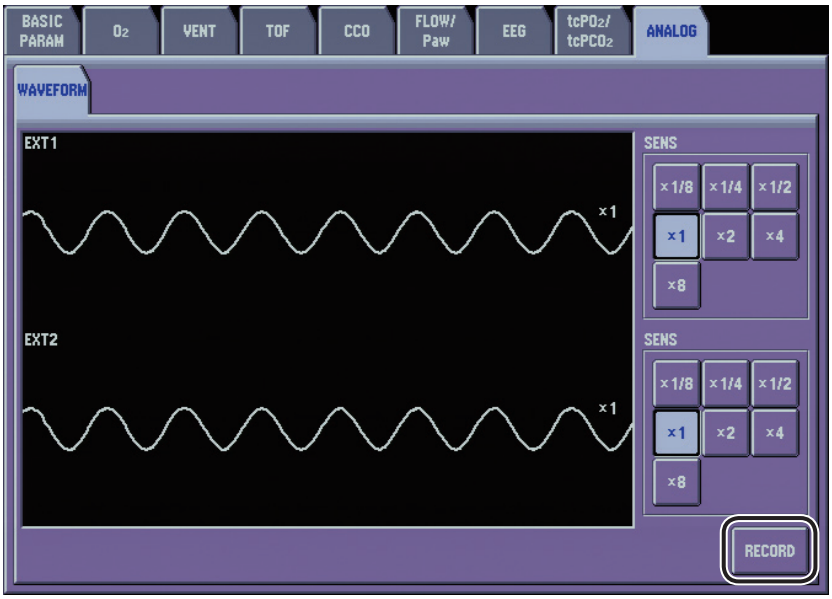
3. Press the [Home] key to return to the home screen.

Recording the Analog Waveforms

The analog waveforms on the ANALOG window can be recorded in real-time or 8 second delayed for the length of time set on the RECORD window of the SETUP window. When this monitor has no recorder and is connected to a network, recording can be performed on the central monitor recorder (remote recording). For details on recording, refer to User's Guide Part I, Section 10.

1. Display the ANALOG window.
   Press the [Menu] key → ANALOG key.

2. Touch the RECORD key. The analog waveforms are recorded on the recorder unit. When the monitor has no recorder unit and is connected to a central monitor network, the waveforms are recorded on the central monitor recorder.



   When CONTINUOUS is set for recording duration, the waveform is recorded until you press the RECORD key on the ANALOG window or the [⏻] key on the recorder module.

3. Press the [Home] key to return to the home screen.

Section 19 Anesthetic Monitoring

General

The measured data acquired by an anesthetic machine can be displayed on the bedside monitor when the anesthetic machine is connected to the monitor with the IF series communication cable. The measured values, waveforms and settings on the anesthetic machine can be displayed on the bedside monitor screen.

- A Heinen + Löwenstein anesthesia workstation can be connected with the IF-918P communication cable.
- A Dräger Medical anesthesia workstation can be connected with the IF-920P communication cable.
- A GE Helthcare anesthesia delivery systems can be connected with the IF-930P communication cable.
- An Air Liquide Medical Systems anesthesia system can be connected with the IF-931P communication cable.
- A MAQUET FLOW-i anesthesia system can be connected with the IF-932P communication cable.
- An ACOMA Medical Industry PRO-next+i and PRO-next+s anesthesia apparatus can be connected with the IF-945P communication cable.
- A Dräger Medical Perseus® A500 anesthesia workstation can be connected with the IF-950P communication cable.
- A Dräger Medical Zeus® Infinity® Empowered anesthesia workstation can be connected with the IF-952P communication cable.

NOTE

- The Heinen + Löwenstein anesthesia workstation, Dräger Medical anesthesia workstation, ACOMA Medical Industry anesthesia apparatus cannot be used with BSM-6000A series.
- An anesthetic machine cannot be used together with a ventilator.
- When an anesthetic machine is used with the AG-920R, GF-110PA/GF-210R multigas unit or GF-120PA/GF-220R multigas/flow unit:
  - The GAS window displays the parameters that are monitored on the multigas or multigas/flow unit.
  - The VENT window displays the parameters of the anesthetic machine.

Monitoring Parameters and Settings

The parameters and settings that can be displayed on the monitor screen depend on the anesthetic machine type as shown below.

Yes: displayed No: not displayed

* The pressure unit (mmHg or kPa) and respiration unit (cmH_2O or hPa) can be changed on the SYSTEM CONFIGURATION screen of the bedside monitor.

Waveforms

Terms	Description	Unit	Cable and Anesthetic Machine Types								
			IF-918P	IF-920P		IF-932P	IF-930P	IF-931P	IF-945P	IF-950P	IF-952P
			Heinen + Löwenstein	Dräger Medical Apollo, Pallas, Primus	Dräger Medical Fabius	MAQUET FLOW-i	GE Healthcare Aisys, Avance, Aespire, Aestiva	Air Liquid Felix	ACOMA PRO-next+i, PRO-next+s	Dräger Medical Perseus® A500	Dräger Medical Zeus® IE
CO_2	Inspired and expired CO_2	mmHg*	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Paw	Airway pressure	cmH_2O*	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
FLOW	Respiratory flow rate	L/min	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes
VOL	Respiratory volume	mL	No	No	No	Yes	Yes	Yes	No	No	No

Numerics

Terms	Description	Unit	Cable and Anesthetic Machine Types								
			IF-918P	IF-920P		IF-932P	IF-930P	IF-931P	IF-945P	IF-950P	IF-952P
			Heinen + Löwenstein	Dräger Medical Apollo, Pallas, Primus	Dräger Medical Fabius	MAQUET FLOW-i	GE Healthcare Aisys, Avance, Aespire, Aestiva	Air Liquid Felix	ACOMA PRO-next+i, PRO-next+s	Dräger Medical Perseus® A500	Dräger Medical Zeus® IE
HAL	Inspired and expired halothane	%	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
ISO	Inspired and expired isoflurane	%	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
ENF	Inspired and expired enflurane	%	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
SEV	Inspired and expired sevoflurane	%	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
DES	Inspired and expired desflurane	%	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
HAL LEV	Halothane consumption	mL	No	Yes	No	No	Yes	Yes	Yes	Yes	No
ENF LEV	Enflurane consumption	mL	No	Yes	No	No	Yes	Yes	Yes	Yes	No
ISO LEV	Isoflurane consumption	mL	No	Yes	No	Yes*	Yes	Yes	Yes	Yes	Yes
SEV LEV	Sevoflurane consumption	mL	No	Yes	No	Yes*	Yes	Yes	Yes	Yes	Yes
DES LEV	Desflurane consumption	mL	No	Yes	No	Yes*	Yes	Yes	Yes	Yes	Yes

* Only when using the IF-932P communication cable with ver. 01-03 or later.

Terms	Description	Unit	Cable and Anesthetic Machine Types								
			IF-918P	IF-920P		IF-932P	IF-930P	IF-931P	IF-945P	IF-950P	IF-952P
			Heinen + Löwenstein	Dräger Medical Apollo, Pallas, Primus	Dräger Medical Fabius	MAQUET FLOW-i	GE Healthcare Aisys, Avance, Aespire, Aestiva	Air Liquid Felix	ACOMA PRO-next+i, PRO-next+s	Dräger Medical Perseus® A500	Dräger Medical Zeus® IE
MAC	Minimum alveolar concentration	—	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes
N_2O	Inspired and expired N_2O	%	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
CO_2	Inspired and expired CO_2	mmHg*	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
O_2 (I)	Inspired oxygen	%	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
O_2 (E)	Expired oxygen	%	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
FiO_2	FiO_2	%	Yes	No	No	No	Yes	No	Yes	No	No
ΔO_2	Difference between inspired and expired O_2 concentration	%	No	Yes	No	No	Yes	No	No	Yes	No
Flow N_2O	N_2O flow	L/min	No	Yes	Yes	No	Yes	No	No	Yes	Yes
Flow Air	Air flow	L/min	No	Yes	Yes	No	Yes	No	No	Yes	Yes
Flow O_2	O_2 flow	L/min	No	Yes	Yes	No	Yes	No	No	Yes	Yes
RR	Respiration rate	/min	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ppeak	Peak airway pressure	cmH_2O*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pplat	Plateau pressure	cmH_2O*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pmean	Mean airway pressure	cmH_2O*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PEEP	Positive end expiratory pressure	cmH_2O*	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
TVe	Expiratory tidal volume	L	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C	Static compliance	mL/ cmH_2O*	Yes	Yes	No	No	Yes	Yes	No	No	No
C20/C	Dynamic compliance during the last 20% of the inspiratory phase in relationship to the total dynamic compliance	—	Yes	No	No	No	No	No	No	No	No
R	Resistance	cmH_2O*/ L/s	Yes	No	No	No	Yes	No	No	Yes	Yes
MV	Expiratory minute volume	L/min	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LEAK	System leakage	mL/min	No	Yes	No	No	No	No	No	Yes	Yes
Cdyn	Dynamic compliance	mL/ cmH_2O*	Yes	No	No	Yes	No	No	No	Yes	Yes

Settings

Terms	Description	Unit	Cable and Anesthetic Machine Types								
			IF-918P	IF-920P		IF-932P	IF-930P	IF-931P	IF-945P	IF-950P	IF-952P
			Heinen + Löwenstein	Dräger Medical Apollo, Pallas, Primus	Dräger Medical Fabius	MAQUET FLOW-i	GE Healthcare Aisys, Avance, Aespire, Aestiva	Air Liquid Felix	ACOMA PRO-next+i, PRO-next+s	Dräger Medical Perseus® A500	Dräger Medical Zeus® IE
set FG	Fresh gas flow setting	L/min	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes
set PEEP	Positive end expiratory pressure setting	cmH_2O*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
set Pmax	Maximum airway pressure setting	cmH_2O*	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes
set Plat	Plateau pressure setting	%	Yes	No	No	No	No	No	Yes	No	No
set Pi	Inspiratory pressure in Pressure Mode setting	cmH_2O*	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
set Ti	Inspiratory time setting	s	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes
set TVi	Tidal volume setting	L	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
set O_2 (I)	Inspired oxygen setting	%	No	Yes	No	Yes	Yes	Yes	No	No	Yes
set RR	Respiration rate setting	/min	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
set I:E (I)	Inspiration expiration ratio (I part) setting	—	No	No	Yes	No	Yes	No	Yes	No	Yes
set I:E (E)	Inspiration expiration ratio (E part) setting	—	No	No	Yes	No	Yes	No	Yes	No	Yes
set I/E	Inspiration expiration ratio	—	Yes	No	No	Yes	Yes	No	No	No	Yes
set BACKUP	Duration of apnea until the triggers a breath on its own	s	Yes	No	No	No	Yes	No	No	No	No
set FLOW TRIG	Flow trigger level setting	L/min	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes
set Pause	Pause time setting	%	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes
set Rise	Rise time setting	s	No	Yes	No	Yes	No	No	No	Yes	Yes
set RRmin	Minimum respiration rate setting	/min	No	Yes	No	No	No	No	No	No	Yes
set SP	Support pressure setting	cmH_2O*	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
set FLOW(I)	Respiratory flow rate setting	L/min	No	No	Yes	Yes	No	No	Yes	No	No

Preparation for Monitoring Anesthetic and Ventilation Parameters

1. Connect the anesthetic machine to the bedside monitor. Refer to the IF series communication cable manual.

2. Connect the anesthetic machine to the patient. Refer to the anesthetic machine manual.

3. Monitoring starts. Set necessary settings.

Monitoring Anesthetic and Ventilation Parameters

After completing the preparation, anesthetic and ventilation data and waveforms appear on the screen.

WARNING

When connecting an external instrument using an interface or communication cable to the monitor, some alarms and messages from the external instrument might not be displayed on the monitor. When the waveform or data is abnormal, check the alarm and message on the external instrument.

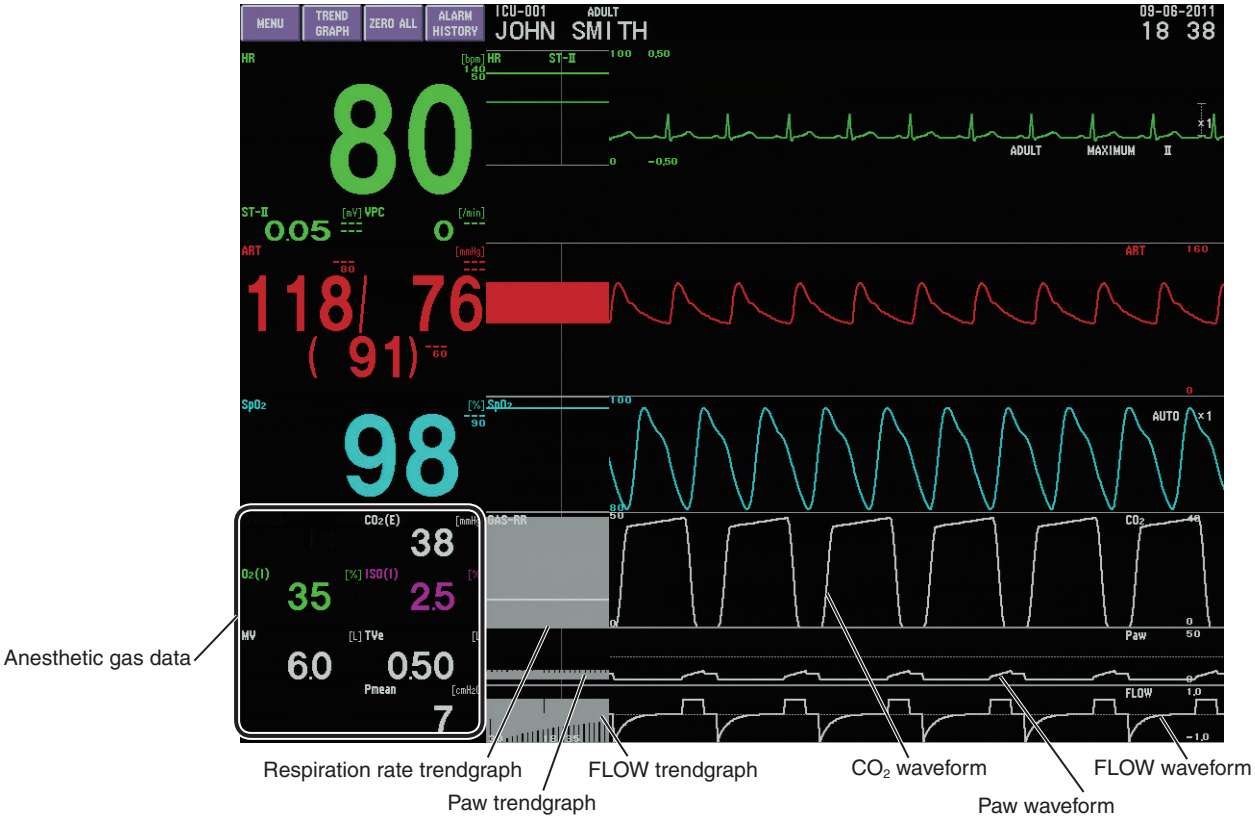
When using the following anesthesia machine, no anesthetic and ventilation alarms are displayed on the bedside monitor.

- MAQUET anesthesia system
- GE Healthcare anesthesia delivery system
- Air Liquide anesthesia system
- ACOMA Medical Industry anesthesia apparatus

NOTE

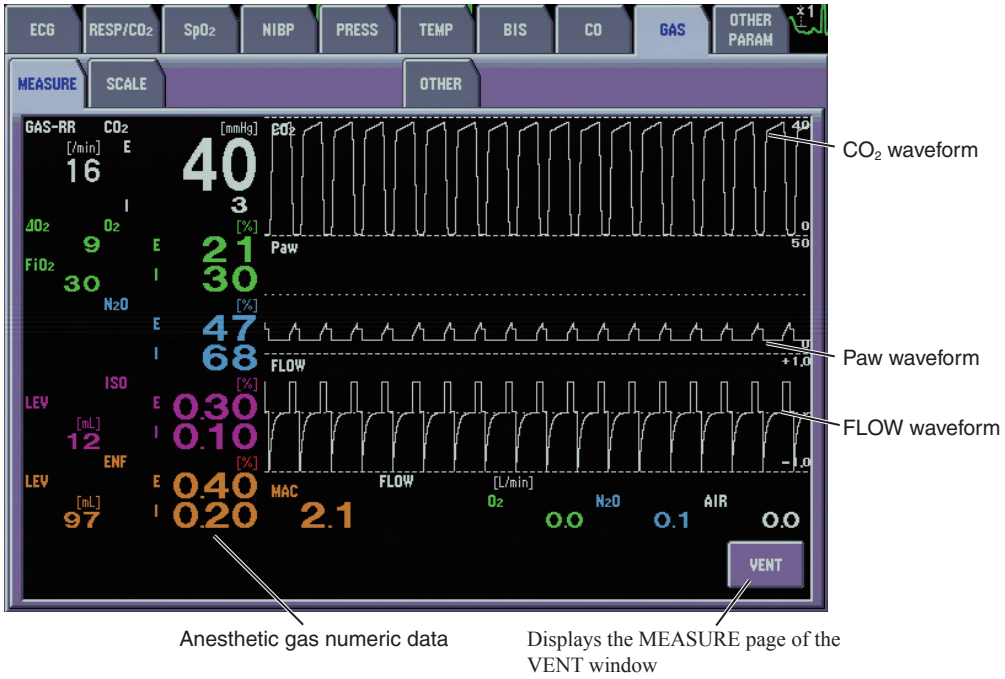
- When "- - -" is displayed for the anesthetic or ventilation values, check the monitoring condition on the anesthetic machine.
- If an anesthetic or ventilation parameter is not monitored on the anesthetic machine, it is not displayed on the bedside monitor.
- Some anesthetic or ventilation parameters cannot be displayed on the bedside monitor even if they are monitored on the anesthetic machine.

Anesthetic and Ventilation Information on the Home Screen



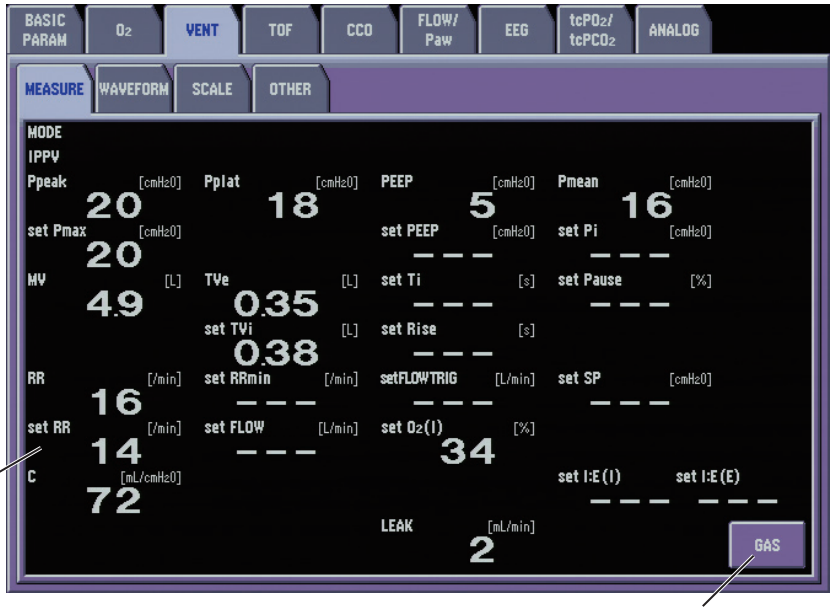
Anesthetic and Ventilation Information on the GAS and VENT Windows

GAS Window



VENT Window

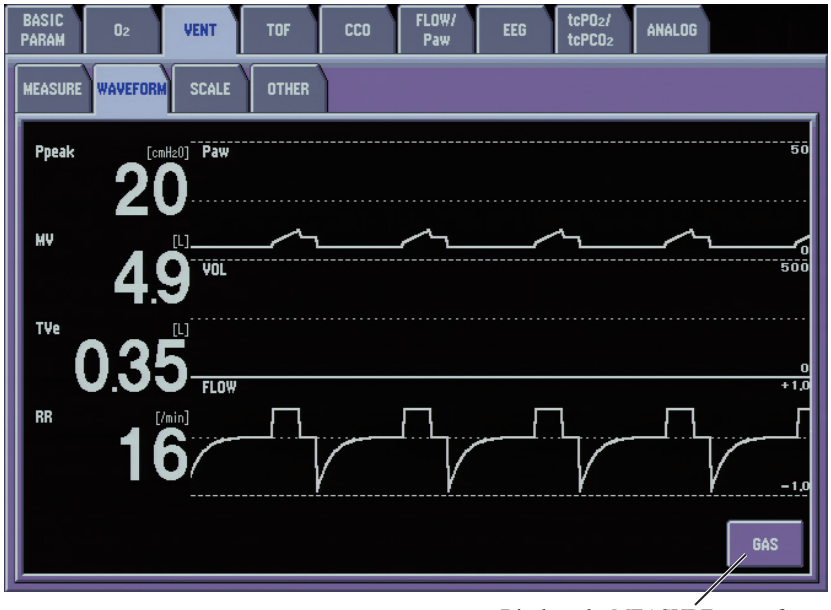
MEASURE page



Measured values and settings

Displays the MEASURE page of the GAS window.

WAVEFORM page



Displays the MEASURE page of the GAS window.

Changing Anesthetic and Ventilation Settings

The following settings can be checked or set for anesthetic and ventilation parameter monitoring.

Anesthetic

- Scale for CO_2, FLOW and Paw waveforms
- Displaying parameters and settings on the home screen

Ventilation

- Scale for FLOW, Paw and volume waveforms
- Displaying parameters and settings on the home screen

The display color for anesthetic and ventilation parameters can be set on the SYSTEM SETUP window. Refer to Section 3 of the Administrator's Guide.

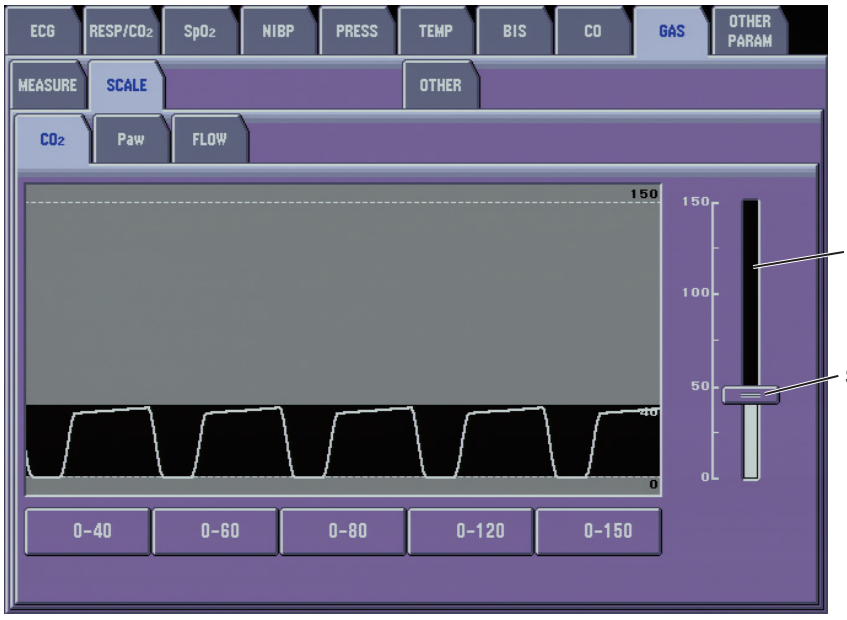
Changing the Waveform Scale

The scale can be changed for the following waveforms when monitored with an anesthesia workstation. The same scale is used on both the home screen and GAS window or VENT window.

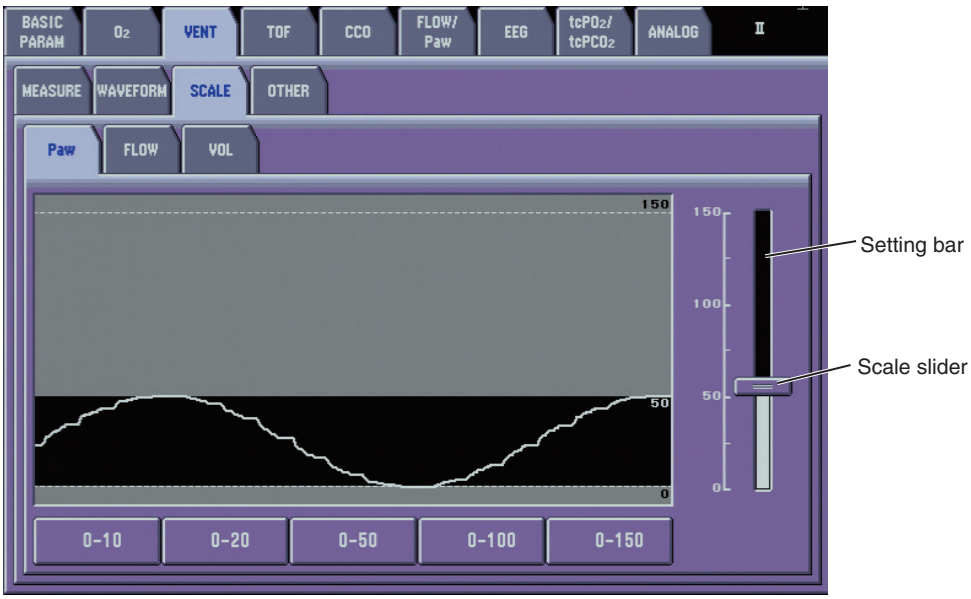
GAS window: CO_2, Paw, FLOW
VENT window: Paw, FLOW, VOL

1. Display the SCALE page of the GAS window or VENT window.
   GAS: Press the [Menu] key → GAS key → SCALE tab → parameter tab.
   VENT: Press the [Menu] key → VENT key → SCALE tab → parameter tab.

2. Select the scale.
   GAS window



VENT window



3. Press the [Home] key to return to the home screen.

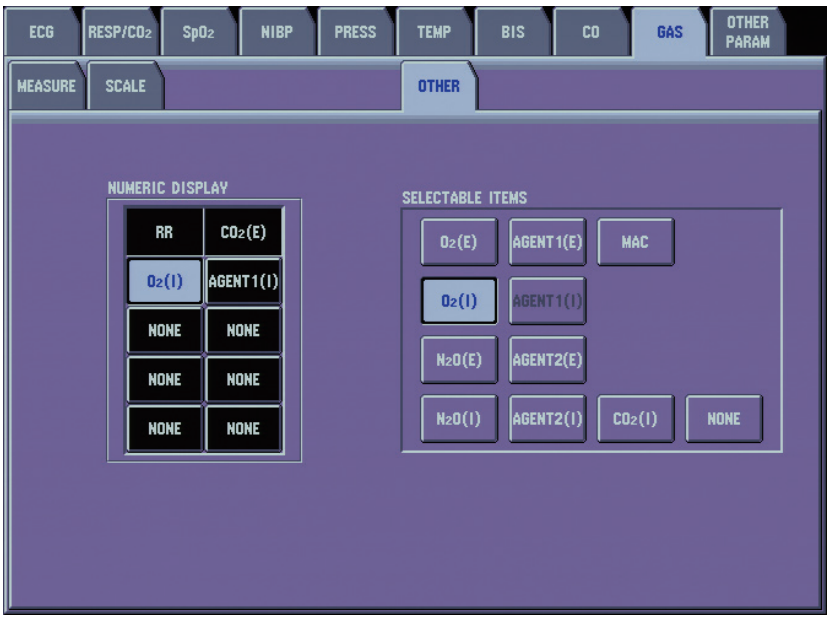
Selecting the Parameters to be Displayed on the Home Screen

Up to 10 anesthetic or 4 ventilator parameters can be displayed on the home screen.

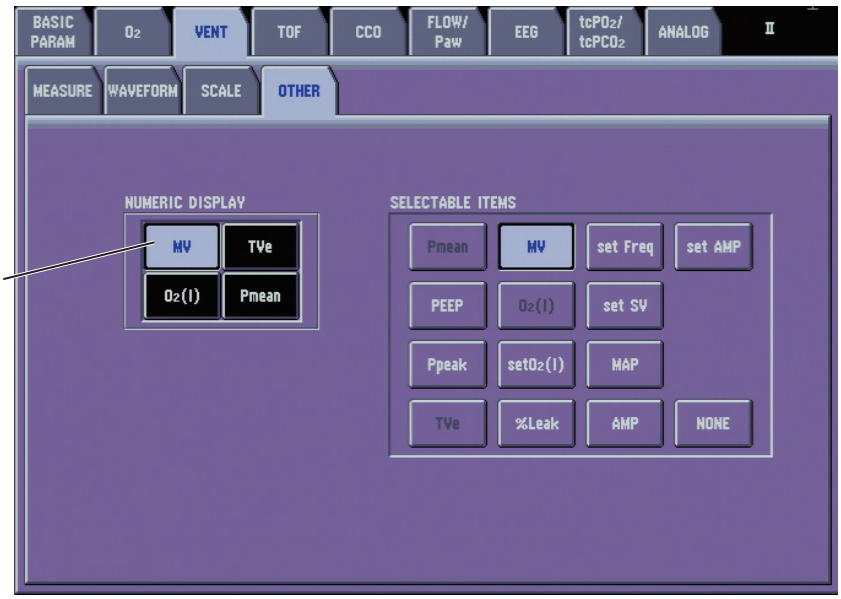
1. Display the OTHER page of the GAS window or VENT window.
   GAS: Press the [Menu] key → GAS key → OTHER tab.
   VENT: Press the [Menu] key → VENT key → OTHER tab.

2. Select the area on the home screen where the parameter is to be displayed in the <NUMERIC DISPLAY> box.

3. Select the parameter to be displayed in the selected area from the <SELECTABLE ITEMS> box.
   GAS window



VENT window



4. Press the [Home] key to return to the home screen.

Section 20 rSO_2 Monitoring

General

rSO_2 can be monitored with the Covidien INVOS™ 5100C cerebral/somatic oximeter. To connect it to the BSM-6000 bedside monitor, the IF-937P communication cable is required.

Refer to the manuals of the oximeter and communication cable together with this guide.

List of Terms

rSO_2: Regional Saturation of Oxygen
BVI: Blood Volume Index
BL: Baseline

Preparing for rSO_2 Monitoring

1. Connect the cerebral/somatic oximeter to the bedside monitor. Refer to the IF series communication cable manual.

2. Connect the cerebral/somatic oximeter to the patient. Refer to the cerebral/somatic oximeter manual.

3. Monitoring starts. Set necessary settings.

Monitoring rSO_2

After completing the preparation, data and waveforms appear on the screen.

WARNING

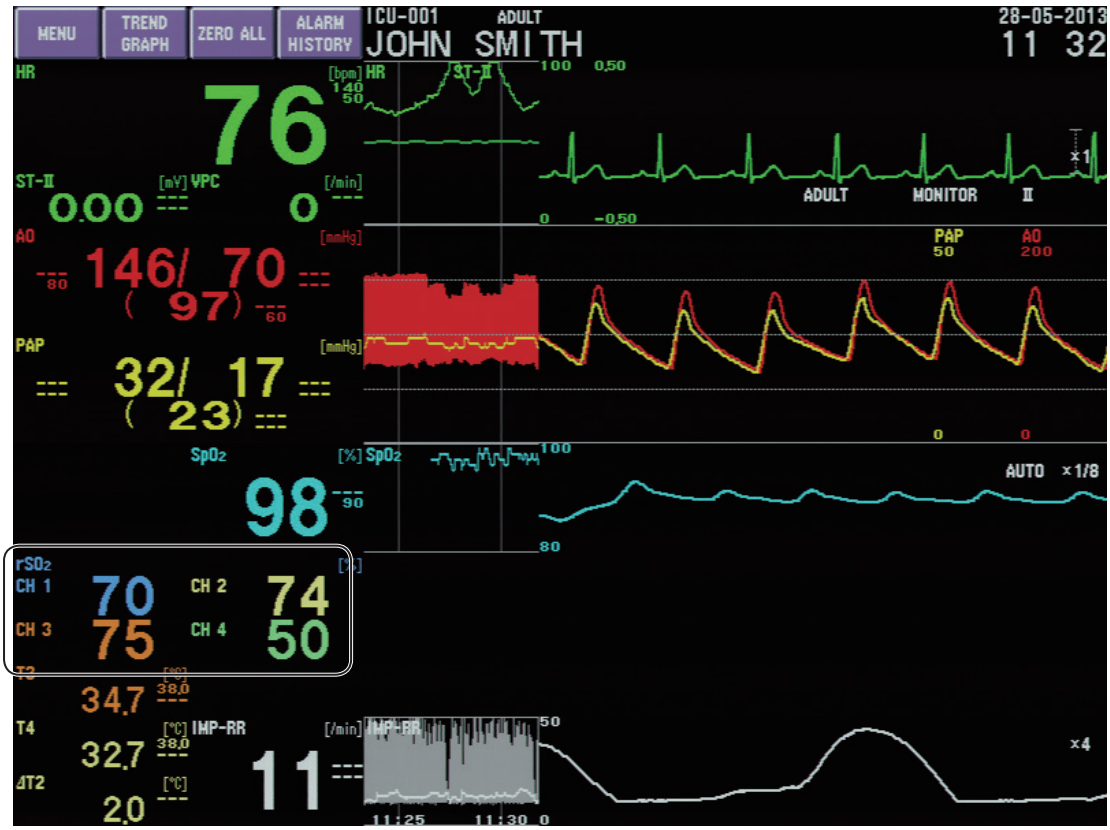
When connecting an external instrument using an interface or communication cable to the monitor, some alarms and messages from the external instrument might not be displayed on the monitor. When the waveform or data is abnormal, check the alarm and message on the external instrument.

When using the Covidien INVOS™ 5100C cerebral/somatic oximeter, no oximeter alarms are displayed on the bedside monitor.

NOTE

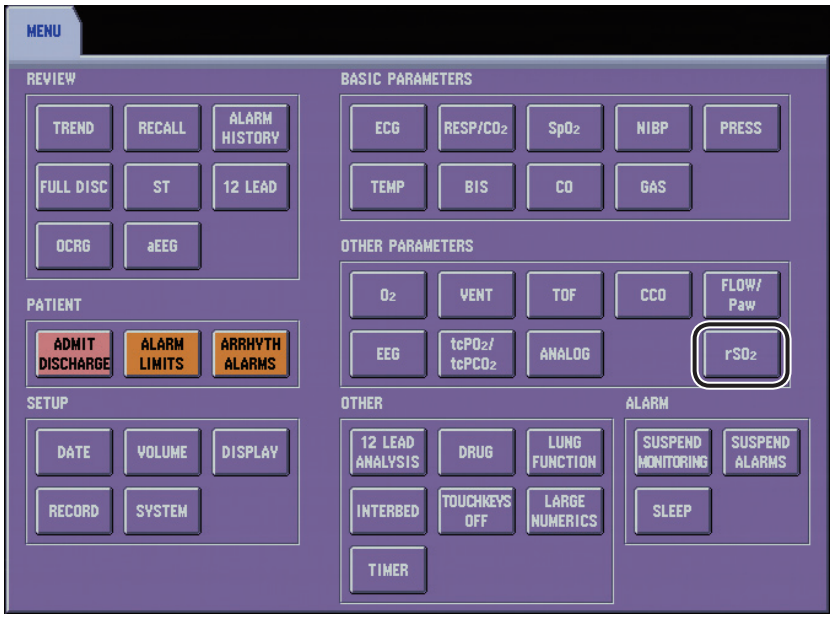
- If an rSO_2 parameter is not monitored on the cerebral/somatic oximeter, it is not displayed on the bedside monitor.
- Some rSO_2 parameters cannot be displayed on the bedside monitor even if they are monitored on the cerebral/somatic oximeter.

rSO_2 Information on the Home Screen

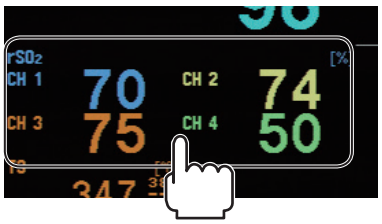


Opening the rSO_2 Window

Press the [Menu] key → rSO_2 key.



Or, touch the rSO_2 area on the home screen.



rSO_2 Information on the MEASURE Window

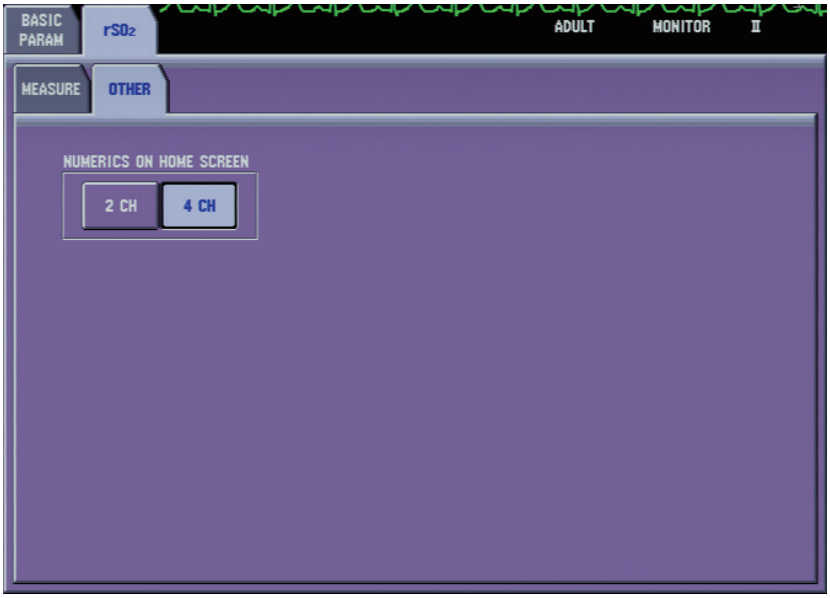
Changing rSO_2 Settings

The settings can be changed on the rSO_2 window. Touch the OTHER tab to change the settings.

Number of rSO_2 channels to display on the home screen can be selected on the OTHER page.

1. Display the OTHER page of the rSO_2 window:
   Press the [Menu] key → rSO_2 key → OTHER tab.

2. Select “2 CH” or “4 CH” in <NUMERICS ON HOME SCREEN>.



3. Close the rSO_2 window to return to the home screen.

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Contact information is accurate as of Jan 2015. Visit www.nihonkohden.com for the latest information.

The model and serial number of your instrument are identified on the rear or bottom of the unit.
Write the model and serial number in the spaces provided below. Whenever you call your representative concerning this instrument, mention these two pieces of information for quick and accurate service.

Model _____ Serial Number _____

Your Representative