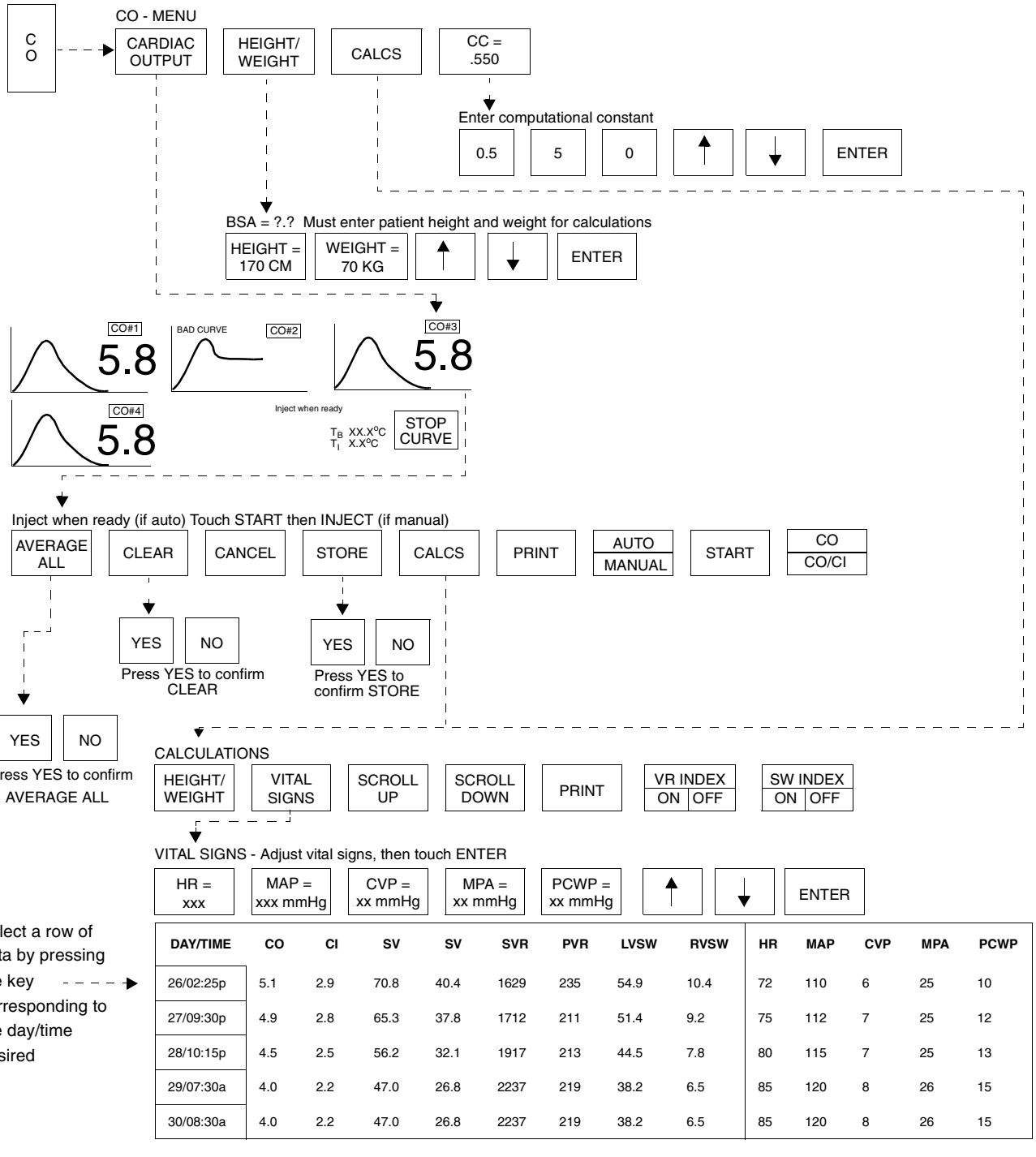
Cardiac Output Directory

Directory of Keys



Select a row of data by pressing the key corresponding to the day/time desired

DAY/TIME	CO	CI	SV	SV	SVR	PVR	LVSW	RVSW	HR	MAP	CVP	MPA	PCWP
26/02:25p	5.1	2.9	70.8	40.4	1629	235	54.9	10.4	72	110	6	25	10
27/09:30p	4.9	2.8	65.3	37.8	1712	211	51.4	9.2	75	112	7	25	12
28/10:15p	4.5	2.5	56.2	32.1	1917	213	44.5	7.8	80	115	7	25	13
29/07:30a	4.0	2.2	47.0	26.8	2237	219	38.2	6.5	85	120	8	26	15
30/08:30a	4.0	2.2	47.0	26.8	2237	219	38.2	6.5	85	120	8	26	15

! • *Based on features purchased, more or fewer keys may appear here than on your menu screens.*

Cardiac Output

Contents

Overview

Cardiac output (CO) monitoring enables you to evaluate the patient's fluid status and the pumping ability of the heart, as well as calculate and display various hemodynamic values.

Cardiac output is calculated by the thermodilution technique using a variation of the Stewart-Hamilton formula. Thermodilution involves injecting a cooled fluid (injectate) through a flow-through housing into an intravascular catheter. The catheter delivers the injectate directly to the right atrium and monitors the temperature downstream from the delivery site at the pulmonary artery.

Cardiac output is determined by measuring the change in blood temperature downstream from the delivery site with respect to time. The change in temperature is inversely proportional to the flow of blood through the right heart. If the flow is large, the volume of blood that the injectate mixes with is large as well, so the monitor detects a small change in temperature. When a smaller flow of blood is diluted by the same volume of injectate, the change in temperature is larger. The injectate has a larger influence on the temperature as measured in the pulmonary artery.

The system displays cardiac output by plotting a curve for each injection. The vertical axis of the curve represents temperature and the horizontal axis represents time.

Spacelabs Medical's cardiac output monitoring automatically captures vital sign values at the moment each CO curve is completed. This data is used to produce hemodynamic calculations.

Setup Procedure

To set up the system for monitoring cardiac output:

1. Insert the cardiac output cable into the module.
2. Attach the thermodilution catheter to the cardiac output cable.
3. Connect either an in-line injectate temperature probe or a reference solution injectate probe to the cardiac output cable.

The setup procedure that follows assumes that the pulmonary artery catheter has been placed. Follow your standard hospital procedure to properly place the pulmonary artery catheter in the patient.

Figure 19-1 illustrates the components used for CO monitoring. When using a reference solution injectate temperature probe, it should be inserted into the cardiac output cable in place of the in-line injectate temperature probe.

When you connect the thermistor connector port of the catheter to the cardiac output cable, the system monitors patient blood temperature (TB) and displays the value on the screen. When you connect the injectate temperature probe, the system detects the temperature of the injectate (TI) and displays it on the screen, but does not trend the data. The system displays a message instructing you to connect the probe or catheter, or to enter the computational constant (CC).

If you connect the cardiac output cable only to the catheter or only to the injectate probe, you can enter or adjust the computational constant but you cannot monitor cardiac output.

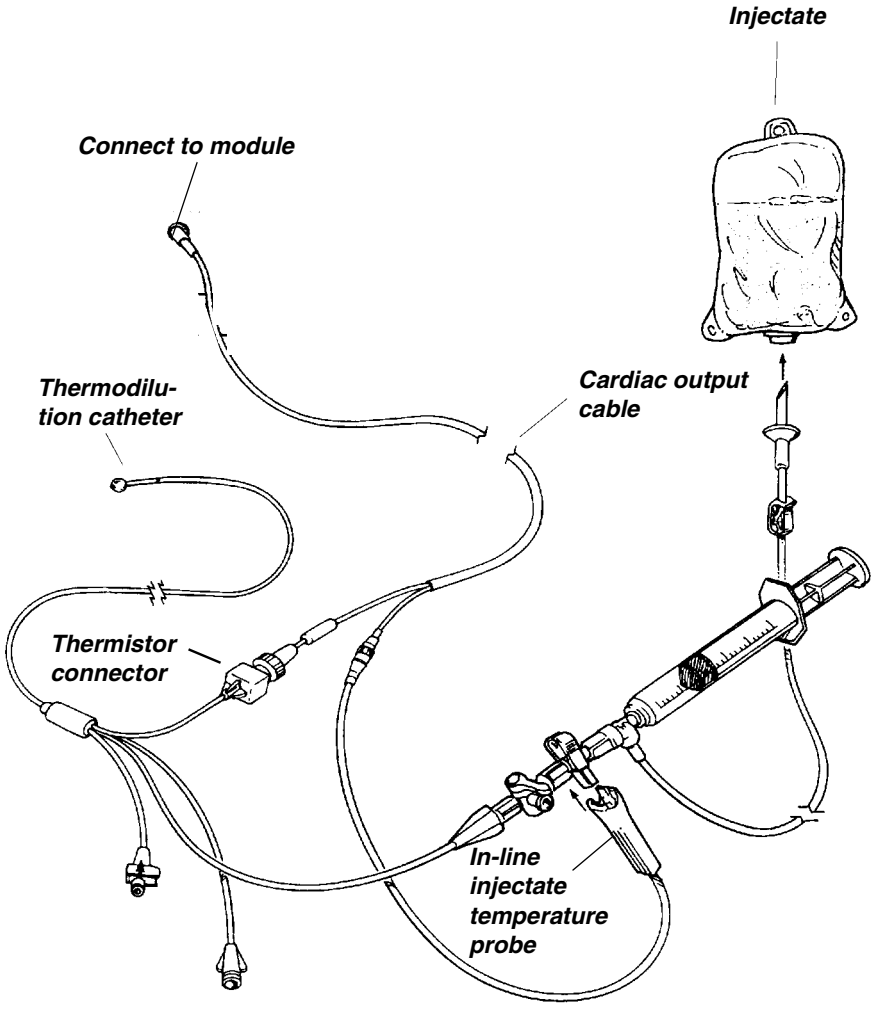


Figure 19-1: Cardiac output monitoring setup

Display Detail

The CO key is displayed once you connect the CO cable to the module. To display the CO main menu, touch the CO key and curves will appear as the system detects the flow for each injection. The message INJECT WHEN READY is displayed when the system is ready to plot a new output curve.

Figure 19-2 illustrates the cardiac output display when curves are being acquired, on a bedside monitor.

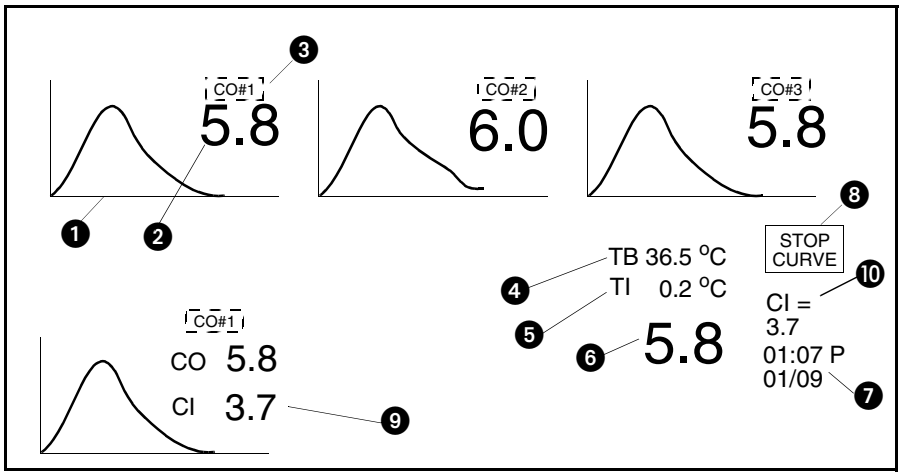


Figure 19-2: Cardiac output display

1. Cardiac output curve
2. Cardiac output (liters/minute)
3. Curve ID number key (used to select a curve)
4. Blood temperature
5. Injectate temperature
6. Cardiac output (average)
7. Time and date of averaging
8. Stop curve key (only displayed during curve drawing)
9. Cardiac index value
10. Cardiac index value (average)

Entering the Computational Constant

To enter the computational constant:

1. Touch CO.
2. Touch CC =.
3. Touch the appropriate keys (tenths, hundredths, and then thousandths) and use arrow keys to adjust.
4. Touch ENTER.

To generate calculations, you must first enter the computational constant (CC) and verify that the system is correctly configured. Refer to your thermodilution catheter package insert for current constants.

The temperature of the injectate changes due to contact with the catheter wall and the surrounding blood. To account for this interaction, the system includes a correction factor in the equation. The correction factor (K or CT) is a function of catheter and flow-through housing dimension, internal volume, and injectate temperature and differs among catheter models and manufacturers.

Once you enter a value for the computational constant, the value is displayed on the CC= key and remains in system memory. Until you enter the computational constant, the message CC REQUIRED is displayed, and ENTER COMPUTATIONAL CONSTANT is displayed on the message line after the CC= key is selected.

Entering Patient Height/Weight

To enter patient height and weight:

1. Touch CO.
2. Touch HEIGHT/WEIGHT.
3. Select HEIGHT = and/or WEIGHT =.
4. Use arrow keys to adjust.
5. Touch ENTER.

To perform indexed hemodynamic calculations, you must enter the patient's height and weight before you generate CO curves. CO uses the patient's height and weight entered during the admit function.

The valid range for height is 10 to 85 in (25 to 215 cm). The valid range for weight is 2 to 400 pounds (1 to 180 kg). After you enter both height and weight values, the system automatically calculates and displays the patient's body surface area (BSA).

Measuring Cardiac Output

To obtain CO measurements:

1. Touch CO.
2. Touch CARDIAC OUTPUT.
3. Select AUTO or MANUAL.

4a Wait for the INJECT WHEN READY or the TOUCH START THEN INJECT message to display.

-OR-

4b If in manual mode, touch START.

5. Inject the prepared injectate into the proximal lumen of the thermodilution catheter.

To maintain the accuracy of the readings, you must allow the catheter to warm up between injections. When in AUTO mode, wait until the INJECT WHEN READY message appears between injections. When in MANUAL mode, wait until the TOUCH START THEN INJECT message appears.

Five curves can be displayed at one time. Some curves may automatically be classified as "bad," in which case they are then labeled BAD CURVE and are automatically excluded from averaging. CO curves are numbered consecutively from 1 to 99.

!

- *To obtain all hemodynamic calculations remember to enter height and weight, and to store a PCWP prior to initiating measurement of CO.*

A 15-minute timer begins after acquisition of the first good curve. After 15-minutes, the AUTO/MANUAL and START keys become invalid (dotted), and the messages MUST SELECT CURVES, AVERAGE, STORE, or CLEAR CO appear. Cardiac output injections are disabled until you perform one of these actions. Injections may resume as soon as the INJECT WHEN READY or TOUCH START, THEN INJECT message appears.

Averaging Cardiac Output

To average all cardiac output curves:

1 Touch CO.
2 Touch CARDIAC OUTPUT.
3 Touch AVERAGE ALL.
4 Touch YES.

This function computes the average using the data from up to five, good, displayed curves. Curves labeled as “bad” are not included in the average.

You can perform cardiac output averaging as soon as the system has measured and displayed at least two acceptable curves.

When the cardiac output averaging is complete:

- The CO zone displays the curves used in the average, the averaged cardiac output, and cardiac index values.
- The time and date of the last curve displays.

Clearing Cardiac Output Curves

To clear or store all curves:

1 Touch CO.
2 Touch CARDIAC OUTPUT.
3 Select CLEAR or STORE.
4 Touch YES.

Occasionally you may want to delete a curve prior to averaging or storing. All curves, or only selected curves, can be cleared. If a “bad” curve is displayed when you select to average, store, or clear another displayed curve, the “bad” curve is also cleared.

When you clear an individual CO curve or all CO curves, the INJECT WHEN READY message is displayed in the first available curve position, so the curves displayed on the screen may not appear in numerical order.

Storing Cardiac Output Curves

To clear or store selected curves:

1 Touch CO.
2 Touch CARDIAC OUTPUT.
3 Touch the CO# keys adjacent to the curves (up to 5) that you wish to clear or store.
4 Select CLEAR or STORE.
5 Touch YES.

This feature enables you to store all of the acceptable, displayed curves at once or individually. The system stores the vital signs and cardiac output value it acquired at the end of curve acquisition, along with the time it displayed each curve. The curves clear from the screen as they are stored. The system does not store “bad” curves. After you store the acceptable curves, the system clears all curves from the screen.

Stopping Curve Drawing and Acquisition

To stop a curve in progress:

1 Touch STOP CURVE.

This feature enables you to stop the curve drawing and data acquisition of a cardiac output curve in progress. The STOP CURVE key only appears during curve drawing. Touching this key will invalidate all curve data for that injection. Once the blood temperature is again stable, the INJECT WHEN READY message will appear if in AUTO mode. The TOUCH START THEN INJECT message will appear if in MANUAL mode.

Selecting Index Normalization

To select indexing:

1. Touch CO.
2. Touch CARDIAC OUTPUT.
3. Touch CALCS.
4. Select VR INDEX ON or SW INDEX ON.

To individualize the values to the patient, the system calculates them with the BSA. Cardiac Index (CI) and Stroke Volume Index (SVI) are automatically displayed.

You can display either the Systemic Vascular Resistance (SVR) and the Pulmonary Vascular Resistance (PVR) or their indexed values (SVRI and PVRI), but not both simultaneously. Similarly, you can display the Left Ventricular Stroke Work (LVSW) and the Right Ventricular Stroke Work (RVSW) or their indexed values (LVSWI and RVSWI), but not both simultaneously.

Displaying Cardiac Index and Cardiac Output Values

To display both cardiac output and cardiac index values:

1. Touch CO|CO/CI.

The cardiac output or both cardiac output/index values can be displayed with the curves. If the CO portion of the CO|CO/CI key is highlighted, only the cardiac output value will be displayed. To activate the display for the cardiac output and cardiac index values, touch the CO|CO/CI key to highlight the CO/CI segment. If the cardiac index value is available, then it is displayed when the CO parameter is inactive.

Displaying Calculations Table

To display the calculations table:

1 Touch CO.
2 Touch CALCS.

Hemodynamic Equations	
BSA	= $Ht^{0.725}$ x $Wt^{0.425}$ x 0.007184
CI	= CO/BSA
SV	= (CO/HR) x 1000
SVI	= SV/BSA
SVR	= 79.9 x [(MAP-CVP)/CO]
SVRI	= 79.9 x [(MAP-CVP)/CI] = 79.9 x [(MAP-CVP)]/[CO/BSA] = 79.9 x [(MAP-CVP)]/[CO x 1/BSA] = 79.9 x [(MAP-CVP)/CO] x BSA = SVR x BSA
PVR	= 79.9 x [(MPA-PCWP)/CO]
PVRI	= 79.9 x [(MPA-PCWP)/CI] = 79.9 x [(MPA-PCWP)]/[CO/BSA] = 79.9 x [(MPA-PCWP)]/[CO x 1/BSA] = 79.9 x [(MPA-PCWP)/CO] x BSA = PVR x BSA

You can view hemodynamic calculations after storing or averaging data. The table includes only those calculations that have been stored or averaged.

Table 1 shows an example of the hemodynamic calculations table displayed when you touch the CALCS key. Each horizontal row is one complete set of data. Each new value appears at the bottom of the table. The system defaults to VR INDEX OFF and SW INDEX OFF.

Table 1: Sample Calculations

DAY/TIME	CO	CI	SV	SVI	SVR	PVR	LVSW	RVSW	HR	MAP	CVP	MPA	PCWP
26/02:25p	5.1	2.9	70.8	40.4	1629	235	54.9	10.4	72	110	6	25	10
27/09:30p	4.9	2.8	65.3	37.8	1712	211	51.4	9.2	75	112	7	25	12
28/10:15p	4.5	2.5	56.2	32.1	1917	213	44.5	7.8	80	115	7	25	13
29/07:30a	4.0	2.2	47.0	26.8	2237	219	38.2	6.5	85	120	8	26	15
30/08:30a	4.0	2.2	47.0	26.8	2237	219	38.2	6.5	85	120	8	26	15

! • *The vital sign values shown in Table 1 are typical if your monitor's UNITS OF MEASURE key is set to mmHg. Consult your system administrator if your display is different from that shown here.*

The system automatically calculates and enters CO and CI values in the table. Values in the columns SV, SVI, SVR, PVR, LVSW, and RVSW are automatically calculated from the vital sign values entered in the columns HR, MAP, CVP, MPA, and PCWP.

The values under the columns HR, MAP, CVP, MPA, and PCWP are parameter values obtained from other channels in the bedside monitor at the time a CO value is calculated or those values you have entered manually. To enter values in these columns refer to *Editing Vital Sign Values* on page 19-10.

If you do not enter height and weight values prior to generating CO curves, the monitor displays any value that uses BSA (e.g. CI, SVI, LVSWI and RVSWI) as **?.?**. If a calculated value is out of the displayable range, the monitor displays the value as **++++**. If any of the vital signs in the hemodynamics table are negative, the system uses the value 0 (zero) in the calculations.

The equations used for the hemodynamics table are defined in the table to the left.

Editing Vital Sign Values

To edit vital sign values:

1. Touch CO.
2. Touch CARDIAC OUTPUT.
3. Touch CALCS.
4. Touch DAY/TIME in the row you wish to select.
5. Touch VITAL SIGNS.
6. Select the vital sign you wish to edit.
7. Use arrow keys to edit the displayed value.
8. Press ENTER.

Select a row of data in the hemodynamic calculations table to turn the vital signs keys ON.

Table 2: Hemodynamic and Vital Signs Values

Label	Name	Units	Default Value	Valid Range
HR	Heart Rate	beats/min	70	0 - 300
MAP	Mean Arterial Pressure	mmHg kPa	80 10.7	0 - 300 0.0 - 40.0
CVP	Central Venous Pressure	mmHg kPa	10 1.3	0 - 99 0.0 - 13.2
MPA	Mean Pulmonary Artery Pressure	mmHg kPa	15 2.0	0 - 99 0.0 - 13.2
PCWP	Pulmonary Capillary Wedge Pressure	mmHg kPa	10 1.3	0 - 99 0.0 - 13.2

Default values are supplied if you touch the VITAL SIGNS key and no prior value is available. When you edit a value, the system recalculates the hemodynamic calculation values using the new vital sign value.

A CVP value is used in calculations if it is available. If only a RAP value is available, then the RAP value is used in place of CVP. If neither CVP nor RAP pressure is available, the system cannot automatically calculate SVR, SVRI, RVSW, or RVSWI. A CVP or RAP value can be manually entered using this edit process.

!

- *To ensure that a RAP/CVP value can be registered, immediately reopen the stopcock to the patient after you inject the bolus so that flow is reinstated.*

A PCWP value is used in calculations if the last stored PCWP value is less than 15-minutes old. If no such PCWP value is present, an LAP value is substituted. If neither PCWP nor LAP values are available, the system cannot automatically calculate PVR, PVRI, LVSW, nor LVSWI and the monitor displays the message NO PCWP VALUE AVAILABLE WITHIN THE LAST 15-MINUTES. You can add a PCWP value manually using this edit process.

View Additional Table Data

To view additional sets of data:

1. Touch CO.
2. Touch CALCS.
3. Touch SCROLL UP to scroll the data up one row, touch SCROLL DOWN to scroll the data down one row.

Five sets of values display at any one time. Additional sets of values can be displayed by scrolling through the data.

Thirty sets of values are saved in the monitor's hemodynamic calculations table so you can remove and re-insert the module without losing hemodynamic values. You can erase these values by discharging a patient or by powering the monitor OFF.

Recording Cardiac Output Curves

To record thermodilution curves:

1 Touch CO.
2 Touch CARDIAC OUTPUT.
3 Touch PRINT.

If a bedside or system printer is installed, you can record all curves in the CO display area. You can also record the calculations table when it is displayed on the screen.

Error Messages

Catheter Fault

There is a problem with the thermodilution catheter. Connect or replace the catheter.

TB Out Of Range

The blood temperature (TB) is unacceptable. The temperature must be between 27° and 43°C.

Probe Fault

There is a problem with the probe. Connect or replace the probe.

TI Too Warm

The injectate temperature (TI) is greater than 25.5°C. Cool down injectate.

Bad Curve

There are a number of different possible causes: unsteady baseline, irregular curve from shunts or poor injection, delayed curve, catheter or probe fault during curve recording. Delete the bad curves as necessary to perform additional cardiac output determination.

Injectate Temperature Error

The temperature difference between the injectate and body is less than 8°C. Cool the injectate down.

Cables and Probes

Refer to Spacelabs Medical Supplies Products catalog for part numbers and specifications for cables, probes, and injectate systems.

Computation Constants/Catheter Compatibility

Nominal resistance @ 37°C 14,004 Ω ± 15%

Refer to the instructions provided with your catheter for the computation constants for your specific catheter, setup injectate temperature, and injectate volume. Contact your local thermodilution catheter sales representative for further information.

- *Cardiac output function is compatible with the Baxter Edwards Critical-Care REF™ and REF-Ox™ catheters for cardiac output measurement,* but cannot perform the REF function.

WARNING:

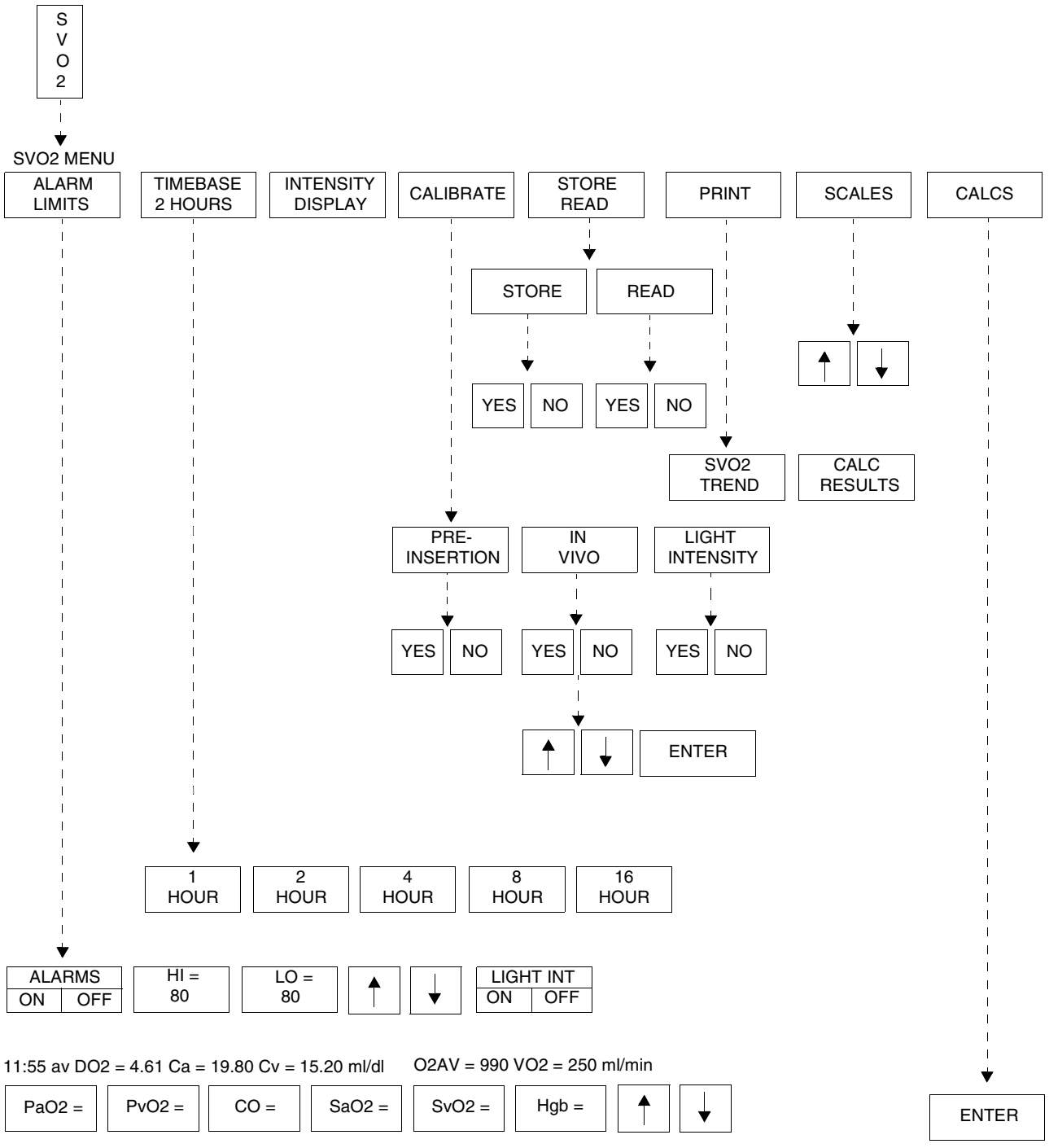
- ***For 3 cc injectate volumes, the 0° - 5°C injectate temperature is required for consistent results.***

Refer to *Calculations* on page 25-5 for hemodynamic and vital sign value tables.

Cardiac Output Troubleshooting Guide

Clinical Situation	Possible Cause	Solution
Invalid pressure reading	■ Stopcock of the CVP or RAP line may not have been turned OFF quickly enough after injection was made.	■ Turn the stopcock off immediately after making the injection to provide the module with the correct pressure value at the time it obtains the curve.
Erroneous CO values using room temperature injectate	■ Injectate too warm.	■ Injectate temperature is above 25.5° C.
	■ Injection rate too slow.	■ Administer bolus smoothly at a rate of ≤ 10 cc/4-seconds.
Unable to obtain indexed values for calcs	■ Did not enter height and/or weight prior to averaging curves.	■ Enter the height/weight and reinject the curves. ■ If the Calcs option is installed, enter the height/weight in hemocalcs to obtain index values without reinjecting curves.
Value of calcs variable displays as +++	■ Measured value is out of range.	■ Check computation constant (CC) values for validity.
Spontaneous CO curves drawn while in AUTO mode	■ Infusion of IV drips or medications through proximal port.	■ Turn off the IV solutions temporarily.
	■ Mechanically ventilated patient causing shifts in PA temperature.	■ Use the Manual mode.
	■ Cardiac arrhythmias causing blood flow variance.	■ Use the Manual mode and time the injection during stable ECG rhythm.
Substantial variance in CO values/irregular curves	■ Varied temperature in bolus. ■ Injection delivered at varying points in the respiratory cycle.	■ Standardize the temperature of bolus. ■ Use the Manual mode and time the injection at end expiration, if desired.
	■ Movement.	■ Standardize the patient position during procedure.
	■ Physiological problems.	■ Any of the following conditions can affect accurate readings: ventricular arrhythmias, low stroke volume, and/or valve insufficiency.
	■ Injectate rate too slow.	■ Administer the bolus smoothly at a consistent rate.
	■ Insufficient time has elapsed between injections to allow blood temperature stabilization.	■ Wait 60- to 90-seconds between injections.

Directory of Keys



- *Based on features purchased, more or fewer keys may appear here than on your menu screens.*

Contents

Overview

Measurements of venous oxygen saturation ($S\bar{v}O_2$) provide a status indicator of the oxygen transport system in the critically ill patient.

Low or rapidly decreasing saturation values indicate an imbalance between oxygen consumption and oxygen delivery. Normal values reflect a balance of the oxygen transport system or the patient's ability to successfully compensate for alterations in oxygen supply or demand. Continuous $S\bar{v}O_2$ monitoring can reduce the frequency of additional invasive measurements and enhance the timeliness of intervention in the critically ill patient.

This system utilizes three-wavelength reflectance spectrophotometry to sense the amount of light absorbed by the blood. The use of three wavelengths compensates for changes in light reflectance from red blood cell surfaces, blood vessel walls, and for variations in hematocrit values. Digital filtering reduces vessel-wall artifacts.

Data acquisition begins when an Abbott Opticath catheter is positioned at a site within the pulmonary artery. The catheter connects to an Abbott Oximetrix optical module which contains three LEDs emitting red and infrared wavelengths of light. The catheter returns reflected light through a second optical fiber to the optical module. Here the light is converted to an electrical signal which the $S\bar{v}O_2$ module recognizes and displays as a saturated venous oximetry value (percent $S\bar{v}O_2$).

CAUTION:
- **The Spacelabs Medical $S\bar{v}O_2$ module will not correctly operate with any other catheter for SvO_2 monitoring.**

Setting Up $S\bar{v}O_2$ Monitoring

To set up $S\bar{v}O_2$ monitoring:

1. Place the catheter's optical connector into the optical module on the connecting cable.
2. Insert the connecting cable into the $S\bar{v}O_2$ module.

In addition to the Spacelabs Medical module, venous oximetry monitoring requires an Abbott Oximetrix 3 optical module with connecting cable and an Abbott Opticath catheter. You must correctly connect all necessary cables, prepare the catheter and patient for this invasive procedure, and calibrate the catheter to begin monitoring.

The system provides two calibration methods. The patient's current status determines the proper calibration method. You can calibrate the catheter:

- while in its sterile package, or
- after it has been placed within the pulmonary artery, and you can verify adequate light intensity during monitoring.

Refer to *Preparing the Catheter* on page 20-5 and *Performing Pre-insertion (in vitro) Calibration* on page 20-6 for more details.

Display Detail

Figure 20-1 provides a trend of oximetry values and the current light intensity value.

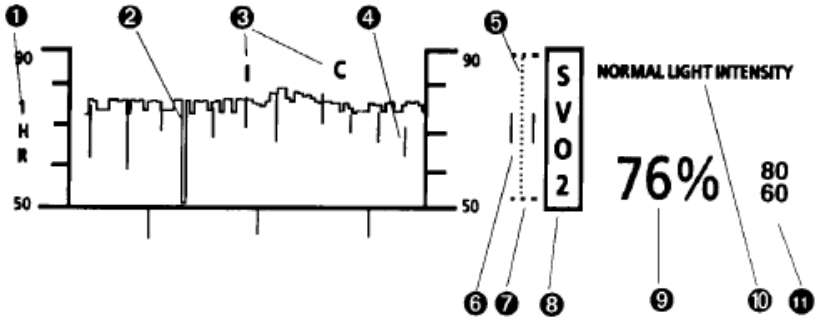


Figure 20-1: Typical venous oximetry display

1. Current time base — 1HR
2. Venous oximetry trend graph
3. Event marks — **I** (in vivo calibration initiated), **C** (in vivo calibration complete)
4. Light intensity display marks (vertical lines) superimposed over trend graph
5. Light intensity bar graph (light meter)
6. Real time intensity signal level (two vertical lines)

❼ Markers for normal intensity levels (two horizontal lines)

❽ $S\bar{v}O_2$ parameter key

❾ Current venous oximetry value — 76%

❿ Status or error message area

⓫ Current alarm limits — high 80, low 60

Preparing the Catheter

Each Abbott Opticath catheter is packaged in a sterile, disposable tray which includes a disposable optical reference. Inspect the catheter tray carefully. If you suspect damage to the tray DO NOT USE THE CATHETER.

Perform the catheter setup according to the instructions included with the catheter. Setup instructions are included here as a convenience.

1. Peel back the outer wrap. Do not break the seal of the inner wrap.
2. Peel back the lift tab to uncover the optical connector at the end of the tray.
3. Pull the optical connector slightly away from the tray. Place the optical module in the recess at the open end of the catheter tray.
4. Open the end of the optical module by pulling straight out in the direction of the arrow (refer to *Figure 20-2*). The monitor will display an INSUFFICIENT LIGHT message.

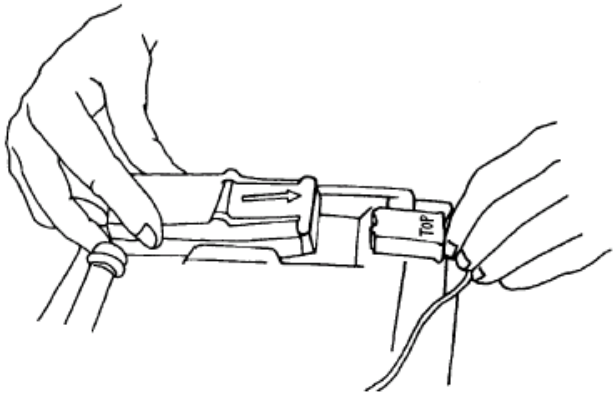


Figure 20-2: Placing the optical module into the catheter tray

5. Place the optical connector into the optical module with the word TOP facing up. Close the module (refer to *Figure 20-3)*.

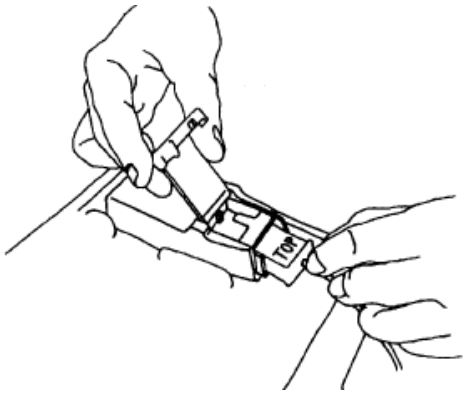


Figure 20-3: Placing the optical connector into the optical module

6. With the inner wrap still in place, press down on the black optical reference at the point labeled PUSH. Listen for a click.

The catheter is now ready for pre-insertion calibration. After you complete the calibration, prepare the patient for catheter insertion.

Performing Pre-insertion (in vitro) Calibration

To initiate pre-insertion calibration:

1 Touch SVO2.
2 Touch CALIBRATE.
3 Touch PRE-INSERTION.
4 Touch YES.

This calibration procedure tales up to 72-seconds. When calibration is successful, the message PRE-INS CAL COMPLETE displays and the event mark P displays on the oximetry trend.

If the catheter fails calibration, verify the following:

- A secure cable connection exists between the optical and $S\bar{v}O_2$ modules.
- The catheter tip is inserted properly within the optical connector.
- You have pressed the optical reference with enough force to hear the click, indicating a secure connection.
- You tested the catheter by replacing it with a known good catheter to ensure proper catheter function.

Repeated calibration failure with a known good catheter may indicate a defective optical module. Replace the optical module if necessary.

Inserting the Catheter

Follow standard hospital procedure to prepare the patient for catheter insertion.

1. Using sterile procedures, peel back the remaining inner wrap from the catheter tray. Pull the retainer (white tab) to release the catheter.
2. Grasp the catheter at approximately the 5 cm mark and gently pull it straight out from the optical reference.

CAUTION:
- **The optical fibers can be damaged if you do not draw the catheter out carefully.**

3. Prepare the catheter and insert it into the patient according to hospital procedure. Oxygen saturation readings will immediately display on the bedside monitor.
4. When the catheter is positioned properly, verify the light intensity signal is within the correct operating range (i.e., the bars on the graph extend at least two vertical dots within the high and low range markers).
5. Perform a light intensity calibration.

- *Do not begin a light intensity calibration if the signal is out of range. If this occurs, refer to* Correcting Out-of-Range Light Intensity *on page 20-11.*

6. Begin continuous mixed venous oxygen saturation monitoring.

Performing Light Intensity Calibration

To initiate light intensity calibration:

1 Touch SVO2.
2 Touch CALIBRATE.
3 Touch LIGHT INTENSITY.
4 Touch YES.

This procedure adjusts the optical module's light intensity reference level to match the light intensity returned through the catheter from the patient's blood. The $S\bar{v}O_2$ module stores this value and signals an alarm if the detected light differs significantly from the stored light levels.

Perform a light intensity calibration only when the catheter is in the proper position in the patient.

Performing In Vivo Calibration

To initiate in vivo calibration:

1. Touch SVO2.
2. Touch CALIBRATE.
3. Touch IN VIVO.
4. Touch YES.
5. Draw blood from the distal lumen when the message DRAW BLOOD is displayed and send to lab for analysis.
6. Use arrow keys to adjust value if displayed value differs from lab value by more than four saturation units.

In vivo calibration compares a drawn (measured) blood gas value with the value displaying on the monitor. The catheter manufacturer recommends that the oxygenation value be checked periodically. Several conditions may necessitate in vivo calibration.

- Catheter was placed without pre-insertion calibration.
- Catheter has been in place for an extended period of time.
- Decaying light intensity values indicate possible damage to the fiber optics (in this case, the catheter manufacturer recommends checking the oxygenation value every 12-hours).
- You believe the saturation reading is incorrect.

!

- *Use only measured oxyhemoglobin saturation values from a co-oximeter. Do not use values calculated from a laboratory blood gas analyzer. Oxyhemoglobin values calculated on the basis of PO_2, pH, and temperature have been shown to be inaccurate.*

Perform an in vivo calibration only when the patient's oxygen saturation is relatively stable and the intensity signal is within normal limits. When calibration begins, the optical module stores the preceding 5-seconds of oxygen saturation data.

Displaying Intensity Data

To display a history of light intensity values:

1. Touch SVO2.
2. Touch INTENSITY DISPLAY.

You can display a history of light intensity values superimposed over the saturation trend graph. This combined display can be valuable for troubleshooting because the quality of light passing the catheter tip directly affects the accuracy of the saturation value. Successful monitoring ensures light intensity values remain within the limits of the bar graph display.

Real time maximum and minimum intensity values display as vertical bars to each side of a vertical row of dots. This display updates every 6-seconds. Horizontal lines represent the recommended operating limits for light intensity.

Removing display of the intensity data does not affect storage of the data in monitor memory, and the current intensity continues to display in the intensity bar.

Setting Alarm Limits

To set or adjust alarm limits:

1. Touch SVO2.
2. Touch ALARM LIMITS.
3. Select ALARMS ON.
4. Select HI= or LO=.
5. Use arrow keys to adjust.

The current limits for venous oximetry display to the right of the parameter key. You can set high or low saturation limits.

The alarm default is OFF. When you turn alarms ON:

- they default to a high of 80% and low of 60%.
- the exceeded limit key flashes.
- the limit value is displayed in the message area of the screen.

Setting the Light Intensity Alarm

To set the light intensity alarm:

1 Touch SVO2.
2 Touch ALARM LIMITS.
3 Select LIGHT IN - ON or OFF.

If the light intensity alarm is turned ON, a second-level alarm will sound in the event of an intensity alert.

Adjusting Trend Display

The most recent minute of mixed venous oxygen saturation data is displayed as a point on the right side of the trend graph. As the module acquires new data, the older data points move left to create a record of data.

Select Timebase

To select a timebase:

1 Touch SVO2.
2 Touch TIMEBASE x HOURS.
3 Select hours.

The SvO_2 module stores the most recent 16-hours of saturation trend data. You can view this data graphically in 1-, 2-, 4-, 8-, or 16-hour time bases. Data is displayed in 1-minute increments on 1- to 4-hour graphs, in 2-minute increments on the 8-hour graph, and in4-minute increments on the 16-hour graph.

Select Scale

To change trend graph size:

1 Touch SVO2.
2 Touch SCALES.
3 Use arrows to adjust.

You can select one of three sizes for the trend graph:

- 30% to 70%
- 40% to 80%
- 50% to 90% (default)

Event Marks

The system automatically displays event marks along the top of the trend graph to note the point when any of the following events occur:

P — pre-insertion calibration initiated

I — in vivo calibration initiated

C — in vivo calibration complete

L — light intensity calibration complete

F — calibration failure

R — light intensity range error

Obtaining Oximetry Calculations

To obtain oxygenation calculations:

1. Touch SVO2.
2. Touch CALCS.
3. Select a manually entered value(s) for PaO_2, PvO_2, Hgb.
4. Use arrow keys to adjust.
5. Touch ENTER.

You can use the calculations feature to obtain specific values for the oximetry measurements listed below.

Arterial oxygen content — Ca

$$CaO_2 = (1.34 \times Hgb \times SaO_2/100) + (0.0031 \times PaO_2)$$

Venous oxygen content — Cv

$$CvO_2 = (1.34 \times Hgb \times S\bar{v}O_2/100) + (0.0031 \times PvO_2)$$

Arterial-venous oxygen content difference

$$avDO_2 = CaO_2 - CvO_2$$

Oxygen availability or oxygen delivery

$$O_2AV = CaO_2 \times CO \times 10$$

Oxygen consumption

$$VO_2 = avDO_2 \times CO \times 10$$

Values for cardiac output (CO), pulse oximetry (SpO_2), and venous oxygen saturation ($S\bar{v}O_2$) are automatically displayed when data is available in the Ultraview Care Network system. You must manually enter laboratory values for PaO_2, PvO_2, and hemoglobin (Hgb) to obtain calculations.

- *If an SaO_2 value is available, it may be used in place of the SpO_2 value.*

Printing Oximetry Data

To print saturation data:

1. Touch SVO2.
2. Touch PRINT.
3. Select $S\bar{v}O_2$ TREND or CALC RESULTS.

You can print venous oximetry data in two formats: the current trend or the results of the most recent set of oxygenation calculations. Refer to *Printing* on page 4-5 for more details on system and bedside printers.

Storing or Reading Data

To read or store data in the optical module:

1. Touch SVO2.
2. Touch STORE READ.
3. Select STORE or READ.
4. Touch YES.

The last 15-minutes of data gathered by the $S\bar{v}O_2$ module may be stored in the optical module's memory before disconnection. That data can be read back into the $S\bar{v}O_2$ module. The stored data includes the year, month, hour, and minute of collection.

Correcting Out-of-Range Light Intensity

Each time you perform a light intensity calibration, the oximetry module stores the intensity value and signals an alarm or error message if the current light level differs significantly from the stored level. Light intensity error messages serve as a reference to determine if the light at the catheter tip is adequate for accurate monitoring. Do not ignore these messages.

The module alerts you to this condition when:

- an INTENSITY ALERT or SVO2 DATA OUT OF RANGE message is displayed; or
- a second level alarm begins.

When the monitor displays the SVO2 DATA OUT OF RANGE or INTENSITY ALERT message, select the intensity display feature to view a history of light intensity values. Refer to *Figure 20-4* to identify the type of abnormal intensity. Refer to the following list of possible causes and solutions.

- High — check the position of the catheter as the tip may lie against the vessel wall. Reposition the catheter according to your hospital protocol.
- Low, dampened, or erratic — check the blood flow past the catheter as a clot may have formed over the catheter tip.

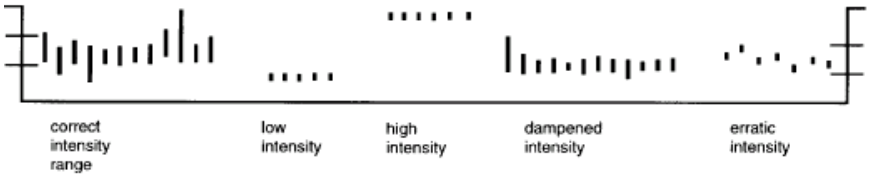


Figure 20-4: Abnormal intensities

Take the following actions:

- If a Spacelabs Medical invasive pressure module is being used, examine the pulmonary artery (PA) pressure waveform for spontaneous wedge indicating the catheter tip may lie against the vessel wall. If this occurs, reposition the catheter.
- If a Spacelabs Medical invasive pressure module is being used for pulmonary artery pressure monitoring, examine the pressure waveform for dampening, indicating clotting over the tip of the catheter. If this occurs, follow hospital procedure to flush the distal lumen. Reposition the catheter if necessary.
- Abnormal resistance when you push the catheter through the distal lumen indicates damage to catheter fiber optics. Reposition the catheter and replace if necessary.
- If connections between the catheter optical connector and the optical module appear loose, tighten the connections.
- If the catheter contains obvious kinks, the optical fibers may be damaged. Replace the catheter.

Correcting Insufficient Light Intensity

The message INSUFFICIENT LIGHT displays when an unusually small amount of light is being received during monitoring or during pre-insertion calibration.

Take the following actions:

- If this message displays while the catheter is exposed to room light during pre-insertion calibration, take no action. It disappears when the catheter is placed in the patient.
- If this message displays during pre-insertion calibration while the catheter is connected to the optical module, verify proper connection to the module.
- Check that the tip is fully inserted into the optical reference and firmly press PUSH on the optical reference until you hear a click. Do not use the catheter if the tip is pulled out of the optical reference when you receive the catheter tray.
- Disconnect the optical module from the catheter, close the optical module lid, and place the optical module in an area out of direct light. If the message disappears, replace the catheter. If the message remains, contact your system administrator.
- Examine the catheter for kinking. If optical fibers are damaged, replace the catheter.

Correcting Calibration Errors

The message CALIBRATION REJECTED displays when pre-insertion or in vivo calibration is not successful.

Take the following action as indicated:

- Check for secure catheter connection to the optical module. Reconnect the catheter if necessary.
- Check the status message on the monitor screen to verify sufficient, stable light intensity. If the INSUFFICIENT LIGHT message displays, refer to the previous section which describes steps to correct this condition.
- Allow the optical module to warm up for one more minute, then retry.

The message NOT CALIBRATED displays and an alert sounds (if alarms are ON) if you begin monitoring before you calibrate the system. The message disappears after you complete a successful calibration.

Correcting Optical Module Errors

The $S\bar{v}O_2$ module performs constant memory checks to ensure data is not lost or changed erroneously. When the OPTICAL MODULE MEMORY ERROR message displays, replace the optical module with a known good unit.

Expect the NO OPTICAL MODULE message whenever you disconnect the optical module from the $S\bar{v}O_2$ module because this suspends $S\bar{v}O_2$ monitoring.

If this message appears when the optical module is not disconnected, replace the module or contact a qualified service person.

Correcting $S\bar{v}O_2$ Display Error

If the oxygen saturation value is out of the display range, the display changes from a percentage to **???**.

Take the following action as indicated:

- Verify proper function of the optical module; no error messages display. Replace with a known good module if necessary.
- Display light intensity history to verify proper catheter function (refer to *Correcting Insufficient Light Intensity* on page 20-12).
- Perform in vivo calibration.

Ensuring Catheter Function

The catheter fiber optics are sensitive to damage. Avoid kinking, excessive manipulation, or grasping with forceps or a hemostat. Damage to the fiber optics reduces transmission of light to and from the blood which significantly compromises oxygen saturation accuracy.

Damage is indicated by one or more of the following:

- Low intensity display.
- Intensity error message displays.
- Intensity alarms begin if alarms are ON.
- Oxygen saturating values are inaccurate.

$S\bar{v}O_2$ Troubleshooting Guide

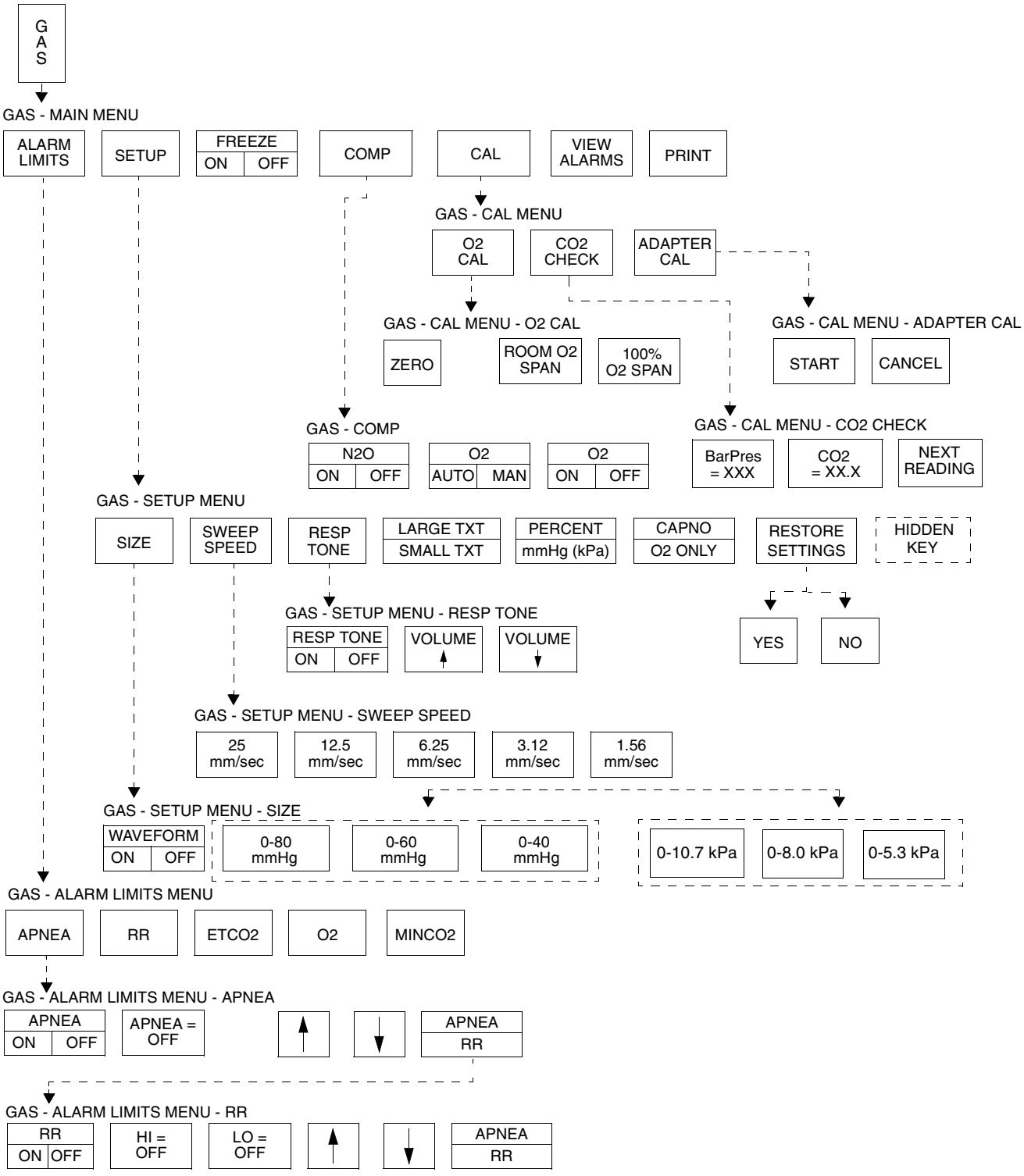
Clinical Situation	Possible Cause	Solution
INTENSITY ALERT or SVO2 DATA OUT OF RANGE message is displayed	■ Faulty catheter position within vessel.	■ Check for spontaneous wedge or balloon inflation; if present reposition the catheter.
	■ Clot over catheter tip.	■ Flush distal lumen.
	■ Loose connections between catheter optical connector and optical module.	■ Tighten the connections.
	■ Kinked or damaged fiber optics in catheter.	■ Replace the catheter.
INSUFFICIENT LIGHT message is displayed	■ Catheter exposed to room light during pre-insertion calibration.	■ No action required; status message only.
	■ Catheter is kinked.	■ Check the catheter.
	■ Faulty connection between catheter and optical module.	■ Fully insert the tip into the optical reference.
CALIBRATION REJECTED message is displayed	■ Faulty connection between catheter and optical module.	■ Reconnect.
	■ Optical module not warmed up.	■ Wait one minute and retry.
??? is displayed in place of SvO_2 value	■ Value out of range.	■ If optical module error message also is displayed, replace optical module.
	■ Poor light intensity.	■ Display light intensity history to verify.
	■ Pre-insertion calibration insufficient.	■ Perform in vivo calibration.

!

- *Catheters should be handled according to your hospital's protocol.*

Capnography Directory

Directory of Keys



- *Based on features purchased, more or fewer keys may appear here than on your menu screens.*

Capnography

Contents

Overview

The 90516 Ultraview Capnograph module is a mainstream gas analyzer, designed to measure the concentration of carbon dioxide in a gas mixture to aid in determining the patient's ventilatory, circulatory, and metabolic status. The capnograph module has a small, lightweight sensor that continuously measures the end-tidal and minimum CO_2 levels in the patient's airway. Respiration can be monitored via airway and endotracheal or tracheostomy tubes. Both adults and neonates can be monitored with this type of capnograph (using separate adult and neonatal airway adapters).

The sensor head contains a small infrared transducer that accurately measures the CO_2 in the airway. The sensor is connected to the airway by an airway adapter. These adapters may either be disposable or reusable and are available in adult and neonatal sizes.

The capnograph automatically compensates for the ambient barometric pressure to ensure accurate readings. A connector is included to allow measurement of O_2 in the airway using a fuel cell type O_2 sensor. A full calibration menu is provided to easily calibrate and use the O_2 sensor. A separate adapter is used for O_2 monitoring.

CAUTION:

- **Although the 90516 capnograph module detects and reports apnea conditions, it is not intended to be a primary diagnostic apnea monitor and/or apnea recording device.**
- **Use only Spacelabs Medical sensors with this monitor. Other sensors may plug in, but will not operate.**
- **Use only Spacelabs Medical airway adapters with Spacelabs Medical sensors. The monitor may not function if other airway adapters are used, and sensor damage may result.**
- **If the patient's airway is configured with a closed suctioning system, make sure the airway adapter is placed close to the suctioning system (on the ventilator side). This will help ensure that the sampling adapter is not impaired during and after suctioning.**
- **U.S. Federal law restricts this device to sale by or on the order of a physician.**

- *If your module is equipped with the Module Configuration Manager feature, you can define your own default settings for such characteristics as alarm limits and display configuration. Refer to Module Configuration Manager on page 7-5 for further details.*

Patient Connection

To start capnography monitoring:

1. Plug the module into the monitor.
2. Plug the sensor connector into the monitor.
3. Perform sensor calibration, if necessary.
4. Prepare the patient according to hospital procedures.
5. Select appropriate airway adapter (neonate or adult).
6. Verify that windows are clean and dry.
7. Place sensor head over the airway adapter and perform an adapter calibration, if necessary.
8. Remove the airway adapter from the sensor head.
9. Insert the airway adapter into the ventilator circuit and Ballard style tracheal suction system (if present) as shown in *Figure 21-1*.
10. Attach the sensor head to airway adapter.
11. Ensure that the sensor head is always positioned above the ventilator circuit so that moisture will not enter the adapter.

Respiration can be monitored via an endotracheal or tracheostomy tube.

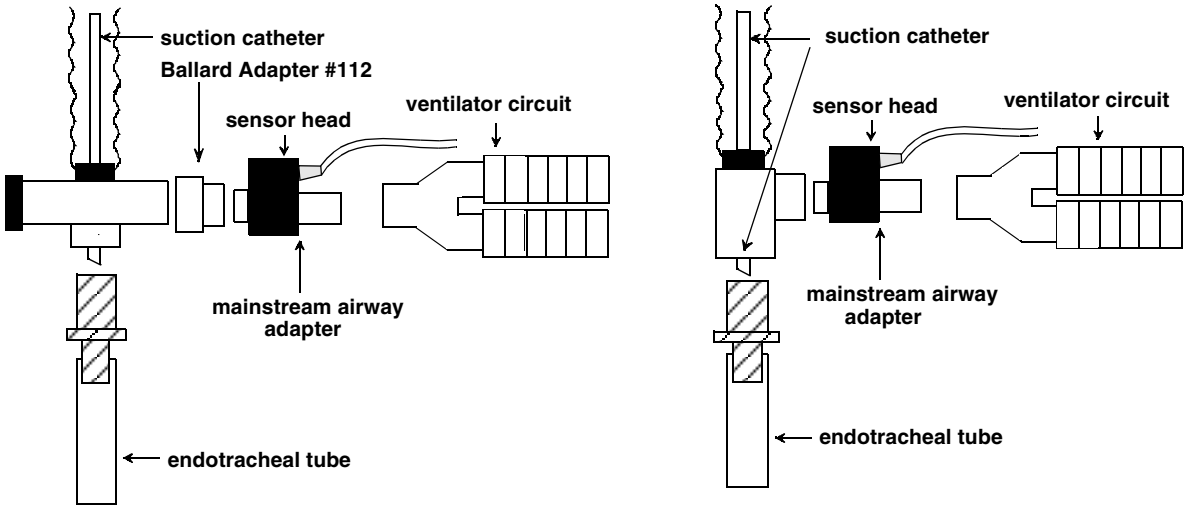
Mainstream capnography is a highly accurate method of measuring respiratory gas values. There are several variations of closed circuit tracheal suction systems that can be used with Spacelabs Medical capnography units. Spacelabs Medical recommends the Ballard style tracheal suction system.

Closed Circuit Tracheal Suction Systems

Closed circuit tracheal suction systems (such as those provided by Ballard) extend the life of the endotracheal tube and associated tubing by allowing the endotracheal tube to be periodically suctioned without detaching it from the ventilator circuit. Spacelabs Medical recommends use of Ballard Model #221 elbow closed tracheal suction systems, or similar systems, with Spacelabs Medical capnography units. Such a system allows the Spacelabs Medical airway adapter to be placed outside the tube through which fluids are being suctioned, reducing the chance of occluding the airway.

Spacelabs Medical does not recommend use of traditional setups that require the airway adapter to be in line with the endotracheal tube. However, if you prefer a traditional setup such as the Ballard Model 2205 style, using the Ballard Model 112 adapter moves the airway adapter away from the suction catheter.

Figure 21-1 shows examples of setups using the Ballard Model #221 and Model 2205 style (with Model 112 adapter). Similar closed systems, such as the Concord Portex (not shown), must be placed in the ventilator circuit in the same positions as shown in *Figure 21-1*.



Ballard closed tracheal suction system with adapter (Model 2205/Adapter #112)

or

Ballard elbow closed tracheal suction system (Model 221)

Figure 21-1: Ballard setups

When you first power on the module, the GAS parameter key is displayed adjacent to a flat waveform.

- *Capnography is not analyzed during unit warm-up.*
- *The typical initial warm-up period is 2- to 5-minutes (5-minutes is the maximum warm-up time). This time varies based upon the temperature of the sensor.*
- *The capnograph is protected against the effects of a cardiac defibrillation discharge and is safe to use on patients with a cardiac pacemaker or other electrical stimulation.*
- *The airway adapter may require regular cleaning or replacement if the capnograph is used on patients that emit excessive mucous.*

Display Detail

When you connect the capnography device to a monitor, the waveform area is displayed in one of four formats, the large and small text formats in normal or view alarms modes. Instructions for choosing a format are detailed later in this manual.

The full screen, large text format is the default display for bedside monitors. The full screen, small text format in VIEW ALARMS is the only display format for the full screen remote view monitors. The split screen central format is available only for central monitors operating in split screen mode. Refer to *Figure 21-2* through *Figure 21-6*.

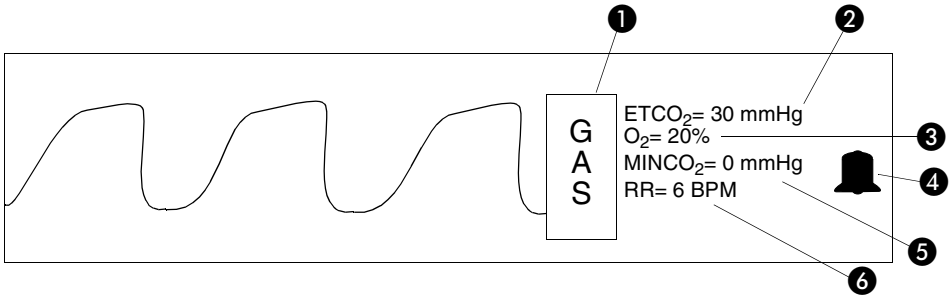


Figure 21-2: Bedside screen in small text (waveform ON)

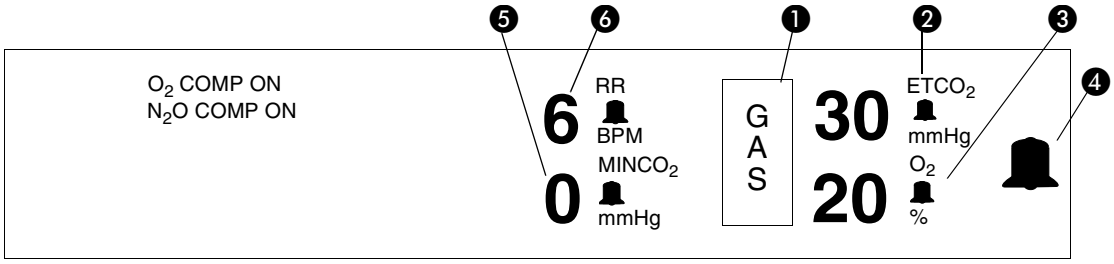


Figure 21-3: Bedside screen in large text (waveform OFF)

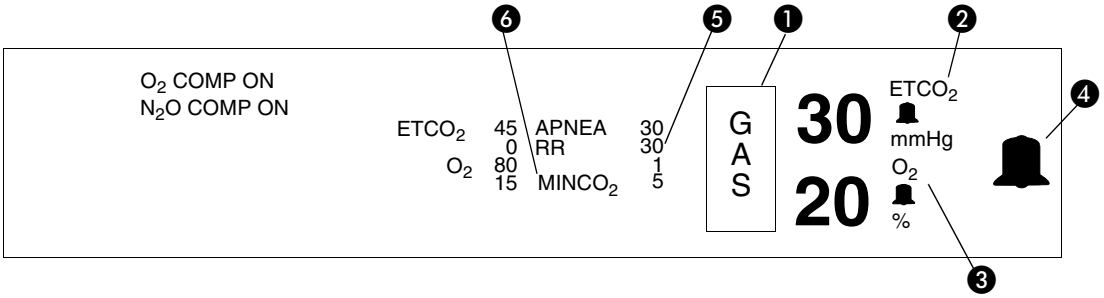


Figure 21-4: Bedside screen in large text during View Alarms (waveform OFF)

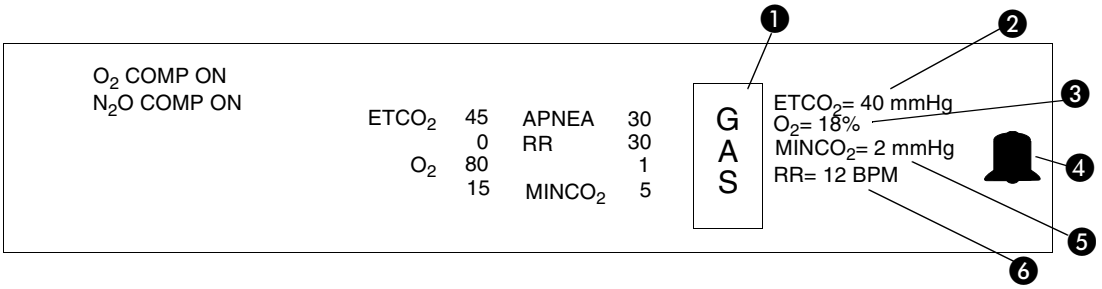


Figure 21-5: Full remote view (waveform OFF)

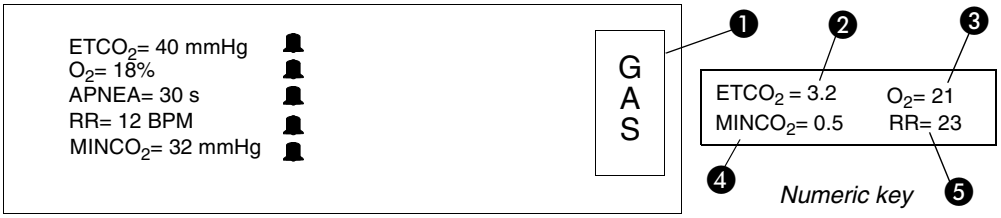


Figure 21-6: Split screen

1. GAS key
2. End tidal carbon dioxide data
3. Oxygen data
4. Alarms ON bell (refer to *Table 1*)
5. Minimum inspired carbon dioxide data
6. Respiratory rate

Table 1: Alarm Status and Display

Alarm Status	Bell Display
At least one alarm ON	Present
At least one alarm ON and violated	Flashing
All alarms OFF	Replaced with GAS ALM OFF in reverse video
At least one alarm ON; alarms temporarily suspended by monitor	Replaced with GAS ALM SUSP in reverse video (flashes if any alarm is violated)

Setting Alarm Limits

To set gas alarm limits:

1. Touch GAS.
2. Touch ALARM LIMITS.
3. Select the parameter for which you wish to set alarm limits.
4. Touch ON for the parameter selected in step 3.
5. Select the HI=, LO=, or APNEA= alarm.
6. Use the arrow keys to set the high and/or low alarm limits or the apnea alarm delay time.
7. Touch PREVIOUS MENU to select another parameter for setting alarm limits.
8. Repeat steps 3 through 7 until all limits are set.

You can set high and low alarm limits for respiratory rate (RR), $EtCO_2$, O_2, minimum CO_2 (high limit only), and the apnea alarm delay time.

When alarm limits for $EtCO_2$ and RR are initially enabled, the limit values depend upon the patient's current readings for those parameters (these limit values are learned). Alarm limits for all other monitored parameters, when enabled; always have the same fixed values.

You can modify limits for any of the monitored parameters. Factory-set default values appear for alarm limits when you initially power up the unit. Factory default settings and ranges for alarm limits are shown on the table below. Refer to *Alarms* on page 2-3 for additional information on alarms.

!

- *The VIEW ALARMS format with small text selected is the default display for all full screen remote. In this format, all text is cleared from the waveform zone and the labels and alarm limits of respiratory rate, $EtCO_2$, O_2, minimum CO_2, and apnea are displayed. The VIEW ALARMS screen is the only format that displays the alarm limits.*

Table 2: Alarm Limit Ranges

Monitored Parameter	Units	Low Alarm			High Alarm			Resolution
		Minimum	Default	Maximum	Minimum	Default	Maximum	
$EtCO_2$	%	0.0	**	9.9 *	0.1	**	10.0 *	0.1
$EtCO_2$	mmHg	0	**	75	1	**	76	1
$EtCO_2$	kPa	0.0	**	9.9	0.1	**	10.0	0.1
RR	BPM	1	**	145	15	**	150	1 for 1 — 30 5 when > 30
APNEA	sec	-	-	-	20	30	45	5
$MINCO_2$	%	-	-	-	0.1	1.0	9.9	0.1
$MINCO_2$	mmHg	-	-	-	1	8	76	1
$MINCO_2$	kPa	-	-	-	0.1	1.0	9.9	0.1
O_2	%	15	18	95	20	100	100	1 for 1 — 30 5 when > 30

* The current barometric pressure measurement affects the maximum high and low alarm limits for $EtCO_2$ when measured in %.

** Learned Alarm Limits

The respiration rate alarm limits default as shown below:

Condition	Limit
RR ≤ 12	LO = 1 BPM
RR > 12	LO = RR* 0.5 (truncated to the next lower resolution)
RR ≤ 20	HI = 30 BPM
RR > 20	HI = RR* 1.5 (rounded to the next higher resolution)

The $EtCO_2$ high alarm limit defaults to the displayed value + 15% and is rounded to the next higher resolution, when needed.

The $EtCO_2$ low alarm limit defaults to the displayed value – 15% and is truncated to the next lower resolution, when needed.

- *If the current $EtCO_2$ reading is 0 when the alarms are first turned ON, special $EtCO_2$ limits are defined. If mmHg is selected, the high and low limits are set to 0 and 1, respectively. If % or kPa is selected, the high and low limits are set to 0.0 and 0.1, respectively.*

Adjusting the Waveform Size

To adjust the waveform scale size:

1. Touch GAS.
2. Touch SETUP.
3. Touch SIZE.
4. Select the desired scale.

The capnography waveform can appear on your monitor in three scale sizes: 0 to 40 mmHg (0 to 5.3 kPa), 0 to 60 mmHg (0 to 8.0 kPa), or 0 to 80 mmHg (0 to 10.7 kPa).

Turning the Waveform Display On/Off

To turn the waveform display ON or OFF:

1. Touch GAS.
2. Touch SETUP.
3. Touch SIZE.
4. Select WAVEFORM ON or OFF.

You can turn the capnography waveform ON or OFF.

Selecting a Unit of Measure

To select a measurement unit:

1. Touch GAS.
2. Touch SETUP.
3. Select PERCENT or mmHg (kPa).

You can monitor capnography values as a percentage or with the monitor's selected units of measurement for pressures (mmHg or kPa).

Selecting a Sweep Speed

To select a sweep speed:

1. Touch GAS.
2. Touch SETUP.
3. Touch SWEEP SPEED.
4. Select desired sweep speed.

You can view capnography waveforms at any of the following sweep speeds: 25, 12.5, 6.25, 3.12, or 1.56 mm/second.

Respiration Tone

To turn tone OFF:

1. Touch GAS.
2. Touch SETUP.
3. Touch RESP TONE.
4. Select RESP TONE OFF.

To adjust the tone volume:

1. Touch GAS.
2. Touch SETUP.
3. Touch RESP TONE.
4. Select RESP TONE ON.
5. Use arrow keys to adjust the volume.

You can turn the respiration cycle tone ON or OFF, and adjust the volume of the respiration cycle tone that sounds at the peak of the respiration cycle.

Selecting a Text Format

To switch text formats:

1 Touch GAS.
2 Touch SETUP.
3 Select LARGE TXT or SMALL TXT.

You can change display formats for capnography by switching between large and small text (refer to *Display Detail* on page 21-6).

Freezing the Waveform

To freeze the gas waveform:

1 Touch GAS.
2 Select FREEZE ON.

You can freeze the waveform display at any time. The waveform stays frozen until you press the FREEZE ON/OFF key again or until you press the NORMAL SCREEN key.

Recording Waveforms

To print gas waveforms:

1 Touch RECORD.
2 Touch flashing GAS parameter. key.

You can print Capnography waveforms and values. Refer to *Printing* on page 4-7 for additional information.

Calibrating the Sensors

Calibrating O_2

To calibrate O_2 using room air

1 Touch GAS.
2 Touch CAL.
3 Touch O2CAL.
4 Disconnect O_2 cell and touch ZERO.
5 Reconnect O_2 cell.
6 Ensure that O_2 cell is in room air
7 Wait for the O_2 reading to stabilize.
8 Touch ROOM O2 SPAN.

A ZERO calibration establishes baseline values for the oxygen channel. You are prompted to perform a ZERO calibration if it is required.

! • *To minimize patient disruptions, perform O_2 zero and span procedures before the O_2 adapter is placed in the ventilator circuit.*

A room O_2 span calibration calibrates the oxygen sensor using room air.

To calibrate O_2 by performing a 100% O_2 span

1 Touch GAS.
2 Touch CAL.
3 Touch O2 CAL.
4 Flow 100% O_2 through the O_2 airway adapter and wait for O_2 readings to stabilize.
5 Touch 100% O2 SPAN.

A 100% O_2 span calibration sets the level for oxygen so that the display reads 100% when pure oxygen is input to the unit. For improved accuracy, a 100% O_2 span calibration should be performed whenever the patient is receiving more than 60% O_2.

! • *Authorized service personnel also use the 100% O_2 span calibration to calibrate the oxygen sensor's response to 100% O_2.*

Calibrating the Airway Adapter

To calibrate the airway adapter:

1. Touch GAS.
2. Touch CAL.
3. Select appropriate airway adapter (neonate or adult).
4. Place sensor head over the airway adapter.
5. Place the sensor and adapter away from all sources of CO_2.
6. Touch ADAPTER CAL.
7. Touch START.

Adapter calibration compensates for the optical differences between the adult and neonatal airway adapters. Adapter calibration needs to be performed each time you switch from an adult airway adapter to a neonatal airway adapter.

- *During calibration, keep the sensor and airway adapter away from all sources of CO_2 (including the patient's and your own exhaled breath, and ventilator exhaust valves).*

Calibrating the CO_2 Sensor

To calibrate the CO_2 sensor:

1. Remove the airway adapter from the sensor head (if present).
2. Place the sensor on the zero cell.
3. When the message ZERO CAL COMPLETE appears, remove the sensor from the zero cell and place it on the reference cell.
4. When the message CALIBRATION VERIFIED appears, remove the sensor from the reference cell (An airway adapter calibration may be required).
5. Sensor is ready for use.

The CO_2 sensor does not require calibration at each power up. Calibration is only necessary the first time the sensor is connected, or when a CAL REQUIRED message is displayed.

Once calibrated, the sensor can be unplugged and reconnected without being recalibrated. However, a sensor calibration is required whenever the CO_2 sensor is changed.

- *To maintain optimum performance of the sensor and capnograph, you should perform a calibration verification of the sensor at least once a week.*

To verify the sensor calibration:

1. Remove the airway adapter from the sensor head (if present).
2. Place the sensor on the reference cell.
3. When the message CALIBRATION VERIFIED appears, remove the sensor from the reference cell (An airway adapter calibration may be required).
4. Sensor is ready for use.

Selecting Gas Compensation

To select gas compensation:

1. Touch GAS.
2. Touch COMP.
3. Select N2O ON, if N_2O is greater than 50%.
4. Touch O2 AUTO to automatically select COMP, if O_2 cell is present.
5. Select O2 MAN, if no O_2 cell is present.
6. Select O2 ON, if O_2 is greater than 60%.

The measurement of CO_2 by infrared analysis is affected by the presence of oxygen and nitrous oxide. The module must be set up with the appropriate compensations turned on in order to obtain accurate end-tidal CO_2 readings when increased levels of O_2 (greater than 60%), or N_2O (greater than 50%) are present in the airway.

- *High concentrations of O_2 will cause a lower than expected CO_2 reading.*
- *High N_2O level will cause a higher than expected CO_2 reading.*

Restoring Default Settings

To restore default settings:

1. Touch GAS.
2. Touch SETUP.
3. Touch RESTORE SETTINGS.
4. Select YES.

With the Module Configuration Manager feature, you can restore all default settings. User-configurable options are listed in *Setting User-Defined Default Values* on page 7-7.

Capnography Troubleshooting Guide

The capnography module displays error messages in the gas waveform zone. Many of these messages also trigger an alarm. If the menu line is available, the monitor displays messages there as well. The table below provides the text, meaning and suggested response to these messages.

Problem or Message	Probable Cause(s)	Suggested Response	Alarm Sounds
SERVICE REQUIRED - Send for repair	■ Incompatible or faulty sensor. ■ Barometric pressure reading error. ■ Module self-test failure.	■ Return to factory for repair or use compatible sensor.	■ Yes
SENSOR OVER TEMPERATURE	■ Sensor is exposed to extreme heat.	■ Remove the excessive heat source from the sensor. If problem persists, return to factory for repairs.	■ Yes
WARMING UP	■ Module or sensor was just plugged in.	■ Allow 2- to 5-minutes to warm up.	■ No
PLACE ADAPTER IN RM AIR	■ The adapter calibration menu is accessed.	■ Either place the sensor head and the airway adapter in room air and start an airway adapter calibration, or leave the adapter calibration menu.	■ No
ADAPTER CAL IN PROGRESS	■ An airway adapter calibration sequence is in progress.	■ Wait until adapter calibration is completed and message goes away.	■ No
ADAPTER CAL ERROR - Perform adapter calibration	■ An error was found during the airway adapter calibration.	■ Place the sensor head and the airway adapter in room air and away from any source of CO_2 and perform an airway adapter calibration. If the problem persists, return to factory for repairs.	■ Yes
NOT CALIBRATED - Place adapter in room air	■ An airway adapter calibration was started, but either the sensor was not ready, or the sensor was on the zero or reference cell, or some CO_2 or a breath has been detected in the last 20-seconds.	■ Place the sensor head and the airway adapter in room air and away from any source of CO_2 and perform an airway adapter calibration. If problem persists, return to factory for repairs.	■ Yes

Problem or Message	Probable Cause(s)	Suggested Response	Alarm Sounds
ADAPTER ERROR - Check airway adapter	■ Airway adapter was removed from the sensor head.	■ Snap airway adapter back into the sensor head.	■ Yes
	■ Optical blockage on airway adapter windows.	■ Clean or replace the airway adapter.	■ Yes
	■ Adapter calibration was not performed.	■ Perform an airway adapter calibration.	■ Yes
CO2 CAL IN PROGRESS	■ A zero calibration of the CO_2 sensor is in progress.	■ Wait for the message ZERO CAL COMPLETE to appear.	■ No
ZERO CAL COMPLETE - Place sensor on REF cell	■ A zero calibration of the CO_2 sensor was completed successfully.	■ Remove the sensor head from the zero cell and place it over the reference cell.	■ No
CO2 ZERO CAL ERROR - Perform zero calibration	■ An error was found during the sensor zero calibration	■ Perform a zero and a reference calibration. If the problem persists, return sensor to factory for repairs.	■ Yes
SENSOR ERROR - CO_2 zero cal required	■ A drift of the source current is detected since the last time that the sensor was either plugged in or zeroed.	■ Perform a zero and a reference calibration. If the problem persists, return sensor to factory for repairs.	■ Yes
CHECKING CALIBRATION	■ A span or reference calibration of the CO_2 sensor is in progress.	■ Wait for the CALIBRATION VERIFIED message to appear.	■ No
CALIBRATION VERIFIED - Remove sensor from cell	■ A reference calibration of the CO_2 sensor was completed successfully.	■ Remove the sensor head from the reference cell and place it over the airway adapter.	■ No

!

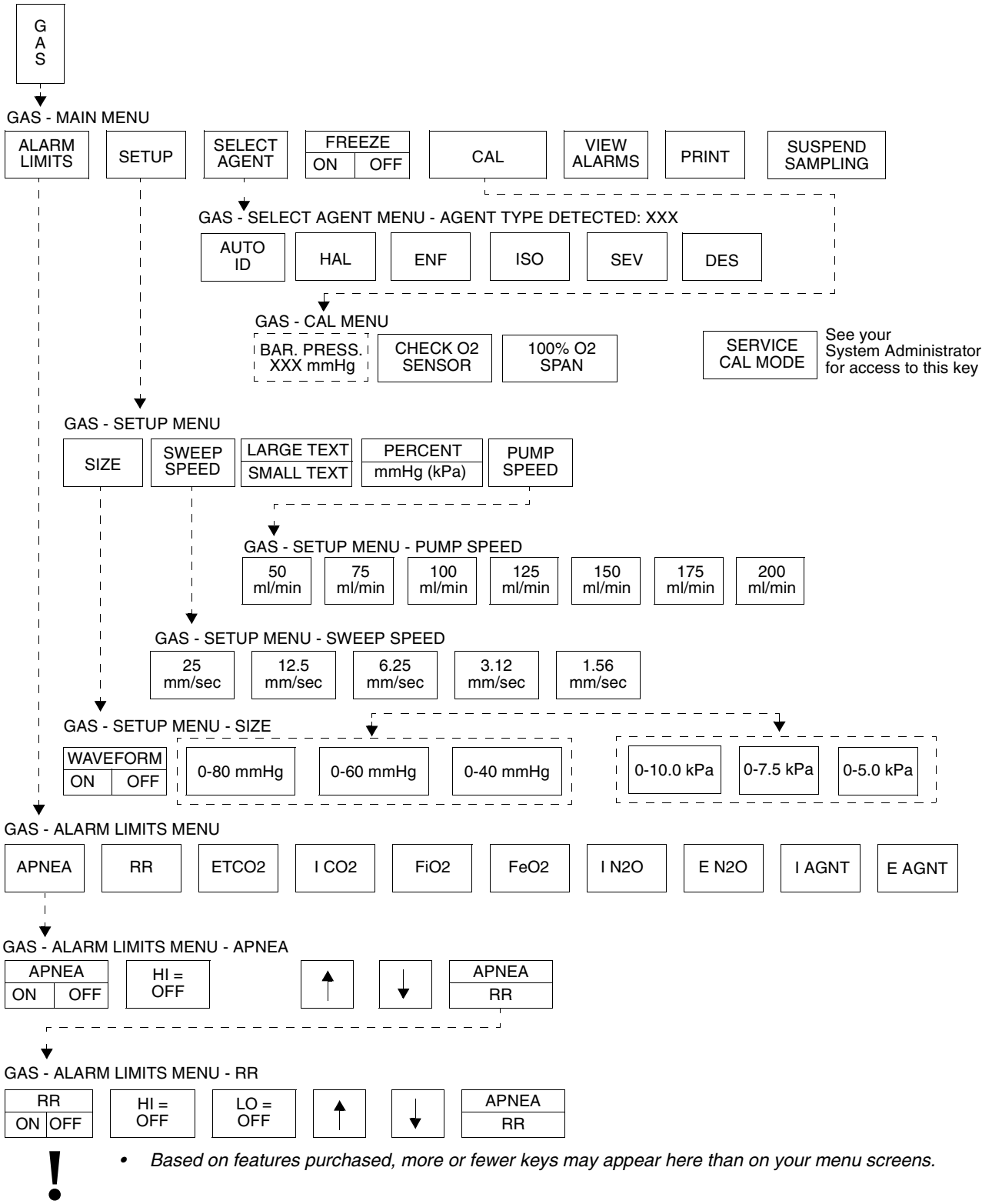
- *The unit does not analyze patient data while the monitor displays the above messages.*

Problem or Message	Probable Cause(s)	Suggested Response	Alarm Sounds
Low or high CO2 values are observed	■ An airway adapter and/or sensor calibration is needed.	■ Perform a zero and a reference calibration, make sure an appropriate airway adapter is selected, and perform an airway adapter calibration. If problem persists, return to factory for repairs.	■ No
ADAPTER CALIBRATION ABORTED	■ The airway adapter calibration was aborted by the user.	■ Wait for the message to go away.	■ No
O2 ZERO COMPLETE	■ The zero calibration of the O_2 sensor was completed successfully.	■ Wait for the message to go away.	■ No
O2 ZERO REJECTED	■ O_2 cell was connected during zero.	■ Disconnect O_2 cell and repeat the O_2 zero.	■ No
21% O2 SPAN COMPLETE	■ The span calibration of the O_2 sensor in room air was completed successfully.	■ Wait for the message to go away.	■ No
O2 SPAN REJECTED - Span value out of range	■ O_2 cell was not functioning during the room O_2 span.	■ Replace O_2 cell perform room O_2 span. If problem persists, return to factory for repairs.	■ No
	■ O_2 cell was not in room air.	■ Place the O_2 sensor in room air and away from any source of higher level oxygen and perform room O_2 span. If problem persists, return to factory for repairs.	■ No
100% O2 SPAN COMPLETE	■ The span calibration of the O_2 sensor using 100% oxygen was completed successfully.	■ Wait for the message to go away.	■ No
100% O2 SPAN FAILED - O2 cell bad or 100% O2 not present	■ O_2 cell is wearing out.	■ Replace O_2 cell and perform 100% O_2 span. If problem persists, return to factory for repairs.	■ No
	■ 100% oxygen was not present in the O_2 sensor airway adapter.	■ Make sure 100% O_2 is present in the O_2 sensor airway adapter and perform 100% O_2 span. If problem persists, return to factory for repairs.	■ No

Problem or Message	Probable Cause(s)	Suggested Response	Alarm Sounds
O2 SPAN REQUIRED - Perform a ROOM O2 SPAN	■ O_2 cell requires new span when initially plugged in.	■ Place the sensor in room air and away from any source of oxygen and perform room O_2 span. If problem persists, return to factory for repairs.	■ No
	■ A drift in the O_2 cell output voltage level was detected.	■ Place the sensor in room air and away from any source of oxygen and perform room O_2 span. If problem persists, return to factory for repairs.	■ No

Multigas Directory

Directory of Keys



- *Based on features purchased, more or fewer keys may appear here than on your menu screens.*

Multigas

Contents

Overview

The Spacelabs Medical Multigas Analyzer simultaneously monitors gas concentrations and alerts clinical personnel when the concentration of anesthetic agents, oxygen, carbon dioxide, or nitrous oxide falls outside of defined limits. The anesthetic agent being administered is automatically identified.

The analyzer is for use primarily in the operating room, but can be used with any Ultraview monitor.

Although the analyzer sounds an alarm when the duration between monitored breaths exceeds user-defined limits, it is not intended to be a primary diagnostic apnea monitor and/or recording device.

Warnings and Cautions

Warnings

The life or health of a patient, clinical staff member, multigas analyzer operator, or other persons may be endangered if the items in this Warnings section are not followed.

WARNING:

- ***Always test the sampling line adapter for a tight connection and proper operation before attaching to a patient.***
- ***To protect the patient's safety, do not silence, suspend, or disable audible alarms without providing continuous, direct observation of the patient.***
- ***Connect the sample gas outlet on the monitor's rear panel to the scavenging system to prevent pollution of the room air.***
- ***Always turn the power off and unplug the analyzer before cleaning to protect against electrical shock.***
- ***To avoid explosion hazards, flammable anesthetic agents such as ether and cyclopropane must not be used in the analyzer.***
- ***Only halothane (HAL), enflurane (ENF), isoflurane (ISO), sevoflurane (SEV), and desflurane (DES) are suitable for use with the analyzer. If any other halogenated anesthetic agent is present, it will be misidentified and/or will interfere with the reported anesthetic agent concentrations.***
- ***The use of antistatic or electrically conductive breathing tubes when using high-frequency electrosurgery equipment may increase the risk of burns and is, therefore, not recommended in any application of this anesthetic monitor.***
- ***The analyzer is not intended for use in an MRI environment.***

Cautions

Equipment may be damaged or cease to function properly if the items in this Cautions section are not followed.

CAUTION:

- **When administering anesthetic agents, incorrect agent identification may occur when a mixture of two or more anesthetic agents occurs in the sample circuit.**
- **Always verify your vaporizer setting when administering anesthetic agents.**
- **Use only original Spacelabs Medical sampling lines and accessories; other sampling lines may cause inaccurate readings and malfunctions.**
- **The diameter of the scavenging system line must be two to three times larger than the sample line tubing to avoid changes in the operating pressure of the monitor, and consequential inaccurate readings or internal damage.**
- **Route the scavenger hose so that it does not kink during operation of the monitor. A kinked or partially kinked scavenger hose can impair performance of the monitor.**
- **If the patient's airway is configured with a closed suctioning system, the airway adapter must be placed near the suctioning system (on the ventilator side). This helps to ensure that the sampling adapter is not impaired during and after suctioning.**
- **Do not use cellular phones or other wireless communications equipment near the analyzer.**

- *Check the disposable water trap regularly during monitoring. Replace the water trap when full.*
- *Between patients, replace the sampling line and check the disposable water trap. Replace the water trap when full.*
- *The Spacelabs Medical sampling lines are for single-patient use only. Cleaning deteriorates the properties of the sampling line, resulting in slower response time and more frequent occlusions*
- *Before you administer nebulized drugs to a patient that is connected to the multigas analyzer, you must disconnect the sample line from the patient or stop the pump by using the SUSPEND SAMPLING key.*
- *To facilitate disconnecting and reconnecting the sample line, use a T-connector in the patient airway circuit and keep the sampling suspended, until all nebulized drugs have cleared from the patient's airway.*

Analyzer Controls and Indicators

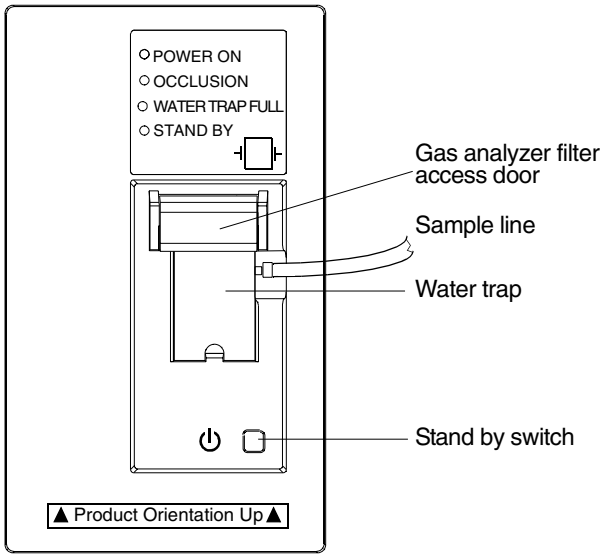


Figure 22-1: Analyzer front panel controls and indicators

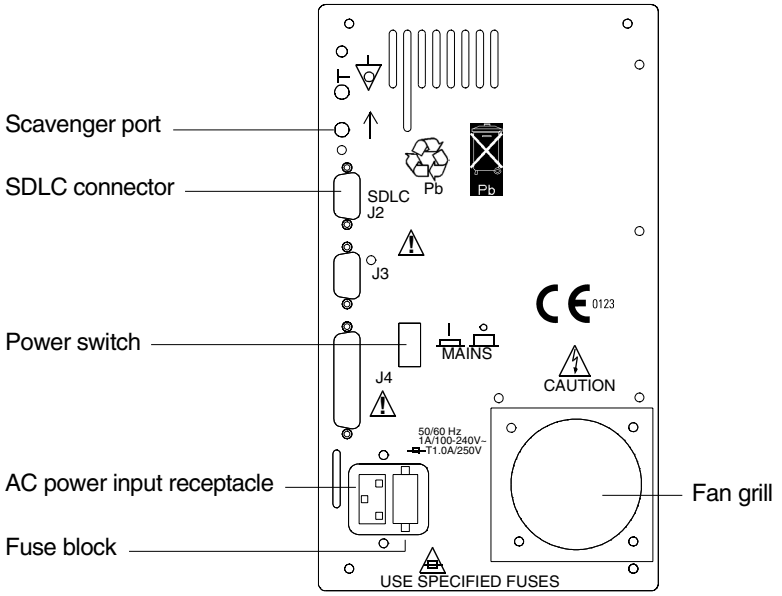


Figure 22-2: Analyzer rear panel controls and indicators

Multigas Setup

To connect the multigas analyzer:

1. Verify that the power cord is connected as required by local standards.
2. Assemble the cables necessary for the desired configuration. (Refer to *90518 Multigas Analyzer Service Manual*, *P/N 070-0643-xx*.)
3. Connect the T-cable assembly between the multigas analyzer and the monitor.
4. Connect the SDLC terminator to the T-cable.
5. Connect the hospital scavenging system to the scavenger port.

Before you put the unit into service, it must be unpacked and the exterior inspected for visible damage. A biomedical technician or an authorized Spacelabs Medical customer service representative should inspect the interior and exterior of the analyzer for signs of visible damage. Instructions for these procedures are in the *90518 Multigas Analyzer Service Manual (P/N 070-0643-xx)*.

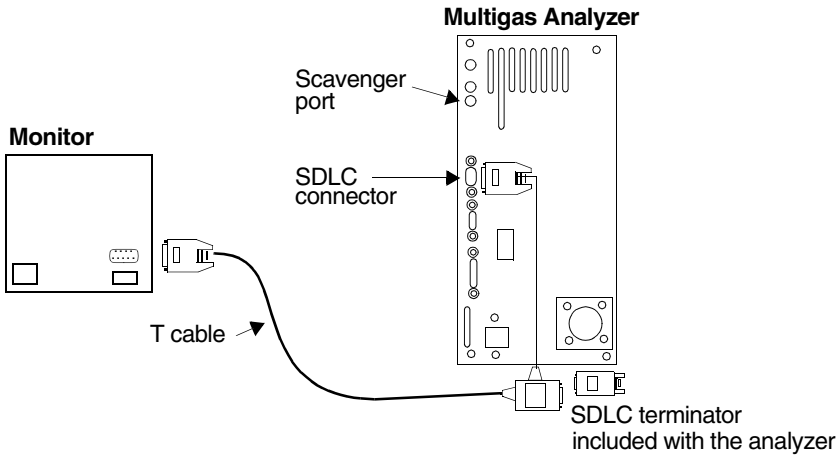


Figure 22-3: Monitor connection

CAUTION:

- **The diameter of the scavenging system line must be two to three times larger than the sample-out tubing to avoid changes in the operating pressure of the monitor, and consequential inaccurate readings or internal damage.**
- **Route the scavenger hose so that it does not kink during operation of the monitor. A kinked or partially kinked scavenger hose can impair performance of the monitor.**

To start multigas monitoring when the unit is OFF:

1. Plug the device power cord into an AC power outlet and assure that the unit is connected to a monitor.
2. If not present, insert the gas analyzer filter above the water trap and close the lid.
3. If not present, insert the water trap with the patient connector on the right side.
4. Check to make certain the Stand By switch is OFF (in the “out” position).
5. Turn power to patient monitor ON.
6. Turn power to gas analyzer ON (ON/OFF switch on back of unit).
7. Prepare the patient according to hospital procedures.
8. Allow the analyzer to warm up for a minimum of 2-minutes. Full accuracy is achieved after 30-minutes.
9. Connect one end of the gas sample line to the gas sampling tee or breathing circuit and connect the other end to the water trap luer connection.
10. Check for a good seal at the top of the water trap.
11. During the use of anesthetic agents, ensure that the scavenge line connects to the scavenger port on the multigas analyzer's rear panel.

Patient Connection

Respiration can be monitored via a nasal cannula, an oxygen mask, or an airway and endotracheal or tracheostomy tube. There are several variations of closed circuit tracheal suction systems that can be used with Spacelabs Medical multigas units.

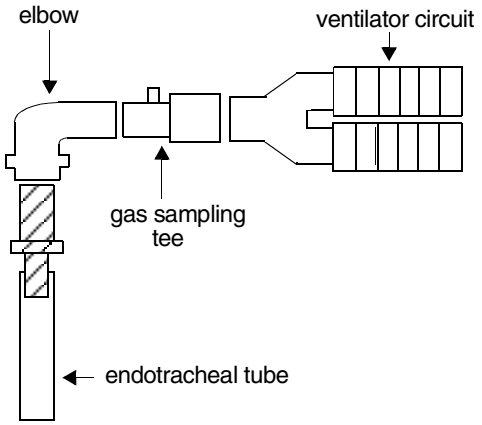


Figure 22-4: Example of sidestream multigas setup for an adult

The sample line must be connected to the disposable water trap and patient circuit. Connect the line to the water trap prior to the insertion of the water trap onto the analyzer to protect the sample port.

CAUTION:

- **If the multigas analyzer is powered on before the patient monitor, communication might not be initiated. Make sure the patient monitor is powered on first.**
- **Use only original Spacelabs Medical sampling lines and accessories. Other sampling lines may cause inaccurate readings and malfunctions. The analyzer must use a sample line that is fabricated from a special material. Use of other sample lines results in erroneous readings. This sample line is color-coded as blue and is available from Spacelabs Medical.**
- **If you use the multigas analyzer with setups that do not include the Spacelabs Medical approved gas analyzer filters, and service inspection determines that patient fluids have contaminated the unit, your warranty will be nullified.**

- *Use the filtered gas sampling tee when you operate the analyzer on patients that emit excessive mucous. This prevents patient fluids from clogging the sample line.*

Prior to connecting to the patient airway, verify that there are no leaks in the sample line, water trap, and gas analyzer filter by sealing the end of the sample line with your thumb. After approximately 15-seconds, the Occlusion LED lights and an occlusion message appears on the monitor. If this does not occur within 30-seconds, check for an air leak by removing and carefully reinstalling the water trap, the gas analyzer filter, and/or the sample line. Repeat the test.

WARNING:

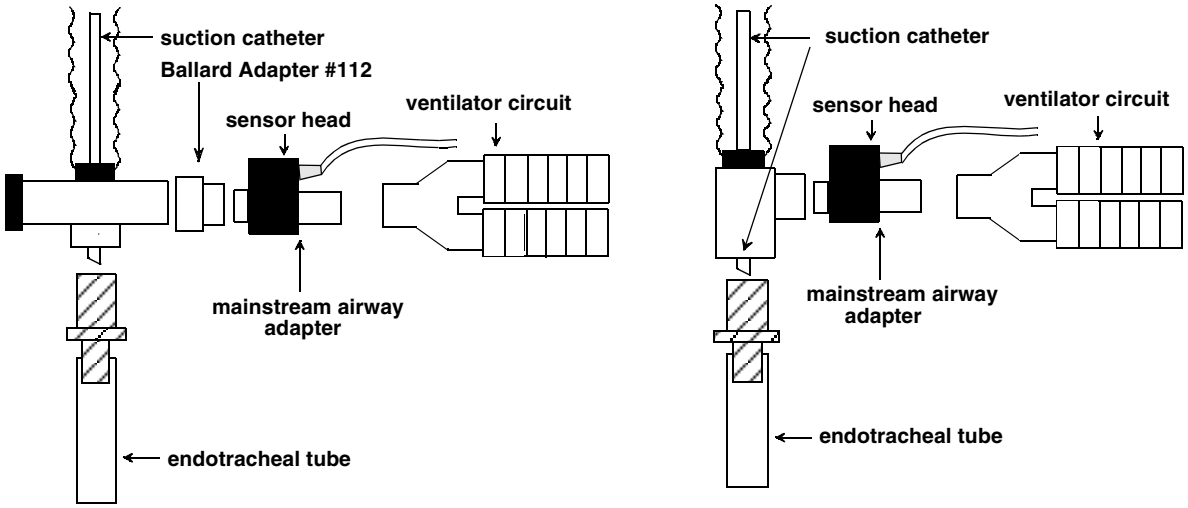
- ***Always test the sampling line adapter for a tight connection and proper operation before attaching to a patient.***

Closed Circuit Tracheal Suction Systems

Closed circuit tracheal suction systems (such as those provided by Ballard) extend the life of the endotracheal tube and associated tubing by allowing the endotracheal tube to be periodically suctioned without detaching it from the ventilator circuit. Spacelabs Medical recommends use of Ballard Model #221 elbow closed tracheal suction systems, or similar systems, with Spacelabs Medical capnography units. Such a system allows the Spacelabs Medical airway adapter to be placed outside the tube through which fluids are being suctioned, reducing the chance of occluding the airway.

Spacelabs Medical does not recommend use of traditional setups that require the airway adapter to be in line with the endotracheal tube. However, if you prefer a traditional setup such as the Ballard Model 2205 style, using the Ballard Model 112 adapter moves the airway adapter away from the suction catheter.

Figure 22-5 shows examples of setups using the Ballard Model #221 and Model 2205 style (with Model 112 adapter). Similar closed systems, such as the Concord Portex (not shown), must be placed in the ventilator circuit in the same positions as shown in *Figure 22-5*.



Ballard closed tracheal suction system with adapter (Model 2205/Adapter #112)

or

Ballard elbow closed tracheal suction system (Model 221)

Figure 22-5: Ballard setups

Operation

CO_2, N_2O, and anesthetic agents are measured by drawing a sample gas stream into the measuring chamber. The absorption of different infrared light wavelengths is measured here. These measurements are compared to a zero concentration light level to calculate the different gas concentrations.

WARNING:

- ***If any halogenated anesthetic agent other than halothane, enflurane, isoflurane, sevoflurane, or desflurane is present, it will be misidentified and/or will interfere with the reported anesthetic agent concentrations.***

CAUTION:

- **When administering anesthetic agents, incorrect agent identification may occur when a mixture of two or more anesthetic agents occurs in the sample circuit.**
- **Always verify your anesthetic vaporizer setting when administering anesthetic agents.**

Oxygen concentration is measured using the micro-fuel cell sensing technology. During the sensing process, the oxygen molecules in the sampled gas diffuse through the sensing membrane and become reduced at the sensing electrode, creating a current signal. The current signal is proportional to the oxygen partial pressure in the sampled gas. The fast response of the oxygen measurement is achieved by combining a unique design of the pneumatic sampling system, fast sensing membrane, and state-of-the-art signal processing electronics. Because this method of measurement has a fast response time, inspired and expired values of O_2 can be reported. This method of O_2 measurement requires periodic replacement of the sensor. The user must perform routine calibration checks to determine when replacement is needed. Refer to *Initiating a Calibration* on page 22-19 for further details.

The analyzer uses a side-stream sampling technique to acquire respiratory gases from an endotracheal tube, nasal cannula, or mask. A constant-flow vacuum system maintains the flow rate through the sample line.

The analyzer is equipped with an external water trap to prevent humidity, water drops, and patient secretions from contaminating the unit or affecting the accuracy of the gas measurements. The water trap collects water drops that condense in the sample line. A “Water Trap Full” indicator warns you that the water trap should be replaced. The analyzer is also equipped with a filter as a second line of defense in case the water trap overflows or nebulized drugs are accidently drawn into the sample line. After the gas sample passes through the water trap and filter, it passes through a Nafion tube that is inside the analyzer. This helps to equalize the humidity of the gas sample so that it is close to the humidity of ambient air.

CAUTION:

- **The analyzer cannot be operated without a water trap and a gas analyzer filter installed.**
- **Replace the water trap and gas analyzer filter as needed. Verify the water trap is not broken as a result of connecting the sample line fitting too tightly or by tugging on the sample line. To verify, place a finger over the end of the sample line and wait for the alarm. Check the sample line connection on the water trap for damage. A broken water trap results in low values due to room air entrainment. If a span calibration is performed with a broken water trap, patient values will be unusually high. Refer to *Initiating a Calibration* on page 22-19 and *Replacing the Gas Analyzer Filter* on page 22-12 for details.**

- *Check the disposable water trap regularly during monitoring. Replace the water trap when full.*
- *Between patients, replace the sampling line and check the disposable water trap. Replace the water trap when full.*

The analyzer automatically compensates for the ambient barometric pressure to ensure accurate readings. Both CO_2 values may appear in partial pressure (in mmHg or kPa) or in percent.

$$\% \text{ Gas} = \frac{\text{PARTIAL PRESSURE GAS}}{\text{BAROMETRIC PRESSURE}} \times 100\%$$

- *Respiration rate and alarm limit accuracies are not specified above 100 breaths per minute.*

Powering ON the Unit

Before powering the multigas analyzer ON, make sure it is attached to a patient monitor and the Stand By switch on the gas analyzer is OFF (in the “out” position). Press POWER ON/OFF located on the rear panel of the analyzer. The patient monitor must be powered on prior to powering on the analyzer.

When you first power ON a properly installed multigas device, the green power-on LED lights within 5-seconds. Within 30-seconds the patient monitor displays the vertical GAS parameter key adjacent to a flat waveform.

If this does not occur, verify that the POWER ON/OFF button is pressed and appears green, and that the front panel STAND BY button is not pressed. The analyzer must be connected to an AC power outlet. Verify that the appropriate SDLC cable and terminator are connected from the unit to the monitor (refer to the *90518 Multigas Analyzer Service Manual, P/N 070-0643-xx*). If the monitor or the module housing has a SDLC switch, check that the switch is in correct position (refer to the operations manual for the monitor or module housing). If the GAS parameter key does not display on the monitor, turn the power to the analyzer OFF, then turn the power to the monitor OFF. Power ON the monitor again, and then power on the analyzer again.

- *The analyzer is protected against the effects of a cardiac defibrillation discharge, and it is safe to use on patients with a cardiac pacemaker or other electrical stimulation.*

No multigas analyzer data appears during the warm-up period following power-on. Data first appears during the stabilization period.

CAUTION:
- **The warm-up period is less than 2-minutes with full accuracy after 30-minutes. You may use it prior to full warm up but be aware of possible inaccuracies in gas analysis.**

Upon initiation of power, all factory-default settings will be re-established. Any modifications made to the default settings (alarm limits, text display, etc.) prior to cessation of power will be lost.

Replacing the Water Trap

The water trap must be disposed of when full. To remove the water trap, grasp the water trap firmly and pull it down from underneath, then lower it from the assembly.

To install a new water trap, grasp it from the bottom and insert it up and into the assembly.

Replacing the Gas Analyzer Filter

The gas analyzer filter must be disposed of when occluded. To remove the gas analyzer filter, lift the filter door, grasp the filter tab, lift up, and remove.

To install the filter, open the filter door, hold the filter by the tab (with the gasket down) and place it into the recess. Close the door after insertion.

WARNING:
- ***The used water trap and gas analyzer filter may contain hazardous fluids and should be disposed of in accordance with hospital procedures.***

Display Detail

When you connect the multigas device to a monitor, the waveform area is displayed in one of four formats, the large and small text formats in normal or VIEW ALARMS modes. Instructions for choosing a format are detailed later in this manual.

The full screen, large text format is the default display for bedside monitors. The full screen, small text format in VIEW ALARMS is the only display format for the full screen remote view monitors. The split screen central format is available only for central monitors operating in split screen mode. (Refer to *Figure 22-10)*.

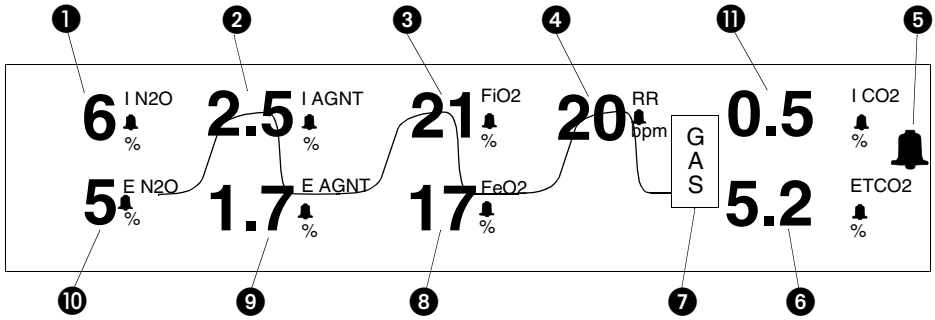


Figure 22-6: Full screen, large text

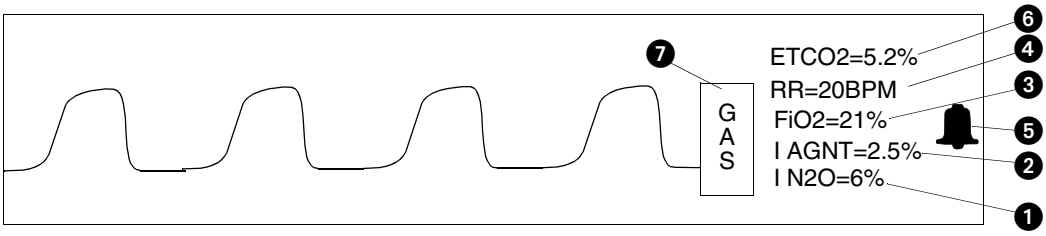


Figure 22-7: Full screen, small text

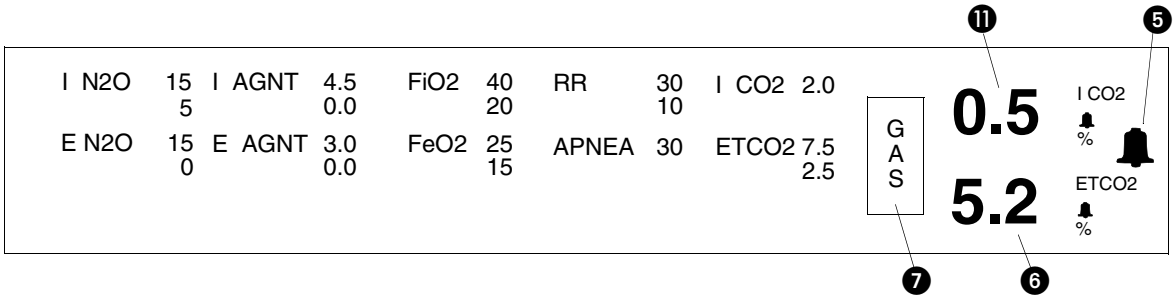


Figure 22-8: Full screen, large text, with VIEW ALARMS

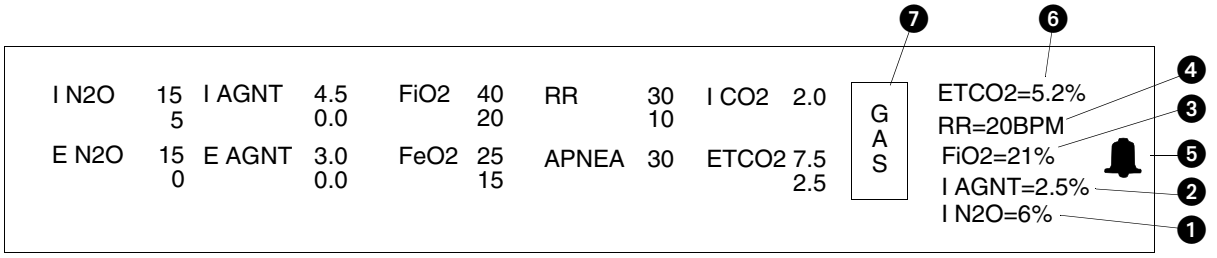


Figure 22-9: Full screen, small text, with VIEW ALARMS

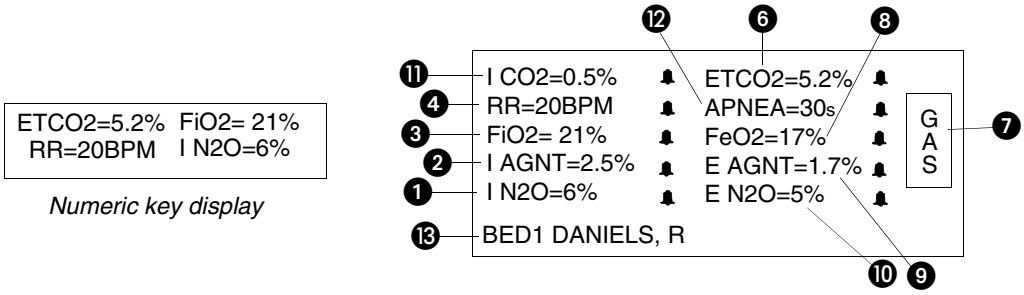


Figure 22-10: Split screen, central with numeric key display

1. Inspired nitrous oxide data
2. Inspired agent
3. Fractional inspired O_2
4. Respiration rate in breaths/minute
5. Alarms ON bell (refer to *Table 1* on page 22-15)
6. End tidal carbon dioxide data
7. Gas screen key
8. Fractional expired O_2
9. Expired agent
10. Expired nitrous oxide data
11. Inspired carbon dioxide data
12. Apnea alarm setting (the delay value)
13. Bed ID and patient name (remote displays only)

Agent Parameter Label View

When in AUTO ID mode, the inspired and expired agent labels are displayed in normal video, and in the MANUAL mode, the labels are displayed in reverse video.

In MANUAL mode, full-screen large text view, the mixed condition is reported by displaying MIX under the parameter label area next to the units of measure. In the full-screen small text view, the parameter labels alternate between the mix label and agent type label. In AUTO ID mode, the agent labels are replaced by “I MIX” and “E MIX”.

No Breath Mode View

Normal mode of operation is in effect as long as breathing is detected. Twenty seconds after the last breath is detected, the analyzer switches to “no breath mode” automatically and the $EtCO_2$, Resp rate, expired agent, FeO_2, and expired N_2O numeric values are shown as **???**. The momentary data is displayed in place of the inspired numeric values.

Setting Alarm Limits

To set gas alarm limits:

1. Touch GAS.
2. Touch ALARM LIMITS.
3. Select the parameter for which you wish to set alarm limits.
4. Touch ON for the parameter selected in step 3.
5. Use the arrow keys to set the high and low alarm limit or the apnea alarm delay time.
6. Touch PREVIOUS MENU to select another parameter for setting alarm limits.
7. Repeat steps 3 through 6 until all limits are set.

You may set alarm limits for the following:

- Apnea (delay is measured in seconds) - high limit
- RR (respiratory rate) - high and low limits
- $EtCO_2$ - high and low limits
- I CO_2 - high limit
- FiO_2 - high and low limits
- FeO_2 - high and low limits
- Inspired and Expired N_2O - high and low limits
- Inspired and Expired Agent - high and low limits

When alarm limits for $EtCO_2$ and RR are initially enabled, the limit values depend upon the patient's current readings for those parameters (these limit values are learned). Alarm limits for all other monitored parameters, when enabled, always have the same fixed values.

Factory-set default values appear for alarm limits when you initially power up the multigas unit. You may modify limits for any of the monitored parameters. These modifications will remain in check until the unit is turned off or placed on Standby. Default settings and ranges for alarm limits are shown in *Table 2* on page 22-16. Refer to *Alarms* on page 2-3 for additional information on alarms.

The VIEW ALARMS display format is the default for all full screen remote and central monitors. In this format, all text is cleared from the waveform zone and ten sets of parameter labels and their alarm limits are displayed. This is the only mode that displays all alarm limits.

Table 1: Alarm Status and Display

Alarm Status	Bell Display
At least one alarm ON	Present
At least one alarm ON and violated	Flashing
All alarms OFF	Replaced with GAS ALM OFF in reverse video
At least one alarm ON; alarms temporarily suspended by monitor	Replaced with GAS ALM SUSP in reverse video (flashes if any alarm is violated)

Table 2: Alarm Limit Ranges

Monitored Parameter	Units	Low Alarm			High Alarm			Resolution
		Minimum	Default	Maximum	Minimum	Default	Maximum	
$EtCO_2$	%	0.0	**	9.9 *	0.1	**	10.0 *	0.1
$EtCO_2$	mmHg	0	**	79	1	**	80	1
$EtCO_2$	kPa	0.0	**	9.9	0.1	**	10.0	0.1
I N_2O	%	0	0	75	5	80	80	5
E N_2O	%	0	0	75	5	80	80	5
RR	BPM	0	**	170	15	**	175	1 for 1 - 30 5 when > 30
APNEA	sec	-	-	-	20	30	45	5
I CO_2	%	-	-	-	0.1	1.0	9.9	0.1
I CO_2	mmHg	-	-	-	1	8	80	1
I CO_2	kPa	-	-	-	0.1	1.0	9.9	0.1
O_2 Inspired (FiO_2)	-	18	18	95	20	100	100	5 when > 30 Otherwise 1
O_2 Expired (FeO_2)	-	15	18	95	20	100	100	5 when > 30 Otherwise 1
Inspired Agent HAL, ISO, ENF, DES, SEV	%	0.0	0.0	19.9	0.1	3.0	20	0.1
Expired Agent HAL, ISO, ENF, DES, SEV	%	0.0	0.0	19.9	0.1	3.0	20	0.1

* The current barometric pressure measurement affects the maximum high and low alarm limits for $EtCO_2$ when measured in %.

** Learned Alarm Limits

The respiration rate alarm limits default as shown below:

Condition	Limit
RR ≤ 12	LO = 1 BPM
RR > 12	LO = RR x 0.5 (truncated to the next lower resolution)
RR ≤ 20	HI = 30 BPM
RR > 20	HI = RR x 1.5 (rounded to the next higher resolution)

The $EtCO_2$ high alarm limit defaults to the displayed value + 15% and is rounded to the next higher resolution, when needed.

The $EtCO_2$ low alarm limit defaults to the displayed value – 15% and is truncated to the next lower resolution, when needed.

!

- *If the current $EtCO_2$ reading is 0 when the alarms are first turned on, special $EtCO_2$ limits are defined. If mmHg is selected, the high and low limits are set to 0 and 1, respectively. If % or kPa is selected, the high and low limits are set to 0.0 and 0.1, respectively.*

Waveform Display

Adjusting Waveform Size

To adjust the waveform scale size:

1 Touch GAS.
2 Touch SETUP.
3 Touch SIZE.
4 Select the desired scale size.

The CO_2 waveform can appear on your monitor in any of three scale sizes: 0 to 80 mmHg, 0 to 60 mmHg or 0 to 40 mmHg (0 to 10.0 kPa, 0 to 7.5 kPa, or 0 to 5.0 kPa).

Turning the Waveform Display Off

To turn the waveform display OFF:

1 Touch GAS.
2 Touch SETUP.
3 Touch SIZE.
4 Select WAVEFORM OFF.

To reduce display clutter, the multigas waveform can be turned off while leaving the numerics visible. When the waveform is off, the size adjustment, sweep speed, and freeze keys are disabled.

Selecting a Sweep Speed

To select a sweep speed:

1 Touch GAS.
2 Touch SETUP.
3 Touch SWEEP SPEED.
4 Select desired sweep speed.

You can view this waveform at any of the following sweep speeds: 25, 12.5, 6.25, 3.12, or 1.56 mm/second.

Freezing the Waveform

To freeze the gas waveform:

1 Touch GAS.
2 Select FREEZE ON.

You can freeze the gas waveform display at any time. The waveform stays frozen until you press the FREEZE ON/OFF key again or until you press the NORMAL SCREEN key. When the waveform is frozen, the SIZE key in the SETUP menu is disabled.

Selecting a Text Format

To switch text formats:

1 Touch GAS.
2 Touch SETUP.
3 Select LARGE TEXT or SMALL TEXT.

You can change display formats for multigas by switching between large and small text (refer to *Display Detail* on page 22-12).

Small text allows clear visualization of the waveform. However, It is recommended that large text be used for routine monitoring.

Selecting a Unit of Measure

To select a measurement unit:

1 Touch GAS.
2 Touch SETUP.
3 Select PERCENT or mmHg (kPa).

You can monitor CO_2 values as a percentage (%), as millimeters of mercury (mmHg) or kilo Pascal (kPa). If you want to use % as the measurement, press the PERCENT/mmHg (kPa) key until PERCENT is highlighted. If you want to measure in mmHg (kPa), press the PERCENT/mmHg (kPa) key until mmHg (kPa) is highlighted.

Selecting an Agent ID

To select Auto Agent ID:

1 Touch GAS.
2 Touch SELECT AGENT.
3 Touch AUTO ID.

To select Agent ID manually:

1 Touch GAS.
2 Touch SELECT AGENT.
3 Select HAL, ENF, ISO, SEV, DES.

You can manually choose an agent type by touching the SELECT AGENT key in the main menu which opens the agent selection sub-menu. The prompt line above the sub-menu identifies the detected agent: DES, SEV, ISO, HAL, ENF. MIX is displayed if more than one agent is detected, and NONE if the agent type is not identified.

WARNING:

- ***In the event an agent is selected manually, but not administered, the analyzer will detect the difference and begin flashing the agent parameter label area and the detected agent's key. This is to alert the clinician to possible errors.***

Touching the AUTO ID key sets the analyzer to automatically use the agent type detected. The five agent keys are the manual agent selection keys. Selecting one of the agent keys forces the analyzer to use and report the concentration levels based upon coefficient factors of the manually selected agent.

CAUTION:

- **If you see AGNT or MIX next to the numeric values on the display, wait until HAL, ISO, ENF, SEV, or DES only appear on the screen to indicate that the multigas analyzer recognizes the agent you are using. The displayed values are based on the coefficient factors of the last detected or selected agent type. If the last detected or selected agent is different than the agent you are using, you may receive inaccurate values. Confirm the agent type before you continue with patient treatment.**

Agent ID Conflict Detection

In AUTO ID mode, if nonzero concentration levels are reported for more than 2-minutes and the agent type is not detected, a conflict is declared and the AUTO ID key flashes.

In manual mode, when an agent type other than the selected agent type is detected, a conflict is declared and the key with the detected agent type flashes.

When a conflict is declared, the agent parameter areas flash on all screens also.

The conflict is confirmed and the flashing of the keys and agent parameter areas stops when either a selection is made in the Select Agent menu (a key is touched) or the Select Agent menu is exited.

Conflict detection is restarted if:

- the agent concentration level goes to zero for more than 2-minutes.
- an agent type is selected that is not the type currently selected and not the first agent type in conflict.

Selecting Stand By Mode

To start multigas monitoring from Stand By mode:

1. Press STAND BY to deactivate the Stand By mode (switch is “out”).
2. If the disposable water trap and filter are not present, install them now.
3. When multigas monitoring is no longer needed, press STAND BY (switch is “in”) or turn unit OFF (on back of unit). **Do not disconnect power to the analyzer or the monitor.**

Stand By mode should be used for short durations only (for example, case turnover). The Stand By feature keeps the unit warmed up.

The Stand By mode is not to be used in place of the power on/off. If the unit is in Stand By mode and loses power (for example, if the unit is unplugged during moving), when power is re-initiated, the analyzer may not display on the patient monitor. It is best to use Stand By mode under supervision.

Press the front panel STAND BY button to initiate the Stand By mode. The pumps stop drawing sampled gases, the analyzer display disappears from the monitor screen, and the STAND BY light illuminates. Press STAND BY again to return the analyzer to its normal operating mode when multigas monitoring is needed again.

CAUTION:

- **If the unit is taken out of Stand By and the analyzer display does not appear on the patient monitor, turn the unit off and then power on correctly.**

Selecting a Pump Speed

To select a pump speed:

1. Touch GAS.
2. Touch SETUP.
3. Touch PUMP SPEED.
4. Select desired pump speed.

You may select any of the following volumes of sampled gases that are drawn for use in measuring gas values: 50, 75, 100, 125, 150, 175, or 200 ml/min, or you may suspend sampling (pumps off). The unit defaults to 175 ml/min whenever it is turned on.

Initiating a Calibration

WARNING:

- ***The gas analyzer calibrations must be performed by qualified personnel.***
- ***The calibration should occur when the unit is not actively monitoring a patient.***

Daily O_2 Sensor Test

To check O_2 sensor:

1. Turn unit on and allow warm up to occur (4-minutes).
2. Touch GAS.
3. Touch CAL.
4. Touch CHECK O2 SENSOR.
5. At completion of successful test, normal monitoring will resume.

The oxygen channel may drift slightly over time; therefore, an O_2 sensor test should be performed daily. This test uses room air to check for aging of the oxygen sensor and may be performed at any time (except during the first 4-minutes of operation). This check does not require special equipment or additional gases.

If drift or aging of the sensor is detected, the 100% O2 SPAN REQUIRED message will be displayed and a 100% O_2 span must then be performed to calibrate the O_2 sensor for high concentration levels (>60%) of oxygen.

Further action is needed if an O2 SPAN FAILURE message or an O2 SPAN REQUIRED message displays on the screen. However, the gas analyzer is still functioning and all Agent, CO_2, and N_2O values remain accurate. The unit can be used until the required calibrations can be performed. To remove the message from the screen, simply touch the GAS key and then the NORMAL SCREEN key of the monitor.

CAUTION:

- **If the message ??? appears in the numerics of FiO_2 *and* FeO_2 at any time you are monitoring a patient, you must perform a check O_2 sensor test.**

To span calibrate O_2 sensor with 100% O_2:

1. Allow unit to stabilize for 30-minutes.
2. Touch GAS.
3. Touch CAL.
4. Disconnect the sample line from patient.
5. Connect the sample line to the sampling port of an airway T-adapter.
6. Connect the airway T-adapter to a source of 100% oxygen supply.
7. Adjust the oxygen supply to flow through the T-adapter at a rate of approximately 500 ml/min.
8. Wait for O_2 value to stabilize.
9. Touch 100% O2 SPAN.
10. Select YES.
11. At completion of successful test, normal monitoring will resume.

100% O_2 Span Calibration

The 100% O_2 Span is used to calibrate the response of the oxygen sensor to 100% O_2. This function sets the level for oxygen so the monitor displays 100% when pure oxygen is input to the unit.

The 100% O_2 Span calibration should be performed monthly or whenever the FiO_2 value is not between 98% and 100% when sampling pure (100%) oxygen. The 100% O_2 calibration must be done correctly. A source of pure O_2 with adequate flow is required to perform this calibration. Some institutions rely on their biomedical engineering department to perform this calibration. When the 100% O_2 calibration is completed successfully, the monitor displays a normal screen with measured values of all gases.

Further action is needed if an O_2 SPAN FAILURE message or an O_2 CELL REPLACEMENT REQUIRED message displays on the screen. However, the gas analyzer is still functioning and all Agent, CO_2, and N_2O values remain accurate. The unit can continue to be used until the required action can be performed. To remove the message from the screen, simply touch the GAS key and then the NORMAL SCREEN key of the monitor.

CAUTION:

- **Performing a 100% O_2 span calibration without using the proper concentration and flow of oxygen will result in span calibration failure.**

O_2 Cell Replacement

To change an O_2 cell, plan on the analyzer to be out of operation for approximately 2-hours. Therefore, if the day begins with a CHECK O2 SENSOR calibration and it is found that additional calibration or O_2 sensor replacement is required, you can simply schedule that within your department (when the biomedical engineers are available). You may continue to use the analyzer until there is time to re-calibrate the unit or change the sensor.

Autozero Calibration

To guarantee accurate readings, the zero reference of the multigas analyzer is automatically calibrated on a regular basis. Autozero calibrations last less than 1.5-seconds and are performed without notice to the user.

The interval between autozero calibrations depends upon the amount of time the unit operates (either in normal or stand by mode). After the unit has been ON for at least 30-minutes, and has become thermally stable, autozero occurs in normal mode at approximately 10-minute intervals.

Pump Calibration

This function is used by service personnel to adjust the pump flow rate. Refer to the *90518 Multigas Analyzer Service Manual P/N 070-0643-xx* for details.

Gas Span Calibration

A gas span calibration is recommended whenever gas values appear to be too low or too high. Always perform a leak test first to verify that the suspected values are not the result of a leak (poor connection, cracked water trap, etc.).

The gas calibration (SPAN) procedure is used to recalibrate the gas channels for CO_2, N_2O, and anesthetic agents. This procedure should be done every 30-90 days. Equipment required for this calibration includes a gas mixture for the calibration, calibration adapter kit, gas pressure regulator, and flow meter. This equipment can be purchased from Spacelabs Medical Supplies Products.

WARNING:

- ***Performing a gas span calibration without the calibrated gas mixture connected adversely affects the accuracy of the analyzer.***
- ***Gas span calibrations must be performed by trained personnel only.***

Refer to the *90518 Multigas Analyzer Service Manual (P/N 070-0643-xx)* for details on calibrating the analyzer.

- *The waveform display and the numeric values may disappear during calibration.*

Suspending Sampling

To suspend sampling:

1 Touch GAS.
2 Touch SUSPEND SAMPLING.
3 Touch RESUME SAMPLING when finished.

Sampling may be suspended by touching the SUSPEND SAMPLING key under the following conditions:

- When suctioning a patient
- Use (by the patient) is temporarily discontinued
- Nebulized drugs are being used

This stops the sampling pump and keeps the system free of debris. Touch the RESUME SAMPLING key to resume sampling.

CAUTION:
- **The sampling must be resumed for proper monitoring of respiratory gases.**

When sampling is suspended, the CAL key is disabled.

Refer to *Patient Connection* on page 22-8 for examples of recommended suction system setups.

Multigas Troubleshooting Guide

The analyzer displays error messages in the gas waveform zone. Many of these messages also trigger an alarm. If the prompt line is available, the monitor displays messages there as well.

Clinical Situation	Possible Cause	Solution	Alarm Sounds
FILTER DOOR OPEN - Close filter access door	■ The gas analyzer filter door is ajar.	■ Close the door by pressing it downward.	■ Yes
OCCLUSION - Check T-adapter, sample line	■ The sample line is blocked.	■ Check the sample line for blockage or crimps, and replace as necessary.	■ Yes
	■ The gas analyzer filter is plugged.	■ Replace the gas analyzer filter cartridge.	■ Yes
SPAN IN PROGRESS	■ One of the span calibration procedures is in progress.	■ Wait until span calibration is completed and message goes away.	■ No
WARMING UP	■ The unit is self testing or warming up.	■ Wait until warm up completes before operating.	■ No
WATER TRAP ABSENT - Install water trap	■ There is no water trap installed in the holder.	■ Install a water trap.	■ Yes
WATER TRAP FULL - Replace or empty	■ The water trap is full.	■ Replace the water trap.	■ Yes

! • *The unit does not analyze sampled gases while the monitor displays any of the above messages.*

Clinical Situation	Possible Cause	Solution	Alarm Sounds
100% O2 SPAN FAILED - Check 100% O_2 gas supply, Check for leaks	■ Sampled gas supply does not have 100% O_2 present when compared to room air O_2.	■ Verify the O_2 supply. Allow the analyzer to warm up for at least 30-minutes before attempting a 100% O_2 span.	■ Yes
	■ Air leak in external sample circuit.	■ Check water trap, gas analyzer filter, and sample lines for air leaks. Replace all leaking components.	■ Yes
	■ Air leak in internal sample circuit.	■ Perform a unit leak test. Service may be required.	■ Yes
	■ External/internal pressures may be out of operating range or measurement of the pressures has failed.	■ Check that the cell pressure in SERVICE CAL MODE is between 525-825 mmHg. If the cell pressure is greater than the barometric pressure, external sample circuit is over pressured, adjust circuit.	■ Yes
	■ O_2 cell linearity error.	■ Contact your Biomed or your Spacelabs Medical service representative.	■ Yes
	■ O_2 concentration may be more than 23% or less than 19% in vicinity of the analyzer.	■ Check the room air around the analyzer for high O_2 concentrations. Successful completion of O_2 span is not possible under this condition. ■ Repeat 100% O2 SPAN (refer to *To span calibrate O2 sensor with 100% O2* on page 22-20). Contact a qualified service person if the span fails again after the above checks.	■ Yes
100% O2 SPAN FAILED - O2 cell replacement required	■ O_2 cell output is below acceptable levels, O_2 values are disabled.	■ Contact your Biomed or your Spacelabs Medical service representative.	■ Yes
100% O2 SPAN REQUIRED	■ Initial 100% O_2 CAL required.	■ Perform 100% O_2 Span.	■ Yes
	■ CHECK O2 SENSOR determined need for 100% O_2 Span to restore specified O_2 accuracy.	■ Perform 100% O_2 Span.	■ Yes
O2 CELL REPLACEMENT REQUIRED	■ Previous O_2 span determined that O_2 cell has aged to the point of needing replacement.	■ Contact your Biomed or your Spacelabs Medical service representative.	■ Yes

Clinical Situation	Possible Cause	Solution	Alarm Sounds
O2 INSTALLATION FAILED - O2 install cal requires new O2 cell	■ Install cal detected an O2 cell output above or below the allowable threshold for a new O2 cell.	■ Contact your Biomed or your Spacelabs Medical service representative.	■ Yes
O2 SPAN FAILED - Check exhaust port	■ Scavenger port is blocked.	■ Remove scavenger port blockage and repeat the SPAN. If the SPAN fails again, contact a qualified service person.	■ Yes
	■ O_2 sensor assembly output is very negative.	■ After checking exhaust port, if RAW = 0 in SERVICE CAL MODE, service is required. Replacement of the O_2 sensor electronics assembly is indicated.	■ Yes
CAL GAS SPAN FAILED - Check span gas supply	■ The unit could not calibrate the gas channel.	■ Repeat the span. Contact a qualified service person if the span fails again.	■ Yes

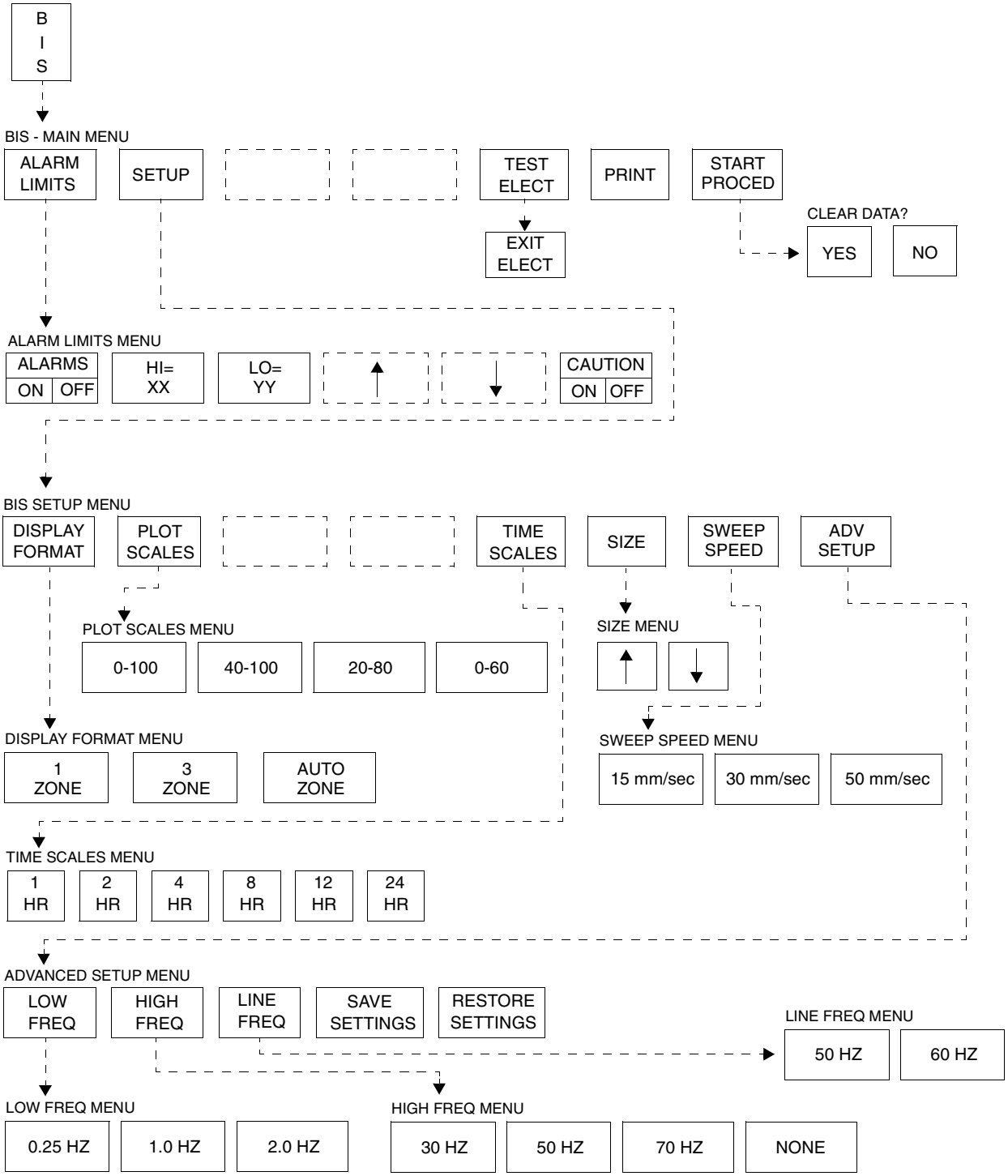
- *The unit does not analyze sampled gases while the monitor displays any of the above messages.*
- *For the above messages, you can touch the GAS key and then the NORMAL SCREEN key to remove the message from the waveform zone and stop the alarm tone. However, the message will continue to display on the monitor's prompt line. Whenever a span failure occurs, the previous calibration factors are not lost. The analyzer continues to function and report the gas values, but the full accuracy of the values are not guaranteed.*

Clinical Situation	Possible Cause	Solution	Alarm Sounds
HIGH VALUES OBSERVED	■ A span calibration was performed while there was a leak in the sample circuit.	■ Check connections and check for a broken water trap. Perform leak test. Verify the anesthesia delivery devices and vaporizer calibrations. Refer to the *90518 Multigas Analyzer Service Manual (P/N 070-0643-xx)* for details. ■ Assure vaporizer accuracy.	■ No
LOW VALUES OBSERVED	■ A leak exists at the sample line connection, a water trap is broken at the luer connection, or a gas analyzer filter is leaking.	■ Check connections and check for a broken water trap. Perform leak test. Verify the anesthesia delivery devices and vaporizer calibrations. Refer to the *90518 Multigas Analyzer Service Manual (P/N 070-0643-xx)* for details.	■ No
		■ Assure vaporizer accuracy.	■ No
Minimum waveform deflection and very low or zero numeric values when breathing normally through a new or unused sample line	■ Clogged or missing gas analyzer filter.	■ Replace or install gas analyzer filter underneath the door above the water trap.	■ No
	■ A large leak in the sample circuit.	■ Check connections and perform a leak test. Refer to the *90518 Multigas Analyzer Service Manual (P/N 070-0643-xx)* for details.	■ No
MIX **NOTE: This message appears in agent numerics area.**	■ Agent mixture detected.	■ The analyzer is not designed to simultaneously measure multiple anesthetic agents. Inaccurate numeric concentration values may be displayed when two or more agents are mixed.	■ No
		■ The displayed value of the mixed condition is based on the combined value of agents using the coefficient factors of the last detected or selected agent type.	■ No

Clinical Situation	Possible Cause	Solution	Alarm Sounds
		■ When the analyzer detects an agent mixture: • In Auto ID Mode — The mixed condition is reported by displaying I MIX and E MIX as the agent labels on all screens. • In Manual ID Mode — In large text screen, the mixed condition is reported by displaying the word MIX under the parameter label area next to the units of measure. In the small text screen or the split screen central, the parameter labels will alternate between the mix labels in normal video and the selected agent-type labels in reverse video. ■ The display zones will continue with the above displays, until the mix of the agents has flushed from the patient and delivery system and a single agent identity has been detected. ■ Depending on the agents used, the residue in the patient, and the breathing or delivery system, mixed conditions can last for more than an hour. ■ If the message persists, contact a qualified service person.	
Zeros or ??? are displayed for one or more of the inspired gases (I N2O, I AGNT, FiO2, or I CO2)	■ No gas is being administered.	■ Administer gas.	■ No
	■ Sample line is not connected.	■ Check sample line connections, the water trap, and the filter above the water trap.	■ No
	■ A leak in the system.	■ Perform a leak test; refer to the *90518 Multigas Analyzer Service Manual* (P/N 070-0643-xx) for more details.	■ No
	■ Failure in one of the internal electronics parts.	■ Cycle the power to the analyzer. If the problems persist, contact a qualified service person.	■ No

BIS Directory

Directory of Keys



- *Based on features purchased, more or fewer keys may appear here than on your menu screens.*

Contents

Overview

The Spacelabs Medical 90482 Bispectral Index® (BIS®) Analysis module acquires and processes real-time EEG data into a BIS number between 0 and 100. The EEG data is also displayed as:

- BIS
- Spectral Edge Frequency (SEF)
- Median Power (MF)
- EMGL (EMG energy in the 70–110 Hz band)
- Signal Quality Index (SQI)
- Suppression Ratio (SR)

The BIS module may be used in any of the Spacelabs Medical monitors listed in *Table 1*, with or without other Spacelabs Medical modules.

Table 1: BIS Compatibility

Model	Description	Minimum Version of Software Required For Compatibility
90363	Ultraview 1500	1.01.10
90364	Ultraview 1600	1.03.08
90369	Ultraview 1050	1.01.10
90367	Ultraview 1030	1.01.12
90385/6	UCW/RDI	1.04.33
90387	Ultraview 1700	1.05.56

The BIS module uses disposable BIS sensors from Aspect Medical, Inc., a Digital Signal Converter (DSC), and a patient interface cable.

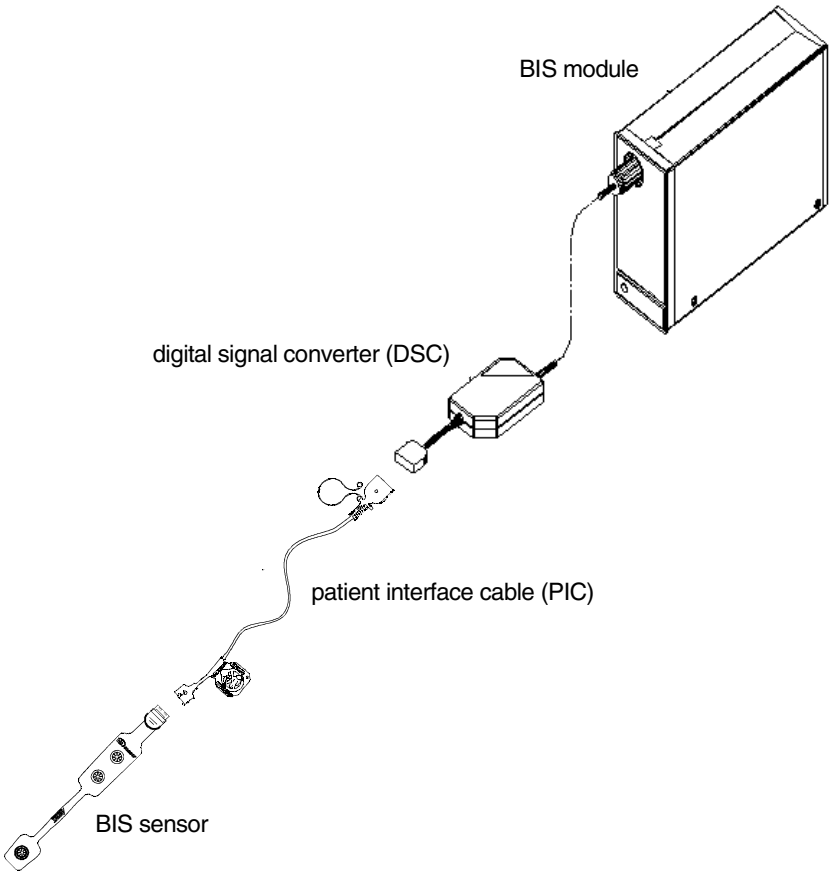


Figure 23-1: Module, DSC, PIC, and sensor

CAUTION:

- **Place the sensors as far away from the electrosurgery site as possible because considerable high frequency current may flow into the electrodes. This can cause patient burns, especially if a defect is present in the neutral cable of the electrosurgical unit. Placing electrodes too close to the electrosurgery site can also cause a noisy EEG trace.**
- **Do not allow conductive parts of sensors or connectors, including the neutral electrode, to contact other conductive parts, including the ground.**
- **Detach all connectors and cables by grasping the connectors and pulling them straight out. Do not detach connectors and cables by pulling on the cables themselves.**

Digital Signal Converter

The digital signal converter (DSC) receives the EEG input from the patient and converts it to digital information that is processed by the module.

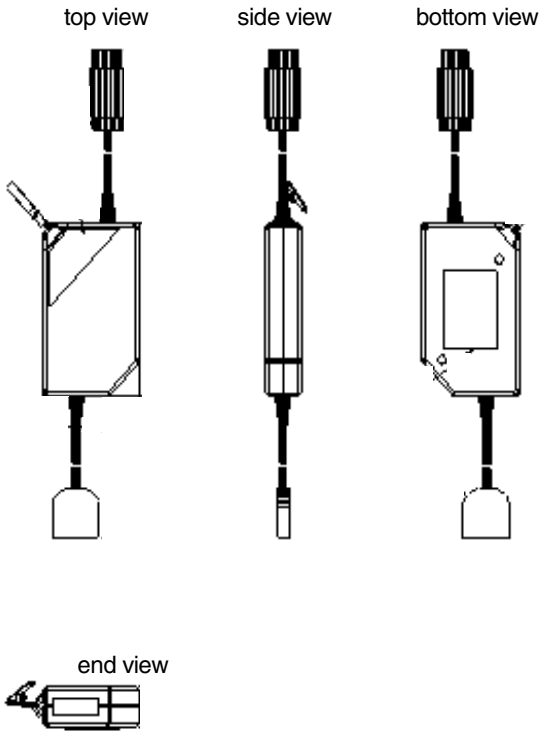


Figure 23-2: Digital signal converter

The DSC plugs into the front of the module as shown in *Figure 23-1*.

Patient Interface Cable

The patient interface cable (PIC) is attached to the three-foot cable on the DSC and connects to the BIS sensor as shown in *Figure 23-1*.

- *The PIC is* not *a disposable cable. Do not dispose of it when you dispose of the attached BIS Sensor.*
- *A cable tie is provided with the PIC to secure it to the DSC cable to prevent accidental disposal of the PIC.*

To attach the PIC to the BIS sensor:

1. Remove the BIS sensor from its packaging.
2. Locate the small, raised arrows on both the light-blue end of the PIC connector and the BIS sensor connector.

Plug the BIS sensor into the PIC so that the arrows are on the same side and point toward each other. You may attach the BIS sensor to the PIC cable either before or after the sensor is placed on the patient.

To replace a faulty or damaged PIC:

1. Remove and discard the unusable cable.
2. Locate the end with a yellow dot on the PIC connector.
3. Engage the PIC connector and the DSC cable connector with the yellow dots oriented the same way, ensuring that they are fully seated.

Patient Preparation

To prepare the patient for monitoring:

1. Make sure the skin surface is clean and dry.
2. Position BIS sensor circle #1 and BIS sensor circle #2 high on the center of the patient's forehead approximately 1.5 inches above the bridge of the nose.
3. Apply BIS sensor circle #3 on either temple between the corner of the patient's eye and the hairline.

CAUTION:
- **The BIS sensor will only work if it is placed on the patient's forehead. Accordingly, it should not be used with any surgical procedure that precludes such placement.**

4. Insert the tab into the patient interface cable until it is fully engaged (if you prefer, you may do this step before applying the sensor to the patient).
5. Using your finger, trace around the adhesive areas of the sensor, including the space between circles #1 and #2 to assure good adhesion and to prevent any bridging between the sensor elements.
6. Press each circle firmly and hold for 5-seconds to assure adequate prepping and to maximize sensor performance.

CAUTION:
- **Do not expose the BIS sensor to surgical skin preparation solutions. This may result in harm to the patient's skin.**

Initialization

Before processing data, the BIS sensor must be applied to the patient.

When the sensor is applied and the PIC and DSC are connected to the module, you are ready to begin BIS monitoring.

1. Touch BIS.
2. Touch START PROCED
   (refer to *START/STOP PROCED Key* on page 23-16).
3. Touch YES at the **Clear Data?** prompt, and the module will automatically perform an impedance test.

- *You do not need to test electrode placement because this is done automatically when you touch START PROCED.*

If the test passes, an **Impedance Test Passed** message displays (*Figure 23-3*).

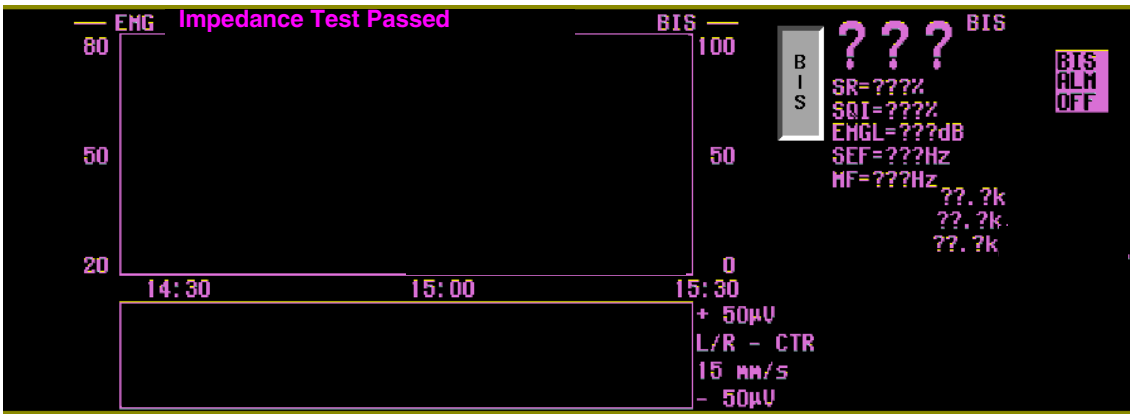


Figure 23-3: Impedance Test Passed message

If the test fails, an **Impedance Test Failed** message displays (*Figure 23-4*).

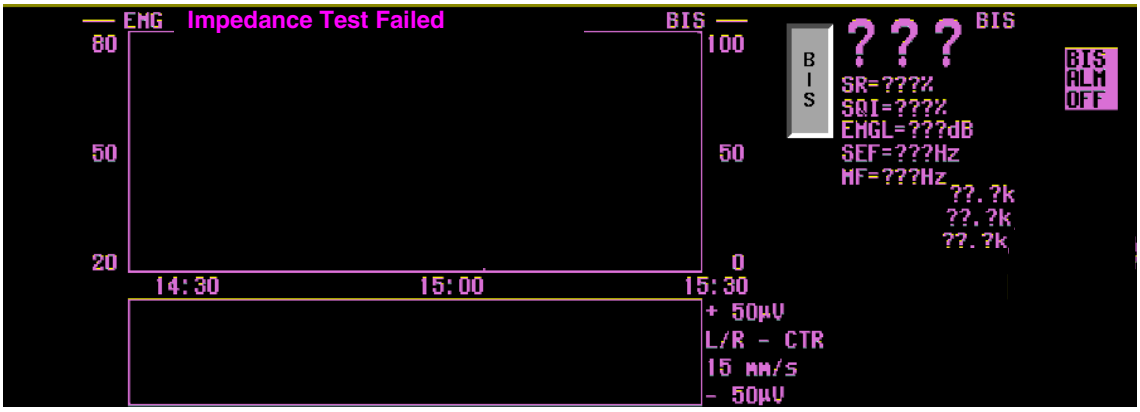


Figure 23-4: Impedance Test Failed message

Impedance Values

If the impedance value is too high, it could indicate that the BIS sensor is no longer making good contact and needs to be examined. Usually artifacts will signal this fact.

After touching the TEST ELECT key, additional feedback is given to the user by flashing the impedance value when the value exceeds the threshold. (Refer to *Impedance Montage* on page 23-11 and *TEST ELECT Key* on page 23-15.)

The Pass/Fail thresholds for the terminals are:

- Ground < 100 Kohms
- Center < 7.5 Kohms
- Left/Right < 7.5 Kohms

!

- *In normal use, the typical impedance value for the ground is less than or equal to 6 Kohms, while the values for the center and left/right terminals are between 0.5 and 1.5 Kohms.*
- *The user cannot control the impedance thresholds.*

Normal Bedside Display Format

Monitor Software

The full bedside view requires three waveform zones. The example in *Figure 23-5* displays the BIS plot and EMGL trends.

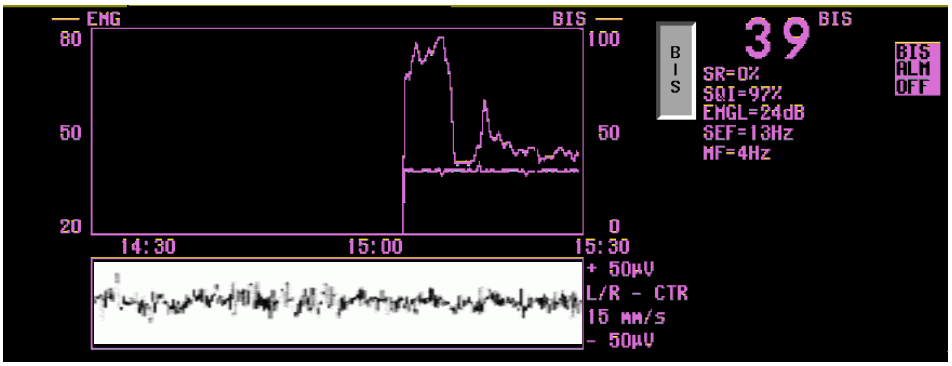


Figure 23-5: BIS bedside display (3 zones)

Analog Waveform

A single waveform is displayed in a box that is 300 pixels wide by 60 pixels high. With this display, roughly 8-seconds of waveform data can be displayed at a sweep speed of 15 mm/sec, 4-seconds at 30 mm/sec, and 2.4-seconds at 50 mm/sec.

Numeric Zone

The numeric zone is to the right of the plot and the moving waveform on the monitor and is usually updated every 2-seconds. Some items, such as sweep speed, are only updated when the selection is changed.

Display Fonts:

- The BIS value is displayed in a large font.
- The units of measure are displayed in a small font.
- The remaining text is displayed in a small font.

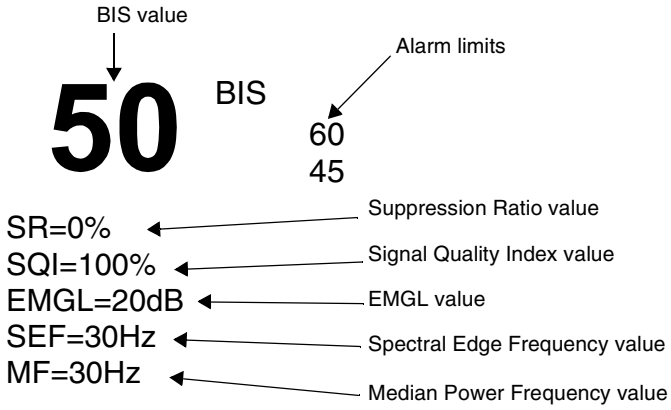


Figure 23-6: Plot area numerics

Alarm Display

When the alarms are turned ON, the high and low alarm limit values are displayed. When the alarms are turned OFF, BIS ALM OFF is displayed. When the alarms are temporarily suspended, BIS ALM SUSP is displayed.

The alarm display consists of a block of reverse video text containing either BIS ALM OFF or BIS ALM SUSP. They are mutually exclusive, and only one will be displayed in the numeric area.

- Turn the alarms OFF by touching ALARM OFF on the **Alarm Limits** menu.
- Temporarily suspend the alarms by pressing the ALARM SUSPEND button on the monitor.

Alarm Suspend

Press the ALARM SUSPEND button on the monitor to temporarily turn off the audible alarm for 3-minutes. The text BIS ALM SUSP replaces the alarm limits. The BIS number continues to flash if the limit is exceeded.

When the temporary time has elapsed, the display returns to normal behavior. If the audible alarm is enabled, the alarm tone will sound again, and the limit number will flash.

In the split screen display, the bell symbol displays in reverse video when the alarms are enabled but suspended. During an alarm violation, the bell symbol flashes in reverse video.

Top Line Annotation

The top of the plot area contains two labels:

- Primary trend label (BIS)
- Secondary trend label (EMGL)

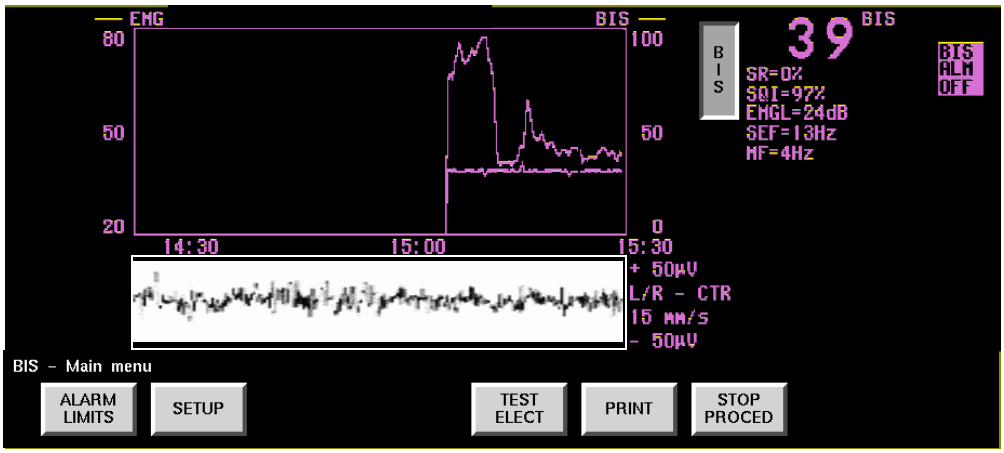


Figure 23-7: BIS primary and secondary trends

Waveform Annotation

Waveform annotations are placed to the right of the moving EEG waveform (refer to *Figure 23-8*).

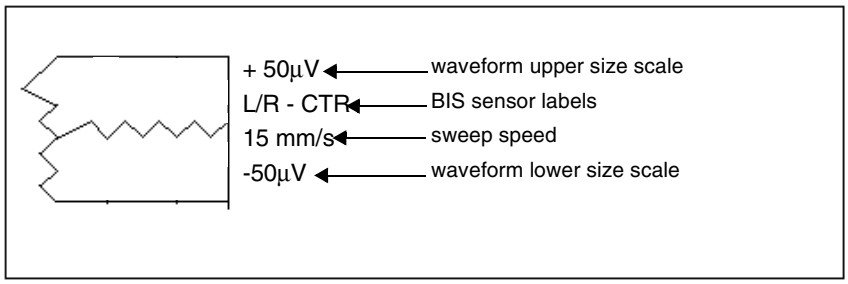


Figure 23-8: Waveform zone annotations

The analog scale size can be set at ±2, ±5, ±10, ±20, ±50, ±100, or ±200 µV. The analog scale limits are displayed with ± and µV in the label.

Impedance Montage

If, during BIS monitoring, you wish to test impedance without losing your trended data, you can perform an impedance test. An impedance test is automatically checked (or tested) every 10-minutes.

The impedance montage is a temporary display that appears when the BIS sensor is connected to a patient and you touch the TEST ELECT key (refer to *TEST ELECT Key* on page 23-15).

The montage displays on the right side of the screen to the right of the second wave zone area from the top.

- *All processing is suspended until you stop the impedance test by touching EXIT ELECT.*

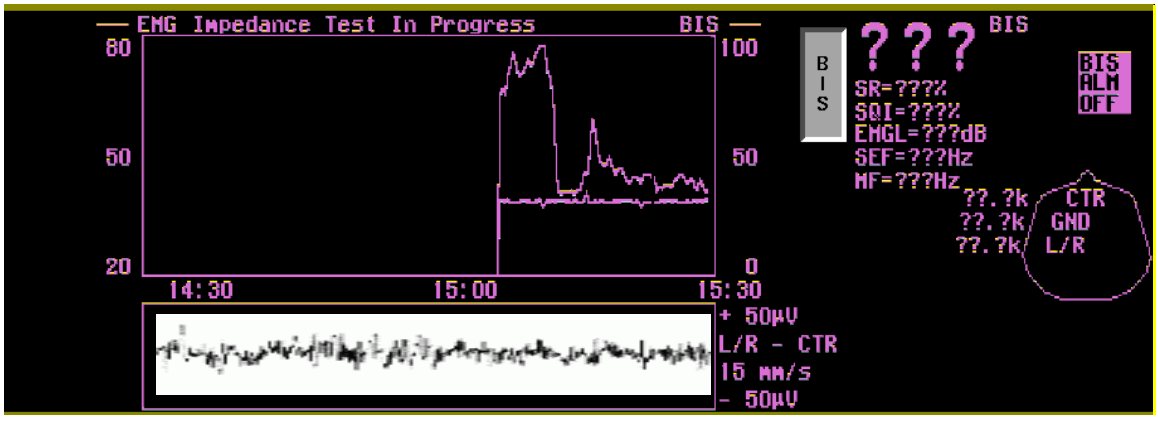


Figure 23-9: Impedance test display

Remote View Display Format

The “Remote View” software option on Ultraview monitors allows you to view the BIS parameter from a remote monitor. This display shows the BIS plot in a single display zone format. No analog waveforms are available in this mode.

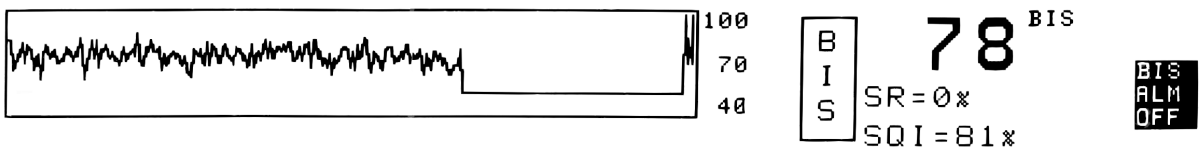


Figure 23-10: Remote display

Remote monitors permit one display zone to be used to display remote channels from other monitors, regardless of the type and the number of zones that are in use at the bedside monitor. When viewing the BIS from another monitor, the lower part of the BIS trend will not be visible due to the patient’s name being there.

In the one zone or remote view mode, all numeric text must be compacted into one display zone height.

In the remote view only, the BIS plot can have variable scaling and only the BIS value can be plotted.

The scaling options for remote view are shown in *Table 2*.

Table 2: BIS Variable Scaling

Parameter	Scaling	Value for the Labels
BIS	0-100	0, 50, 100
	40-100	40, 70, 100
	20-80	20, 50, 80
	0-60	0, 30, 60

Split Screen Display Format

- *A split screen display is available only on central monitors.*

The split screen display is shown in *Figure 23-11*.

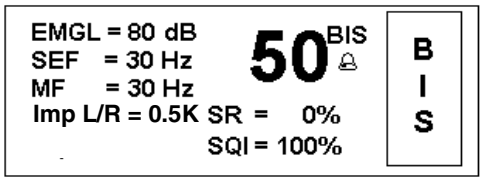
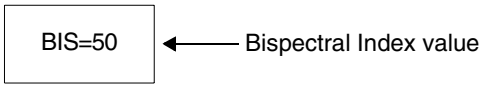


Figure 23-11: Split screen display

Numeric Key Format

The numeric parameter key is labeled with the combined Bispectral Index value. You can display the BIS parameter as an icon on the bottom of the monitor screen. This allows other parameters to be displayed in the waveform zone. The full BIS display is restored whenever this icon is touched.



BIS Main Menu

The **Main** menu is the initial menu that displays when you touch the BIS key.

- *In the remote view, only the ALARM LIMITS, SETUP, and PRINT keys are active. All other keys are disabled.*

Refer to the following sections for descriptions of each key:

- *ALARM LIMITS Key* on page 23-13
- *SETUP Key* on page 23-14
- *TEST ELECT Key* on page 23-15
- *PRINT Key* on page 23-16
- *START/STOP PROCED Key* on page 23-16

ALARM LIMITS Key

Touch ALARM LIMITS on the **Main** menu to display the **Alarm Limits** menu.

This menu turns the BIS alarms ON or OFF, sets the upper and lower BIS alarm limits, and turns the Caution alarm ON or OFF.

Setting Alarm Limits

To raise or lower each alarm limit setting, first touch the HI or LO key, then touch the up or down arrow key. Each touch of an arrow key raises or lowers the alarm limit by five units. There are separate values for the low limit and the high limit.

- *The alarm limits appear on the HI and LO keys as they are changed.*

Caution Alarm

Touch CAUTION ON to enable the caution alarm.

When the caution alarm is enabled, you will be warned when the BIS value is within five units of either alarm limit.

When the BIS value is within the caution zone, the BIS number flashes.

- *No tone is emitted for the caution alarm.*

SETUP Key

This menu enables you to set the display parameters to be used during the procedure. Refer to the following sections for descriptions of each key:

- *DISPLAY FORMAT Key* on page 23-14
- *PLOT SCALES Key* on page 23-15
- *TIME SCALES Key* on page 23-15
- *SIZE Key* on page 23-15
- *SWEEP SPEED Key* on page 23-15
- *ADVANCED SETUP Key* on page 23-15

DISPLAY FORMAT Key

From this menu, you can set the type of display you want to use.

- Touch 1 ZONE to display the single waveform zone format (*Figure 23-12)*.
- Touch 3 ZONE to display the full bedside view format (*Figure 23-13)*.
- Touching AUTO ZONE displays either format as follows:
  - 3-zone format if the BIS parameter key is touched.
  - 1-zone format if the BIS parameter key is not touched.

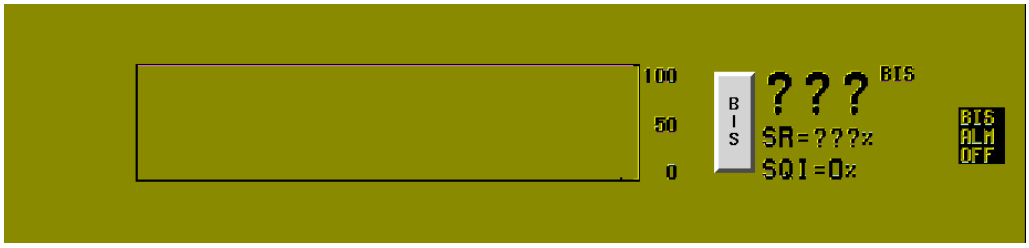


Figure 23-12: One-zone display

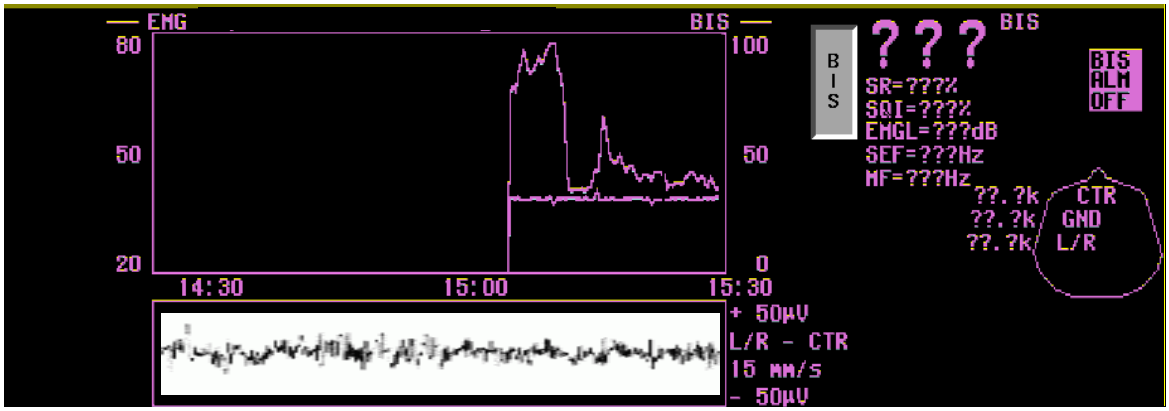


Figure 23-13: Three-zone display

PLOT SCALES Key

Select the vertical display scale range options for the graphical BIS trend display in the one-zone or remote view format only. The selections are: 0–100, 40–100, 20–80, or 0–60.

TIME SCALES Key

This menu is used to select the time base for the BIS and EMGL trend plots to indicate the total number of hours represented by the *x*-axis of the BIS plot display. Available time base options are 1-, 2-, 4-, 8-, 12-, and 24-hours.

SIZE Key

From this menu, you can modify the amplitude scale of the analog waveforms. The available amplitude scales (full scale) can be set at ±2, ±5, ±10, ±20, ±50, ±100, and ±200 μV. Touching the ↑ or ↓ key changes the scale to the next value up or down. The default setting is ±50.

SWEEP SPEED Key

This menu allows you to modify the sweep speed of the analog waveform(s). The selections are 15, 30, or 50 mm/sec.

ADVANCED SETUP Key

This menu allows you to control a variety of functions. (On a remote display, only the BIS SCALES key is available.)

LOW FREQ — Touch LOW FREQ on the **Advanced Setup** menu to set the lowest frequency that is displayed and processed. The options are 0.25 Hz, 1.0 Hz, and 2.0 Hz.

HIGH FREQ — Touch HIGH FREQ on the **Advanced Setup** menu to set the highest frequency that is displayed and processed. The options are 30 Hz, 50 Hz, and 70 Hz. Selecting NONE disables any high frequency filtering.

LINE FREQ — Touch LINE FREQ on the **Advanced Setup** menu to select either a 50 Hz or 60 Hz line frequency.

SAVE SETTINGS — Touch SAVE SETTINGS to store the current selections in memory for later recall.

RESTORE SETTINGS — Touch RESTORE SETTINGS to recall the stored settings from memory and reset all the current settings. The display may change with this operation.

TEST ELECT Key

Touch TEST ELECT to initiate a continuous impedance check of all electrodes (refer to *Impedance Montage* on page 23-11). Touching this key displays the Impedance Montage, and the key label changes to EXIT ELECT.

When you touch EXIT ELECT, the Impedance Montage display disappears and the key label changes to TEST ELECT again.

PRINT Key

Touch PRINT to print a bitmap display of the BIS and EMGL trends. The analog waveform is *not* printed using this key. Press the RECORD button on the monitor and touch the BIS parameter key to print the analog waveform.

START/STOP PROCED Key

Touch START PROCED to denote the beginning of a procedure to be recorded.

If prior data has been stored for the patient, you have the option of retaining archived data or clearing it.

- Touch NO to append the new data to the existing data.
- Touch YES to erase the trend memory and clear the trend display.

When you touch START PROCED, its function and label change to STOP PROCED.

When you touch STOP PROCED, the label changes to START PROCED again.

Status Messages

Status messages are displayed in the waveform zone when in 3-zone format.

Processing may be suspended when any of these messages are displayed. The numeric data may be displayed as question marks. The EEG waveform may have artifacts.

The status message will continue to display until all faults are corrected.

Table 3: Status Messages

Message	User Action
Impedance Test In Progress	The impedance test is in progress; this should normally last 10- to 15-seconds.
Re-prep Ground Electrode	The impedance test has failed; check to see that all the electrodes are connected properly. The module will not collect data until the test passes.
DSC Test in Progress	The system is performing a hardware self test of the DSC cable.
DSC Not Connected	Check that the PIC cable is connected to the DSC and at the front of the module. If connected, and the DSC doesn't work, the DSC or module may require service.
DSC Shut Down - Restart Module	Too many fatal errors (overcurrent, voltage regulation) have occurred with this DSC, and the module has stopped communicating. Remove the module and reinsert it. If this problem persists, the DSC and/or module may require service.
Illegal DSC ID: DSC Turned Off	An unrecognized DSC has been connected to the module. Connect correct DSC. If error persists, the DSC and/or the module may require service.
Illegal PIC ID	An unrecognized Patient Interface Cable has been connected to the DSC. The PIC may be defective. Replace the PIC.
Check the Sensor	The BIS sensor has an impedance which is too high. Check the cable connections and correct as necessary. If the message persists, check the impedance of the sensor and replace the sensor as necessary.
PIC Not Connected	The Patient Interface Cable may be disconnected from the DSC. Check the cable connections. The PIC may be defective. Replace the PIC.

Table 3: Status Messages (continued)

Message	User Action
Last Impedance Test Not Completed	At least one BIS element failed during the last impedance test and the test was ended by pressing the STOP PROCED key. Repress the element that failed. Re-test the impedance. This message will also appear if the test was ended prematurely by pressing STOP PROCED.
Poor Signal Quality	The Signal Quality Index is poor and the numeric display blinks. Check BIS Sensor. This may occur as a result of artifacts such as those generated from motion or the presence of electrocautery devices.
Bad Signal Quality	The Signal Quality Index is unacceptable, therefore, the Primary Trend variable cannot be calculated. Check BIS Sensor. This may occur as a result of artifacts such as those generated from motion or the presence of electrocautery devices.
Iso-electric EEG Detected	No discernible EEG activity is detected for several minutes, SR = 100. Check the patient. Check the BIS Sensor for proper connection.
Check BIS Sensor (GND Element)	The ground element on the patient has an impedance that is too high. Check the Sensor and cable connections, and correct as necessary. If the message persists, check the impedances of the BIS Sensor. Re-prep the patient's scalp if necessary.
Hardware Error, Service Required	Major problems in the DSC, BIS engine or module. Requires servicing.

Definitions

BIS — Bispectral Index Analysis. A mathematical calculation derived from the frequency, power, and phase throughout the entire frequency range of the EEG. The Index is a number between 0 and 100.

DSC — The Digital Signal Converter. The DSC contains the input connector, amplifiers, and digitizer for the 90482 one channel EEG. The DSC is configured for referential montage monitoring.

EEG — Electroencephalogram. Real-time electrical activity of the brain. The EEG waveform can be further separated (digitized) into elements. The signal can be processed in time, frequency, and Fourier analysis.

EMG — Electromyogram. Electrical activity of the muscles. Processed as the absolute power in the frequency (Hz) range. This product calculates EMGL, which is over a fixed 70 to 110 Hz frequency range.

EMGL — EMG Low. Refer to EMG.

Epoch — The time during which the bispectral index is calculated.

MF — Median Power Frequency measured in Hz. The frequency at which 50% of the total power lies equally on either side. The frequency range is between 0.5 and 30 Hz.

Montage — A pattern of linking electrodes together over the scalp to generate a display of EEG channels in a particular way. Montages can be bipolar or referential.

PIC — The Patient Interface Cable. Used by the BIS module. This cable is configured to tell the DSC and module to automatically use a single channel montage for the BIS Sensor. The BIS Sensor is normally placed on the left or right side of the forehead.

SEF — Spectral Edge Frequency. The frequency (measured in Hz) at which 95% of the total EEG power lies below it and 5% lies above it. Frequency range is between 0.5 and 30 Hz.

SQI — Signal Quality Index. The percentage of good epochs in the last 60-seconds that are used to calculate the Bispectal Index and spectral variables. Not affected by the suppression ratio. Percentage values range between 1 and 100.

SR — Suppression Ratio. The percentage of time in the last 60-seconds in which the EEG signal is considered suppressed. Percentage values range from 0.0 to 100.

Care and Maintenance

BIS Module and Host Monitor Cleaning

To clean monitor screens and covers, modules, processors, and printers use a cloth or swab that has been slightly dampened in a solution of warm water and a mild detergent. Avoid solvents that may damage the product cases. Follow your hospital protocol.

CAUTION:

- **Using cleaning agents other than those listed may cause degradation to the product's plastic enclosure and labels. Refer to *Cleaning and Sterilization* on page 32-1 for questions or concerns regarding cleaning.**

Digital Signal Converter Cleaning

Clean all visible blood, liquids, and soil as soon as possible from the Digital Signal Converter (DSC), cabling, and connectors. Use a lint-free, absorbent towel that has been moistened (damp, but not dripping) with a solution of mild detergent and lukewarm, clean water. Using light pressure, thoroughly clean all surfaces. Dilute and handle detergents and disinfectants according to their instructions. Dispose of the towels properly.

CAUTION:

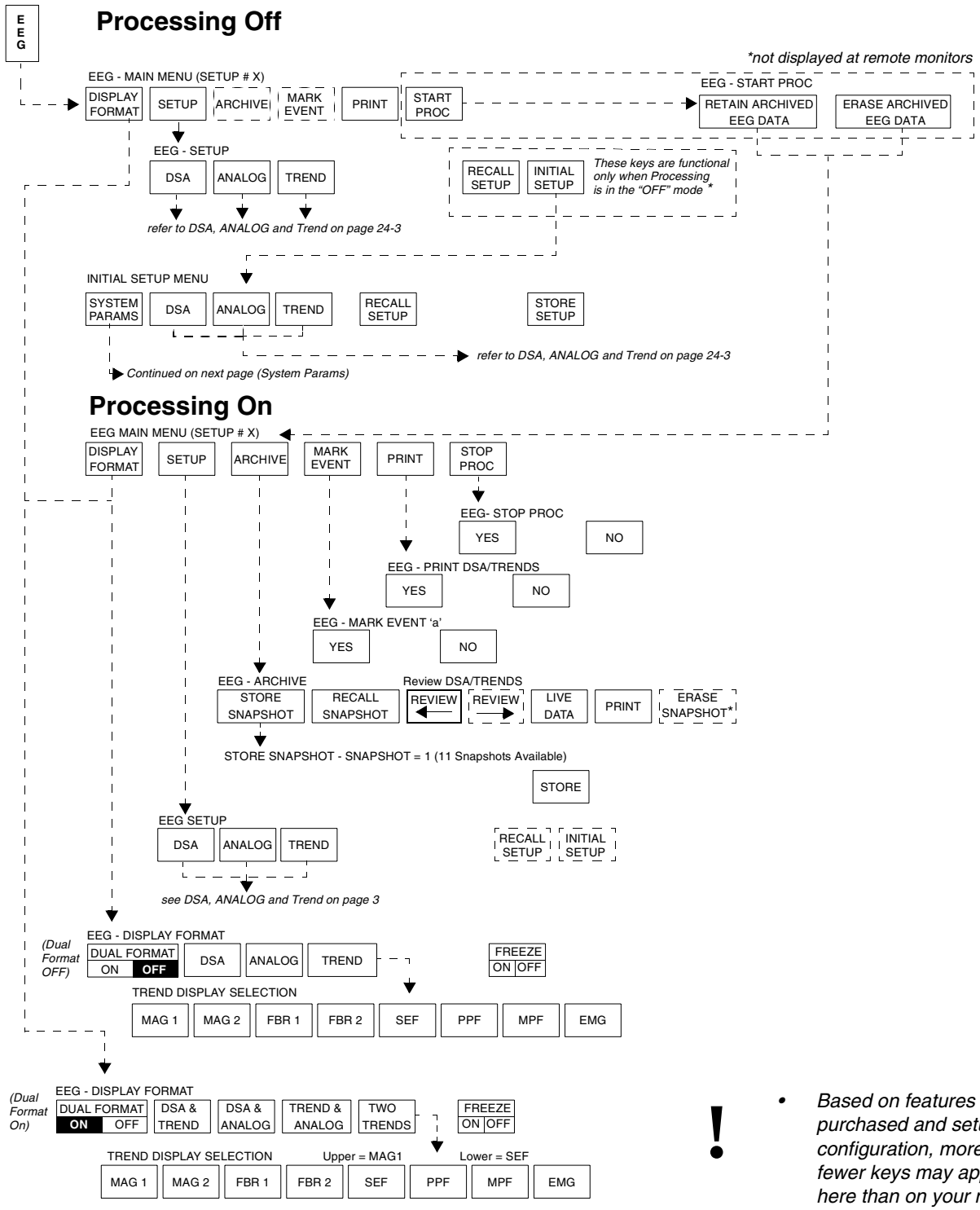
- **When cleaning the connectors (or other small features of the DSC), do not let dirt, moisture, or lint get trapped in the cracks or cavities of the receptacle or pin ends.**
- **Do not autoclave any of the components of the BIS monitoring system. Autoclaving will seriously damage the components.**

Before cleaning, wipe thoroughly. Apply an approved disinfectant for the DSC with a germicidal, disposable wipe, such as the SANI-CLOTH. Active ingredients in the approved wipe are: *n*-Alkyl dimethyl benzyl ammonium choride (0.1%), and *n*-Alkyl dimethyl ethylbenzyl ammonium chloride (0.1%). Be sure the disinfectant is not dripping from the wipe. Using light pressure, wipe the surface of the DSC, its cabling, and connectors as indicated by manufacturer's instructions. Dispose of the wipes properly.

BIS Sensor Disposal

The BIS Sensor is a patient-connected, single-use sensor that must be disposed of after each use. Dispose of the sensor per your applicable hospital practice.

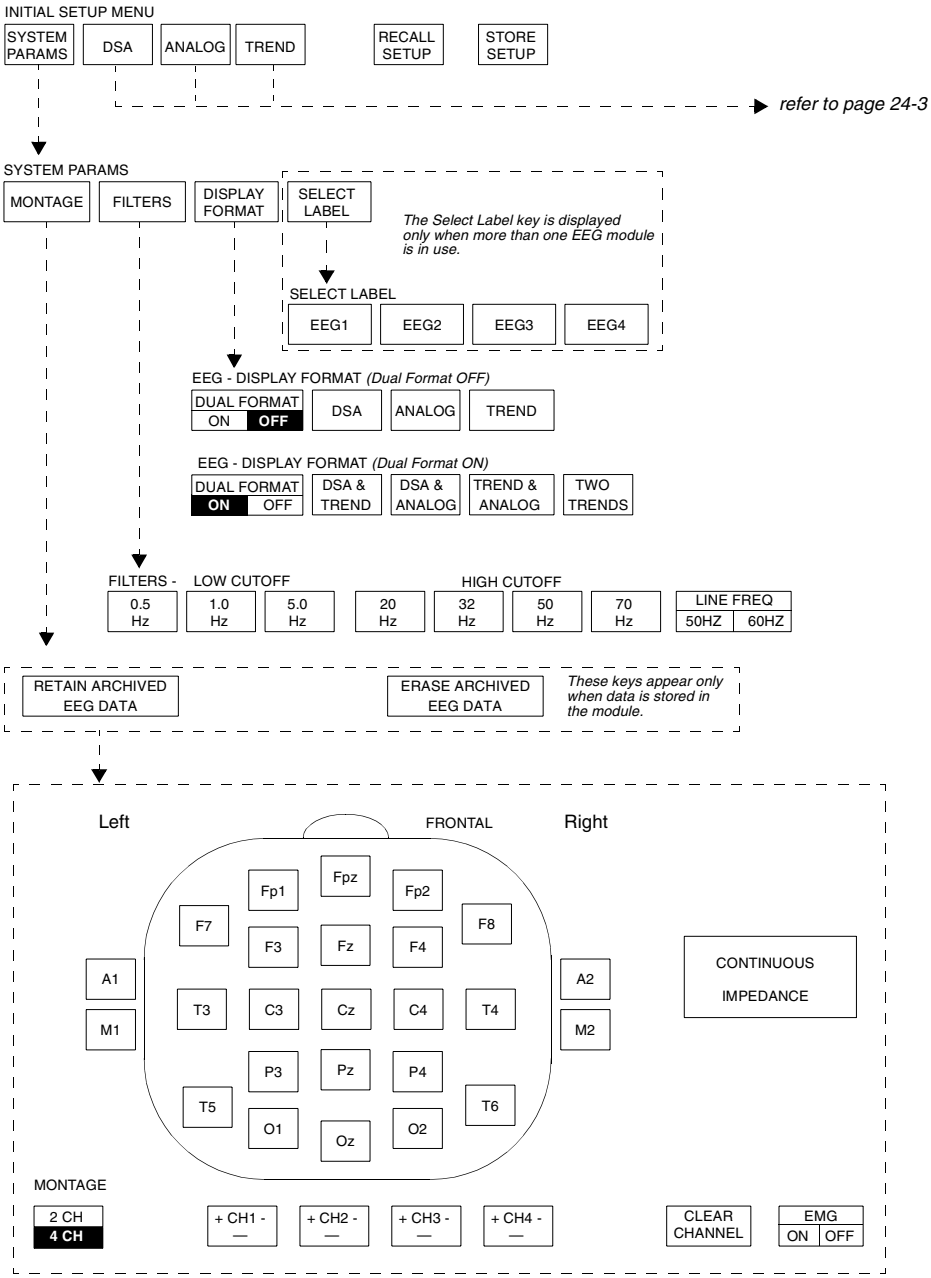
Directory of Keys



- *Based on features purchased and setup configuration, more or fewer keys may appear here than on your menu screens.*

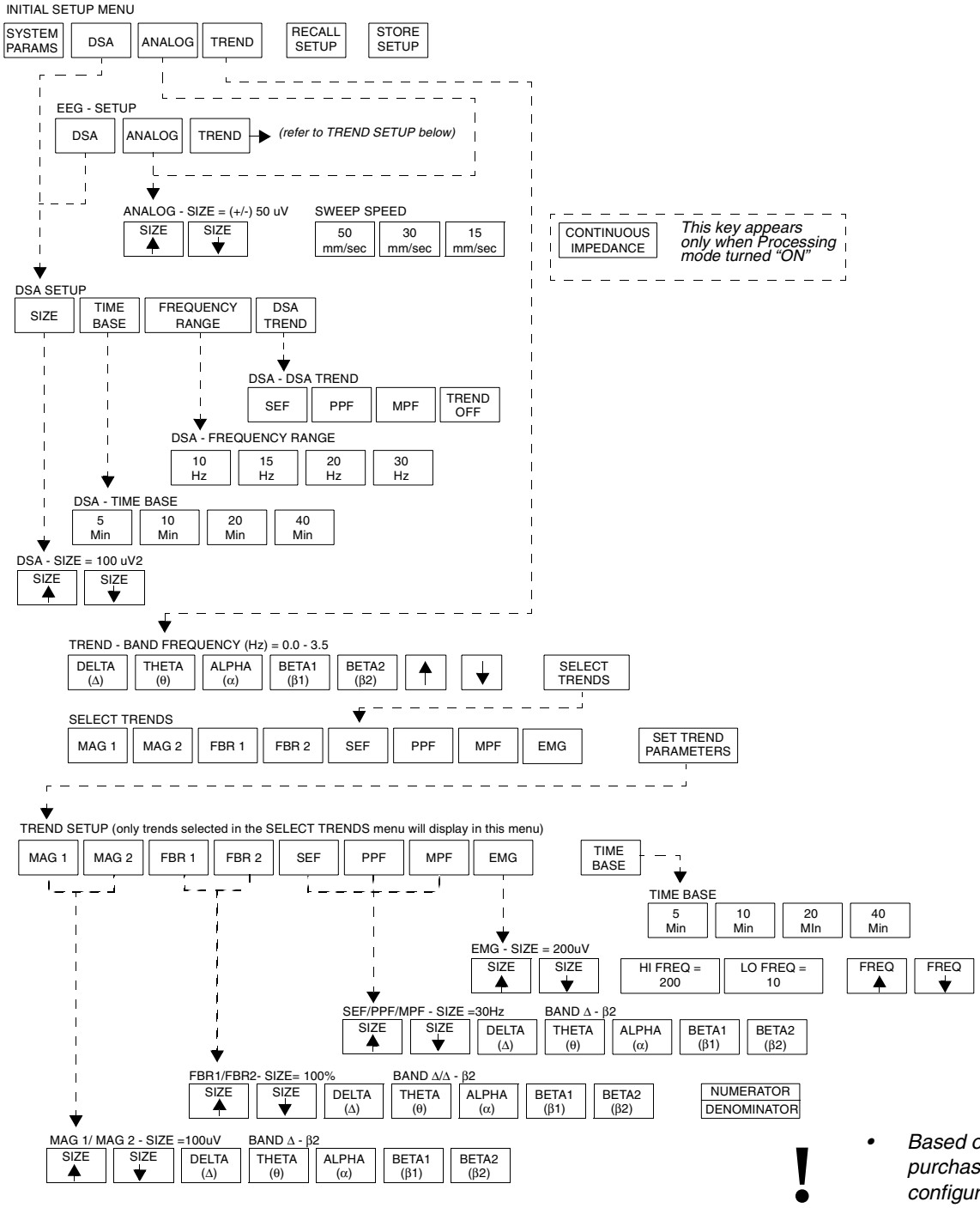
Directory of Keys - Processing Off

SYSTEM PARAMETERS



- *Based on features purchased and setup configuration, more or fewer keys may appear here than on your menu screens.*

Directory of Keys



- *Based on features purchased and setup configuration, more or fewer keys may appear here than on your menu screens.*

EEG

Contents

Overview

The Spacelabs Medical Electroencephalograph (EEG) module is a two or four channel processed EEG monitor, used to acquire, process, and display brain electrical activity. The module also includes one channel of EMG (electromyogram) for measuring and displaying muscle electrical activity.

The EEG can be displayed as an analog waveform or as processed EEG. The analog EEG is displayed as a moving waveform similar to ECG. The analog signal is converted to the frequency domain using the Fast Fourier Transform (FFT) algorithm, and displayed as a spectral plot (density spectral array) or as trended parameters.

EEG data is displayed in a left/right hemisphere orientation for both the analog and processed data. The data appearing on the left part of the display indicates left hemisphere EEG, while the right part of the display shows right hemisphere EEG. This right and left orientation of the display remains consistent throughout the various display types. Display formats include analog EEG, density spectral array (DSA), and various EEG trends.

EEG can be viewed in single or dual format. The single format displays one type of EEG at a time. If you wish to see two EEG formats at one time, choose dual format display. With dual format display, you can see both DSA and analog, trend and analog, DSA and trend, or two trends.

A snapshot of DSA and trends can be stored and recalled. EEG data can also be marked with an event label to facilitate recall for later examination.

The EEG is commonly divided into four frequency bands. From lowest to highest, they are: Delta (less than 4 Hz), Theta (4 to 8 Hz), Alpha (8 to 13 Hz), and Beta (13 Hz and higher). Delta waves emanate from the central region of the brain, and occur most frequently if a patient is an infant or a sleeping adult. Theta waves, also from the central region, occur in children and lightly sleeping adults. Alpha waves originate primarily from the occipital region of the brain, and occur in adults that are relaxed or drowsy. Finally, Beta waves emanate from the parietal and frontal regions of the brain, and indicate that the patient is alert and awake. Normal EEG patterns are influenced by cerebral blood flow, medications, and anesthetic levels.

The beta band can be divided into two bands. The low beta band is labeled beta1 and usually represents signals between about 13 Hz and 20 Hz. The high beta band is labeled beta2 and usually represents signals between about 20 Hz and 30 Hz. It is clinically useful to separate the beta band for trending purposes, especially when looking at high frequency activity.

CAUTION:

- **The Spacelabs Medical model 90481 EEG module should only be used by someone with a knowledge of and/or background in EEG monitoring.**

Setting Up the EEG Module

Up to six setup configurations can be saved and recalled as needed. To recall a particular EEG display setup requires only that you touch one of the six recall setup keys.

After determining what your EEG monitoring needs are, Spacelabs Medical recommends that you pre-configure the EEG module and store your configuration setup. Module configurations should be set up and stored prior to connecting a patient for monitoring. In this way, you can simply select a pre-configured setup after you connect the patient.

Also, some of the configuration menus are not available after EEG processing has started. Therefore, it is recommended that you pre-configure the module, defining the trend parameters, frequency ranges, and other variables (such as those outlined in the bulleted list below), before processing starts. This way, you will not have to stop processing to change some parameters.

The following sections describe:

- How to change the module's EEG monitoring parameters and store them
- The EEG displays
- How to prepare the patient for monitoring
- How to connect the patient to the module
- Bedside and central monitors

Configuring the EEG Module

There are several different ways to configure the EEG module. You can monitor EEG in either two or four channel mode. You may also elect to monitor EMG. The EEG module also allows you to choose several formats for the EEG display, from analog waveforms to trend displays. Since the EEG module can store up to six setups, you will want to determine which setups best suit your needs, and store them in the module. You can then recall any of these configurations simply by recalling a setup you have pre-configured.

Some of the factors to consider when configuring a setup are:

- Electrode placement; what lead placement locations are best for your application?
- Filters; what should the low cutoff, high cutoff and line frequency settings be?
- Display format; what type of data display is best?
- Size; what size best shows the data you have chosen?
- Time base; which time base best reflects the information you need?
- Frequency range; what range do you wish to monitor?
- Trends; do you want to trend an EEG parameter?
- Sweep speed; what speed should an analog display use?
- EEG band frequencies; what frequency ranges do you want to apply to the delta, theta, alpha and beta bands?
- Trends; what size do you want your trends to be? What frequency bands should the trends reflect?

Initial Setup

To access the initial setup menus: (processing must be off)

1 Touch EEG.
2 Touch SETUP.
3 Touch INITIAL SETUP.

Touching the INITIAL SETUP key will display the Initial Setup menu. The Initial Setup menu has four general categories of parameters:

- System Parameters
- DSA
- Analog
- Trends

- *When the module is first inserted into the module housing, processing is stopped. To access the Initial Setup menus after the EEG module is processing information, first turn the processing off.*
- *The following instructions on accessing the initial setup menus assumes that processing is off. The quickstart steps addressing initial setup procedures also assume that processing is off.*

System Parameters

The system parameters sub-menu accesses the montage display, where electrode lead placement is entered and EMG is enabled, the filters sub-menu, used to set the high and low cutoff and line frequency filters, the display format menu, used to choose the data format and the EEG label selecting sub-menu.

To enter electrode lead placement: (processing must be off)

1. Touch EEG.
2. Touch SETUP.
3. Touch INITIAL SETUP.
4. Touch SYSTEM PARAMS.
5. Touch MONTAGE.
6. Touch ERASE ARCHIVED EEG DATA (if data is stored in module).
7. Touch MONTAGE.
8. Select 2 or 4 channel.
9. Select desired channel.
10. Touch CLEAR CHANNEL.
11. Select desired electrode placement sites.
12. Repeat steps 9 through 11 until all channels are defined.

To set low cutoff, high cutoff and line frequency filters:

1. Touch EEG.
2. Touch SETUP.
3. Touch INITIAL SETUP.
4. Touch SYSTEM PARAMS.
5. Touch FILTERS.
6. Select desired low cutoff, high cutoff and line frequency values).

To display EEG in dual format:

1. Touch EEG.
2. Touch DISPLAY FORMAT.
3. Select DUAL FORMAT ON.

To select an EEG label (if using more than one EEG module in one monitor):

1. Touch EEG.
2. Stop processing (if started).
3. Touch SETUP.
4. Touch INITIAL SETUP.
5. Touch SYSTEM PARAMS.
6. Touch SELECT LABEL.
7. Select desired label.

To set the size of DSA:

1 Touch EEG.
2 Touch SETUP.
3 Touch DSA.
4 Touch SIZE.
5 Adjust size.

To set DSA time base:

1 Touch EEG.
2 Touch SETUP.
3 Touch DSA.
4 Touch TIME BASE.
5 Select time base.

To set DSA frequency range:

1 Touch EEG.
2 Touch SETUP.
3 Touch DSA.
4 Touch FREQUENCY RANGE.
5 Select frequency range.

To set DSA trend:

1 Touch EEG.
2 Touch SETUP.
3 Touch DSA.
4 Touch DSA TREND.
5 Select trend.

DSA

The DSA sub-menu offers the following choices:

- SIZE

Use the up and down arrows to size the DSA. When you touch SIZE (after processing has started), the display will show a histogram of the EEG data (*Histogram Display* on page 24-18). As you touch the up and down arrows to change size, you will notice that the histogram changes size.

Choose a histogram size which gives the best DSA contrast for your application.

- TIME BASE

Touch TIME BASE to choose the amount of time the X-axis display represents. Touch either 5,10, 20, or 40 min to select a DSA screen time. The active key will highlight.

- *The trend time base will change to track the DSA time base.*

- FREQUENCY RANGE

Touch the FREQUENCY RANGE key to choose the DSA frequency range. Touch either 10Hz, 15Hz, 20Hz, or 30Hz. The active key will highlight.

- DSA TREND

Touch DSA TREND to choose the type of trend you wish to display on top of the DSA. Choose either SEF, PPF, MPF, or TREND OFF. The active key will highlight.

To display analog EEG:

1 Touch EEG.
2 Touch DISPLAY FORMAT.
3 Select DUAL FORMAT OFF.
4 Touch ANALOG.

To set the analog size:

1 Touch EEG.
2 Touch SETUP.
3 Touch ANALOG.
4 Select size

To select sweep speed:

1 Touch EEG.
2 Touch SETUP.
3 Touch ANALOG.
4 Select sweep speed.

Analog

Touch the ANALOG key to show the sub-menu that allows you to set the SIZE of the analog trace, and the SWEEP SPEED of the display. Use the arrow keys to change the size. Touch the desired sweep speed to select.

To add or delete trend:

1 Touch EEG.
2 Touch SETUP.
3 Touch INITIAL SETUP.
4 Touch TREND.
5 Touch SELECT TRENDS
6 Select or de-select trends.

To select the trend band:

1 Touch EEG.
2 Touch SETUP.
3 Touch INITIAL SETUP.
4 Touch TREND.
5 Select band.
6 Set frequency.

Trends

Touch the TREND key in the INITIAL SETUP menu to access the Band Frequency sub-menu. This sub-menu allows you to set the frequency ranges for the five EEG frequency bands (DELTA, THETA, ALPHA, BETA1, BETA 2). Touch the up or down arrow keys to change the upper frequency range for each band. The lowest frequency for each band is set by the upper frequency of the band to its left.

The SELECT TRENDS key allows you to choose the various trends to be available for selection from the DISPLAY FORMAT, SETUP, and ARCHIVE menus.

You can select any combination of MAG1, MAG2, FBR1, FBR2, SEF, PPF, MPF, or EMG. You may not see all the trend options when you enter the trends sub-menus. This is because you must select which trends appear in the trend sub-menus. Select those trends you wish to have available by accessing the Initial Setup menu, and choosing the trends you want.

Setting Trend Parameters

MAG1, MAG2, SEF, PPF, MPF

The sub-menu provides keys for changing the trend size and frequency band.

- *Greek symbols are used to represent the delta, theta, alpha, and beta bands.*

BAND

Trend parameters are calculated and displayed for the frequency bands set in this menu. For example, magnitude in the alpha band can be calculated by selecting the alpha frequency band for MAG1. You define the frequency range for each band in the Initial Setup Menu.

Touch the appropriate keys to select the frequency band for each trend. If more than one band is required, first touch the lowest frequency band (it will be highlighted), then touch the highest (it will also be highlighted). The keys in-between the lowest and highest frequency will be highlighted to indicate that these bands have been selected.

The frequency band setting is displayed above the frequency band keys on the message line as follows:

BAND x-y

x is the lowest frequency band, and y is the highest.

If only one band is selected, y is blank since the lowest and highest frequency bands are the same.

To set the trend size:

1 Touch EEG.
2 Touch SETUP.
3 Touch TREND.
4 Select trend.
5 Adjust size.

SIZE

Trend size should be set using the SIZE ↑ or SIZE ↓ keys so that the trend parameter lies close to the middle of the graph.

FBR1, FBR2

The frequency band ratio trends are a trend plot of the ratio (in percent) of total power in one frequency band divided by the total power in a second frequency band.

Frequency band ratio trend parameters (FBR1, FBR 2) require a frequency band for the numerator and denominator. The frequency range for each band is defined in the Initial Setup menu.

SIZE

Trend size should be set using the SIZE ↑ or SIZE ↓ keys so that the trend parameter lies close to the middle of the graph.

NUMERATOR DENOMINATOR

Touch the NUMERATOR/DENOMINATOR key and select NUMERATOR. Touch the appropriate keys (DELTA, THETA, ALPHA, BETA 1, BETA 2) to select the frequency band for the numerator. Now touch the DENOMINATOR key, and again choose an appropriate band for the denominator.

If more than one band is required, first touch the lowest frequency band, then the highest.

The frequency band setting is displayed above the frequency band keys on the message line. You will see the following format for the display:

BAND x1-y1/x2-y2

where x1 is the lowest frequency band for the numerator, and y1 is the highest frequency band for the numerator. The lowest frequency band for the denominator is x2, and the highest, y2.

Time base

Touch TIME BASE to choose the amount of time the X-axis display represents. Touch either 5,10, 20, or 40 min to select a trend screen time. The active key will highlight.

- *The DSA time base will change to track the trend time base.*

EMG

SIZE

Trend size should be set using the SIZE ↑ or SIZE ↓ keys so that the trend parameter lies close to the middle of the graph.

FREQUENCY

Select either HI FREQ= or LO FREQ=. Press the FREQ ↑ or FREQ ↓ key until the desired value appears in the XFREQ= key. Repeat for the other key.

Storing a Setup

To store a setup:

1. Touch EEG.
2. Touch SETUP.
3. Touch INITIAL SETUP.
4. Change desired parameters.
5. Touch STORE SETUP
6. Touch the setup key to which you want to store the current setup.

Once you have set the EEG module's parameters the way you want them, you may store the current settings to one of six setup keys. Access the Initial Setup menu by first touching the SETUP key from the Main menu, then touching INITIAL SETUP. From the Initial Setup menu, touch STORE SETUP. You will then see six setup keys labeled SETUP #1, SETUP #2, etc. Store the current settings by touching one of the setup keys.

- *Processing must be stopped before a setup can be stored.*
- *The message EEG Setup Successfully Stored is displayed on the message line when the setup is stored.*

Recalling a Setup

To recall a setup: (processing must be off)

1. Touch EEG.
2. Touch SETUP.
3. Touch RECALL SETUP.
4. Touch ERASE ARCHIVED EEG DATA (if data is stored in module).
5. Touch RECALL SETUP
6. Select desired setup

To recall a setup, make sure processing is stopped, then touch the SETUP key. Touch RECALL SETUP. You will then see the retain or erase archived EEG data keys if data is stored in the module. If you want to change your setup, you will have to erase any archived EEG data. If you choose to retain archived EEG data, you cannot select another setup.

EEG Electrode Lead Selection (Montage)

To select EEG electrode leads:

1. Touch EEG.
2. Touch SETUP.
3. Touch INITIAL SETUP
4. Touch SYSTEM PARAMS.
5. Touch MONTAGE.
6. Touch ERASE ARCHIVED EEG DATA (if data is stored in the module).
7. Select 2 or 4 channel.
8. Select desired channel.
9. Touch CLEAR CHANNEL.
10. Select desired electrode placement sites.
11. Repeat steps 8 through 10 until all channels are defined.

To select which leads you have placed and their placement sites, touch the MONTAGE key (under SYSTEM PARAMS in the Initial Setup) to enter a sub-menu in which the electrodes can be selected and the impedance of each electrode can be measured. First, select either two or four channels for EEG recording. If two channel recording is selected, the CH3 and CH4 keys will be inactive, and the electrode names are removed.

The following procedure is used to select electrode names for each channel:

1. Touch the desired channel key (CH1, CH2, CH3, CH4).
2. Touch the CLEAR CHANNEL key to delete previously defined electrodes for the channel.
3. Touch one of the 25 keys in the montage to select the first electrode. The key will flash on and off, and appear in the channel key as the positive input. Select a second electrode. The key will again flash on and off, and your selection will appear in the channel key as the negative or reference input.

- *The first electrode name displayed in the channel key is the positive input, while the second electrode name is the negative or reference input.*
- *When selecting the next channel, the electrodes that were selected for the first channel will stop flashing, but will remain highlighted.*

4. Touch the CLEAR CHANNEL key to erase both electrode names if you make an error when entering the electrode names. Re-enter the pair of electrode names after you clear them.
5. Touch each of the channel (CH1, CH2, CH3, CH4) keys in succession to complete the setup.

EEG Displays

Display Formats

The EEG module can display several formats. The formats can be grouped into two types: dual display format, and single display format.

The single format displays are:

- DSA
- ANALOG
- TREND

The dual display formats are:

- DSA & TREND
- DSA & ANALOG
- TREND & ANALOG
- TWO TRENDS

!

- *When the format is Two Trends, the message line indicates whether the upper or lower trend is selected by displaying the trend in reverse video.*

Analog EEG Display

To display analog EEG:

1 Touch EEG.
2 Touch DISPLAY FORMAT.
3 Select DUAL FORMAT OFF.
4 Touch ANALOG.

Analog EEG is displayed as a moving waveform for each channel. The trace moves from left to right. The analog waveform clips or flat-lines when the amplitude exceeds full scale.

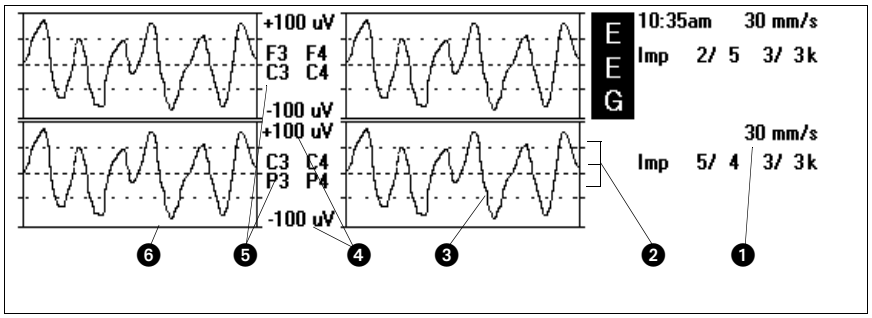


Figure 24-1: Four-channel analog EEG display

❶ Sweep Speed — This number represents the sweep speed of the displayed and recorded analog trace. The sweep speed can be set to 15, 30, or 50 mm/sec. All EEG channels use the same sweep speed.

❷ Amplitude Grid — This grid is drawn under the analog trace and divides the amplitude scale into four segments. A dashed line is drawn at the baseline or center of each display zone. Solid lines are drawn at the top and bottom edge of the zone (peak values), and dotted lines are drawn halfway between the edge of the zone and the baseline. Tick marks are drawn on the Y-axis at each division. Each division represents peak amplitude divided by four.

❸ Analog Waveform — This trace sweeps from left to right, reflecting brain electrical activity for the channel monitored.

❹ Peak to Peak Signal Amplitude — These numbers indicate the maximum and minimum amplitude ranges of the analog signal (set by user).

❺ Electrode labels — These number-letter combinations indicate the electrode lead placement.

❻ Time Axis — Time is measured along the X-axis for each analog trace. Each waveform window displays 4-seconds at a sweep speed of 15 mm/sec, 2-seconds at 30 mm/sec, and 1.2-seconds at 50 mm/sec.

To enable EMG with trend overlay and analog EEG:

1 Touch EEG.
2 Touch DISPLAY FORMAT.
3 Select FREEZE ON.

Freezing the Display

To freeze the analog waveform, touch the FREEZE ON/OFF key. The ON section of the key will highlight. Touch the key again to turn off the freeze, and the OFF section of the key will highlight. Freeze mode is used to stop the moving waveform so transient features can be captured and inspected.

To display DSA EEG with trend overlay:

1 Touch EEG.
2 Touch DISPLAY FORMAT.
3 Select DUAL FORMAT OFF.
4 Touch DSA.
5 Touch PREVIOUS MENU.
6 Touch SETUP.
7 Touch DSA.
8 Touch DSA TREND.
9 Select desired trend.

Density Spectral Array (DSA) EEG Display With Trend Overlay

Processed EEG is displayed as a Density Spectral Array (DSA) similar to the pattern shown in the four channel EEG below. The DSA pattern is shown with a SEF trend overlay.

Data moves from right to left, and is updated every 4-seconds (5-minute time base).

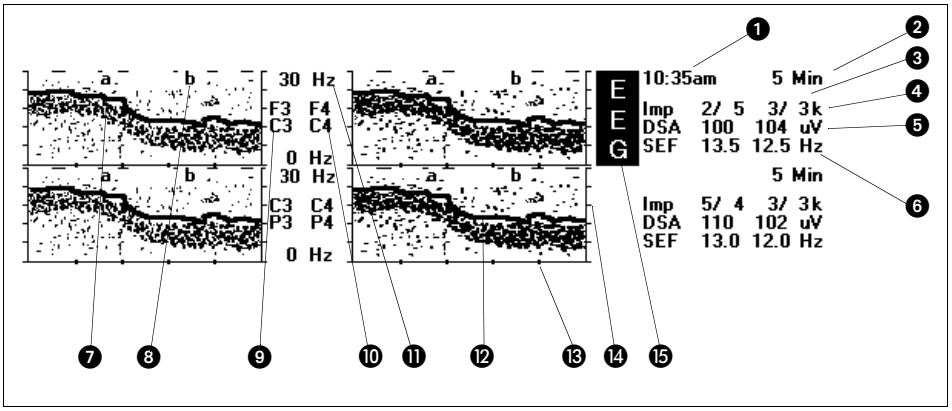


Figure 24-2: Four-channel DSA EEG display with trend overlay

1. Real-time Clock — Displays the time the last epoch was acquired.
2. Time Base — Total time of the DSA plot; ranges from 5- to 40-minutes.
3. Message Line — The following messages can be displayed: NOT PROCESSING, REDISPLAYING, REVIEWED, RECALLED.
4. Electrode Impedance — Electrode impedances are automatically measured and displayed every 5-minutes after processing is started. If electrode impedances are greater than the acceptable range (5 K ohms for each electrode or 2 K ohms differential between the pairs) the impedance values will flash if the impedance of any electrode exceeds 5 K ohms, or if the difference between the electrode pairs exceeds 2 K ohms. If the impedance exceeds 99 K ohms, ++ is displayed.
5. DSA Magnitude (DSA) — Total magnitude of the EEG in the frequency range displayed for the last epoch for channels 1 and 2. The number on the left indicates the left hemisphere magnitude, the right value shows right hemisphere magnitude.
6. Overlay Trend Parameter — Numeric value for channels 1 and 2 of either the Spectral Edge Frequency (SEF), Peak Power Frequency (PPF), or Median Power Frequency (MPF) for the last epoch displayed. The number on the left is the frequency for the left hemisphere of the brain, while the right number is the frequency of the right hemisphere.
7. Artifact Flag — Artifact detection is marked by lighting a pixel on the top line. On color monitors, artifacts will be marked with a red pixel.
8. Event Marker — Used to tag significant clinical events. Can place 52 unique letters; a-z and A-Z. Used in identifying and recalling stored DSA data.

❾ Left Hemisphere Electrode Labels — EEG channels are labeled with lead names selected in the Initial Setup Menu. Here, the left anterior EEG channel is labeled F3-C3, and the left posterior channel is labeled C3-P3.

❿ Right Hemisphere Electrode Labels — In this setup, the label for the right anterior channel is F4-C4, and the right posterior channel is labeled C4-P4.

⓫ Frequency Axis Label — Frequency is displayed along the vertical, or Y axis. The labels indicate the range displayed. The bottom line will always read 0 Hz. The top line will show 10, 15, 20, or 30 Hz, depending on what maximum frequency is chosen.

⓬ Density Spectral Array (DSA) Display With Trend Overlay — For monochrome monitors, the DSA pattern is formed by packing dots in proportion to signal amplitude at each frequency. Frequencies with higher power have higher dot densities. For color monitors, the DSA pattern is formed using seven levels of grey. The intensity of each pixel is proportional to signal amplitude at each frequency. The Trend Overlay is drawn on top of the DSA pattern. The overlay can indicate the Spectral Edge Frequency (SEF), Median Power Frequency (MPF), or Peak Power Frequency (PPF). On color monitors, it appears as a magenta line.

⓭ Time Axis — The horizontal, or X axis represents time. Two vertical columns of pixels are drawn each update period. The display update rate depends on the time base selected. The time base is the total time of the displayed DSA, and can be set to 5-, 10-, 20- or 40-minutes. The time axis is divided into five equal segments using intensified dots.

⓮ Frequency Axis — The vertical or Y axis represents the DSA frequency. The vertical axis is divided into five segments. Each segment is equal to the total frequency displayed, divided by five.

⓯ EEG parameter Key — Touch this key to access all EEG menus. If there is more than one EEG module connected to the monitor, then you can label the keys EEG1, EEG2, EEG3, or EEG4.

Trend Displays

To display EEG trends:

1 Touch EEG.
2 Touch DISPLAY FORMAT.
3 Select DUAL FORMAT OFF.
4 Touch TREND.
5 Select desired trend.

The EEG module can trend up to seven EEG parameters:

- Two magnitude parameters (MAG 1 and MAG 2)
- Two frequency band ratio parameters (FBR 1 and FBR 2)
- Spectral edge frequency (SEF)
- Peak power frequency (PPF)
- Median power frequency (MPF)

All trends should be selected before processing starts. Select the frequency band for each trend in the Setup menu. In the figure below, the magnitude of the EEG (MAG 1) is calculated for the frequency bands delta to beta2 and trended. One trend parameter can be displayed at a time for each EEG channel when dual format is off. The trend is drawn as a double wide line. A five point moving average filter is used to smooth the data on the trend plot.

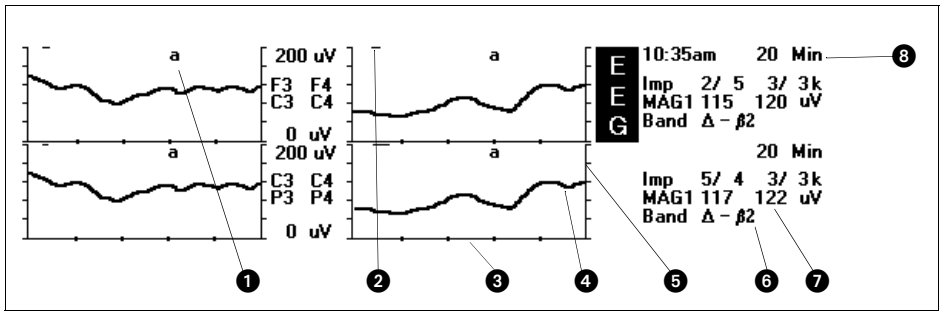


Figure 24-3: Four-channel EEG trend display

1. Event Marker — Used to tag significant clinical events. Can place 52 unique letters; a-z and A-Z. Used in identifying and recalling stored trend data.
2. Artifact Flag — Artifact detection is marked by lighting a pixel on the top line. On color monitors, artifacts will be marked with a red pixel.
3. Horizontal Axis — The horizontal, or X-axis represents time. The time base is the total time of the displayed trend, and can be set to 5-, 10-, 20- or 40-minutes. The time axis is divided into five equal segments using intensified dots.
4. Trend Line — The trend line represents the trended EEG parameter and moves from right to left.
5. Vertical Axis — The vertical, or Y-axis represents either the magnitude (in microvolts), frequency (in hertz), or ratio (in percent). When MAG 1, MAG 2, or EMG are displayed, magnitude is shown (values range from 2μV to 900 μV). When SEF, PPF, or MPF are displayed, frequency is shown (values are 5 Hz, 10 Hz, 15Hz, 20Hz, 30Hz). When FBR 1 or FBR 2 are displayed, percent is shown (values range from 10% to 900%).
6. Band — The EEG band trended (Delta, Theta, Alpha, Beta1, Beta2, or combination. Greek letters are displayed to represent each band).
7. Trend Value — Shows the type of trend displayed and its numeric value. MAG 1 indicates a magnitude trend.
8. Time Base — Total time of the trend plot; ranges from 5- to 40-minutes.

To change the trend time base:

1 Touch EEG.
2 Touch SETUP.
3 Touch TREND.
4 Touch TIMEBASE.
5 Select timebase.

To change DSA size:

1. Touch EEG.
2. Touch SETUP.
3. Touch DSA.
4. Touch SIZE.
5. Set DSA size.

Histogram Display

The histogram display is used to set the appropriate scale or size for the DSA display. This helps to optimize the DSA display contrast. The histogram vectors should fill as much of the window as possible without saturating. The histogram display can also be used to see EEG power and frequency changes in each epoch. It provides expanded information for each column of DSA data. The histogram display is only accessed when changing the DSA size after processing has been started.

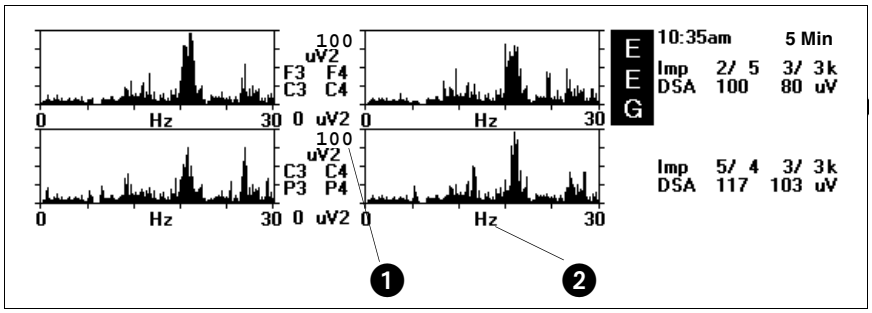


Figure 24-4: EEG display of histograms (4 channels)

❶ Amplitude Axis — The vertical, or Y-axis represents the amplitude. The bottom of the Y-axis is always labeled as 0 uV2 (zero microvolts squared). The top of the Y-axis is labeled with the maximum power you select. The power displayed in the above figure (100 uV2) indicates full scale power of the histogram vectors.

❷ Frequency Axis — The horizontal, or X-axis represents the frequency range (0 to 30Hz) and is divided into five equal sections with tic marks.

Dual Format Display

To display DSA EEG with trend overlay and analog EEG:

1 Touch EEG.
2 Touch DISPLAY FORMAT.
3 Select DUAL FORMAT ON.
4 Touch DSA & ANALOG.
5 Touch EEG.
6 Touch SETUP.
7 Touch DSA.
8 Touch DSA TREND.
9 Select desired trend.

You can display the EEG in two formats simultaneously. Enable dual format from the DISPLAY FORMAT menu. This allows the display of DSA and analog, DSA and trend, trend and analog, or two different trends. In addition, the second display zone can be used to show recalled snapshots of DSA or trends, simultaneously with live DSA or trend data.

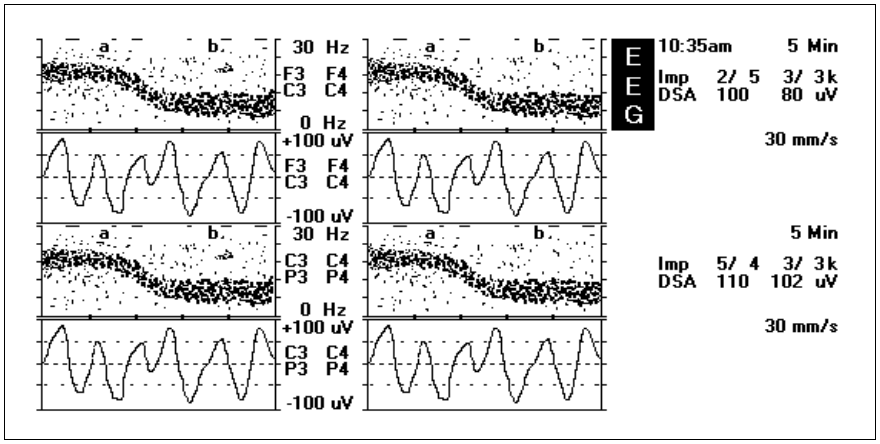


Figure 24-5: Dual format DSA and analog EEG

EMG Display

To enable EMG processing:

1 Touch EEG.
2 Touch SETUP.
3 Touch INITIAL SETUP.
4 Touch SYSTEM PARAMS.
5 Touch MONTAGE.
6 Touch ERASE ARCHIVED EEG DATA (if data is stored in the module).
7 Touch MONAGE.
8 Select EMG ON.

There is one EMG channel that can be used to monitor muscle electrical activity. Select EMG with the EMG ON /OFF key in the Montage menu. The ON section of the key will be highlighted when it is on. Touch the key and select OFF to turn off the EMG channel. The OFF portion of the key will be highlighted.

- *EMG is displayed only as a trend.*

To view EMG trend:

1 Touch EEG.
2 Touch DISPLAY FORMAT.
3 Select DUAL FORMAT OFF.
4 Touch TREND.
5 Touch EMG.

Although EMG uses only one channel, the EMG trend is displayed in each channel so it can be used to compare against EEG when dual format is on.

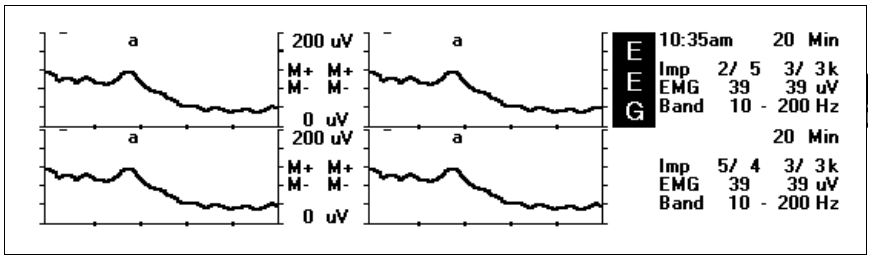


Figure 24-6: EMG display

Archiving EEG

Reviewing EEG Data

The module continuously stores the last 2- to 24-hours of DSA and trend data. The number of hours it can store depends on the amount of memory installed. You can scroll back and forth in half screen increments using the left and right REVIEW keys. Data is not displayed until you remove your finger from the left and right arrow keys. If you keep your finger pressed on one of the arrow keys, you can rapidly scroll to the approximate place in the data. Time and date information for the position in the data is displayed on the message line, as well as any event marks placed in the data.

When reviewed data is being displayed, the message REVIEWED is shown in reverse video on line two of the numeric zone.

- *When DSA & TRENDS are displayed simultaneously in Dual Format mode, the Review keys scroll through DSA and trend data.*

Recalled EEG data (Dual Format Off)

You can store and recall snapshots of DSA and trended data. Recalled data is displayed in the same format as live data.

When dual format is off, recalled EEG data replaces live data for each channel.

When recalled data is being displayed, the message RECALLED is displayed in reverse video on line two of the numeric zone.

Recalled EEG Data (Dual Format On)

When dual format is on, two data formats (e.g., DSA and analog) are displayed. If recalled data is requested, the recalled EEG data is displayed in the second zone. Recalled data is always displayed below the live data. The message RECALLED tells you that the data in the second zone is recalled data. This can be used to display baseline data below the live data.

Live Data

To display live data:

1. Touch EEG.
2. Touch ARCHIVE.
3. Touch LIVE DATA.

Touch the LIVE DATA key to resume displaying live DSA, analog, or trends. This key provides an easy means to return to live data after displaying reviewed data or recalled snapshots.

Marking Events

To mark an event:

1 Touch EEG.
2 Touch MARK EVENT.
3 Touch YES

An event can be identified on the DSA or Trend displays by placing an event label on the display at the point where the event occurs. Up to 52 event labels (a-z; A-Z) can be placed on the DSA and Trend displays. The event label is stored and displayed with the DSA and all Trend displays in all four channels.

After touching the MARK EVENT key, touch the YES key to place an event label. Touch the NO key to cancel marking an event. Touching either key returns you to the main menu.

The next event label to be placed is displayed above the YES/NO keys on the message line. The message appears as follows:

MARK EVENT 'X'

'X' is a letter a-z; A-Z. If the event label is 'Z,' the message Z is the last event mark that can be placed is displayed and the Mark Event key will appear dotted after Z is placed.

- *Event labels will be placed as close in time as possible to the event. The Mark Event key appears dotted when an event label cannot be placed.*

Storing DSA/Trend Snapshots

To store a DSA or trend snapshot:

1 Touch EEG.
2 Touch ARCHIVE.
3 Touch STORE SNAPSHOT.
4 Touch STORE.

From the Main menu, touch the ARCHIVE key, touch the STORE SNAPSHOT key then touch the STORE key.

The following messages are displayed on the message line:
SNAPSHOT = UU (ZZ Snapshots Available)

UU is the snapshot number (1 to 44) and ZZ is the number (0 to 44) of snapshots that can still be stored.

The number of snapshots that can be stored depends on the amount of memory in the EEG module. The base module can store 11 four-channel or 22 two-channel snapshots. If the module has sufficient memory, then up to 44 snapshots (four-channel) can be stored.

Recalling DSA/Trend Snapshots

To recall a DSA or trend snapshot:

1. Touch EEG.
2. Touch ARCHIVE.
3. Touch RECALL SNAPSHOT.
4. Select desired snapshot.
5. Touch Recall.
6. Select DSA or trend parameter.

To print a stored snapshot:

1. Touch EEG.
2. Touch ARCHIVE.
3. Touch RECALL SNAPSHOT.
4. Select desired snapshot.
5. Touch Recall.
6. Select DSA or trend parameter.
7. Touch PRINT.
8. Touch YES.

Touch the RECALL SNAPSHOT key. Use the arrow keys to choose a snapshot. Touch the RECALL key, then touch DSA to display the density spectral array for the selected snapshot, or touch a trend key to display the trended EEG.

- *You can use marked events as a method for keeping track of snapshots that you want to recall. Use the arrow keys to move through the stored data. The message prompt will indicate whether there are any marked events in the snapshot. Note which marked events appear in the message prompt, then recall the snapshot when you see the event label you want. The time and date of each snapshot is also displayed in the message prompt.*

Erasing Snapshots

To erase a DSA/ TREND snapshot:

1. Touch EEG.
2. Touch ARCHIVE.
3. Touch ERASE SNAPSHOT.
4. Select desired DSA/TREND snapshot.
5. Touch ERASE.

Touch ERASE SNAPSHOT to erase DSA/TRENDS snapshots.

Touch the left or right arrow keys to select the snapshot to be deleted.

DSA/Trends snapshots are identified by snapshot number, marked events and time and date at which the snapshot was stored.

Touch the ERASE key to erase the selected snapshot of DSA/Trends.

Printing EEG

To print DSA or Trends:

1. Touch EEG.
2. Touch PRINT.
3. Touch YES.

From the Main menu, touch the PRINT key to display a sub-menu in which all displayed DSA and Trends are printed. One print key controls all four EEG channels. The printout is a screen dump of the entire DSA or trend display zone, including all data displayed in the numeric zone (on the right side of the EEG key).

Touch the YES key to print the DSA and trend display. Touch the NO key to cancel the printout.

- *Analog EEG is not printed using the print key. Use the monitors RECORD key to print Analog EEG.*
- *Recording could be terminated if the analog size is changed during the recording.*

Patient Preparation

To setup EEG or EMG monitoring:

1. Attach lead wires to EEG or EMG electrodes.
2. Apply electrodes
3. Attach electrode lead wires to patient cable.
4. Insert module into module slot.
5. Attach EEG patient cable to module.

Patient Preparation

Electrodes must be properly placed on the patient to obtain the optimum signal. Use small ECG silver/silver chloride electrodes, EEG cup electrodes (silver or gold), or their equivalent. Electrodes are available from Spacelabs Medical.

CAUTION:

- **Only use patient cables specified by Spacelabs Medical. Other cables may degrade performance and may damage the UCW or PCMS monitor during defibrillation. Do not use stainless steel electrodes.**

Attach lead wires to the electrodes before applying them to the patient. If you apply lead wires after applying the electrodes, you may displace some of the conductive gel, resulting in signal degradation. Connect all electrodes needed for EEG monitoring. You will need six electrodes (minimum) for four channel operation, and five electrodes (minimum) for two channel monitoring. Missing electrodes will result in loss of EEG waveforms.

WARNING:

- ***To ensure against any possibility of electric shock, do not touch lead electrodes, or the monitor during defibrillation. The conductive parts of electrodes or any other patient connection should not contact other conductive parts, including the neutral electrode and earth (ground).***
- ***Keep the monitor and its power cord and cables away from the electrosurgery unit and its associated cables and power cord.***
- ***If electrodes are used adjacent to the electrosurgical site, considerable high frequency current may flow through them, causing patient burns, especially if a defect is present in the return pad of the electrosurgical unit. For this reason, electrodes should be placed as far away from the surgery site as possible.***

Prepare the patient for electrode placement as follows:

- If possible, choose a site that avoids hair interference, and is as high on the scalp as possible.
- Clean each site with a medically approved abrasive cleaner (such as OmniPrep™ or NuPrep™) using a cotton tip applicator in a circular motion to mildly abrade the skin. (The abrasive cleaner should not be used on patients with a history of skin allergies to cosmetics or lotions. As a substitute, use a skin degreaser such as alcohol.)
- Use alcohol wipes to further clean each site and remove residual OmniPrep. Then, using dry gauze, rub site briskly, avoiding excessive abrasion of the skin surface.
- Ensure that gel is moist in each electrode.
- Attach lead wires to electrodes before applying to patient.

- Apply electrodes to the site by pressing around the outer edge of the electrode. DO NOT press on the center of the electrode since this may interfere with proper adhesion. The electrode, especially its center, must lie flat against the patient's skin.
- Select CONTINUOUS IMPEDANCE and measure electrode impedances after all electrodes have been placed and lead wires and patient cable are connected. Acceptable maximum impedances: 5 K ohms for each electrode, 2 K ohms differential between the pairs.

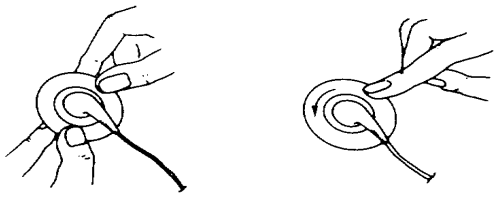


Figure 24-7: Electrode application

Position as high as possible on the placement sites. Avoid hair interference.

Smooth electrode adhesive area to the skin with a circular motion.

!

- *Electrode impedances are automatically measured and displayed every 5-minutes after processing is started. If electrode impedances are greater than the acceptable range (5 K ohms for each electrode or 2 K ohms differential between the pairs) the impedance values will flash if the impedance of any electrode exceeds 5 K ohms, or if the difference between the electrode pairs exceeds 2 K ohms. If the impedance exceeds 99 K ohms, ++ is displayed.*

EEG Electrode Placement

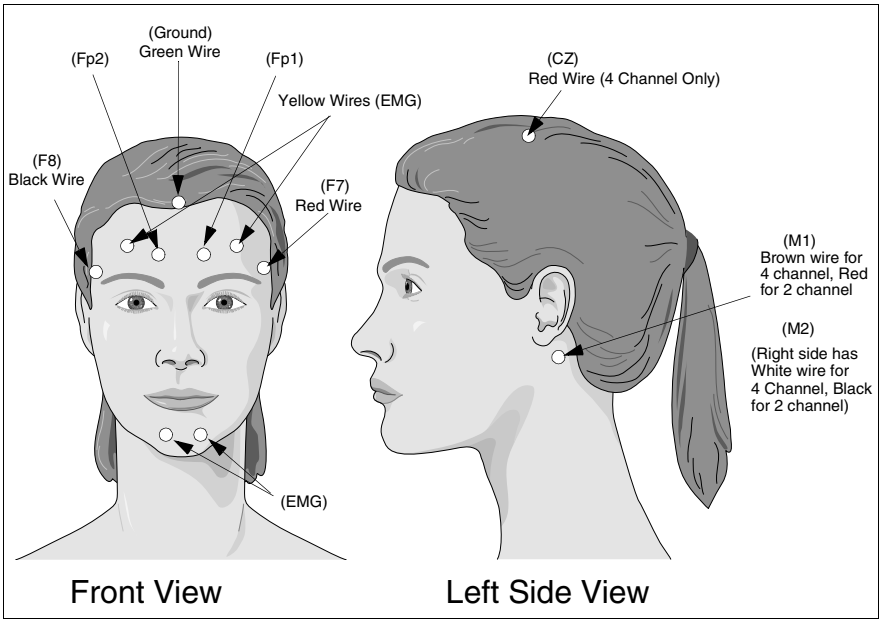


Figure 24-8: Recommended electrode lead placement for the operating room

Channel #	4 Channel	2 Channel
Channel 1	CZ-F7 (Red/Red)	F7-M1 (Red/Red)
Channel 2	CZ-F8 (Red/Black)	F8-M2 (Black/Black)
Channel 3	CZ-M1 (Red/Brown)	
Channel 4	CZ-M2 (Red/White)	
Channel 5	EMG (two yellow)	EMG (two yellow)
2 Ch & 4 Ch	Ground (Green)	Ground (Green)

You have the choice of monitoring in two channel or four channel mode. Note the changes in the color of the leads when using two channel as opposed to four channel mode. Also, if using the four channel mode, note that an extra lead (CZ - Red Wire) is necessary.

!

- *Use the special adaptor to connect CZ (red wire) to the + input of each channel. Use a silver cup for electrode CZ. Attach with conductive paste or collodion.*

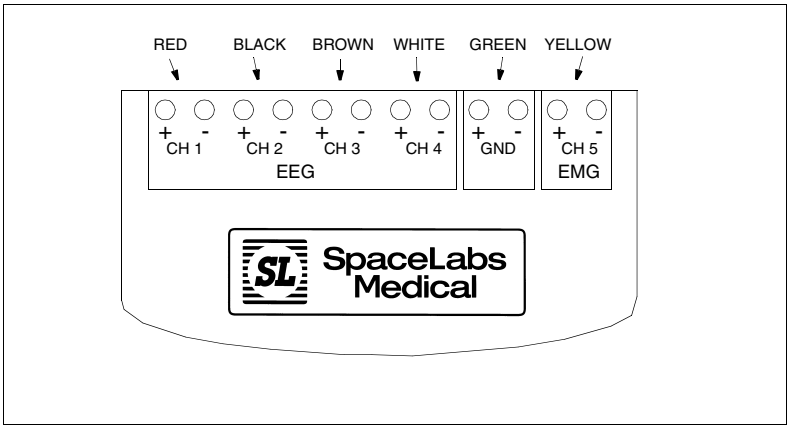


Figure 24-9: EEG patient connector

- *Spacelabs Medical recommends the 10-20 International Electrode Placement System for charting electrode placement on a patient. Use this reference if you require additional information regarding electrode placement.*

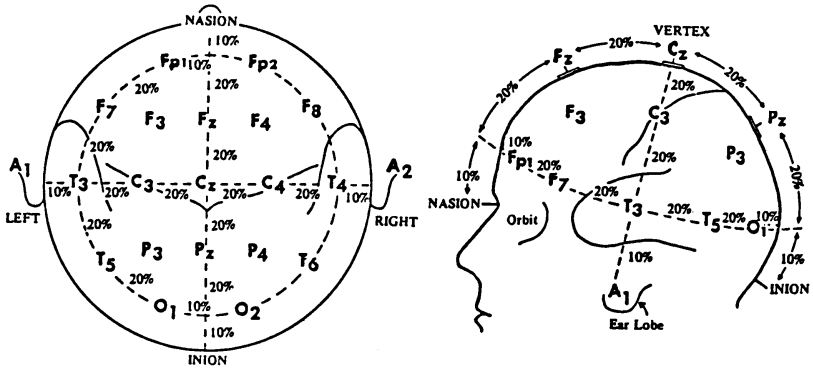


Figure 24-10: 10-20 International electrode placement system

The EEG module contains an electrosurgical interference suppression (ESIS) filter which automatically provides some noise suppression when electrocautery interference is detected.

EMG Electrode Placement

Use two yellow EMG lead wires and place the electrodes as shown in the electrode lead placement illustration. The EMG is displayed as a trend, and uses channel five in the EEG module.

Starting and Stopping Processing

The EEG module can operate in either the processing on or off mode. To set up the module, you need to have processing turned off. Processing off is the default mode when you first insert the module into the module housing.

- *You can only access the Initial Setup menu when processing is off.*

The Initial Setup menu allows you to access other menus needed for defining the various configurations you may want to store.

Only analog EEG is displayed when the power has first been turned on, or the processing has been stopped. Processing of the data and the display of DSA or trends will start when the START PROC key is touched.

To start processing:

1 Touch EEG.
2 Touch START PROC.
3a Touch ERASE ARCHIVED EEG DATA for each new patient.
3b Touch RETAIN ARCHIVED EEG DATA if the data in the module is to be saved.

START PROC

Touch the RETAIN ARCHIVED EEG DATA key to begin processing without erasing EEG data stored in the module. This is useful if processing is suspended, then resumes on the same patient. The key will change to STOP PROC after it is pressed.

Touch the ERASE ARCHIVED EEG DATA key to erase all EEG data presently stored in the module. Processing begins and START PROC changes to STOP PROC.

To stop processing:

1 Touch EEG.
2 Touch STOP PROC.
3 Touch YES.

STOP PROC

Touch the YES key to stop processing and return to the main menu. The STOP PROC key changes back to START PROC. Touch the NO key to return to the main menu without interrupting processing.

Continuous Impedance

To put the module in continuous impedance mode from the Montage screen:

1 Touch EEG.
2 Touch SETUP.
3 Touch INITIAL SETUP.
4 Touch SYSTEM PARAMS.
5 Touch MONTAGE.
6 Touch CONTINUOUS IMPEDANCE.

Touch the CONTINUOUS IMPEDANCE key to put the module in continuous mode. In continuous mode, the impedance of each electrode is measured and displayed every 2-seconds. Use this mode when the electrodes are first placed on the scalp or when the impedance of an electrode is out of range (absolute above 5 K ohms and differential above 2 K ohms), and must be re-applied.

- *EEG/EMG data is corrupted when continuous impedance is selected.*

To put the module in continuous impedance mode:

1 Touch EEG.
2 Touch SETUP.
3 Touch ANALOG.
4 Touch CONTINUOUS IMPEDANCE.

Touch the CONTINUOUS IMPEDANCE key again to un-highlight it, and turn off continuous checking. This places the impedance checking in auto mode, which updates every 5-minutes when processing is on.

The displayed impedance value will flash to alert you if the values are out of range.

- *Continuous Impedance is automatically turned off when leaving the montage or analog setup menus.*

Filters

To set the low cutoff, high cutoff or line frequency filters:

1 Touch EEG.
2 Touch SETUP.
3 Touch INITIAL SETUP.
4 Touch SYSTEM PARAMS
5 Touch FILTERS
6 Select desired filter settings.

You can set the low and high cutoff filters and line frequency filter in the system parameter menu. The low cutoff filter determines the lowest frequency that is displayed and processed, and the high cutoff filter determines the highest frequency that is displayed and processed. The LINE FREQ key selects either 50Hz or 60Hz line frequency.

Touch the FILTERS key to enter the sub-menu where the high cutoff, low cutoff and line frequency filters are set.

Touch one of the keys (0.5Hz, 1.0Hz, 5.0Hz) to select the desired low cutoff filter. The key will be highlighted.

Touch one of the keys (20Hz, 32Hz, 50Hz, 70Hz) to select the desired high cutoff filter. The key will be highlighted.

Touch LINE FREQ and select 50Hz or 60Hz. The selection will be highlighted.

Remote Monitors

This section covers the differences in display format and user menus between the local bedside monitor and remote monitors. EEG cannot be displayed on a split-screen central monitor and remote monitors do not have access to all keys and functions that are available at the local bedside.

Bed Name / Patient Name Interference

If the EEG key is not selected then bed name and patient name are displayed at the bottom of the display zone on remote monitors. This conflicts with display of the EEG data. When the EEG key is selected bed name is displayed on the message line instead.

Display Formats - Remote Bedside

EEG uses one, two or four display zones at the local bedside, depending on how you configure the module. Remote views at bedside monitors only use one display zone to display the remote EEG data.

Case #1 - One display zone used at the local bedside (2 EEG channels, dual format off).

In this case, the remote display of EEG data is almost identical to the local bedside's display of that data (refer to *Figure 24-11*).

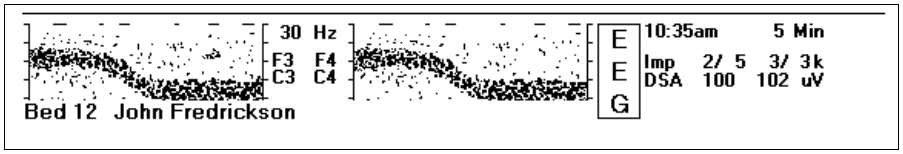


Figure 24-11: EEG remote display
patient name/bed name ON

Case #2 - Two display zones used at the local bedside (4 EEG channels, dual format on or 2 EEG channels, dual format off).

The local bedside requires two display zones to display EEG data for all EEG channels. The remote bedside can only use one display zone for EEG data, so a special key, labeled NEXT VIEW, is displayed in the EEG menu. This key allows you to toggle between each EEG view. The text displayed above this key indicates how many views are available and which is currently being displayed (refer to *Figure 24-12*).

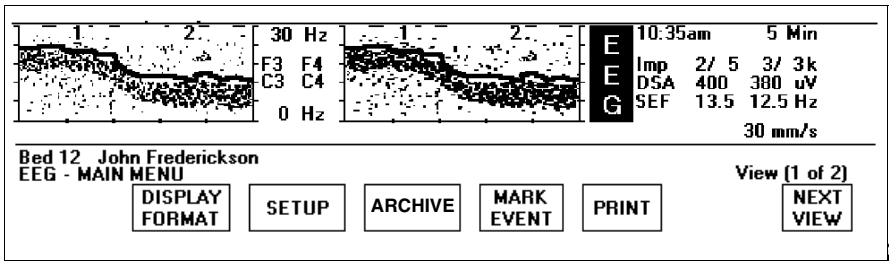


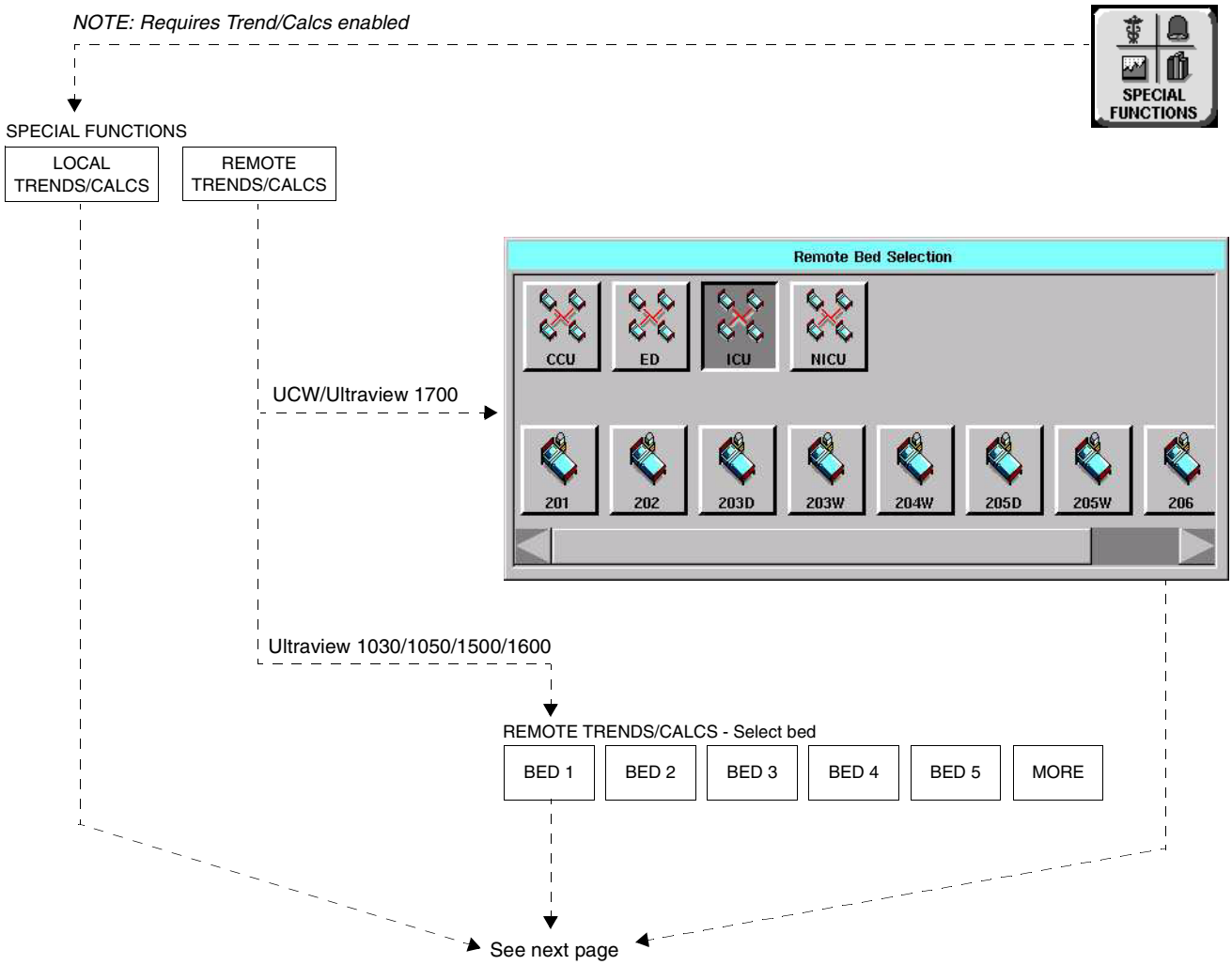
Figure 24-12: EEG remote bedside display
patient name/bed name OFF
Multiple views with NEXT VIEW key

Case #3 - Four display zones used at the bedside (4 EEG channels, dual format on).

The local bedside requires four display zones to display EEG data for all EEG channels. The remote bedside can only use one display zone for EEG data, so a special key, labeled NEXT VIEW, is displayed in the EEG menu. This key allows you to cycle between each EEG view. The text displayed above this key indicates how many views are available and which is currently being displayed.

Calculations Directory

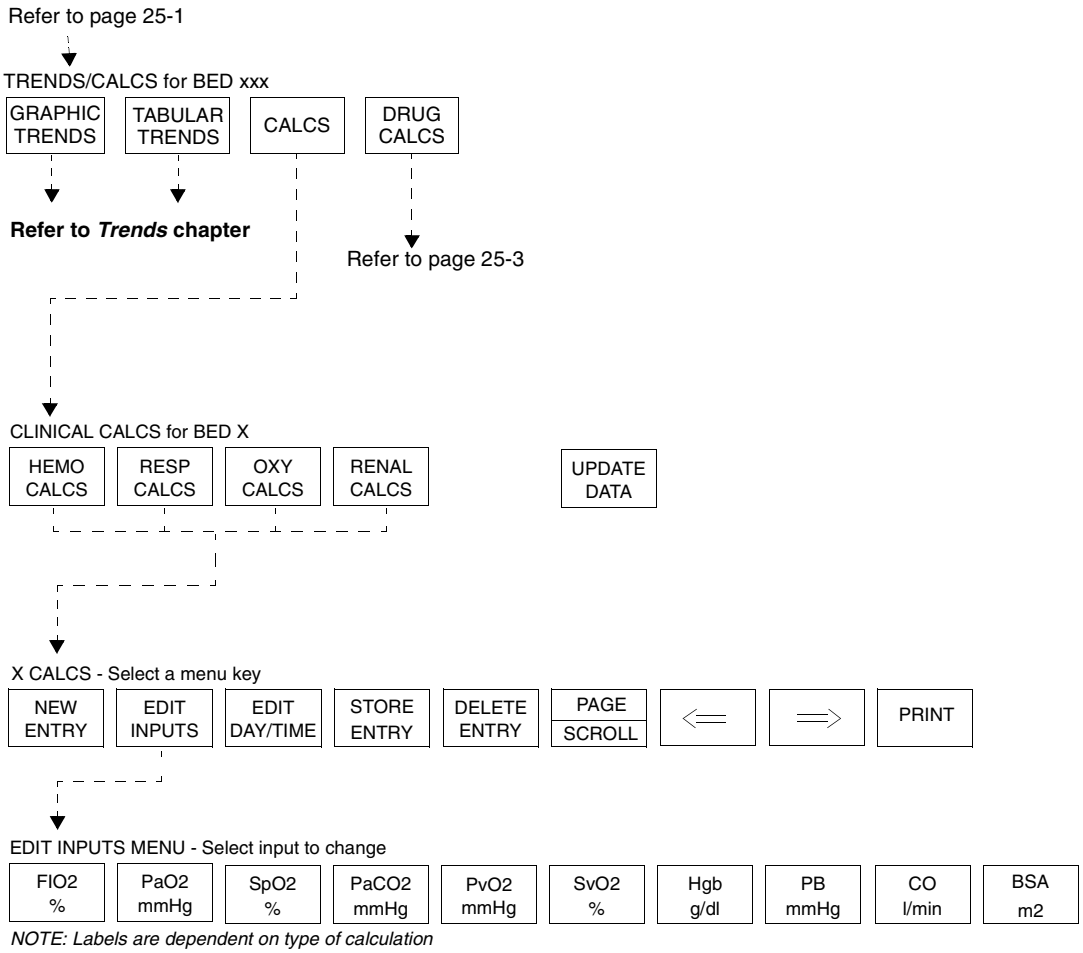
Directory of Keys - Remote Calcs



! • *Based on features purchased, more or fewer keys may appear here than on your menu screens.*

Calculations Directory

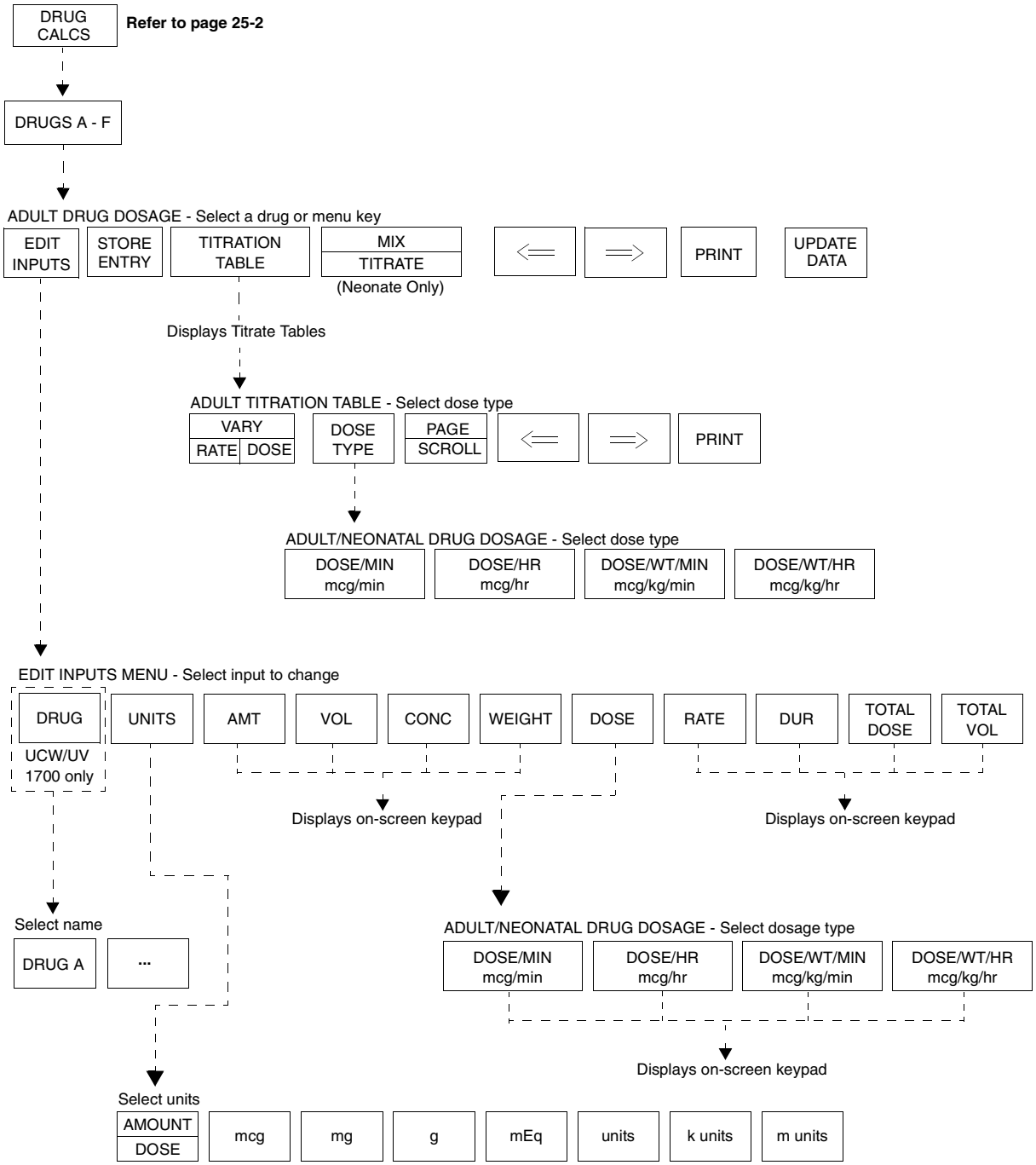
Directory of Keys - Clinical Calcs



NOTE: Labels are dependent on type of calculation

! • *Based on features purchased, more or fewer keys may appear here than on your menu screens.*

Directory of Keys - Drug Dosage



- *Based on features purchased, more or fewer keys may appear here than on your menu screens.*

Calculations

Contents

Overview

The Clinical Calculations feature can be divided into two types: (1) Physiologic and (2) Drug Dosage. Physiologic calculations include hemodynamic, respiration, oxygenation, and renal. These calculations use input values entered manually or collected automatically by the system to produce a set of output values. Drug Dosage calculations enable you to determine infusion rates for drugs based on drug concentration, desired dose, patient weight, and type (adult or neonate).

Setting Up Physiologic Calculations

Values are entered into the system in several ways. You can take a snapshot of currently monitored inputs by selecting the NEW ENTRY key (refer to *Creating a New Entry* on page 25-8). You may also specify a day and time to gather input data from the past, although this function is generally limited to the past 24-hours.

The system displays a combined total of 200 entries into the four physiologic calculations tables. Each table has an Edit Inputs menu that is used to edit input data. You can also create a record of both input and output data by printing the displayed table.

Setting Up Drug Dosage Calculations

The Drug Dosage calculation feature enables you to edit the inputs and to store up to six drug records. Titration tables are displayed for each drug record entered.

Drug dosage calculations operate similarly to physiologic calculations except that weight is handled differently, and that you must select an ADULT or NEONATE patient type. Refer to *Entering Patient Type and Gender* on page 3-9 for details on adult/neonate selection.

WARNING:

- ***If the monitor is turned OFF, all clinical calculations data will be lost.***

Accessing Calculation Data

To access local or remote calcs:

1 Touch SPECIAL FUNCTIONS.
2a Select LOCAL or REMOTE TRENDS/CALCS.
2b If you selected REMOTE TRENDS/CALCS, select a bed.
3 Touch CALCS.
4 Select a calcs key (HEMO, RESP, OXY, RENAL).

Calculations can be accessed via the local bedside monitor or from a remote monitor on the network depending upon the options purchased. Contact your system administrator for details if you are unable to access this function.

The data displayed in the Calculations table is from the local bedside or the specified remote monitor as selected.

Updating Data Between Monitors

The UPDATE DATA key is used to synchronize calculation data between multiple monitors. For example, if lab data for calculations were entered at the central monitor and stored in the bedside monitor database, using the UPDATE DATA key would provide those values for calculations performed at the bedside.

Display Detail - Physiologic Calculations

Tables for Physiologic calculations occupy several display zones above the message line, allowing display of waveforms on the remaining display zones of the screen. The Drug Dosage calculations table has a different format, but occupies the same four lower display zones.

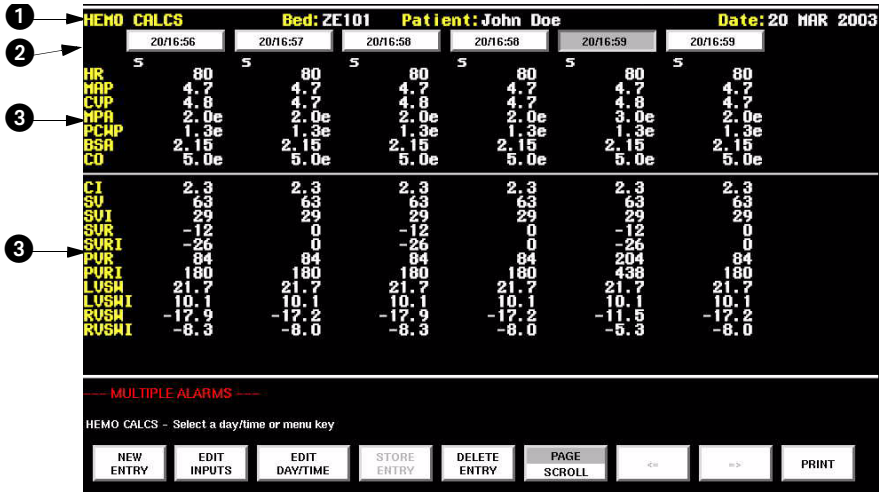


Figure 25-1: Physiologic calculations table

1. The top line of the table shows the type of calculations performed, the bed name, and the patient name.
2. A day/time key is displayed at the top of each data column. Each day/time key indicates the day, hour, and minute. The hours can be in either 12-hour or 24-hour format, depending on the system setup. When you use the 12-hour format, A or P are displayed to indicate either a.m. or p.m.
3. Calculation inputs are listed on the top of the table. Output from the calculations are listed under the dividing line at the bottom of the table. Eight columns of data can display on the screen at once, each column appears under the key which corresponds to the day and time at which the data was collected. New data values are entered to the right of existing ones. If the table is full, older entries are shifted left one column. Data columns that do not display remain in memory. A highlighted key indicates a selected column.

!
- *All keys appear disabled except for NEW ENTRY and PRINT until at least one record (data column) is displayed in the table.*

To view calcs data:

1 Touch CALCS.
2 Select a calcs key.
3a Toggle the PAGE/SCROLL key to SCROLL.
3b Use the → or ← keys to move data by one column.

-OR-

4a Toggle the PAGE/SCROLL key to PAGE.
4b Use the → or ← keys to move data by seven columns.

Scrolling and Paging

Toggle the PAGE/SCROLL key to SCROLL and use the left or right arrows to move the Calculations table over one column in the desired direction. Newer records display to the right, older records to the left.

Toggle the PAGE/SCROLL key to PAGE and use the left or right arrows to move the calculations table over seven columns, or one whole page, in the desired direction. Touch the right arrow key to display the next newer page (seven columns) of records. This key does not function when the newest record is displayed in the table. Touch the left arrow key to display the next oldest page (seven columns) of records. The scrolling stops when the oldest record is displayed on the table.

To create a new entry:

1. Access Local or Remote Calcs.
2. Touch NEW ENTRY.
3. Touch EDIT INPUTS to input new data not available in the system.
4. Select an input key.
5. Use the on-screen keypad to input the value.
6. Touch ENTER on the on-screen keypad.
7. Touch PREVIOUS MENU.
8. Touch STORE ENTRY to retain entry in Calcs table.

Creating a New Entry

Touch the NEW ENTRY key to create a new record for the current day and time and to add the record to the Calculations table. The new record is positioned immediately to the right of existing records. If all the columns on the screen are filled, the display shifts to the left and the new record is displayed in the far right column.

The new record's DAY/TIME key is highlighted and contains the current day and time. The available input values are displayed in the input column and calculated results appear in the output column. Any unavailable inputs or outputs are displayed as question marks.

NEW ENTRY does not function when a total of 200 records exist in all the Physiologic calculations tables for the selected system. If you want to make further entries, you must first delete some of the existing entries from one or more of the calculations tables.

- *Touch NEW ENTRY, then touch STORE ENTRY to store the entry in the database. Entries that have not been stored remain in the table until you select a different bed or patient, then they disappear.*

To edit a record:

1. Access Local or Remote Calcs.
2. Touch EDIT INPUTS.
3. Select an input value to edit.
4. Use the on-screen keypad to change the input value.
5. Touch ENTER on the on-screen keypad.
6. Touch PREVIOUS MENU, then STORE ENTRY to retain entry in Calcs table.

Editing Inputs

Each type of calculation displays its own Edit Inputs menu containing the inputs listed in the upper part of the Calcs table. The name of the input and units of measure appear on each EDIT INPUTS key for the Physiologic calculations. Once an input has been edited, the letter **e** is displayed immediately after the edited value in the table.

- *The displayed units for pressure values, height, and weight may vary based on your monitor's configuration. Contact your system administrator for details.*

When you select an input key, the on-screen keypad appears. Refer to *Using the On-Screen Keypad (Ultraview 1030/1050/1500/1600 only)* on page 3-7 for on-screen keypad operating instructions.

If you enter a height and weight in the BSA menu, the system automatically computes a BSA. However, changing the BSA directly invalidates any height or weight previously entered.

- *Changing the height and weight in the BSA menu does not affect the height and weight in the Admit/Discharge menu.*

Refer to *Table 1* for adult and neonatal BSA, height and weight values for hemodynamics, oxygenation, and renal calculations.

Table 1: BSA, Height, and Weight Calculations

Label	Name	Units	Default Value (1030, 1050, 1500, 1600 only)		Valid Range
			Adult	Neonatal	
BSA	Body Surface Area	m^2	1.81	0.11	0.03 - 3.69
HT	Height	cm in	170 66.9	35 13.8	20 - 215 7.9 - 84.6
WT	Weight	kg lb	70.000 154.324	1.500 3.307	0.2 - 250.0 0.441- 551.156

Editing Day and Time

To create a record for a past time:

1. Access Local or Remote Calcs.
2. Touch NEW ENTRY.
3. Highlight the DAY/TIME key on a new or prior entry.
4. Touch EDIT DAY/TIME.
5. Select DAY, HOURS, or MINUTES.
6. Use the on-screen keypad to change.
7. Touch ENTER on the on-screen keypad.
8. Touch PREVIOUS MENU, then STORE ENTRY to retain entry in Calcs table.

To create a Calculations record for a specified day and time, create a new entry and highlight the DAY/TIME key. Then touch EDIT DAY/TIME and enter the day and time for the record you want to create.

Touch the DAY, HOUR, or MINUTE keys to highlight that key and display the on-screen keypad. The selected parameter and value appear in the on-screen keypad.

The hour can appear in either 12-hour or 24-hour format. If the system is set for 12-hour format, use the AM/PM key to select a.m. and p.m. on the DAY/TIME key.

When editing minutes and hours, you cannot change the value to a future time.

When you have entered the day, hour, and minute via the on-screen keypad, the input values and output calculations reflect data available from the system at the entered time. An **e** appears under any edited DAY/TIME key.

Storing an Entry

To store an entry:

1. Access Local or Remote Calcs.
2. Highlight DAY/TIME key of the entry to be stored.
3. Touch STORE ENTRY.

Touching the STORE ENTRY key after touching the DAY/TIME key stores the record of input values and output calculations in the selected monitor's database. Up to 100 stored records may be saved in each system.

The letter **s** is displayed under the DAY/TIME key to indicate that the record has been stored. If you edit a record after it has been stored, the letter **s** is removed because the newly edited changes have not been stored. Storing a record overwrites the data already stored.

- *Stored records are saved until the system is powered down or until patient data is purged via the Admit/Discharge function.*

Deleting an Entry

To delete an entry:

1. Access Local or Remote Calcs.
2. Highlight DAY/TIME of the entry to be deleted.
3. Touch DELETE ENTRY.
4. Touch YES.

After selecting a DAY/TIME key, you may delete a record by touching the DELETE ENTRY key. A menu is displayed to confirm the deletion. A record previously stored in the database via the STORE ENTRY key will be deleted from the database, as well as from the table.

Automatically displayed records, such as cardiac output data, remain in the database. These records reappear, even if deleted, when you leave and then return to a patient or bed.

Printing

To print calcs data:

1. Access Local or Remote Calcs.
2. Touch PRINT.

Touch the PRINT key to print the currently displayed page of the Calculations table. The complete table prints on a 4-channel recorder. On a 2-channel recorder, the top half of the table prints first followed by the bottom half.

Hemodynamic Calculations

To view current hemodynamic calcs:

1. Touch CALCS.
2. Touch HEMO CALCS.

Hemodynamic calculations provide significant data describing cardiovascular system performance.

Cardiac output values from a Cardiac Output (CO) module automatically create records in the Hemodynamic Calculation table.

Table 2: Hemodynamic Input

Label	Name	Units	Default Value	Valid Range
HR	Heart Rate	beats/min	70	0 - 300
MAP	Mean Arterial Pressure	mmHg kPa	80 10.7	-50 - 300 - 6.7 - 40.0
CVP	Central Venous Pressure	mmHg kPa	10 1.3	-50 - 99 -6.7 - 15.0
MPA	Mean Pulmonary Artery Pressure	mmHg kPa	15 2.0	-50 - 99 -6.7 - 15.0
PCWP	Pulmonary Capillary Wedge Pressure	mmHg kPa	10 1.3	-50 - 99 -6.7 - 15.0
CO	Cardiac Output	l/min	5.0	0 - 40.0

When you create a new entry, any current values for HR, MAP, CVP, MPA, and PCWP are displayed in the table. The system will enter the current body surface value into the table, if available. The most recent CO value (if less than 15-minutes old) is also put into the table. If the system locates a CO value, then values for MAP, CVP, MPA, or PCWP not currently available are put into the table from the CO record. Any inputs which remain unavailable display question marks. The DAY/TIME key displays the current time.

Hemodynamic Calculations require several specific pressure values, including CVP, MAP, and PCWP. CVP and MAP are monitored continuously; PCWP is an episodic value. A data substitution may occur if any of these pressure values are not available when you touch NEW ENTRY. When a substitution occurs, one of the error messages listed here displays on the message line.

- **Warning...RAP has been substituted for CVP.**

  A continuous RAP value is used instead of the continuous CVP value if CVP is not available.

- **Warning...NIBP has been substituted for MAP.**

  An episodic mean NIBP value which is less than 15-minutes old is used instead of MAP if the continuous MAP value is not available.

- **Warning...LAP has been substituted for PCWP.**

  A continuous LAP value is used instead of the episodic PCWP value if the PCWP value is not available or is more than 15-minutes old.

Table 3: Hemodynamic Output

Label	Name	Units
CI	Cardiac Index	L/min^2
SV	Stroke Volume	ml/beat
SVI	Stroke Volume Index	$ml/beat/m^2$
SVR	Systemic Vascular Resistance	$dynes \times sec/cm^5$
SVRI	Systemic Vascular Resistance Index	$(dynes \times sec/cm^5) \times m^2$
PVR	Pulmonary Vascular Resistance	$dynes \times sec/cm^5$
PVRI	Pulmonary Vascular Resistance Index	$(dynes \times sec/cm^5) \times m^2$
LVSW	Left Ventricular Stroke Work	g x min/beat
RVSW	Right Ventricular Stroke Work	g x min/beat
LVSWI	Left Ventricular Stroke Work Index	$g \times min/beat/m^2$
RVSWI	Right Ventricular Stroke Work Index	$g \times min/beat/m^2$

Table 4: Hemodynamic Equations

BSA	$= Ht^{0.725} \times Wt^{0.425} \times 0.007184$
CI	= CO/BSA
SV	= (CO/HR) x 1000
SVI	= SV/BSA
SVR	= 79.9 x [(MAP-CVP)/CO]
SVRI	= 79.9 x [(MAP-CVP)/CI] = 79.9 x [(MAP-CVP)]/[CO/BSA] = 79.9 x [(MAP-CVP)]/[CO x 1/BSA] = 79.9 x [(MAP-CVP)/CO] x BSA = SVR x BSA

Table 4: Hemodynamic Equations (continued)

PVR	= 79.9 x [(MPA-PCWP)/CO]
PVRI	= 79.9 x [(MPA-PCWP)/CI] = 79.9 x [(MPA-PCWP)]/[CO/BSA] = 79.9 x [(MPA-PCWP)]/[CO x 1/BSA] = 79.9 x [(MPA-PCWP)/CO] x BSA = PVR x BSA
LVSW	= 0.0136 x SV x (MAP - PCWP)
RVSW	= 0.0136 x SV x (MPA - CVP)
LVSWI	= LVSW / BSA
RVSWI	= RVSW / BSA
Assumes pressures are measured in mmHg	

Respiration Calculations

To view current respiration calcs:

1 Touch CALCS.
2 Touch RESP CALCS.

Respiration calculations describe the performance of the lungs in the ventilation process.

Unless you have a ventilator Flexport interface, most input values for Respiration calculations must be manually entered.

Table 5: Respiration Input

Label	Name	Units	Default Value	Valid Range
RR	Respiration Rate	breaths/min	20	0-200
$PaCO_2$	Partial Pressure of Arterial Carbon Dioxide	mmHg kPa	40 5.3	0-150 0-20.0
VT	Tidal Volume	ml/breath	500	0-3000
PIP	Peak Inspiratory Pressure	cmH_2O	50	0-200
PLT	Plateau Pressure	cmH_2O	30	0-200
PEEP	Positive End Expiratory Pressure	cmH_2O	10	0-50
$PECO_2$	Partial Pressure of Expired Carbon Dioxide	mmHg kPa	35 4.7	0-150 0-20.0

Table 6: Respiration Output

Label	Name	Units
VMIN	Minute Volume	l/min
Cst	Static Compliance	ml/cmH_2O
Cdyn	Dynamic Compliance	ml/cmH_2O
VD	Dead Space Volume	ml
VD/VT	Dead Space to Tidal Volume Ratio	Ratio
VA	Alveolar Ventilation	ml/min

Table 7: Respiration Equations

VMIN	= VT x RR/1000
Cst	= VT/(PLT-PEEP)
Cdyn	= VT/(PIP-PEEP)
VD	= ($PaCO_2$ - $PECO_2$) x ($VT/PaCO_2$)
VD/VT	= VD/VT
VA	= (VT - VD) x RR

Oxygenation Calculations

To view current oxygenation calcs:

1 Touch CALCS.
2 Touch OXY CALCS.

Oxygenation calculations provide specific data describing the efficiency with which the body acquires, circulates, and utilizes oxygen in the cardiopulmonary system. Input values for Oxygenation calculations are automatically obtained from SpO_2, $S\bar{v}O_2$, cardiac output modules, or Flexport interfaces. You must manually enter inputs for laboratory blood analysis values.

Table 8: Oxygenation Input

Label	Name	Units	Default Value	Valid Range
$Fi0_2$	Fractional Inspired Oxygen	%	50	0 - 100
PaO_2	Partial Pressure of Arterial Oxygen	mmHg kPa	100 13.3	0 - 500 0 - 70.0
SpO_2	Arterial Oxygen Saturation	%	97	0 - 100
$PaCO_2$	Partial Pressure of Arterial Carbon Dioxide	mmHg kPa	40 5.3	0 - 150 0 - 20.0
$P\bar{v}O_2$	Partial Pressure of Mixed Venous Oxygen	mmHg kPa	38 5.1	0 - 99 0 - 15.0
$S\bar{v}O_2$	Mixed Venous Oxygen Saturation	%	75	0 - 99

Calculating O_2AV, O_2AVI, VO_2, and VO_2I requires a CO value to complete the calculations. The most recent CO value (less than 15-minutes old) is used for these calculations if it is available.

Table 9: Oxygenation Output

Label	Name	Units
$CTaO_2$	Arterial Oxygen Content	ml/dl
$CTvO_2$	Venous Oxygen Content	ml/dl
$avDO_2$	Arteriovenous Oxygen Content difference	ml/dl
O_2AV	Oxygen Availability	ml/min
O_2AVI	Oxygen Availability Index	$ml/min/m^2$
VO_2	Oxygen Consumption	ml/min
VO_2I	Oxygen Consumption Index	$ml/min/m^2$
O_2ER	Oxygen Extraction Ratio	None
PAO_2	Partial Pressure of Alveolar Oxygen	mmHg kPa
Qs/Qt	Pulmonary Venous Admixture Shunt	%
P/F	PaO_2/FiO_2 ratio	None

Table 10: Oxygenation Equations

$CTaO_2$	$= (1.34 \times Hgb \times SpO_2 100) + (0.0031 \times PaO_2)$
$CTvO_2$	$= (1.34 \times Hgb \times S\bar{v}O_2/100) + (0.0031 \times P\bar{v}O_2)$
$avDO_2$	$= CTaO_2 - CT\bar{v}O_2$
O_2AV	$= CTaO_2 \times CO \times 10$
O_2AVI	$= O_2AV/BSA$
VO_2	$= avDO_2 \times CO \times 10$
VO_2I	$= VO_2/BSA$
O_2ER	$= (CTaO_2 - CTvO_2)/CTaO_2$
PAO_2	$= [(FiO_2/100) \times (PB^*-47)] - PaCO_2 /0.8$
Qs/Qt	$= 100 \times \frac{[(1.34 \times Hgb) + (0.0031 \times PAO_2) - CT\bar{a}O_2]}{[(1.34 \times Hgb) + (0.0031 \times PAO_2) - CT\bar{v}O_2]}$
* PB = Barometric Pressure	

Renal Calculations

To view current renal calcs:

1 Touch CALCS.
2 Touch RENAL CALCS.

Renal calculations provide data related to kidney function. Input for Renal calculations, other than a previously entered BSA, must be manually entered. The system automatically computes BSA when you enter a height and weight into this menu.

Table 11: Renal Input

Label	Name	Units	Default Value	Valid Range
URK	Urine Potassium	mEq/l	60	0 - 300
PLOSM	Plasma Osmolality	mOsm/L	290	0 - 999
UROSM	Urine Osmolality	mOsm/L	575	0 - 9999
SerNa	Serum Sodium	mEq/l	140	0 - 999
CR	Serum Creatinine	mg/dl	1.10	0 - 9.99
UCR	Urine Creatinine	mg/dl	50.0	0 - 999.9
BUN	Blood Urea Nitrogen	mg/dl	12	0 - 999
URNa	Urine Sodium	mEq/L	90	0 - 999
URINE	Urine Volume	ml/day	2000	0 - 9999

Table 12: Renal Output

Label	Name	Units
URNaEX	Urine Sodium Excretion	mEq/day
URKEX	Urine Potassium Excretion	mEq/day
Na/K	Urine Sodium: Potassium Ratio	Ratio
COSM	Osmolal Clearance	ml/day
CH_2O	Water Clearance	ml/day
U/POSM	Urine: Plasma Osmolality Ratio	Ratio
FENa	Fractional Sodium Excretion	%
CRCL	Creatinine Clearance	$ml/min/m^2$
NSLOSS	Non-Saline Loss	ml/day
BUN/CR	BUN: Creatinine Ratio	Ratio
U/CR	Urine: Serum Creatinine Ratio	Ratio

Table 13: Renal Equations

URNaEX	= URNa x URINE/1000
URKEX	= URK x URINE/1000
Na/K	= URNa/URK
COSM	= (UROSM/PLOSM) x URINE
CH_2O	= URINE - COSM
U/POSM	= UROSM/PLOSM
FENa	= (URNa/SerNa) x (CR/UCR) x 100
CRCL	= (UCR/CR) x (URINE/1440) x 1.73/BSA
NSLOSS	= URINE - (URINE x UrNa/SerNa)
BUN/CR	= BUN/CR
U/CR	= UCR/CR

Drug Dosage Calculations

When you touch DRUG CALCS, either the Adult Drug Calcs screen or the Neonatal Drug Calcs screen displays, along with the Drug Dosage menu (refer to *Figure 25-2* and *Figure 25-3)*.

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- *Since only three columns appear on the screen at one time, each illustration includes two screens — one with columns for Drug A, B, and C, and one with columns for Drug D, E, and F.*

Display Detail - Drug Dosage Calculations

ADULT DRUG CALCS Bed: ZE101 Patient: John Doe Date: 20 MAR 2003

	DRUG A		DRUG B		DRUG C	
NAME						
AMOUNT	400.00	mg	2.00	g	16.00	mg
VOLUME	250	ml	250	ml	250	ml
CONC	1.60	mg/ml	8.00	mg/ml	64.00	mcg/ml
WEIGHT	88.451e	kg	88.451e	kg	88.451e	kg
DOSE	500.00	mcg/min	2.00	mg/min	10.00	mcg/min
	30.00	mg/hr	120.00	mg/hr	600.00	mcg/hr
	5.65	mcg/kg/min	22.61	mcg/kg/min	0.11	mcg/kg/min
	339.17	mcg/kg/hr	1.36	mg/kg/hr	6.78	mcg/kg/hr
RATE	18.75	ml/hr	15.00	ml/hr	9.38	ml/hr
DURATION	1.00	hr	1.00	hr	1.00	hr
TOTAL DOSE	30.00	mg	120.00	mg	600.00	mcg
TOTAL VOL	18.75	ml	15.00	ml	9.38	ml

ADULT DRUG CALCS Bed: ZE101 Patient: John Doe Date: 25 MAR 2003

	DRUG D		DRUG E		DRUG F	
NAME						
AMOUNT	50.00	mg	50.00	mg	50.00	mg
VOLUME	250	ml	250	ml	250	ml
CONC	200.00	mcg/ml	200.00	mcg/ml	200.00	mcg/ml
WEIGHT	88.451e	kg	88.451e	kg	88.451e	kg
DOSE	200.00	mcg/min	200.00	mcg/min	200.00	mcg/min
	12.00	mg/hr	12.00	mg/hr	12.00	mg/hr
	2.26	mcg/kg/min	2.26	mcg/kg/min	2.26	mcg/kg/min
	135.67	mcg/kg/hr	135.67	mcg/kg/hr	135.67	mcg/kg/hr
RATE	60.00	ml/hr	60.00	ml/hr	60.00	ml/hr
DURATION	1.00	hr	1.00	hr	1.00	hr
TOTAL DOSE	12.00	mg	12.00	mg	12.00	mg
TOTAL VOL	60.00	ml	60.00	ml	60.00	ml

Figure 25-2: Adult drug calcs (drug keys A - F)

NEONATAL DRUG CALCS Bed: ZE101 Patient: John Doe Date: 25 MAR 2003

	DRUG A MIX		DRUG B MIX		DRUG C MIX	
NAME						
AMOUNT	10.00	mg	1.00	mg	2.50	g
VOLUME	100	ml	100	ml	100	ml
CONC	100.00	mcg/ml	10.00	mcg/ml	25.00	mg/ml
WEIGHT	1.500	kg	1.500	kg	1.500	kg
DOSE	7.50	mcg/min	0.75	mcg/min	83.33	mcg/min
	450.00	mcg/hr	45.00	mcg/hr	5.00	mg/hr
	5.00	mcg/kg/min	0.50	mcg/kg/min	55.56	mcg/kg/min
	300.00	mcg/kg/hr	30.00	mcg/kg/hr	3.33	mg/kg/hr
RATE	4.50	ml/hr	4.50	ml/hr	0.20	ml/hr
DURATION	1.00	hr	1.00	hr	1.00	hr
TOTAL DOSE	450.00	mcg	45.00	mcg	5.00	mg
TOTAL VOL	4.50	ml	4.50	ml	0.20	ml

NEONATAL DRUG CALCS Bed: ZE101 Patient: John Doe Date: 25 MAR 2003

	DRUG D MIX		DRUG E MIX		DRUG F MIX	
NAME						
AMOUNT	3.00	mg	3.00	mg	3.00	mg
VOLUME	100	ml	100	ml	100	ml
CONC	30.00	mcg/ml	30.00	mcg/ml	30.00	mcg/ml
WEIGHT	1.500	kg	1.500	kg	1.500	kg
DOSE	0.75	mcg/min	0.75	mcg/min	0.75	mcg/min
	45.00	mcg/hr	45.00	mcg/hr	45.00	mcg/hr
	0.50	mcg/kg/min	0.50	mcg/kg/min	0.50	mcg/kg/min
	30.00	mcg/kg/hr	30.00	mcg/kg/hr	30.00	mcg/kg/hr
RATE	1.50	ml/hr	1.50	ml/hr	1.50	ml/hr
DURATION	1.00	hr	1.00	hr	1.00	hr
TOTAL DOSE	45.00	mcg	45.00	mcg	45.00	mcg
TOTAL VOL	1.50	ml	1.50	ml	1.50	ml

Figure 25-3: Neonatal drug calcs (drug keys A - F)

Select the DRUG A - F keys as you selected the DAY/TIME keys in other calculations tables. When you begin drug dosage calculations, the patient's currently stored weight (automatically converted to kilograms) appears in the table. Thereafter, selecting a drug key allows you to edit the data in the column below it.

The DRUG A - F keys do not display actual drug names. However each column's default values are derived from common mixtures of frequently used drugs.

Table 14: Drug Dosage Equations

CONC	= Amount/Volume
RATE	= Dose/Conc
DOSE	= Rate x Conc
TOTAL VOL	= Rate x Duration
TOTAL DOSE	= Dose x Duration

To access local or remote calcs and drug calcs:

1 Touch SPECIAL FUNCTIONS.
2a Select LOCAL or REMOTE TRENDS/CALCS.
2b If you selected REMOTE TRENDS/CALCS, select a bed.
3 Touch DRUG CALCS.
4 Select DRUG A, B, C, D, E, or F.

To enter a drug dose value:

1 Access Local or Remote Drug Calcs.
2 Touch EDIT INPUTS.
3 Select the desired key.
4 Use on-screen keypad to change value.
5 Touch ENTER on the on-screen keypad.

Entering Drug Dosage Values

From the Drug Dosage menu you can edit the inputs, store up to six drug records, display two titration tables for each of these drug records, and print any of the displayed information.

You can enter drug values for adults or neonates, depending on the current patient type selection (refer to *Discharging a Patient* on page 3-9 for more information). If NEONATE was selected, the MIX/TITRATE key is displayed. The MIX/TITRATE key toggles to highlight either MIX or TITRATE and affects how calculations are performed when the DOSE is edited.

While WEIGHT is the only drug dosage input automatically entered by the system, default values are present when you first display the table. You can edit any value by manually entering a new value. Weight must be entered in kilograms.

Table 15: Drug Dosage Calculations

Label	Name	Valid Range	Possible Units of Measure
AMT	Amount	0.01-9999.99	mcg, mg, g, mEq, units, k units, m units
VOL	Volume	1-9999	ml
CONC	Concentration	0.01-9999.99	mcg/ml, mg/ml, g/ml, mEq/ml, units/ml, k units/ml, m units/ml
WEIGHT	Weight	0.2-250.0	kg
DOSE/MIN & DOSE/HR	Dose/Time	0.01-9999.99	* mcg/xx, mg/xx, g/xx, mEq/xx, units/xx, k units/xx, m units/xx
DOSE/WT/MIN & DOSE/WT/HR	Dose/Weight/Time	0.01-9999.99	* mcg/kg/xx, mg/kg/xx, g/kg/xx, mEq/kg/xx, units/kg/xx, k units/kg/xx, m units/kg/xx
RATE	Flow Rates	0.1-999.99	ml/hr
DUR	Duration	0.1-999.99	hr
TOTAL DOSE	Total Dose	0.01-9999.9	mcg, mg, g, mEq, units, k units, m units
TOTAL VOL	Total Volume	0.1-9999.99	ml
* where xx is minutes or hours			

To begin editing input values, touch a DRUG key. Touch EDIT INPUTS to display the Edit Inputs menu. Touch any input key on the Edit Inputs menu, except UNITS and DOSE (described later), to display the on-screen keypad. During editing, the menu prompt shows the minimum and maximum values you can enter. Touch ENTER in the on-screen keypad to update the Drug Dosage table.

Changing Units of Measure

To change drug units:

1. Access Local or Remote Drug Calcs.
2. Touch EDIT INPUTS.
3. Touch UNITS.
4. Select units to change.

Units of measurement are displayed on the table to the right of the data values. Changing the selected units for AMOUNT may also change the displayed units for CONC. Changing the selected units for DOSE may also change the displayed units for DOSE/WT and TOTAL DOSE.

If the values for CONC, DOSE/HR, DOSE/WT/HR, and TOTAL DOSE exceed the range of their currently selected units, that value is divided by 1000 and the units change accordingly. For example, if the value for TOTAL DOSE is 123,456 mg, it will be displayed as 123.46 g. This value is rounded because only two digits can be displayed to the right of the decimal point.

WEIGHT is displayed in kilograms (kg), regardless of the system's setting for weight. Weights in pounds automatically convert to kilograms prior to being displayed.

Units Submenu

This menu allows you to choose one of three types of units (grams, mEq, and units) for AMOUNT or DOSE.

Changing the units for AMOUNT may change the units for CONC. Changing the unit type for AMOUNT changes the unit type for DOSE. Either may scale the values and units for CONC, DOSE, DOSE/WT, and TOTAL DOSE up or down for values less than 0.01 or greater than 9999.99.

Changing the units for DOSE may change the units for DOSE/WT and TOTAL DOSE. As a result, both the minute and hour values for DOSE and DOSE/WT may change.

Dose Submenu

When you select DOSE in the Edit Inputs menu, four dose type keys are displayed. Select any of these keys to edit the corresponding value shown in the Drug Dosage Calculations table. The system automatically calculates and displays the changes for the other three dose types in the Drug Dosage Calculations table.

The dose type selected for a specific drug defines the dose unit used for that drug's titration tables. When you store a Drug Calculation record, the dose type is also stored.

Storing a Record

To store a drug record entry:

1. Access Local or Remote Drug Calcs.
2. Select a Drug key.
3. Touch STORE ENTRY.

Touch STORE ENTRY to store the record and to display the letter **s** under the associated DRUG key. You can store six records, one for each DRUG key. If you edit a record that has been stored, the system removes the letter **s** because the newly edited changes have not been stored.

Displaying Titration Tables

To display titration tables:

1 Access Local or Remote Drug Calcs.
2 Touch TITRATION TABLE.

To vary based on rate/dose:

1 Access Local or Remote Drug Calcs.
2 Touch TITRATION TABLE.
3 Touch VARY RATE/DOSE.

The VARY RATE/DOSE toggle key and DOSE TYPE keys are displayed when you touch TITRATION TABLE. VARY RATE varies the rate (holding the concentration constant) and calculates (titrates) the corresponding dose using the selected dose unit type. VARY DOSE varies the dose (holding the drug concentration constant) and calculates (titrates) the corresponding delivery rate in ml/hr.

The DOSE TYPE key displays the DOSE TYPE menu where the dose values are displayed and the Titration table is updated with the selected dose type. This key is disabled whenever VARY RATE is selected, and enabled when VARY DOSE is selected.

In the titration tables, flow rate and dose are calculated using the equations below.

$$\text{FLOW RATE in ml/hr} = \frac{\text{DOSE x 60 min/1 hr}}{\text{AMOUNT/VOLUME}}$$

$$\text{DOSE in xx/min} = \frac{\text{FLOW RATE x AMOUNT x 1hr/60 min}}{\text{VOLUME}}$$

NEONATAL DRUG CALCS Bed: ZE101 Patient: John Doe Date: 25 MAR 2003
AMOUNT = 10.00 mg DOSE = 7.50 mcg/min DRUG A
VOLUME = 100 ml RATE = 4.50 ml/hr WEIGHT = 1.500 kg

Dose	Rate	Dose	Rate	Dose	Rate	Dose	Rate	Dose	Rate
7.33	4.40	10.67	6.40	14.00	8.40	17.33	10.40	20.67	12.40
7.50	4.50	10.83	6.50	14.17	8.50	17.50	10.50	20.83	12.50
7.67	4.60	11.00	6.60	14.33	8.60	17.67	10.60	21.00	12.60
7.83	4.70	11.17	6.70	14.50	8.70	17.83	10.70	21.17	12.70
8.00	4.80	11.33	6.80	14.67	8.80	18.00	10.80	21.33	12.80
8.17	4.90	11.50	6.90	14.83	8.90	18.17	10.90	21.50	12.90
8.33	5.00	11.67	7.00	15.00	9.00	18.33	11.00	21.67	13.00
8.50	5.10	11.83	7.10	15.17	9.10	18.50	11.10	21.83	13.10
8.67	5.20	12.00	7.20	15.33	9.20	18.67	11.20	22.00	13.20
8.83	5.30	12.17	7.30	15.50	9.30	18.83	11.30	22.17	13.30
9.00	5.40	12.33	7.40	15.67	9.40	19.00	11.40	22.33	13.40
9.17	5.50	12.50	7.50	15.83	9.50	19.17	11.50	22.50	13.50
9.33	5.60	12.67	7.60	16.00	9.60	19.33	11.60	22.67	13.60
9.50	5.70	12.83	7.70	16.17	9.70	19.50	11.70	22.83	13.70
9.67	5.80	13.00	7.80	16.33	9.80	19.67	11.80	23.00	13.80
9.83	5.90	13.17	7.90	16.50	9.90	19.83	11.90	23.17	13.90
10.00	6.00	13.33	8.00	16.67	10.00	20.00	12.00	23.33	14.00
10.17	6.10	13.50	8.10	16.83	10.10	20.17	12.10	23.50	14.10
10.33	6.20	13.67	8.20	17.00	10.20	20.33	12.20	23.67	14.20
10.50	6.30	13.83	8.30	17.17	10.30	20.50	12.30	23.83	14.30

Figure 25-4: Titration table

Figure 25-4 displays a sample Vary Rate Titration table. The amount and volume is displayed at the top of the table along with the dose and rate units. The units for amount and dose are the same units used in the Drug Dosage table.

The drug (A through F) and patient weight are displayed at the top of the table.

Dosages can vary between 0.01 and 9999.99 mg/min, and rates can vary between 0.1 and 999.99 ml/hr.

The patient type (ADULT or NEONATE) is displayed in the upper left corner of the table.

CAUTION:

- **If any value in the Drug Calculation table is over its designated range, ++++.++ will be displayed for values of AMOUNT, CONC or DOSE, or RATE and the Titration Table becomes inaccessible.**

Adjusting the Table Range

Use the SCROLL and PAGE keys in the Titration Table menu to select the range of data displayed in the titration table. The default range is 1-100.

Printing

To print calcs data:

1 Access Local or Remote Drug Calcs.
2 Touch PRINT.

Touch the PRINT key to print the currently displayed page of the Calculations table. The complete table prints on a 4-channel recorder. On a 2-channel recorder, the top half of the table prints first followed by the bottom half

Recalculations

You can recalculate all Drug Dosage inputs except for the amount/hour entries shown for DOSE and DOSE/WT. In most cases, changing one parameter automatically recalculates and redisplays other parameters under that DRUG key. *Table 16* shows adult patient recalculation rules, except where noted in AMOUNT and VOLUME. When TITRATE on the MIX/TITRATE key is selected, DOSE, DOSE/WEIGHT, and FLOW RATE results are the same for Adult and Neonatal.

Table 16: Drug Dosage Recalculations

Edit	Constants	Results
AMOUNT	Holds VOLUME constant	Calculates CONC
	Holds DOSE (dose/min) constant	Calculates FLOW RATE (ADULT only)
	Holds DUR constant	Calculates TOTAL VOL (ADULT only)
	Holds DOSE constant	Calculates FLOW RATE
	Holds DUR constant	Calculates TOTAL DOSE (NEONATAL only)
VOLUME	Holds AMOUNT constant	Calculates CONC
	Holds DOSE/MIN constant	Calculates FLOW RATE (ADULT only)
	Holds DUR constant	Calculates TOTAL VOL (ADULT only)
	Holds DOSE constant	Calculates FLOW RATE
	Holds DUR constant	Calculates TOTAL DOSE and VOL (NEONATAL)
CONC	Holds VOLUME constant	Calculates AMOUNT
	Holds DOSE/MIN constant	Calculates FLOW RATE
	Holds DUR constant	Calculates TOTAL VOL
WEIGHT	Holds DOSE/MIN constant	Calculates DOSE/WEIGHT/MIN
	Holds DOSE/HR constant	Calculates DOSE/WEIGHT/HR
DOSE or DOSE/WEIGHT (TITRATE)	Holds WEIGHT constant	Calculates other 3 DOSE and DOSE/WEIGHTS
	Holds CONC constant	Calculates FLOW RATE
	Holds DUR constant	Calculates TOTAL DOSE and TOTAL VOL
DOSE or DOSE/WEIGHT (MIX)	Holds WEIGHT constant	Calculates other 3 DOSE and DOSE/WEIGHTS
	Holds FLOW RATE constant	Calculates CONC
	Holds VOLUME constant	Calculates AMOUNT
	Holds DUR constant	Calculates TOTAL DOSE
FLOW RATE (TITRATE)	Holds CONC constant	Calculates DOSE/MIN and DOSE/HR
	Holds WEIGHT constant	Calculates DOSE/WEIGHT/MIN and DOSE/WEIGHT/HR
	Holds DUR constant	Calculates TOTAL VOL
FLOW RATE (MIX)	Holds DOSE/HR constant	Calculates CONC
	Holds VOLUME constant	Calculates AMOUNT
	Holds DUR constant	Calculates TOTAL DOSE and TOTAL VOL
DUR	Holds DOSE/MIN constant	Calculates TOTAL DOSE
	Holds FLOW RATE constant	Calculates TOTAL VOL
TOTAL DOSE	Holds CONC constant	Calculates FLOW RATE
	Holds DUR constant	Calculates DOSE/MIN, DOSE/HR, and TOTAL VOL
	Holds WEIGHT constant	Calculates DOSE/WEIGHT/MIN and DOSE/WEIGHT/HR
TOTAL VOL	Holds DUR constant	Calculates FLOW RATE
	Holds CONC constant	Calculates DOSE/WEIGHT/MIN and DOSE/WEIGHT/HR
	Holds WEIGHT constant	Calculates DOSE/WEIGHT/MIN and DOSE/WEIGHT/HR

Configurable Drug Names (UCW and Ultraview 1700 Only)

Using the Drug Name List

To use the list of drug names:

1. Touch the DRUG key in the Drug Calcs Edit Inputs menu.

Figure 25-5: Edit Inputs menu

2. The DRUG NAME LIST menu appears, enabling you to choose from the master drug list. Select the appropriate drug name and then touch ACCEPT. The drug name and stored default values are transferred into the currently selected drug (A through F). Select CANCEL to remove the selection menu without changing the current settings for the drug. Drug Calcs will display the selected drug name below the key.

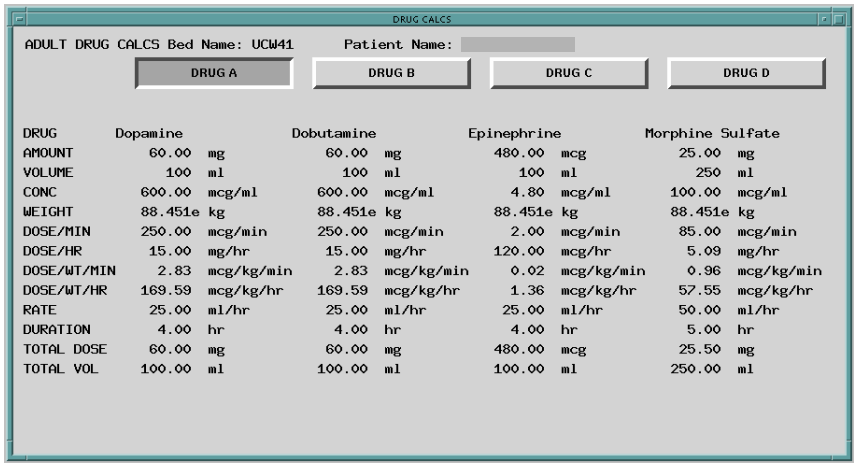

Figure 25-6: Drug Calcs display

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- *The drug default values for drugs A through F can be overwritten and not affect the master drug list entry. However, selecting another drug name for drug A, B, C, D, E, or F will override all previously-edited values and will insert the master default settings. Ensure that the changes are effected after selecting the drug name (and not before).*

Remote Drug Names

Drug names on local bedside monitors can be edited remotely from the host monitor. The local names can be stored in the remote monitor even if the remote bed does not include the drug in its own stored list. Drug names can be kept consistent by transferring master drugs lists from one bed to another allowing remote bed access to the master drug list.

Table 17: Hemodynamic Calculations

Variable	Calculation	Normal Range*
Cardiac Index (CI)	$\frac{CO}{BSA}$	2.5 - 4.0 liters/min/m^2
Stroke Volume (SV)	CO x 1000 HR	60 - 130 ml/beat
Stroke Volume Index (SVI)	$\frac{SV}{BSA}$	30 - 65 ml/beat/m^2
Systemic Vascular Resistance (SVR)	MAP - CVP x 79.9 CO	900 - 1400 dynes x sec/cm^5
Systemic Vascular Resistance Index (SVRI)	MAP - CVP x 79.9 CI (Converts to SVR x BSA)	1760 - 2600 (dynes x sec/cm^5) x m^2
Pulmonary Vascular Resistance (PVR)	MPA - PCWP x 79.9 CO	20 - 130 dynes x sec/cm^5
Pulmonary Vascular Resistance Index (PVRI)	MPA - PCWP x 79.9 CI (Converts to PVR x BSA)	36 - 235 (dynes x sec/cm^5) x m^2
Left Ventricular Stroke Work (LVSW)	(MAP - PCWP) x SV x 0.0136	
Left Ventricular Stroke Work Index (LVSWI)	(MAP - PCWP) x SVI x 0.0136 (Converts to LVSW/BSA)	45 - 75 g x min/m^2/beat
Right Ventricular Stroke Work (RSVW)	(MPA - CVP) x SV x 0.0136	
Right Ventricular Stroke Work Index (RVSWI))	(MPA - CVP) x SVI x 0.0136 (Converts to RVSW/BSA)	4 - 8 g x min/m^2/beat
(HR = Heart Rate; BSA = Body Surface Area; MAP = Mean Arterial Pulse; CVP = Central Venous Pressure; MPA = Mean Pulmonary Artery Pressure; PCWP = Pulmonary Capillary Wedge Pressure)		

Table 18: Renal Calculations

Variable	Acquisition Method or Calculation	Units
Urine Potassium (URK)	Laboratory Measurement	mEq/L
Plasma Osmolality (PLOSM)	Laboratory Measurement	mOsm/L
Urine Osmolality (UROSM)	Laboratory Measurement	mOsm/L
Serum Sodium (SerNa)	Laboratory Measurement	mEq/L
Serum Creatinine (CR)	Laboratory Measurement	mg/dl
Urine Creatinine (UCR)	Laboratory Measurement	mg/dl
Blood Urea Nitrogen (BUN)	Laboratory Measurement	mg/dl
Urine Sodium (URNa)	Laboratory Measurement	mEq/L
Urine Volume (URINE)	Data Entry	ml/day
Urine Sodium Excretion (URNaEX)	URNa x URINE/1000	mEq/day
Urine Potassium Excretion (URKEX)	URK x URINE/1000	mEq/day
Urine Sodium to Urine Potassium Ratio (Na/K)	URNa/URK	(ratio)
Osmolar Clearance (COSM)	(UROSM/PLOSM) x URINE	ml/day
Water Clearance (CH_2O)	URINE - COSM	ml/day
Urine Osmolality to Plasma Osmolality Ratio (U/POSM)	UROSM/PLOSM	(ratio)
Fractional Sodium Excretion (FENa)	(URNa/SerNa) x (CR/UCR) x 100	%
Creatinine Clearance (CRCL)	(UCR/CR) x URINE/1440) x 1.73/BSA	ml/min/m^2
Non-Saline Loss (NSLOSS)	URINE - (URINE x URNa/SerNa)	ml/day
BUN to Creatinine Ratio (BUN/CR)	BUN/CR	(ratio)
Urine Creatinine to Serum Creatinine Ratio (U/CR)	UCR/CR	(ratio)

Note: The values listed here represent commonly published ranges for adults and are for reference purposes only.

Table 19: Oxygenation Calculations

Variable	Calculation	Normal Range*
Arterial Oxygen Saturation (SaO_2)	Laboratory Measurement (SaO_2) or Pulse Oximetry (SpO_2)	95 - 100%
Partial Pressure of Arterial Oxygen (PaO_2)	Laboratory Measurement	80 - 100 mmHg
Mixed Venous Oxygen Saturation ($S\bar{v}O_2$)	Laboratory Measurement or Monitored Value	60 - 80%
Partial Pressure of Mixed Venous Oxygen ($P\bar{v}O_2$)	Laboratory Measurement	35 - 45 mmHg
Oxygen Availability (O_2AV)	$CTaO_2$ x CO x 10	900 - 1100 ml/min
Oxygen Availability Index (O_2AVI)	O_2AV/BSA	497 - 608 ml/min/m^2
Arterial Oxygen Content ($CTaO_2$)	(1.34 x Hgb x SpO_2/100) + (PaO_2 x 0.0031)	18 - 20 ml/dl
Mixed Venous Oxygen Content ($CT\bar{v}O_2$)	(1.34 x Hgb x $S\bar{v}O_2$/100) + ($P\bar{v}O_2$ x 0.0031)	14 - 16 ml/dl
Arterial/Venous Oxygen Difference ($avDO_2$)	$CTaO_2 - C\bar{T}vO_2$	3 - 5.5 ml/dl
Oxygen Consumption (VO_2)	$avDO_2$ x CO x 10	200 - 300 ml/min
Oxygen Consumption Index (VO_2I)	VO_2/BSA	110 - 166 ml/min/m^2
Oxygen Extraction Ratio (O_2ER)	VO_2/O_2AV (Simplifies to $avDO_2/CTaO_2$)	1/4 or 0.25
Partial Pressure of Alveolar Oxygen (PAO_2)	[(FiO_2/100) x (PB - 47)] - $PaCO_2$/0.8	100 mm Hg
Pulmonary Venous Admixture Shunt (Qs/Qt)	100 x[(1.34 x Hgb) + (0.0031 x PAO_2) - $CTaO_2$)] / (1.34 x Hgb) + (0.0031 x PAO_2) - $CT\bar{v}O_2$	Variable, depending on FiO_2
PaO_2/FiO_2 Ratio (P/F)	PaO_2/FiO_2	Variable, depending on FiO_2
(Hgb = Hemoglobin; PB = Barometric Pressure)		

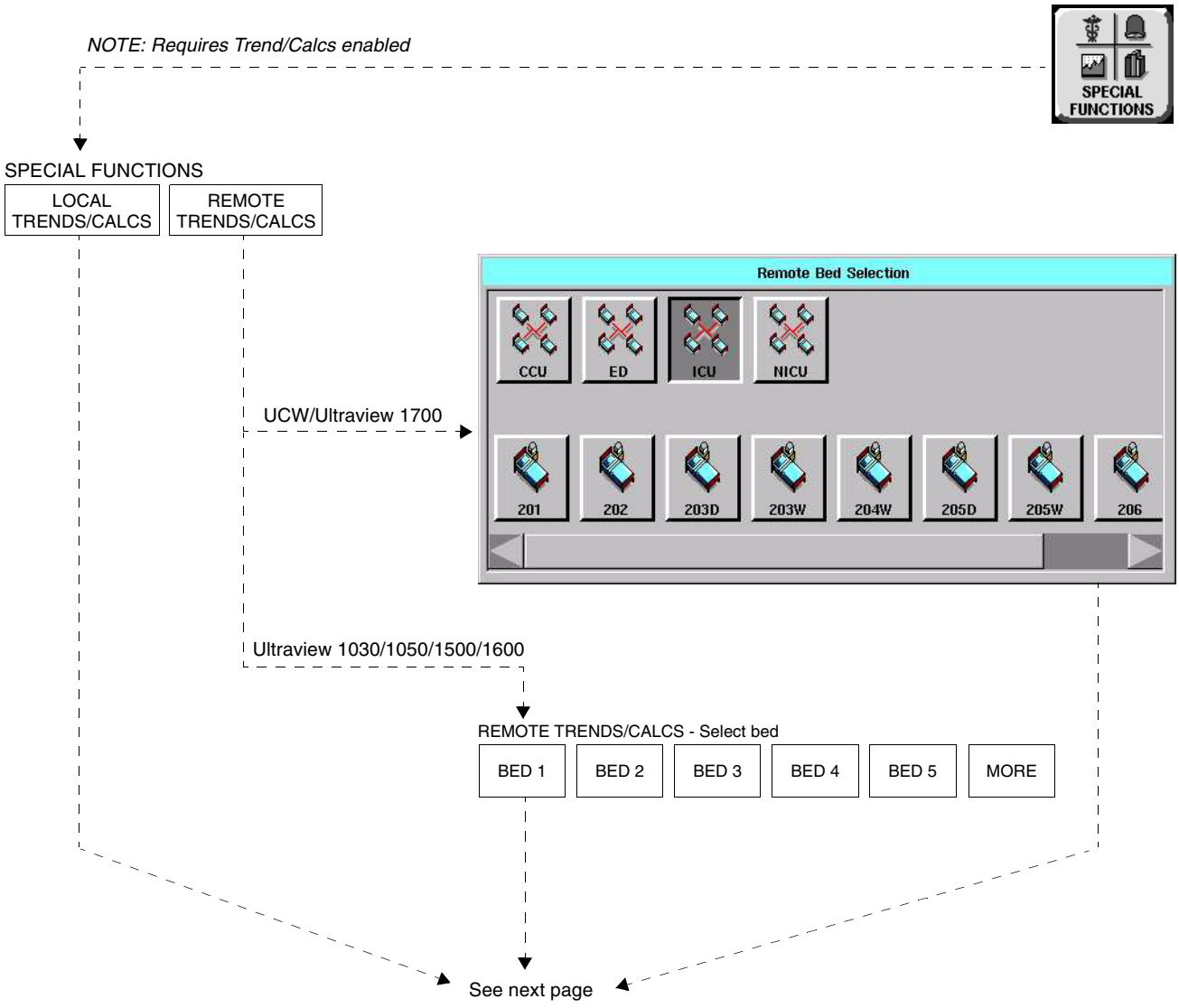
Table 20: Respiration Calculations

Variable	Calculation	Units
Respiratory Rate (RR)	Monitored Value or Ventilator	breaths/min
Partial Pressure of Arterial Carbon Dioxide ($PaCO_2$)	Laboratory Measurement	mmHg
Tidal Volume (VT)	Ventilator	ml/breath
Peak Inspiratory Pressure (PIP)	Ventilator	cmH_2O
Plateau Pressure (PLT)	Ventilator	cmH_2O
Positive End Expiratory Pressure (PEEP)	Ventilator	cmH_2O
Partial Pressure of Expired Carbon Dioxide ($PECO_2$)	Data Entry	mmHg
Minute Volume (VMIN)	VT x RR/1000	L/min
Static Compliance (Cst)	VT/(PLT - PEEP)	ml/cmH_2O
Dynamic Compliance (Cdyn)	VT/(PIP - PEEP)	ml/cmH_2O
Dead Space Volume (VD)	($PaCO_2$ - $PECO_2$) x (VT/$PaCO_2$)	ml
Dead Space to Tidal Volume Ratio (VD/VT)	VD/VT	(ratio)
Alveolar Ventilation (VA)	(VT - VD) x RR	ml/min

Note: Acceptable values for individual patients should be determined by hospital protocol and the attending physician.

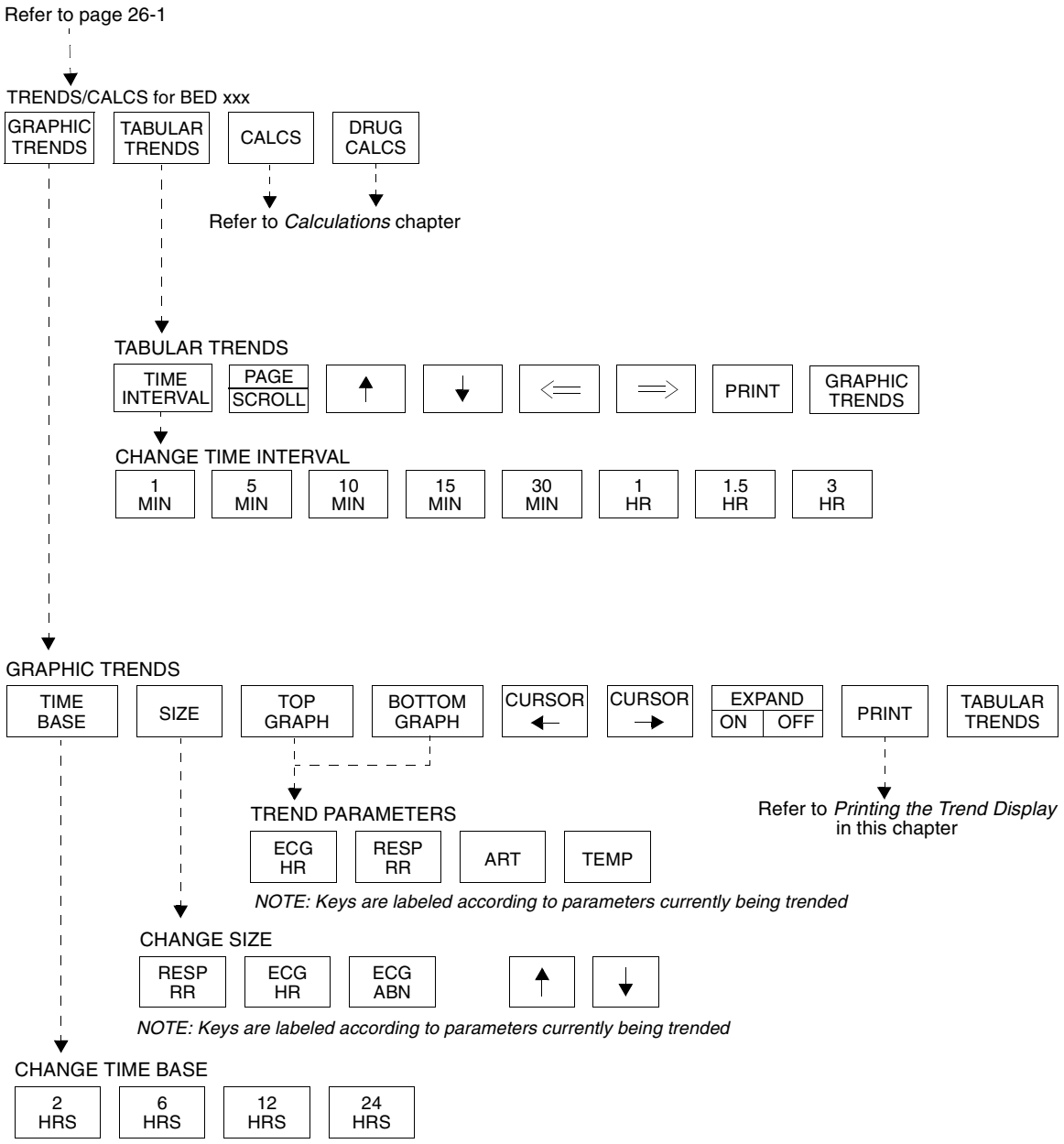
Trends Directory

Directory of Keys



! • *Based on features purchased, more or fewer keys may appear here than on your menu screens.*

Directory of Keys



- *Based on features purchased, more or fewer keys may appear here than on your menu screens.*

Trends

Contents

Overview

To display a trend:

1 Touch SPECIAL FUNCTIONS.
2a Select LOCAL TRENDS/ CALCS or REMOTE TRENDS/ CALCS.
2b If you touched REMOTE TRENDS/CALCS, select a bed.
3a Touch GRAPHIC TRENDS.
-OR-
3b Touch TABULAR TRENDS.

(Follow these three steps to start each quickstart in this chapter.)

Trends are a convenient way of displaying numeric data that has been collected for a patient over the last 24-hours. Your monitor can display a graphic trend or tabular trend (depending on the option purchased) of collected numeric data for every parameter except delta temperature and EEG. This data appears in a table format similar to common flowsheets or spreadsheets.

Graphic trends can appear in three formats.

- Continuous trends represent parameters with continuous monitoring. A solid line connects trend points.
- Episodic trends represent parameters that produce individual events. Episodic values are displayed as an **x**, **+**, or **0**. A dotted line connects each episode.
- Histogram trends are displayed as vertical bars starting at a base of zero.

The system collects trend values every minute and episodic trend values as they become available. Up to the last 24-hours of collected data in memory is displayed and the system saves trend values for as long as memory limitations allow. In most cases, an episodic trend contains at least 30 values.

!

- *When you suspend alarms with the TONE RESET/ALM SUSPEND key the system may not collect trend data. Contact your system administrator to enable this function.*

Display Detail

Graphic Trend Display

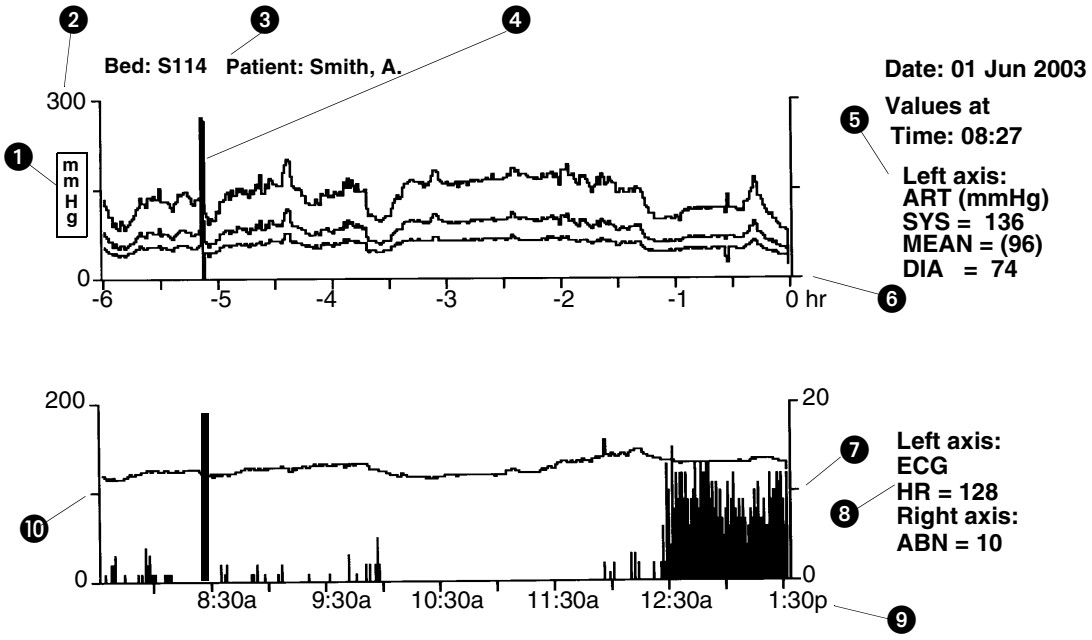


Figure 26-1: Graphic trends display

1. Trend unit of measure (unit labels are not displayed for parameters with one acknowledged unit of measure for example, ECG, RESP, and CO.)
2. Scale value - use SIZE key to select
3. Bed and patient identification
4. Cursor
5. Data values for top graph*
6. Upper trend time axis
7. Right axis for bottom graph
8. Data values for bottom graph*
9. Lower trend time axis
10. Left axis for bottom graph

* When the cursor is displayed, data values reflect those at the cursor location, and the **Values at** label is displayed. When the cursor is not displayed, data values reflect current values, and the **Current Values** label is displayed.

The system maintains settings for trend displays (time base, parameters, size, etc.) until you change them or display a new patient's trend.

The messages “No trends available for this bed” or “Trend data not available” appear when trend data has yet to be accumulated for the selected bed.

Tabular Trends Display

You can view a tabular trend of continuous patient data and episodic patient data acquired within the last 24-hours by touching the TABULAR TRENDS key.

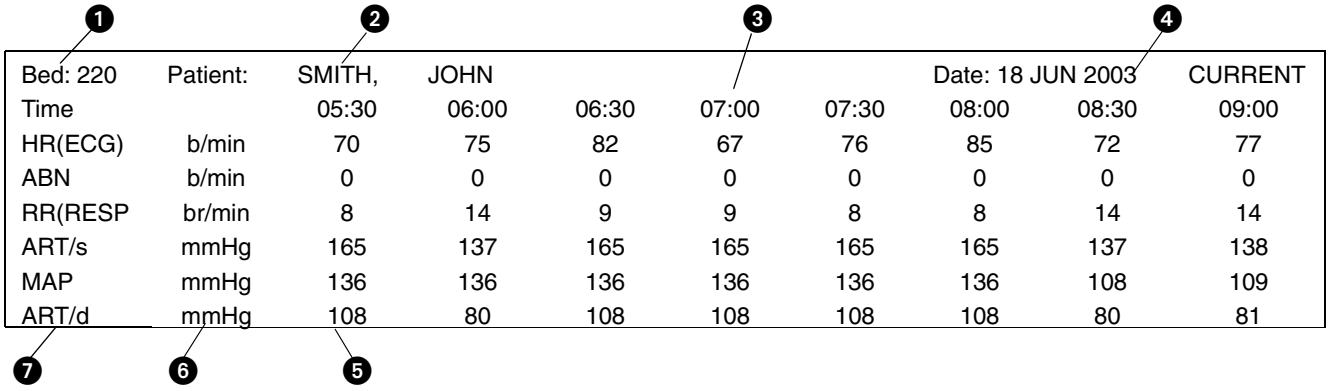


Figure 26-2: Tabular trends display

1. Bed identification
2. Patient name
3. Times that data was collected
4. Date of tabular trend
5. Trended data
6. Unit of measure for each parameter
7. List of parameters

Parameters always appear in descending order of priority. Data that is monitored on a continuous basis always precedes episodic data. Episodic values are presented according to the sequence in which they were originally stored. Data older than 24-hours is not displayed.

Calculations data does not appear in tabular trends.

Printing the Trend Display

You can print a copy of the displayed graphic trend or tabular trend at any time.

To print the trend display:

1 Adjust trend display as desired.
2 Touch PRINT.

! • *When using a 2-channel printer, the top and bottom half of the trend display print consecutively.*

Graphic Trends Features

Selecting Trend Parameters

To select a parameter for the top or bottom graph:

1 Select TOP GRAPH or BOTTOM GRAPH.
2 Select desired parameter.

The first time you display a patient's graphic trend, the highest priority parameter is displayed on the bottom trend graph and the next highest priority parameter is displayed on the top graph. You can view other trends by selecting them from the Trend Parameter menu.

Using the Cursor

To move the cursor:

1 Touch cursor keys as needed.

The graphic trends cursor is a solid, vertical line that moves across the entire trend graph (refer to *Figure 26-1* on page 26-4). The home position of the cursor is at the extreme right end of the graph. Once the cursor moves from its home position, the CURRENT VALUES label changes to reflect the cursor's current position. The CURRENT VALUES label now displays **VALUES at** and the time. These values represent the data acquired from the patient.

!

- *The trend graph continues to update EXCEPT when the cursor is moved from its home position. It updates again when the cursor returns to its home position.*
- *When switching between Graphic Trends and Tabular Trends, the cursor remains in the same position. For example, if the cursor is placed on data 2-hours previous to the current time in Graphic Trends, when moving directly to Tabular Trends, the screen will display the same time frame, and the corresponding data column will be highlighted.*

Selecting a Time Base

To set a trend graph time base:

1 Touch TIME BASE.
2 Select 2, 6, 12, or 24 HRS.

The time base for each trend graph can be set for 2-, 6-, 12-, or 24-hours. The displayed resolution for each time base is:

2-hours	=	1-minute
6-hours	=	1-minute
12-hours	=	2-minutes
24-hours	=	4-minutes

Selecting a Scale Size

To adjust the scale size:

1 Touch SIZE.
2 Select desired parameter key.
3 Use arrow keys to adjust.

You can adjust the scale for each parameter. Initially, the system selects a scale that includes all monitored values for the displayed parameter. You may adjust the scales using the arrow keys.

Expanding the Trend Display

To expand the trend display:

1. Touch either CURSOR key to move the cursor to the desired location.
2. Select EXPAND ON.

You may expand the trend display to include only an hour's worth of information. With EXPAND ON, the TIME BASE key does not operate and updating of the trend graph is suspended on the graph as it is currently displayed. When EXPAND is OFF, the trend graph returns to its original display. Moving the cursor while EXPAND is ON does not change the cursor's position in the OFF mode.

Tabular Trends Features

Setting a Time Interval

To set a time interval

1. Touch TIME INTERVAL.
2. Select the desired time interval.

You can display acquired data at various time intervals: 1-, 5-, 10-, 15-, and 30-minutes; and 1-, 1.5-, and 3-hours.

For continuous data, the value displayed in the tabular trend table is the value taken at the displayed time. It is not an average of all readings taken during that time period.

When more than one episodic reading occurs in the same time interval, only the most recent value is displayed. Asterisks to the right of the episodic value indicates that more data entries are available for that time interval.

The trend table automatically updates at the end of each time interval. This shifts all data columns to the left to include the new interval.

!

- *Updating is suspended when you review data while paging or scrolling.*

Viewing Off-Screen Information

To view additional parameters and data (for Tabular Trends):

1. Select PAGE or SCROLL.
2. Use the ↑ and ↓ arrow keys to move parameter rows up or down.

To view additional parameters and data (from a different time):

1. Use the PAGE and SCROLL up and down arrow keys to move parameter rows vertically.

   -OR-

2. Use the PAGE and SCROLL left and right keys to move data columns horizontally.

You can view up to 22 rows and 7 columns of parameter data on a single screen in a tabular trend.

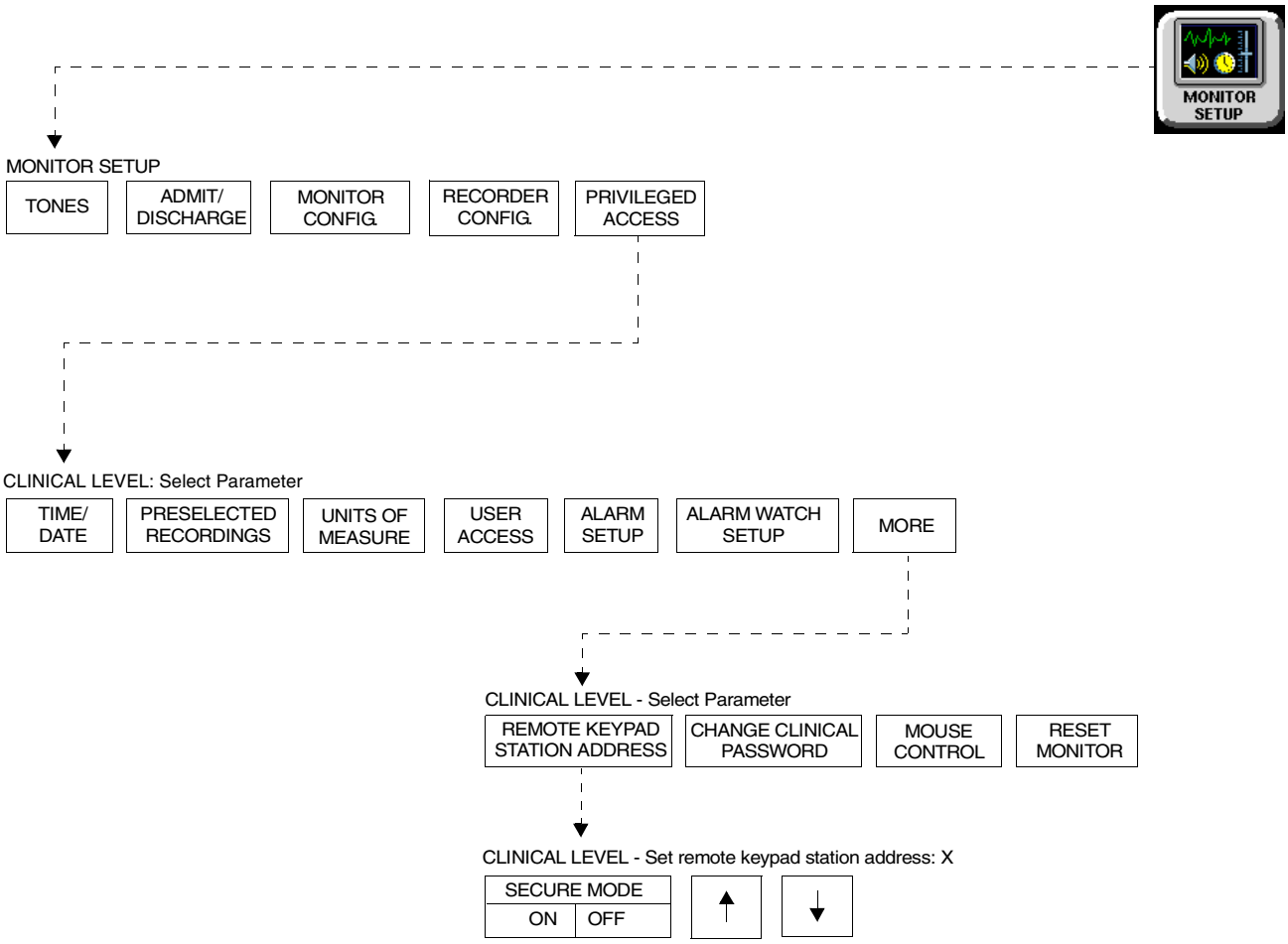
You can view additional parameters by moving rows up or down. When you select PAGE, the arrow keys move the entire page up or down. When you select SCROLL, the arrow keys move the display up or down one parameter row at a time.

You can view data collected at other times by moving columns left or right. When you select PAGE, the arrow keys move the display to show an entirely new set of columns. When you select SCROLL, the arrow keys move the display left or right by one column.

Trends Troubleshooting Guide

Clinical Situation	Possible Cause	Solution
Current patient data not being added to trends	■ If alarms are suspended data may not be trended at the bedside monitor.	■ Turn ON alarms or have your system administrator enable your system to trend while alarms are suspended.
	■ EXPAND key ON (trend data will not be lost).	■ Change EXPAND to OFF. Resume ECG processing.
	■ Cursor not in home position (trend data will not be lost).	■ Move the cursor to the extreme right position.
PCWP trend not available	■ PCWP values not saved.	■ Save the PCWP values.
Incorrect unit of measure displayed	■ Incorrect unit of measure configured for system.	■ Contact your system administrator.
CALCS data not trending	■ Trends cannot trend CALCS.	■ Use the CALCS menu to display this data.
NO TRENDS AVAILABLE FOR THIS BED message is displayed	■ No trend data has yet accumulated for the selected parameter.	■ Allow sufficient time for data to accumulate.
Numerous entries with ??? instead of vital signs	■ Alarm Suspend was selected frequently.	■ Contact your system administrator to collect data during Alarm Suspend periods.
	■ ECG/Resp processing suspended.	■ Do not suspend ECG processing unless the patient is off the system.
		■ Ensure that ECG/Resp amplitude and signal quality are sufficient.

Directory of Keys - UCW and Ultraview 1700



! • *Based on features purchased, more or fewer keys may appear here than on your menu screens.*

Remote Keypad

Contents

Overview

The remote keypad option allows you to remotely suspend or adjust alarms, access graphic trends, adjust waveform size, initiate recordings, etc. The zoom function enlarges menu keys on the monitor making them easy to read from across the room.

!

- *The operational range of the remote keypad is approximately 20 feet.*

Setting Up the Remote Keypad

The remote keypad is a cordless, hand-held transmitter powered by an internal battery (refer to *Figure 27-1*). It sends your instructions via infrared signals to the monitor's receiver. The maximum operating range is 20 feet at an angle of up to 45 degrees on either side of the receiver.

The remote keypad provides all of the functions you need to operate your monitor remotely.

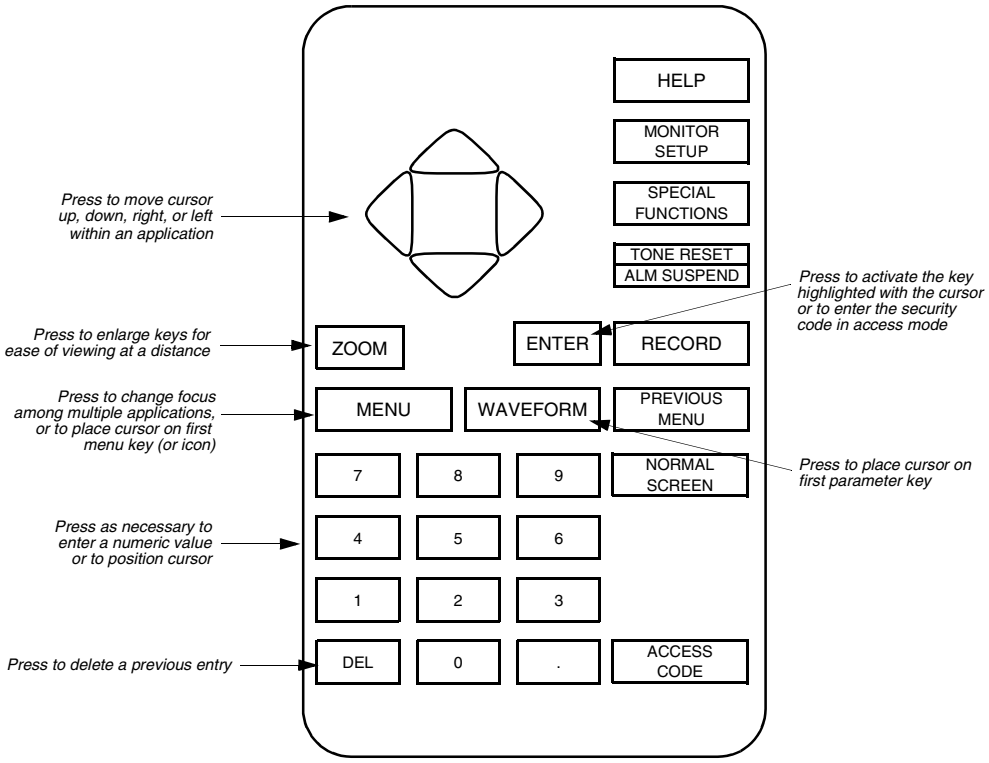


Figure 27-1: Remote keypad

Setting Up the Receiver

An optional receiver is required for the Ultraview 1700. The receiver attaches to the side of the monitor and connects to the nurse alert port (J14) on the back of the monitor. A nurse alert may still be used with the monitor by plugging the nurse alert into the port on the rear of the receiver.

!

- *The 90360-03 receiver is only compatible with the Ultraview 1700 S/N 387-1xxxxxx and higher.*
- *The receiver is integrated into the UCW, and no external receiver is required.*

Selecting a Parameter

To select a parameter:

1 Point the remote keypad at the monitor's receiver.
2 Press WAVEFORM for parameter number 1.
3a Press up or down arrow keys to desired parameter.
-OR-
3b Press the number of the desired parameter.
4 Press ENTER.

The parameter (waveform) keys display vertically near the right side of the screen, with parameter number one at the top (except on a split screen central display). Press the WAVEFORM key to activate the parameter (waveform) selection mode.

- *The remote keypad cursor remains on the screen for approximately one minute following the last keypad activity or until you touch the touchscreen itself.*

Operating Menu Keys

To operate menu keys:

1 Point the remote keypad at the monitor's receiver.
2 Select a parameter key.
3 Press MENU.
4a Press left or right arrow key to desired position.
-OR-
4b Press the number of the desired menu key.

The menu keys display horizontally across the bottom of the screen with menu key number one at the far left. Press the ZOOM key once to activate the zoom feature, making each key easier to see. Press the ZOOM key again to turn OFF the zoom feature.

Recording a Waveform

To print data from a waveform zone:

1 Point remote keypad at the monitor's receiver.
2a Press up or down arrow keys to desired parameter.
-OR-
2b Press the number of the desired parameter.
3 Press RECORD.
4 Repeat step 2a.
5 Press ENTER.

After you activate the RECORD key, you have 2-seconds to highlight a parameter (waveform) key. To ensure enough time in making a selection, place the cursor on the parameter (waveform) key and press the cursor for an additional 2-seconds, before you press the RECORD key on the remote keypad.

- *When printing several parameters at the same time or when trying to print an event such as a single abnormal beat, it is easier to use keys on the monitor rather than on the remote keypad to direct the recording.*

Programming Access Codes

Access codes ensure that the receiver responds only to a remote keypad with a matching code number. If a keypad's access code differs from the receiver's, the command is ignored. This prevents interference from other remote keypads.

The programmed access code (1 to 32) is displayed on the monitor. This code is stored in the monitor's memory and retained whenever the monitor is reset or powered OFF.

!

- *Remote keypad systems can be operated in an unsecured mode without access codes so that the receiver accepts commands from any remote keypad. When in the unsecured mode, the word* **ALL** *appears on the monitor.*

When programming a monitor's access code, the keypad's access code must initially match the receiver's. The new access code is programmed simultaneously with the keypad's. The monitor temporarily displays the remote keypad's access code, then returns to displaying its own code.

!

- *To prevent inadvertently changing other access codes, unplug all other monitors (or move the remote keypad directly in front of the monitor to be programmed) and place your finger over the remote keypad's infrared window during programming (sufficient signal transmits through your finger to program the receiver).*

To select the unsecured mode:

1 Touch MONITOR SETUP.
2 Touch PRIVILEGED ACCESS.
3 Enter Clinical password.
4 Touch MORE.
5 Touch REMOTE KEYPAD STATION ADDRESS.
6 Select SECURED MODE OFF.

To verify a remote keypad's current access code:

1 Point the remote keypad at the monitor's receiver.
2 Touch ACCESS CODE.
3 Touch ENTER.

To set a remote keypad's access code:

1 Point the remote keypad at the monitor's receiver.
2 Touch ACCESS CODE.
3 Select first digit.
4 Select second digit.
5 Touch ENTER.

To set the monitor's access code:

1 Touch MONITOR SETUP.
2 Touch PRIVILEGED ACCESS.
3 Enter Clinical password.
4 Touch MORE.
5 Touch REMOTE KEYPAD STATION ADDRESS.
6 Select SECURED MODE ON.
7 Use the arrow keys to select the number.

Remote Keypad Troubleshooting Guide

Clinical Situation	Possible Cause	Solution
Monitor accepts commands from any keypad	■ Monitor operating in an unsecured mode.	■ Select an access code and program both the monitor/receiver and the keypad to that code.
During programming, another receiver was inadvertently changed	■ Remote keypad placed too close to another monitor's receiver.	■ Move the keypad directly in front of the receiver to be programmed and place your finger over the keypad window during programming.
Monitor does not respond	■ Monitor may not support remote keypad.	■ Press the ACCESS CODE key. If an **A** is not displayed (below the NORMAL SCREEN key), contact your system administrator or biomed.
	■ Depleted battery in remote keypad.	■ Replace battery in remote keypad.

Remote Display

Contents

Overview

The Ultraview 1700 provides an optional output to a remote-configurable secondary display. This secondary display enables you to view selected parameters from the primary display.

The primary monitor is used to control the configuration and waveform display characteristics of the secondary remote display. The secondary display has no touchscreen surface or functional keys.

Setting Up the Secondary Display

To set up the remote display:

1. Touch MONITOR SETUP.
2. Touch SECONDARY CONFIG.
3. Touch PARAMETER CONFIG.
4. Select a parameter.
5. Select the destination priority.
6. Select a color.
7. Select the parameter key to be colored (the key and waveform will appear in the chosen color).
8. Touch STORE to store local color and priority settings.

The Configuration menu for the secondary display appears on the primary monitor. The menu functions identically to the primary monitor's menu although it has three additional keys.

Selecting Colors and Priorities

Each parameter has a specific default color and priority. You can change the colors or priority levels of the parameters to customize the monitor to your specific needs.

After making any configuration change, touch STORE to make the secondary display changes permanent. If you do not touch STORE, the system disregards your changes.

! • *Your display may not be configured to allow changes to parameter priorities or colors. Contact your hospital system administrator for details.*

The PARAMETER CONFIG key allows you to change the system default priorities and colors. The current parameter priority and color default is visible from the DISPLAY PRIORITIES toggle key. The LOCAL key displays the current active

parameters and the ALL key displays all possible parameters. Each parameter is assigned a display priority, with the highest priority appearing at the top of the screen.

Blank parameter keys allow you to force a space above, between, or below other parameters. Blanks can be inserted into any priority template by selecting the blank and putting it into the desired location. This causes a blank zone to be inserted into the corresponding display area and all active parameters with a lower priority to be pushed down.

The STORE key stores the current local priority and color settings into non-volatile memory.

The RESTORE key restores the last stored local priorities and color settings from memory.

The FACTORY DEFAULTS key restores the factory default priority and color settings.

Copying Stored Values of the Primary Monitor

To copy the stored values of the primary:

1. Touch MONITOR SETUP.
2. Touch SECONDARY CONFIG.
3. Touch PARAMETER CONFIG.
4. Touch COPY PRIMARY PRIO/COLOR.
5. Touch STORE.

Touch COPY PRIMARY PRIO/COLOR to duplicate the primary display's stored settings for priorities and colors on the secondary display. Touch STORE to put these changes into effect.

You can use the Copy Primary Prio/Color function to remove blank zones resulting from parameters that were deleted while the secondary display was in Lock mode.

Restoring a Stored Value

To restore the last stored configuration:

1. Touch MONITOR SETUP.
2. Touch SECONDARY CONFIG.
3. Touch PARAMETER CONFIG.
4. Touch RESTORE.

Touch RESTORE to reset the secondary display's configuration screen to its last stored changes. Restoring the screen also stops the Copy Primary function (if STORE has not yet been touched).

Copying Primary Attributes to the Secondary

To copy the primary monitors configuration:

1. Touch MONITOR SETUP.
2. Touch SECONDARY CONFIG.
3. Touch PARAMETER CONFIG.
4. Touch COPY PRIMARY PARAM ATTR.

Touch COPY PRIMARY PARAM ATTR to copy the primary's current parameter attributes or settings to the secondary display. Parameter colors and priorities are not copied.

Use this key to:

- Remove any blank zones caused by deleting a parameter while the secondary was locked.
- Insert any new parameters added while the secondary was locked.
- Change sizes, sweep speeds, full scales ON/OFF, etc., to match the primary monitor's configuration.

Resetting Default Values

To set factory default values of secondary display:

1 Touch MONITOR SETUP.
2 Touch SECONDARY CONFIG.
3 Touch PARAMETER CONFIG.
4 Touch FACTORY DEFAULTS.
5 Touch STORE.

Touching FACTORY DEFAULTS resets the secondary display to its factory values. Touch STORE to make these changes permanent.

Options that can be reset include:

- Relative priorities and colors to factory default configuration of primary
- Blanks caused by deleting a parameter while in Lock Mode

Touching this key does not insert any new parameters added while the secondary display was in Lock Mode.

Tracking or Locking Displays

To lock the secondary display:

1 Adjust parameter attributes on primary to reflect how you want the secondary to appear.
2 Touch MONITOR SETUP.
3 Touch SECONDARY CONFIGURATION.
4 Touch PARAMETER CONFIGURATION.
5 Touch LOCK.

In addition to parameter color and priority, you may configure other attributes of the secondary display to be different from the primary monitor. To make additional adjustments to each display separately, select LOCK after you configure the secondary display. This allows the secondary display to remain largely unchanged when you adjust the primary display. If you need the secondary display to duplicate changes to the primary, set the secondary display to TRACK. Refer to the *Table 1* (where X = yes) for the effect of Track and Lock on each display characteristic.

To make additional changes to the secondary screen after you select LOCK, return to the Secondary Configuration menu and touch TRACK.

Table 1: Remote Display Track and Lock Chart

	Always independent of primary	**Track mode copies primary**	**Lock mode copies primary**	**Lock mode does not copy primary**
Colors/priorities	**X**			
Waveform size		**X**		**X**
Sweep speed		**X**		**X**
Full scales ON/OFF		**X**		**X**
Full scales 4/6 zones	**X**			
# of minor graticules	**X**			
Screen/waveform attributes		**X**		**X**
Addition of parameter on primary		**X**		**X**
Deletion of parameter on primary		**X**	**X**	
Pressure/ECG key labels		**X**	**X**	
Zone size of certain displayed parameters		**X**	**X**	

Adjusting Scaled Display

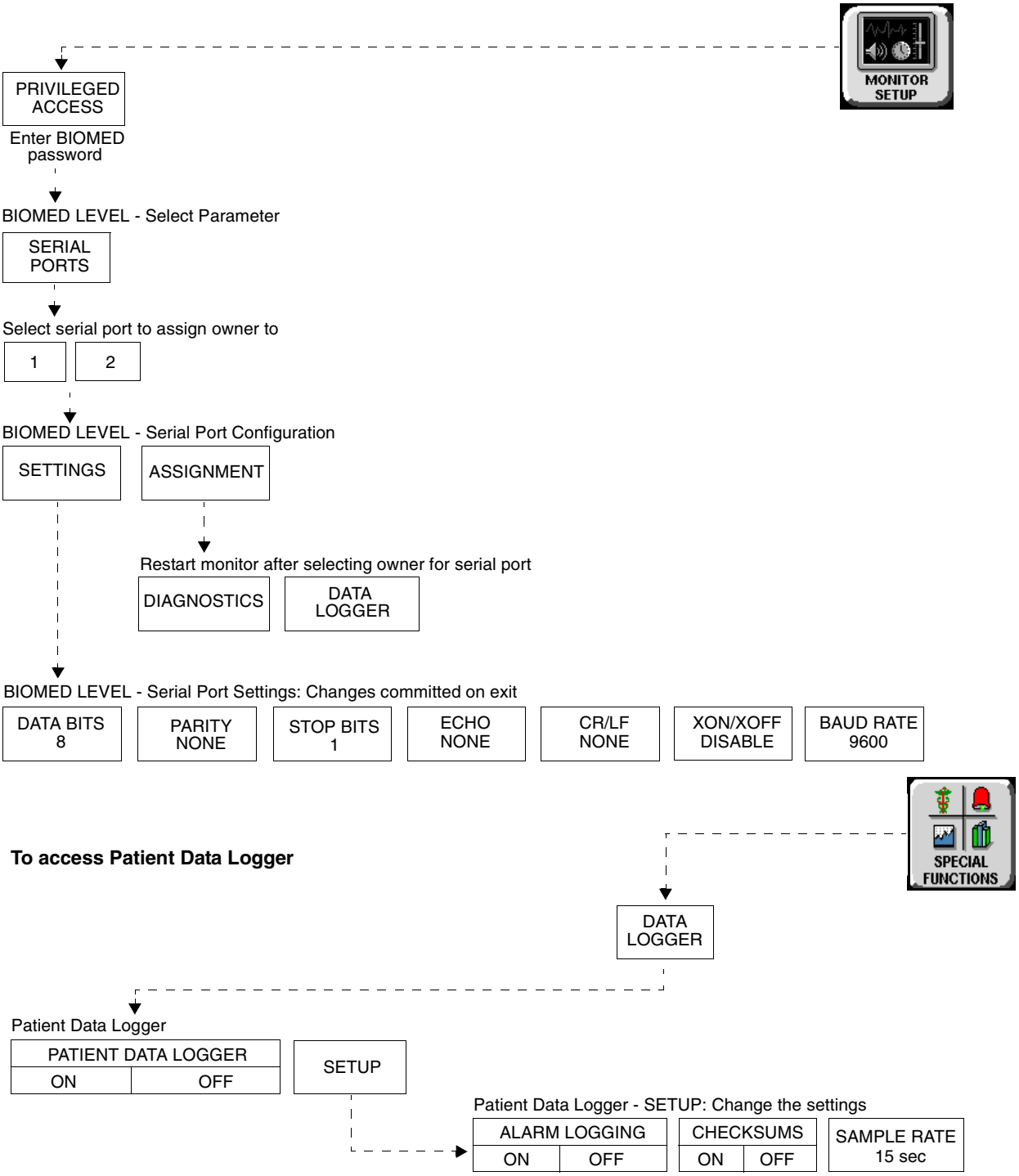
The display of parameters in scales for the secondary display is independent of the primary monitor. Scales are adjusted using the same menu as the primary except when a secondary display is enabled, the PRIMARY/SECONDARY key appears in the menu. This key allows you to choose which display you want to change.

To adjust the scaled display:

1. Touch MONITOR SETUP.
2. Touch PRIVILEGED ACCESS.
3. Enter Clinical password.
4. Touch SCALED DISPLAY.
5. Touch PRIMARY/ SECONDARY key to choose display to change.
6. Select MINOR GRATICULE ON.
7. Use arrow keys to adjust.

Patient Data Logger Directory

Directory of Keys - Bedside only



- *Based on features purchased, more or fewer keys may appear here than on your menu screens.*

Patient Data Logger

Contents

Overview

The Patient Data Logger option automatically sends patient vital signs from the monitor to an external device, such as a printer or a terminal. Episodic patient data is also sampled and transmitted. The output is in the form of ASCII text byte strings, and is printed using standard RS232 serial communications via the monitor's serial port. Refer to the *Display Detail* on page 29-5 for further information.

This option continues to send data whether the external device is on-line or off-line. Data transmission can be stopped by reassigning the data port or disabling the Patient Data Logger.

Your system administrator (or other designated personnel) must first set up communication between the monitor and the external device by assigning the serial port to Patient Data Logger, and then adjusting the serial port settings. The various serial settings can be adjusted to suit the device attached to the serial port. Refer to the appropriate service manual for more details.

To set up Patient Data Logger (the user must have System Administrator access):

1 Touch MONITOR SETUP.
2 Touch PRIVILEGED ACCESS.
3 Enter biomed password.
4 Touch SERIAL PORTS and select a port.
5 Touch ASSIGNMENT.
6 Touch DATALOGGER.
7 Touch PREVIOUS MENU.

To set serial settings:

8 Touch SETTINGS.
9 Touch the desired setting key(s) to display desired settings.
10 Touch NORMAL SCREEN to effect changes.

The sample rate refers to the frequency of data sampling and can be set to time intervals ranging from 5-seconds to 60-minutes. The new sample rate takes effect at once.

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- *The option is only available on bedside monitors.*
- *Ensure that any cables or other computer or communications equipment connected to the bedside monitor comply with applicable medical standards.*
- *The combination of PDL baud rate and sample rate must be selected carefully. Slow baud rates, in combination with frequent data transmissions, may cause loss of data. This is especially true if a large amount of patient vital sign data is being monitored. However, some devices cannot accept data at high baud rates. This may limit the range of sample rates at which your device can accept data readings from the monitors.*

The data logger output requires a serial cable that swaps pins (refer to *Table 1*). The serial cable must be properly connected at both ends and the data logger output enabled.

Table 1: Serial Cable Pinout

Input	Output
2	3
3	2
4	5
5	4

Display Detail

The Patient Data Logger report is automatically sent to an external device, such as a printer or terminal, once the serial port is assigned and toggled ON.

The data fields that appear on this report (ECG, RESP, ART, SpO_2, and $EtCO_2$) will vary depending on the parameter modules installed on the system.

SPACELABS MEDICAL PATIENT DATA LOGGER

PATIENT NAME DOE, JOHN Bed # 01 DATE 08 JUN 2003

		ECG					RESP	ART	mmHg	SPO2		EtCO2		
TIME	HR	ABN	LEAD	LEAD2	ST1	ST2	RATE	SYS/DIA	MEAN	%	RESP	%	AGENT	%
14:55:49	212	0	VI	II	2.08	-2.00	52	138/81	109	93	0	0.1	HAL	0.0
14:55:54	158	0	VI	II	2.08	-2.00	47	138/81	109	95	0	0.1	HAL	0.0
14:55:59	146	0	VI	II	2.08	-2.00	39	138/81	110	96	0	0.1	HAL	0.0
14:56:04	146	0	VI	II	2.08	-2.00	36	138/81	110	97	0	0.1	HAL	0.0
14:56:10	212	0	VI	II	2.08	-2.00	47	138/81	109	97	0	0.1	HAL	0.0
14:56:15	200	0	VI	II	2.08	-2.00	53	138/81	110	97	16	5.2	HAL	0.1
14:56:20	146	0	VI	II	2.08	-2.00	43	138/81	110	97	16	5.2	HAL	0.1
14:56:25	146	0	VI	II	1.84	-2.56	36	138/81	109	97	16	5.2	HAL	0.1
14:56:30	211	0	VI	II	1.84	-2.56	43	138/81	110	97	16	5.2	HAL	0.1
14:56:35	212	0	VI	II	1.84	-2.56	53	138/81	110	97	16	5.2	HAL	0.1
14:56:45	146	0	VI	II	1.84	-2.56	36	138/81	110	97	16	5.2	HAL	0.1
14:56:52	200	0	VI	II	1.84	-2.56	39	138/81	109	79	16	5.2	HAL	0.1

Figure 29-1: Patient Data Logger report sample

- *All lines on this report are terminated by a line-feed, carriage-return combination.*
- *Lines may wrap if the line length exceeds the display or printer width.*
- *The report prints a maximum of 132 characters per line and 2 lines per entry.*
- *The report prints data from a maximum of 11 parameter groups (for example, ECG, RESP, ART, etc.). (Fewer parameters are printed if the line length limit is reached.)*

Data Printouts

Each line of the data printout may contain up to 132 characters and is terminated with line feed and carriage return characters.

- *If you are monitoring a large number of parameters and have an 80-column printer, the data from one reading may require more than one line. If your printer has a wrap-around feature, this will be handled automatically. If you prefer that each data reading fit onto one line, condense the printer's type or use a wide-carriage (132 column) printer.*

The PDL transmits two types of information: page headers and data lines. The page header appears at the top of each page and contains the patient's name, the bed number, and the current date. A new page is generated when any the following situations occur:

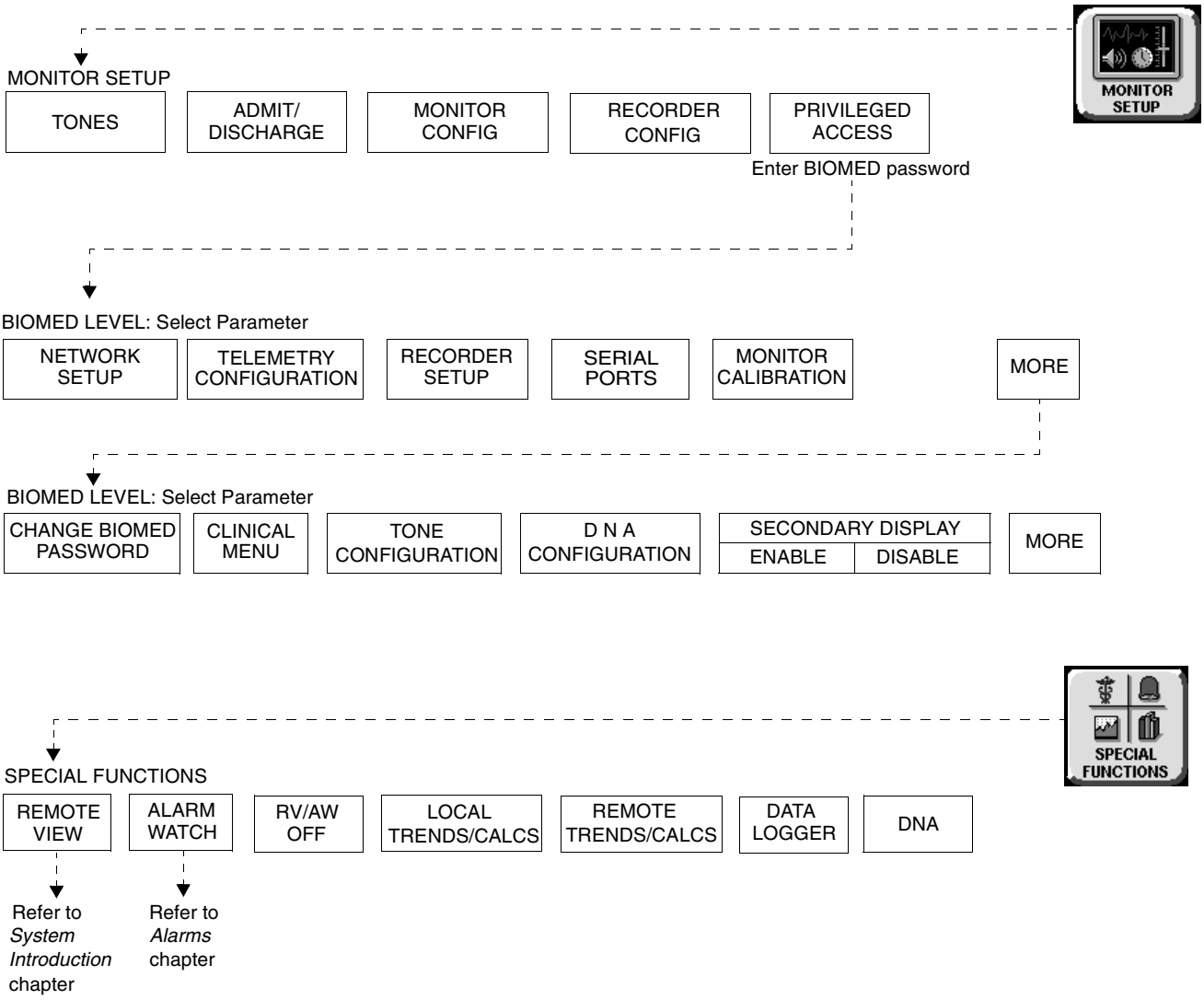
- The end of a page is reached (that is, 50 data lines have been transmitted).
- The monitored vital signs parameters change.
- The patient name or bed number changes.
- The current date changes.

Data lines are transmitted at the interval specified at configuration. Each data line contains the time that the data was collected, as well as the data collected for each vital sign parameter being monitored.

Patient Data Logger Troubleshooting Guide

Clinical Situation	Possible Causes	Solution
Data is displayed with improper spacing or double spacing	■ The PDL interface sends a carriage return/line feed sequence at each end-of-line. The external device may not be set up properly.	■ Set the external device for “0” line feed.
No data is displayed or printed on the external device	■ There is a power problem or the cables are faulty. The device may not be set up properly.	■ Check the power and cables. Ensure that the device is in the online mode and that RS-232 port requirements are satisfied. ■ Check for RS-232 compatibility at the monitor and at the external device. ■ Check the monitor port assignments and port connections.
Data is lost or garbled	■ The cable is faulty. ■ The parity is set incorrectly. ■ Baud rate settings may be inappropriate.	■ Check the cables. ■ Verify the baud rates and parity settings.

Directory of Keys - UCW and Ultraview 1700



! • *Based on features purchased, more or fewer keys may appear here than on your menu screens.*

DNA

Contents

Overview

To set up DNA (must have System Administrator menu access):

1. Touch MONITOR SETUP.
2. Touch PRIVILEGED ACCESS.
3. Enter biomed password.
4. Touch MORE.
5. Touch DNA CONFIGURATION.
6. Enter desired configuration using the keyboard.
7. Touch OK.
8. Touch RESET MONITOR.

To access DNA:

1. Touch SPECIAL FUNCTIONS.
2. Touch DNA.
3. Touch the desired application icon.

The Dynamic Network Access (DNA) feature allows you to view and control a remote application.

Your hospital system administrator (or other designated personnel) must first set up communication between the UCW and Ultraview 1700 and the external computer(s) before DNA can be accessed. Refer to the *Universal Clinical Workstation (UCW) and Ultraview 1700 Monitors Service Manual (P/N 070-0470-xx)* for more details.

- *Ensure that any computer or communications equipment connected to the network comply with applicable medical standards.*

Ultraview Care Network Product Specifications

Contents

System Safety Specifications

System Introduction and Network Basics on page 1-1 includes information concerning the interconnection of equipment within the Ultraview Care Network. Initial connection of auxiliary line-operated equipment to a monitor must be performed by a hospital biomedical engineer or a Spacelabs Medical Customer Service Representative. For further information or instructions regarding interconnection of units, contact a qualified service person or your local Spacelabs Medical representative.

After installation and/or interconnection with other units, the equipment leakage current shall not exceed the local (provincial) acceptable values.

Accessory equipment connected to the analog and digital interfaces must be certified according to the respective IEC standards (that is, IEC 950 for data processing equipment and IEC 601-1 for medical equipment). All configurations shall comply with the system standard IEC 601-1-1+A1. Everyone who connects additional equipment to the signal input part or signal output part configures a medical system, and is, therefore, responsible to ensure that the system complies with the requirements of the system standard IEC 601-1-1+A1. If in doubt, consult the technical service department or your local customer service representative.

All Spacelabs Medical equipment is intended for use with a fixed mains socket-outlet. If a system is configured using multiple portable socket-outlets, this system must be reviewed for compliance with IEC 601-1-1+A1, including the maximum load and enclosure leakage currents requirements. The multiple portable socket outlet cannot be placed on the floor. If the leakage limit is exceeded, a second Protective Earth, fixed at both ends with a tool, may be necessary. This second Protective Earth must be tested to the requirements of clause 18 of IEC 601-1.

Equipment weighing more than 20 kg is not portable. To lift heavy equipment, support under corners and lift according to hospital procedures.

Use of patient cables, transducers, sensors and supplies other than those specified by Spacelabs Medical may degrade equipment performance, including defibrillation protection.

Input leakage current for all patient input channels is less than 10 μA making ECG units suitable for direct cardiac application. The maximum non-destructive voltage that can be applied to any input or output connector on the monitors, modules or printers is +5 V. All signal inputs or outputs are for exclusive connection to equipment specified by Spacelabs Medical.

Disposal of these devices and all accessories must be in accordance with local and federal laws.

Table 1: Ultraview Care Network Products Power Rating

Product	Frequency	Electrical Rating	Fuse Rating
90367/90369	50/60 Hz	100-240VAC 2.0-1.0A	N/A
90385/90363	50/60 Hz	2.5A/100-120V 1.3A/220-240V	2-T3A/250V 2-T3.15A/250V
90386	50/60 Hz	1.35A/100-120V 0.8A/220-240V	2T2A/250V 2-T1.25A/250V
90479-A	50/60 Hz	2A/115V 1A/230-240V	2-T2.5A/250V (Slow) 2-T1.6A/250V
90364/90387/90491/ 90499/94000	50/60 Hz	100-240V 2.0-1.0A	N/A

WARNING:

- ***To protect against electrical shock, proper grounding is essential.***
- ***If a monitor is in battery mode during defibrillation, the monitor must be properly grounded using the ground terminal provided on the rear panel or by using the protective ground in the power cord.***
- ***If the integrity of the external protective earth conductor is in doubt, the equipment must be operated from its internal power source (if applicable).***

When interconnecting equipment, avoid using optional battery operation. If such operation cannot be avoided, the battery-operated instrument must be grounded using the ground terminal on the rear panel or the protective ground (earth) in the power cord.

Power Cord:

- 3-wire, 18-gauge, hospital grade, or
- 3-wire, 0.75mm^2, European harmonized.

Plug:

- 3-terminal polarized, with protective ground.

WARNING:

- ***Do not use a 3-to-2 plug adapter.***
- ***Ground terminal of the plug is connected directly to the frame of the instrument. Any interruption of the grounding connector can create an electric shock hazard.***

Equipment Classification

All of the products listed below are classified as “Class 1- ordinary equipment (not protected against harmful ingress of liquids or flammable anesthetic mixtures), continuous operation.” In addition, the 90367, 90369, and 94000 are internally powered.

Table 2: Equipment Classification

Product	Type*	Product	Type*
90367/90369	Depends on module used BF-Defibrillator-proof with O_2/CO_2 option*	94000	B-FHR (Ultrasound) BF-UA CF-FECG Depends on module used
90478	B	90424	CF-Defibrillator-proof
90385/90363	Depends on module used	90482	BF
90386	Depends on module used	90496	CF-Defibrillator-proof
90387/90364	Depends on module used	90491	Depends on module used
90426/29/30	BF-Defibrillator-proof	90513/14	BF-Defibrillator-proof
90449/69	B	90515/16	BF-Defibrillator-proof
90479	Depends on module used	90499	Depends on module used

* Refer to *Symbols on page 34-1* for type definitions.

Equipment Maintenance Requirements

Corrective or maintenance procedures must be performed by qualified personnel.

Periodic maintenance procedures are required every 12 months to verify that:

- the equipment is physically sound.
- resistance between the chassis ground connector on the rear panel and the protective ground of the mains input is not greater than 0.1 ohm.
- isolation resistance between ground and mains is greater than 2 meg-ohm.

While the equipment is operating normally verify that:

- chassis leakage current is less than 100 μA.
- patient leakage current is less than 10 μA (Type CF), 100 μA (Types B and BF).

While the equipment is operating in single fault condition verify that:

- chassis leakage current is less than 300 μA (100-120 V), 500 μA (220-240 V);
- patient leakage current is less than 50 μA (Type CF), 500 μA (Types B and BF).

Under non-optimal environmental conditions or periods of intense use, more frequent checks are recommended.

If the equipment has been dropped, abused or damaged in any way (if the monitor or module becomes wet, for example), a qualified service person must verify that the unit is working correctly and that all safety features are intact.

Visually inspect all patient cables each time the unit is used. Check for worn or damaged plastic covering, frayed or broken wires, cracked connections or any other signs of damage. Do not use cables which exhibit obvious damage.

Ultraview Care Network Module Compatibility

If any function (NIBP, ECG, SpO_2, etc.) on your system does not contain a feature described in this manual:

- Your product may contain an earlier version of software. Contact your customer service representative and refer to the original documentation that accompanied your system.
- Your system configuration may be different from that described in this manual. Refer to notes in this manual describing features where system configuration is likely to impact the available features.

Before moving a Ultraview Care Network module from one network to another, be certain that the module software version is compatible with that required by the second network. If in doubt, have a qualified service person verify compatibility between the module and the network.

Cleaning and Sterilization

Contents

Monitors

To clean Ultraview Care Network monitor screens and covers, modules, processors, and printers use a cloth or swab that has been slightly dampened in a solution of warm water and a mild detergent. Avoid solvents which may damage the product cases. Follow your hospital protocol.

CAUTION:

- **Use of cleaning agents other than those listed may cause degradation to the product's plastic enclosure and labels. Questions or concerns regarding cleaning issues should be directed to Spacelabs Medical Technical Support.**

Touchscreen Cleaning

There is not a separate shield over the face of the screen on the UCW or Ultraview 1500. Clean the screen with a soft cloth moistened with either 70% alcohol OR soapy water.

- *Follow your hospital protocol for the handling of blood and body fluids.*
- *Do not allow liquid to enter the monitor.*

Accessories

- Where provided, follow the manufacturers' instructions concerning disposable and reusable supplies.
- As applicable, follow your hospital protocol concerning cleaning, disinfection and/or sterilization of reusable supplies.

Use of patient cables, transducers, sensors or supplies other than those specified by Spacelabs Medical may degrade module performance.

TRU-CUFF Noninvasive Blood Pressure Cuffs

TRU-CUFF® Disposable Cuff

The disposable cuff wrap is designed for single patient use. It is packaged non-sterile and cannot be soaked, rinsed or sterilized.

TRU-CUFF Reusable Cuff

The reusable cuff is packaged non-sterile. It may be cleaned and disinfected with an enzymatic detergent and 10% solution of household bleach (5.25% sodium hypochlorite).

Cuff Cleaning and Disinfection

Materials

- Enzymatic detergent such as ENZOL (US) or CEDEZYME (UK)
- 10% solution of household bleach (5.25% sodium hypochlorite) in distilled water
- Soft cloths or bristle brushes
- Spray bottles

Procedure

1. Prepare the enzymatic detergent and bleach solutions in separate bottles per the manufacturer's instructions.
2. Spray detergent liberally on cuff, allow to sit for one minute.
3. Remove detergent with a soft cloth. For persistent contamination, scrub with a soft bristled brush.
4. Rinse cuff thoroughly with distilled water.
5. Spray bleach solution on the affected area until saturated. Allow the cuff to sit for 5-minutes.
6. Remove any excess solution with a soft cloth and rinse again with distilled water. Allow 2-hours for air drying at ambient temperature.

Cables and Lead Wires

Cleaning

TRU-LINK® cables and lead wires may be cleaned with the following agents:

- Mild soap and water solution
- U.S. Pharmacopeia (USP) green soap
- Sodium hypochlorite solution (1:10 dilution of household bleach in water)
- Phenolic germicidal detergent solutions (1% aqueous solutions)
- Isopropyl alcohol solution (70%)

To clean product:

1. Prepare cleaning agent according to manufacturer's instructions.
2. Saturate a clean cloth with designated cleaning agent.
3. Wipe off exposed surfaces of product.
4. Re-wipe product with clean water.
5. Wipe dry.

Tape adhesive may be removed with Spacelabs Medical's adhesive tape remover pads (P/N 392196-001).

- *The compatibility of TRU-LINK products with chemical agents other than the type identified is unknown.*
- *The effective use of any cleaning or disinfecting procedure is subject to the proper preparation of each agent per the manufacturer's instructions.*

CAUTION:
- **Do not immerse connector ends or cables in liquid.**

Sterilization

TRU-LINK cable and lead wires are provided non-sterile. Following use they may be ethylene oxide (EO) sterilized. Follow standard hospital protocol for processing.

CAUTION:
- **Do not steam autoclave.**

- *Product is compatible with sterilization process. Actual product sterility is dependent on a qualified sterilization cycle and procedure.*

Pulse Oximetry Sensors

For cleaning information see the manufacturer's instructions enclosed with each sensor.

Capnography Sensors

The capnography sensor and cable should be cleaned routinely, especially between patient uses. Before cleaning, make sure the sensor is disconnected from the module and/or monitor. Sensors and cable assemblies may be wiped using a cloth or swab dampened in alcohol or 10% bleach solutions. Mild detergents may also be used initially to remove any residual buildup. Sensor should be wiped immediately following cleaning with distilled water and then dried to remove any cleaning residue.

CAUTION:

- **Under no circumstances should sensors be immersed in a solution of any type.**
- **Do not autoclave the sensor.**
- **Never use solvents, acetone, or abrasive cleaning agents.**
- **Do not force the sensor onto the airway adapter.**
- **Avoid undue stress on the sensor head and cable.**

!

- *After unpacking, keep the sensor container. When not in use, disconnect the sensor from the module and/or monitor, clean, and place it into the container for safe keeping.*
- *Sensor exposure to cleaning agents should be limited to a maximum of 15- to 20-minutes. Longer intervals of exposure could produce a slight dulling of the original surface finish.*

Visually inspect the sensor, cable, and the airway adapters for any sign of physical damage. Verify that the plugs and connectors are in good working condition and that the pins and prongs are not bent. Use a cotton swab dampened with alcohol, or a mild soap, to carefully clean the windows of the sensor head and the calibration cells. Always remove any damaged or questionable sensor or airway adapter from service.

90518 Multigas Analyzer

WARNING:
- ***Always turn the unit off and unplug the power cord before cleaning to protect against electrical shock.***

Exterior

The exterior of the 90518 should be cleaned and disinfected as necessary. Use a clean cloth or swab dampened in a solution of warm water and mild detergent. Squeeze the cloth out thoroughly before use. Disinfect the unit with Hemosol or similar disinfectant.

CAUTION:
- **Do not allow liquid to enter the interior of the 90518. If this should occur, check the unit for proper operation and verify its performance accuracy prior to reuse.**

Disposable and reusable patient accessories are available for the 90518.

- Disposable accessories are for single-patient use only and must not be sterilized or cleaned for reuse on other patients. Refer to the instructions provided with each patient accessory to determine if the accessory may be cleaned and reused on the same patient.
- Reusable accessories can be used on multiple patients after cleaning and/or sterilizing. Refer to the instructions provided with these accessories for details.

Instructions provided with patient accessories may contain warnings regarding their use. Read these instructions carefully prior to use.

- *The Spacelabs Medical sampling lines are for single-patient use only. Cleaning deteriorates the properties of the sampling line, resulting in slower response time and more frequent occlusions.*

Fan Grill

The analyzer has a fan grill located on the rear panel. It must be kept free from dust and other contaminants.

Batteries

The analyzer contains two lead-acid batteries used to provide short-term operation during a power failure. The analyzer retains the operating configuration for up to 5-minutes during an AC power interruption. The batteries should be replaced every year.

All batteries should be disposed of properly to protect the environment. Lithium batteries should be fully discharged before disposal. Batteries such as lead-acid (Pb) and nickel-cadmium (Ni-Cd) must be recycled. Please follow your internal procedures and/or local (provincial) laws regarding disposal or recycling.

CO_2 Scrubber

The analyzer contains an internal CO_2 scrubber which must be replaced every year.

Refer to the *90518 Multigas Analyzer Service Manual (P/N 070-0643-xx)* for details on replacing the CO_2 scrubber, cleaning and sterilization procedures.

Ultrasound Transducers

Basic cleaning should be performed regularly to ensure continued reliability.

1. Keep accessories clean.
2. Wipe transducers with a soft cloth moistened with a germicidal solution after each use.
3. Wipe off any ultrasound gel on the ultrasound transducers or the monitor as soon as possible.

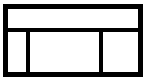
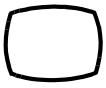
Diagnostic Messages

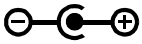
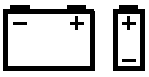
Message	Cause/Action
MONITOR SUPPORTS xx PARAMETERS. ADDITIONAL PARAMETERS MAY OVERLOAD IT	Data for more than **xx** parameters is being input to the monitor. System performance may decline. Unplug modules to improve performance.
UNABLE TO SUPPORT A NEW MODULE AT THIS TIME	There is not enough system memory to support a new module. Unplug modules to free memory.
UNABLE TO SUPPORT A NEW CHANNEL AT THIS TIME	There is not enough system memory available to support a new channel. Detach channels to free memory.
DIAGNOSTIC ERROR ENCOUNTERED LOADING MODULE	Checksum error detected loading module. Module is unsupported.
DIAGNOSTIC ERROR ENCOUNTERED LOADING CHANNEL	Checksum error detected loading channel. Channel is unsupported.
OUT OF MEMORY - DELETING HEMO ENTRY	There is not enough system memory available to the application to complete the requested operation. Try again later.
OUT OF MEMORY - DELETING RESP ENTRY	There is not enough system memory available to the application to complete the requested operation. Try again later.
OUT OF MEMORY - DELETING OXY ENTRY	There is not enough system memory available to the application to complete the requested operation. Try again later.
OUT OF MEMORY - DELETING RENAL ENTRY	There is not enough system memory available to the application to complete the requested operation. Try again later.
CREATE NEW ENTRY FAILURE - MAXIMUM NUM ENTRIES EXCEEDED	The maximum number of Calcs entries are in use. Delete existing entries to create new ones.
REMOTE MONITOR NOT RESPONDING	Calcs timeout expired waiting for remote GDS response. Verify remote monitor is on network, and try again.
ERROR READING STORED CALCS DATA	Bad return code from GDS on data read. GDS is possibly corrupt. Reboot monitor.
ERROR STORING CALCS DATA	Bad return code from GDS on data store. GDS is possibly corrupt. Reboot monitor.
ERROR DELETING STORED CALCS DATA	Bad return code from GDS on data delete. GDS is possibly corrupt. Reboot monitor.
NO TRENDS AVAILABLE FOR THIS BED	There is no trend data in GDS. Wait one minute and try again.
NO OTHER BED ON THE NETWORK HAS ACTIVE PARAMETERS	This message is in response to a remote request. The monitor has determined that there are no beds on the network with active parameters so remote operations are not possible at this time.
THERE ARE NO PARAMETERS ACTIVE ON THIS BED	The selected bed has no active parameters. In order to remotely work with the monitor at the selected bed, it must have active parameters.
PARAMETER IS NOT AVAILABLE TO MONITOR	Failed attempt to attach to channel. Try again.
COMMUNICATIONS WITH REMOTE MONITOR INTERRUPTED	Lost connection to remote monitor. Verify that the remote monitor is on the network and retry remote operation.
THIS OPERATION WILL CAUSE THE MONITOR TO RESET	The requested operation will reboot the monitor. If you do not want this to occur, touch PREVIOUS MENU or NORMAL SCREEN.
THIS INSERTION WILL CAUSE PRIOR ASSIGNMENT TO BE LOST	The requested zone assignment will cause a previously assigned zone to be lost. Touch PREVIOUS MENU or NORMAL SCREEN to abort the operation.

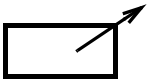
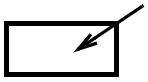
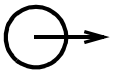
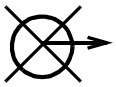
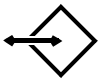
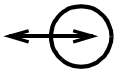
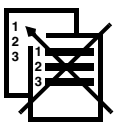
Message	Cause/Action
REMOTE BED SELECT FEATURE IS IN USE BY ANOTHER APPLICATION	The Remote Bed Select window is in use by another application. Only one application may use this window at one time. Touch the application which is using the Remote Bed Select feature and touch PREVOUS MENU or NORMAL SCREEN to abort the selection. The window will now be available for use.
UNABLE TO RECORD THE REQUESTED ALARM CHANNEL(S)	Unable to perform the requested operation. Verify that a recorder is selected and operational (has paper) and try again.
UNABLE TO RECORD THE REQUESTED CHANNEL(S)	Unable to perform the requested operation. Verify that a recorder is selected and operational (has paper) and try again.
PARAMETERS NOT AVAILABLE FOR RECORDING	Unable to perform the requested operation. Verify that a recorder is selected and operational (has paper) and try again.
CAUTION - MONITOR SETTINGS MAY HAVE CHANGED	The battery for non-volatile memory has failed. That memory resets the monitor to the default settings and the default settings may not match hospital preferences. Contact your hospital biomed to check Biomed and Clinical Menu settings and Alarm Watch setup.
PAPER OUT	There is no paper in the fetal chart recorder. Load paper.
RECORDER OFF	Indication that the fetal chart recorder is powered OFF. Power ON fetal chart recorder.
“CHECK CABLE” “NO CONNECTION”	Invalid CIM address. Verify that the CIM cable is properly connected to the monitor and the wall outlet.
“CHECK CABLE” then “OLD XXX NEWXXX” then “ID CHANGE!” ALTERNATELY	The CIM ID has changed unexpectedly during operation. Verify that the CIM cable is properly connected to the monitor and the wall outlet.
ADMIT PATIENT	No patient name has been entered. Enter patient name into BirthNet or standalone monitor.

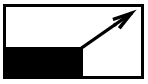
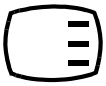
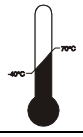
Symbols

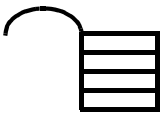
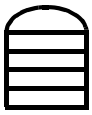
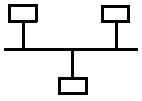
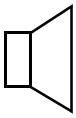
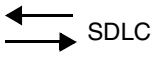
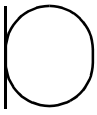
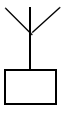
The following list of international and safety symbols describes all symbols used on Spacelabs Medical products. No one product contains every symbol.

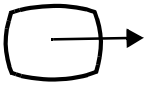
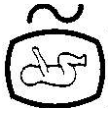
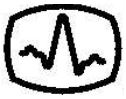
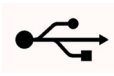
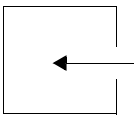
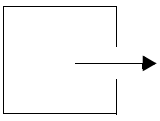
Symbol	Description	Symbol	Description
	UCW or Ultraview 1700 HELP Key		UCW or Ultraview 1700 MONITOR SETUP Key
	UCW or Ultraview 1700 SPECIAL FUNCTIONS Key		UCW or Ultraview 1700 ALARMS Key
	UCW or Ultraview 1700 RECORD Key		UCW or Ultraview 1700 PREVIOUS MENU Key
	UCW or Ultraview 1700 NORMAL SCREEN Key		UCW or Ultraview 1700 mouse connection
	UCW or Ultraview 1700 Keyboard Connection		ON — Power Connection to Mains
	OFF — Power Disconnection from Mains		On Position for Push button Power Switch
	Off Position for Push button Power Switch		STOP or CANCEL Key
	CONTINUE Key		START/STOP Key
	START/STOP		START (NIBP) Key
	On Direction		ON/OFF
	Television; Video Display		Recycle
	Protective Earth Ground		Functional Earth Ground

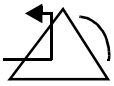
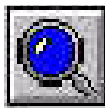
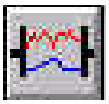
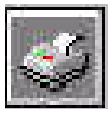
Symbol	Description	Symbol	Description
	ON — Part of the Instrument Only		OFF — Part of the Instrument Only
	Partial ON/OFF		STAND-BY Key
	All batteries should be disposed of properly to protect the environment. Lithium batteries should be fully discharged before disposal. Batteries such as lead-acid (Pb) and nickel-cadmium (Ni-Cd) must be recycled. Please follow your internal procedures and or local (provincial) laws regarding disposal or recycling.		Caution - hazardous voltages. To reduce risk of electric shock, do not remove the cover or back. Refer servicing to a qualified service personnel (U.S.A.). DANGER - High Voltage (International)
	PAUSE or INTERRUPT		Slow Run
	Replace Fuse Only as Marked		Fuse
	Power supply jack polarity. (+ / - Signs May be Reversed)		Equipotentiality Terminal
	Battery Replace only with the appropriate battery.		Replace only with the appropriate battery. (+ / - Signs May be Reversed)
	Alternating Current		Direct Current
	Both Direct and Alternating Current		AC/DC Input
A	Amperes	Hz	Hertz
V	Volts	W	Watts
	Temporary Shut Off of Alarm Tone or Screen Indicators		Alarm

Symbol	Description	Symbol	Description
	ENTER Key		PRINT REPORT Key
	Attention - Consult Operations or Service Manual for Description		Risk of Explosion if Used in the Presence of Flammable Anesthetics
	Indicator — Remote control		Indicator — Local Control
	Return Unit to Monitor Mode		Indicator — Out of Paper
	Activate Recorder for Graphics		Recorder Paper
	Indoor Use Only		Auto Mode (NIBP)
	Output		No Output (Terminated)
	Data Input/Output	?	HELP (Explain Prior Screen) Key
	Clock/Time Setting Key		Input/Output
	Monitor Setup Select Program Options		Set Initial Conditions Menu
	Access Special Function Menu		Normal Screen
	Return to Prior Menu		TREND/TIMER Key
	Gas Exhaust		Electrocardiograph or Defibrillator Synchronization

Symbol	Description	Symbol	Description
	Arterial Pulse		IEC 601-1 Type BF equipment. The unit displaying this symbol contains an F-type isolated (floating) patient-applied part providing an adequate degree of protection against electric shock.
	IEC 601-1 Type BF equipment which is defibrillator-proof. The unit displaying this symbol contains an F-type isolated (floating) patient-applied part which contains an adequate degree of protection against electric shock, and is defibrillator-proof.		IEC 601-1 Type CF equipment. The unit displaying this symbol contains an F-type isolated (floating) patient-applied part providing a high degree of protection against electric shock.
	IEC 601-1 Type CF equipment. The unit displaying this symbol contains an F-type isolated (floating) patient-applied part providing a high degree of protection against electric shock, and is defibrillator-proof.		ETL Laboratory Approved
	IEC 601-1 Type B equipment. The unit displaying this symbol contains an adequate degree of protection against electric shock.		Canadian Standards Association Approved
	Keypad		Enlarge, Zoom
	Menu Keys		Delete
	Waveform/Parameter Keys		PCMCIA Card
	Keep Dry		Fragile; handle with care
	Foot Switch		This Way Up
	Environmental Shipping/Storage Temperature Limitations		Environmental Shipping/Storage Humidity Limitations

Symbol	Description	Symbol	Description
	Open Padlock		Closed Padlock
	Down Arrow		Up Arrow
	Event	TEMP temp	Temperature
	Antenna		Environmental Shipping/Storage Altitude Limitations
	Network Connection		Audio Output, Speaker
	Remote Alarm; Nurse Alert		Nurse Call
	Serial Port 1		Serial Port 2
	External marker push button connection		SDLC Port
	Microphone		Mermaid Connector

Symbol	Description	Symbol	Description
	Note		Video Output
	Warning About Potential Danger to Human Beings		Caution About Potential Danger to Equipment
	Non-Invasive Blood Pressure (NIBP), Neonate		Fetal Monitor Connection (Analog)
	Fetal Monitor Connection RS232 (Digital)		Physiological Monitor Connection RS232 (Digital)
	Input		Reset
	Hard Drive		Power Indicator LED
	Activate Telemetry Recorder		Omnidirectional Microphone
	Battery Status		Universal Serial Bus
	Stand-by		Low Battery
	Gas Sampling Port		Gas Return Port

Symbol	Description	Symbol	Description
	Operates on Non-Harmonized Radio Frequencies in Europe		Service Message
	Happy Face		Sad Face
	Reset		Power Indicator LED
	Magnifying Glass		Compression
	File Cabinet		List of Rooms
	Arrows		Printer

Abbreviations used as symbols are shown below.

Symbol	Description	Symbol	Description
1 - 32	Access Codes 1 Through 32	**AIR**	Air
ANT 1 **ANT 2**	Diversity Antenna System 1 Diversity Antenna System 2	**Arr1** **ArrNet2**	Arrhythmia Net 1 Arrhythmia Net 2
CH **ch**	EEG, EMG, or ECG Channel EEG Channels - CH1, CH2, CH3, CH4 EMG Channel - CH5	**cmH_2O**	Centimeters of Water
CMV	Controlled Mechanical Ventilation	**C.O.** **CO** **co**	Cardiac Output
DIA **dia**	Diastolic	**ECG** **ecg**	Electrocardiogram
EEG **eeg**	Electroencephalogram	**EMG** **emg**	Electromyogram
ESIS	Electrosurgical Interference Suppression	**EXT**	External
FECG	Fetal Electrocardiogram	**FHR1** **FHR2**	Fetal Heart Rate, Channel 1 Fetal Heart Rate, Channel 2
GND **gnd**	Patient Isolated Ground	**HLO** **hlo**	High-Level Output
I:E	Inspiration Expiration Ratio	**Multiview**	Multi-Lead Electrocardiogram
NIBP **nibp**	Non-Invasive Blood Pressure	**N_2O**	Nitrous Oxide
O_2	Oxygen	**PEEP**	Positive End Expiratory Pressure
PRESS **press** **PRS**	Pressure	**Pmin**	Minimum Inspiratory Pressure

Symbol	Description	Symbol	Description
Ppeak	Peak Inspiratory Pressure	**RESP** **resp**	Respiration
SDLC	Synchronous Data Link Control	**SPO2** **SpO2** **SpO_2** **SaO_2**	Arterial Oxygen Saturation as Measured by Pulse Oximetry
SVO2 **S$\underline{v}$O2** **SvO_2**	Mixed Venous Oxygen Saturation	**SYS** **sys**	Systolic
T1 **T2** **T3** **T4**	Temperature 1 Temperature 2 Temperature 3 Temperature 4	**UA**	Uterine Activity or Umbilical Artery
VAC	Vacuum connection		