SATLITE PLUS™
OSE-123

OPERATOR'S MANUAL

All specifications subject to change without notice

Manual No. 878380

SERIAL NOS. 88671 -

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WARNINGS AND CAUTIONS

A WARNING INDICATES A POTENTIALLY HARMFUL SITUATION

ELECTRICAL SHOCK HAZARD

* Do not open instrument covers. No user serviceable parts inside.

* Connect power cord to a properly grounded 3-wire outlet. Unplug before servicing, and before cleaning or disinfection.

* Do not autoclave with steam or ethylene oxide. Do not immerse in liquids or allow liquids to enter the cabinet interior.

EXPLOSION HAZARD

* Do not use SATLITE PLUS™ in the presence of flammable anesthetics.

PATIENT SAFETY

* Constant attention by a qualified individual is needed whenever a patient is under anesthesia or connected to a ventilator. Some equipment malfunctions require immediate action. A malfunction may pass unnoticed in spite of equipment or monitor alarm.

* Ensure proper contact of the return electrode of electrosurgery unit to avoid possible burn damages via the ECG electrodes or the SaO_2 probe.

* Pacemaker patients: Rate meters may continue to count the pacemaker rate during occurrences of cardiac arrest or some arrhythmias. Do not rely entirely upon rate meter alarms. Keep pacemaker patients under close surveillance.

* Change the SaO_2-probe site frequently to avoid pressure necrosis.

* Exercise extreme care to assure continued circulation distal to the probe site after application.

* A damaged probe, or a probe or lead soaked with liquids (like saline or blood) may cause electrocautery burns.

FAILURE OF OPERATION

* Note any error messages or deviations from normal operation. If the monitor fails to respond as described, do not use it until the situation has been corrected by qualified personnel.

DATA VALIDITY

* Do not expose the SaO_2-probe detector to strong ambient light while it is being used to monitor a patient. A poor signal may result.

* Do not attach the probe to the same limb as an inflated blood pressure cuff. Valid data will not be received when the cuff is inflated.

A CAUTION INDICATES A CONDITION THAT MAY LEAD TO EQUIPMENT DAMAGE OR MALFUNCTION

* Do not apply tension to the probe cable.

* Check rear panel voltage settings before connecting the monitor to mains power.

* Avoid storing the monitor and probes at temperatures outside the specified range (-5 to +50°C / 23 to 122°F).

* Connect only a high impedance device to the analog output jack. Improper loading will upset the correspondence between measured voltage and intended output voltage.

* When cleaning the monitor exterior, avoid ammonia or acetone based cleaners as they may damage the monitor surface.

* Do not autoclave probes or leads with steam or ethylene oxide.

* Do not soak or immerse probes or leads in any liquid solution.

* After sterilization with ethylene oxide, probes or leads should be quarantined in a well ventilated area to allow dissipation of residual ethylene oxide gas absorbed by the probe.

* Always use hospital grade grounded receptacle.

* No repair should be undertaken or attempted by unqualified personnel.

* Electrodes of dissimilar metal should not be used.

* Use only original DATEX patient cables and accessories.

* Always turn power OFF from SATLITE PLUS™ before making any connections or disconnections of DATEX gas monitors, graphics printer or battery module.

* Always use the DATEX special cable between SATLITE PLUS™ and Think-Jet Graphics Printer (Hewlett Packard) to guarantee full patient safety. Other cables may damage the SATLITE PLUS™ monitor.

1 UNPACKING AND INSPECTION

Upon receipt of your SATLITE PLUS™ monitor, check the shipping carton for damage and test the electrical performance of the monitor. If the carton has been damaged, or if damage to the SATLITE PLUS™ monitor may have occurred, notify the carrier immediately. In the event of electrical or operational damage contact your sales representative. The SATLITE PLUS™ monitor is delivered in one carton containing the following items:

PART NO.	QTY	DESCRIPTION
OSE-123	1	SATLITE PLUS™ monitor
54563	1	Power cord
873612	1	Clip-on finger probe
54590	1	Three Lead ECG Trunk Cable
54592	1	Set of ECG Lead Wires
878380	1	SATLITE PLUS™ Operator's Manual

For available accessories, see Chapter 5 Accessories.

2 SATLITE PLUS™ MONITORING SYSTEM

2.1 SATLITE PLUS™ Stand Alone Oxygen Saturation and ECG Monitor

The SATLITE PLUS™ is a pulse wave oximeter equipped with an ECG channel. Combining ECG measurement with SaO_2 measurement provides better motion artefact rejection as well as an additional clinical parameter. This combination gives added value in OR, ICU, Induction Rooms and Recovery Rooms.

Datex pulse wave oximeters have a unique, diagnostic, high resolution waveform display for the plethysmographic pulse wave. The pulse wave is a rapid and immediate indicator of various disturbances during anesthesia.

In addition to SaO_2 readings and plethysmographic waveform SATLITE PLUS™ provides continuous readings of heart (pulse) rate and ECG trace.

The ECG section incorporates a standard three-lead (leads I, II and III) monitoring capability. The ECG channel features an integral electrosurgery filter, defibrillator protection and pacemaker pulse rejection and detection.

Variable pitch tone - indicating a changing tone of pulse beep according to changing SaO_2 level - is included as an important feature. In other words, when SaO_2 level decreases the tone falls and vice versa.

The design allows for flexibility and external connections - now and in the future.

The SATLITE PLUS™ can also be used as a stand alone non-invasive arterial oxygen saturation and plethysmographic pulse wave monitor without the ECG waveform.

2.2 SATLITE PLUS™ Pulse Wave Oximeter Combined with a DATEX Gas Monitor

The gas display feature adds the capability of displaying gas waveforms and trends obtained from a Datex capnometer or multigas monitor. If Capnomac™ is used as the gas monitor, SATLITE PLUS™ displays CO_2, O_2 or anesthetic agent analog waveforms and trends of CO_2, O_2 and anesthetic agents (AA) as well as N_2O.

> **NOTE:** If the pulse oximeter is used with a DATEX gas monitor, the appropriate interface cable has to be ordered separately.

For detailed information concerning installation and display selection of SATLITE PLUS™ when combined with a DATEX gas monitor, see Appendix A.

2.3 Front Panel

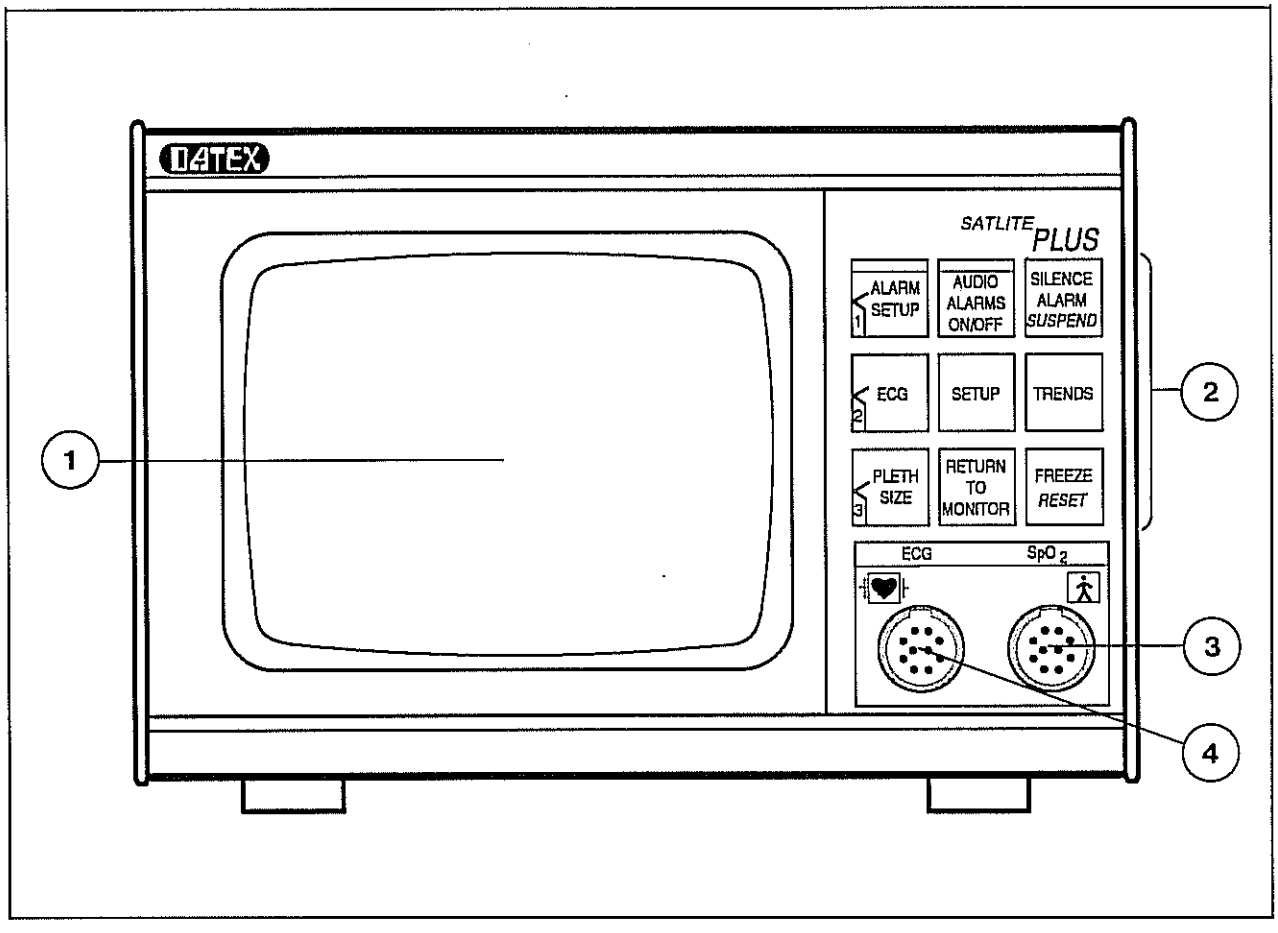


Figure 2-1 SATLITE PLUS™ Front Panel

The SATLITE PLUS™ front panel consists of:

1) 5" green monochrome CRT screen

2) Keyboard

3) Pulse oximeter probe connector

4) ECG cable connector

2.4 Rear Panel

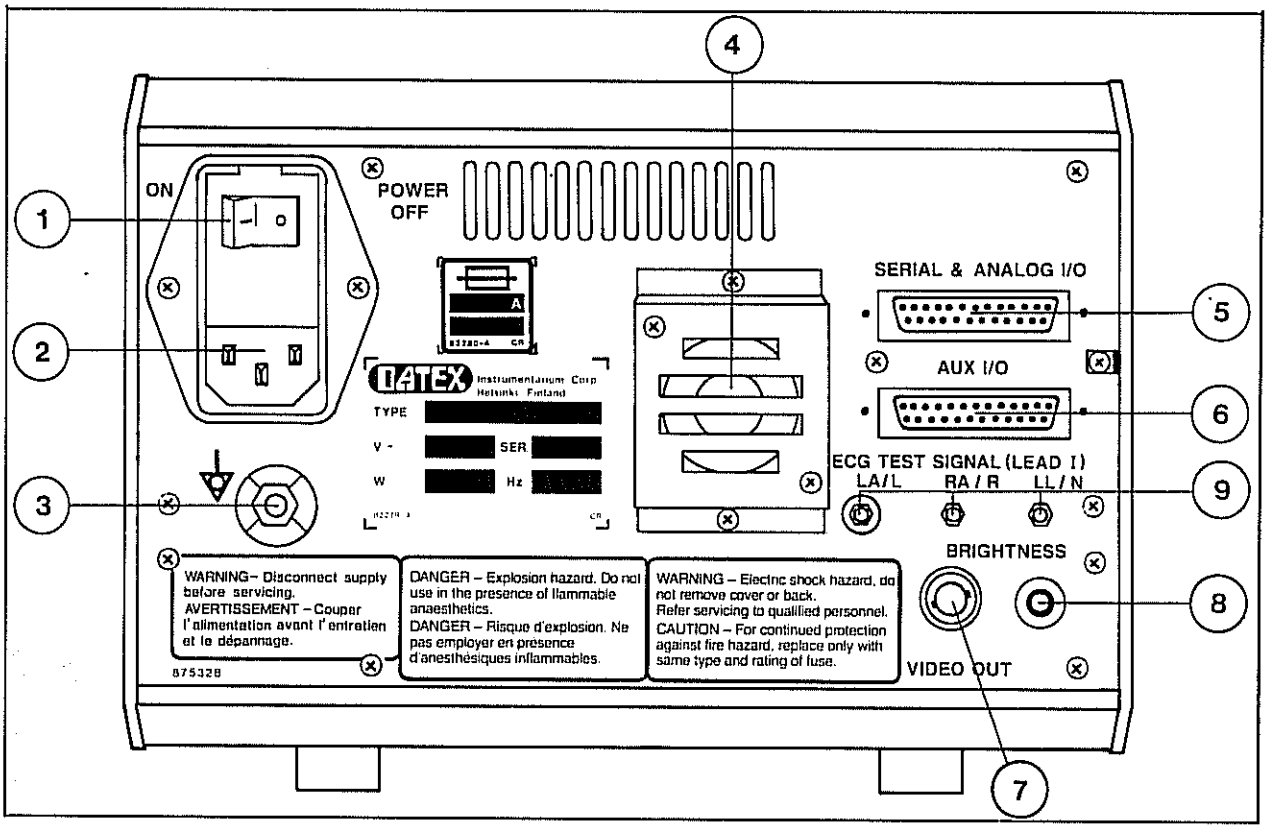


Figure 2-2 SATLITE PLUS™ Rear Panel

(1) Power switch to turn instrument on/off.

(2) Receptacle and fuse holder for line cord.

(3) Ground connector pin.

(4) Loudspeaker.

(5) Connector - D type, 25 pin. Analog and serial I/O. Connections to host gas monitor, analog recorder, BM-123 and computer (RS-232C). See Appendices D and F for pin designation and serial output format.

(6) Connector - D type, 25 pin. Provides interface to Graphics Printer.

(7) Video output connector. Provides interface to auxiliary video display or video printer.

(8) Brightness adjustment knob.

(9) ECG test signal pins.

3 OPERATION

3.1 Preoperative Check-list

Perform the following tests daily to assure proper operation of the monitor. Do not use the monitor if it fails any test. Remove it from use until the situation has been corrected by qualified service personnel.

a) Inspect the monitor case for damage.

b) Check the SaO_2 probe for foreign material and ensure that the LED and photodetector windows are clean.

c) Verify that the finger probe opens and closes smoothly. If there is any unevenness or variations in the closing motion, replace the probe.

d) Check the cleanliness and possible breakages of the ECG cables and leads.

e) Connect the probe and the ECG cable to the monitor. Check that the connectors make firm connections with the monitor, and that the cables are not bent or twisted.

f) Turn the monitor on. The unit performs an automatic start-up and self-test procedure. Verify that the text STARTING, Datex SATLITE PLUS™ Prog. 875406-yy Revision No, dd:mm:yy appears in the middle of the screen and that no error messages are displayed. Verify that the messages PROBE OFF (with finger probe) and LEADS OFF are displayed.

   If the ECG cable is not connected and the SATLITE PLUS™ monitor is used as a pulse wave oximeter without the ECG waveform, verify that the message ECG OFF is displayed.

> **NOTE:** Error messages may appear after turning the monitor on. In case of any error message, discontinue use and consult authorized service personnel.

g) Attach the probe to your finger. Wait for the automatic pulse search to be successfully completed and readings to stabilize.

h) Verify that the pulse rate and the oxygen saturation values are in the expected range, and that the plethysmographic pulse wave is regular.

i) Verify that the low SaO_2 alarm limit and the low and high HR (PR) alarm limits are displayed. Turn ALARMS OFF and verify that the ALARMS OFF message is displayed. Turn ALARMS ON again.

j) Connect the ECG leads to the test pins on the rear panel. The display should show a train of 1 mV pulses and the HR should be 60 ±1 bpm.

k) Enter ALARM SETUP and set the high and low alarm limits of heart (pulse) rate and SaO_2 beyond actual readings, one at a time. Ensure that the alarm tone sounds, and that the reading flashes on the video display.

l) Remove the probe from the finger. Ensure that the alarm message PROBE OFF appears on the screen and that the alarm tone sounds once immediately, twice after 10 seconds and after 20 seconds gives continuous beeps.

m) Remove the ECG leads from the test pins. Ensure that the alarm message LEADS OFF appears on the screen and that an alarm tone sounds as when the PROBE OFF message is given.

n) Unplug the probe from the monitor. Ensure that the alarm message NO PROBE appears on the display.

WARNING: FAILURE OF OPERATION: If the monitor fails to respond as described, do not use it until the situation has been corrected by qualified personnel.

3.2 Monitoring with SATLITE PLUS™

3.2.1 To Start Monitoring

a) Connect the SaO_2 probe and the ECG cable to the monitor.

If SATLITE PLUS™ is used as a pulse wave oximeter without the ECG waveform, do not connect the ECG cable to the monitor. The message ECG OFF is shown on the screen.

b) Turn power on using the switch at the rear of the monitor.

c) The monitor goes through an automatic self-test and start-up procedure. Confirm that no error messages appear.

When the ECG cable is not connected, the monitor acts as a pulse wave oximeter. To start the ECG mode, connect the ECG cable and attach the leads to the patient or press the ECG key for at least two seconds. The text ECG MODE IN X SECOND(S) (countdown 4-3-2-1) appears on the screen. The text ECG on the upper trace channel indicates that the ECG mode is chosen.

d) Attach the SaO_2 probe and the ECG electrodes and leads to the patient. Readings will appear in approximately 15 seconds, when the automatic pleth pulse search has been successfully completed. The monitor automatically sets the optimal pulse amplitude range after two sweeps.

The monitor is now ready for use.

WARNING: DATA VALIDITY: Do not attach the probe to a limb with an inflated blood pressure cuff. Valid data will not be received when cuff is inflated.

NOTE: If the pulse search does not succeed or there is a low quality signal, try another probe position. If the message LEADS OFF appears, check the attachment of the electrodes to the patient.

NOTE: Read the Operator's Manual thoroughly before using the monitor.

e) For individual settings and adjustments, press SETUP, ALARM SETUP, ECG or PLETH keys and use the softkeys 1, 2 or 3 to proceed. Follow the instructions on the screen. Press RETURN TO MONITOR to return to basic display mode. A RETURN TO MONITOR is automatically performed 60 seconds after the last key touch.

WARNING: Alarms can be switched off by pressing the ALARMS ON/OFF key. The alarms off situation is indicated by the message ALARMS OFF in the upper right corner of the display screen. ALWAYS MAKE SURE THAT ALARM LIMITS ARE SET AND ALARMS ARE ON WHEN MONITORING A PATIENT.

3.2.2 Combination Waveform Display

The ECG and plethysmographic pulse waveform display is shown on the screen after turning the monitor on.

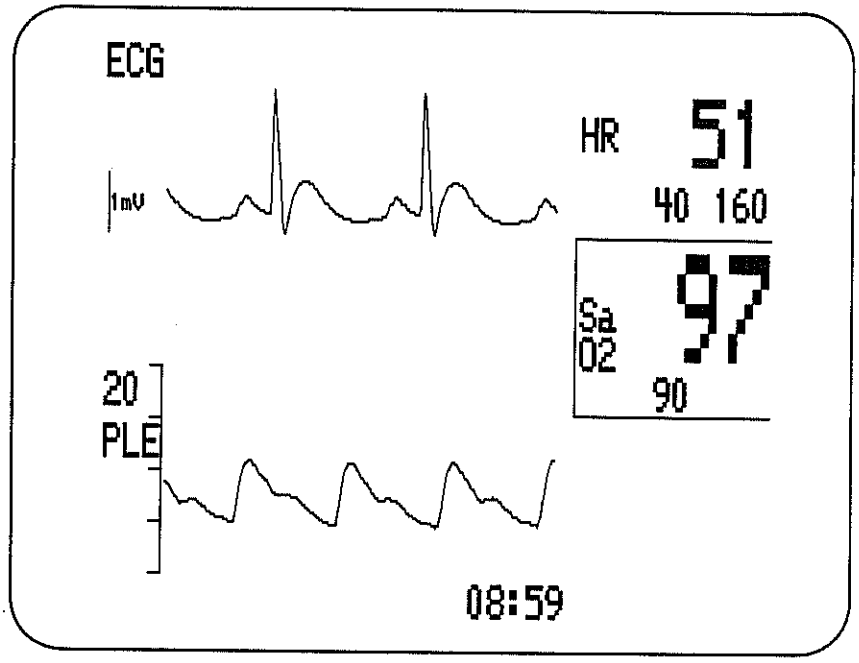


Figure 3-1 Continuous Combination Display

The following figure and the explanations related to it show the display fields for different numerical values and messages.

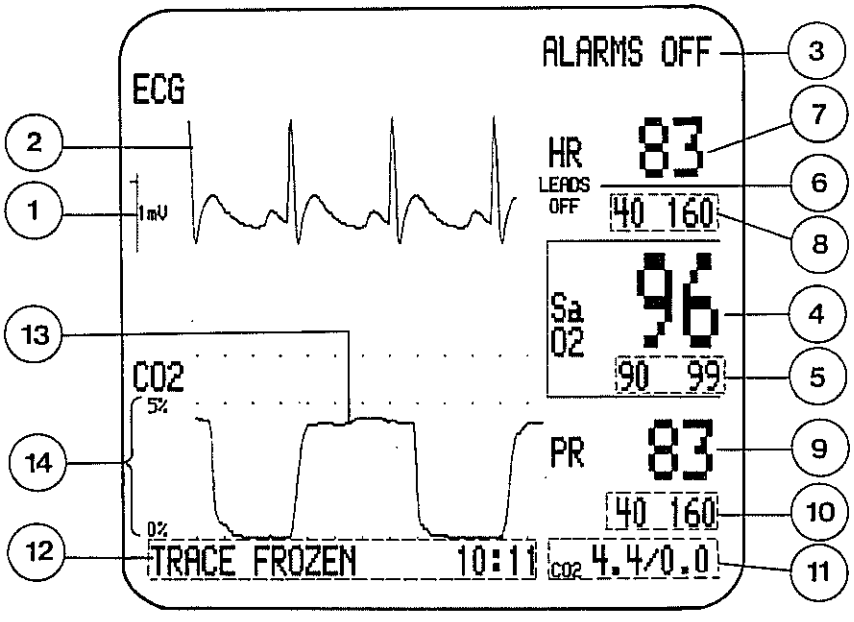


Figure 3-2 Display Fields for Numerical Values and Messages

(1) Scale for trace 1.

(2) Trace 1.

(3) Field for alarms related messages like ALARMS OFF, SaO2 LOW(HIGH) and RATE LOW (HIGH).

(4) SaO_2 value in percent or messages PROBE OFF, NO PROBE, CHECK PROBE, PULSE SEARCH, ARTEFACT and ---.

(5) SaO_2 alarm limits.

(6) Field for messages like LEADS OFF or ECG OFF.

(7) HR value in beats per minute or messages ASY and ---.

(8) HR alarm limits.

(9) PR value in beats per minute or ---.

(10) PR alarm limits.

(11) CO_2 values in percent or mmHg, when SATLITE PLUS™ is connected to DATEX Normocap® gas monitor.

(12) Field for messages like TRACE FROZEN, HR-PR MISMATCH and real time clock.

(13) Trace 2.

(14) Scale for trace 2.

3.3 Attachment of the Finger Probe

Important in using Pulse Oximatry Probes

Pulse oximetry probes may cause stress at the measuring site during long term monitoring. Always confirm that circulation is not prevented by observing the plethysmographic waveform and the measuring site.

WARNING: PATIENT SAFETY: Change measuring site frequently to prevent pressure necrosis.

To prevent pressure necrosis check the measuring site frequently. Change the site every 2-4 hours. For patients with poor peripheral circulation, use 1 hour intervals.

Remove fingernail polish, artificial (cosmetic) fingernails and cut long fingernails.

NOTE: Proper coverage of the detector is essential.

Use the finger which best fits into the probe. Generally the middle finger is recommended.

Clean the surface of the probe between patients.

Set the finger into the probe housing so that the finger tip touches the finger stop inside the probe. Make sure that the finger covers the detector inside the probe.

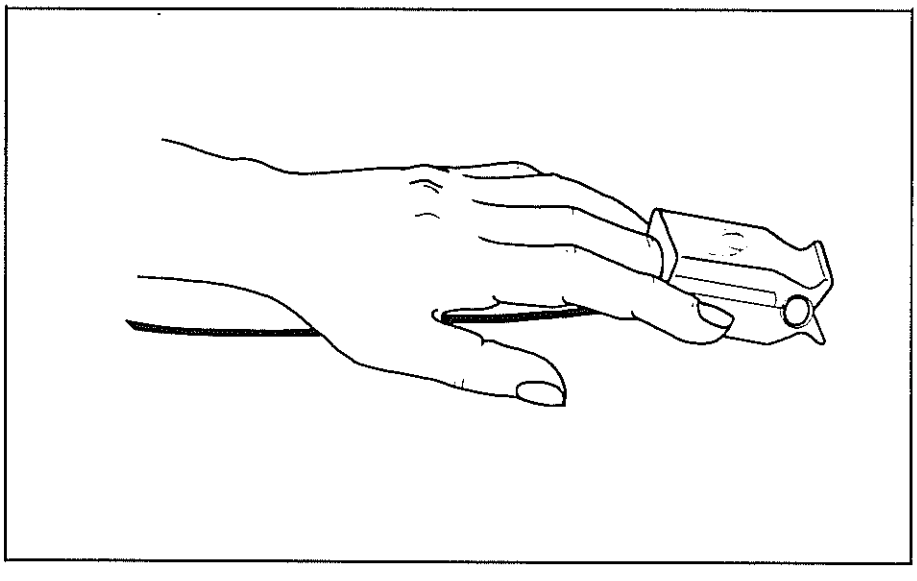


Figure 3-3 Correct Finger Probe Attachment (Emitter is Identified as a Red Light Source)

CAUTION: Do not pull the probe cable.

To determine if the probe is attached correctly and the display data is verifiable, see the SIGNAL AND DATA VALIDITY section.

For further information on available pulse oximetry probes and their use, see Application Manual (p/n 876475).

3.3.1 Interfering Substances

The saturation values may be erroneously high in smokers, or in patients who have burns or carbon monoxide (CO) intoxication.

NOTE: The pulse oximeter cannot distinguish between HbCO, MetHb and HbO_2.

Intravascular dyes, for example methylene blue, indigo carmine, indosyanine green or any substances that contain dyes, that change usual arterial absorption of the light may cause erroneous readings. Some drugs (vasoconstrictive drugs, such as phenylephrine hydrochloride, dopamine) may affect the accuracy of the instrument.

3.3.2 Signal and Data Validity

It is important to determine that the SaO_2 probe is attached to the patient correctly and that the data is verifiable. To make this determination a number of indicators from the monitor are of assistance. It is critical to observe all of them simultaneously when ascertaining signal and data validity.

1) Plethysmographic pulse wave
2) Amplitude value of plethysmographic pulse wave
3) ECG waveform
4) History (trend information)
5) Environmental conditions

The unit is designed to minimize the influence of electrocautery. Electrocautery may, however, under some circumstances affect the accuracy of the instrument. Caution should be applied when reading the saturation values during electrocauterization.

3.4 Summary of Keyboard Controls

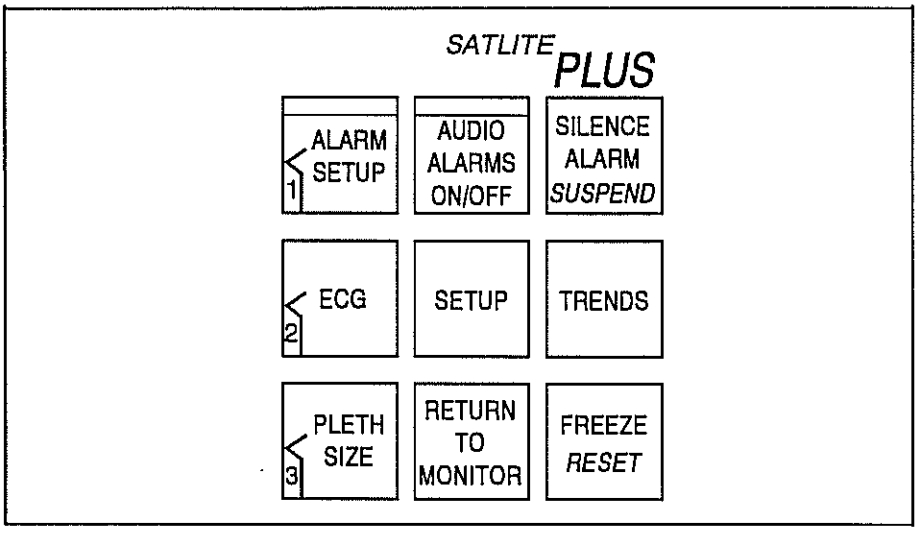


Figure 3-4 SATLITE PLUS™ Keyboard

The function of each key is as follows:

NOTE: Functions denoted by italics demand prolonged pressing of the corresponding key.

(1) ALARM SETUP - Enters the parameter alarm limit adjustment menu.

The options for alarm limit settings are displayed on the screen next to the softkeys. Alarms can be selected and set individually by using the softkeys.

(2) AUDIO ALARMS ON/OFF - Turns all audible alarms, except Asystole, on and off.

When alarms are off, the text ALARMS OFF is displayed in the upper right corner of the video screen. Audible alarms are activated only after a successful pulse or QRS search.

(3) SILENCE ALARM - Silences active audible alarms for 2 minutes.

SUSPEND - Alarm suspend of all audible alarms for 2 minutes is achieved by pressing the softkey until the text AUDIBLE ALARM OFF 2 MIN appears on the screen.

(4) SETUP - Enters the SOUND, DISPLAY and GAS RANGE menus.

The options for the selections are displayed on the screen next to the softkeys 1, 2 and 3.

(5) TREND - Calls and scrolls trend displays.

A trend display will stay on the screen for 60 seconds, or until the RETURN TO MONITOR key is pressed, or until the next trend display is called up by pressing the TREND key once more.

(6) PLETH - Selects scale for the displayed plethysmographic pulse wave amplitude.

(7) ECG - Selects the size of the displayed ECG waveform, selects sweep speed of waveforms and chooses the waveform, from which the heart (pulse) rate is calculated.

(8) FREEZE - Provides instant freezing of the displayed waveforms. Pressing FREEZE again, or RETURN TO MONITOR, unfreezes the waveforms. The freeze is automatically deactivated after 60 seconds.

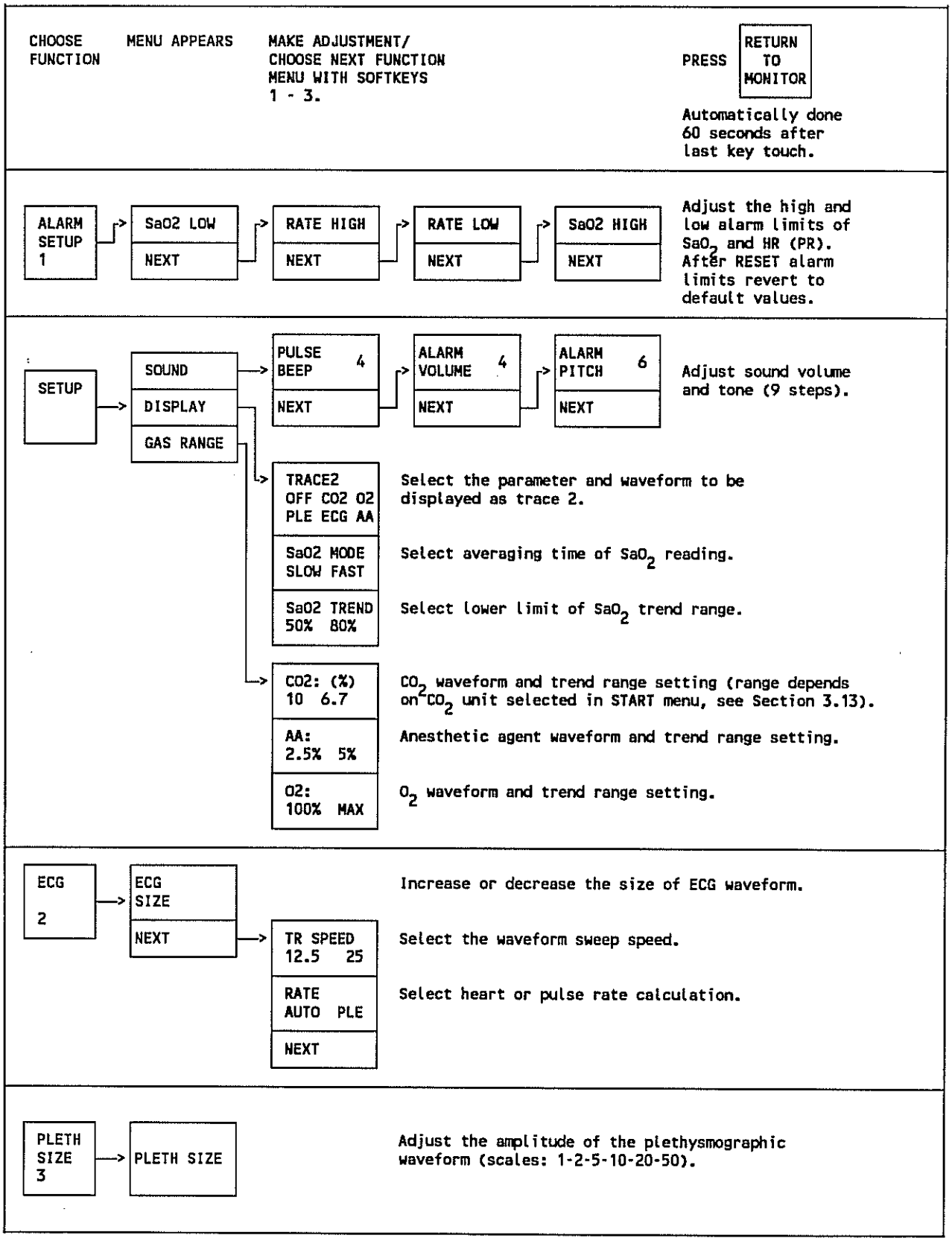
RESET - Pressing and holding of the *RESET* key for 5 seconds causes reset.

At reset trend memories are cleared and settings revert to their default values.

(9) Softkeys 1, 2, 3 - Perform selections and functions shown on the screen next to the number.

(10) RETURN TO MONITOR - Returns to real time display mode. The monitor will automatically perform RETURN TO MONITOR 60 seconds after the last key touch.

3.5 Summary of Menu Functions



3.6 Default Settings

The monitor has various default settings. Part of these are fixed default settings, i.e. preset settings, which are automatically selected when the monitor is turned ON or after RESET, and the rest are user-adjustable default settings.

FIXED DEFAULT SETTINGS

PARAMETER	DEFAULT SETTING	ALTERNATIVE SELECTION
DISPLAY		
a) ECG cable and SaO_2 probe connected	combined ECG and pleth waveform display	combined ECG waveform and SaO_2 trend or cascaded ECG waveform
b) ECG cable not connected	continuous pulse oximeter display	
c) gas monitor connected	combined ECG and CO_2 waveform display	combined ECG and O_2, AA or pleth waveform display
SaO_2 MODE	SLOW MODE (SaO_2 displayed as a 5 s average; HR (PR) displayed as a 10 s average and updated every 5 s)	FAST MODE (SaO_2 beat-to-beat values)
ALARM LIMITS	SaO_2 HIGH - OFF	40-99, one step further turns alarm OFF
	SaO_2 LOW - 90	40-99
	RATE HIGH - 160	30-250, one step further turns alarm OFF
	RATE LOW - 40	250-30, one step further turns alarm OFF
ECG/PLETH	sweep speed 25 mm/s	12.5 mm/s
RATE	HR calculated from ECG waveform	PR calculated from pleth pulse waveform

USER-ADJUSTABLE DEFAULT SETTINGS

PARAMETER	DEFAULT SETTING	ALTERNATIVE SELECTION
SaO_2 TREND	SaO_2 TREND range 50 - 100 %	80 % - 100 %
GAS	CO_2 unit %	mmHg
	CO_2 waveform range 0 to 6.7 %	0 to 10 %. If mmHg is chosen as CO_2 unit the default is 0 to 51 mmHg. Selection: 0 to 76 mmHg.
	O_2 waveform range 0 to 100 %	MAX O_2 +1 %...-7.4 %
	AA waveform range 0 to 2.5 %	0 to 5 %
PULSE BEEP VOLUME	4	1 - 9
ALARM VOLUME	4	1 - 9
ALARM PITCH	6	1 - 9

3.7 Display Messages

MESSAGE	DESCRIPTION
ALARMS OFF	Indicates that the audible alarm function is 'off'. Flashing 'ALARMS OFF' message indicates that the audible alarm suspend has been activated.
SaO_2 LOW	Indicates that the low SaO_2 alarm limit has been violated.
SaO_2 HIGH	Indicates that the high SaO_2 alarm limit has been violated.
RATE LOW	Indicates that the low HR (PR) alarm limit has been violated.
RATE HIGH	Indicates that the high HR (PR) alarm limit has been violated.
PULSE SEARCH	a) After the monitor has been switched on and the probe is attached to the patient, this message will be displayed until the plethysmographic pulse waveform is found or probe is off. b) Poor quality signal (due to artifacts or very weak pulse) is preventing pulse recognition. Monitoring will start as soon as signal quality improves.
NO PROBE	The probe cable connector is not plugged into the monitor.
PROBE OFF	Loose contact between probe and monitoring site, or probe not attached to the patient. **NOTE**: Loose contact of Versalite™ or Flexalite™ probe is more difficult to determine, PROBE OFF may not always be displayed.
LEADS OFF	Indicates that some (or all) electrodes are not attached to the patient or that the ECG cable is not connected to the monitor.
ECG OFF	Indicates that ECG is not used and that the monitor is in pulse wave oximeter mode.
HR-PR MISMATCH	This message is given when the heart rate, measured from the ECG waveform and the pulse rate, measured from the plethysmographic waveform, differ from each other. This indicates disturbances in either ECG or pulse waveform, e.g. ECG noise or motion artefacts. The message appears in the bottom message field.
ASY	Indicates asystole (10 seconds absence of QRS complex in ECG). The message is shown instead of the HR (PR) value.
ARTEFACT	Large swings of the monitored plethysmographic signal, due to motion for example.

MESSAGE	DESCRIPTION
- - -	The monitor has not been able to calculate a value for SaO_2 or HR (PR) during the last 5 seconds.
LOW QUALITY SIGNAL	Indicates that the measured pulse waveform signal quality is poor due to weak pulse. The SaO_2 measurement may be inaccurate.
ECG NOISE	Indicates high frequency noise, frequent ECG overload or clipping, elevated baseline noise or heart rate over 250. The message is shown in the bottom message field.
AUDIBLE ALARM OFF 2 MIN	When activating the audible alarm suspend function this message will be displayed briefly. During the two minutes, the 'ALARMS OFF' text will flash on and off.
ECG MODE IN X SECOND(S)	Indicates that the ECG mode is reached within x seconds. Occurs in the pulse oximeter mode after start-up if the ECG cable and the leads are not connected. The text appears in the bottom comment field when the ECG key is pressed for at least two seconds.
TRACE FROZEN	Indicates that the waveforms are frozen.
ERROR MESSAGES:	
CHECK PROBE	Probe or cable may be broken or the probe is not properly installed. Check probe site or replace probe.
N2O CONNECTION NOT POSSIBLE. SELECT CO2, O2 OR AA FOR ANALOG OUTPUT	The analog output of the Multicap^{R} or Capnomac^{TM} monitor has been selected to N_2O, which can not be displayed by SATLITE PLUS^{TM}. Reselect the analog output of the gas monitor, see Appendix A.
PROGR. ERROR	Internal malfunction in SATLITE PLUS^{TM}. Contact a qualified service technician.
EEPROM FAILED AT n	Internal malfunction in SATLITE PLUS^{TM}. Contact a qualified service technician.

MESSAGE	DESCRIPTION
ROM CHECKSUM ERROR	Internal malfunction in SATLITE PLUS™. Contact a qualified service technician.
PERMANENT MEMORY IS SET TO FACTORY DEFAULTS	If the software of the monitor has been changed, this message may be given and indicates that previous operator-settings have been reset to the initial factory values.

3.8 Monitoring Parameters

3.8.1 ECG and Heart Rate

Prepare skin and attach the electrodes to the patient according to the table below:

Code	IEC (Europe)	AAMI (USA and Canada)
LA/L = left arm	yellow	black
RA/R = right arm	red	white
LL/N = left leg	black	red

If the connections are proper, the LEADS OFF message disappears and the ECG waveform, HR numeric display and QRS detection indicator '*' will appear.

The bar at the left end of the ECG tracing corresponds to 1 mV amplitude. Increasing ECG gain affects this bar accordingly.

ECG signal testing

The ECG test signal connectors on the rear panel are for checking the integrity of patient leads, cables and amplifier.

Connect ECG lead wires to the clip-on connectors according to the letter codes.

Adjusting the size of the ECG waveform

a) Press the ECG key to enter the ECG size adjustment menu.

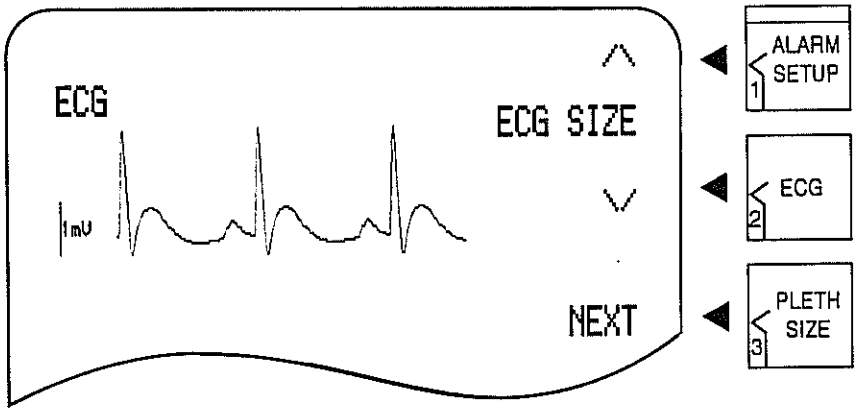


Figure 3-5 ECG SIZE Menu

b) Press softkey 1 to increase or softkey 2 to decrease the size of the ECG waveform.

c) Press softkey 3 (NEXT) to enter the following adjustment menu relating to ECG monitoring.

Selecting sweep speed of ECG waveform and heart or pulse rate calculation

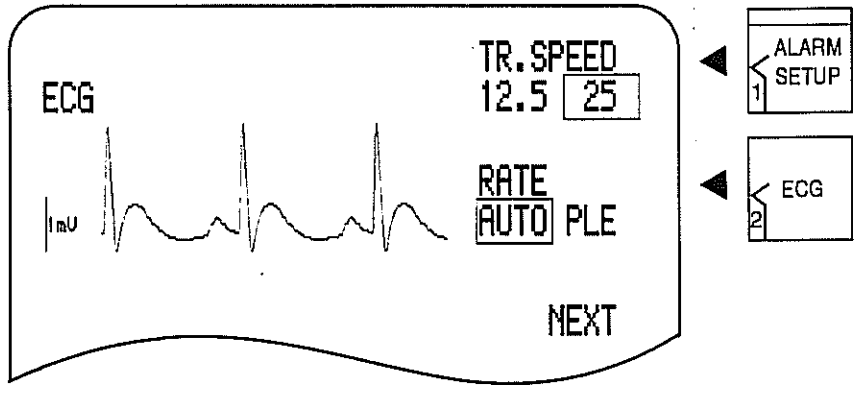


Figure 3-6 ECG Monitoring Settings

a) Press softkey 1 (TR.SPEED) to select the trace sweep speed, FAST 25 mm/s or SLOW 12.5 mm/s. The selection affects the speed of all waveforms.

b) Press softkey 2 (RATE) to select the waveform, from which heart or pulse rate is calculated. Selection AUTO calculates the heart rate from the ECG waveform, if available, and the abbreviation HR is shown on the screen. The QRS indicator '*' is located on the upper waveform channel.

Selection PLE calculates the pulse rate from the plethysmographic pulse waveform and is abbreviated PR. The PULSE indicator '*' is located on the lower waveform channel.

The HR reading is displayed on the screen above the SaO_2 reading, the PR reading below the SaO_2 reading. The heart or pulse rate readings are always given as 10 s averages and are updated on the display every 5 s.

The selections are indicated by a rectangular frame. Press RETURN TO MONITOR to complete.

Display Selection

The waveform displayed on trace two can be changed during monitoring.

a) Press the SETUP key to enter the SETUP menu.

b) Press softkey 2 (DISPLAY) to enter the DISPLAY menu.

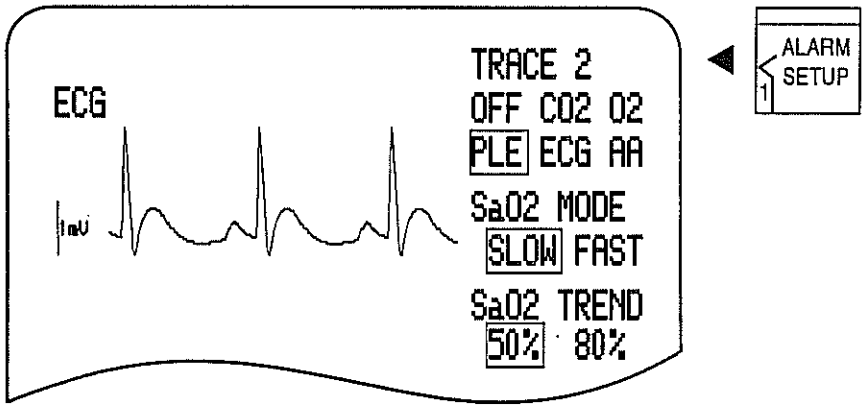


Figure 3-7 DISPLAY Menu

c) Press softkey 1 (TRACE 2) to select the waveform to be displayed on trace two as follows:

OFF	SaO_2 trend
PLE	plethysmographic waveform
ECG	cascaded ECG waveform

For selections related to gas waveform display, see Appendix A.

When the cascaded ECG waveform is selected the upper channel displays the current information and the lower channel the earlier one, see Figure 3-8.

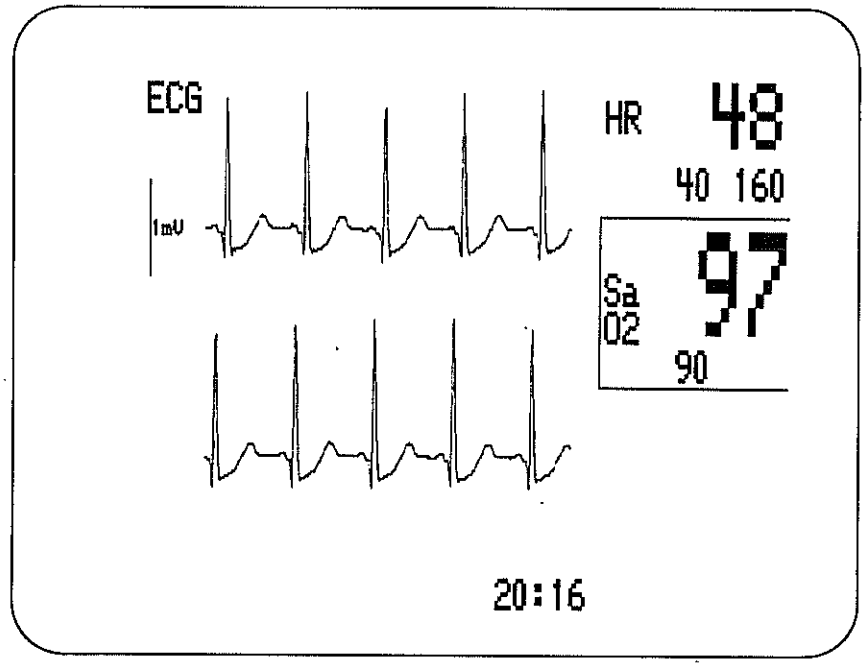


Figure 3-8 Cascaded ECG Display

Adjusting the QRS beep volume

a) Press SETUP key to enter the SETUP menu.

b) Press softkey 1 (SOUND) to enter the SOUND menu.

c) Adjust the QRS beep volume on a scale from 1 - 9 by using softkey 1 (UP) or 2 (DOWN). Step 1 turns the sound off.

Press RETURN TO MONITOR to complete.

The tone of the QRS beep changes with varying SaO_2 value, falling when SaO_2 value falls, and vice versa.

Pacemaker Pulse Detection and Marking

An automatic pacemaker pulse rejection function is included. When a patient with a cardiac pacemaker is monitored, the pacing pulse is seen as a constant height marker, see Figure 3-9.

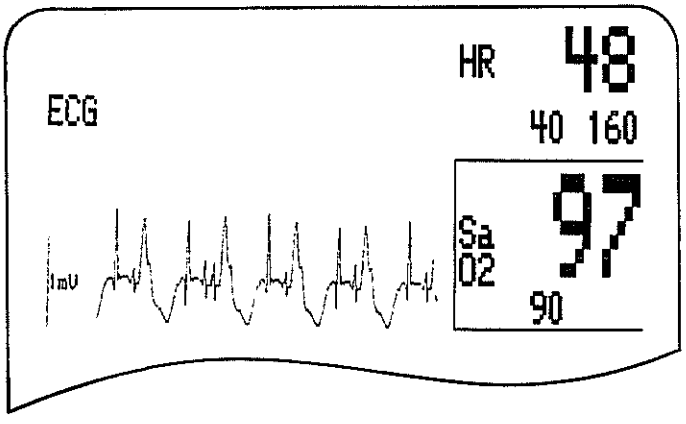


Figure 3-9 Pacemaker Markers

WARNING: PATIENT SAFETY: Rate meters may continue to count the pacemaker rate during occurrences of cardiac arrest or some arrhythmias. Do not rely entirely upon rate meter alarms. Keep pacemaker patients under close surveillance.

3.8.2 Arterial Oxygen Saturation (SaO_2)

The arterial oxygen saturation refers to the amount of oxygen carried by arterial hemoglobin. Expressed as a percent, it defines the amount of oxygen carried compared to total capacity (also called functional or in vivo oxygen saturation).

The measurement is based on the light absorption of the pulsating arterial blood. SATLITE PLUS™ measures and displays the SaO_2 percentage either as a beat-to-beat or as a 5 second average value.

A falling SaO_2 value causes the pulse beep tone to fall and vice versa.

The adjustments relating to the oxygen saturation measurement and display are made through the SETUP menu, which is entered by pressing the SETUP key.

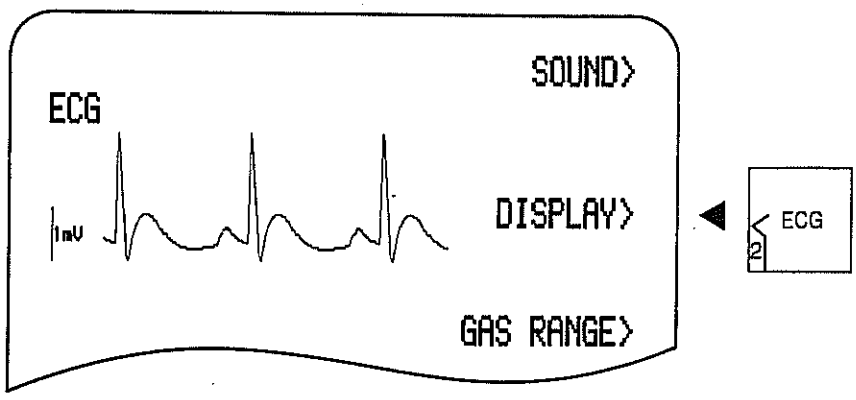


Figure 3-10 SETUP Menu

Press softkey 2 (DISPLAY) to enter the DISPLAY menu.

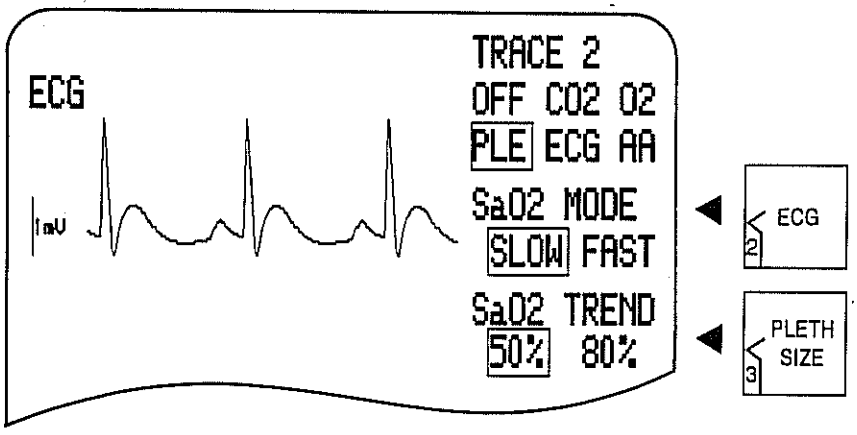


Figure 3-11 DISPLAY Menu

Changing SaO_2 averaging and update mode

a) Press softkey 2 (SaO2 MODE) in the DISPLAY menu to change the SaO_2 averaging and update mode. The active selection is indicated by a rectangular frame. In the SLOW mode, SaO_2 readings are given as 5 s averages. In the FAST mode SaO_2 readings are beat-to-beat values.

Changing SaO_2 trend range

a) Press softkey 3 (SaO2 TREND) in the DISPLAY menu to select the lower limit of the SaO_2 trend range to 50 % or 80 %. Selection is indicated by a rectangular frame.

Press RETURN TO MONITOR to complete.

3.8.3 Plethysmographic Pulse Wave and Pulse Rate

The amplitude of the plethysmographic pulse wave is automatically adjusted at the beginning of the measurement after the PULSE SEARCH period to give an optimal display. During operation there will be no automatic gain settings: changes in the peripheral circulation will be reflected as changes in the plethysmographic pulse wave amplitude. It is however possible for the user to make adjustments.

Adjusting pleth pulse wave amplitude

a) Press PLETH SIZE key to enter the plethysmograph adjustment menu.

b) Use the up and down arrows (softkeys 1 and 2) to select the plethysmographic pulse wave scales 50-20-10-5-2-1.

Adjusting pulse beep volume

The selected volume of the QRS beep is valid also for the pulse beep and vice versa, see Section 3.8.1.

Selecting sweep speed of pleth waveform

The selected sweep speed of the ECG waveform is valid for other waveforms too, see Section 3.8.1.

3.9 Alarms

When an alarm occurs, a repeating audible tone is produced and the display of the alarming parameter flashes on and off. A press of the SILENCE ALARM *SUSPEND* key silences the audible tone for 2 minutes. The display of the alarming parameter continues to flash until the cause for the alarm has been eliminated also when alarms have been turned OFF. Asystole causes an audible alarm during ALARMS OFF.

3.9.1 Adjusting Alarm Limits

The high and low alarm limits of SaO_2 and HR (PR) can be adjusted by the user. After turning the power on, alarms are ON and the default alarm limits are shown on the screen:

SaO_2 HIGH	OFF
SaO_2 LOW	90
RATE HIGH	160
RATE LOW	40

NOTE: Default alarm limits are set whenever the power is turned on after an interruption of more than 15 seconds, or when the FREEZE *RESET* key is pressed continuously for more than 5 seconds.

SaO_2 and HR (PR) high and low alarm limits

a) Adjust the alarm limits by pressing the ALARM SETUP key. The ALARM SETUP menu is entered.

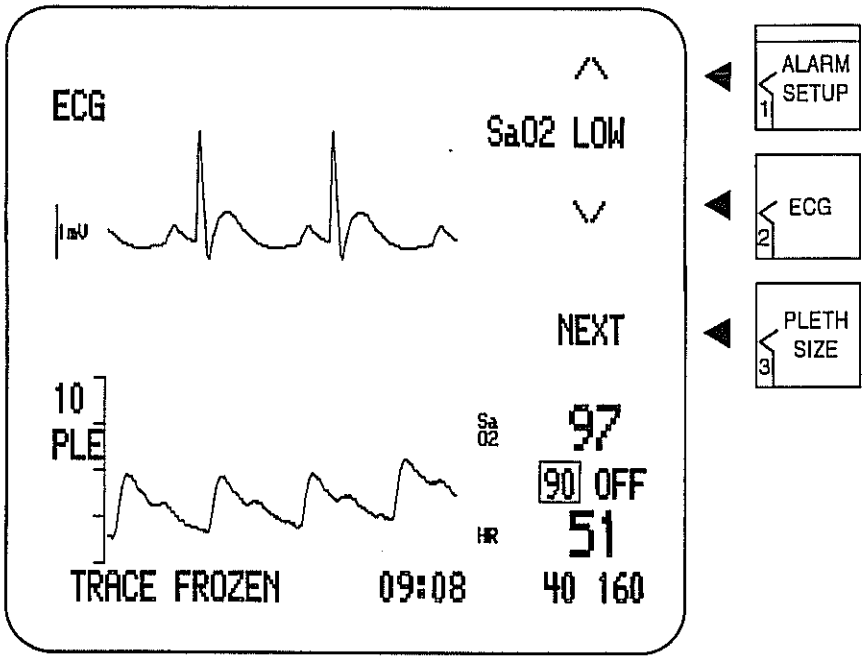


Figure 3-12 ALARM SETUP Menu

b) Press softkeys 1 or 2 to adjust the alarm limits upwards or downwards (HR (PR) in steps of five).

c) Scroll the parameter sequence (SaO_2 LOW -> RATE HIGH -> RATE LOW -> SaO_2 HIGH) by pressing softkey 3 (NEXT).

The adjusted alarm limit and the actual value of the corresponding parameter are displayed in the lower part of the menu field. The alarms can be set within following limits:

SaO_2 HIGH	-	up to 99, going one step further turns alarm off
LOW	-	down to 40

NOTE: SaO_2 HIGH cannot be set lower than SaO_2 LOW and vice versa

RATE HIGH	-	up to 250, going one step further turns alarm off
LOW	-	down to 30, going one step further turns alarm off

NOTE: RATE HIGH cannot be set lower than RATE LOW and vice versa.

Press RETURN TO MONITOR to complete.

3.9.2 Adjusting the Alarm Volume and Pitch

a) Press SETUP key to enter the SETUP menu.

b) Press softkey 1 (SOUND) to enter the SOUND menu.

c) Press softkey 3 (NEXT) to enter the ALARM VOLUME adjustment menu.

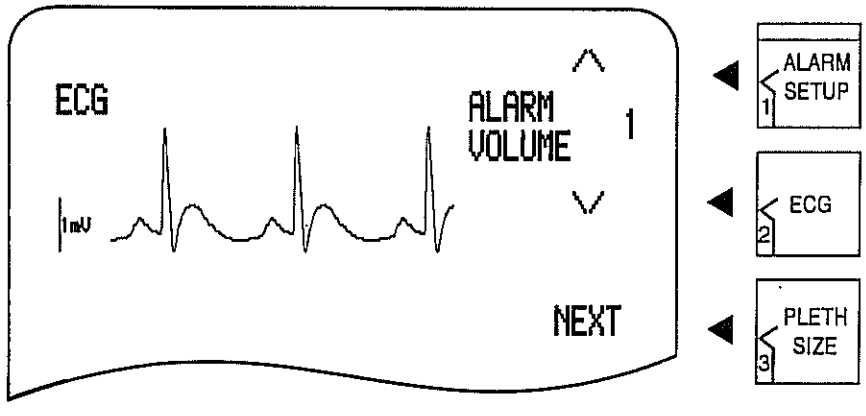


Figure 3-13 ALARM VOLUME Adjustment Menu

d) Adjust the sound level on a scale from 1 to 9 with softkey 1 (UP) or 2 (DOWN). The selection is shown on the screen.

NOTE: The audible alarm has a minimum sound level. It cannot be set to zero.

e) Press softkey 3 (NEXT) to enter the ALARM PITCH adjustment menu and the sound level is adjusted accordingly.

Press RETURN TO MONITOR to complete.

3.9.3 Patient Alarms

There are two types of alarms and warnings:

1. non-adjustable alarms

ASY (asystole)

2. adjustable alarms

Heart (pulse) rate
SaO_2

After turning the power on, alarms are ON.

Patient related alarms are active when ALARMS are ON (ALARMS OFF message is absent from the screen). Alarms are given after 10 s both as an audio tone and visually, by blinking of the alarming parameter and showing the corresponding alarm message.

NOTE: Always make sure that alarms are on after attaching the probe to the patient (no "ALARMS OFF" on the screen).

When alarms are on, violating the alarm limits causes the ASY alarm message to appear in the HR field or the following alarm messages to appear on top of the menu field:

SaO_2 LOW
SaO_2 HIGH
RATE LOW
RATE HIGH

3.9.4 Equipment Related Alarms

When pulse search is performed, or proper monitoring is impaired by a signal that is too weak, or by a displaced probe etc, a message is displayed on the screen:

NO PROBE
PROBE OFF
PULSE SEARCH
ARTEFACT
- - -
LEADS OFF
CHECK PROBE

If ALARMS are ON (ALARMS OFF message is absent from the screen) an audio alarm will sound as well. When an equipment related alarm is triggered, except for PULSE SEARCH, the monitor produces a single beep tone, after 10 seconds it produces two beep tones and a repeated beep tone after 20 seconds.

NOTE: On start-up and after alarm silence audible alarms are only activated after pulse search has been successfully completed.

3.9.5 Audible Alarm Suspend

The audible alarm can be temporarily inactivated for two minutes prior to an alarm condition, in order to avoid nuisance alarms, for example during extubation. Visible indication of an alarm is still given. If an alarm is triggered, the parameter numerics will flash. Press SILENCE ALARM *SUSPEND* key for two seconds. An audible beep will be given and the message AUDIBLE ALARM OFF 2 MIN will briefly be displayed. As a reminder, the ALARM OFF indicator will flash during the two-minute period. Audible alarm suspend is a useful feature when moving the device from one patient to another.

3.10 Trends

SATLITE Plus™ provides a 1 h 45 min or 7-hour trending of SaO_2, heart (pulse) rate and plethysmographic pulse volume amplitude on the display. When the monitor is connected to an appropriate Datex gas monitor, trends of CO_2, O_2, N_2O, and anesthetic agent are added. The maximum trending of all parameters will then be 1 h 45 min.

For information concerning gas trends, see Appendix A.

NOTE: During the trend display the monitor is active and the SaO_2 and HR (PR) values are continuously updated and displayed.

NOTE: During the trend display the scale of the pulse wave trend can be adjusted with the PLETH SIZE key.

3.10.1 Trend Display

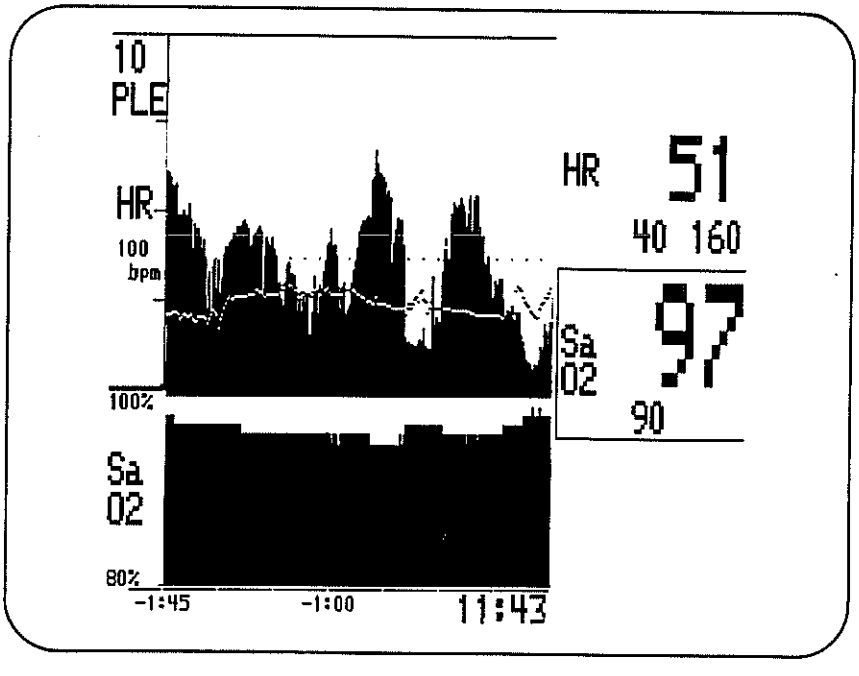


Figure 3-14 SaO_2, Plethysmogram and HR (PR) Trends

3.10.2 Selecting Trend Display

Press TRENDS key to call up the first trend display. The trend stays on the screen for a maximum of 60 seconds. Scroll the available trends by pressing the TRENDS key. Press RETURN TO MONITOR for immediate return to real time display.

3.11 Freezing the Waveforms

The FREEZE key provides an instant freezing of the displayed waveforms for 60 s. The message TRACE FROZEN in the bottom field of the screen indicates that the FREEZE key has been activated. Pressing FREEZE again or RETURN TO MONITOR releases the traces immediately.

3.12 Resetting the Monitor

Prolonged pressing of the FREEZE *RESET* key activates a countdown procedure and the message RESET IN X SECOND(S) is shown on the screen. If the key is kept pressed the countdown proceeds 4-3-2-1 and the unit is RESET when the counter reaches zero. If the key is released before RESET occurs the unit returns to its basic real time display mode without change of settings. RESET is useful for clearing trend memories and returning user-adjustable features to default values.

3.13 Start Menu

The START MENU is accessed by continuously pressing any key during power-up or reset.

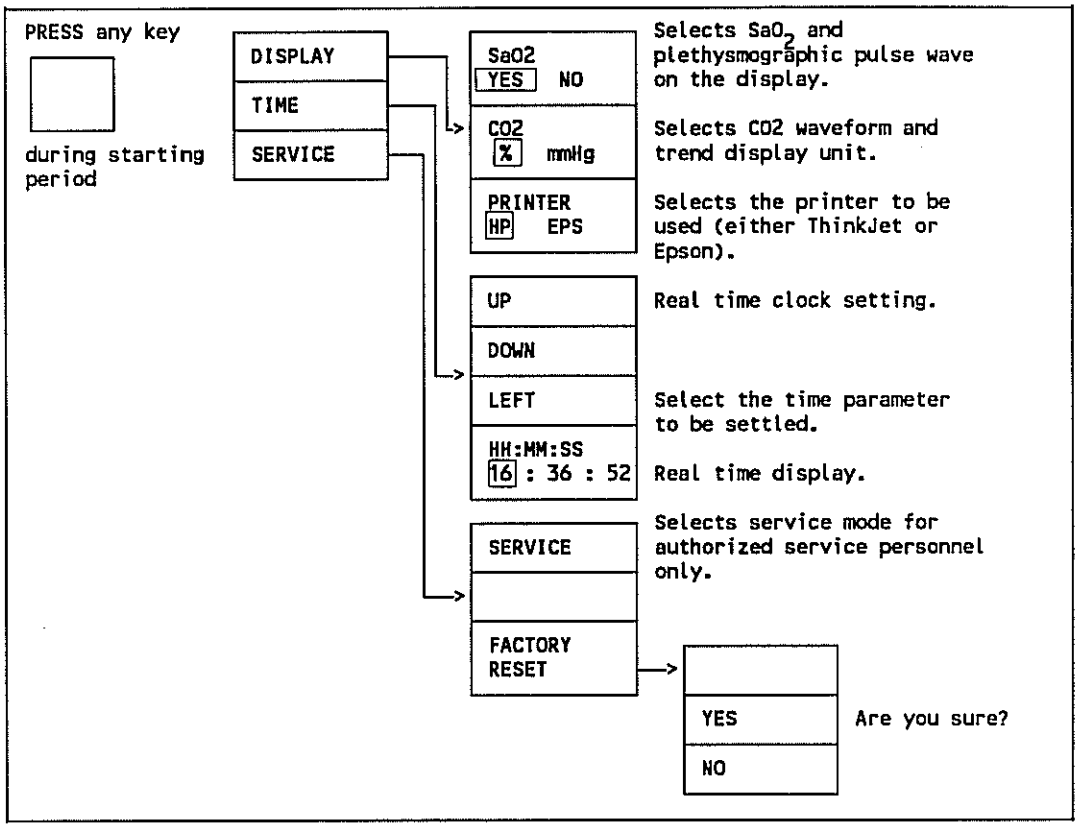


Figure 3-15 START MENU Functions

The following adjustments and selections are made through the START menu:

DISPLAY

Pulse Oximeter Function

a) Press softkey 1 (DISPLAY). The DISPLAY menu is entered.

b) Press softkey 1 (SaO_2) to turn the pulse oximeter function on or off.

CO_2 Unit

a) Press softkey 2 (CO_2) to select the unit for CO_2 waveform and trend displays.

Printer Selection

a) Press softkey 3 (PRINTER) to select either ThinkJet or Epson printer as a graphics printer.

Press RETURN TO MONITOR to complete.

TIME

a) Press softkey 2 (TIME) to enter the real time clock adjustment menu. The active function (hh:mm:ss) is indicated by a rectangular frame.

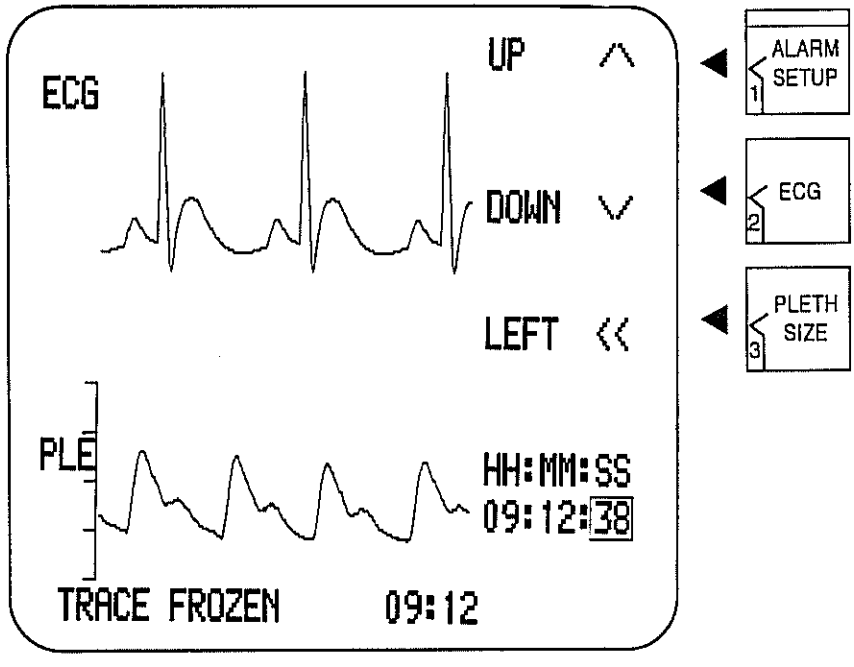


Figure 3-16 Real Time Clock Adjustment

b) Adjust the time by using the up or down arrows (softkey 1 and 2).

c) Use softkey 3 (LEFT) to choose the following time parameter to be set.

Press RETURN TO MONITOR to complete.

SERVICE

The service function has been developed for authorized service personnel only. See the Service Manual for detailed instructions.

Press RETURN TO MONITOR twice to return to real time display.

3.14 Troubleshooting

The following troubleshooting scheme helps the user to find a possible cause of malfunction:

TROUBLE	ACTION
No screen display when power is turned on	If no key touch beep either, check power and BM-123 connection. Check also that BM-123 is not on stand-by. Fuse blown? If key touch beep is present, but no screen display, turn the brightness adjustment knob clockwise.
Message "NO PROBE"	Check that probe is properly connected. Faulty probe? Try another.
Message "PROBE OFF", although probe properly applied to the patient.	Try another placement. Faulty probe? Try another.
Message "N2O CONNECTION NOT POSSIBLE. SELECT CO2, O2 OR AA FOR ANALOG OUTPUT".	Make sure that the gas wanted for real time display is selected for analog output in the gas monitor.
Message "ECG NOISE"	Check that electrodes and cables are properly connected. The patient may be cold or position is uncomfortable. For further instructions, see the SATLITE PLUS™ Service Manual.

4 MAINTENANCE

4.1 Cleaning and Disinfection

4.1.1 Monitor

WARNING: ELECTRICAL SHOCK HAZARD: Always turn the power off before cleaning the monitor. Ensure that the monitor is unplugged prior to cleaning and that the unit is completely dry before use.

DATEX Measuring Chamber Cleaning Fluid (85969) is specially designed for cleaning of sensitive surfaces and is also suitable for cleaning of external surfaces. As an alternative to the DATEX cleaning fluid any mild, non-alkaline, and non-corrosive fluid can be used for cleaning the external surface.

CAUTION: Never immerse the monitor in liquid.

CAUTION: Do not autoclave or gas sterilize this monitor.

4.1.2 Probes

The probes are the only surfaces of the monitor that come in contact with the patient. Clean the probes after each use as follows:

a) Disconnect the probe from the patient.

b) Disconnect the probe from the monitor.

c) Clean the pad surfaces with a soft cloth and the furrows around the pads with a small swab using the DATEX Measuring Chamber Cleaning Fluid, or a mild soap and water solution. Alternatively use an isopropyl alcohol (70 %) swab.

d) Allow the probe to dry completely before returning it to operation.

CAUTION: Do not soak or immerse probe in any liquid solution.

CAUTION: Do not autoclave probes.

The probes may be sterilized at 49-55 degrees centigrade (120 - 130 degrees Fahrenheit) using Ethylene Oxide. In all cases follow the sterilizer manufacturer's recommendations for specific aeration periods required.

CAUTION: After sterilization with Ethylene Oxide, probes should be quarantined in a well ventilated area to allow dissipation of residual Ethylene Oxide absorbed by the probe. Follow sterilizer manufacturer's recommendations for specific aeration periods required.

WARNING: A damaged probe, or a probe soaked with liquids (like saline or blood) may cause electrocautery burns.

5 ACCESSORIES

ITEM	ORDER NO
Clip-on finger probe	873612
Versalite™ probe	874634
Versalite™ clip (package of 5 pcs)	875450
Disposable adhesive wrap (adult size) (package of 10 pcs)	874660
Disposable adhesive wrap (pediatric size) (package of 10 pcs)	874842
Mini-Versalite™ probe	875072
Mini-Versalite™ probe aligner, long (package of 5 pcs)	875717
Mini-Versalite™ probe aligner, short	875762
Mini-Versalite™ clip (package of 5 pcs)	875726
Probe connection cable	875071
Flexalite™ probe set	876607
Flexalite™ probe set (USA)	876606
Flexalite™ adult wrap (10 packages of 10 pcs)	73102
Flexalite™ pediatric wrap (10 packages of 10 pcs)	73103
Flexalite™ neonatal wrap (10 packages of 10 pcs)	73104
Disposable preparation tape (package of 12 pcs)	875282
Normocap® to SATLITE PLUS™ interface cable	873770
Multicap®/Capnomac™ to SATLITE PLUS™ interface cable	874622
Power cord (EUR)	54563
Power cord (USA)	86236
Thinkjet Graphics Printer (including mounting bracket)	CCP-104
Printer paper (2500 sheets)	73027
Measuring chamber cleaning fluid	85969
Printer printhead cartridge	572731
Isolated printer interface cable for CCP-104	873152
Add-on battery module	BM-123
Connection cable BM-123 to OS/OSE-123	875522
Carrying handle for BM-123 and OS/OSE-123	876082
Clip-on finger probe with 10 m/33 ft cable (USA)	875643
Clip-on finger probe with 10 m/33 ft cable (EUR)	875642
ECG	
Neonatal ECG electrode (pkg of 25 pcs)	572681
Normal ECG electrode (pkg of 40 pcs)	572682
Cables with IEC codes:	
Three-lead trunk cable	545905
Three-lead wire set with clips	545925
Three-lead wire set with banana plugs	545924
Three-lead, one piece cable with clips	545921
Cables with AAMI codes:	
Three-lead trunk cable	545910
Three-lead wire set with clips	545923
Three-lead, one piece cable with clips	545930

6 TECHNICAL DATA

SPECIFICATIONS

Arterial Oxygen Saturation (SaO_2)

IEC class BF patient isolation.

Measurement range	0 to 100 %
Accuracy	(% SaO_2 ± 1 SD) 100 to 80%: ±2 digits 80 to 50%: ±3 digits 50 to 0 %: unspec.
Resolution	1 digit (= 1 %)
Display averaging time	5 seconds or beat-to-beat

Pulse beep pitch corresponds to SaO_2 level.

Heart (Pulse) Rate

Measurement range	30 to 250 bpm
Accuracy	±1 %, ±1 bpm
Resolution	1 bpm
Display averaging time	10 seconds, updated every 5 seconds
Adjustable pulse beep	

Plethysmographic Pulse Wave

Gain auto-set during start up.
User-adjustable gain during operation.

Alarms Adjustable alarm limits for SaO_2 and heart (pulse) rate (high and low). Warnings for low perfusion, probe off, no probe and alarm limit crossings.
Comprehensive system error messages.

Trends SaO_2, heart (pulse) rate, and pulse amplitude, 1 h 45 min and 7 h.
Connected to a Datex gas monitor: SaO_2, heart (pulse) rate, pulse amplitude, CO_2, O_2, N_2O and AA (1 h 45 min).

Real Time Clock

Display 5" green monochrome picture tube

General Data

Operating temperature	+ 10 to +35°C (+50 to 95°F)
Storage temperature	-5 to +50°C (23 to 122°F)
Power requirements	100/115/220/240 VAC; 50/60 Hz; 50 W

External Connections

Analog and serial (RS-232C) input/output.
Serial output for graphics printer.
Composite video output.

Dimensions

Depth	310 mm (12.2 in)
Width	220 mm (8.7 in)
Height	165 mm (6.5 in)
Weight	6.2 kg (13.6 lb)

Respiratory Gas Display

CO_2, O_2 or anesthetic agent waveform
CO_2, O_2, N_2O and anesthetic agent trend, 1 h 45 min
- via appropriate Datex gas monitor

Clip-on Finger Probe

Dimensions:

Height:	28 mm (1.1 in)
Width:	26 mm (1.0 in)
Depth:	55 mm (2.2 in)
Weight:	30 g (1 oz) (without cable and connector)

Cable Length 4 m (13 ft)

ECG channel in SATLITE PLUS™

IEC class CF patient isolation

Sweep speeds	12.5 and 25mm/s, (0.49 and 0.98 in) ±10%
Defibrillation protection	5000 V, 400 J
Dielectric strength	2500 VAC
Input impedance	>2.5 Mohms/10 Hz
System noise	<40 µV (p-p, RTI)
Leakage current (220 Vrms/50 Hz)	<10 µA
Allowable offset	+300 mV DC
Patient auxiliary current	<0.2 µA DC
Gain range	0.4 to 4.0 mV/cm (1.02 to 10.2 mV/in)
Display bandwidth	0.5 to 30 Hz (-3dB)
Heart rate range	30 to 250 bpm
Accuracy	±1 %, ±1 bpm
Resolution	1 bpm
Heart rate update interval	5 s
Pacemaker pulse detection	5...500 mV, 0.5...2 ms pulses

Alarms and Messages

Technical message	Leads off
Medical alarm	Heart rate limit violation
	Asystole
Alarm delay: Heart rate	<10s after HR limit violation
Asystole	<10s after the last detected QRS-complex
Test: Three lead rear panel connector	HR 60 bpm ±1

ECG cables

Trunk cable length	3 m/9.8 ft
Lead wire length	800 mm/31.5 inches

Audible Alarms

Loudspeaker frequency	850 Hz (adjustable)

Safety IEC-601
CSA

The accuracy verifications have been statistically derived and correlated to simultaneous measurements of SaO_2 (fractional) measured on an Instrumentation Laboratory IL/282 CO-oximeter and Radiometer OSM-3 oximeter.

APPENDICES

A SATLITE PLUS™ PULSE WAVE OXIMETER COMBINED WITH A DATEX GAS MONITOR

Connecting Satlite PLUS™ to a DATEX gas monitor provides a wide range of display features from a single system.

Trends of both inspiratory and expiratory values of CO_2, O_2, N_2O and the anesthetic agent can be viewed from the video screen and added bonus of real-time CO_2, O_2, or anesthetic agent waveform display is also provided.

A.1 Installation

a) Turn power off both in the gas monitor and SATLITE PLUS™ before making any connections.

b) MULTICAP® or CAPNOMAC™

Use interface cable 874622. Connect the cable end labelled CNO/AGM to the analog output/printer connector on the gas monitor's rear panel.

NORMOCAP®

Use interface cable 873770. Connect the cable end labelled CD to the analog output connector on the gas monitor's rear panel.

Connect the cable end labelled OS/DV to the serial & analog I/O (upper) connector on the rear panel of SATLITE PLUS™.

c) Turn power on in the gas monitor and in SATLITE PLUS™. CO_2 is automatically selected for analog output and SATLITE PLUS™ displays the capnogram.

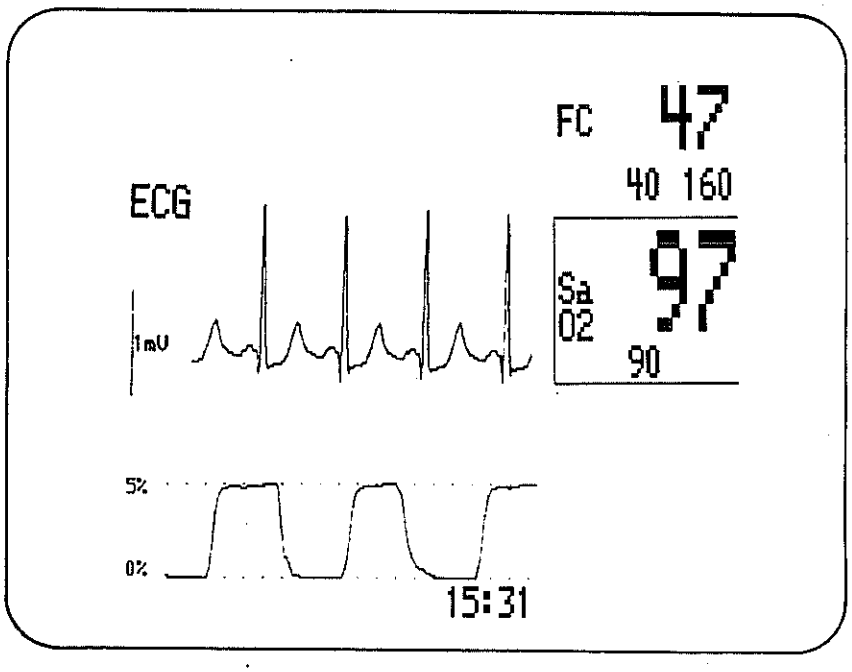


Figure A-1 Default Display with a Multigas Monitor (Multicap^{R} or Capnomac^{TM}) ECG and CO_2 Waveform

A.2 Display Selection

To select O_2 or AA for analog output in standard Multicap^{R} or Capnomac^{TM} (without 4 channel analog output option) and for waveform display in SATLITE PLUS^{TM}, press the RETURN TO MONITOR key for 5 s in Capnomac^{TM} or Multicap^{R} to perform the initial self-check. Immediately after the start of the self-check press the O_2 or any AA key until the program code Pr xxxxxx-xx appears and the message O_2 or AA is shown in the MEAN END TIDAL CO_2 field.

The O_2 or AA waveform can also be selected from start-up. Press the O_2 or any AA key during the gas monitor start-up procedure until the program code Pr XXXXXX-XX appears, and the message O_2 or AA is shown in the MEAN END TIDAL CO_2 field.

By pressing the appropriate anesthetic agent key an abbreviation Halo (Halothane), Enfl (Enflurane) or Isof (Isoflurane) will appear in the anesthetic agent display. The corresponding abbreviations on the display of SATLITE PLUS^{TM} are HAL, ENF and ISO.

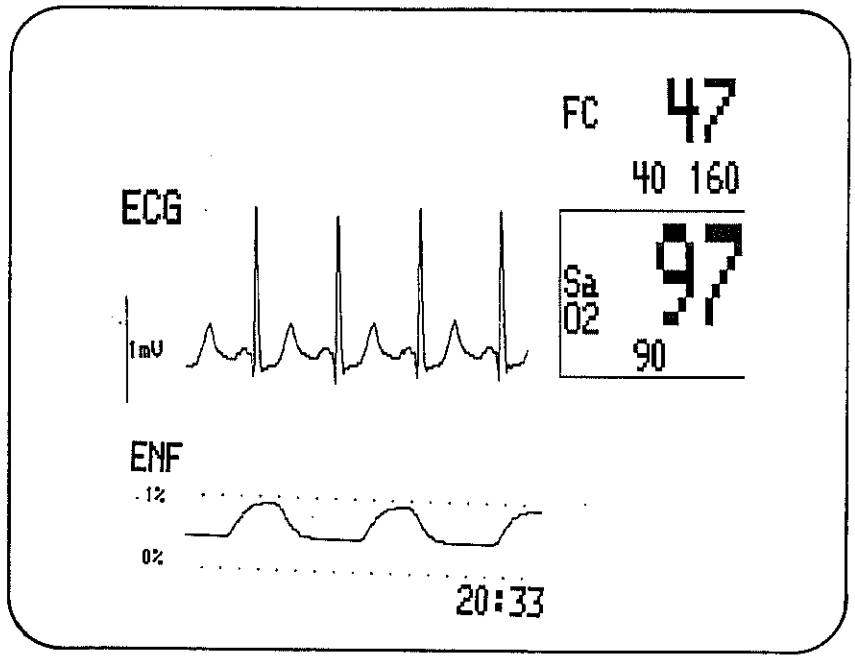


Figure A-2 ECG and Anesthetic Agent Waveform

In Capnomac^{TM} and Multicap^{R} monitors equipped with the multiple analog output option (the option is indicated by a green label on the rear panel next to the output connector), CO_2 is also automatically selected for gas waveform display in SATLITE PLUS^{TM}. The selection can be changed during operation. Press the SETUP key in SATLITE PLUS^{TM}. Press softkey 2 (DISPLAY) in the SETUP menu. By pressing softkey 1 (TRACE 2) the gas waveform display can be changed. The selection is indicated by a rectangular frame.

The display ranges of the gas waveform and trends can be adjusted as follows:

a) Press SETUP key to enter the SETUP menu.

b) Press softkey 3 (GAS RANGE) to enter the GAS RANGE menu.

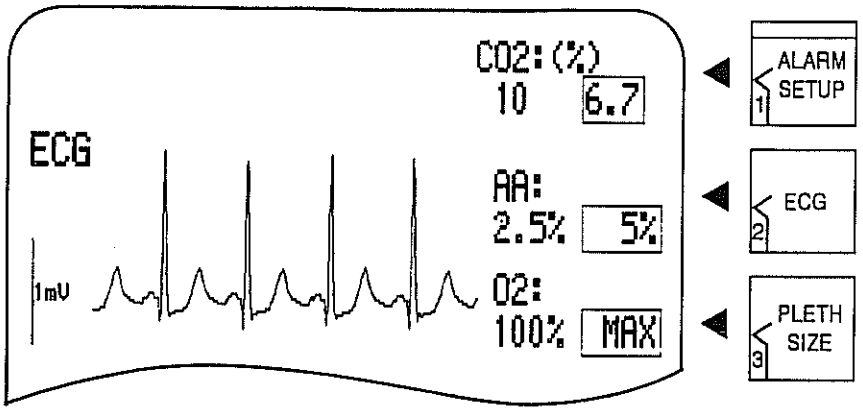


Figure A-3 GAS RANGE Menu

c) Select the ranges by using softkeys 1, 2 and 3. The selections are indicated by a rectangular frame.

Press RETURN TO MONITOR to complete.

A.3 Trends

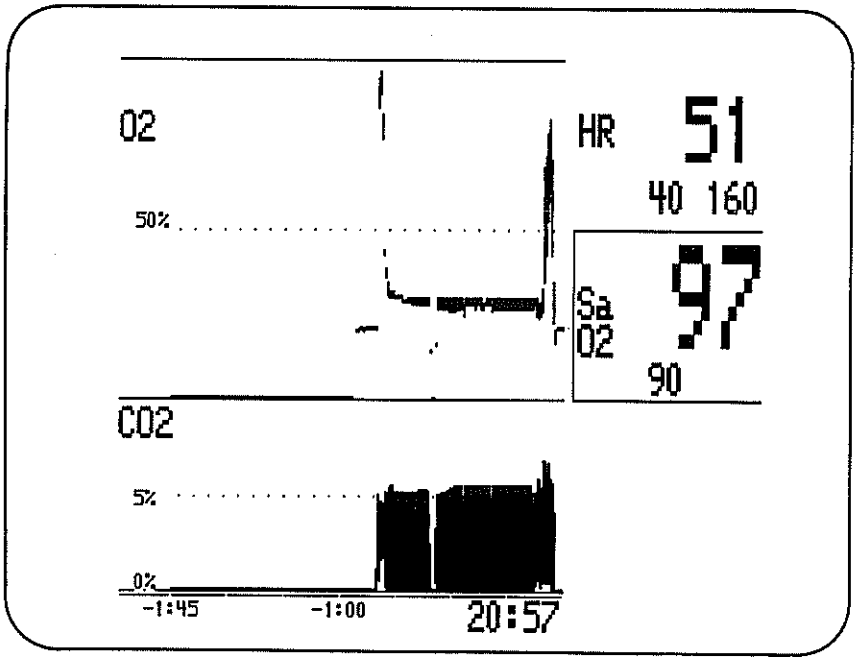


Figure A-4 CO_2 and O_2 Trends;

a) Press TRENDS key to call up the SaO_2, plethysmogram and HR (PR) trends on the video screen for 60 s.

b) Press TRENDS key twice within one minute and the trends of CO2 and O2 are displayed.

c) Press TRENDS key three times and the N_2O and AA trends are displayed.

Press RETURN TO MONITOR or TRENDS key to revert to real time display.

NOTE: For detailed information on the use of the DATEX gas monitors, see the corresponding Operator's Manual.

B BM-123 ADD-ON BATTERY MODULE

BM-123 is an add-on battery module for SATLITE PLUS™ pulse oximeter. With this module added SATLITE PLUS™ can now also be used during transportation.

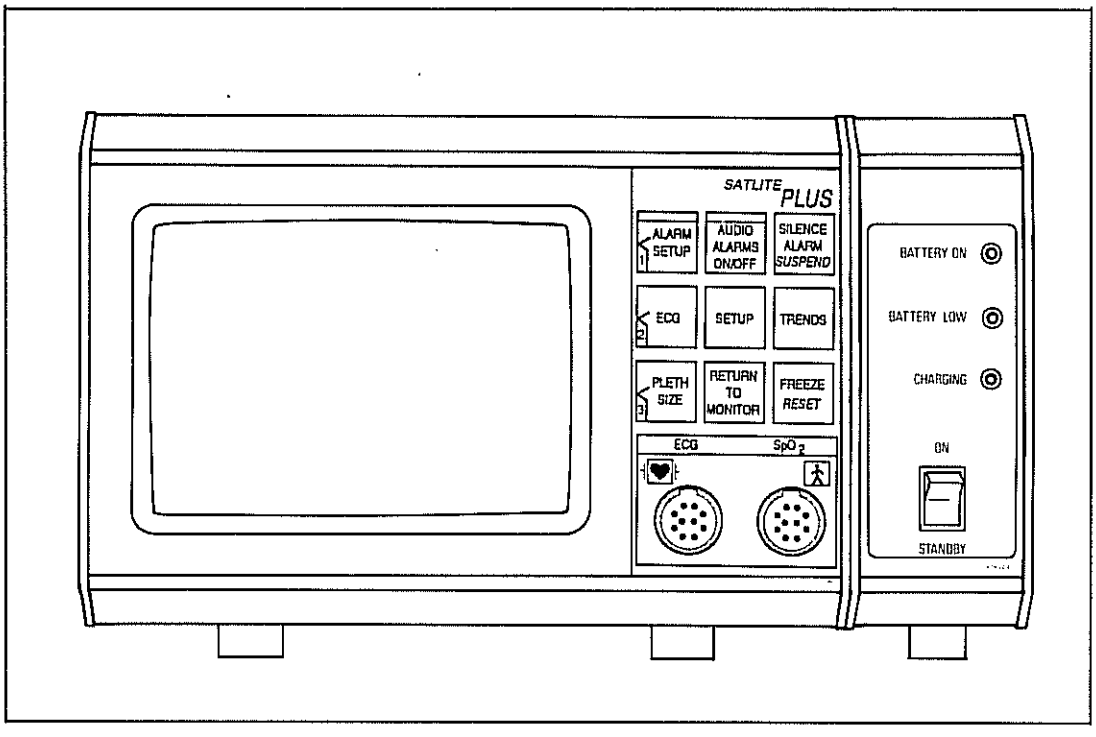


Figure B-1 BM-123 mounted to SATLITE PLUS™

B.1 Installation

Switch the power off from the monitor. Mount the battery module on the right side of the monitor with the four screws. Adjust the front foot underneath the module for stability.

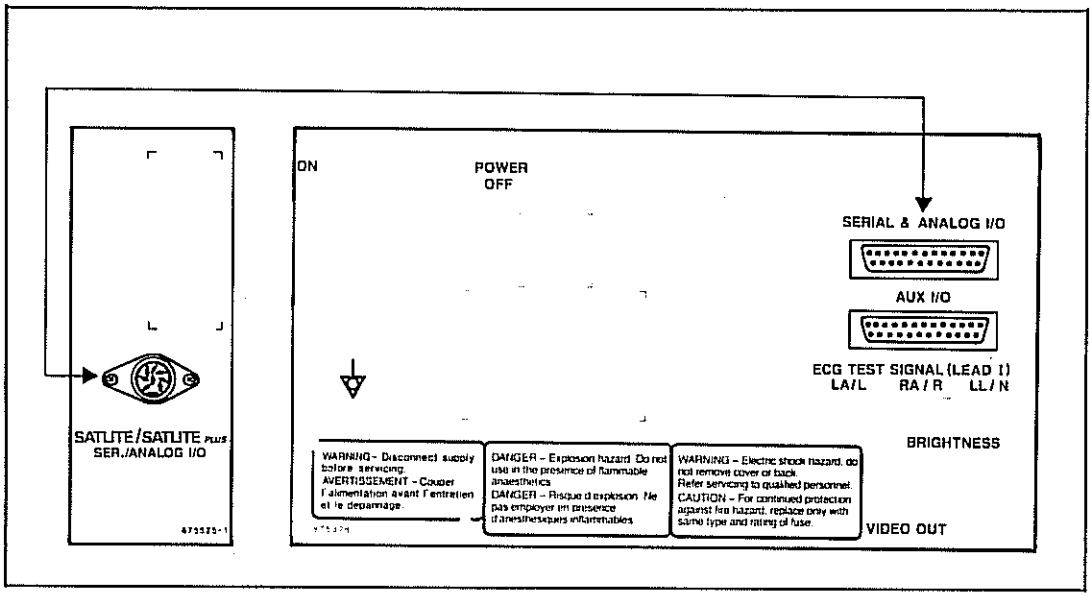


Figure B-2 Rear Panel Connections

Connect the "BM-123 to OS/OSE-123" (875522) cable from the SERIAL/ANALOG I/O connector of the monitor to the SATLITE/SATLITE PLUS SERIAL/ANALOG I/O connector of the battery module.

WARNING: The monitor must be switched off and the battery module set on STANDBY before connecting the cable from the battery module to the monitor.

B.2 Operation

B.2.1 Mains Operation and Recharging

Always keep the rear mounted power switch of the monitor ON.

Use the STANDBY switch of the BM-123 for turning monitoring ON and OFF.

When connected to mains and power switch ON, the batteries are continuously charged. The recharging time, from empty batteries to specified operating time of 40 minutes, is 6 hours at nominal voltage.

NOTE: In order to prolong the working life of the batteries, the battery module should be fully charged at least once every three months.

B.2.2 Battery Operation

When the monitor is powered from the battery, the power switch of the monitor can be either OFF or ON. The STANDBY switch of BM-123 controls power to the monitor. When the switch is turned ON, the green BATTERY ON light is lit and the monitor will work for 40 minutes on a full charge.

If the monitor does not start check that the switch on the BM-123 is ON and that the interconnecting cable is properly connected.

When charge capacity falls to approximately 25 % of its maximum value, the BATTERY LOW light will start to flash, indicating an operating time of less than 15 minutes. Power is then automatically switched off.

NOTE: When connecting the monitor to mains again, ensure the power switch is ON, in order to recharge the batteries.

B.3 Specifications

Dimensions	Depth	310 mm/12.2 in
	Width	55 mm/2.2 in
	Height	165 mm/6.5 in
Weight	4.0 kg/8.8 lb	
Installation	Install on the right side of the monitor by four screws through the module	

Connections

25-pin D-connector to SERIAL & ANALOG I/O of the monitor, 8-pin DIN connector to BM-123.

Battery type

Two lead acid batteries, 2 Ah, 12 V

Battery capacity

40 minutes

Recharge time
(to reach 40 minutes operation time)

6 hours at nominal voltage

CAUTION: Less than nominal voltage (100V, 115V, 220V or 240V) may prolong recharge time or decrease operation time.

C CCP-104 GRAPHICS PRINTER

The optional Graphics printer CCP-104 provides continuous hardcopy trends of all monitored parameters.

The following trends can be printed on the printer paper: HR (PR), SaO_2, pleth amplitude, % O_2, % CO_2, % N_2O and % AA (anesthetic agent). The gas ranges are fixed (0 - 100 % for O_2 and N_2O, 0 - 10 % for CO_2, 0 - 5 % for AA, see Figure B-2). To plot the trends connect the interface cable of CCP-104 Graphics Printer (Figure C-1) to the AUX I/O connector on the rear panel of SATLITE PLUS™. Turn power on both on the printer and monitor, or if printing is started during monitoring, the monitor must be reset by pushing the FREEZE/RESET key for 5 seconds in order to get the calibrated ranges printed on the printout.

SaO_2 and heart (pulse) rate are printed every 100 seconds in a numeric form on the right hand side of the printout, with the exception that respiration rate is printed every ten minutes in the same column.

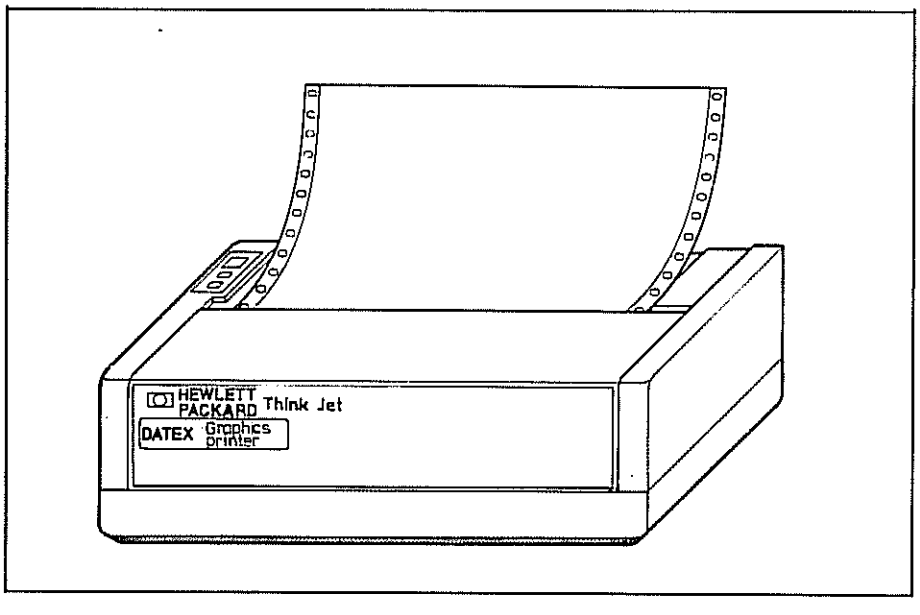


Figure C-1 CCP-104 Graphics Printer

The measured parameters can be printed also in a numeric string form by connecting the interface cable to SERIAL & ANALOG I/O connector on the rear panel. The data format printed is shown in Appendix D.

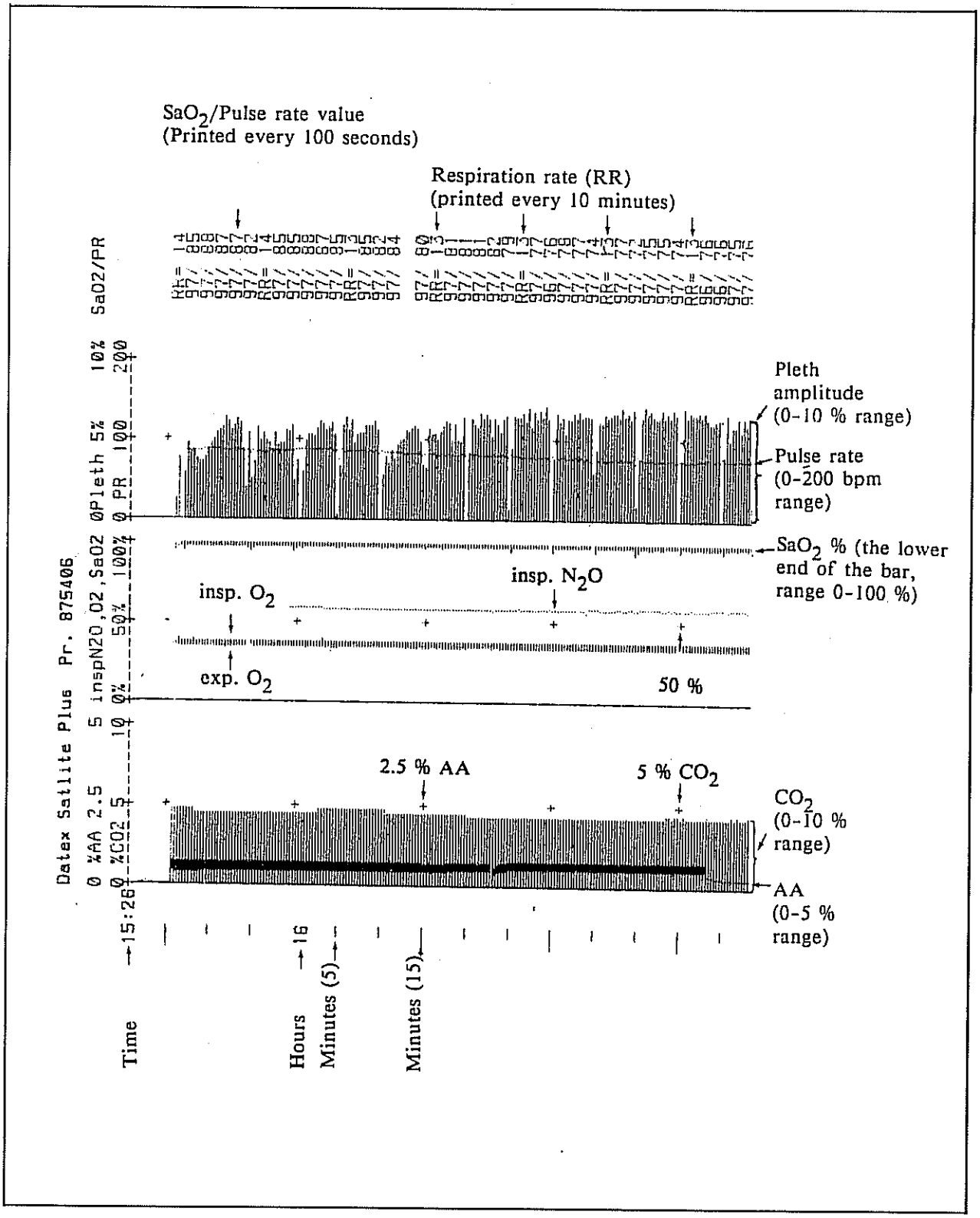


Figure C-2 Graphic Printout

D RS-232C COMPUTER OUTPUT (SERIAL & ANALOG I/O CONNECTOR)

Data format: 1200 Baud, 8 bits, no parity, 1 stop bit.

1. Regular output string format sent every 10 seconds (ET- and FI-values are 10 sec averages from Multicap^{R}, Capnomac^{TM}). If any field is not used 000 is transmitted in that field.

```
E03,000,007,013,048,012,000,000,000,000,000,CO2, 000,078,097,031,018,007,700
E03,000,007,013,045,009,000,000,000,000,000,     , 000,087,097,036,021,007,700
E03,000,007,013,045,011,000,000,000,000,000,CO2, 000,080,097,049,029,007,700
E03,000,007,013,055,016,000,000,000,000,000,     , 000,077,097,045,027,007,700
E03,000,007,014,055,016,000,000,000,000,000,CO2, 000,077,097,041,024,007,700
E03,000,007,014,052,019,000,000,000,000,000,     , 000,079,097,039,023,007,700
E03,000,007,014,059,018,000,000,000,000,000,CO2, 000,076,097,048,027,007,700
E03,000,007,014,050,018,000,000,000,000,000,     , 000,074,097,052,030,007,700
E03,000,007,014,040,011,000,000,000,000,000,CO2, 000,070,097,057,034,007,700
E03,000,007,014,048,007,000,000,000,000,000,     , 000,071,097,049,029,007,700
```

<===== OSE / DV-123 ID

<===== Not in use

<===== Hours

<===== Minutes

<===== $ETCO_2$ % x 10

<===== $FICO_2$ % x 10

<===== ETO_2 %

<===== FIO_2%

<===== ETN_2O %

<===== FIN_2O %

<===== ETAA % x 10

<===== FIAA % x 10

<===== Alternately selected anest., HAL, ENFL, ISO, 3 blanks (No. sel.) and selected analog output: CO_2, O_2, N_2O, ALL

<===== Respiration rate (1/min)

<===== Heart rate (PR) (1/min)

<===== SaO_2 %

<===== Ired ampl. MOD % x 10

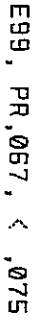
<===== Red ampl. MOD % x 10

<===== Gain

<===== Status

2. Alarm Activation/Deactivation String

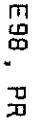
Alarm activation string appears immediately when an alarm is given.



<=====	OSE-123 and alarm activation string identification
<=====	Alarm parameter
<=====	Present value
<=====	< or > depending on whether low or high limit
<=====	Limit

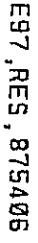
The alarm parameter can be one of the following: SAO (SaO_2), PR (pulse rate), POF (probe off), NPR (no probe), PUS (pulse search), ASY (asystole), LQS (low quality signal). For alarms like probe off, only the identification and alarm parameter are transmitted.

Alarm deactivation string is sent when the reason of the alarm no longer applies, or when the alarm is either silenced or turned off.



<=====	OSE-123 and alarm deactivation string identification
<=====	Alarm parameter

3. Command/Info String



<=====	OSE-123 and command/ info string identification
<=====	RES for reset, POW for power-up
<=====	Program revision no.

E ACTIVATING THE PRINTHEAD CARTRIDGE (CCP-104)

The ThinkJet printhead cartridge is durable, disposable, and easy to maintain. Observing a few simple rules will keep your printhead trouble-free.

During shipping an air bubble may collect in the printhead causing the print to fade out after a few lines. To correct, follow these three steps:

a) Hold printhead upright and insert a straightened paper clip into the hole in the center of the clear plastic casing.

b) Press paper clip gently against the internal inner ink reservoir membrane until a large droplet of ink (size of a pea) covers most of the top silver plate.

c) Remove paper clip and allow ink to absorb back into printhead for about 30 seconds. Wipe off the excess ink with a tissue.

Your printhead is now activated and ready to install in the printer.

Periodically, the printing surface (top silver plate) may require cleaning with a tissue to remove paper dust that can accumulate and block one of the inkjets (cleaning will correct a missing row of dots.

Begin use of the printhead cartridge prior to the expiration date printed on the package.

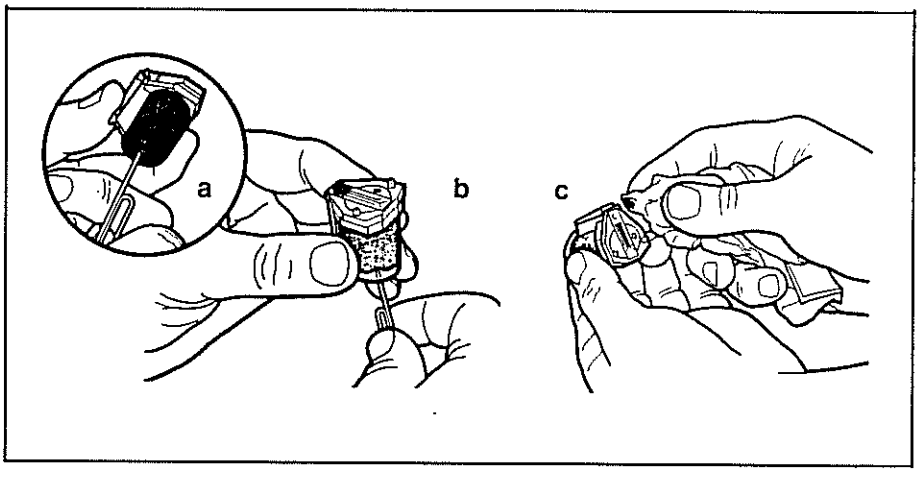
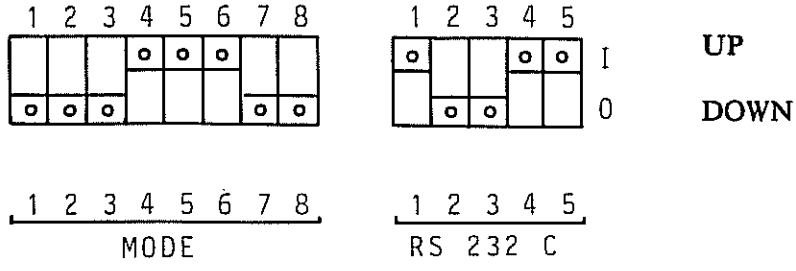


Figure E-1 Activating the Printhead Cartridge

DIP SWITCH SETTINGS

For locally purchased HP ThinkJet printers the following switch settings of Mode and Data communications must be made



F CONNECTORS

TABLE F-1. Rear Panel D-Connectors. Serial & Analog I/O

Pin No	I/O	Signal
1		Protective ground
2	O	TXD (RS232C)
3	I	RXD -"-
4	O	RTS0 -"-
5	I	CTS0 -"-
6	I	Ext DEC0 (TTL) (BM-123 Standby)
7		Signal ground
8	I	Ext DEC1 (TTL) (BM-123 Standby)
9	O	+12 VDC, 50 mA max
10	O	-12 VDC, 50 mA max
11	O	+15 VDC, 100 mA max
12	O	-15 VDC, 100 mA max
13	O	Red signal 0 - +10 V
14	I	O_2, 10 V = 100 % O_2
15	O	5 VDC, 500 mA max
16	O	ECG (Gain=1750)
17	I	AA, 5 V = 5 % AA
18	I	N_2O, 10 V = 100 % N_2O
19	O	SaO_2, 10 V = 100 % SaO_2
20	I	CO_2, 10 V = 10 % CO_2
21	O	+22 VDC, 1 A max
22	O	Infrared signal 0 - +10 V
23	O	-22 VDC, 1 A max
24	O	20 VAC, 1 A max
25	O	20 VAC, 1 A max

NOTE: All power output current limits are total for both connectors.

TABLE F-2. Rear Panel D-Connectors. AUX I/O

Pin No	I/O	Signal
1		Protective ground
2	O	TXD1 (RS232C)
3	I	RXD1 -"-
4	O	RTS1 -"-
5	I	CTS1 -"-
6	I	DEC0 (TTL)
7		Signal ground
8	I	DEC1 (TTL)
9	O	+12 VDC, 50 mA max
10	O	-12 VDC, 50 mA max
11		Not connected
12		Not connected
13	I	CTS2 (TTL) (not used)
14	O	TXD2 (TTL) (not used)
15	O	+5 VDC, 500 mA max
16	O	RXD2 (TTL) (not used)
17		Not connected
18		Not connected
19	O	RTS2 (TTL) (not used)
20	O	Alarm call
21	O	+22 VDC, 1 A max
22		Not connected
23	O	-22 VDC, 1 A max
24	O	20 VAC, 1 A max
25	O	20 VAC, 1 A max

Rear Panel BNC-Connector. Video Out

Composite video signal: 1 V_{pp} 24 MHz, 75 ohm h_{sync} 15.75 kHz, v_{sync} 50 Hz

TABLE F-3. Front Panel SaO_2-Sensor Connector (right)

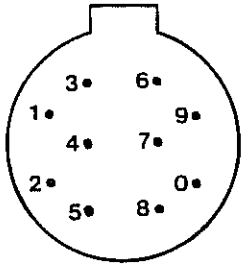
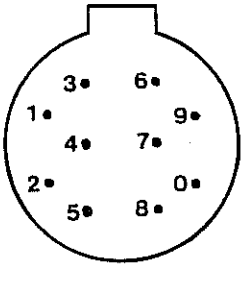
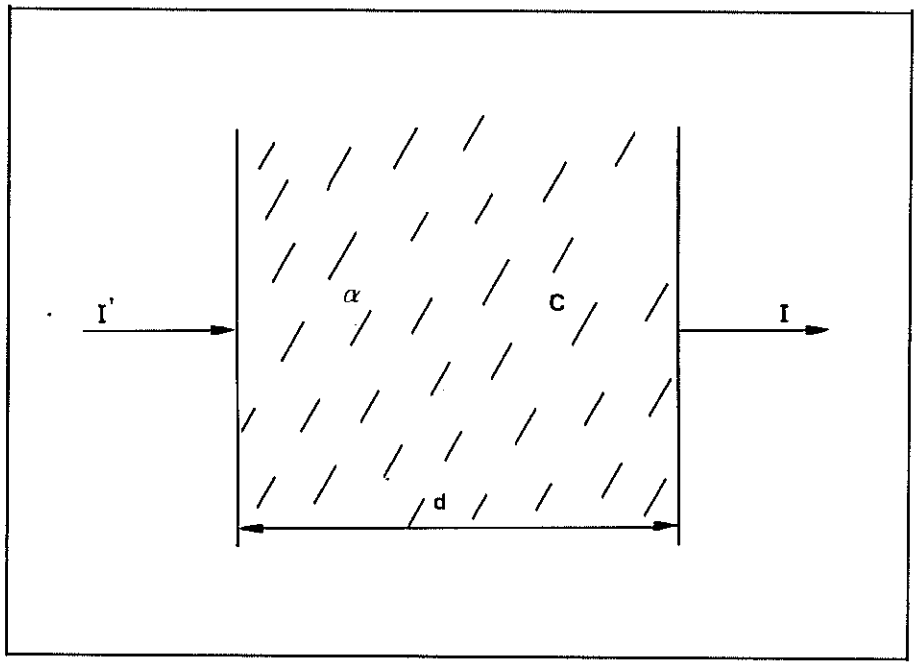
	Pin No.	Signal
 front view	1	I_s
	2	I_b
	3	Not connected
	4	(R_c)
	5	(R_c)
	6	GND
	7	I_{led}
	8	V_b (-4 ±0.3 V)
	9	GND
	0	+12 V_p

TABLE F-4. Front Panel ECG-Cable Connector (left)

	Pin No.	Signal
 front view	1	R(RA)
	2	L(LA)
	3	F(LL)
	4	Not connected
	5	Not connected
	6	Shield (GND)
	7	Not connected
	8	Not connected
	9	Not connected
	0	Not connected

G THEORETICAL BASIS OF SATURATION MEASUREMENT

The absorption of pulsating arterial blood is determined by hemoglobin in red blood cells. The absorption of light in the blood is dependent on the wavelength and the amount of oxygen bound to hemoglobin. This means that the oxygen saturation level can be measured photometrically, if the absorption characteristics of hemoglobin are known. The method is based on the Lambert-Beer's law, which defines the intensity of transmitted light through the subject as a function of the intensity of incident light, thickness of the transmitted solute and concentration and absorption coefficients of the solute at a certain wavelength, see Figure G-1.



Lambert Beer's law: $I = I' e^{- Cd}$,

where
- I = intensity of transmitted light
- I' = intensity of incident light
- = absorption coefficient
- C = concentration of solute
- d = depth of absorption layer

Figure G-1 The Attenuation of Light Intensity in the Substance

The pulse oximeter measures the absorption of incident light at two wavelengths. The wavelengths used in SATLITE PLUS™ are 910 nm in the infrared region and 660 nm in the red region. The absorption of red light is dependent on amount of

reduced hemoglobin (strong absorption in deoxygenated hemoglobin and weak in oxyhemoglobin), see Figure G-2. Other hemoglobins (HbCO, MetHb) have weak absorption coefficients. If the concentration of HbCO + MetHb in the blood differs greatly from 1 %, it may cause an error to the measured SaO_2 reading.

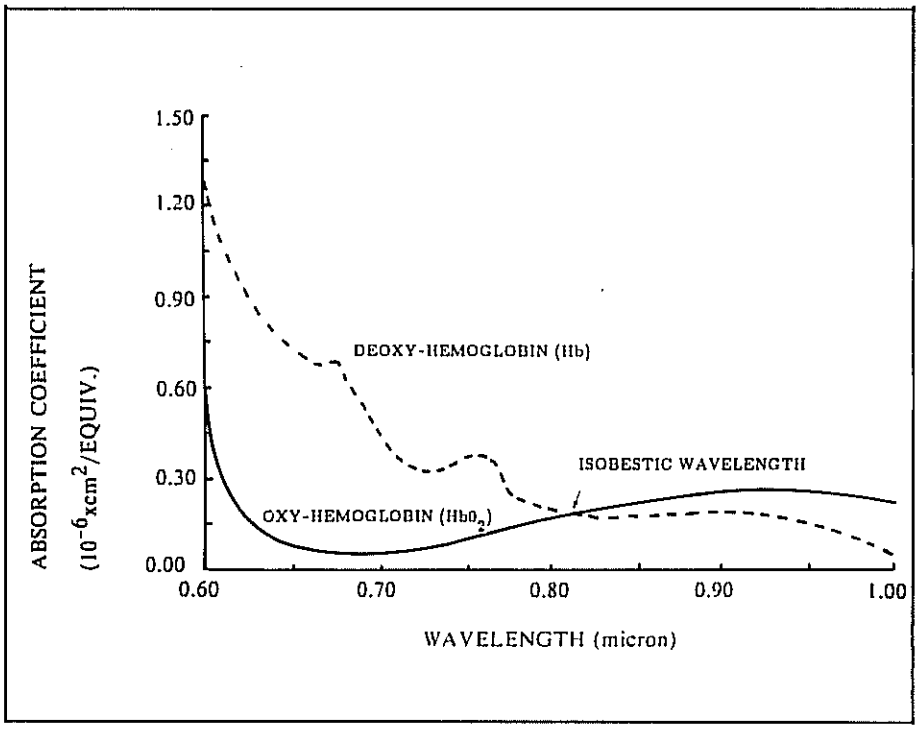


Figure G-2 Absorption Coefficients of Hemoglobin

Principle of Pulse Oximetry

Two wavelengths of light (910 and 660 nm) are emitted by LEDs (light emitting diodes) situated on one side of the probe. The incident light is attenuated by the tissue, and detected by the photosensitive detector on the opposite side of the probe. The pulsating arterial blood adds a pulsation to the attenuation, because the volume of the subject in the path of the transmitted light changes. The total absorption can be divided into components, which are equivalent to compartments in the substance: tissue, venous blood, arterial blood and the pulse added volume of arterial blood, see Figure G-3. Only the pulse added volume of arterial blood gives variations to transmitted light intensity, which gives the blood pulsation curve.

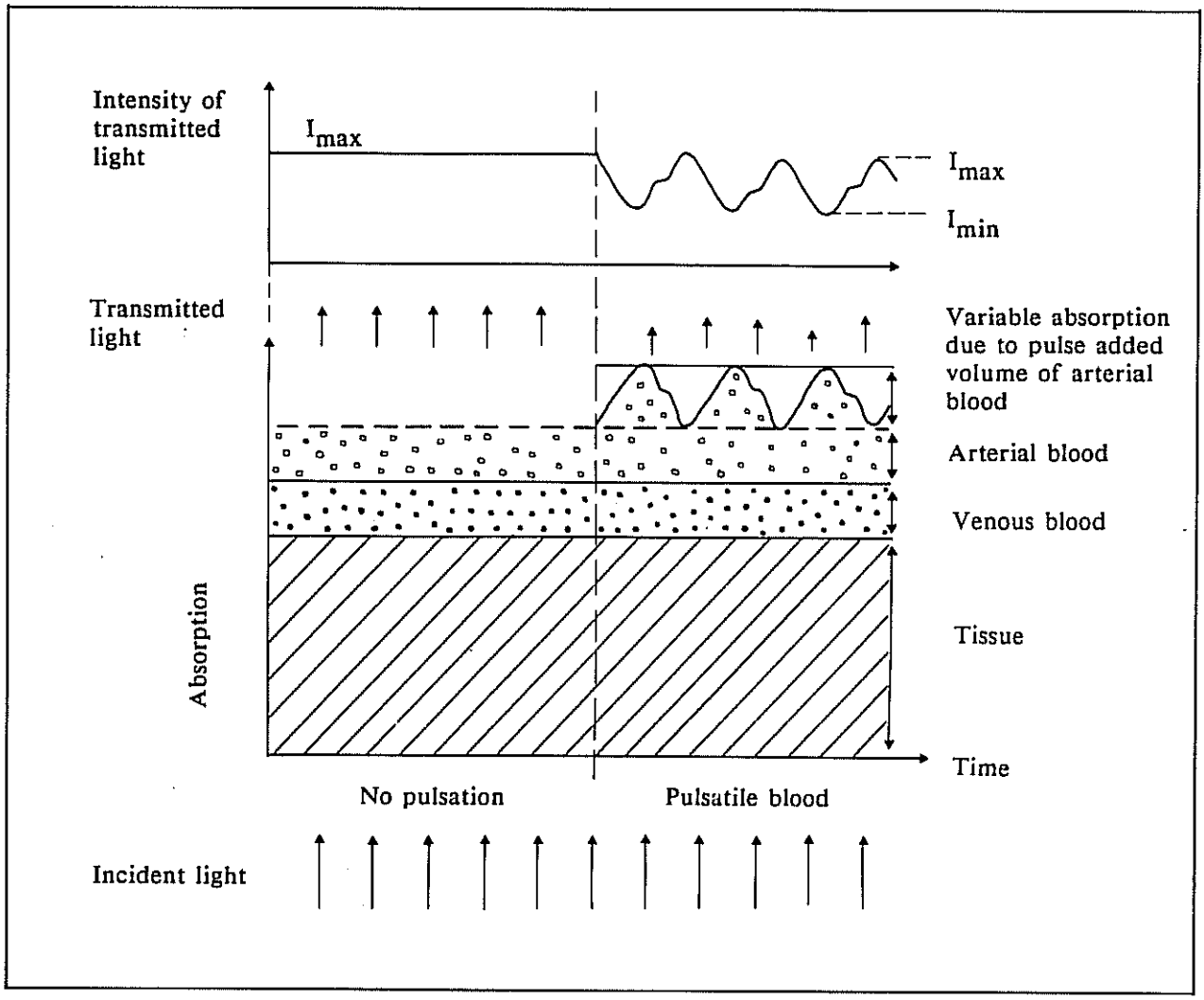


Figure G-3 Absorption of Light in Tissues and its Effect to the Intensity of Transmitted Light

The light intensity curve is amplified and further processed. The pulse oximeter calculates the R/IR ratio (red/infrared) using the maximum amplitudes and amplitude variations in both infrared and red light curves. The oxygen saturation is calculated from an empirically determined relationship between R/IR ratio and the arterial oxygen saturation.

The influence of fetal hemoglobin on the readings has not been separately investigated, but it is believed that the absorption characteristics of fetal hemoglobin are the same as for normal hemoglobin.