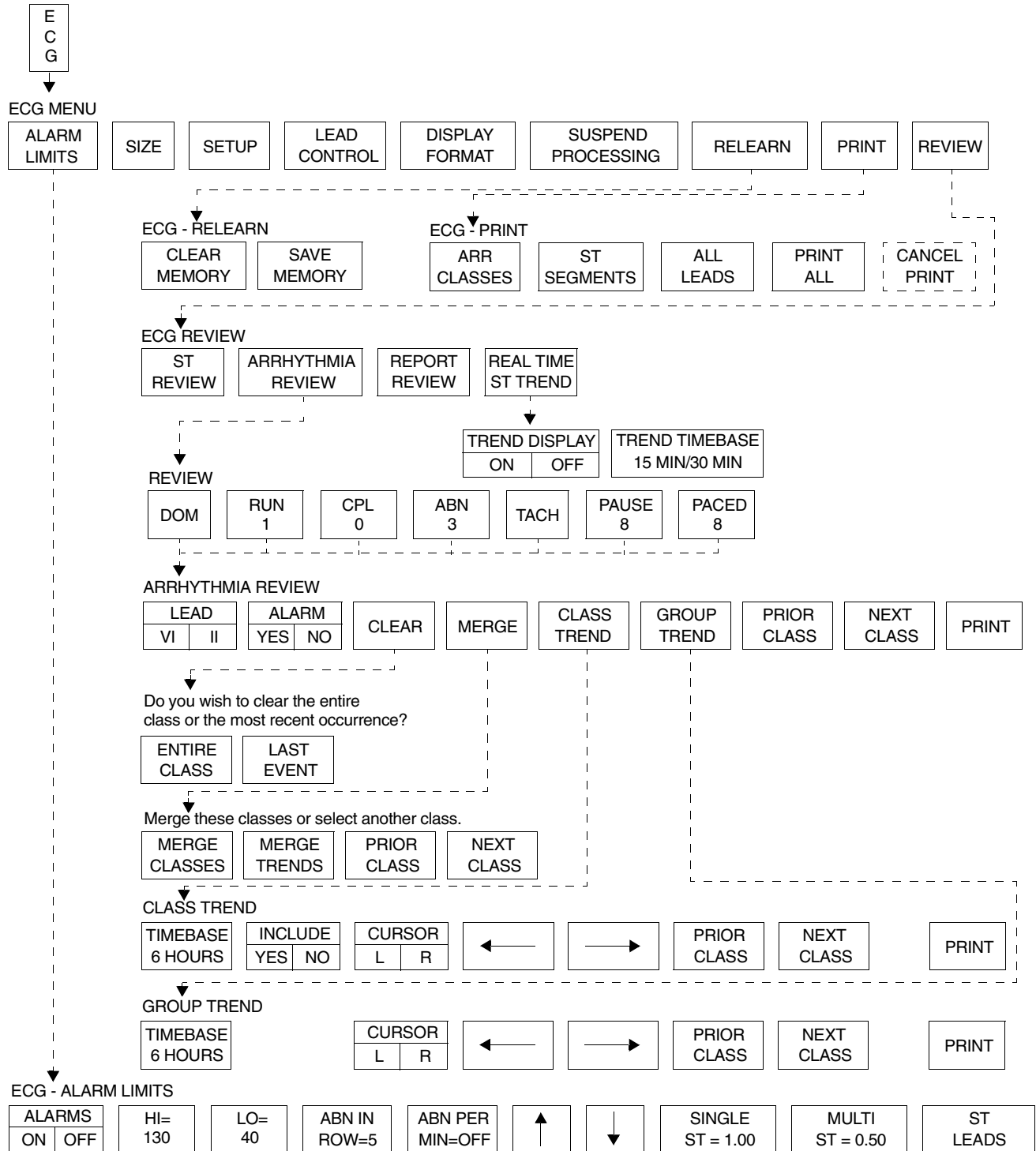


Arrhythmia Directory

Directory of Keys



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

Contents

Overview	3
Setting Up Arrhythmia Monitoring	4
Setting and Adjusting Alarms	6
Reviewing Arrhythmias	8
Display Detail	9
Controlling Arrhythmia Alarms	10
Clearing a Class or Event	10
Merging Classes/Trends	10
Plotting Arrhythmia Trend Graphs	12
Printing Arrhythmia Data	13
Arrhythmia Problem Solving	14
Arrhythmia Troubleshooting Guide	16

Overview

Two levels of arrhythmia detection and review are available in Spacelabs Medical monitors.

The Multiview I option provides enhanced arrhythmia detection and alarms for ventricular tachycardia, couplets, and single abnormal beats in addition to the detection and alarm capabilities for high and low heart rates, ventricular fibrillation, and asystole.

The Multiview II option expands arrhythmia detection to include pauses and tachycardias of a supraventricular origin. This option also offers storage capabilities so that trends of arrhythmia episodes as well as dominant and paced rhythms can be reviewed, edited and printed.



- *No arrhythmia detection system can correctly detect and classify all arrhythmias 100% of the time. Use sound clinical judgement when monitoring patients with arrhythmias.*
- *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.*

Setting Up Arrhythmia Monitoring

To set up arrhythmia monitoring:

- 1 Set up system and patient for standard ECG monitoring.
- 2 Touch ECG.
- 3 Touch SETUP.
- 4 Touch CONFIG.
- 5 Ensure ADULT is selected.
- 6 Select ARR ON.

To disable arrhythmia detection:

- 1 Touch ECG.
- 2 Touch SETUP.
- 3 Touch CONFIG.
- 4 Select ARR OFF.

With the Multiview I or II option, the ARR ON/OFF key (located in the Config menu under Setup) can be used to selectively enable or disable arrhythmia detection functions. Arrhythmia detection must be enabled if you wish to establish a new dominant waveform (refer to *Relearning the Dominant Waveform* on page 9-5 for more details).



- *The Arrhythmia ON/OFF key is only available in modules with the Multiview I or II options.*

When you turn arrhythmia detection ON

- IN LEARN appears above the ECG tracing in the first zone
- the RELEARN key is present in the ECG menu
- ABN IN ROW and ABN PER MIN keys are present in the Alarm Limits menu
- ECG alarms are momentarily deactivated until the learn sequence completes
- Rate and ST alarm limits are initialized
- Abnormals in a Row and Abnormals per Minute alarm limits are initialized

When you turn arrhythmia detection OFF

- IN LEARN appears above the ECG tracing in the first zone
- no arrhythmia detection features or menus are displayed
- ECG alarms are momentarily deactivated until the learn sequence completes
- Rate and ST alarm limits are initialized

Learning the Dominant Waveform

During the learn sequence, IN LEARN is displayed on the monitor while the system establishes the heart rate and begins to classify each beat. Rate alarms are set based on this learned heart rate (if they have not been previously set to Fixed in the Module Configuration Manager). The first non-premature beat that occurs ten times is established as the dominant class. When the learn sequence is completed, the IN LEARN message disappears.

Examples of actions that initiate a learn sequence are:

- Power ON
- Module insertion
- Changing patient type (adult/infant)
- Enabling/disabling arrhythmia detection
- Patient admission via the Admit/Discharge menu

The system will not classify a paced beat as the dominant class. If the patient is 100% paced and there is no dominant class at the end of the learn sequence, the first single, non-paced beat detected five times becomes the dominant class.

Detecting Abnormal Beats

The system compares each incoming beat with the dominant class. It examines morphology and the intervals between both the previous and following beats to determine whether the beat does or does not match the dominant. If the system determines the beat is abnormal, it compares the new beat with each of the abnormal shapes categorized since the learn sequence was completed. If the current beat fails to match any of the existing shapes (and after five occurrences), the system classifies it as a new abnormal class.

Detecting Pauses

The system classifies an R-R interval that is 1.8 times (or 80%) longer than the average R-R interval as a pause.

The last beat detected preceding the pause is displayed to the left of center in the pause class. The system does not count two consecutive, long R-R intervals both in the pause class. Instead, it assumes that a sudden rate change occurred and updates the heart rate immediately.

Detecting Paced Beats

If the Paced mode is enabled in the ECG Setup menu and the system does not detect a paced beat during the learn sequence, a paced class will be created once the system detects the first paced beat.

The system identifies two different types of paced beats:

- paced
- AV-paced

The paced class is created for ventricular-paced beats defined as a QRS complex which is preceded by a single pacemaker pulse.

The AV-paced class is created for beats that are preceded by two pacemaker pulses.

The QRS complex must follow the pacemaker pulse within 150 msec for the beat to be classified into either paced class. If the pacemaker pulse precedes the QRS complex by more than 150 msec, the beat may be triggered by an atrial pacemaker and is not classified in either paced class.

Relearning the Dominant Waveform

To relearn the dominant waveform:

- 1 Touch ECG.
- 2 Touch RELEARN.
- 3 Select SAVE MEMORY or CLEAR MEMORY.

You can relearn the dominant rhythm and establish a new dominant at any time during monitoring. After touching the RELEARN key, you can either clear the memory or save the memory. Once a selection is made, the relearn sequence is initiated during which ECG alarms are suspended. The old dominant is labeled as exdominant and stored as an abnormal class.



WARNING:

- *Until the patient's rate and morphology are learned, ECG alarms for high rate, low rate, run, couplet, abnormal per minute, and tachycardia are not active.*

Selecting CLEAR MEMORY clears all arrhythmia and ST segment data and resets the Abnormals per Minute, Abnormals in a Row, and ST segment alarms. Upon completion of the learn sequence, ECG alarms are enabled and rate alarms limits are reset.

Selecting SAVE MEMORY saves all previously-acquired arrhythmia and ST segment data. Once the learn sequence is completed, ECG alarms are enabled and rate alarms are reset. The Abnormals per Minute and Abnormals in a Row alarms remain unchanged. If ST segment level alarms were enabled prior to the relearn sequence, they will be reset.

Automatic Dominant Class Update

The system uses the following rules to update the dominant class:

- An abnormal class that occurs more frequently than 50% of all beats in the previous 60-seconds, and occurs three beats more frequently than the current dominant during that period, automatically becomes the new dominant class.
- The old dominant is put into an abnormal class and given the status EXDOMINANT. This class can become dominant again and has the same characteristics as any other active class.

The message, NEW DOMINANT, is displayed above the ECG trace for 60-seconds after the new dominant is established.

Setting and Adjusting Alarms

To set or adjust alarms for abnormal beats (arrhythmia detection must be enabled):

- 1 Touch ECG.
- 2 Touch ALARM LIMITS.
- 3 Touch ALARMS ON.
- 4 Select ABN IN ROW = or ABN PER MIN =.
- 5 Use arrow keys to adjust.

In addition to the alarms described in *ECG* on page 8-3, the Multiview I or II options provide alarms for these additional conditions.

Abnormals in a Row Alarm

Following the learn sequence, the Abnormals in a Row alarm limit is set based on either factory defaults or user-defined settings. You can adjust the alarm limit from two to ten or you can deactivate it.

- Setting the Abnormals in a Row alarm limit to three or greater will initiate a RUN ALARM message when three or more consecutive abnormal beats (at a rate greater than 90 BPM) occur.
- Setting the Abnormals in a Row alarm limit to two will initiate a COUPLET ALARM message when two consecutive abnormal beats occur.

The factory default setting for the Abnormals in a Row limit is five.

Abnormals per Minute Alarm

Following the learn sequence, the Abnormals per Minute alarm limit is set based on either factory defaults or user-defined settings. You can adjust the alarm limit from 1 to 99, or it can be deactivated.

The factory default setting for the Abnormals per Minute limit is OFF.



- If the alarm limit for high rate, low rate, ABN/MIN, or ABN IN ROW is displayed in reverse video, this is an indication that alarm tone, alarm recording, and alarm watch have been disabled for the indicated alarm.

Table 1 describes the arrhythmias detected with the Multiview I or II options (with arrhythmia detection enabled).

Table 1: Classification of Events

Type of Class	Defining Characteristics	Prematurity Required	Max # of Classes Allowed	Type of Waveform Storage
ABNORMAL **	1 beat of abnormal morphology	No	12	Qualifying occurrence (5th) + most recent
COUPLET **	2 consecutive beats of abnormal morphology	No for the first beat; Yes for the second beat *		Qualifying occurrence (3rd) + most recent
RUN	3 or more consecutive beats of abnormal morphology	No for the first beat; Yes for each subsequent beat *	32	6-seconds of each occurrence. First in, first out. Saves longest Run and Pause
PAUSE	An R-R interval that is 1.8 x (or 80%) longer than normal	No		
ASYSTOLE	Absence of QRS for 5-seconds or more	No	NA	6-seconds of last occurrence stored as a pause when following normal beats
PACED	1 pacemaker flag followed by a QRS (within 150 msec)	No	1	First paced beat occurrence each minute (PACED key must be set to YES)
AV PACED	2 pacemaker flags followed by a QRS	No	1	First paced beat occurrence each minute (PACED key must be set to YES)
TACH (SUPRA VENTRICULAR)	≥ 5 or more premature dominant beats in a row	Yes *	1	6-seconds of last occurrence
VFIB	NA	No	1	6-seconds of last occurrence
DOMINANT **	NA	NA	1	Qualifying occurrence (10th) + the most recent each minute

* Prematurity is defined as an instantaneous R-R interval that is (1) 15% premature as compared to the average R-R interval and, (2) ≤666 msec for couplets and runs, and ≤500 msec for tachycardias of a supraventricular origin.

** Template-forming classes.

Reviewing Arrhythmias

To review arrhythmias:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Select an arrhythmia class type for review.
- 4 Select NEXT CLASS or PRIOR CLASS keys to progress through the review.



- *Arrhythmia Review and Edit functions are only available in modules with the Multiview II option in the ADULT mode, and with both arrhythmia detection and review enabled.*

Selecting Arrhythmia Classes

The numerical value for each arrhythmia key indicates the number of occurrences that the system has stored. If none have been detected, the numerical value inside the key is 0 and the key outline is dotted. For classes that only store the last occurrence of that type of arrhythmia (for example, tachycardias of a supraventricular origin), a value is not displayed. The system updates the menu as new classes are created.

Selecting Leads for Review

When you access the Arrhythmia Review menu, the LEAD key text changes to indicate which leads were being monitored the last time the displayed event occurred. The lead associated with the currently displayed waveform is highlighted. You can change the lead selection by touching the LEAD key.

Multiple Arrhythmia Classes

The system distinguishes between classes of the same type that have different morphologies by assigning numbers to each class. The class number is displayed to the right of the class type; for example, ABNORMAL 1.

The system will display, in sequence, up to 32 different runs and/or pauses. However, the system always keeps the longest run or pause. If the system detects one more pause and/or run than it can store, it replaces the oldest run or pause with the new one (that is, first in-first out).

Updating Classes

The system updates the review waveform once each minute for the dominant, paced and AV paced classes. Otherwise, it updates with each occurrence.

Display Detail

The system stores and displays arrhythmia review data in two categories: non-template forming classes and template-forming classes.

The non-template forming class displays a waveform that is 6.25-seconds long and is representative of the most recent occurrence.

The template-forming class displays two waveforms. The waveform on the left is 1.25-seconds long; the arrhythmia that originated the class is centered. The waveform on the right is 4.5-seconds in length and the most recent occurrence of the class is centered.

The lead, frequency, and time and date of last occurrence appear to the right of each presentation.

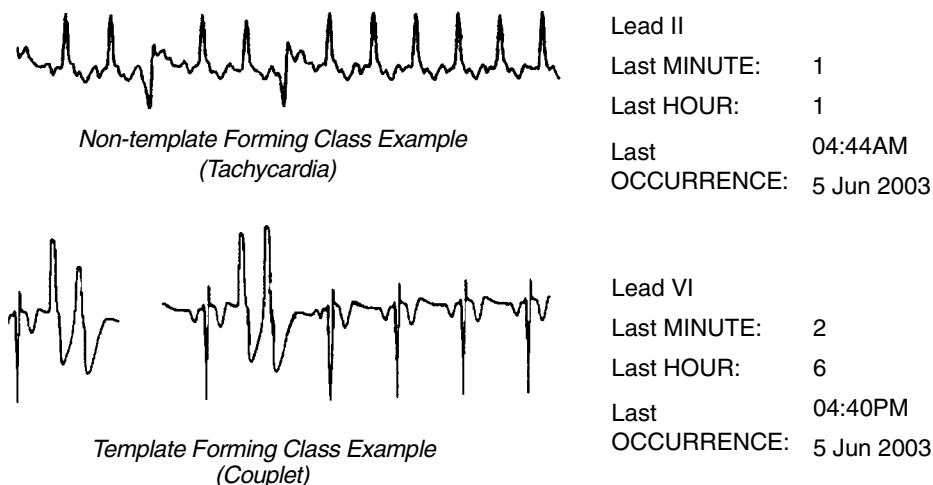


Figure 9-1: Arrhythmia waveforms

Controlling Arrhythmia Alarms

To control arrhythmia alarms:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch ARRHYTHMIA REVIEW.
- 4 Select CPL, ABN or TACH.
- 5 Select ALARM YES or NO.

Touch ALARM YES or NO to enable or disable alarms for couplets, single abnormalities, or tachycardia. Disabling alarms for a specific arrhythmia prevents alarm generation for subsequent detection of that arrhythmia class. At least one episode of the class must be stored before the alarm can be disabled.

Clearing a Class or Event

To clear a class or the most recent event in a class:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch ARRHYTHMIA REVIEW.
- 4 Select an arrhythmia class.
- 5 Touch CLEAR.
- 6 Select ENTIRE CLASS or LAST EVENT.

When you clear a class, the system removes it from memory. Touch the ENTIRE CLASS key to clear the displayed class and template from memory and from the trend buffer. When the system finishes clearing the class, the Arrhythmia Review menu appears and displays the next class.

Touch the LAST EVENT key to remove only the most recent occurrence of the displayed class from memory. The LAST EVENT key is only active for abnormal and couplet classes.

When you clear the most recent event:

- the system removes the most recent occurrence of that class from memory.
- the system displays the message **The last occurrence of this class was deleted** in place of the cleared waveform.
- the system updates the frequency and last occurrence totals. The system does not redisplay the updated information until you redisplay the class.

Merging Classes/Trends

To merge class or trend data:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch ARRHYTHMIA REVIEW.
- 4 Select an arrhythmia class.
- 5 Touch MERGE.
- 6 Use PRIOR CLASS or NEXT CLASS to display the two classes you wish to merge.
- 7 Select MERGE CLASSES or MERGE TRENDS.

Merging enables you to take two different classes or trends from the same group and merge them together into a single class, combining the trend history and time of last occurrence. When the module is frequently storing a single morphology as two different classes, merging the classes opens up storage for new classes while saving all arrhythmia data.

Merging Classes

Two classes may be merged when the system interprets two abnormal beats as different classes but the clinician sees them as the same class. This could occur if a patient's dominant beat is experiencing frequent changes in polarity or when the electrodes have been repositioned.

At the start of merging two classes, one class appears on the left side of the screen and the second class appears on the right side. The message "Merge these classes or select another class" appears at the bottom of the screen.

If the two classes look clinically the same, they can be merged by touching the MERGE CLASSES key. Once merged, the first beat will be displayed as a template on the left side of the screen with the message (M1) following the class title. Any subsequent beat that fits any of the merged templates will then be stored in that class.

You can merge a maximum of two classes into a third class. The following constraints apply to merging classes:

- Two single templates can be merged into a class with one template.
- One class of two (previously merged) templates can be merged with one additional template.
- If a class has been merged once, then (M1) follows the class number, for example, ABNORMAL 12 (M1).
- If a class has been merged twice, then (M2) follows the class number, for example, ABNORMAL 12 (M2).

Merging Trends

There is no limit to the number of trends that you can merge. Merging trends of arrhythmia data deletes the template for the class that has been merged. If an arrhythmia event occurs that matches the merged class, a new class will be created.

If you want to combine the data for two routinely recurring arrhythmia classes, merge the classes rather than merge the trends. Merging classes permits the two classes to be stored and trended together on an ongoing basis.

If you want to combine an active arrhythmia class with an inactive class, merge the trends. An example of an inactive arrhythmia class is the dominant morphology associated with a previous lead selection.

Merge Constraints

The following additional constraints apply to merging individual classes or trends:

- If the system cannot merge any of the existing classes or trends, the MERGE key is disabled (the key will appear dotted) in menus for those classes/trends.
- Only classes/trends that the system can merge are presented.
- Single abnormal classes/trends can be merged with each other, or with the dominant, paced, or AV paced classes/trends.
- Couplets can only be merged with couplets.
- Runs and pauses cannot be merged.

Plotting Arrhythmia Trend Graphs

To plot a trend graph:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch ARRHYTHMIA REVIEW.
- 4 Select an arrhythmia class for review.
- 5 Select CLASS TREND or GROUP TREND.

When you plot trend graphs the display area consists of:

- a 1.5-second segment of the selected class waveform on the left (individual class trends only).
- a trend graph of the selected class, or group of classes, on the right. Refer to *Figure 9-2: Abnormal class trend*.

When you select CLASS TREND, the trend graph plots occurrences of events that match that particular class. The total number of events that occurred during the time period between the cursors appears below the trend graph.

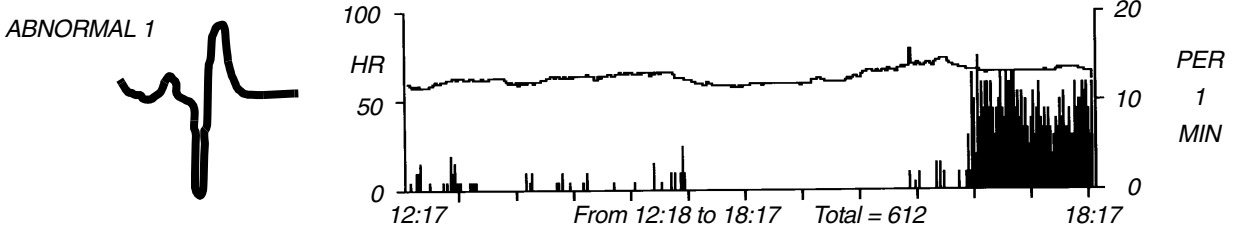


Figure 9-2: Abnormal class trend

When you select GROUP TREND, the trend graph plots occurrences of all events in that group of classes along with the average heart rate. For example, the group trend for abnormalities plots the occurrences of all single abnormalities regardless of the class in which they were stored.

- The dominant group trend graph displays the total of all abnormal beats, including beats in runs, over the selected timebase.
- A total of all events specific to the selected class over the selected timebase is displayed for all other trended classes.

Each trend graph is displayed with two scales:

- the scale on the left represents heart rate.
- the scale on the right displays the number of arrhythmias over the trended period.

Scales are automatically selected, based on the heart rate and arrhythmia values.

To select a timebase for class or group trends:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch ARRHYTHMIA REVIEW.
- 4 Select an arrhythmia class.
- 5 Select CLASS TREND or GROUP TREND.
- 6 Select TIMEBASE (6-, 12-, or 24-hours).

Selecting a Timebase

You can also select the time period over which the system trends arrhythmia data. The factory default setting is 6-hours. Resolution for each timebase is shown below.

Resolution	Timebase
1-minute	= 6-hour trend graph
2-minutes	= 12-hour trend graph
4-minutes	= 24-hour trend graph

To exclude a class in a group trend:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch ARRHYTHMIA REVIEW.
- 4 Select an arrhythmia class.
- 5 Touch CLASS TREND.
- 6 Select INCLUDE NO.

To position the cursors on the trend graph:

- 1 Touch the CURSOR to highlight either the L or R portion.
- 2 Touch the trend plot to position the cursor near the desired point.
- 3 Use the arrow keys for adjustment of the cursor.

To print recordings of ALL arrhythmia events:

- 1 Touch ECG.
- 2 Touch PRINT.
-OR-
- 3 Touch PRINT ALL.
- 4 Touch ARR CLASSES.

To print selected arrhythmia classes:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch ARRHYTHMIA REVIEW.
- 4 Select an arrhythmia class.
- 5 Touch PRINT.

To print selected arrhythmia trends:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch ARRHYTHMIA REVIEW.
- 4 Select an arrhythmia class.
- 5 Select CLASS TREND or GROUP TREND.
- 6 Touch PRINT.

Excluding Classes from Trends

Use this function to exclude specific classes from the group trend for that class as well as from the dominant trend graph (only valid with CPL and ABN classes). This function defaults to YES indicating that all classes will be included. When you select a class, the template for that class displays on the screen. It is followed by a trend graph that plots all of the occurrences of that class over the selected trend graph timebase.

Positioning the Cursors

The cursors are small, bright lines that move along the bottom of the trend display and allow you to view the number of trended events that occurred between any two points in time displayed on the trend graph.

Initially, the left (L) cursor is located flush with the left edge of the trend graph, and the right (R) cursor is located flush with the right edge of the trend graph. The number of trended events between, and inclusive of, the cursor points appear below the trend graph. If the cursors move past each other, the L cursor becomes the R cursor and vice versa. The highlighted L or R portion of the CURSOR key changes accordingly.

Printing Arrhythmia Data

All printouts of ECG or arrhythmia data are annotated with the following data:

- Bed identification
- Time and date of the printout
- Lead designator

You can print all arrhythmia data for all classes or individually selected classes. You can also print individually selected arrhythmia trend plots.

Selecting PRINT ALL prints all ST events and all arrhythmia classes. PRINT ALL also prints *all* leads.

Arrhythmia Problem Solving

Refer to *ECG* on page 8-3 for additional monitoring tips.

False Alarms

Careful attention to good monitoring techniques, especially during setup, will reduce false alarms. When false alarms occur, check the following:

- Multiple classes with atrial fibrillation or flutter waveforms. Either 1) merge these classes with the dominant or another abnormal class, 2) deactivate the alarms for these classes, or 3) consider deactivating the Abnormals per Minute alarm.
- Repetitive artifact mimicking QRS complexes. Review the morphology of abnormal classes that are triggering alarms. Either merge these abnormal classes together or deactivate the alarm for these classes.
- In some cases VFIB may resemble previously classified abnormal beats which may cause VFIB to be detected as a RUN. If this occurs, use the waveform display as the primary indication of condition.
- Some beats may not be recognized as morphologically different from the learned, dominant beat. You may be able to improve performance by changing electrode positions or switching to a lead setting that provides better differentiation between the dominant and abnormal beats.

Abnormal Beats Mis-classified

There are a number of possible situations that might cause beats to be improperly classified (either too many or too few).

- If the message NOISY SIGNAL is displayed, too much noise is present on either one, or both, ECG channels.
- If the message ECG VOLTAGE TOO LOW is displayed, the signal level is below the threshold for QRS detection.
- Some beats are not recognized as being different from the learned dominant beat.

You may be able to improve performance in these cases by changing electrode positions or by switching to a lead setting that provides a better signal or allows abnormal beats to be more clearly differentiated from dominant beats.

No Couplet or Run Alarms

If alarms do not occur as expected, check the following:

- Abnormal in a Row alarm limit may be set too high to generate alarm for couplets. When you wish to be alerted for couplets, set Abnormal in a Row alarm limit to 2.
- Abnormal beat(s) may not meet the classification criteria of 15% prematurity (for the second beat in a couplet or subsequent beats — at 90 BPM — in a run) and R-R intervals of less than or equal to 666 msec. No action is indicated. An Abnormal in a Row alarm (COUPLET or RUN) will not be generated unless both criteria are met.
- Processing may have been suspended or the signal quality may be poor. Resume processing or check electrodes for other causes of a poor signal.

Previous Abnormal Classes Missing in Arrhythmia Review

If you find that previously classified abnormal beats are no longer stored for review, one of the following conditions have occurred:

- The class has been cleared.
- Memory was cleared using the RELEARN key or data was purged during the Admit/Discharge function.
- A module error recovery reset occurred.

Classes Full

The total number of abnormal and couplet classes that can be stored is 12. When the system detects the 13th class, the message CLASSES FULL is displayed with an alert tone (if tone is set to ON). All subsequent alarm events will initiate an alarm, even if classes are full.

A “classes full” condition can be cleared by:

- Merging one or more classes
- Merging one or more trends
- Deleting one or more abnormal or couplet classes



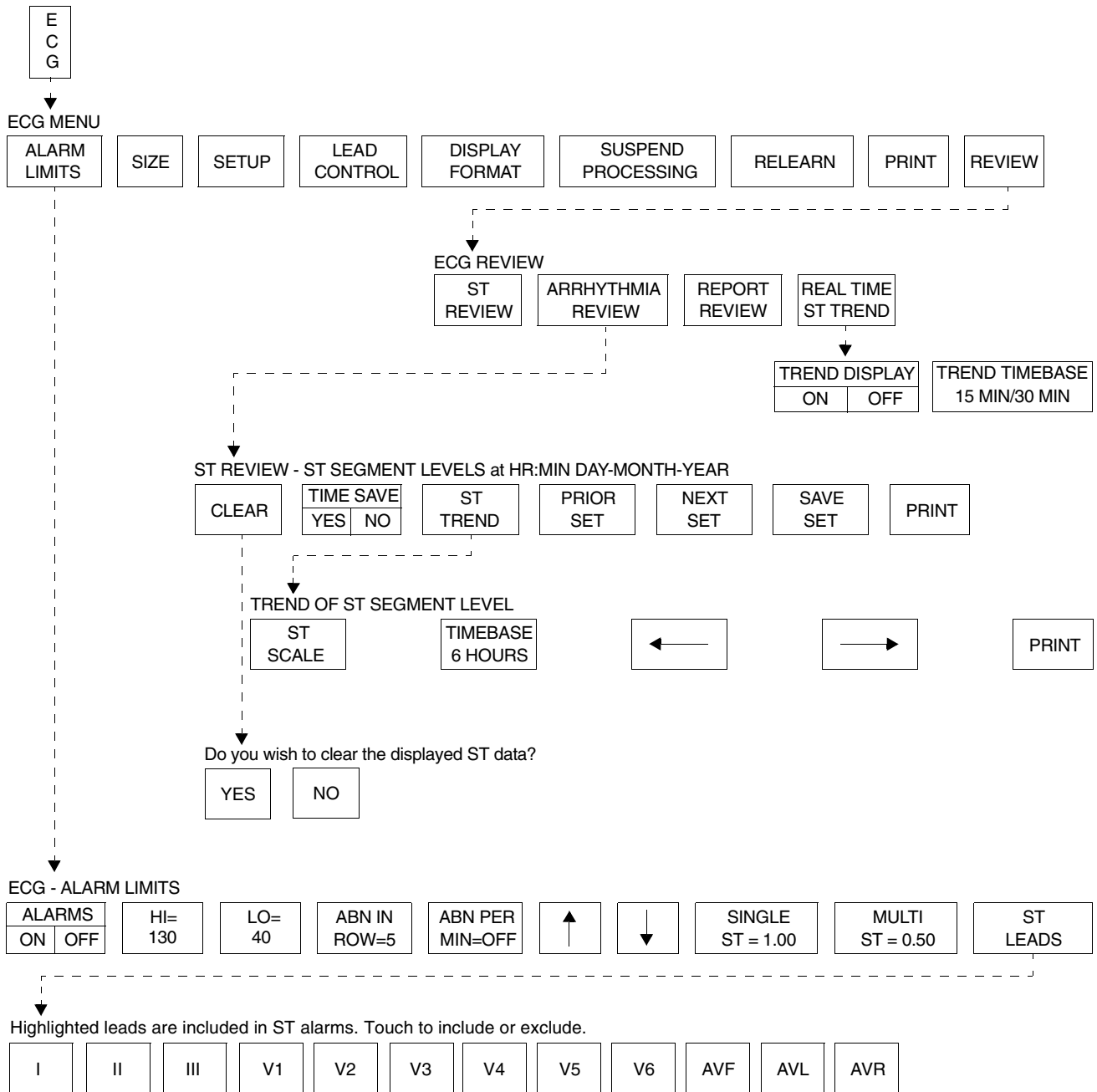
- *All alarm events occurring when classes are full will initiate an appropriate alarm.*

Arrhythmia Troubleshooting Guide

Clinical Situation	Possible Cause	Solution
Abnormal beat not detected	<ul style="list-style-type: none"> ■ Module receiving inadequate signal; NOISY SIGNAL or ECG VOLTAGE TOO LOW messages appear. Noise level is over allowable range, or signal level is below QRS detection threshold. 	<ul style="list-style-type: none"> ■ Make the necessary adjustments to restore good signal. ■ Check all leads to determine a better monitoring lead or select another lead. ■ Remove the cause of the noise.
	<ul style="list-style-type: none"> ■ Some beats not recognized as morphologically different from the learned dominant beat. 	<ul style="list-style-type: none"> ■ No action required; some events that may be diagnosed as abnormal by a skilled clinician may not meet the module's criteria for abnormality.
	<ul style="list-style-type: none"> ■ System has not seen 5 abnormal or 3 couplets of like morphology to generate a class. 	<ul style="list-style-type: none"> ■ No action is required.
	<ul style="list-style-type: none"> ■ Arrhythmia detection is not enabled. 	<ul style="list-style-type: none"> ■ Enable arrhythmia detection through the ECG Setup menu.
False Alarms	<p>NOTE: Careful attention to good monitoring technique, especially setup, will keep false alarms at a low level. If false alarms do occur, however, check the following.</p>	
	<ul style="list-style-type: none"> ■ Noise on the signal caused by poor electrode application is the most common cause of false alarms. 	<ul style="list-style-type: none"> ■ Remove the cause of the noise. ■ Deactivate alarm for the classes that fill up with repetitive artifact; do not clear these classes.
	<ul style="list-style-type: none"> ■ Multiple abnormal classes with atrial fibrillation or flutter waveforms. 	<ul style="list-style-type: none"> ■ Merge the class with the dominant or another abnormal class. ■ Deactivate alarm for these classes, or consider deactivating the ABN PER MIN alarm.
	<ul style="list-style-type: none"> ■ Atrial fibrillation continually triggering TACH alarm. 	<ul style="list-style-type: none"> ■ Consider deactivating TACH alarm.
	<ul style="list-style-type: none"> ■ Limits set too close to patient's heart rate. 	<ul style="list-style-type: none"> ■ Check and adjust the alarm limits.
	<ul style="list-style-type: none"> ■ Amplitude of ECG signal has dropped below threshold of R-wave detector. 	<ul style="list-style-type: none"> ■ Reposition electrodes and relearn patient's rhythm.

ST Analysis Directory

Directory of Keys



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

ST Analysis

Contents

Overview	3
Display Detail	4
Setting Up ST Monitoring	5
Adjusting Alarms	5
Selecting Leads for ST Alarms	7
Reviewing ST Data	8
Clearing ST Data	8
Viewing ST Trends	9
Selecting the ST Trend Timebase	9
Printing ST Data	10
ST Analysis Troubleshooting Guide	11

Overview

The ST analysis function monitors changes to the ST segment level.



- *The significance of ST changes can only be determined by a clinician.*
- *The value of ST segment measurements may be affected by:*
 - *wide complex QRS's (for example, bundle branch block).*
 - *Wolff-Parkinson-White (WPW) syndrome.*
 - *fusion beats classified as dominants.*

Since the ST segment is composed of frequencies at the lower end of the frequency range (0.05 Hz), the system automatically analyzes the ST segment at 0.05 Hz regardless of whether the display mode is set to monitor or extended.

ST segment analysis starts during the ECG learn sequence. Based on the dominant waveform, the PR (isoelectric), J, and ST points are automatically identified for each beat. The amplitude difference between the ST point and the PR point is referred to as the ST segment level.



- *You can define your own default settings for alarm limits. Refer to Default Alarm Limits on page 2-3 for further details.*

Display Detail

The current ST segment level is displayed for all leads to the right of the ECG parameter key in the split view and the full view modes. Question marks (???) are displayed when the current ST segment level is not available, or as OFF when the lead is not connected.

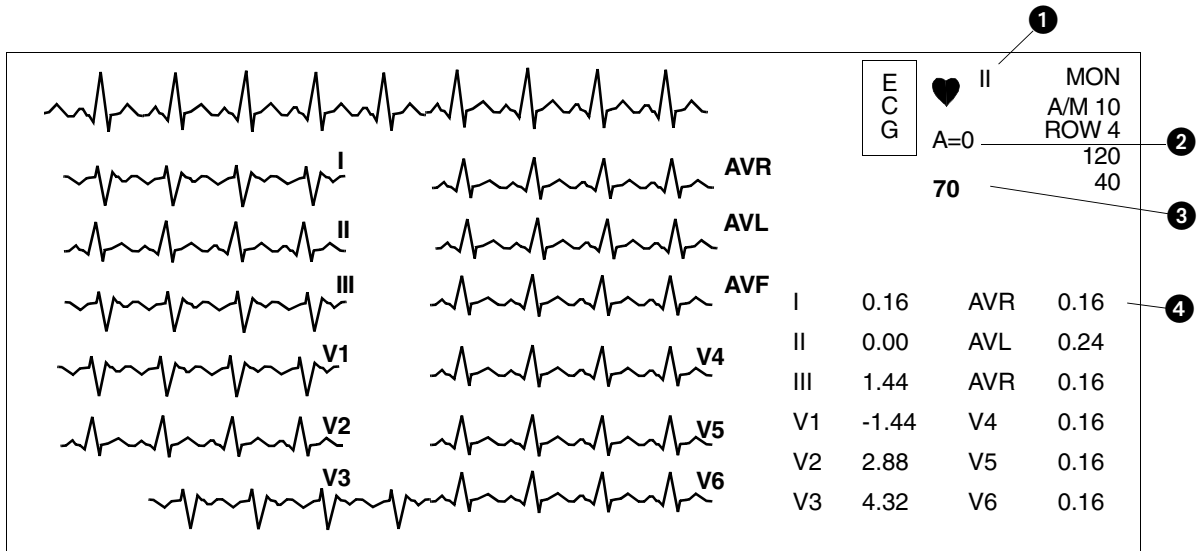


Figure 10-1: ST segment display (full view)



Figure 10-2: ST segment display (split view)



Figure 10-3: Real-time ST trend display

- 1 ECG lead designator
- 2 Abnormals per minute counter
- 3 Current heart rate
- 4 ST segment levels (updates at 30-second intervals)
- 5 ST segment level (single lead); asterisk indicates ST alarms are enabled
- 6 Real-time ST trend
- 7 Amplitude scale in millivolts
- 8 Time scale - either 15- or 30-minutes

Setting Up ST Monitoring

To set up ST monitoring:

- 1 Set up system and patient for standard ECG monitoring.
- 2 Touch ECG.
- 3 Touch SETUP.
- 4 Touch CONFIG.
- 5 Select ADULT.

ST analysis is performed on all available ECG leads, even if they are not currently displayed. Setup for ST monitoring is the same as for ECG monitoring. Refer to *ECG* on page 8-1 for setup details.



- *ST Analysis and Review functions are only available in the adult mode in modules with the ST option.*

Adjusting Alarms

To set or adjust ST alarms:

- 1 Touch ECG.
- 2 Touch ALARM LIMITS.
- 3 Select SINGLE ST or MULTI ST.
- 4 Use arrow keys to adjust.

You can adjust alarm limits in increments of 0.25 mm as needed for both single lead ST and multiple lead ST.

ST alarms can be activated manually or automatically once the system has acquired an ST segment measurement. Typically, the system acquires this data within 30- to 60-seconds after completion of the learn sequence.



- *Disabling ECG alarms also disables ST alarms.*

The SINGLE ST alarm allows you to monitor for localized changes that may only be detectable in a single lead. An ST alarm for a SINGLE LEAD will activate if the ST level for *any* one lead exceeds the SINGLE ST alarm limit, with respect to its current reference level.

The factory default setting for the single lead ST alarm limit is 1.00 mm.

The MULTI ST alarm allows you to monitor for global changes that may be detectable in multiple leads. An ST alarm for MULTIPLE LEADS will activate if the ST level for three or more leads exceeds the MULTI ST alarm limit, with respect to each lead's current reference level.

The factory default setting for the multi-lead ST alarm limit is 0.50 mm.



- The MULTI ST alarm limit cannot be set above the SINGLE ST alarm limit if both alarms are enabled.

At the time that ST monitoring is initiated, the current reference level for all leads is set to 0.00 mm (isoelectric). A SINGLE ST alarm will activate if any lead has an initial ST level that exceeds the SINGLE ST alarm limit. Or, a MULTI ST alarm will activate if three or more leads have initial ST levels that exceed the MULTI ST alarm limit.

Whenever a SINGLE or MULTI ST alarm is activated, the reference level for all leads is automatically reset based on each lead's current ST level. This allows changes in ST levels to be dynamically tracked throughout the patient's course of treatment.

As shown in *Figure 10-4: ST segment alarm function*, when the patient's ST segment trend line rises and violates the first alarm threshold, a new baseline and a new upper alarm threshold are established (the amount of change needed to set off another alarm is denoted by Delta). The lower alarm threshold remains unchanged. Though the patient's ST segment continues to climb, it does not reach the new alarm threshold, so a new upper limit is not set. When the ST level declines, the alarm threshold also declines until the original alarm thresholds are re-established. As the patient's ST level continues to decline, a new threshold is established when an alarm condition occurs.

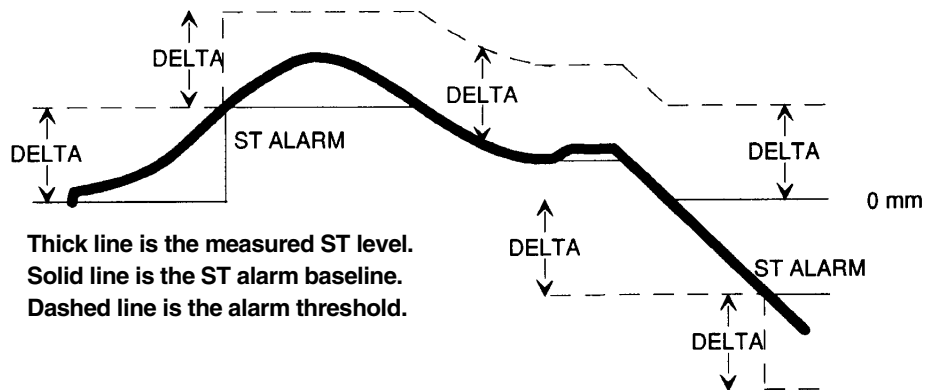


Figure 10-4: ST segment alarm function

As a second example, assume the SINGLE ST alarm is set at 1.00 mm. The initial ST amplitude for a particular lead is +0.60 mm. Based on the initial reference level of 0.00 mm, an alarm would activate if the ST level exceeds +1.00 mm. Therefore, no alarm occurs. Instantaneously, the ST level increases to +1.20 mm. SINGLE ST alarm occurs and the new reference level for the lead is set to +1.20 mm. The next ST alarm for that lead, assuming no changes are made in other leads, would be activated at +2.20 mm.

Selecting Leads for ST Alarms

To select or deselect leads for ST alarms:

- 1 Touch ECG.
- 2 Touch ALARM LIMITS.
- 3 Touch ST LEADS.
- 4 Select or deselect leads.

Touching the ST LEADS key allows you to select which leads are to be used to generate ST alarms. Leads that are not clinically relevant for a patient can be disabled to allow tighter limits to be placed on more clinically significant leads.

All highlighted leads will be used to generate ST alarms.

The factory default setting is all leads included.

Displaying Real-Time ST Trends

To display a real-time ST trend:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch REAL TIME ST TREND.
- 4 Select ON.
- 5 Select TREND TIMEBASE of 15- or 30-minutes.

To facilitate the assessment of short-term changes in ST-segment levels, measurements for a single lead can be displayed as a real-time trend.

The amplitude scale for the trend display is dynamically adjusted to show the maximum and minimum values for the selected time scale.

The time scale for the trend display is user-selectable — either 15-minutes or 30-minutes.

Trend data is continuously updated at 3-second intervals.

Reviewing ST Data

To review ST data:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch ST REVIEW.

Use the ST Review menu to display and review ST segment data. A snapshot of ST segments for all available leads is displayed. The time and date of the ST snapshot is displayed on the menu prompt line. Touch the PRIOR SET or NEXT SET key to display ST data at other time points. *Figure 10-5* is an example of a ST segment snapshot.

Nine ST snapshots can be stored for display. The oldest ST snapshot, not marked as SAVED, will be deleted to make room to store a new snapshot. To save an ST snapshot, touch the SAVE SET key.

ST snapshots are automatically stored whenever an ST alarm occurs or at pre-selected time intervals. To store the ST snapshots at periodic intervals, select TIME SAVE YES. Available intervals are 5-, 10-, 15-, 30- or 60-minutes (only available in the Module Configuration Manager).

The factory default setting for the time save interval is 15-minutes.

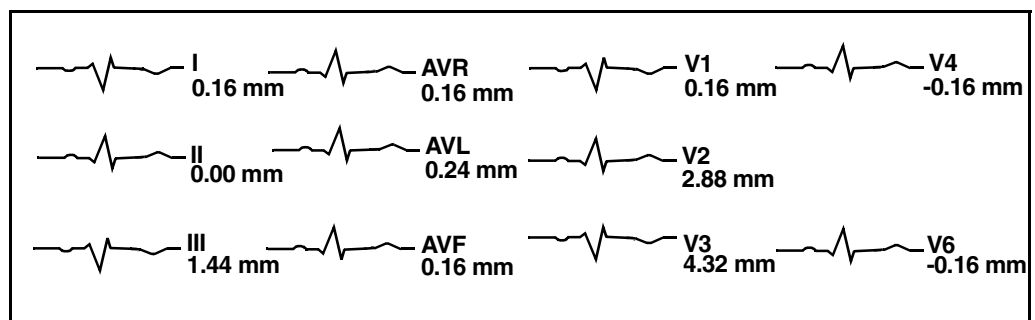


Figure 10-5: ST segment display

Clearing ST Data

To clear the displayed ST data:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch ST REVIEW.
- 4 Touch CLEAR.
- 5 Select YES.

Touching the CLEAR key and then confirming your choice by selecting YES clears the currently displayed data for all leads from memory. Data is also cleared from the trends.

Viewing ST Trends

To view ST trends:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch ST REVIEW.
- 4 Touch ST TREND.
- 5 Touch the trend plot near the desired data point. Then use arrow keys to adjust the cursor position.

Trends showing deviations in ST segment level are displayed for each lead monitored in the past 24-hours. Touching the trend graph or one of the arrow keys in the menu produces a cursor on the baseline of the trend plot. Position this cursor at a point of interest in the trend to determine the ST segment level for all displayed leads at that time. A measurement for each lead is displayed in the table to the right of the trend display.

Figure 10-6: ST trend display shows an example of a trend display. The graph plots deviations in ST segment level over time.

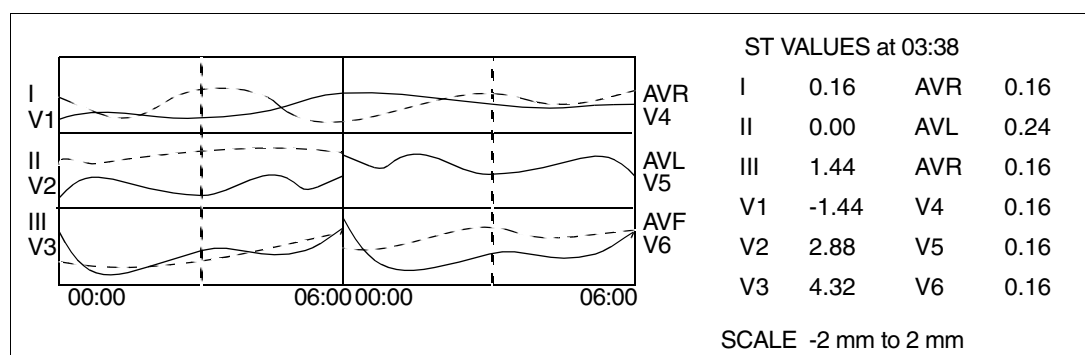


Figure 10-6: ST trend display

Selecting the ST Trend Timebase

To select a timebase:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch ST REVIEW.
- 4 Touch ST TREND.
- 5 Select TIMEBASE of 1.5-, 3-, 6-, 12-, or 24-hours.

You can select the time period over which the ST data is displayed in a trended format. Resolution for each timebase is shown below.

Resolution	Timebase
30-seconds	1.5-hours
1-minute	3-hours
2-minutes	6-hours
4-minutes	12-hours
8-minutes	24-hours

Available timebases are 1.5-, 3-, 6-, 12-, or 24-hours. The factory default setting for the ST trend timebase is 6-hours.

Printing ST Data

To print all ST segment data:

- 1 Touch ECG.
- 2 Touch PRINT.
- 3 Touch ST SEGMENTS.

To print selected ST segments:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch ST REVIEW.
- 4 Touch PRINT.

To print the current trend data:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch ST REVIEW.
- 4 Touch ST TREND.
- 5 Touch PRINT.

Printouts of ST segment data are annotated with the following:

- Bed identification
- Time and date of the printout
- Lead designator

ST segment waveforms can be printed from either the PRINT or ST REVIEW menu.

To print *all* the available ST segment waveforms, use the PRINT menu.

To print only *selected* ST segment waveforms or ST trends, use the ST REVIEW menu.



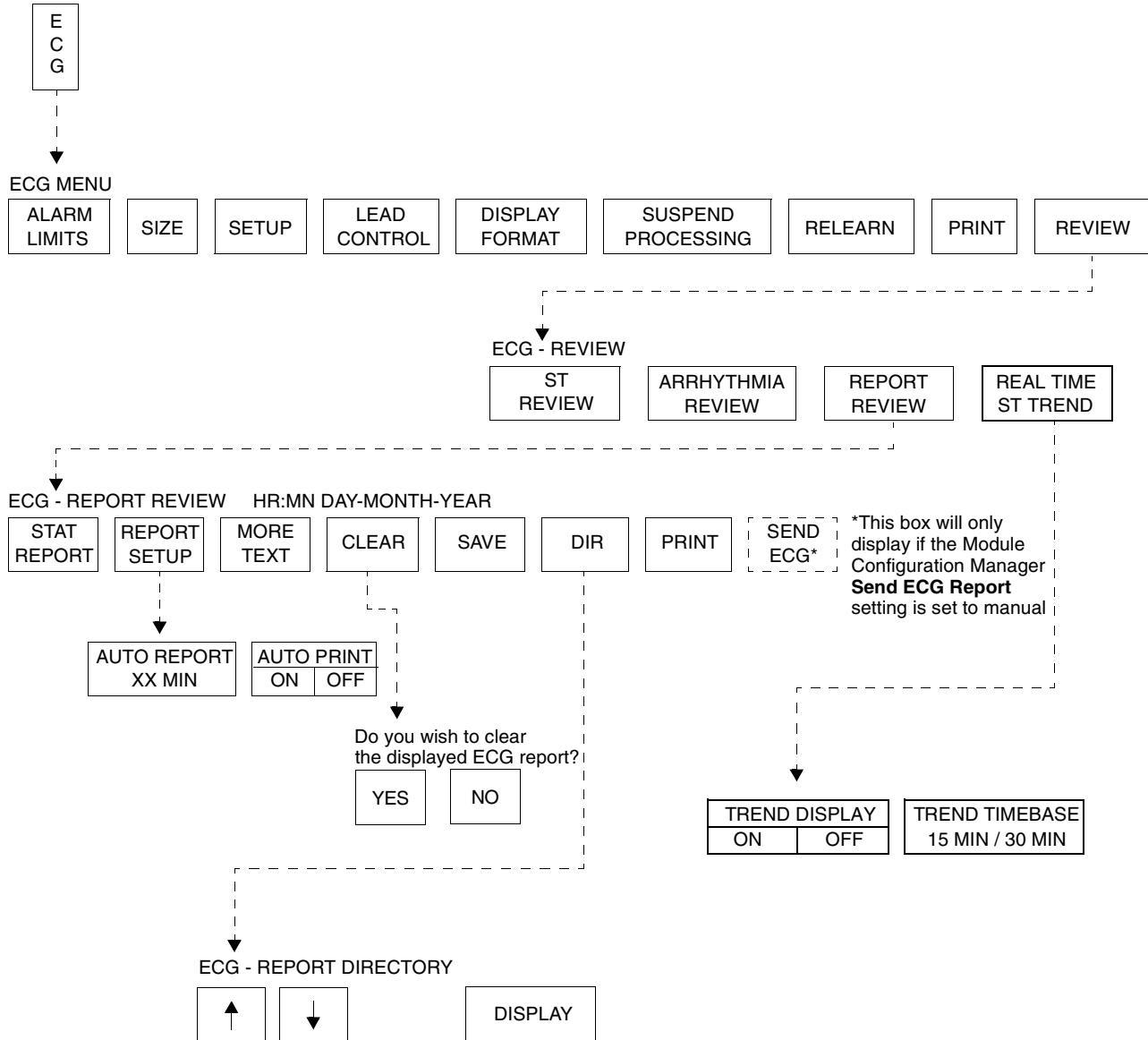
- *ST Segment data cannot be printed with the 90449 printer module.*

ST Analysis Troubleshooting Guide

Clinical Situation	Possible Cause	Solution
No access to ST analysis functions	<ul style="list-style-type: none">■ The system must learn the ST segment level before it can provide access to ST analysis functions.	<ul style="list-style-type: none">■ Wait until the system analyzes sufficient QRS complexes to calculate the ST segment level (approximately one minute).
ST = ?? is displayed	<ul style="list-style-type: none">■ Infrequent occurrence of dominant beats.■ ECG amplitude may be insufficient to detect QRS complexes.	<ul style="list-style-type: none">■ ST analysis not performed on paced, premature dominant or abnormal beats.■ Check QRS amplitude.

12-Lead Diagnostics Directory

Directory of Keys



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

12-Lead Diagnostics

Contents

Directory of Keys	1
Overview	3
Display Detail	4
Initiating a 12-Lead Report	4
Automatic Scheduling of 12-Lead Reports	5
Saving and Clearing 12-Lead Reports	5
Sending 12-Lead Reports	5
Report Directory Display	6
Patient Demographics	6

Overview

The 12-lead report function acquires and displays 12 ECG vectors in the same format as an electrocardiograph.

Diagnostic electrocardiographic devices obtain conventional ECG signatures that accurately represent both the detailed waveforms in each cardiac cycle and the beat-to-beat variability to determine cardiac rhythm. Prior to analysis, the ECG data is split into two different paths: one to the module's monitoring functions and the other to the diagnostic functions. The ANSI/AAMI specifications for diagnostic electrocardiographic devices, as required by the data in the diagnostic path, is acquired at 500 samples per second.

The output from both the monitoring and diagnostic functions are combined and transferred to the bedside monitor for display and distribution to the Ultraview Care Network.



- *No automated analysis is completely reliable. A physician should read all ECG results.*
- *Special problems exist with pediatric ECGs because of the considerable differences in the signal characteristics of adult and infants and because of the evolution of the ECG patterns from birth to adolescence.*
- *Digital systems produce a noticeable modulating effect from one cycle to the next, particularly in pediatric ECGs. This phenomenon, which is not physiologic, is due to the asynchronism between data acquisition sample rate and the peak of the QRS waveform.*

Display Detail

The 12-lead report display shows 2.5-seconds of waveform data per lead. Presentation of the leads may be in a standard format (refer to *Figure 11-1*) or the Cabrera format. When analysis is complete, measurements and diagnostic statements are displayed above the waveform data (requires option D).

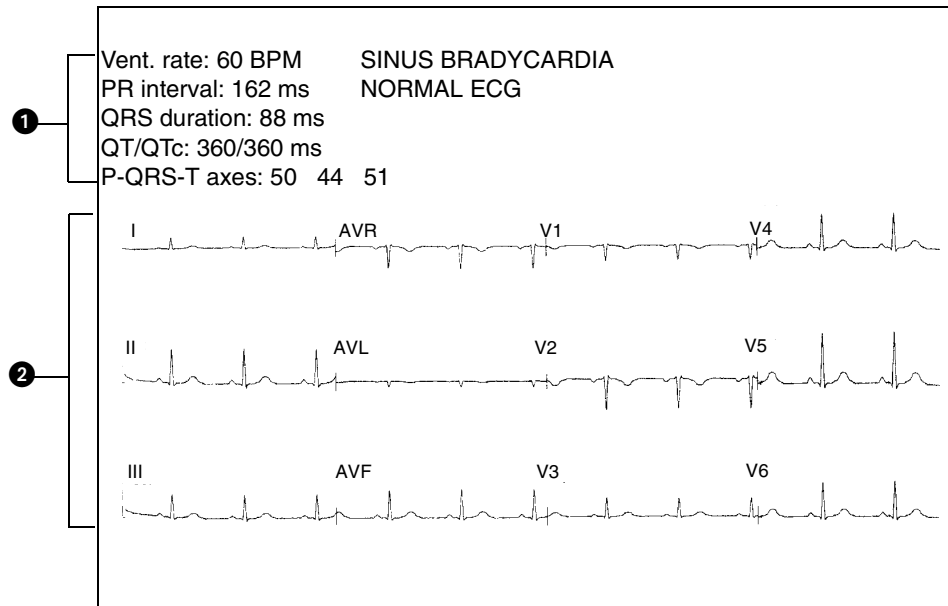


Figure 11-1: 12-lead report display

- ❶ Measurement and interpretation data (requires Option D)
- ❷ ECG traces for 12 leads (2.5-seconds/lead)

Initiating a 12-Lead Report

To initiate a 12-lead ECG report:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch REPORT REVIEW.
- 4 Touch STAT REPORT.

You can acquire a 12-lead report by touching STAT REPORT. Initiating a STAT REPORT will not affect the automatic schedule.



- When monitoring paced patients, ECG processing and the pacepulse detection function will be suspended for 10-seconds whenever acquisition of an ECG report is in process. Temporarily suspending these functions allows the actual pacepulse to be displayed/printed in the 12-lead report without interfering with arrhythmia analysis.
- If the STAT REPORT key is labeled LEADS OFF, one or more of the 12 leads is disconnected. Check all electrode connections before proceeding.

Automatic Scheduling of 12-Lead Reports

To schedule 12-lead ECG reports:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch REPORT REVIEW.
- 4 Touch REPORT SETUP.
- 5 Select AUTO REPORT OF 30-minutes, 1-hour, 2-hours, 4-hours, 8-hours, or 24-hours.
- 6 Touch AUTO PRINT ON or OFF.

12-lead reports can be acquired automatically by selecting an interval time using the AUTO REPORT key. User-selectable intervals include 30-minutes or 1-, 2-, 4-, 8-, or 24-hours. Selecting OFF will disable this feature.

12-lead reports can be printed as they are acquired by selecting AUTO PRINT ON, or saved in memory for review and printing at a later time by selecting AUTO PRINT OFF.

Touching the PRINT key at any time will print the displayed diagnostic report.



- *Automatic 12-lead reports are inhibited whenever the ECG signal is not of sufficient quality to produce a diagnostic report.*

Saving and Clearing 12-Lead Reports

To save/clear a 12-lead ECG report:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch REPORT REVIEW.
- 4a Touch SAVE (while the report is displayed).
- OR-
- 4b Touch CLEAR (while the report is displayed).
- 4c Touch YES to confirm (for CLEAR only).

All 12-lead reports are stored in the module's memory. The module can store multiple 12-lead reports (the exact number depends upon the ECG waveforms). When the module's report memory is full, the oldest report that has not been saved is replaced by the newest report.

To retain the currently displayed report in memory indefinitely, touch the SAVE key.

To clear the currently displayed report from memory, touch the CLEAR key and then confirm your choice by selecting YES.



- *If your monitoring system is interfaced to an ECG Management System and you are using a single module to acquire 12-lead reports at multiple bedsides, clear the 12-lead report(s) from memory before proceeding to the next patient's bedside.*

Sending 12-Lead Reports

To manually send 12-lead ECG reports:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch REPORT REVIEW.
- 4 Touch SEND ECG.

12-lead ECG reports can be manually sent to an ECG Management System as they are acquired. To establish this as the default, use the **Send ECG Report** feature in the Module Configuration Manager and change the user setting to Manual. Refer to *Table 1 ECG Parameter Configuration on page 7-9* for more information.

If you select Manual, all reports are sent only to an ECG Management System when you touch SEND ECG.



- *The SEND ECG key is not displayed if the Send ECG Report feature is set to Automatic.*
- *The default setting is Automatic.*

Report Directory Display

To view directory of 12-lead ECG reports:

- 1 Touch ECG.
- 2 Touch REVIEW.
- 3 Touch REPORT REVIEW.
- 4 Touch DIR.

Touching the DIR key will display a directory of 12-lead reports. The time and date of each report is shown with the summary diagnosis.

Use the arrow keys to select the report of interest, then touch the DISPLAY key to display the selected diagnostic report.

Reports that have been saved will be marked as YES in column three.



- A summary statement (column 4) is only displayed if option D is present.

TIME	DATE	SAVED	DIAGNOSIS
1:00	28 AUG	YES	ABNORMAL ECG
1:30	28 AUG		NORMAL ECG
2:00	28 AUG		NORMAL ECG
2:30	28 AUG		NORMAL ECG
3:00	28 AUG	YES	ABNORMAL ECG
3:30 AM	28 AUG	YES	NORMAL ECG

Figure 11-2: Report directory display

Patient Demographics

The patient's gender, date of birth, height, and weight are required by the diagnostic ECG algorithm. This information is entered via the patient Admit function.

If patient demographic information is not entered, the diagnostic ECG algorithm will use the following defaults:

Table 1: Patient Demographic Default Values

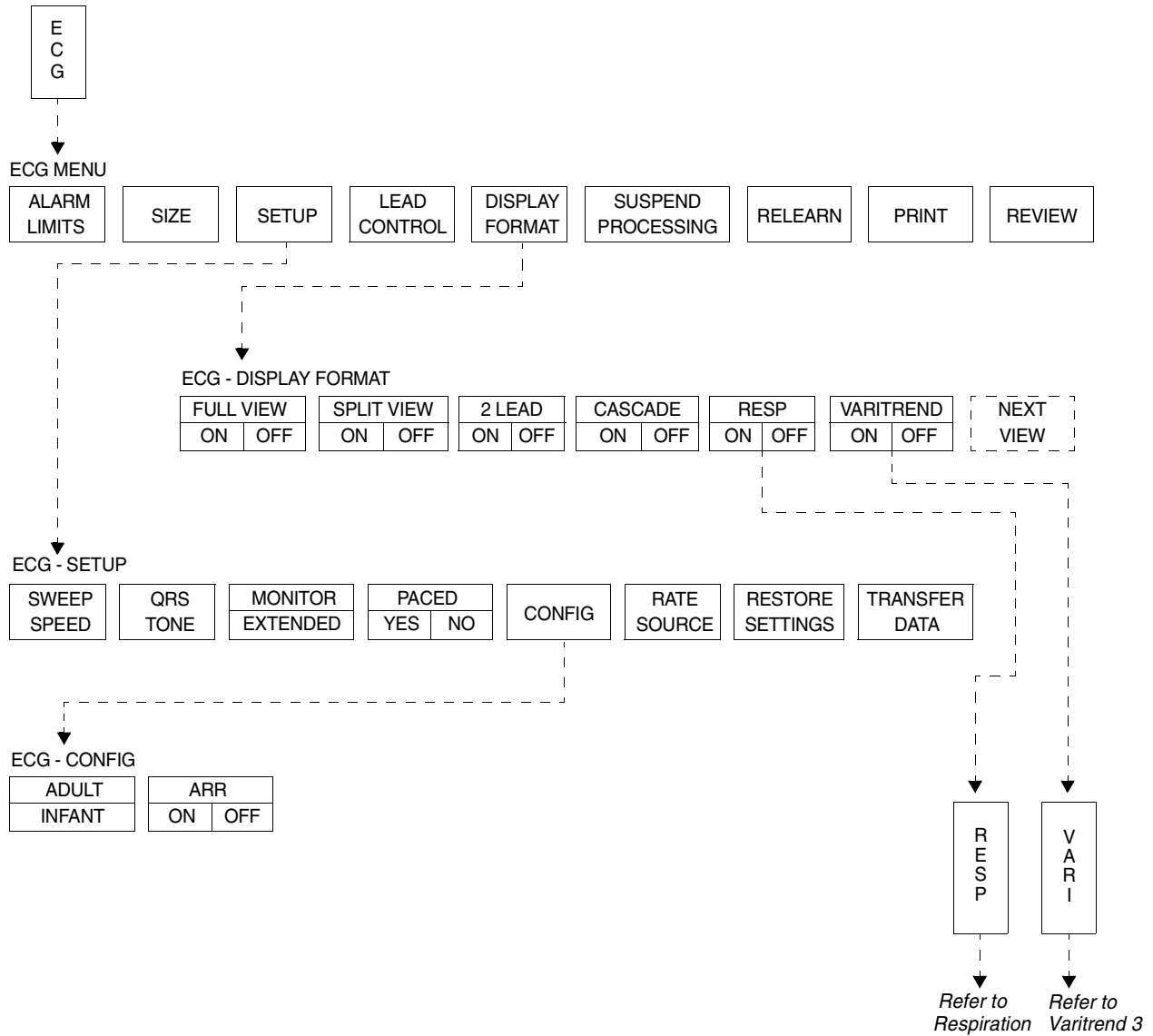
Demographic	Default Value
Date of Birth	40 years
Gender	Male
Height	5'10"
Weight	180 lbs



- For an accurate diagnosis, the patient's demographics must be entered correctly.

Respiration Directory

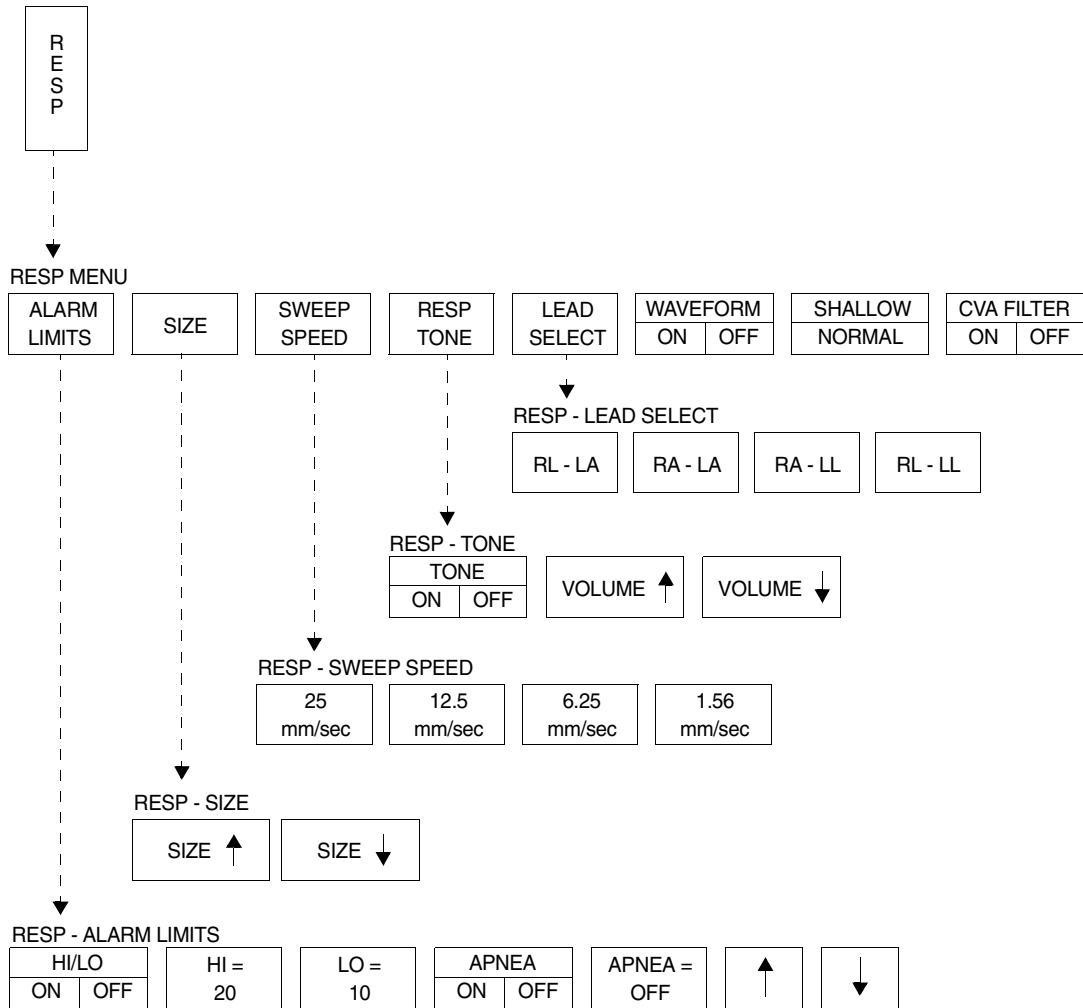
Directory of Keys - ECG



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

Respiration Directory

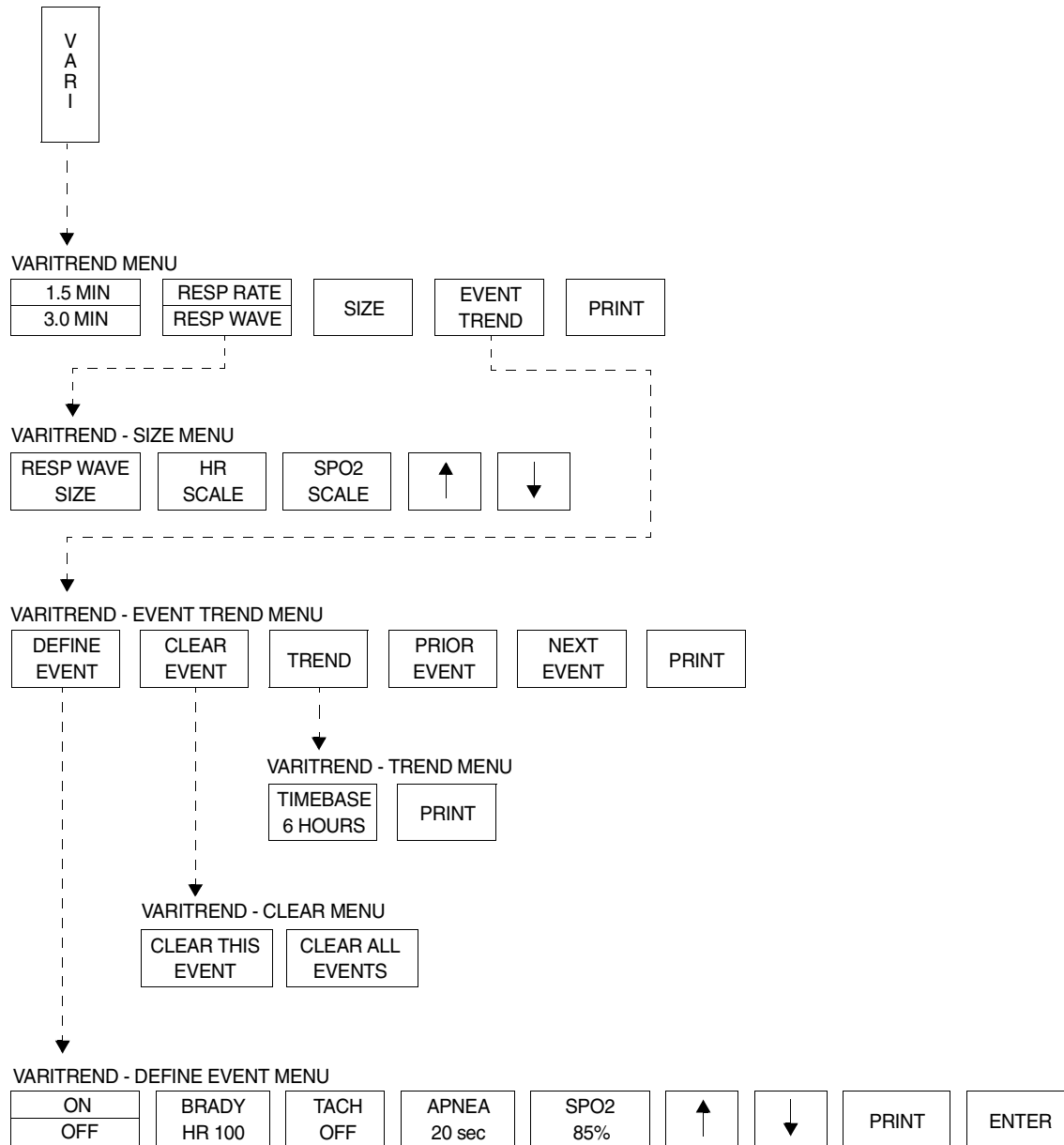
Directory of Keys - Respiration



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

Respiration Directory

Directory of Keys - Varitrend 3



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

Contents

Overview	5
Setting Up Respiration Monitoring	6
Display Detail	6
Selecting Adult or Infant Mode	7
Setting and Adjusting Alarms	7
Turning Respiratory Waveform On/Off	8
Adjusting Waveform Size	8
Adjusting Sweep Speed	8
Adjusting Respiration Tone	8
Selecting Respiration Leads	8
Adjusting Respiration Sensitivity	9
Using the Cardiovascular Artifact Filter	9
Restoring User-Defined Settings	10
Recording Respiration Waveforms	10
Configuring Varitrend 3 Graphs	10
Printing Varitrend 3 Graphs	13
Respiration Troubleshooting Guide	14

Overview

The respiration function detects and displays a waveform that:

- represents each breath.
- provides the respiration rate.
- detects and rejects cardiovascular artifact.
- initiates alarms when limits are violated for either the respiration rate or apnea.

Changes in thoracic impedance during patient inspiration and expiration provide respiration data through the use of the ECG cable. Lead selection for respiration is independent of lead selection for ECG, even though both receive data from the same electrodes.

Varitrend 3, an optional feature in some modules, generates a graph that plots heart rate, SpO₂, and respiratory rates. You can view this plot on the monitor or print it on a system or bedside printer.

The Event Trend feature of Varitrend 3 enables you to screen for apparent life threatening events such as bradycardia, with desaturation, or apnea accompanied by a change in heart rate. This feature plots bradycardia, tachycardia, apnea and desaturation trends for viewing and printing. A 24-hour trend of events is maintained and up to 48 events are stored in memory. Refer to *Configuring Varitrend 3 Graphs* on page 12-10 for more details.



- You can define your own default settings for alarm limits and the display configuration. Refer to *Setting User-Defined Default Values* on page 7-7 for further details.

Setting Up Respiration Monitoring

To set up respiration monitoring:

- 1 Attach the patient ECG leads.
- 2 Plug the ECG cable into the module's ECG input.
- 3 Touch ECG.
- 4 Touch DISPLAY FORMAT.
- 5 Select RESP ON.
- 6 Touch RESP.
- 7 Select additional keys as necessary.

Refer to the *Directory of Keys - Respiration* on page 12-2 for a flow diagram of respiration keys and menus.



- If the RESP ON/OFF key does not appear in the ECG Display Format menu, your module does not include the respiration option.
- The RESP key must be ON in the ECG Display Format menu to display the RESP parameter key.



CAUTION:

- If you suspend ECG processing using the SUSPEND PROCESSING key in the ECG menu, you also suspend respiration processing.

Display Detail

Respiration appears on the monitor in the following format:

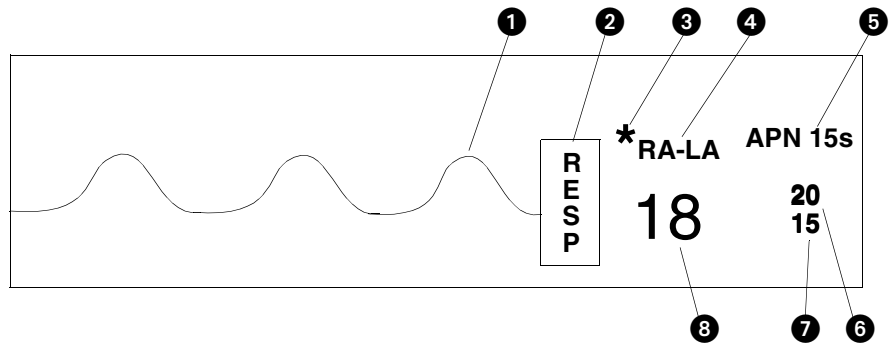


Figure 12-1: Respiration display

- 1 Respiration trace
- 2 Respiration parameter key
- 3 Respiration indicator (flashes once per detected breath)
- 4 Selected lead for respiration
- 5 Apnea alarm limit in seconds
- 6 High respiratory rate alarm limit
- 7 Low respiratory rate alarm limit
- 8 Current respiratory rate

Selecting Adult or Infant Mode

To specify the patient type:

- 1 Touch ECG.
- 2 Touch SETUP.
- 3 Touch CONFIG.
- 4 Select ADULT or INFANT.

The respiration function provides both adult and infant operational modes to optimize monitoring accuracy.

When you select adult or infant, RESP alarm limits and breath detection sensitivity are adjusted based upon your selection.



CAUTION:

- When the system is in the infant mode, respiration alarm activation can be delayed for up to 3-minutes. (The factory default setting for alarm delay is 3-minutes.) Closely observe the patient during this period.

Setting and Adjusting Alarms

To set or adjust rate alarms:

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

The factory default setting for respiratory rate alarms is OFF in the adult mode and ON in the infant mode. Once respiratory alarms are enabled, the factory default settings are as follows:

	High Rate	Low Rate
Adult	150% of learned rate; not below 30 breaths/minute	0 breaths/minute
Infant	100 breaths/minute	10 breaths/minute

To set or adjust apnea alarms:

- 1 Touch RESP.
- 2 Touch ALARM LIMITS.
- 3 Select APNEA ON.
- 4 Touch APNEA=.
- 5 Use arrow keys to adjust.

The factory default setting for apnea alarms is OFF in the adult mode and ON in the infant mode. When active, the factory default setting is 20-seconds in both modes. The apnea alarm setting is adjustable from 5- to 40-seconds, or the alarm can be disabled.

Refer to *Setting Alarm Limits* on page 2-4 for details on system alarm operation.



- If the alarm limit for high rate or low rate is displayed in reverse video, the alarm tone, alarm recording, and alarm watch have been disabled.

Apnea Alarms

Apnea alarm limit is the maximum duration allowed between breaths before the respiration rate is set to zero. The apnea alarm limit may be set from 5- to 40-seconds in 5-second increments.

- If the APNEA ALARM is turned ON, the APNEA ALARM will sound after the apnea limit is reached.
- If the APNEA ALARM is turned OFF, the respiration rate will be set to zero after 20-seconds or when the apnea alarm limit is reached, whichever is greater. If the low rate alarm is ON, it will sound 10-seconds after the rate is set to zero.

To turn the respiration waveform display ON or OFF:

- 1 Touch RESP.
- 2 Select WAVEFORM ON/OFF.

To adjust respiratory waveform size:

- 1 Touch RESP.
- 2 Touch SIZE.
- 3 Adjust waveform size using SIZE ↑ or SIZE ↓.

To select a respiration sweep speed:

- 1 Touch RESP.
- 2 Touch SWEEP SPEED.
- 3 Touch the appropriate mm/sec key.

To adjust the respiration tone volume:

- 1 Touch RESP.
- 2 Touch RESP TONE.
- 3 Select TONE ON.
- 4 Adjust tone volume using VOLUME ↑ or VOLUME ↓.

To select respiration leads:

- 1 Touch RESP.
- 2 Touch LEAD SELECT.
- 3 Select the appropriate lead configuration.

Turning Respiratory Waveform On/Off

You may choose to turn the respiration waveform OFF and display only the respiration numeric values.

The factory default setting for respiration waveform is ON.

Adjusting Waveform Size

You can increase or decrease the size of the respiration waveform display. This changes the displayed size only, and does not affect the signal gain or breath detection sensitivity.

Adjusting Sweep Speed

The sweep speed determines the rate at which the respiration waveform moves across the screen. Sweep speed selections are 25, 12.5 (factory default), 6.25, or 1.56 mm/sec.

Adjusting Respiration Tone

You can select an audible tone to sound with each respiratory cycle. The tone volume is adjustable or can be disabled.

The factory default setting for tone is OFF.

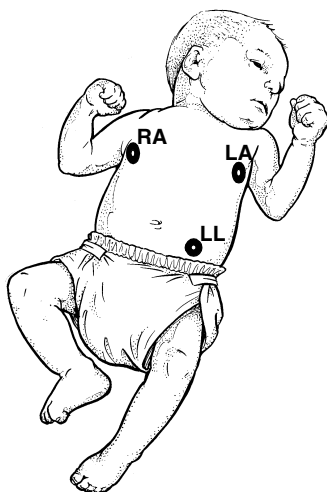
Selecting Respiration Leads

Respiration lead selections are RL-LA, RA-LA, RA-LL, and RL-LL.

- RA-LA represents the line of maximum respiratory effort in adults and chest-breathing infants.
- RA-LL represents the line of maximum respiratory effort in abdominal-breathing infants.
- The factory default setting for respiration lead selection is RA-LA.



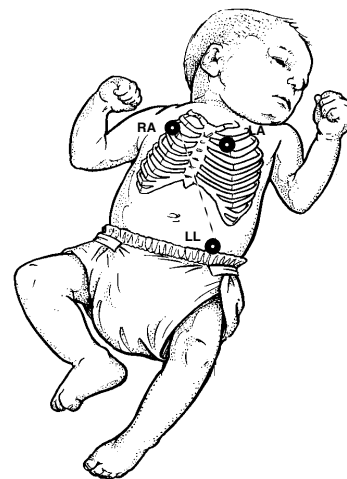
- *When a good respiration signal cannot be attained from the selected lead, the message LOSS OF SIGNAL is displayed and ??? appears in place of the respiratory rate.*



Maximum Impedance Change:

Position RA and LA electrodes at the nipple level, midaxillary line.

Position LL below the diaphragm, preferably below the umbilicus.



Alternate Method:

Position RA and LA electrodes at the 2nd intercostal space, midclavicular line.

Position LL below the diaphragm, preferably below the umbilicus.

Figure 12-2: Infant electrode placement

Adjusting Respiration Sensitivity

To adjust respiration monitoring sensitivity:

- 1 Touch RESP.
- 2 Select SHALLOW or NORMAL.

Two input sensitivities for respiration monitoring are available. You can set them based on the patient's respiratory effort; shallow or normal. Use the shallow mode if the monitor has difficulty counting the respiratory rate and/or the waveform is difficult to read. Selecting the SHALLOW mode also lowers the detection sensitivity nearer to the low amplitude waveform of infants.

The factory default for sensitivity is NORMAL in the adult mode, and SHALLOW in the infant mode.

Using the Cardiovascular Artifact Filter

To enable the CVA filter:

- 1 Touch RESP.
- 2 Select CVA FILTER ON.

Respiration is monitored based on impedance changes which occur with the expansion and contraction of the chest. However, the physical action of the heart pumping blood and the flow of blood through the vasculature also creates changes in impedance known as cardiovascular artifact (CVA).

To disable the CVA filter:

- 1 Touch RESP.
- 2 Select CVA FILTER OFF.

In the absence of respiration, for example, during episodes of apnea, it is possible for a waveform to appear in the respiration zone which represents CVA rather than true respirations. In such cases, the rate of the CVA would be the same as the heart rate.

The Spacelabs Medical CVA detection filter provides a method of discriminating between true respiratory effort and cardiac activity. The filter checks for coincidence between the respiratory and the heart rate. If the rates are the same, the digital display for respiratory rate changes to CVA, a CVA message appears in the waveform zone, and an apnea alarm is triggered if the apnea alarm has been enabled. This minimizes the possibility of apneic episodes being undetected due to CVA. Episodes of CVA will be reflected as a respiratory rate of zero in the trends.

If the patient's respiratory and heart rates are actually identical, you may want to disable the CVA filter.



WARNING:

- ***If you disable the CVA detection filter, you will not be alerted to the presence of CVA if it replaces the respiration waveform.***

Restoring User-Defined Settings

To restore user-defined settings:

- 1 Touch ECG.
- 2 Touch SETUP.
- 3 Touch RESTORE SETTINGS.
- 4 Select YES.

With the Restore Settings feature, you can restore the user-configurable settings to the defaults previously stored as user settings. User-configurable options are listed in *Setting User-Defined Default Values* on page 7-7



- *Module Configuration Manager is an optional feature for some modules. Your module may not contain this option.*
- *RESTORE SETTINGS changes the user-configurable settings for all parameters in the module.*
- *Once restored, alarm ON/OFF status and alarm limits are reset to the previously stored user settings.*

Recording Respiration Waveforms

To print Respiration waveforms:

- 1 Touch RECORD.
- 2 Touch flashing RESP parameter key.

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

Configuring Varitrend 3 Graphs

To turn Varitrend 3 ON or OFF:

- 1 Touch ECG.
- 2 Touch DISPLAY FORMAT.
- 3 Select VARITREND ON or OFF.

In Varitrend 3, trends for heart rate and SpO₂ are displayed in the upper half of the zone. Either the respiration rate trend or the compressed respiration waveform is displayed in the lower half of the zone.



- *If the VARITREND ON/OFF key does not appear in the ECG Display Format menu, your module does not include the Varitrend option.*

To set the horizontal time scale:

- 1 Touch VARI.
- 2 Select 1.5 MIN or 3.0 MIN.

Setting the Time Scale

You can set the time scale for the horizontal axis at either 1.5- or 3.0-minutes.

To select the type of respiratory display:

- 1 Touch VARI.
- 2 Select RESP RATE or RESP WAVE.

Selecting Respiratory Display Type

The lower graph displays the trend for either the respiration rate or the compressed respiration waveform.

- RESP RATE displays the current respiration rate trend.
- RESP WAVE displays a compressed respiration waveform.

To select respiration rate scale:

- 1 Touch VARI.
- 2 Touch RESP RATE.
- 3 Touch SIZE.
- 4 Touch RESP RATE SCALE.
- 5 Use arrow keys to adjust.

Selecting Respiratory Rate Scale

You can adjust the scale for the respiration rate trend. Scale selections include 0-50, 0-100, 0-150, or 0-200 breaths/minute.

To select a respiration waveform:

- 1 Touch VARI.
- 2 Touch SIZE.
- 3 Touch RESP WAVE SIZE.
- 4 Use arrow keys to adjust.

Selecting Respiratory Waveform Size

You can trend a compressed respiration waveform. In this mode, the message RESP WAVEFORM appears next to the vertical axis instead of scale values.

To select heart rate scale:

- 1 Touch VARI.
- 2 Touch SIZE.
- 3 Touch HR SCALE.
- 4 Use arrow keys to adjust.

Selecting Heart Rate Scale

You can plot heart rate. Scale selections include 0-100, 0-150, 0-200, 0-250, 0-300, 50-150, 100-200, 100-250, and 100-300 beats/minute.

To select an SpO₂ scale:

- 1 Touch VARI.
- 2 Touch SIZE.
- 3 Touch SPO2 SCALE.
- 4 Use arrow keys to adjust.

Selecting SpO₂ Scale

You can plot SpO₂. Scale selections include 0-100, 25-100, 50-100, and 75-100%.

To access Event Trend:

- 1 Touch VARI.
- 2 Touch EVENT TREND.

To define an event:

- 1 Touch VARI.
- 2 Touch EVENT TREND.
- 3 Touch DEFINE EVENT.
- 4 Select event(s) to define.
- 5 Use arrow keys to adjust.
- 6 Touch ENTER.

To display event trends:

- 1 Touch VARI.
- 2 Touch EVENT TREND.
- 3 Touch TREND.

To clear events:

- 1 Touch VARI.
- 2 Touch EVENT TREND.
- 3 Touch CLEAR EVENT.
- 4 Select CLEAR THIS EVENT or CLEAR ALL EVENTS.

To print events:

- 1 Touch VARI.
- 2 Touch EVENT TREND.
- 3 Touch PRINT.

To print event trends:

- 1 Touch VARI.
- 2 Touch EVENT TREND.
- 3 Touch TREND.
- 4 Touch PRINT.

Defining Events

The Event Trend feature of Varitrend 3 enables you to store events that represent a change in a patient's condition based on multiple variables. You can define criteria for up to five different events. For example, you may want to store episodes where the heart rate drops to less than 100 bpm, apnea lasts for more than 20-seconds, or the SpO₂ value drops to less than 85%.

The patient's status will be continually checked against each event definition. If any of the criteria are violated, a snapshot of the Varitrend 3 display representing this deviation will be stored. The event will also be added to the event trend.

Displaying Event Trends

Events are trended according to their duration and frequency. Regardless of the defining criteria, all events are plotted (grouped) together in the event trend graph. You can select to view these trends in 6-, 12-, or 24-hour time periods. Resolution for each timebase is shown below (15-minutes for a 6-hour trend, 30-minutes for a 12-hour trend, 60-minutes for a 24-hour trend).

The top trend displays the duration of the longest event in each time period. The bottom trend displays the number of events that occurred during each time period. Scaling, for the vertical axis for each trend, is automatically adjusted based upon patient data.

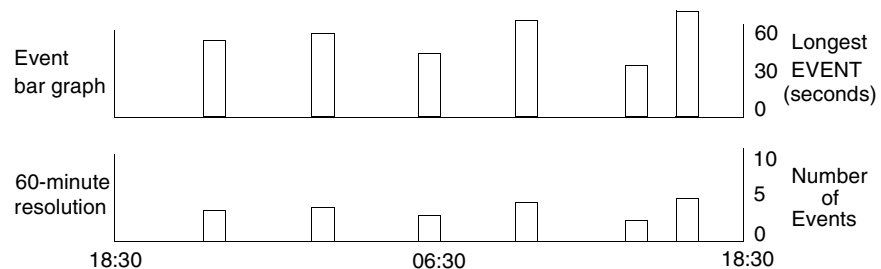


Figure 12-3: Event trend graph



- Events longer than 4-minutes will be reported as 4-minute events.

Clearing Events

If you choose to clear a single event the data that represents that episode will be removed from the event trends. You may also clear all events and trends. This will have no effect on the event definitions.

Printing Varitrend 3 Graphs

To print a Varitrend 3 graph:

- 1 Touch VARI.
- 2 Touch PRINT.

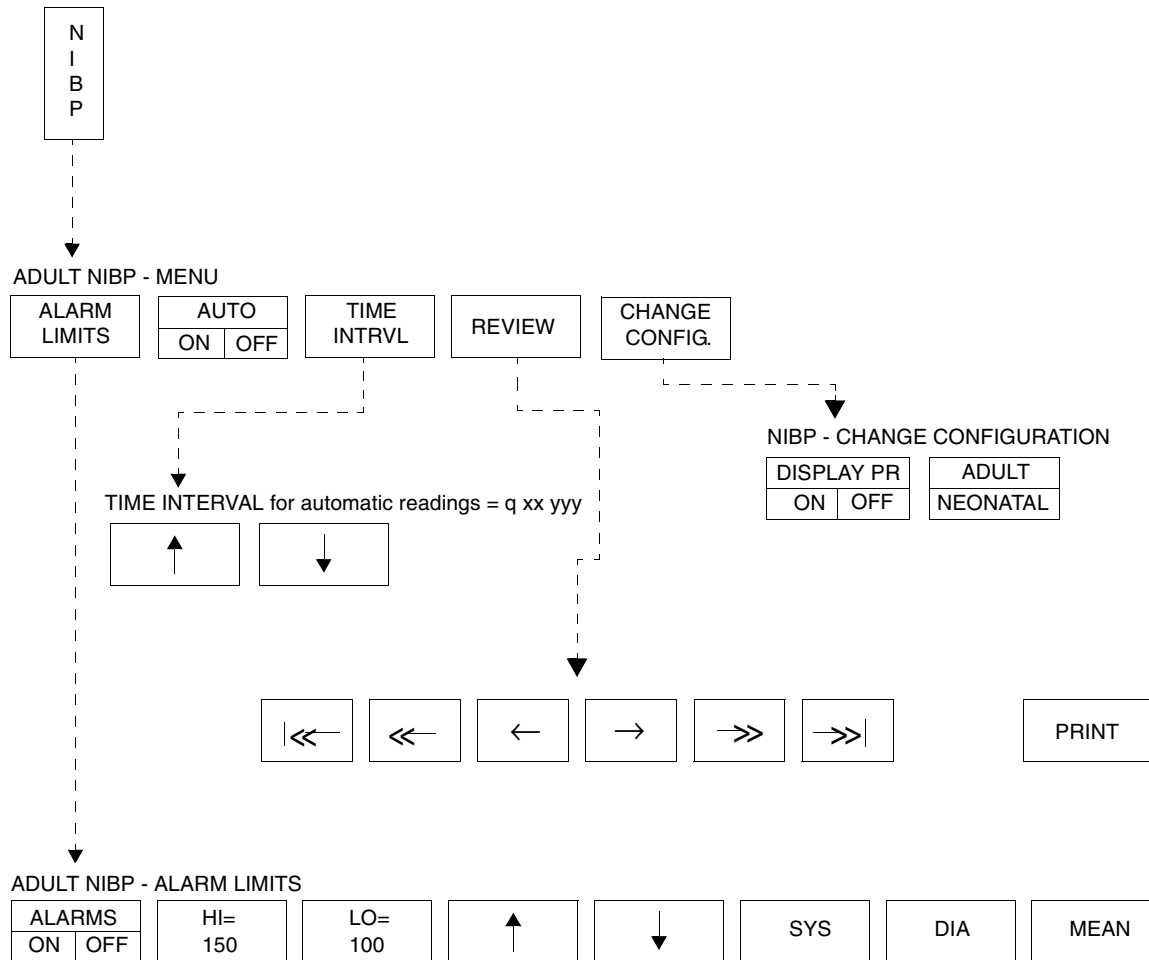
You may produce a recording of the currently displayed Varitrend 3 graph. Refer to *Printing* on page 4-1 for a complete overview of printer functions.

Respiration Troubleshooting Guide

Clinical Situation	Possible Cause	Solution
Inaccurate respiratory rate or 0 displayed. Question marks displayed instead of rate	<ul style="list-style-type: none">■ Respiration too shallow for normal detection.■ ECG electrode contact or placement poor.■ Incorrect lead selection for respiration.■ CVA artifact.	<ul style="list-style-type: none">■ Touch the SHALLOW/NORMAL key to highlight SHALLOW.■ Apply new electrodes. Make sure to properly prepare the skin; position electrodes on the chest where the chest expansion is the greatest.■ Select the appropriate lead. Best lead selection is typically RA-LA for adults and RA-LL for infants.■ Assess the patient for apnea. Reselect lead for better signal quality.
No respiration waveform. LOSS OF SIGNAL message is displayed	<ul style="list-style-type: none">■ ECG electrodes or patient cable not attached.	<ul style="list-style-type: none">■ Select another lead.■ Reconnect the leads or the patient cable.
No respiration waveform is displayed	<ul style="list-style-type: none">■ Channels have not been configured to display respiration.	<ul style="list-style-type: none">■ Select RESP ON in the ECG Display Format menu.

NIBP Directory

Directory of Keys



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

Contents

Overview	3
Setting Up NIBP Monitoring	4
Display Detail	6
Setting and Adjusting Alarm Limits	7
Selecting Adult or Neonatal Mode	8
Displaying Heart (Pulse) Rate Data	8
Initiating a Manual Measurement	8
Setting Automatic Measurements	9
Stopping a Measurement in Progress	9
Recording Measurements	10
Reviewing Measurements	10
Recording Waveforms	10
Restoring User-Defined Settings	10
Status Messages	11
NIBP Troubleshooting Guide	12

Overview

Noninvasive blood pressure (NIBP) uses oscillometric monitoring to measure systolic (S), diastolic (D), and mean (M) arterial blood pressures. The Ultraview Care Network monitor displays these readings and the time the measurement was initiated. You can also display heart rate. The monitor can display up to ten readings at one time and store up to 120 readings.



- *Blood pressure measurements determined with this module are equivalent to those obtained by a trained observer using the cuff/stethoscope auscultation method, within the limits prescribed by the American National Standard, Electronic or automated sphygmomanometers.*
- *Use only cuffs specified by Spacelabs Medical. Other cuffs may adversely affect performance and measurement accuracy.*
- *There are no hazards associated with using non-invasive blood pressure equipment during defibrillation or high-frequency electrosurgery because both the cuff and cuff tubing are non-conductive materials.*
- *You can define your own default settings for such characteristics as alarm limits and display configuration. Refer to Setting User-Defined Default Values on page 7-7 for further information.*

Setting Up NIBP Monitoring

To set up NIBP monitoring:

- 1 Attach the cuff tube to the appropriate module front panel connector.
- 2 Attach the cuff to the patient.
- 3 Touch NIBP.
- 4 Touch additional screen keys as needed.

Proper cuff selection and application is essential in ensuring the accuracy of NIBP readings. To select the proper cuff, first measure the circumference of the limb at its midpoint. Match the limb measurement to the range of appropriate circumferences (in centimeters) specified on each cuff. When applied, the index line on a correctly sized cuff will fall within the designated range markings on the cuff. If the cuff is too wide for the patient, the reading will be falsely lowered. If too narrow, the reading will be falsely elevated. The cuff results in the greatest chance of error, so a variety of cuff sizes should be available to accommodate your full patient population.

The cuff should be snugly applied. When the cuff is properly applied to an adult, you should be able to insert one finger between the cuff and the limb. If you can insert two fingers, the cuff is too loose which may result in falsely elevated readings. Ensure that the inflation tube is not kinked or occluded when the cuff is applied.

During blood pressure measurement, the inflated cuff reduces blood flow to the limb to which it is applied. Do not apply a cuff to a limb that has restricted blood flow. Check the patient periodically to ensure cuff application does not impair limb circulation.



WARNING:

- ***Cuff tubing connectors may incorporate luer fittings. Exercise caution when used in proximity with intravenous fluid lines.***
- ***Inadvertent connection of cuff tubing with luer fittings to intravascular fluid systems could allow air to be pumped into a blood vessel.***



CAUTION:

- **Do not use extensions or adapters with the neonatal inflation tube, other than those specified.**
- **Do not apply the cuff to an extremity with restricted or otherwise compromised blood flow.**
- **Do not apply the cuff to a limb being monitored with a pulse oximetry sensor. SpO₂ readings will be affected during NIBP monitoring.**
- **Do not apply the cuff to any extremity being used for intravenous infusion or catheterization.**
- **Do not apply the cuff to any area of breached or injured skin.**

Patient Factors Affecting Readings

Excess patient movement, speech, or muscle contractions (as a result of severe pain or shivering) can interfere with automated NIBP readings. Ensure that the patient is quiet and not moving during NIBP readings just as you would during manual readings. Avoid applying external pressure to the cuff during readings. Institute measures to minimize shivering and alleviate pain.

Some arrhythmias may cause beat-to-beat pressure fluctuations that can make obtaining NIBP readings more difficult. Increased variability of readings can result from these pressure variations. If it becomes difficult to obtain readings in the presence of arrhythmia, pressure should be temporarily verified using another method. Pressure also varies cyclically with normal respiration. With deep respirations, or in certain patients, this effect may be enhanced, increasing reading variability.

For patients in shock, indirect methods of measuring pressure (auscultatory, oscillometric, doppler) may not be reliable because of peripheral vascular changes. These changes include peripheral vasoconstriction and diminished peripheral circulation resulting from shunting of blood to central organs. In some cases, peripheral pulses or Korotkoff sounds may be diminished or disappear in spite of adequate blood pressure. In such cases, measuring a cuff pressure may be impossible or give misleading results. Direct (invasive) blood pressure measurements should be considered in patients with signs of shock or any patient who rapidly becomes unstable for unknown reasons.

Display Detail

Figure 13-1 and Figure 13-2 illustrate typical NIBP displays. You can view NIBP readings from any Ultraview Care Network bedside or central monitor on a network. The NIBP display on a split-screen central monitor appears in a format slightly different from that of a bedside or full-screen central monitor.

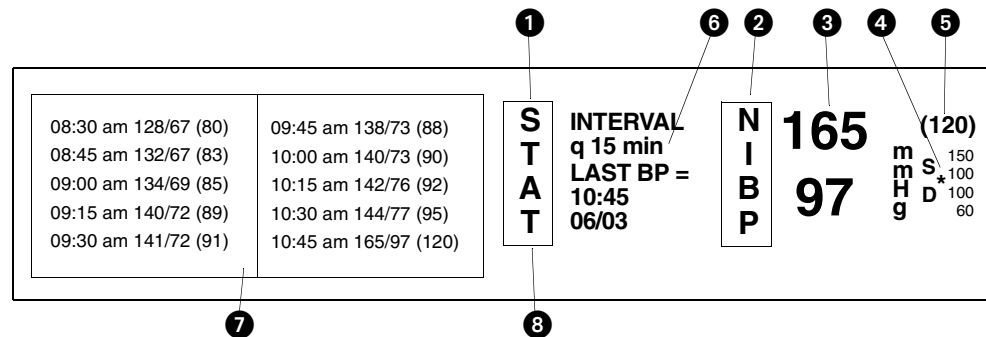


Figure 13-1: Bedside monitor display

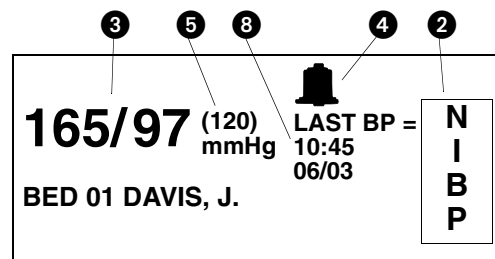


Figure 13-2: Central monitor, split-screen display

- ❶ STAT key initiates an immediate blood pressure measurement. While a measurement is in progress the key label changes to STOP.
- ❷ NIBP key.
- ❸ Last systolic and diastolic readings.
- ❹ NIBP alarm limits. Split-screen central monitors display a bell symbol when alarms are enabled. Bedside monitors display the high and low alarm limits for systole and diastole. The asterisk indicates alarms are enabled for mean pressure.
- ❺ Mean reading.
- ❻ Current interval for automatic readings (q 15 min). **q'** in place of **q** indicates that the reduced delay of 5-seconds between readings is active (refer to *Setting Automatic Measurements* on page 13-9).
- ❼ NIBP measurement table.
- ❽ Time and date of the last reading.

Bedside monitors show an NIBP table displaying a chronological listing of NIBP readings. The oldest data is at the top of the left column. Each reading contains the time of the measurement and the pressure values for systolic, diastolic, and mean. As new measurements are taken, the oldest data moves off the screen.



- If you remove one NIBP module and insert another without purging data (via ADMIT/DISCHARGE), the NIBP table may display data for two patients.

Central monitors display the last NIBP reading only.

Setting and Adjusting Alarm Limits

To set or adjust alarms:

- 1 Touch NIBP.
- 2 Touch ALARM LIMITS.
- 3 Select SYS, DIA, or MEAN.
- 4 Select ALARM ON.
- 5 Select HI= or LO=.
- 6 Use arrow keys to adjust.

You can define alarm limits for systolic, diastolic and mean values. The factory default setting for NIBP alarms is OFF. The default alarm limits settings for both the adult and the neonate modes are listed in *Table 1*.

Table 1: Alarm Limits

		HIGH		LOW	
Neonatal	Systolic	85 mmHg	(11.5 kPa)	55 mmHg	(7.5 kPa)
	Diastolic	75 mmHg	(10.0 kPa)	45 mmHg	(6.0 kPa)
	Mean	80 mmHg	(10.5 kPa)	50 mmHg	(6.5 kPa)
Adult	Systolic	150 mmHg	(20.0 kPa)	100 mmHg	(13.5 kPa)
	Diastolic	100 mmHg	(13.5 kPa)	60 mmHg	(8.0 kPa)
	Mean	110 mmHg	(14.5 kPa)	90 mmHg	(12.0 kPa)

Selecting Adult or Neonatal Mode

To select the patient type:

- 1 Touch NIBP.
- 2 Touch CHANGE CONFIG.
- 3 Select ADULT or NEONATAL.

In modules that offer both adult and neonatal modes, you can determine the current mode by observing which key is highlighted or by reading the menu prompt in the NIBP menu. The factory default setting is adult.

The following events occur with each change of mode:

- The monitor erases current NIBP readings from the display but retains them in memory.
- Previous NIBP readings appear immediately if present in memory. If not, readings appear as the measurements are taken.
- Alarm limits and state (ON/OFF) are automatically changed for the new mode (adult or neonatal).
- Active NIBP alarms reset; alarms in violation terminate and suspended alarms end.



WARNING:

- *The mode (adult or neonatal) selected must correlate with the hose connected to the module and the patient type.*

Displaying Heart (Pulse) Rate Data

To display heart rate on NIBP table:

- 1 Touch NIBP.
- 2 Touch CHANGE CONFIG.
- 3 Select DISPLAY PR ON.

Non-invasive pressure measurements may be displayed with or without a pulse rate. If you choose to display pulse rate, only five measurements may be displayed in the NIBP table. Otherwise, ten measurements may be displayed as shown in *Figure 13-1: Bedside monitor display*. Pulse rate is obtained from ECG, arterial pressure (ART), SpO₂, and NIBP (in that order), depending on the availability of these parameters.

Initiating a Manual Measurement

To start an immediate measurement:

- 1 Touch STAT.

You can start a measurement at any time by touching the STAT key.

If an initial measurement attempt is not successful, a single retry will be initiated after a 5-second interval (short-term mode) or 30-second interval (long-term mode).



- *New measurements cannot be initiated if another measurement is already in progress.*

Setting Automatic Measurements

To determine automatic measurement intervals:

- 1 Touch NIBP.
- 2 Select AUTO ON.
- 3 Touch TIME INTRVL.
- 4 Use arrow keys to adjust interval.

The NIBP module always powers ON with automatic measurements set to OFF. The current time interval for automatic measurements is displayed on the message line above the arrow keys.

The factory default setting for automatic time interval is 15-minutes.

For automatic time intervals of less than 5-minutes, the module makes special allowances for a rapid succession of readings. For the first 15-minutes after you set up a reading (turn AUTO mode ON or select a new time interval), the minimum delay between readings is only 5-seconds. When this five-second delay is active, the interval message will appear with an apostrophe, after the **q** (**q'**). After the 15-minute period, the minimum delay between readings becomes 30-seconds.



WARNING:

- *During blood pressure readings the inflated cuff reduces blood flow to the limb to which it is applied. Consider this when selecting short time intervals.*

Measurement Intervals

Adult and neonatal measurement intervals are as follows:

- between 1- and 10-minutes in 1-minute increments,
- between 10- and 60-minutes in 5-minute increments, or
- 1-, 2-, 4-, or 8-hours.

Automatic Reading Times

Turning automatic mode ON or changing the interval, initiates a new measurement schedule. When the selected interval is a multiple of 5-minutes, automatic readings will always begin at the next five-minute division. Selecting AUTO ON shortly before the desired five-minute division can be used to synchronize measurements to exact clock times.

For example, if at 8:03 you select a time interval of 15-minutes, automatic readings will occur at 8:05 and 8:20. If at 8:22 the interval is changed to 7-minutes, the next automatic readings will occur at 8:29 and 8:36.



- *Touching STAT BP will take an immediate reading without affecting scheduled reading times.*

Stopping a Measurement in Progress

To stop an NIBP measurement currently in progress, press the red **Deflate** button on the front of the module or the STOP key on the display. The next automatic reading will begin on schedule.

Recording Measurements

To print the NIBP measurements currently displayed:

- 1 Touch NIBP.
- 2 Touch REVIEW.
- 3 Touch PRINT.

To print the most recent measurement (no table):

- 1 Touch RECORD (monitor key).
- 2 Touch NIBP.

To review NIBP measurements:

- 1 Touch NIBP.
- 2 Touch REVIEW.

You can choose to print out either the complete NIBP display or only the numeric values of the last reading.

Reviewing Measurements

You can review a patient's NIBP measurements by scrolling through the measurement table line-by-line or page-by-page. (A page is limited to five measurements if the pulse rate is displayed. Otherwise, a page is ten measurements.)

To scroll line-by-line, touch the single arrow keys:

- To review earlier measurements, touch the ← key.
- To review later measurements, touch the → key.

To scroll page-by-page, touch the double arrow keys:

- To review earlier measurements, touch the «— key.
- To review later measurements, touch the —» key.

To page to the earliest five (or ten) measurements, touch the |«— key.

To page to the latest five (or ten) measurements, touch the —»| key.

Recording Waveforms

To print NIBP waveforms:

- 1 Touch RECORD.
- 2 Touch flashing NIBP parameter key.

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

Restoring User-Defined Settings

To restore user-defined settings:

- 1 Touch ECG.
- 2 Touch SETUP.
- 3 Touch RESTORE SETTINGS.
- 4 Select YES.

With the Restore Settings feature, you can restore the user-configurable settings to the defaults previously stored as user settings. User-configurable settings are listed in *Setting User-Defined Default Values* on page 7-7.



- *RESTORE SETTINGS* changes the user-configurable settings for all parameters in the module.

Status Messages

At the beginning of a blood pressure measurement:

- The mean value of the previous reading disappears.
- The message READING IN PROGRESS replaces the diastolic value.
- A bleed step replaces the previously displayed systolic pressure.

If the system fails to complete an initial measurement reading, the message SECOND READING REQUIRED will be displayed along with a description of the cause of the failure. A second measurement automatically begins either 5- or 30-seconds later, depending on whether the short-term automatic mode is active. If the second attempt fails:

- The message NO READING is displayed.
- An alarm sounds (if alarms are turned ON).
- One of the following messages is displayed:

INFLATE ERROR

HW ERROR

NO DATA

If the **Deflate** button on the front of the module or the STOP key on the display is pressed during a reading, the reading will end and the messages NO READING and CUFF DEFLATE will be displayed.

If the system detects unstable beat-to-beat blood pressures during measurements, one of two messages will be displayed:

- In the neonatal mode, MOTION is displayed.
- In the adult mode, ARTIFACT is displayed.

If an error status message is displayed and the system is unable to proceed with its current operation, you must correct the fault before the system can continue. If you are unable to correct the fault, contact a qualified service person.

If NIBP SYSTEM FAILURE ERROR NUMBER = XX (bedside only), or HW ERROR (bedside and remote) displays, it indicates that a hardware problem has caused the NIBP portion of the module to be inoperable. The module must be serviced by a qualified service person before NIBP measurements can be taken.

If the error message CUFF CAN NOT BE DEFLATED displays, it indicates that the deflate hardware is blocked and the cuff cannot be deflated. Remove the cuff from the limb immediately and have the module serviced. The module must be serviced by a qualified service person before NIBP measurements can be taken.

If either of the above messages are displayed, a RESET NIBP key will be present in the Change Config menu. Touch the RESET NIBP key to re-enable non-invasive blood pressure monitoring.



- *If these messages occur repeatedly, discontinue NIBP monitoring and contact a qualified service person.*

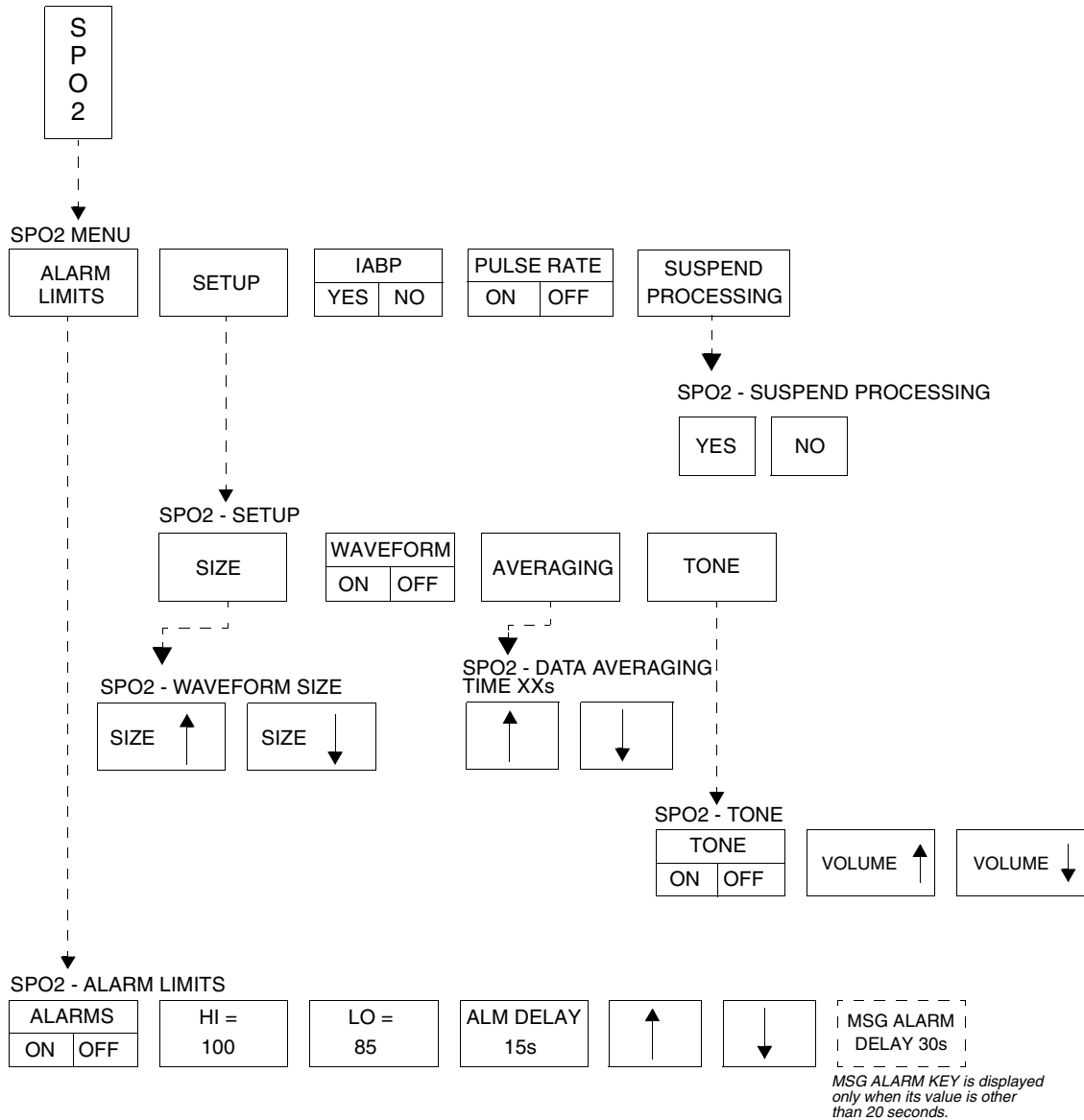
NIBP Troubleshooting Guide

Clinical Situation	Possible Cause	Solution
No NIBP screen key is displayed	<ul style="list-style-type: none"> Module not inserted correctly. 	<ul style="list-style-type: none"> Remove and re-insert the module.
No NIBP readings can be obtained	<ul style="list-style-type: none"> Incorrect or inoperative cuff in use. Cuff tubing is attached to an adult outlet, but monitor is configured in the neonatal mode (or vice versa). Tubing is kinked. Some arrhythmias (for example, atrial fibrillation and frequent ventricular ectopy) may cause a single or repeated failure to obtain a reading (may be due to true beat-to-beat variations in pressure). Excessive patient motion or muscle contractions associated with shivering or severe pain. Blood pressure outside of measurement range. 	<ul style="list-style-type: none"> Replace with the cuff known to be operative. Connect tubing to the correct outlet. Correlate monitor mode, cuff and patient type. Locate kink and straighten tubing. Document arrhythmia if present, verify pressure with another method, then follow hospital procedure for care of this type of patient. Ensure that patient is quiet with minimal movement during NIBP readings. Minimize the patient's shivering. Verify extremely high or low pressures with another method.
Intermittent or complete failure to operate	<ul style="list-style-type: none"> Hardware error (codes 10, 20, and 30) detected during previous measurement. 	<ul style="list-style-type: none"> Check the presence of the RESET NIBP key in the CHANGE CONFIG menu. Touch RESET NIBP to re-enable monitoring. Remove the module from service and call a qualified service person if this condition occurs repeatedly.
Apparent incorrect value	<ul style="list-style-type: none"> Wrong size cuff for patient. Cuff is damaged. Excessive patient motion, shivering or severe pain. False high readings may be the result of venous congestion caused by frequent readings. Cuff too loose or positioned incorrectly. 	<ul style="list-style-type: none"> Measure patient's limbs at the midpoint. Match limb measurement to the range specified on the cuff (undersizing the cuff results in the greatest degree of error). Replace with a good cuff. Ensure the patient is quiet with minimal movement during NIBP readings. Minimize the patient's shivering. Reduce the frequency of the readings. Tighten the cuff or reposition it appropriately.

Clinical Situation	Possible Cause	Solution
Variable readings occur	<ul style="list-style-type: none"> ■ Some arrhythmias may cause beat-to-beat pressure and NIBP readings. ■ Larger than normal influence of respiratory phases on blood pressure (inspiratory fall in blood pressure; expiratory rise). 	<ul style="list-style-type: none"> ■ Document the arrhythmia, if present. Verify the pressure using another method, then follow hospital procedure for care of this type of patient. ■ NIBP software usually compensates for normal variation.
No NIBP readings or questionable values in the presence of shock	<ul style="list-style-type: none"> ■ Peripheral vascular changes experienced during shock may reduce the reliability of blood pressure readings obtained with any indirect method. Peripheral pulses may be diminished or absent. 	<ul style="list-style-type: none"> ■ Consider invasive pressure measurements in patients with symptoms of shock or in any patient who rapidly becomes unstable for unknown reasons.

SpO₂ Directory

Directory of Keys



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

Contents

Overview	3
Setting Up SpO ₂ Monitoring	4
Dual SpO ₂ Monitoring	5
Display Detail	5
Ensuring Accurate Monitoring	6
Using the Sensorwatch Feature	6
Setting and Adjusting Alarm Limits	6
Selecting Data Averaging Period	7
Using SpO ₂ with Intra-Aortic Balloon Pumps	7
Adjusting Tone Volume	8
Modifying Waveform Display	8
Viewing Pulse Rate	8
Restoring User-Defined Settings	9
Suspending/Resuming SpO ₂ Processing	9
Recording SpO ₂ Waveforms	9
Error Messages	10
Sensors	12
SpO ₂ Troubleshooting Guide	13

Overview

Pulse oximetry allows continuous noninvasive monitoring of a patient's hemoglobin oxygen saturation. The oximetry sensor contains two light emitting diodes (LEDs) that transmit specific wavelengths (typically 660 and 940 nanometers) of light that are received by a photo detector.

Oxygen saturated blood absorbs light differently compared to unsaturated blood. The amount of light absorbed by the blood can be used to calculate the ratio of oxygenated hemoglobin to total hemoglobin in arterial blood. The monitor displays this ratio as percent SpO₂. Normal values range from 95 to 100%.



WARNING:

- ***A pulse oximeter should NOT be used as an apnea monitor.***
- ***A pulse oximeter should be considered an early warning device. If a trend towards patient deoxygenation is indicated, blood samples should be analyzed by a laboratory co-oximeter to completely understand the patient's condition.***
- ***When used according to the manufacturers' instructions, sensors have no adverse effect on tissues.***



- *Pulse oximetry may interfere with magnetic resonance imaging (MRI) procedures. Refer to your hospital's protocols for specific instructions.*
- *You can define your own default settings for such characteristics as alarm limits and display configuration. Refer to Setting User-Defined Default Values on page 7-7 for further information.*
- *The ECG lead wires of the 90343 telemetry transmitter must be connected to the patient in order to perform ECG and blood oxygen saturation monitoring.*

Setting Up SpO₂ Monitoring

To set up SpO₂ monitoring (non-telemetry):

- 1 Connect the adapter cable to the module.
- 2 Attach the sensor to the patient and connect the sensor cable to the adapter cable.
- 3 Touch SPO2.

To set up SpO₂ monitoring (telemetry):

- 1 Connect the SpO₂ adapter cable to the transmitter.
- 2 Attach the sensor to the patient and connect the sensor cable to the SpO₂ adapter cable.
- 3 Initiate ECG monitoring.
- 4 Touch ECG.
- 5 Touch CHANNEL FORMAT.
- 6 Touch SPO2 ON.

When you connect the adapter cable to the module the SPO2 key will be displayed. Attach the sensor to the patient and then to the adapter cable.



CAUTION:

- **Use only patient sensors specified by Spacelabs Medical. If you use sensors other than those specified, it may degrade performance and could damage the monitor during defibrillation.**
- **Spacelabs Medical recommends the use of sensors repaired or remanufactured by the original manufacturer only.**
- **Check the sensor site frequently. Do not allow the sensor to remain on one site for a prolonged period of time, especially when monitoring neonates. Refer to the sensor manufacturer's instructions.**
- **Never attach an SpO₂ sensor on a limb being monitored with a blood pressure cuff or a limb with restricted blood flow.**
- **A poorly applied sensor may give incorrect saturation values. The Sensorwatch signal strength indicator is used to identify a poorly applied sensor or a poorly chosen site. Re-apply the sensor. Refer to *Using the Sensorwatch Feature* on page 14-6 for further details.**
- **Choose a site with sufficient perfusion to ensure accurate oximetry values.**

An adapter cable is required between the sensor and the module. Do not discard the adapter cable when you have finished using a disposable oximetry sensor. Disconnect the sensor cable from the adapter cable before discarding the sensor.

Connect the SpO₂ adapter cable to the module or telemetry transmitter by aligning the cable with the notch on the SpO₂ connector on the front of the module or telemetry transmitter. Push the cable straight into the connector. To remove the cable, press the latch release on the bottom of the cable and pull the cable straight out.

Dual SpO₂ Monitoring

Some modules support real-time monitoring of dual SpO₂ sites. To employ this option, insert a second Spacelabs Medical SpO₂ module into an available slot in the monitor. The new parameter will be displayed below the first SpO₂ channel. Affix a label to the monitor's bezel to indicate the sensor site location (for example, right hand, left foot) for each SpO₂ parameter displayed on the monitor.

Display Detail



- For telemetry display information refer to Display Detail on page 17-12.

These figures illustrate a typical SpO₂ display. You can view oximetry values from any Ultraview Care Network bedside or central monitor on a network.

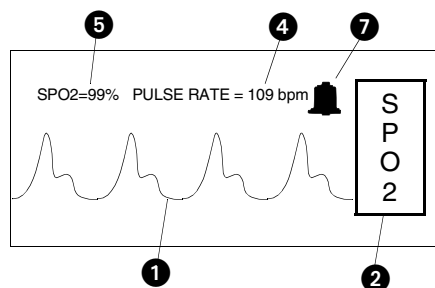


Figure 14-1: Split screen central monitor

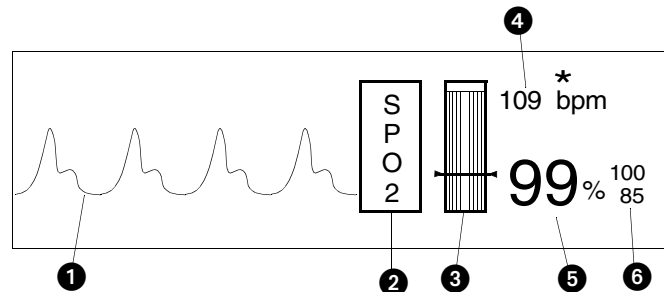


Figure 14-2: Bedside monitor

- 1 Pulse plethysmographic waveform
- 2 SPO2 key
- 3 Sensorwatch signal strength indicator

Shaded area (waveform index, WFI) expands up proportionally to signal strength; horizontal line indicates minimum signal level.

No shading (lowest waveform index) corresponds to no detected signal strength or a faulty sensor.

- 4 SpO₂ pulse rate (asterisk flashes when pulse is detected - on bedside monitors only)
- 5 Current SpO₂ value (percent)
- 6 High and low SpO₂ alarm limits
- 7 The bell indicates that alarms are enabled (on split screen central only)

Ensuring Accurate Monitoring

While each sensor requires site specific application procedures, the following general points aid in ensuring oximetry monitoring success.

- Choose a site that provides proper alignment of the LEDs and receiving photodetector.
- Reduce light interference when monitoring a neonate under bright light by using a diaper or other light block over the sensor.
- Select a site that has unrestricted blood flow and can remain as immobile as possible to reduce or eliminate movement artifact.
- Do not restrict blood flow when securing a sensor with tape.
- Do not select a site near potential electrical interference (electrical cords, for example).
- The Sensorwatch bar should be above the minimum signal level.

Using the Sensorwatch Feature

The Sensorwatch feature is a graphical presentation of the amplitude of the signal received from the sensor. It can be used to determine the best sensor site and application.

Changes in the displayed shaded level signify the changes in the patient's perfusion or changes in the application of the sensor. The horizontal line near the bottom fourth of the graphic represents the minimum signal level that results in accurate saturation values. When the shading is just below this point, the message LOW SIGNAL STRENGTH - REPOSITION OR REPLACE SENSOR is displayed and SENSORWATCH flashes.

When the shading is below the line:

- Reposition the sensor to a different site to provide better perfusion.
- Reposition the sensor so that better contact is made with the skin and the LEDs and photodetector are aligned better.
- Replace a defective sensor.
- Wait for the patient to warm and the perfusion to increase.

Setting and Adjusting Alarm Limits

To set or adjust SpO₂ alarms (non-telemetry):

- 1 Touch SPO2.
- 2 Touch ALARM LIMITS.
- 3 Touch ALARMS ON.
- 4 Touch HI=, LO=, ALM DELAY, or MSG ALARM DELAY (if present).
- 5 Use arrow keys to adjust.

Pulse oximetry alarm limits and delays are based either on factory default limits or user-defined limits. The factory default settings for alarm limits are 100% for high and 85% for low. For alarm delays, the factory default settings are 15-seconds for alarm limit delay and 20-seconds for message alarm delay. Refer to *Alarms* on page 2-3 for further information concerning Ultraview Care Network alarm operations.

Refer to *SpO2* on page 7-31 for SpO₂ parameter tables listing available user settings and factory defaults for this parameter. Refer to *Table 3 ECG Parameter Configuration (Telemetry Only)* on page 7-13 and *Table 4 ECG Alarm Attributes (Telemetry Only)* on page 7-16 for telemetry information.

To set or adjust SpO₂ alarms (telemetry):

- 1 Touch ECG.
- 2 Touch ALARM LIMITS.
- 3 Touch SPO2 ALARM LIMITS.
- 4 Select SPO2 ALARMS ON.
- 5 Select HI=, LO=, ALM DELAY, and MSG ALARM DELAY.
- 6 Use arrow keys to adjust.

To specify a data averaging period:

- 1 Touch SPO2.
- 2 Touch SETUP.
- 3 Touch AVERAGING.
- 4 Use arrow keys to adjust.

To use with balloon pump (non-telemetry):

- 1 Touch SPO2.
- 2 Touch IABP YES.

Additional Information for Telemetry Products

When SpO₂ alarms are enabled, a bell symbol is displayed between the SPO2 label and the SpO₂ measured saturation value. When an SpO₂ alarm is detected, the displayed parameter value blinks yellow if the alarm priority is Low or Medium, and blinks red if the alarm priority is High.

Selecting Data Averaging Period

Use this feature to smooth the oximetry saturation value by averaging patient input values over 4-, 8-, or 16-seconds. The default value is 8-seconds.

- For non-telemetry products, the data averaging period is displayed in the menu prompt line of the AVERAGING menu.
- For telemetry products, refer to the 90343, 90347, 90478, 90479-A *Ultraview Digital Telemetry Service Manual (P/N 070-0744-xx)* for setting up the data averaging period.

Using SpO₂ with Intra-Aortic Balloon Pumps

Enabling the intra-aortic balloon pump (IABP) feature informs the SpO₂ software that an IABP is in use. The SpO₂ software must differentiate between true arterial pulsations and those produced by the IABP. With the IABP feature enabled, the transmitter excludes the IABP-generated pulsations from the calculation for SpO₂.

The IABP feature also may be useful with patients experiencing irregular heart rhythms. Enabling the IABP feature permits the transmitter to reject irregular pulses, providing a more accurate SpO₂ measurement.



- *When the IABP feature is enabled, the pulse rate obtained from SpO₂ may not match the heart rate obtained from ECG.*
- *In cases of excessive patient motion or artifact, the accuracy of the SpO₂ measurement may be compromised when the IABP feature is enabled.*
- *(90343 only) When the IABP operation is selected, the SPO2 status key in the Channel Format menu indicates IABP. The Service Manual describes how to configure the telemetry transmitter for use with an IABP.*

To adjust tone volume (non-telemetry):

- 1 Touch SPO2.
- 2 Touch SETUP.
- 3 Touch TONE.
- 4 Touch TONE ON.
- 5 Use arrow keys to adjust.

To modify display of the waveform (non-telemetry):

- 1 Touch SPO2.
- 2 Touch SETUP.
- 3 Verify WAVEFORM ON.
- 4 Touch SIZE.
- 5 Touch SIZE↑ or SIZE↓ to adjust.

To modify the pulse rate display (non-telemetry):

- 1 Touch SPO2.
- 2 Touch PULSE RATE ON/OFF.

To display heart rate from SpO₂ sensor (telemetry):

- 1 Touch ECG.
- 2 Touch SETUP.
- 3 Touch RATE SOURCE.
- 4 Select SpO₂ ON.
- 5 Select SpO₂ as rate source.

Adjusting Tone Volume

Use this function to turn the pulse tone ON or OFF. The pitch varies according to the SpO₂ value. The higher the oxygen saturation, the higher the pitch.

The default setting for the pulse tone is OFF.



- *This feature is not supported in telemetry products.*

Modifying Waveform Display

Use this function to turn the plethysmographic waveform display ON or OFF. The default setting is ON.

Use the SIZE key to change the height of the displayed waveform as necessary for clarity. This changes the displayed size only and does not affect the signal gain.



- *Amplitude of the displayed waveform is not proportional to the pulse amplitude.*
- *This feature is not supported in telemetry products.*

Viewing Pulse Rate

You can obtain and view a pulse rate derived from the saturation data. The pulse rate is displayed within the range of 30 to 250 beats per minute ±3 beats per minute.

The default setting for the pulse rate display is ON for non-telemetry products.

For telemetry products, the heart rate for display is obtained directly from the acquired ECG leads or an alternate rate source. SpO₂ can be used as the alternate source if it is set for continuous measurement, but not when SpO₂ is set for episodic measurement.

Restoring User-Defined Settings

To restore user-defined settings:

Configurations with ECG

- 1 Touch ECG.
- 2 Touch SETUP.
- 3 Touch RESTORE SETTINGS.
- 4 Touch YES.

To restore user-defined settings:

Configurations without ECG

- 1 Touch TEMP.
- 2 Touch RESTORE SETTINGS.
- 3 Touch YES.

To suspend SpO₂ processing:

- 1 Touch SPO2.
- 2 Touch SUSPEND PROCESSING.
- 3 Touch YES.

To resume SpO₂ processing:

- 1 Touch SPO2.
- 2 Touch RESUME PROCESSING.
- 3 Touch YES.

To print SpO₂ waveforms:

- 1 Touch RECORD.
- 2 Touch flashing SPO2 parameter key.

With the Restore Settings feature, you can restore the user-configurable settings to the defaults previously stored as user settings. User-configurable settings are listed in *Setting User-Defined Default Values* on page 7-7.



- *RESTORE SETTINGS* changes the user-configurable settings for all parameters in the module.
- Once restored, alarm ON/OFF status and alarm limits are reset to the previously stored user settings.

Suspending/Resuming SpO₂ Processing

When you touch YES in the Suspend Processing menu, analysis and display of the SpO₂ data is suspended. If you touch NO, the display returns to the SpO₂ menu without affecting processing.

When you suspend SpO₂ processing:

- The message SPO2 PROCESSING SUSPENDED appears in the SpO₂ waveform zone.
- Question marks replace the SpO₂ and pulse rate values.
- The message SPO2 ALM OFF replaces the alarm limits.
- The keys in the SpO₂ Alarm Limits menu display outline to indicate they are disabled.
- The SUSPEND PROCESSING key changes to RESUME PROCESSING.



- *This feature is not supported in telemetry products.*

Recording SpO₂ Waveforms

You can print SpO₂ waveforms and values. Refer to *Printing* on page 4-7 for additional information.

Error Messages



WARNING:

- **Error messages indicate a problem or condition which may affect accurate monitoring values. Do not ignore these messages. Correct any fault before continuing.**

When error messages are displayed, the saturation value and pulse rate immediately change to ??? and an alarm may occur if your module is configured to do so. If it occurs, this alarm does not begin until after the message alarm delay time has elapsed.

If your module has been configured for an alarm using the Module Configuration Manager feature, the parameter key will flash red for high priority alarms or yellow for medium and low priority alarms. Refer to *Module Configuration Manager* on page 7-5 for more information.

Telemetry products use different text for their SpO₂ error messages than non-telemetry products. *Table 1* serves as a key for interpreting the telemetry messages. Telemetry products also display their error messages within ECG's display zone, so the following ECG alarm messages take priority over other SpO₂ messages.

- LEADS OFF
- NOISY SIGNAL
- ECG ALARMS SUSPENDED

Table 1: Telemetry Message Equivalent

SpO ₂ Message	Equivalent Telemetry SpO ₂ Message
ADAPTER DISCONNECTED – CHECK CONNECTION AT MODULE	SPO2 UNAVAILABLE
FAULTY SENSOR – REPLACE SENSOR	SPO2 FAULTY SENSOR
SENSOR DISCONNECTED – CHECK CONNECTION AT ADAPTER CABLE	SPO2 SENSOR DISCONNECTED
SENSOR OFF PATIENT – CHECK CONNECTION AT PATIENT	SPO2 SENSOR OFF PATIENT
INSUFFICIENT SIGNAL – REPOSITION OR REPLACE SENSOR	SPO2 INSUFFICIENT SIGNAL
AMBIENT LIGHT INTERFERENCE – COVER SENSOR AREA	SPO2 AMBIENT LIGHT INTF.
NOISY SIGNAL	SPO2 NOISY SIGNAL
LOW SIGNAL STRENGTH – REPOSITION OR REPLACE SENSOR	SPO2 INSUFFICIENT SIGNAL

ADAPTER DISCONNECTED — CHECK CONNECTION AT MODULE

- The module does not detect an adapter cable connected to the front panel. Check proper adapter cable connection.
- If the message persists and the adapter cable is secure, replace the adapter cable.
- The channel will drop and the alarm will stop after approximately 10-seconds.
- On remote view, there may be no audible alarm on the remote monitor before the channel drops.

SENSOR DISCONNECTED — CHECK CONNECTION AT ADAPTER CABLE

- The module does not detect a sensor. Check the proper connection of the sensor with adapter cable.
- If the message persists, replace the sensor and/or the adapter cable.

SENSOR OFF PATIENT — CHECK CONNECTION AT PATIENT

- The module does not detect a valid sensor input signal. Check the patient for proper sensor placement.
- The tissue between the LED and photodiode is too transmissive. If the sensor placement seems correct and the message persists, try a sensor site with a thicker tissue bed.



- *This message is not available with disposable SpO₂ sensors or non-clip type sensors.*

FAULTY SENSOR — REPLACE SENSOR

- The LED and/or photodiode have failed. Replace the sensor.

AMBIENT LIGHT INTERFERENCE — COVER SENSOR AREA

- The sensor is receiving external light interference from a bright light source near the sensor. Shield the sensor from the external light source.
- The sensor photodiode and LEDs are misaligned on flexible sensors thereby allowing light to enter. Realign the sensor photodiode with LEDs.
- If the message persists, replace the sensor.

INSUFFICIENT SIGNAL — REPOSITION OR REPLACE SENSOR

- Insufficient signal for proper operation as evidenced by a low deflection on Sensorwatch signal strength bar.
- Poor sensor application or site. Correctly re-apply or reposition to a better perfused site or massage site.
- If the message persists, replace the sensor.

NOISY SIGNAL

- Sensor signal disturbed by motion or other interference. Eliminate sensor movement. Message disappears when the value is obtained.
- Sensor placement adjacent to power cords or other electrically noisy devices. Move the noisy device or move the sensor to another site.
- If the message persists, replace the sensor.

LOW SIGNAL STRENGTH — REPOSITION OR REPLACE SENSOR

When this message appears the saturation and pulse rate continue to be displayed; however, the Sensorwatch flashes as a indication of a possible error condition.

- Insufficient blood flow between the sensor light emitter and detector. Move the sensor to an area of higher perfusion.
- Poor sensor application. Reposition to place active components closer to skin or locate to a better perfused site.
- Sensor site is below the blood pressure cuff. Move to another site.
- If the message persists, replace the sensor.

Sensors

For further information about biocompatibility or sensor disposal, refer to the Spacelabs Medical Product Specification sheets and to the manufacturer's instructions enclosed with each sensor.

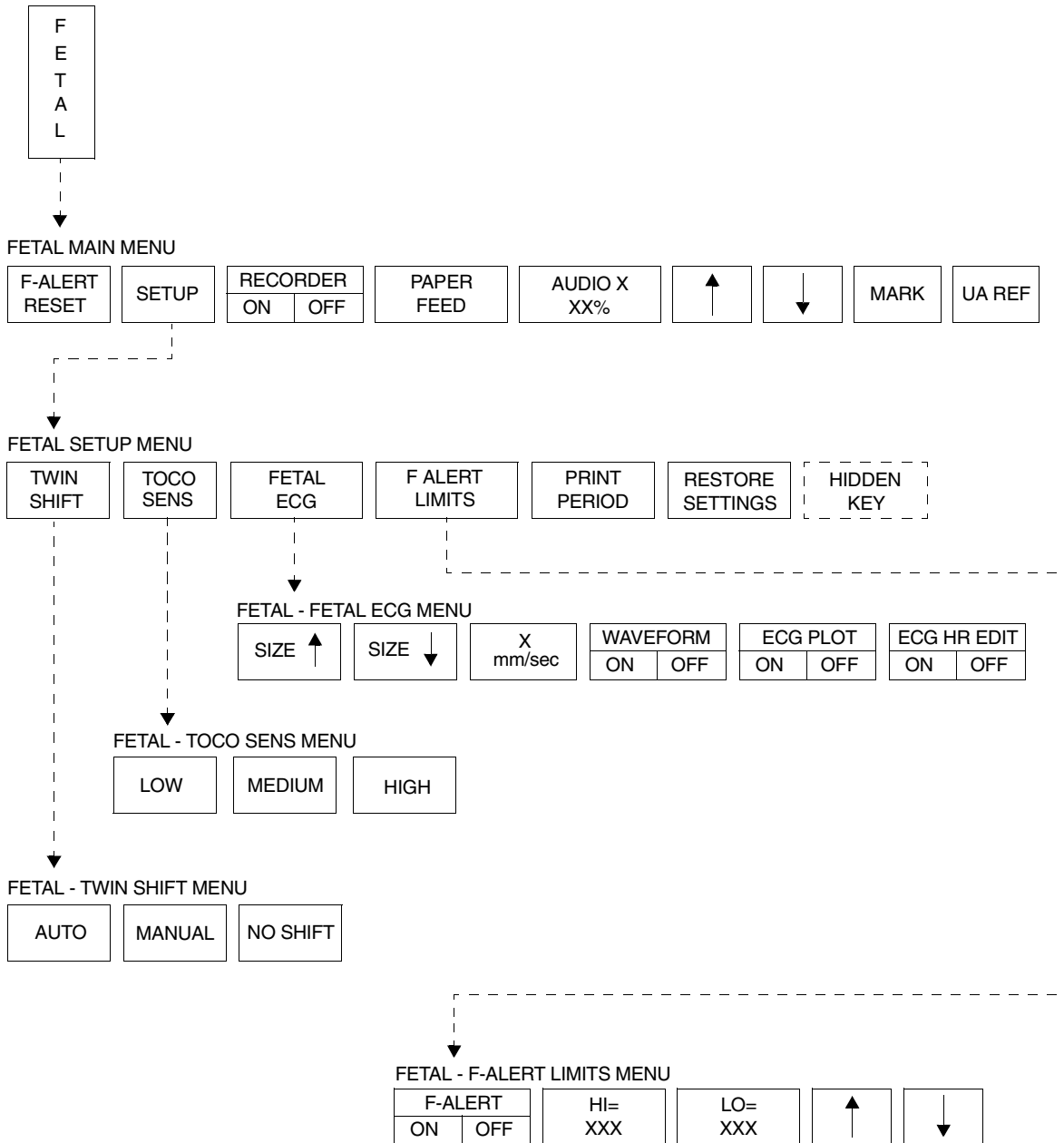
SpO₂ Troubleshooting Guide

Clinical Situation	Possible Cause	Solution
No SpO₂ parameter key is displayed	■ Module not inserted correctly.	■ Remove and reinsert the module.
	■ Adapter cable not connected to module properly.	■ Correctly connect the adapter cable.
	■ Sensor not connected to adapter cable.	■ Correctly connect the sensor.
	■ SpO ₂ is not enabled at the 90343 transmitter.	■ Call a qualified service person to check transmitter DIP switch 1 and 2.
	■ SpO ₂ is not enabled at the 90478 receiver.	■ Call a qualified service person to set transmitter DIP switch 8 to OFF.
SpO₂ value displays ???	■ Sensor not connected to patient.	■ Reattach the sensor.
	■ Excessive patient motion.	■ Urge patient to remain still while reading is in progress.
	■ Module is in the initialization phase (the first 15-seconds after sensor application).	■ Wait until the initialization is complete.
	■ Adapter cable not connected to the module properly.	■ Correctly connect the adapter cable.
	■ Sensor not connected to the adapter cable.	■ Correctly connect the sensor.
	■ Low battery indicator constantly illuminated.	■ Call a qualified service person.
	Low signal strength	■ Sensor placement not optimum.
		■ Align the LED with the sensor photo detector.
■ Sensor is placed below blood pressure cuff.		■ Move the sensor to an alternate limb.
Intermittent or complete failure to operate	■ Module error.	■ Call a qualified service person.

Clinical Situation	Possible Cause	Solution
Factors which cause significant variances in sensor accuracy	<ul style="list-style-type: none"> ■ Presence of dysfunctional hemoglobins (COHb, MetHb). 	<ul style="list-style-type: none"> ■ Follow hospital procedure for determining oxygenation in these patients.
	<ul style="list-style-type: none"> ■ Presence of intravascular dyes (indocyanine green, methylene blue) depending on their concentration in the blood stream. 	<ul style="list-style-type: none"> ■ Follow hospital procedure for determining oxygenation in these patients.
No SpO₂ alarms are displayed (telemetry only)	<ul style="list-style-type: none"> ■ High ambient light level. 	<ul style="list-style-type: none"> ■ Reduce light levels near the patient.
	<ul style="list-style-type: none"> ■ Electrosurgical interference. 	<ul style="list-style-type: none"> ■ Follow hospital procedure for determining oxygenation in these patients.
	<ul style="list-style-type: none"> ■ Patient is significantly anemic (Hb less than 5g/dl) or patient has received large amounts of IV solutions. 	<ul style="list-style-type: none"> ■ Follow hospital procedure for determining oxygenation in these patients.
No SpO₂ alarms are displayed (telemetry only)	<ul style="list-style-type: none"> ■ ECG "Leads Off" condition exists. 	<ul style="list-style-type: none"> ■ Re-attach ECG lead wires to patient and resume ECG monitoring to clear pending ECG alarms.
	<ul style="list-style-type: none"> ■ Higher priority alarm condition is present. 	<ul style="list-style-type: none"> ■ Clear current alarm condition and/or re-prioritize SpO₂ alarms of interest in the Module Configuration Manager. ■ When SpO₂ alarms are set ON, all SpO₂ alarm conditions will cause the parameter value (or ???) to blink according to the alarm priority set by using the Module Configuration Manager.

Fetal Monitoring Directory

Directory of Keys



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

Fetal Monitoring

Contents

Overview	3
Fetal Display Detail	3
Starting Operation	5
Ultrasound Monitoring	7
Uterine Activity	9
ECG Monitoring	10
Intrauterine Pressure Monitoring	11
Main Menu	13
Fetal Heart Rate Alerts	13
Bradycardia Alert	14
Tachycardia Alert	16
Recorder Operations	17
Module Configuration Manager	23
Telemetry Option	26
Mermaid Option	27

Overview

This chapter describes the fetal monitor functionality of the Spacelabs Medical Maternal Obstetrical Monitor™ (MOM™). For instructions on optional maternal parameters such as ECG, SpO₂, temperature, and NIBP refer to the appropriate chapter of this manual.

Fetal Display Detail

The fetal module automatically allocates a single display zone when it establishes communication with the Maternal Obstetrical Monitor. This zone consists of numeric values and messages. When an internal fetal ECG electrode is applied to the patient, a second zone displays the fetal ECG waveform from channel 1. This zone does not display when using ultrasound-monitoring technique.

For singleton births, this display will appear as follows:

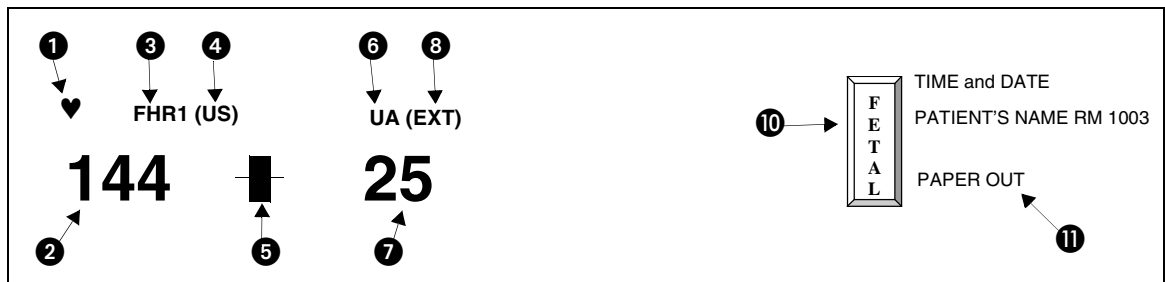


Figure 15-1: Singleton birth display

For a twin pregnancy, the display appears as follows:

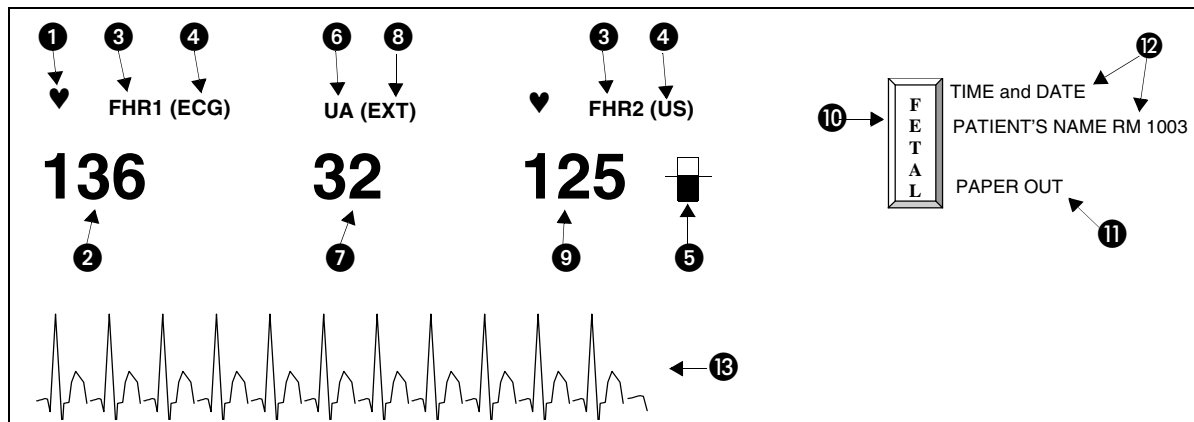


Figure 15-2: Twin display

- ❶ Heart beat indicator (flashes once per detected beat)
- ❷ Channel 1 heart rate (beats per minute)
- ❸ FHR channel label
- ❹ Source of heart rate signal (US = ultrasound, ECG = spiral ECG)
- ❺ Signal indicator
(full = good signal; half full = adequate; empty = poor or no signal)
- ❻ UA channel label
- ❼ Uterine activity measure (units for toco; mmHg or kPa for IUP)
- ❽ Source (EXT for toco; mmHg, or kPa for IUP)
- ❾ Channel 2 heart rate (beats per minute)
- ❿ Fetal parameter key
- ⓫ Status messages (appear when appropriate)
- ⓬ Time, date, patient name and room number
- ⓭ Fetal ECG trace from spiral electrode

Starting Operation

Power ON

To prepare the monitor for operation:

1. Plug the appropriate end of the power supply cord into the monitor's right side panel receptacle labeled J1.
2. Secure the connector with the screw that is provided.
3. Plug the other end of the power cord into a properly grounded three-wire outlet marked *Hospital Grade* or *Hospital Only*.
4. Press the main power switch ON. The monitor will perform a self-test.



- *If the MOM unit is powered OFF for a period of 3-minutes, all data, including the patient's name, is purged from memory.*

Standalone unit (not connected to BirthNet):

The patient's name will flash on the display if all the following conditions are met:

- The patient's name has been admitted through the monitor setup.
- The patient was not discharged from the monitor before powering OFF the monitor.
- The unit was not powered OFF for a period greater than 3-minutes.

If the flashing name is correct, the clinician should confirm the identity of the patient by touching the F-ALERT RESET key. Following confirmation, the patient's name will print on the fetal strip and will continue to print every 20-minutes.

If incorrect, use the MONITOR SETUP/ADMIT DISCHARGE key to admit the new patient.

Under standalone conditions, the patient's name will also flash if no fetal heart rate data has been received for a period of 10-minutes on channel 1. Touch the F-ALERT RESET key to confirm the patient's name.

When connected to BirthNet, the patient's name will flash the first time the monitor intercepts a name from BirthNet (after power ON) to inform the clinician of the identity of the patient. Touch the F-ALERT RESET key to confirm the information. The patient name will also automatically print on the fetal strip. Subsequent admission through BirthNet will not cause the name to flash if the monitor has not been powered OFF between patients.



- *The Admit/Discharge feature of the monitor is primarily a standalone feature. Use of this feature when connected to BirthNet might create a situation where the name of the patient entered under ADMIT in Monitor Setup will appear on the maternal strip while the fetal strip is identified with the patient's name from BirthNet. If the hospital chooses to use the Admit/Discharge function, it is recommend that the monitor be powered OFF for 3-minutes between patients.*

Under standalone or BirthNet connections, when the monitor is in fetal heart rate alert status, the clinician will have to first touch the F-ALERT RESET to reset the alert, and again, to confirm the patient's name.

To advance and calibrate the fetal recorder paper:

- 1 Touch PAPER FEED.

Loading Chart Paper

To load chart paper:

1. Press the **Recorder Release** button and slide the drawer out to reveal the paper bin.
2. Pull out one or two sheets of paper from the top of a new packet and place the remaining packet of paper into the recorder drawer. Position the top of the paper (fetal heart rate scale) toward the left of the drawer with the printed side facing up.
3. Slide the recorder door back until it snaps securely in place. Make sure that the leading two sheets of paper hang out of the monitor.



- *For the protection and proper performance of the recorder, use only paper approved by Spacelabs Medical. Failure to use approved paper may result in a malfunction.*

Calibration

Calibration provides a functional check of the equipment and helps ensure a reliable recording. Calibration should be performed before beginning a recording and can be done at any time during monitoring.

To calibrate:

1. Touch the FETAL key.
2. Touch the PAPER FEED key.
3. FHR 1–150, UA –50, and FHR 2–180 will be displayed and the recorder will print corresponding lines on the fetal strip chart.



- *Following calibration, check that the recorder printed a line at 150 and 180 to ensure the paper is the correct scale.*

Ultrasound Monitoring

Channel 1

The ultrasound transducer sends sound waves into the uterine cavity and detects echoes returning from objects in the path. The monitor uses auto-correlation to analyze these echoes from moving objects, specifically the fetal heart. The rhythm of the motion is used to compute the fetal heart rate. To produce a reliable recording, **the transducer must be positioned properly** to send sound waves directly at the fetal heart.



- *To obtain consistent, reliable information, proper application of transducers is essential.*

Ultrasound Transducer Preparation and Application

The transducer connections are color-coded and uniquely keyed.

1. Plug the ultrasound transducer (green) connector into the FHR1 (green) connector on the front of the monitor. The groove on the transducer connector must be aligned properly.
2. Apply a generous amount of gel over the face of the ultrasound transducer.



- *The gel is necessary to ensure that good signals are produced by the transducer. Use enough gel to cover the flat transducer face before it is placed on the mother's abdomen. Add additional gel, if necessary, to improve the signal.*

3. Adjust the volume as necessary to hear the fetal heart sounds while positioning the ultrasound transducer.



- *Remember to calibrate the monitor each time you begin a monitoring session. Refer to Calibration on page 15-6.*

4. Place the transducer on the mother's abdomen and gently move it along the abdomen to locate the sharpest and clearest fetal heart sounds.



- *Keep the transducer face in contact with the abdomen. Tilt the transducer to locate the clearest heart sounds, then reposition it in the direction of the tilt until you hear the best signal while the transducer is flat on the abdomen.*

5. The transducer should be held securely in place with the transducer belts without causing discomfort to the patient.
6. Check the mother's pulse. Be sure it does not coincide with the displayed heart rate. If it does, the transducer may be detecting the maternal blood flow, rather than the fetal heart beat. Reposition the transducer toward the fetal heart.

To set the twin FHR shift:

- 1 Touch the SETUP key on the main fetal menu.
- 2 Touch the TWIN SHIFT key.
- 3 Select MANUAL, AUTO, or NO SHIFT mode.

Channel 2

The monitor is equipped with a second FHR connector to provide simultaneous monitoring of twins. Both fetuses can be monitored using ultrasound transducers. Ultrasound transducer preparation and application for the second fetus is the same as for a single fetus. Volume controls for both channels are located on screen.



- *Make sure that both transducers are not directed at the same fetus. Review the information on Differentiation of Fetal Heart Rate on page 15-8 and Coincidence Recognition on page 15-8.*

Differentiation of Fetal Heart Rate

To aid in distinguishing twin fetal heart rates, the operator can select one of three modes for presentation of the fetal heart rate data for the second fetus. The three modes are:

- FHR2 prints on the same scale as FHR1
- FHR2 prints on a scale 30 bpm below FHR1 (twin shift manual setting)
- FHR2 shifts to a scale 30 bpm below FHR1 when the monitor detects the two FHRs to be in proximity to each other (auto setting). To differentiate twin FHRs on the fetal strip chart, the FHR2 trend prints in a light gray compared to the darker FHR1 trend. When twin fetal heart rates intersect, the FHR2 trend prints dots only, rather than a line, to enhance the distinction between the two. Finally, the recorder prints **HR2** every 10-minutes with a dotted line pointing to the FHR2 trend. If the 30-bpm offset is activated, the message will read **HR2, Add 30**.



- *Once shifted, FHR2 will remain on this alternate scale until the monitor detects a consistent pattern of baseline separation between the two fetal heart rates. In many cases, this alternate scale may remain in effect throughout the delivery.*

Coincidence Recognition

The system has a coincidence recognition feature to detect the same heart rates between FHR1 and FHR2 over a period of time. When a coincidence is suspected, the monitor prints a question mark (?) on the strip chart to notify the clinician.



- *If these marks appear, the FHR1 and FHR2 signals may be from the same fetus. Re-check the ultrasound transducer positions. If necessary, reposition the transducers to capture the fetal heart rates from different fetuses.*
- *This detection may not occur if channel 1 is in ECG mode and channel 2 is ultrasound, because of the difference in signal processing.*
- *This detection may not occur if one or both of the ultrasound channels have a poor signal quality.*

Uterine Activity

The toco transducer detects uterine activity by sensing changes in tension on the abdomen. Although absolute uterine pressure cannot be measured by this method, the toco transducer does provide a reliable indication of the timing and approximate duration of contractions.



- *Do not use any kind of gel on the toco transducer.*

To initialize uterine activity:

- 1 Touch the UA REF key.
- 2 Touch YES to confirm.

To set the Toco sensitivity:

- 1 Touch the SETUP key on the main fetal menu.
- 2 Touch the TOCO SENS key.
- 3 Select LOW, MEDIUM, or HIGH sensitivity.

Toco Transducer Preparation and Application

1. Plug the toco transducer (yellow) connector into the UA (yellow) connector on the front of the monitor. The groove on the toco transducer connector must be aligned properly.
2. Position the transducer on the maternal abdomen. The best location is usually midline between the fundus and the umbilicus.
3. The transducer should be held securely in place with the transducer belts without causing discomfort to the patient.
4. To initialize, touch the UA REF key. The UA display will reset to 20 units momentarily.



- *Toco sensitivity can be set at three different levels enabling you to adjust the sensitivity to meet the specific needs of a particular patient.*

ECG Monitoring

In addition to ultrasound, channel 1 is designed to monitor fetal heart rate using an invasive spiral electrode to obtain the fetal ECG and derive the heart rate. The ECG (internal) mode is generally considered the most accurate and reliable method to obtain a fetal heart rate.

Fetal ECG Electrode Preparation and Application



WARNING:

- ***Because the tip of the fetal spiral electrode is designed to penetrate the fetal skin, it may present the possibility of trauma, hemorrhage, or infection. Therefore, these electrodes should only be used under aseptic conditions. Refer to contraindications and application instructions on the electrode manufacturer's packaging.***
- ***To apply the fetal ECG spiral electrode, the membranes must be ruptured.***



- *If both the fetal heart rate and uterine activity are to be monitored using internal techniques, it is generally recommended that the intra-uterine catheter be inserted before the attachment of the spiral electrode.*

1. Prepare an area on the patient's upper thigh or, preferably, on the lower abdomen by cleaning with an alcohol swab. Allow to dry.
2. Apply a pre-gelled ECG skin electrode to the prepared area.
3. Plug the leg clip (green) connector into the FHR 1 (green) connector on the front of the monitor. The groove on the transducer connector must be aligned properly.



- *To acquire ECG data, the leg clip must be connected to FHR channel 1.*
- *The leg clip does not work on FHR channel 2.*

4. Apply the fetal spiral electrode according to the instructions on the manufacturer's packaging.
5. Once the spiral electrode has been attached, press the top of each push post on the leg clip to reveal a slot. Insert each wire (two) from the electrode into each slot on the leg clip. There are no color-coded requirements, either wire can be inserted into either post.
6. Gently pull the wires to make sure they are firmly attached to the leg clip. They should not disconnect.
7. Attach the leg clip to the pre-gelled skin ECG electrode on the patient's thigh or abdomen.
8. Check that the monitor is receiving appropriate signals, and adjust the audio key to hear the tone (R-wave detection), as necessary.

Intrauterine Pressure Monitoring

Actual intrauterine pressure, including contraction frequency, duration, intensity, and uterine tone (pressure between contractions), is measured using an intrauterine catheter and pressure transducer. Application techniques for internal pressure catheters are considered to be beyond the scope of this manual. Consult the manufacturer's instructions included with the package for proper application techniques.



WARNING:

- *When inserting the intrauterine pressure catheter, the membranes must be ruptured.*

Pressure Transducer Preparation and Application: Reusable Pressure Transducer (Fluid Filled Catheter)

1. Follow manufacturer's instructions on the preparation and insertion of the intrauterine catheter.
2. Level the pressure transducer with the maternal xiphoid or the top of the fundus.
3. Plug the pressure transducer (yellow) connector into the UA (yellow) connector on the front of the monitor. The groove on the transducer connector must be aligned properly.
4. Attach a 3-way stopcock (from the intrauterine catheter kit) to the side port of the pressure transducer (strain gauge). Attach a pressure relief valve or dead-end stopper to the top port.
5. Once the intrauterine catheter has been inserted, remove the catheter guide, and attach the catheter to the 3-way stopcock.
6. Fill a 20 cc syringe with sterile water and attach it to the 3-way stopcock.
7. Turn the handle of the stopcock toward the pressure transducer and flush the catheter with at least 5 cc of sterile water.



- *Check to ensure that all of the air bubbles have been removed.*
- *If there are still air bubbles in the dome, repeat the process.*

8. Turn the handle of the stopcock toward the catheter.
9. Lift the cap on the pressure relief valve or remove the dead-end stopper on the top of the pressure transducer (strain gauge) dome to vent the dome. Flush the transducer with 1 to 2 cc of sterile water.



CAUTION:

- **Do not attempt to force water into the transducer dome unless it is vented to the air. Permanent damage to the transducer may result.**

10. Touch the RECORDER key to turn the recorder ON.
11. Touch the UA REF key to initialize.

12. Press **Yes** to confirm the initialization. The UA display should read 0 (zero). Release the cap on the pressure relief valve or replace the dead-end stopper to reseal the dome.



- *Check to see that all of the air bubbles have been removed.*
- *If there are still air bubbles in the dome, repeat the process.*

13. Turn the handle of the stopcock toward the syringe to begin recording uterine activity.



- *Between contractions, the UA channel should not return to zero. This is the measure of the uterine resting tone.*

If, during monitoring, the UA channel does not appear to be accurately recording contractions or the tracing of the contractions looks jagged or angular, either the catheter has collected debris from the amniotic fluid or it contains air bubbles. If this happens, take the following steps:

1. Turn the 3-way stopcock toward the pressure transducer.
2. Flush with 5-10 ml of sterile water.
3. Turn the handle of the stopcock toward the syringe.
4. Check the recording.

Transducer-Tipped Catheter — Disposable

Application techniques for internal pressure transducers are considered to be beyond the scope of this manual. Consult the manufacturers instructions included with the package for proper application technique.

1. Plug the intrauterine pressure catheter (yellow) connector into the UA (yellow) connectors on the front of the monitor.
2. Touch the UA REF key to initialize.
3. Press **Yes** to confirm the initialization. The UA display on the monitor should read 0 (zero) and the strip chart should record 0 (zero).
4. Follow manufacturer's instructions on the preparation and application of the intrauterine pressure catheter.



- *To check that the system is operational, it is often helpful to ask the patient to cough. This should produce an artifact on the fetal strip chart recording.*
- *Utah Medical IPC 400 is the only catheter-tipped transducer recommended for use with this monitor.*

To initialize uterine activity:

- 1 Touch the UA REF key.
- 2 Press **Yes** to confirm.

Main Menu

When the FETAL key is touched, the menu will appear at the bottom of the screen. This menu will remain on screen during the monitoring session, unless the operator accesses another menu screen. To return the to Main menu, touch the FETAL key.

Fetal Heart Rate Alerts

To turn F-Alert ON or OFF:

- 1 Touch the SETUP key on the main fetal menu.
- 2 Touch the F-ALERT limits key.
- 3 Select F-ALERT ON or OFF.

To set fetal alert limits:

- 1 Touch the SETUP key on the main fetal menu.
- 2 Touch the F-ALERT limits key.
- 3 Select F-ALERT ON.
- 4 Select the HI= or LO= key.
- 5 Use the arrow keys to adjust the limits.

To silence and reset the alert:

- 1 Touch F-ALERT RESET.

The fetal module provides two alert conditions for fetal heart rate: operator-set limits and pattern recognition.

The fetal heart rate pattern recognition alert function activates if the bradycardia or tachycardia alert limits are violated for a preset period of time or if heart rate patterns described below occur. The alert function serves the purpose of notifying the care giver of a potential condition that might be developing and should not replace any of the care giver's functions.



- *When an alert condition occurs, the monitor provides several indications. Alert reset removes these indications.*
- *A message flashes Heart Rate F-Alert.*
- *The FETAL key will flash.*
- *A tone will sound if tones are enabled.*

The monitor will generate an alert when twenty consecutive, one-second samples of fetal heart rate are below the operator-set limit. The factory default is 84 bpm.

Bradycardia Alert

Type 1

The heart rate is divided into eight groups of 20-seconds each. Group **H** represents the current 20-seconds.

An alert will activate if Groups **G** and **H** are below 90 bpm.

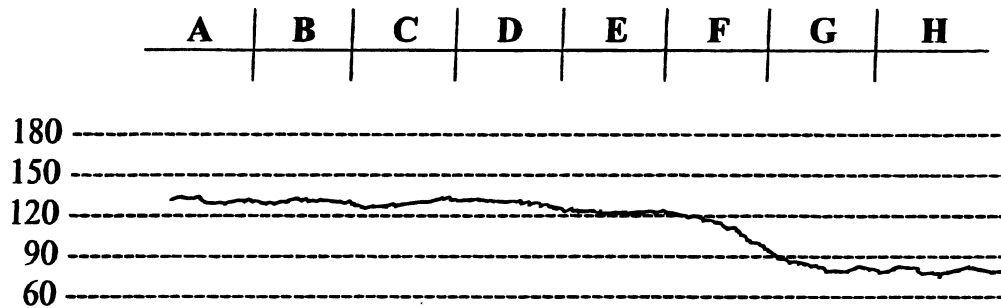


Figure 15-3: Type 1 bradycardia alert



CAUTION:

- Any time the alert activates, the heart rate must return to normal before the Alert can be reactivated. Reset the alert by pressing the F-ALERT RESET key on the screen.
- If a group of heart rates is less than 30 bpm, the algorithm considers this condition a loss of signal and a NO ALERT will occur.



- All representations of fetal heart rates in this chapter are computer generated.

Type 2

An alert will activate if:

- Group **H** is less than Group **F**; and
- Group **G** is less than Group **E**; and
- Group **F** is less than Group **D**; and
- Group **E** is less than Group **C**; and
- Group **H** is below Group **C** by more than 30 bpm.

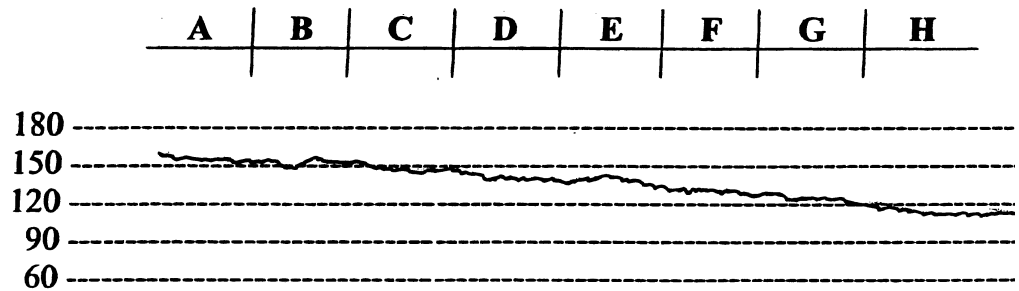


Figure 15-4: Type 2 bradycardia alert

Type 3

An alert will activate if the average of Groups **G** and **H** is lower than the average of Groups **A**, **B**, **C**, and **D** by more than 40 bpm.

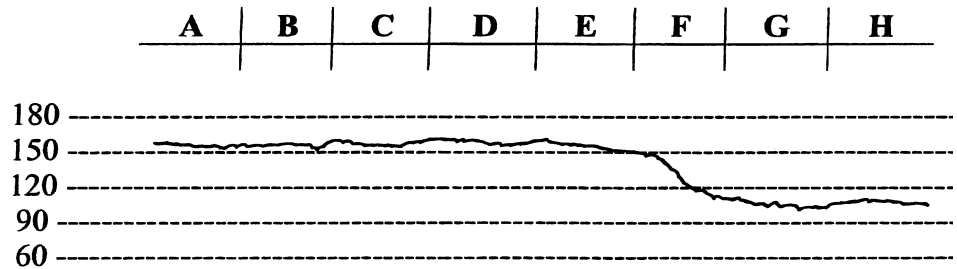


Figure 15-5: Type 3 bradycardia alert

Tachycardia Alert

The monitor analyzes the fetal heart rate for tachycardia using the following algorithms. The heart rate is divided into eight groups of 20-seconds each.

Type 1

An alert will activate if:

- Group **C** is less than 180 bpm, and
- Groups **F**, **G**, and **H** are each greater than or equal to 190 bpm.

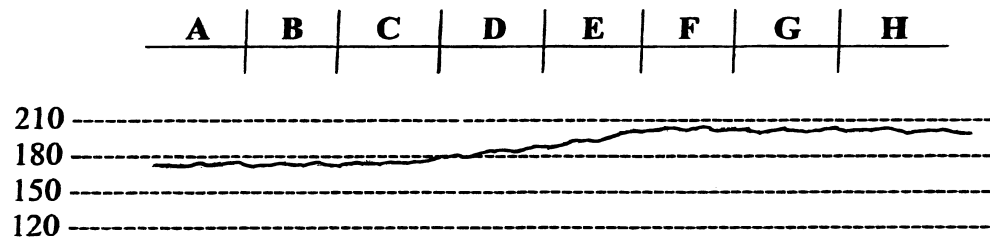


Figure 15-6: Type 1 tachycardia alert



- The most recent Heart Rate Group is **H**; Heart Rate Group **A** must not be zero.

Type 2

An alert will activate if Group **A** is less than the tachycardia limit set by the operator, and Groups **B**, **C**, **D**, **E**, **F**, **G**, and **H** are each greater than or equal to the tachycardia limit set by the operator. The example shown below has the limit set at 180 bpm.

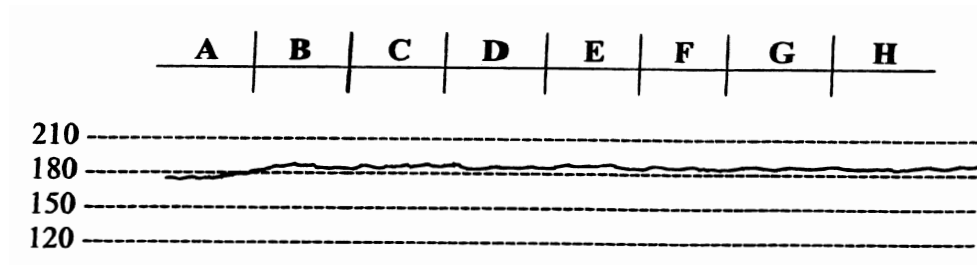


Figure 15-7: Type 2 tachycardia alert

Recorder Operations

The monitor is automatically programmed to print predetermined data items on the fetal strip chart. The following two strips identify the data items and illustrate how twin FHRs print on the strip. The recorder will also print values from maternal monitoring parameters. When installed with the BirthNet Obstetrical Data Management System, designated data items entered in BirthNet will also print on the strip.

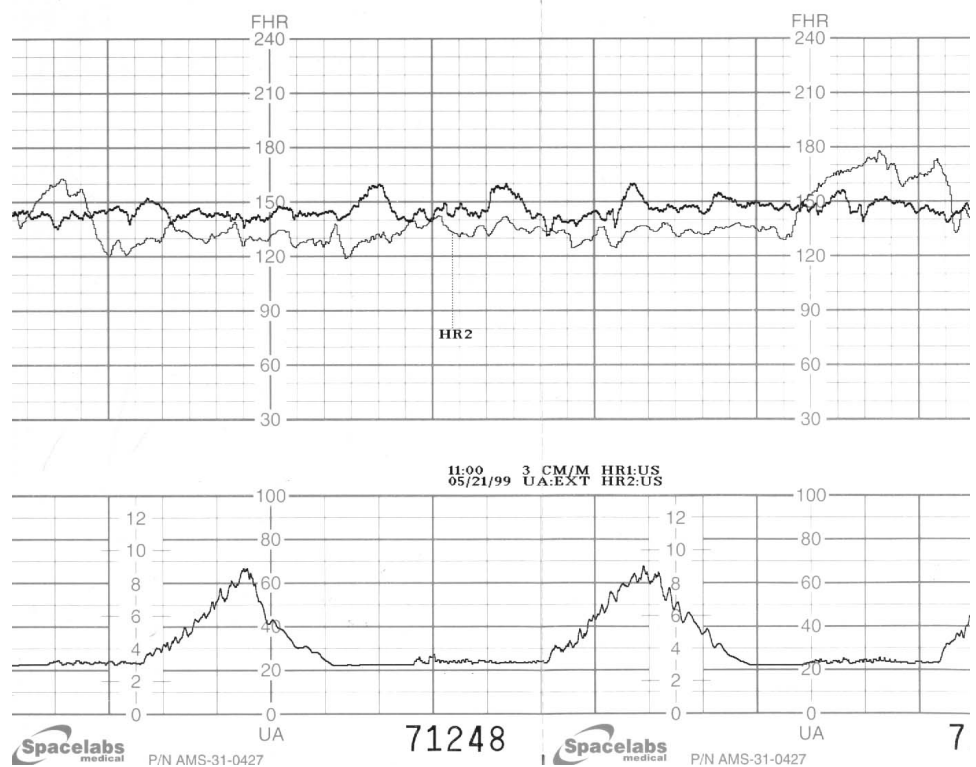


Figure 15-8: Twin fetal heart rates on the same scale

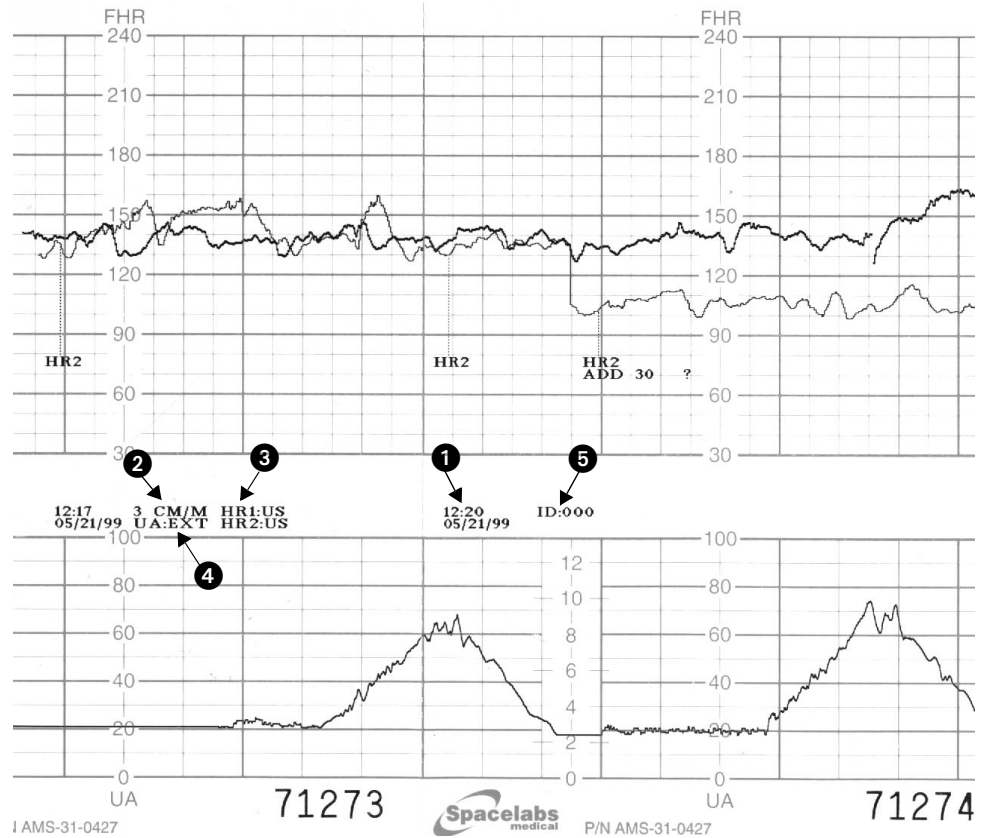


Figure 15-9: Twin fetal heart rates on same scale, then shifted to separate scales

These messages print according to the following schedule:

Table 1: Print Time Intervals

DATA ITEM	TIME INTERVALS
1 Time and Date	Every 5-minutes
2 Recorder Speed	5-, 20-, 35-, and 50-minutes after the hour
3 HR Mode	5-, 20-, 35-, and 50-minutes after the hour
4 Uterine contraction mode	5-, 20-, 35-, and 50-minutes after the hour
5 Monitor ID #	10-, 25-, 40-, and 55-minutes after the hour
Twin Shift (when selected)	Every 10-minutes "HR2 add 30" prints
? (for signal coincidence)	Upon detection

Event Marker Functions

To mark an event on the fetal strip:

- 1 Touch the MARK key.

To mark an event on the strip chart recorder, touch the MARK key on the screen. The recorder will print a black bar at the top of the heart rate scale. The monitor is also equipped with an external Event Marker. When the external Event Marker is pressed, the recorder prints an arrow at the top of the heart rate scale.

To set the time interval for SpO₂ and MHR parameters to print on the fetal strip:

- 1 Touch the SETUP key on the main fetal menu.
- 2 Touch PRINT PERIOD.
- 3 Select numeric value equal to the number of minutes to set the time interval for SpO₂ and MHR parameters to print on the fetal strip.

Printing Heart Rates Over 240 bpm (ECG only)

When a spiral electrode is in use and the heart rate exceeds 240 bpm, the numeric value (up to 300) is displayed on the screen. On the fetal strip chart, the monitor will automatically plot the scale at half-rate when the heart rate is over 240 bpm (i.e., if the heart rate is **250 bpm**, it plots at **125 bpm**). A two-dot bar prints on the top of the fetal strip chart to indicate this half-rate scale is in effect. When the heart rate falls below 240 bpm, the monitor resumes normal plotting procedures.

Maternal Parameters

The maternal physiological data (such as SpO₂, NIBP, etc.) from the Ultraview Command Module or other Spacelabs Medical modules are printed on the fetal strip at designated intervals (1- to 60-minutes).



- *Maternal SpO₂ and heart rate values are printed on the strip as MSpO₂ and MHR.*

To set ECG HR Edit:

- 1 Touch the SETUP key on the main fetal menu.
- 2 Touch the FETAL ECG key.
- 3 Select ECG HR Edit ON or OFF.

ECG HR Edit

The fetal module can recognize and edit fetal heart rate changes between two consecutive heart beats that are greater than 30 beats per minute. If ECG edit is ON, connecting (slew) lines between consecutive heart rates are not plotted. Under these circumstances, the tracing appears to have gaps.

To set ECG plot:

- 1 Touch the SETUP key on the main fetal menu.
- 2 Touch the FETAL ECG key.
- 3 Select ECG PLOT ON or OFF.

ECG Plots

When monitoring in the ECG mode (spiral electrode), the monitor can be setup to print short "rhythm strips". If a change in heart rate greater than 20 bpm between two consecutive fetal ECG complexes is detected, this change triggers the monitor to plot the ECG rhythm strip, representing approximately 4-seconds of data: 2-seconds before and 2-seconds after the triggering event.



- *The monitor does not recognize another triggering event until the rhythm plot is complete. Following completion, the monitor will recognize and plot the next event.*
- *Artifacts may also trigger the monitor to plot the fetal ECG.*

The ECG rhythm strip feature can also be triggered manually. When the Event Marker is pressed (and the ECG HR is not plotting), a small arrow appears on the strip and the ECG rhythm strip plots.

The ECG data is presented at standard 25 mm/sec, although the monitor runs at 3 cm/min. It will take about three and a half minutes at 3 cm/min. for an entire ECG rhythm strip to print.



- *Arrows indicate the triggering event.*

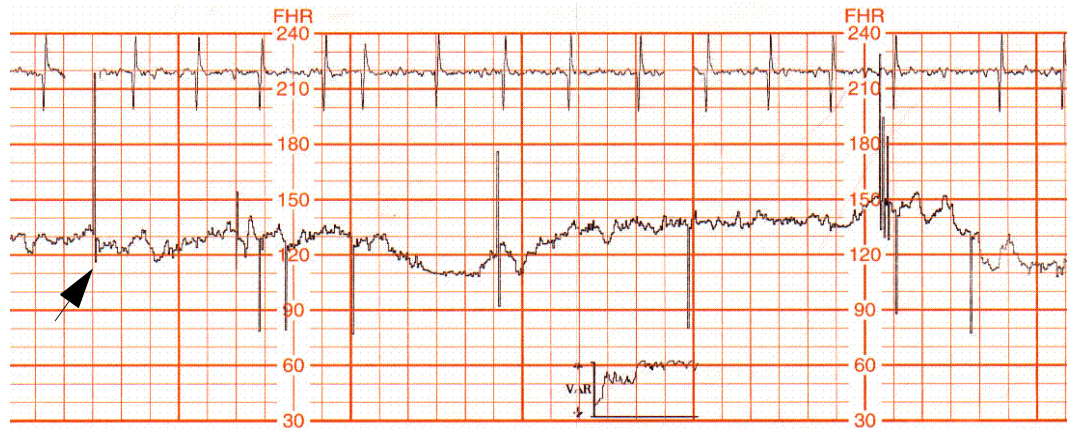


Figure 15-10: ECG rhythm strip

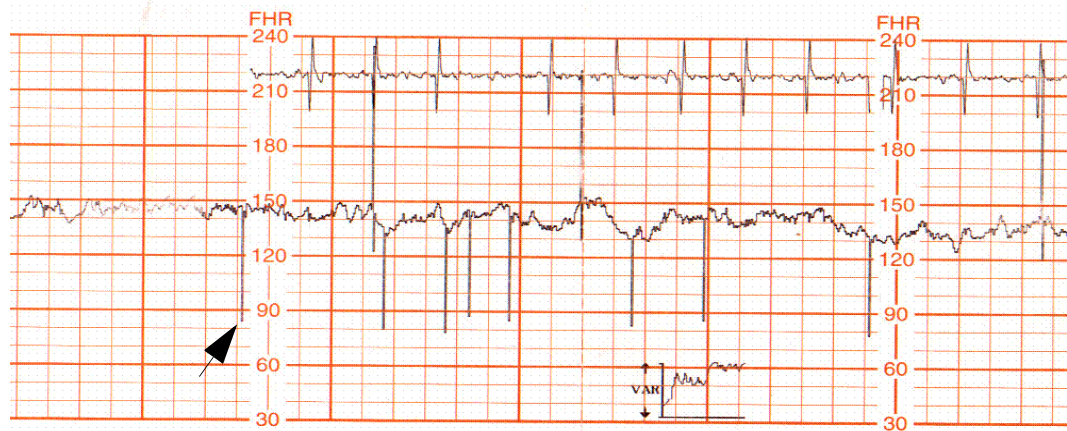


Figure 15-11: ECG rhythm strip

Variability Trend Plots

When operating in ECG mode, a trend of fetal heart rate variability is automatically calculated and plotted. This X-Y graph, printed every 10-minutes, is computed by combining long-term and short-term heart rate variability. One point is plotted for each 128 heart beats.

The X-axis corresponds to time, and the Y-axis corresponds to the value of variability for each measurement. The Y-axis is divided into three levels of variability:

- above average
- average
- below average

The most recent data is represented at the right side of the graph and it takes approximately 100-minutes of monitoring for the variability plot to reach its full capacity.

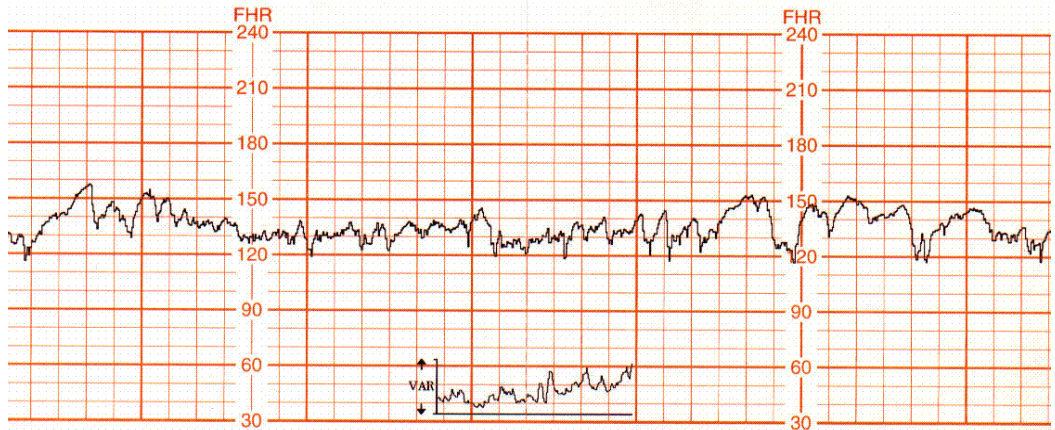


Figure 15-12: Above-average variability plot

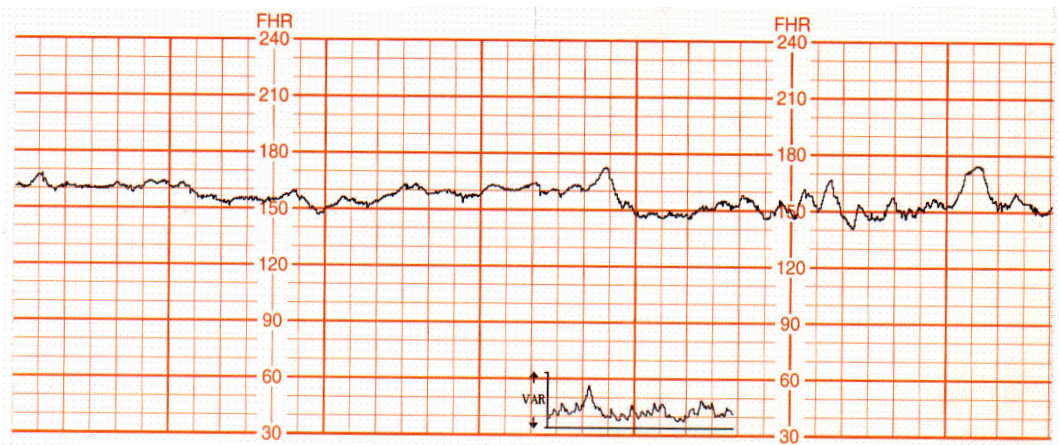


Figure 15-13: Average variability plot

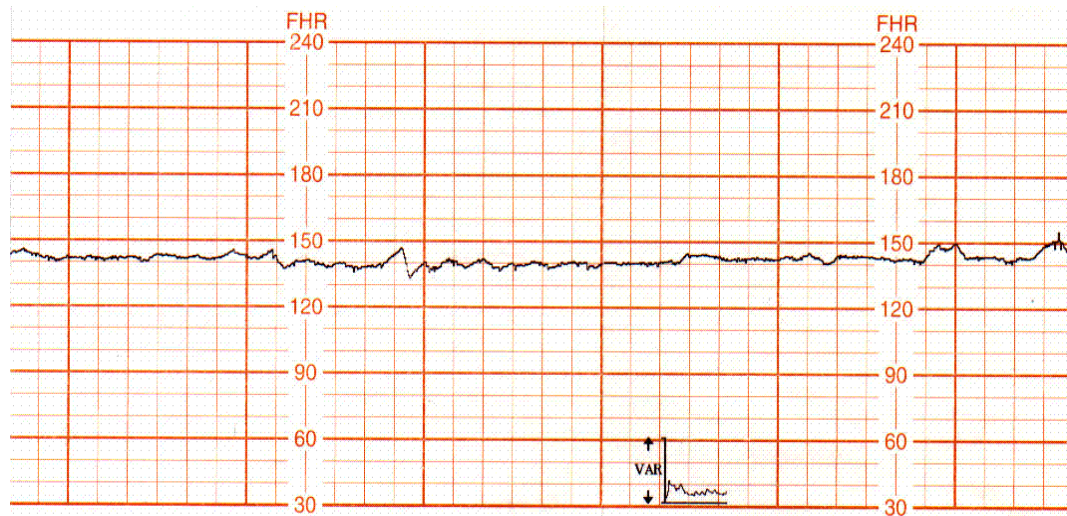


Figure 15-14: Below-average variability plot



- The Variability Trend Graph is only generated in direct ECG mode from FHR channel 1.
- Variability data is not meant to indicate the status or well being of the fetus.
- Variability data is a mathematical expression of the variability of the fetal heart rate displayed in a convenient way.

Paper Out Memory

If the recorder runs out of chart paper, the screen flashes PAPER OUT in the dedicated status area on the screen.

When this condition occurs, the monitor continues to collect and store fetal heart rate and uterine activity data up to one hour (40-minutes if monitoring twins). Once the paper is replaced, the monitor prints the stored data at 12 times real time. A vertical line marks the start and end points, along with the messages MEM START and MEM END. When the stored data has been printed, normal (real-time) recording resumes.

To disable the fetal recorder:

- 1 Select RECORDER OFF.



- All collected data is erased when the recorder is powered OFF.
- If you wish to print the collected data, do not power OFF the recorder when replacing the paper.
- To terminate a print session on the fetal strip chart, select RECORDER OFF.

Module Configuration Manager

The Module Configuration Manager feature provides the capability to define and store all user-configurable options for the fetal parameter. Once configured, these settings control its operation whenever the monitor is powered ON.

Display Detail

The User Settings screens list all user-configurable options. From these screens you can change and store the options in your monitor.

Figure 15-15 illustrates the User Settings screen which is used to change and store fetal rate alarm limits.

The parameter configuration table in this chapter lists all available options, the available user settings, and the factory defaults for each parameter.

PARAMETER DESCRIPTION	VALUE	PARAMETER DESCRIPTION	VALUE
FETAL RATE ALERT	OFF	ECG RATE ALARMS (INFANT)	NO SHIFT
• HIGH RATE	180	TOCO SENSITIVITY	MEDIUM
• LOW RATE	84	ECG PLOT	ON
FETAL ECG WAVEFORM	ON	ECG EDIT	OFF
• FECG WAVEFORM SIZE	1.00	EXTERNAL DEVICE	NONE
• FECG SWEEP SPEED	25	PRINT PERIOD	10
Enable/Disable Fetal Rate Alert			

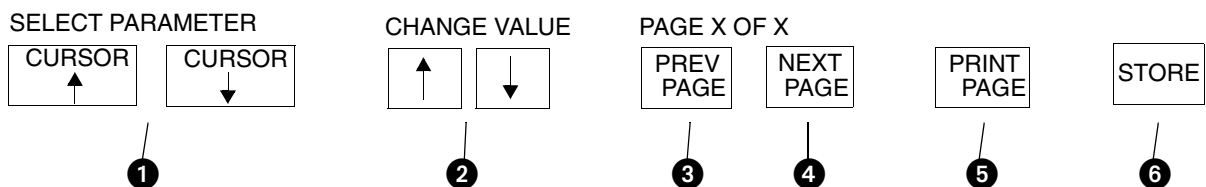


Figure 15-15: User settings

- ❶ CURSOR ↑ and CURSOR ↓ keys scroll through the two columns of parameters on the screen.
- ❷ ↑ and ↓ keys scroll the list of valid settings for the highlighted parameter.
- ❸ PREV PAGE key returns to the previous screen.
- ❹ NEXT PAGE key advances to the next screen.
- ❺ PRINT PAGE key prints the current screen.
- ❻ STORE key stores the currently selected settings as defaults.

Setting User-Defined Default Values

Use the User Settings screens to change and store settings. If the setting for the selected parameter cannot be changed, the message THIS SETTING CANNOT BE CHANGED will be displayed.

The ability to access the Module Configuration Manager screens can either be visible to all users or remain hidden. The factory default setting is INVISIBLE. Adjust the SYSTEM SETUP key to the VISIBLE setting to enable user access to this function.

Storing Changed Settings

Touch the STORE key after entering configuration changes for any page. This action stores the currently selected settings for all entries.

The Patient Admit/Discharge function allows you to SAVE the changes in the alarm limit settings as the default settings for future patients, or RESTORE the original default settings upon discharge of that patient or admission of a new patient.

Parameter Configurations

To review or change settings:

- 1 Touch FETAL.
- 2 Touch SETUP.
- 3 Touch the hidden key 3 times.
- 4 Touch DEFAULT STORAGE.
- 5 Touch USER SETTINGS.
- 6 Use CURSOR \uparrow and CURSOR \downarrow to scroll through the parameter description list.
- 7 Use \uparrow and \downarrow to change the settings.
- 8 Touch NEXT PAGE to continue to next screen of parameters.
- 9 Touch STORE to save the new settings.
- 10 Touch YES when the Yes/No message is displayed.

Table 2: Fetal Parameter Configuration

Parameter	Available User Settings	Factory Defaults	User Settings
Fetal Rate Alert	On/Off	Off	
High Rate Limit	160-210 bpm	180 bpm	
Low Rate Limit	70-130 bpm	84 bpm	
FECG Waveform	On/Off	On	
FECG Waveform Size	0.10-2.00	1.00	
FECG Sweep Speed	25 or 50 mm/sec	25 mm/sec	
Twin Shift	Auto/Manual/No shift	No shift	
Toco Sensitivity	High/Medium/Low	Medium	
ECG Plot	On/Off	On	
ECG Edit	On/Off	Off	
External Device	None/Nellcor FSpO ₂	None	
Print Period	1- to 60-minutes	10-minutes	
Chart Recorder	On/Off	On	
Speed	1, 2, or 3 cm/minute	3 cm/minute	
Heat	1/2/3	2	
Alignment	0-10	3	
Scale	USA/INTL	USA	
Variability Plot	On/Off	On	
FHR1 Audio Level	Off, 50% - 100%	75%	
FHR2 Audio Level	Off, 50% - 100%	75%	
Patient Name Source	Auto/Manual	Auto	
Time/Date Format	USA/INTL	USA	
CIM Protocol	A/B	A	
CIM Baud Rate	9.6k/19.2k	9.6k	
Modem ID	0-255	0	
Simulator	On/Off	Off	
Begin Address	0-127	0	
End Address	0-127	0	
Increment	1-63	0	
System Setup Key	Visible/Invisible	Invisible	
Patient Admit/Discharge	Save/Restore	Restore	

Table 3: Fetal Alert Attributes

Alarm Type	Tone Type			Alarm Recording			Alarm Watch		
	Available User Settings	Factory Defaults	User Settings	Available User Settings	Factory Defaults	User Settings	Available User Settings	Factory Defaults	User Settings
Fetal Heart Rate Alert	Medium	Medium		N	N		Y/N	N	

Telemetry Option

Each fetal monitor can be equipped with a fetal telemetry system to provide continuous monitoring of an ambulatory patient. The patient carries a small transmitting device that transmits signals to the fetal monitor for recording. The fetal telemetry system transmits ultrasound, Toco, and nurse call information to a corresponding receiver connected to the fetal monitor.

Fetal Monitor Telemetry Operating Instructions

1. Open the battery compartment and install a fresh 9-volt alkaline battery.
2. Insert the antenna into the antenna jack on the transmitter.
3. Ensure that either the whip antenna or extended range antenna system is attached to the fetal monitor. The whip antenna should be extended at least two sections.
4. Power ON the transmitter.
5. Apply the ultrasound transducer and toco transducer. (Refer to *Ultrasound Transducer Preparation and Application* on page 15-7 and *Toco Transducer Preparation and Application* on page 15-9.) The data from the telemetry unit is transmitted to the fetal monitor for display and printing on the strip chart.
6. The unit is supplied with headphones that allow the patient to listen to the fetal heart sounds. The patient should continually hear fetal heart sounds through the earphones. She should be instructed to move the ultrasound transducer slightly if the sound quality diminishes. If unable to reestablish the heart sounds, the patient should notify her clinician.
7. When the red **Nurse Call** button on the transmitter is pressed, an audible tone emits from the fetal monitor. To cancel the tone, touch the F-ALERT RESET key on the Fetal Main menu.



- *When the transmitter is powered ON, it should emit a short tone to indicate that the battery is good. If the battery is low, the transmitter emits a steady tone until depleted. Replace the battery if the transmitter is emitting a steady tone or is depleted.*
- *If the patient exceeds the receiving range, the signal may be weak or may drop out. The patient should return to within range of the fetal monitor.*
- *Certain locations may require that the whip antenna be fully extended to enhance reception.*
- *Each telemetry unit (transmitter) operates on a specific radio frequency and is uniquely paired with a receiver internal to the fetal module. These must remain together to operate properly.*

Mermaid Option

The Mermaid option is designed to enhance the birthing experience for mothers who require continuous monitoring but would like to relax in a shower or tub, or to move around without being “tethered” to a monitor. The patient wears a small transmit badge that is attached to the waterproof ultrasound and toco transducers by a short cable. Mermaid differs from telemetry in that the transmission of the fetal heart rate and uterine contractions take place through infrared technology rather than radio frequencies. The transducers run on batteries that will operate for 8-hours (typical) before batteries must be changed. Recharge time is about one hour. You may have some minor interference from lights in the patient’s room, or the patient may move beyond the range of the system. If this should happen, either move the receiver to a location with a better view of the patient, or have the patient move closer to the antenna.

Monitoring Procedure

1. Make sure that the Maternal Obstetrical Monitor is attached to the Mermaid receiver system. The connector is located on the right side panel of the Maternal Obstetrical Monitor.
2. Attach a battery pack (a) to the Mermaid toco transducer by aligning the ridge with the transducer cable connector (b). The battery pack should fall into the transducer element with a noticeable movement.

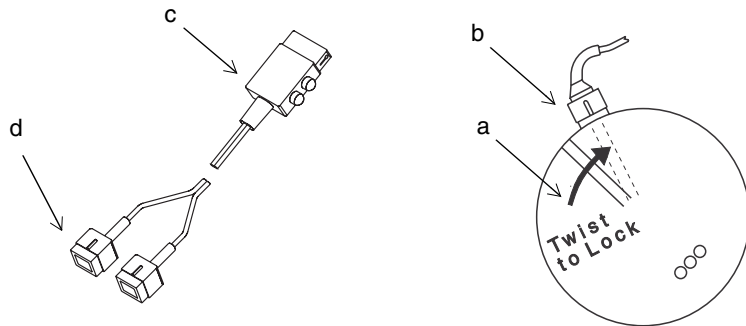


Figure 15-16: Wireless transducer — Mermaid system

3. Twist the battery pack clockwise slightly to lock it into the Toco transducer. Repeat the procedure for the Mermaid ultrasound transducer.
4. Pin the transmit badge (c) to the patient's clothing (preferably at shoulder level) with the clasp or use the necklace provided. Clothing or blankets must not cover the badge.
5. Attach either of the blue connectors (d) on the transmit badge to the Mermaid Toco transducer.
6. Position the Mermaid Toco transducer on the patient's abdomen using the same technique as conventional transducers. Refer to *Toco Transducer Preparation and Application* on page 15-9 for more information.
7. Attach the other blue connector (d) on the transmit badge to the Mermaid ultrasound transducer.
8. Position the Mermaid Ultrasound transducer using the same technique as conventional transducers. Refer to *Ultrasound Transducer Preparation and Application* on page 15-7 for more information.
9. When the monitoring session is finished, remove the battery packs and the transmit badge from the transducers. Follow hospital procedures for cleaning the equipment. Refer to *Cleaning and Sterilization* on page 32-1.
10. Store the transducer elements and transmit badge in the compartment in the rear of the recharger unit.
11. Store the battery in the charger by following the steps outlined below.



CAUTION:

- **Patients wearing Mermaid transducers should not wander into areas where another Mermaid system is operating. This would interfere with the other patient's data.**

Recharging Batteries

1. The battery packs are enclosed in the top half of the Mermaid ultrasound and Toco transducers (*Figure 15-17*). To remove the packs (a) from the transducer elements, twist the pack counterclockwise. There will be a noticeable movement. Simply pull the battery pack to disengage.



- *Thoroughly dry the battery pack before inserting it into the charger.*
- *The Mermaid battery charger may be used in the patient vicinity if it is powered by one of the following certified, medical-grade, power supplies:*
 - *Ault, Model SW172; Rated Input: 100-240VAC, 0.75-0.35A, 50/60Hz; Rated Output: 12VDC, 2.75A (P/N 010-1554-00)*
 - *Ault, Model VM100AMB1203B01; Rated Input: 100-250VAC, 0.3A, 50/60Hz; Rated Output: 12VDC, 0.85A (P/N 1043900-108)*
- *These power supplies are designated Class I by the applicable safety standards. Medical-grade, grounded outlets and power cords are required to ensure patient safety margins.*
- *Three lights indicate a full charge and 8-hours (typical) of operation. Two lights indicate that 2-hours (minimum) of monitoring time is left. One light indicates that less than 2-hours of monitoring time is left. When the one light starts to flash, less than 15-minutes of battery capacity is left.*

2. Insert a battery pack (a) in the docking station (e) on the recharger by aligning the ridge with the red dot. The battery pack should fall into the docking station with a noticeable movement.

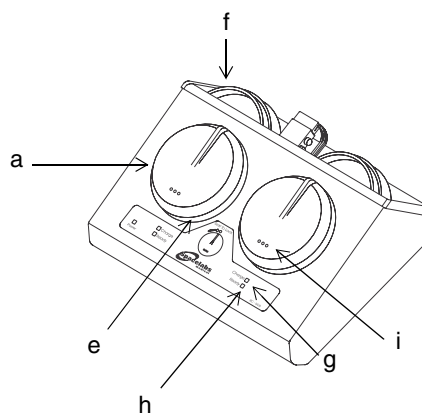


Figure 15-17: Wireless transducer — Mermaid system

3. Twist the battery pack clockwise slightly to lock it into the docking station. The bottom of the transducers do not need to be charged and should be stored along with the transmit badge in the compartment located in the rear of the recharger unit (f).

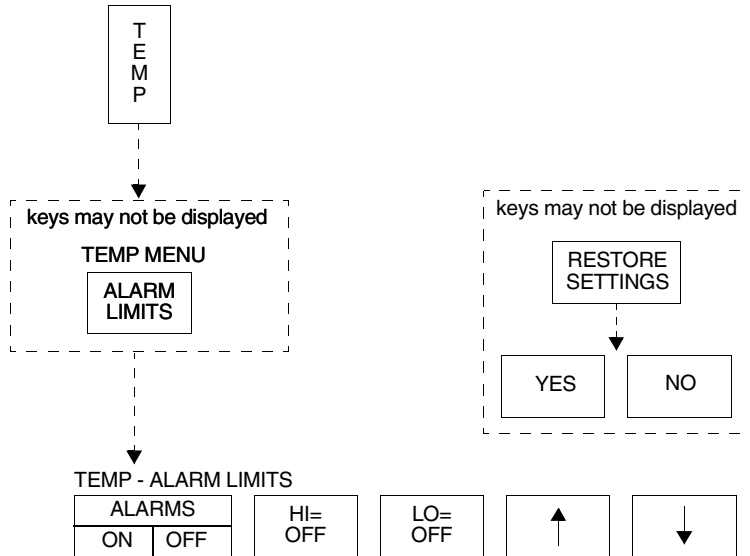
Ultraview Care Network

4. The amber light (g) on the recharger unit indicates that the battery pack is being charged. A green light (h) indicates that charging is complete. It may take up to one hour to reach a full charge. The battery packs may be left on the charger when the transducers are not in use.
5. Each battery pack has three green lights (i) to indicate the remaining charge. The lights automatically power ON whenever the battery pack is attached to the transducer or is being charged.

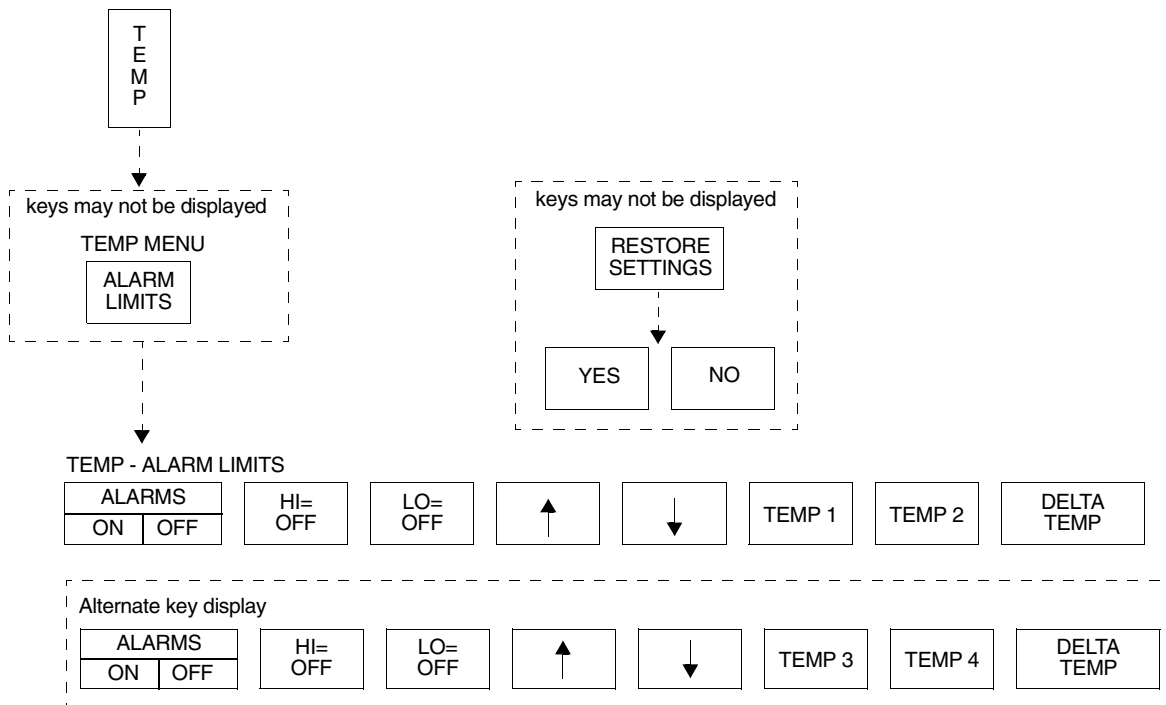
Temperature Directory

Directory of Keys

One Temperature



Two Temperatures (same module)



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

Temperature

Contents

Overview	3
Setting Up Temperature Monitoring.	3
Display Detail.	4
Setting or Adjusting Temperature Alarm Limits	5
Recording Temperatures	5
Restoring User-Defined Settings	5
Temperature Troubleshooting Guide.	6

Overview

Either one or two temperature inputs can be monitored. Whenever two temperatures from the same module are monitored, a delta value (temperature difference between the two readings) is calculated.

Temperatures are displayed in degrees centigrade only. You can set independent high and low alarm limits for each temperature, and the delta temperature.

Setting Up Temperature Monitoring

To set up temperature monitoring:

- 1 Attach the temperature probe(s) to the patient.
- 2 Plug the temperature probe(s) into the module.
- 3 Touch TEMP.
- 4 Select additional keys as needed during monitoring.

Attach the temperature probe(s) to the patient and then to the module. The TEMP key and temperature values now appear on the monitor screen. Touch TEMP to display the Temperature menu.



- *You can define your own default settings for alarm limits. Refer to Setting User-Defined Default Values on page 7-7 for further details.*

Display Detail

Temperature readings appear on the monitor screen as soon as you plug a temperature probe into the module.

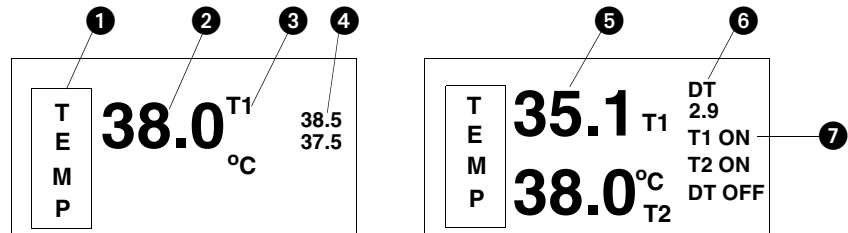


Figure 16-1: Temperature display

- 1 Temperature parameter key
- 2 Single channel temperature reading
- 3 Temperature label
- 4 High and low temperature alarm limits
- 5 Two temperatures (T1/T2 or T3/T4)
- 6 Delta temperature (DT)
- 7 Status of temperature alarms



- When alarm limits are set on more than one temperature, the alarm limits for only one temperature will be displayed. To view the alarm limits, touch TEMP, then ALARM LIMITS, then select the TEMP 1, TEMP 2, TEMP 3, TEMP 4, or DELTA TEMP key.

Setting or Adjusting Temperature Alarm Limits

To set or adjust alarm limits

- 1 Touch TEMP.
- 2 Touch ALARM LIMITS.
- 3 Select TEMP 1, TEMP 2, TEMP 3, TEMP 4, or DELTA TEMP.
- 4 Select ALARMS ON.
- 5 Select HI= or LO=.
- 6 Use arrow keys to adjust limit.

High and low alarm limits can be set for T1 (T3), T2 (T4), and the temperature difference (DT) between two temperatures.

The factory default settings for high and low temperature alarms are 37.5°C and 36.5°C. Refer to *Default Alarm Limits* on page 2-3 for details on system alarm operation.

Recording Temperatures

To print a strip chart of current temperature readings:

- 1 Touch RECORD.
- 2 Touch TEMP while it flashes.

You can send currently displayed temperature readings to a bedside recorder or system printer. Refer to *Printing* on page 4-5 for an overview of system printing information.

Restoring User-Defined Settings

To restore user-defined settings:

Configurations with ECG

- 1 Touch ECG.
- 2 Touch SETUP.
- 3 Touch RESTORE SETTINGS.
- 4 Select YES.

With the Restore Settings feature, you can restore the user-configurable settings to the defaults previously stored as user settings. User-configurable settings are listed in *Setting User-Defined Default Values* on page 7-7.



- *RESTORE SETTINGS changes the user-configurable settings for all parameters in the module.*

To restore user-defined settings:

Configurations without ECG

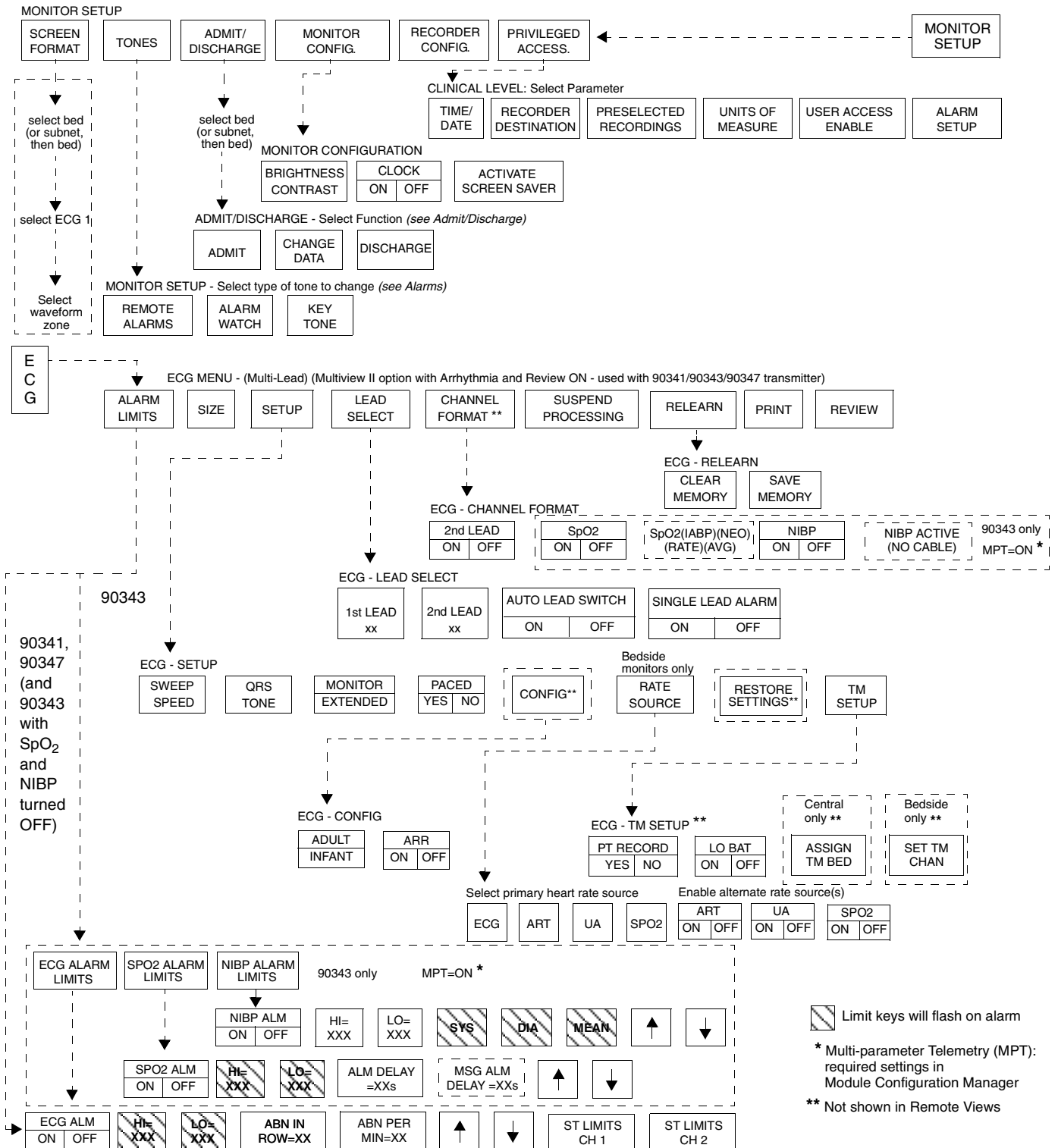
- 1 Touch TEMP.
- 2 Touch RESTORE SETTINGS.
- 3 Select YES.

Temperature Troubleshooting Guide

Clinical Situation	Possible Cause	Solution
Intermittent or no operation	■ Module error.	■ Call a qualified service person.
Temperature not displayed	■ Module not inserted correctly.	■ Reinsert the module.
	■ Probe not connected to module.	■ Reconnect the probe.

Digital Telemetry Directory

Directory of Keys



Digital Telemetry

Contents

General Telemetry Overview	3
Multiparameter Telemetry Overview	5
Intended Use	6
Transmitters	6
Selecting Options for the 90341 Lead Display	8
Cleaning	10
Digital Telemetry Receiver Module	10
Display Detail	12
Assigning a Telemetry Channel	14
Tuning a Telemetry Receiver	14
Entering Patient Information	15
Setting or Adjusting Alarm Limits	15
Acknowledging Signal Loss	15
Discharging a Patient	16
Setting Battery Status Alarms	16
Controlling Patient-Initiated Recordings	16
Telemetry Alarm Message Summary	16
Multiparameter Telemetry (NIBP)	17
Setting or Adjusting Alarm Limits	22
Displaying New or Previous Readings	22
NIBP Alarm Message Summary	22
NIBP Troubleshooting Guide	24

General Telemetry Overview

The 90478 digital telemetry receiver module, when used in conjunction with Spacelabs Medical telemetry transmitters, an Ultraview monitor, and 90479-A modular receiver housing, provides continuous monitoring of electrocardiographic signals in order to detect abnormal cardiac rhythms, including asystole, ventricular fibrillation, and ventricular tachycardia. In addition, when used with the 90343 digital telemetry multi-parameter transmitter and the 90217 Ambulatory Blood Pressure (ABP) monitor, monitoring of electrocardiographic signals is augmented by the availability of continuous or episodic SpO₂ measurements and episodic noninvasive blood pressure (NIBP) measurements.

One operational mode is available with the 90343 and the 90347 multi-lead transmitters. When all electrodes are connected to the patient, leads I, II, III, AVR, AVL, AVF, and Vx are available. When no chest lead is applied, leads I, II, III, AVR, AVL, and AVF are available using the remaining connected electrodes.

ECG monitoring in telemetry is identical to hardwired ECG monitoring. Refer to *ECG Setup* on page 8-4 for more information.

For more information on SpO₂ and NIBP monitoring refer to *Setting Up SpO₂ Monitoring* on page 14-4 and *Multiparameter Telemetry (NIBP)* on page 17-17.



- *Spacelabs Medical's telemetry equipment complies with Part 15 and Part 95 of the FCC Rules and with RSS-210 of Industry Canada and with requirements of other national spectrum management authorities. Repeated here are operational cautions for biomedical telemetry from the FCC Rules (47CFR15.242(f)):*

"Biomedical telemetry devices must not cause harmful interference to licensed TV broadcast stations or to other authorized radio services, such as operations on the broadcast frequencies under subpart G and H of part 74 of this chapter, land mobile stations operating under part 90 of this chapter in the 470-512 MHz band, and radio astronomy operation in the 608-614 MHz band. (See section 15.5). If harmful interference occurs, the interference must either be corrected or the device must immediately cease operation on the occupied frequency. Further, the operator of the biomedical telemetry device must accept whatever level of interference is received from other radio operations. The operator, i.e., the health care facility, is responsible for resolving any interference that occurs subsequent to the installation of these devices."

- *Medical telemetry equipment is only for installation and use in hospitals and health care facilities. It is not permitted for use in vehicles that operate outside of the medical facility premises. The user of this equipment is not authorized to make any changes or alterations that could compromise the national certifications.*
- *Operation of telemetry equipment in the 608 - 614 MHz, part of the Wireless Medical Telemetry Service (WMTS) and in authorized spectrum of each country, may be geographically restricted by government regulation. Operation of this equipment in U.S. WMTS bands requires coordination and registration with the FCC designated frequency coordinator.*
- *Both the standard and limb lead modes for the 90341 work correctly with or without the right leg electrode attached. However, for optimum performance, the right leg electrode should always be used.*
- *The RA lead wire for the 90343 and the 90347 must be connected to the transmitter at all times. This lead wire also serves as the transmitter's antenna.*



WARNING:

- ***Operating television receivers or other CRT displays near the transmitter (within 2 to 3 feet), or operation of some pacemaker programmers may suppress the ECG waveform, preventing QRS detection and rate counting. An erroneous asystole alarm may result.***

Multiparameter Telemetry Overview



90217 ABP Monitor

The 90343 digital telemetry multiparameter transmitter sends NIBP data acquired by the 90217 ambulatory blood pressure (ABP) monitor to the 90478 digital telemetry receiver. The 90478 displays the patient's episodic NIBP data and trigger alarms based on thresholds set at the patient monitor. Refer to *Setting Up NIBP Monitoring* on page 17-17 for information on configuring and using ABP monitors with multiparameter telemetry.

The 90217 ABP monitor is a small, lightweight, battery-powered unit designed to take blood pressure measurements. Refer to the *90207/90217 ABP Monitors Operations Manual (P/N 070-0137-xx)* and the *90121 ABP Report Management System Operations Manual (P/N 070-0529-xx)* for more detailed information on this product, its initialization by a direct PC interface, patient preparation, and event codes.

NIBP uses oscillometric monitoring to measure systolic (S), diastolic (D), and mean (M) arterial blood pressures. The pressure readings are sent from the 90217 ABP monitor to the 90343 transmitter by a connecting cable. The 90343 transmitter includes the NIBP readings in the communications to the 90478 receiver using the radio frequency data link. NIBP measurements are checked to eliminate the possibility of erroneous readings and valid measurements are displayed on the monitor and stored for trending. The Ultraview monitor displays valid measurements and the time the measurement was acquired. The most recent reading is displayed by the Ultraview monitor. The most recent 120 readings are stored and may be displayed by the monitor.



- *All system connections must be made by Spacelabs Medical personnel only.*
- *Leakage currents are not affected by the high level output in the 90478. The patient is electrically isolated from the patient monitor by the RF link.*
- *The 90217 ABP monitor is intended for use with adult patients only and, when used with the 90343 Digital Telemetry Transmitter, must also involve ECG monitoring.*
- *The ECG lead wires of the 90343 must be connected to the patient in order to perform ECG, SpO₂ and NIBP monitoring.*
- *The 90217 ABP monitor, when used with the 90343 Digital Telemetry Transmitter, purges its measurements as they are successfully sent. This operation differs from when the 90217 ABP monitor is used in a stand-alone manner and stores a maximum of 240 NIBP readings and event codes.*
- *NIBP readings which are not successfully transmitted by the 90217 to the 90478 within 24-hours of their measurement are unavailable for display or trending.*



WARNING:

- ***Changes or modifications not expressly approved by Spacelabs Medical will void the user's authority to operate the equipment.***

Intended Use

As an option, on adult patients, additional abnormal cardiac rhythms, such as ventricular runs, tachycardia, and ST segment deviations can be detected. The Ultraview Digital Telemetry System also provides a means for the episodic monitoring of NIBP signals to detect abnormal events such as high and low blood pressure. Finally, it provides a means for both continuous and episodic monitoring of blood oxygen saturation signals in order to detect oxygen desaturation caused by abnormal pulmonary/circulatory functions.



- *Episodic monitoring of NIBP values and continuous and episodic monitoring of blood oxygen saturation values are only supported in conjunction with ECG monitoring. SpO₂ and NIBP alarms are inhibited by ECG leads-off condition.*

The Spacelabs Medical 90341, 90343, and 90347 Ultraview Digital Telemetry Systems are intended for use with either adult or neonatal patients in a hospital environment. When the NIBP option is selected in the 90343 configuration, the NIBP feature is to be used with adult patients only.



WARNING:

- ***The Ultraview Digital Telemetry transmitters are contraindicated for use with other medical instrumentation (e.g., respiration monitors using impedance pneumography, electrocautery, etc.) that source electrical current through the patient. Further, telemetry monitoring is contraindicated for the Operating Room environment.***

Transmitters

The transmitter is a small, battery-powered device carried by the patient that monitors ECG activity and SpO₂/NIBP (90343 only) data, and transmits this information to the telemetry receiver module.

- The 90341 transmits two leads of ECG and uses up to five lead wires. Two leads may be displayed simultaneously.
- The 90343 and 90347 transmit four leads of ECG and use up to five lead wires. However, only two leads may be displayed simultaneously.
- The 90343 is also capable of transmitting numerical NIBP and SpO₂ data. This data is displayed simultaneously with that of the ECG waveform data.

Each telemetry channel requires its own transmitter operating on a unique radio frequency. Channel receivers are tuned from the Ultraview monitor touchscreen to receive the available transmitter frequencies.



- *Operation of this equipment may be subject to licensing requirements by your local telecommunications authority. Please check with your Spacelabs Field Service Engineer.*

**WARNING:**

- *Medical telemetry spectrum allocations may be assigned to frequencies already allotted to other priority users. This means that telemetry operations may be exposed to radio frequency interference that may disrupt or impede telemetry patient monitoring during the life of this equipment. You are urged to regularly consult with applicable local and federal regulatory agencies (e.g., FCC, FDA, etc.) regarding the locations and frequencies of other spectrum users in your geographic area. A Spacelabs Medical field service engineer may be able to assist you in reconfiguring your equipment frequencies to reduce the risk of interference. Spacelabs Medical cannot, and does not, guarantee interference-free telemetry operation.*

Up to five standard disposable silver/silver chloride chest electrodes are connected to the patient. The ECG lead wires are attached to these electrodes and connected to the transmitter. A patient-operated RECORD button initiates an ECG strip at the system printer, if this feature is enabled at the central or bedside monitor.

**CAUTION:**

- This device has a limited bandwidth range of .05 to 30 Hz, which may adversely affect the recording of high frequency components in the ECG signal, especially when the morphology of the ECG changes rapidly.
- This device has a limited dynamic range of ± 4 mV, which may render the device vulnerable to saturation by ECG signals with amplitudes higher than 4 mV.
- To clean the transmitter, use only the following solutions per the manufacturer's labeling: isopropyl alcohol (70%), hydrogen peroxide, Cidex, Betadine, and Clorox. Use of cleaning solutions other than those listed will VOID the warranty of the digital telemetry transmitter cases.
- Patients should not use any type of electronic equipment (e.g., portable radios, cellular telephones, pagers, personal computers, etc.) while connected to any medical electronic device without in-situ evaluation by the biomedical engineering staff.
- Use of 2-way radio equipment and other personal communication devices must be evaluated in-situ to assess the potential for disruption of monitoring.



- *Clean the transmitter after each use. The transmitter does not require any preventive maintenance other than cleaning.*

Selecting Options for the 90341 Lead Display

There are two operational modes available with the 90341 dual-lead transmitter: (1) the standard mode which offers a choice of one V lead (V1-6), plus lead II, or (2) the limb lead mode which offers choices of the leads I, II, III, AVR, AVL, or AVF. The standard mode is available if the chest lead is applied. The limb lead mode is available when there is not a chest lead applied. Loss of the chest electrode changes the ECG - Lead Select menu to the limb lead mode if the left arm, left leg, and right arm electrodes are intact. Refer to *Patient Preparation and Electrode Application* on page 8-6 for lead placement illustrations.



- Both modes work correctly with or without the right leg electrode attached. However, for optimum performance, the right leg electrode should always be used.

Connected Electrodes (X)				Valid Lead Vectors
C	LA	LL	RA	
X	X	X	X	V1-6 and II (standard mode)
X	X	X		III (standard mode)
X	X		X	I (standard mode)
X	X			total lead failure (standard mode)
X		X	X	II (standard mode)
X			X	None (lead failure)
X		X		None (lead failure)
X				None (lead failure)
			X	None (lead failure)
		X		None (lead failure)
	X			None (lead failure)
				None (lead failure)
	X	X		III (limb lead mode)
	X		X	I (limb lead mode)
		X	X	II (limb lead mode)
	X	X	X	I, II, III, AVR, AVL, AVF (limb lead mode)



- If one of the leads fails, a lead fault message will display in the upper left corner of the waveform zone. If there is not a valid lead vector, the message LEADS OFF displays and an alarm tone sounds.

Transmitter Batteries

A 9-volt alkaline battery is recommended for standard use in the digital telemetry transmitter. A 9-volt lithium battery may also be used for applications requiring more extended battery service life.

Always observe the battery position and polarity as illustrated at the bottom of the battery compartment. After battery installation, close and latch the compartment cover. The transmitter begins transmitting as soon as the battery is in place.



- *Whenever the transmitter is not in use, the battery should be removed. Insert a battery only when the transmitter is being used with a patient.*
- *When the battery level falls below approximately 7.0 volts, the low battery LED on the transmitter will flash once every 15-seconds. The LOW BATTERY message may appear after the low battery LED on the transmitter begins to flash. When the battery level falls below 6.0 volts, the low battery LED will flash once every 2-seconds. When the battery level falls below 5.5 volts, the SpO₂ and NIBP functions will shut down.*
- *The LOW BATTERY message appears and an alarm tone sounds (if LO BAT is set to ON) when the transmitter battery voltage falls below approximately 7.0 volts. When this message appears, the transmitter has approximately 3-hours of operating time left, depending on transmitter type, selected options, and the type of battery.*

Battery Disposal

The 90341, 90343 and 90347 Ultraview Digital Telemetry transmitters are operated by 9-volt, primary (non-rechargeable) batteries that must be properly disposed of when discharged. The batteries specified may be of either alkaline or lithium chemistry. Attempting to recharge these batteries is not recommended and can result in leaking, venting, or explosion.

Disposing of used batteries may be subject to national, state/provincial, and/or local regulation, which varies depending on jurisdiction.

Follow the battery manufacturer's recommended handling procedure for both types of batteries: Collect and transport the batteries in a manner that prevents short circuit, compacting, mutilation, or any other physical abuse or electric handling that would destroy their physical integrity. Exposure to high temperatures or fire can cause the batteries to leak, vent, or explode.

The recommended disposal procedure for alkaline batteries is to transport them to a hazardous waste landfill. Since these batteries may not be classified as hazardous waste, they may be transported to the disposal facility as non-hazardous waste.

The recommended disposal procedure for lithium batteries is to transport them as hazardous waste to a hazardous waste facility. If the batteries are physically sound, disposal of these discharged batteries in a hazardous waste landfill may be permissible. If the batteries are leaking, cracked, opened, vented, or otherwise not physically sound, they must be transported to a qualified hazardous waste facility.

Cleaning

The transmitter does not require any preventive maintenance other than cleaning but should be cleaned after each use.

To clean the transmitter, use only the following agents.

- Mild soap and water solution
- U.S. Pharmacopoeia (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%)

Digital Telemetry Receiver Module

The 90478 telemetry receiver module plugs into a bedside or transport monitor, or into a digital telemetry module housing. The receiver module receives patient vital signs data from the transmitter. This data is reconstructed by the receiver module, displayed on the monitor and analyzed as described in *ECG* on page 8-3, *Arrhythmia* on page 9-3, and *ST Analysis* on page 10-3. Refer also to *SpO₂* on page 14-3.



WARNING:

- ***Telemetry systems may be more susceptible to interference than hardwired systems, which may impact signal quality.***
- ***Operation of hand-held, wireless telephone equipment (cordless telephones, cellular telephones) near telemetry systems may cause interference and should be discouraged. While personal communication devices are turned on, a separation of >6.5 feet (>2 meters) should be maintained between personal communication devices and interior walls, the patient cables, and any electronic medical device to which the patient may be connected. Patients should not use any type of electronic communication equipment while connected to any electronic medical device without an on-site evaluation by the biomedical staff. Two-way radio equipment and other personal communication devices must be evaluated on site to determine if additional space limitations are needed.***
- ***Do not install a telemetry receiver module into a bedside that is currently equipped with any other ECG module, hardwired or telemetry (or SpO₂ module or NIBP module, if the 90343 is operating with that specific receiver module). Doing so may cause inaccurate patient data displays at remote monitors.***

Digital Telemetry Receiver Housing

The telemetry receiver housing can hold up to eight separate telemetry receiver modules. Except for the ON/OFF switches, there are no operator controls on the module housing. For normal operation with AC mains power applied, the AC

mains indicator light on the front panel of the housing must be illuminated. Operating the system without AC mains power is limited to 10-minutes of battery backup time.

NOTE: The UCW bedside connects to the remote module housing, and the UCW central connects to the digital telemetry module housing.

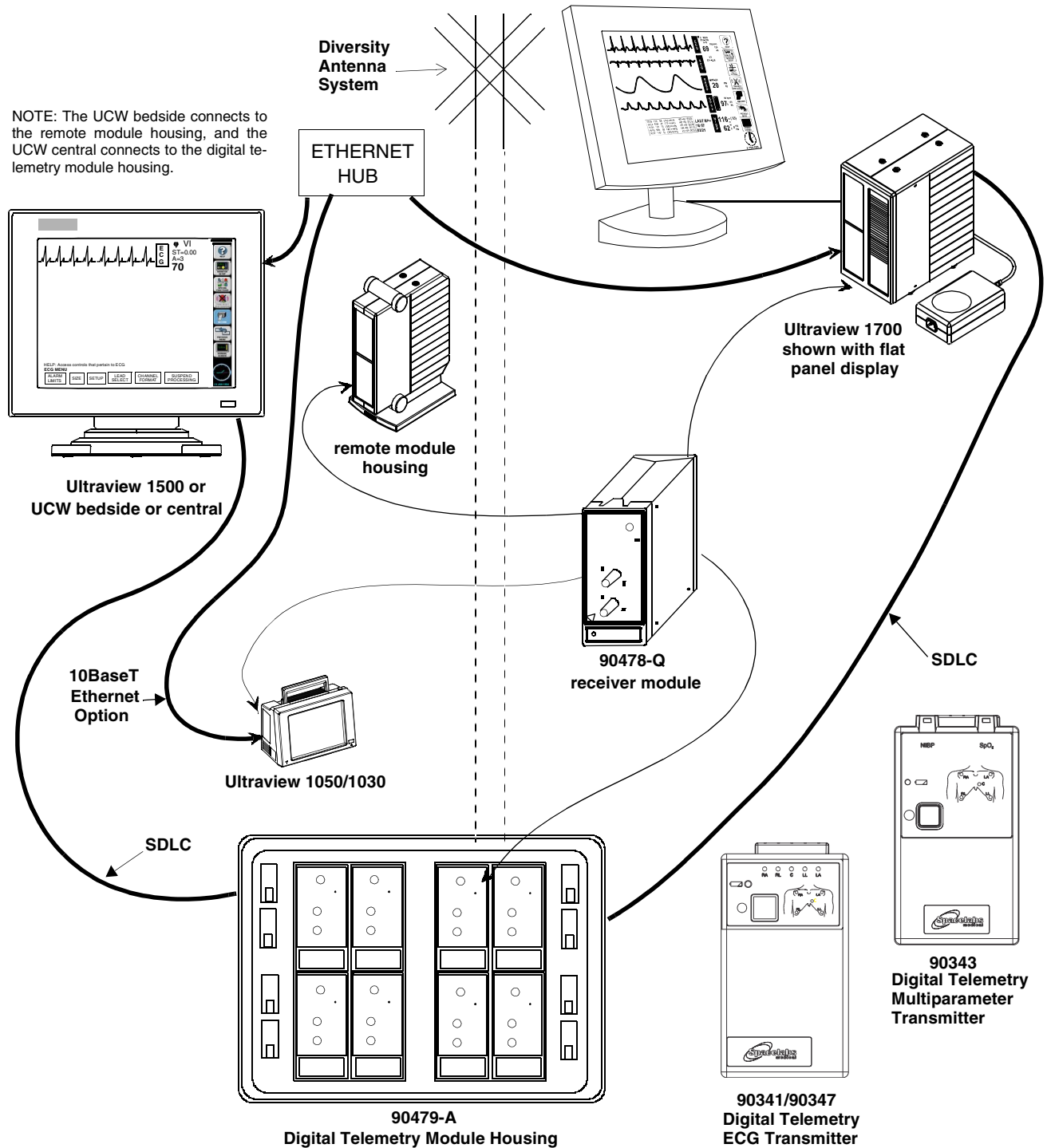


Figure 17-1: Ultraview digital telemetry system

Display Detail

Signal detection is indicated on your monitor when an ECG signal appears next to the ECG parameter key in the zone assigned to receive the transmitted telemetry channel. The transmitter's channel number is always identified above the waveform, to the left of the ECG key.

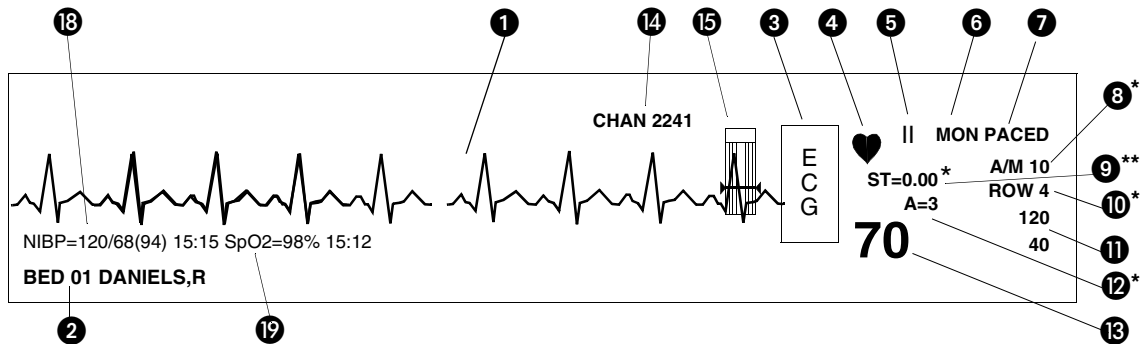


Figure 17-2: Display zone — full screen

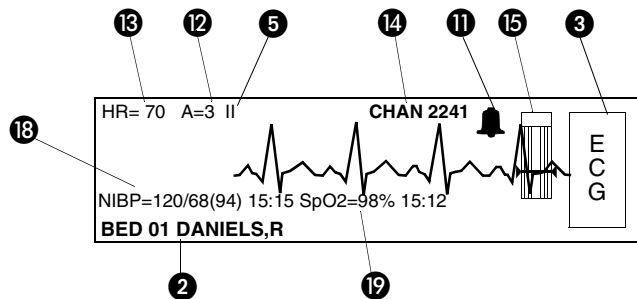


Figure 17-3: Display zone — split screen



- Due to the similarity between ECG and Digital Telemetry displays, the items described below are consistently numbered in both chapters. Refer to Display Detail on page 8-9.

- 1 ECG trace for first lead
- 2 Bed name
- 3 ECG key for first lead
- 4 QRS indicator (flashes once per detected beat)
- 5 ECG lead designator
- 6 Display resolution (monitor or extended)
- 7 Paced operation indication (pacemaker detection is enabled)

- 8 Abnormals per minute alarm limit *
- 9 ST segment level for first lead**
(the asterisk indicates ST alarms are enabled)
- 10 Abnormals in a row alarm limit *
- 11 ECG rate alarm limits. Split-screen central monitors display a bell symbol when alarms are enabled; bedside monitors display the rate alarm limits (120/40)
- 12 Abnormals per minute counter *
- 13 Current heart rate
- 14 Telemetry channel number
- 15 Sensorwatch signal strength indicator

Shaded area (waveform index, WFI) expands up proportionally to signal strength; horizontal line indicates minimum signal level.

No shading (lowest waveform index) corresponds to no detected signal strength or a faulty sensor.

- 16 SpO₂ level
- 17 Refer to Display Detail in ECG (not used)
- 18 Non-invasive blood pressure — systolic/diastolic (mean)
Equal sign becomes bell symbol when NIBP alarms are enabled
Hour and minutes of last reading
- 19 SpO₂ reading and time of last reading
Equal sign becomes bell symbol when SpO₂ alarms are enabled
Hour and minutes of last reading

* Only appears with the Multiview I or II option in the adult mode with Arrhythmia detection enabled.

** Only appears in adult mode with the ST segment analysis option.

Assigning a Telemetry Channel

To initiate telemetry ECG monitoring:

- 1 Select a transmitter.
- 2 Note its channel number.
- 3 Attach lead wires to transmitter.
- 4 Attach lead wires to electrodes.
- 5 Apply electrodes to patient.
- 6 Install a transmitter battery.
- 7 Close the transmitter case.

To set up the central for ECG (if bed name not remembered):

- 1 Touch key label that matches transmitter's frequency.
- 2 Select bed/room number for transmitter channel.

To set up the central for ECG (MPT=OFF):

- 1 Touch MONITOR SETUP.
- 2 Touch SCREEN FORMAT.
- 3 Select subnet and bed/room number.
- 4 Select ECG and then desired zone.

To tune a receiver module:

- 1 Touch ECG.
- 2 Touch SETUP.
- 3 Touch TM SETUP.
- 4 Access the SET TM CHANNEL menu.
- 5 Select the digit to change. Use the ↑ ↓ keys to select the value for that digit.
- 6 Repeat for all digits as necessary.
- 7 Touch STORE.

Your central monitor can only display a telemetry channel after that channel has been assigned a specific bed name. Refer to the steps to the left to assign a specific bed name to a telemetry channel.

After a bed name is assigned, the central monitor may need to be configured to display data associated with that bed name in a specific display zone. Refer to the steps to the left to assign the bed to a specific display zone, if needed.



- *Your central monitor may be configured to remember beds that are assigned to individual telemetry channels using the Module Configuration Manager feature. These beds are permanently assigned until you unassign or reassign them. Refer to Module Configuration Manager on page 7-5 for more information.*

Tuning a Telemetry Receiver

A telemetry receiver module must be tuned to a transmitter's assigned frequency before it can receive data from that transmitter. Qualified personnel can use the ECG TM SETUP menu to tune the receiver module.



- *Telemetry transmitters have preassigned channel frequencies (or numbers) that cannot be changed. The channel number is identified on the back of the transmitter's case.*
- *Only qualified personnel should tune telemetry receiver modules to receive data from a telemetry transmitter. Telemetry receiver modules must be used with a transmitter on the same frequency.*
- *Qualified service personnel should set the telemetry transmitter's frequency band via the Module Configuration Manager feature.*
- *Telemetry channel assignment is not accessible in REMOTE VIEW displays.*

Entering Patient Information

Refer to *Admit/Discharge* on page 3-3 for information on this subject.

Setting or Adjusting Alarm Limits

To set or adjust multiparameter telemetry alarms:

- 1 Touch ECG.
- 2 Touch ALARM LIMITS.
- 3a Touch ECG ALARM LIMITS
-OR-
- 4a Touch NIBP ALARM LIMITS
-OR-
- 5a Touch SPO2 ALARM LIMITS.
- 6a **For ECG and NIBP** — Touch HI = or LO = key.
- 6b **For SpO₂** — Touch HI=, LO=, ALM DELAY, or MSG ALARM DELAY (if present).
- 7 Use the arrow keys to adjust.

Alarm limits for multiparameter telemetry are adjusted the same way as the alarm limits in other parameters. The only difference is that the multiparameter telemetry requires you to select a specific parameter to adjust. Once that selection is made, adjustments are made as described in *Setting and Adjusting Alarms* on page 8-13, *Setting and Adjusting Alarm Limits* on page 13-7, and *Setting and Adjusting Alarm Limits* on page 14-6.

Acknowledging Signal Loss

To acknowledge signal loss, select NO.

When a telemetry signal is lost because the transmitter is out of range or the battery is removed, the receiver indicates this condition by replacing the normal ECG waveform with the triangular squelch waveform. The text SQUELCH is included in the annotation for any strip chart recording initiated during this period. The ECG waveform is automatically displayed if the lost signal returns.

After 8-seconds of signal loss, the monitor displays the INTERMITTENT SIGNAL LOSS message in the waveform zone and initiates the signal loss alarm. Select YES to discharge the patient (refer to *Discharging a Patient* below), or select NO to suspend this alarm.



WARNING:

- *SpO₂ and NIBP data cannot be displayed when the INTERMITTENT SIGNAL LOSS message is displayed.*
- *All monitors that display the telemetry channel display the message IS SIGNAL LOSS PERMANENT? in the waveform zone, but only the monitor that is hosting this telemetry channel displays YES and NO keys below this message.*

Discharging a Patient

To discharge a patient:

- 1 Remove battery.
- 2 Disconnect the transmitter from the patient.
- 3 Touch YES to confirm signal loss permanent.
- 4 Touch YES to discharge.
- 5 Touch YES to purge data.

The process of discharging a patient begins by removing the battery from the transmitter. The monitor responds to this as described *Acknowledging Signal Loss* on page 17-15.

The monitor that is hosting this telemetry channel displays keys labeled YES and NO below this message (other monitors do not display these keys). Selecting NO to this message (or any of the following messages) cancels the discharge process, redisplay the IS SIGNAL LOSS PERMANENT? message, and cancels the intermittent signal loss alarm.

Selecting YES to this message indicates that the signal loss is permanent and continues the discharge process by changing the message to DISCHARGE THIS PATIENT?. Select YES to continue the discharge process or NO to cancel the discharge process.

If YES was selected, the message changes to PURGES DATA - ARE YOU SURE?. Select YES a third time to discharge the patient, erase all patient data from memory, and cancel the intermittent signal loss alarm. Touch NO to cancel the discharge process.

Setting Battery Status Alarms

To control low battery alarms:

- 1 Touch ECG.
- 2 Touch SETUP.
- 3 Touch TM SETUP.
- 4 Select LO BAT ON or OFF.

The telemetry battery alarm tone and a LOW BATTERY message displayed in the ECG zone alert you to a low battery condition in the transmitter. You can disable the low battery alarm tone if your bedside or central is configured to do so.

The factory default setting for this alarm is ON.

Controlling Patient-Initiated Recordings

To control transmitter's Patient Record function:

- 1 Touch ECG.
- 2 Touch SETUP.
- 3 Touch TM SETUP.
- 4 Select PT RECORD YES or NO.

If the Patient Record function is activated (PT RECORD is YES) in the ECG TM SETUP menu, the patient may initiate a recording by pressing the RECORD button on the front of the transmitter.

Telemetry Alarm Message Summary

The following are general telemetry messages and apply to the 90341, 90343 and 90347 transmitters.

INTERMITTENT SIGNAL LOSS

The intermittent signal loss message indicates that the patient may be out of antenna range or the battery is depleted. Return the patient into antenna range. Check that the battery is functioning properly. A low priority alarm tone sounds after 10-seconds in this condition.

LOW BATTERY

A low battery message indicates that the battery is weak. After this message appears, the battery has approximately 3-hours of useful life left (depending on the type of battery used). Install a new battery. A low priority alarm tone sounds if the SETUP menu's LOW BAT ON/OFF key is set to ON.

SIGNAL INTERFERENCE

The signal interference message indicates, via the displayed triangle squelch waveform, that an interfering signal has been detected. A signal can no longer be detected because of interference from a stronger signal source lasting more than 0.5-seconds. A low priority alarm tone sounds whenever this message is displayed in the waveform zone.

IS SIGNAL LOSS PERMANENT?

The permanent signal loss message indicates that no RF signal is being detected.

Multiparameter Telemetry (NIBP)

Setting Up NIBP Monitoring

Proper cuff selection and application is critical in ensuring the accuracy of NIBP readings. To ensure proper cuff selection, first measure the circumference of the limb at its midpoint. Match the limb measurement to the range of appropriate circumferences (in centimeters) specified on each cuff. If the cuff bladder is too wide for the patient, the reading will be falsely lowered; if it is too narrow, the reading will be falsely elevated. Undersizing the cuff results in the greatest chance of error, so a variety of cuff sizes should be available to accommodate your full patient population.

Apply the cuff snugly. When the cuff is properly applied to an adult, you should be able to insert one finger between the cuff and the arm. If you can insert two fingers, the cuff is too loose, which may result in falsely elevated readings. Ensure that the hose is not kinked when the cuff is applied.

During blood pressure measurement, the inflated cuff reduces blood flow to the limb to which it is applied. Do not apply a cuff to a limb that has restricted blood flow. Check the patient periodically.



- *Do not apply a blood pressure cuff to a limb being monitored with a pulse oximetry sensor, because SpO₂ is affected during NIBP readings. Avoid applying a cuff to a limb that has an intravenous line in place. Do not apply a cuff to a limb that has restricted blood flow.*
- *Use only single hose cuffs to ensure proper operation. Spacelabs Medical's hoses are non-conductive with respect to defibrillator discharge effects.*

Patient Factors Affecting Readings

Excess patient movement, speech, or muscle contractions as a result of severe pain or shivering can interfere with automated NIBP readings. Ensure that the patient is quiet and not moving during NIBP readings just as you would manual readings. The patient must avoid applying external pressure to the cuff during readings. Institute measures to minimize shivering and alleviate pain.

Some arrhythmias may cause beat-to-beat pressure fluctuations that can make obtaining NIBP readings more difficult. If it becomes difficult to obtain readings in the presence of arrhythmia, pressure should be temporarily verified using another method (i.e., auscultatory, oscillometric, Doppler). Pressure also varies cyclically with normal respiration. With deep respirations or in certain patients this effect may be enhanced, increasing reading variability.

For patients in shock, indirect methods of measuring pressure (auscultatory, oscillometric, Doppler) may not be reliable because of peripheral vascular changes. These changes include peripheral vasoconstriction and diminished peripheral circulation resulting from shunting of blood to central organs. In some cases, peripheral pulses or Korotkoff sounds may be diminished or disappear in spite of adequate blood pressure. In such cases, measuring a cuff pressure may be impossible or give misleading results. Direct blood pressure measurements (invasive) should be considered in patients with signs of shock or any patient who rapidly becomes unstable for unknown reasons.

Setting Up the ABP Monitor

To set up NIBP monitoring:

- 1 Initialize the ABP monitor as described in the ABP Operations Manual.
- 2 Apply appropriate cuff to patient.
- 3 Attach cuff to ABP monitor.
- 4 Connect NIBP adapter cable (012-0588-xx) between ABP monitor and 90343 transmitter.
- 5 Touch ECG.
- 6 Touch CHANNEL FORMAT.
- 7 Select NIBP ON.

The 90217 ABP monitor must be initialized prior to the monitoring of each patient. Initialization is accomplished using the 90121 ABP Report Management System. (Refer to *Setting Up the ABP Monitor* in the *90207/90217 ABP Monitors Operations Manual, P/N 070-0137-xx.*)



CAUTION:

- **Failure to initialize the ABP monitor as specified may result in the display and storage of measurements that are incorrect or that were acquired from a prior patient. The operator must initialize the ABP monitor before each patient use.**

After the monitor has been initialized, prepare the patient for monitoring as follows:

1. Turn on the monitor and wait for the monitor to perform self-tests. When the LCD displays the current time, the monitor is ready for operation.
2. Strap the monitor to the patient on the hip opposite the side on which the cuff is worn. Secure the monitor using the patient's own belt or the ABP pouch strapped over the opposite shoulder. When using the shoulder strap, use the belt supplied with the monitor, or the patient's belt, to provide additional security.
3. To select the proper cuff, measure the circumference of the limb at the point where the cuff is to be applied. Match the limb measurement to the range of appropriate circumferences (in centimeters) specified on each cuff (refer to *Table 1: Cuff Size by Limb Circumference on page 17-19*).

Table 1: Cuff Size by Limb Circumference

Cuff Size	Limb Circumference
Pediatric	13 to 20 cm
Small adult	17 to 26 cm
Average adult	24 to 32 cm
Large adult	32 to 42 cm
Extra-large adult	38 to 50 cm

- Position the cuff so that the center of the inflatable bladder is directly over the brachial artery. The center of the bladder location is marked on the outside of the cuff. Once the proper position is determined, the cuff must be tightened to ensure that it is equally snug at the top and bottom edges and that it is not kinked. This is especially important on larger arms. Insert a finger between the cuff and the limb to ensure it is not too tight. It may be necessary to wrap the cuff with its tail at an angle to achieve uniform tightness. If the cuff is not equally snug at the top and bottom edges, the number of readings available will be limited and the monitor may indicate that the cuff is improperly applied.



- Use only Spacelabs Medical cuffs with this monitor. Using other manufacturer's cuffs may result in inaccurate readings, even if the manufacturer's recommended size is observed.
- If the cuff is too small, pressure readings may be falsely high; a cuff that is too large produces a falsely low reading. The bladder can be positioned in the cuff for either the left or right arm.



CAUTION:

- Avoid compression or restriction of pressure in the NIBP patient connector tubes. Check that operation of the equipment does not result in prolonged impairment of circulation.**
 - Do not apply cuff to areas of breached or injured skin.**
 - Cuff hose connections use luer fittings. Be careful not to connect the ABP monitor into an intravenous fluid line when working close to them.**
 - This product contains natural latex rubber components to which some people may be allergic. These components include the bladder and the first four inches of tubing extending from the cuff.**
- Once the cuff is applied, the arm should be relaxed at the patient's side. To avoid reading errors due to hydrostatic pressure differences, the level of the cuff on the arm should be near the level of the heart.
 - Lead the hose up the arm with the cuff and place it across the back of the patient. Drape the hose so it does not cause the patient discomfort and is not pinched shut by too tight a radius. *Figure 17-4* displays the most common positions for the cuff hose.

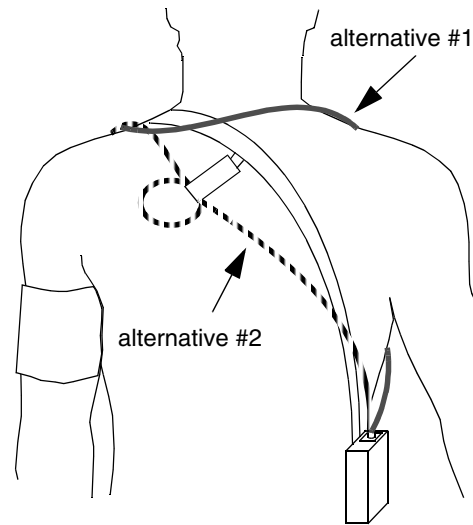


Figure 17-4: Common cuff hose positions

7. Connect the hose to the monitor.
8. To verify proper monitor operation, take one or more blood pressure readings. Push the START/STOP key to begin a measurement.
9. The 90343 transmitter must be configured for use with the 90217 ABP monitor by opening the battery compartment door, removing the battery, and setting DIP switches 5 ON and 8 OFF. Refer to *Figure 17-2* on page 17-12.
10. The 90478 receiver must be configured for operation with the 90343 transmitter and attached 90217 ABP monitor. Touch the ECG key to display the main menu. Touch CHANNEL FORMAT, then touch NIBP ON. The monitor will display the NIBP measurement in a numeric format in the display zone. The values of the measurement are displayed as ??? until a valid NIBP measurement has been taken.

11. Interconnect the adapter cable between the communications port on the ABP monitor and the NIBP port on the 90343 as shown in *Figure 17-5*.

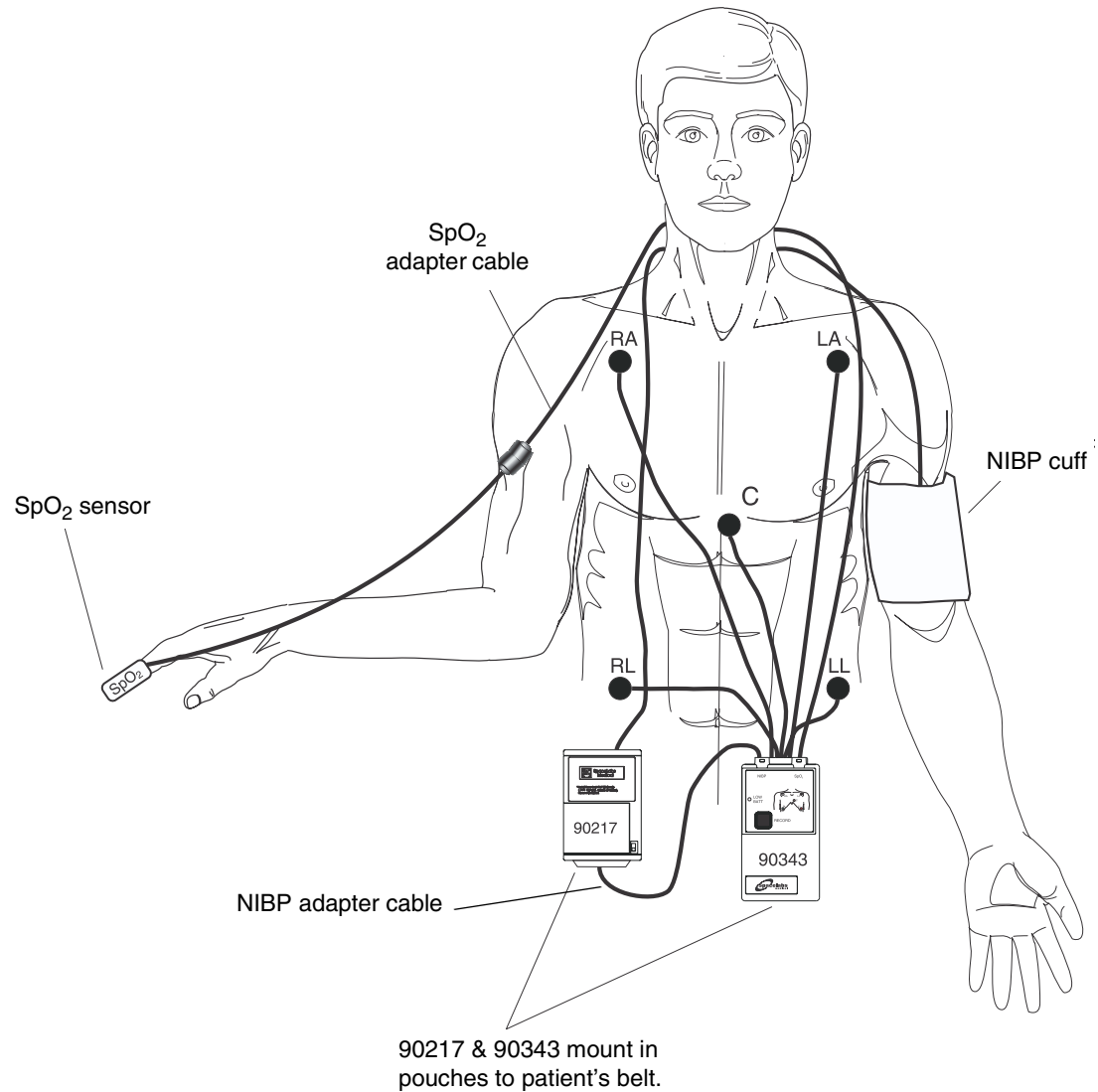


Figure 17-5: Transmitter ECG, SpO₂, and ABP monitor connections

Figure 17-2 and *Figure 17-3* illustrate typical NIBP displays. You can view NIBP readings from any Ultraview bedside or central monitor on a network. NIBP displays on a split-screen central monitor appear in a format slightly different from that of bedside or full-screen central monitors.

Setting or Adjusting Alarm Limits

To set or adjust NIBP alarms:

- 1 Touch ECG.
- 2 Touch ALARM LIMITS.
- 3 Touch NIBP ALARM LIMITS.
- 4 Select NIBP ALM ON.
- 5 Select SYS, DIA, or MEAN.
- 6 Select HI= or LO=.
- 7 Use arrow keys to adjust.

Refer to *NIBP* on page 13-3.

Displaying New or Previous Readings

To display the current reading:

- 1 Touch ECG.
- 2 Touch CHANNEL FORMAT.
- 3 Select NIBP ON.

The current (or latest) NIBP reading taken may be displayed when the NIBP parameter is enabled and the 90217 ABP monitor is correctly setup. The current reading is displayed just below the isoelectric line showing systolic, diastolic, and mean values with the time of the reading. The displayed values are replaced by ??? when no valid values have been acquired from the 90217.

The previous NIBP readings may be displayed using the Tabular Trend or Graphic Trend monitor functions. The parameter trend information is collected from the module on a minute-by-minute basis and stored in system memory for retrieval. The collected NIBP trend readings may be displayed in the same manner as any other monitored parameter. Refer to *Trends on page 26-3* for more information.

NIBP Alarm Message Summary

The 90217 ABP monitor provides an extensive set of result codes that indicate the status of the monitor and the potential causes of an inability to take a valid reading.

When any alarm message is displayed, the NIBP parameter value is immediately changed to ??? and an alarm is triggered. If your module has been configured for an alarm using the Module Configuration Manager, the parameter display will blink yellow for Low and Medium priority alarms, and will blink red for High priority alarms. The alarm condition will persist until a new NIBP reading is taken. (Refer to *Module Configuration Manager on page 7-5* for more information).

The monitor displays the following messages to provide ABP status information to the caregiver. These messages summarize the 90217 event codes. Some of these messages include an event code in parentheses to provide more detailed analysis of the event. A complete list of the event codes can be found in the *90207/90217 ABP Monitors Operations Manual, P/N 070-0137-xx*.

Telemetry products display their error messages within ECG's display zone, so the following ECG alarm messages take priority over other NIBP messages.

- LEADS OFF
- NOISY SIGNAL
- ECG ALARMS SUSPENDED

NIBP UNAVAILABLE (xx)

Displayed when the 90217 ABP monitor has detected an internal condition, defined by the code (xx). Typically, this indicates a hardware or software failure that requires that the transmitter be removed from service.

NIBP READING FAILURE (xx)

Displayed when the ABP monitor was unable to make a reading. The code (xx) defines the cause of failure.

NIBP AIR LEAK

Displayed when an air leak has been detected in the pneumatic system, preventing a reading from being taken.

NIBP LOOSE OR NO CUFF

Displayed when the cuff was able to be inflated in a manner indicating that it was not attached to the patient correctly.

NIBP PATIENT CANCELLED

Displayed when the patient has pressed the START/STOP button on the ABP monitor, halting a reading in progress.

NIBP LOW BATTERY

Displayed when the primary (3xAA) battery voltage is low. Replace with fresh batteries.

NIBP KINKED HOSE

Displayed when the pressure value increased too rapidly indicating a kinked hose or other restriction.

NIBP EVENT CODE (xx)

Displayed when the event code returned from the ABP monitor is not defined into one of the other messages.

NIBP Troubleshooting Guide

Clinical Situation	Possible Cause	Solution
No NIBP displays	■ Adapter cable not inserted correctly.	■ Remove and re-insert adapter cable.
	■ NIBP not enabled on 90343 or 90478.	■ Enable NIBP function by setting transmitter DIP switch 5 ON and setting DIP switch 8 OFF.
	■ 90217 ABP not properly initialized.	■ Re initialize 90217 ABP using 90121.
	■ 90343 Low battery indicator constantly illuminated.	■ Call qualified service person.
No NIBP readings can be obtained	■ Incorrect or inoperative cuff in use.	■ Replace with cuff known to be operative.
	■ Tubing is kinked.	■ Locate kink and straighten tubing.
	■ Some arrhythmias (e.g., atrial fibrillation and frequent ventricular ectopy) may cause a single or repeated failure to obtain a reading (may be due to true beat-to-beat variations in pressure).	■ Document arrhythmia if present, verify pressure with another method, then follow hospital procedure for care of this type of patient.
	■ Excessive patient motion or muscle contractions associated with shivering or severe pain.	■ Ensure that patient is quiet with minimal movement during NIBP readings; minimize patient's shivering.
	■ Blood pressure outside of measurement range.	■ Verify extremely high or low pressure with another method.
Intermittent or complete failure to operate	■ 90217 ABP error.	■ Remove 90217 ABP from service; record event code; and call qualified service person.
Apparent incorrect value	■ Wrong size cuff for patient.	■ Measure patient's limbs at the midpoint; match limb measurement to range specified on cuff (undersizing the cuff results in the greatest degree of error).
	■ Cuff is damaged.	■ Replace with good cuff.
	■ Excessive patient motion, shivering or severe pain.	■ Ensure patient is quiet with minimal movement during NIBP readings; minimize patient's shivering.
	■ False high readings may be the result of venous congestion caused by frequent readings.	■ Reduce frequency of readings.
	■ Cuff too loose or positioned incorrectly.	■ Tighten cuff or reposition appropriately.

Clinical Situation**Possible Cause****Solution**

90217 ABP Display is incorrect

- Data not retained.
 - Low or no power.
 - May be one of the following: time-out, no reading due to air leak in the system, improper cuff size, cuff size not properly attached to the 90217 ABP.
- Replace backup battery.
 - Check the batteries for a full charge; if needed, replace or recharge the batteries.
 - Isolate cause and correct.
-

No NIBP alarms are displayed

- ECG "Leads Off" condition exists.
 - Higher priority alarm condition is present.
- Re-attach ECG lead wires to the patient and resume ECG monitoring to clear pending ECG alarms.
 - Clear current alarm condition and/or re-prioritize NIBP alarms of interest in the Module Configuration Manager.
 - When NIBP alarms are set ON, all NIBP alarm conditions will cause the parameter value (or ???) to blink according to the alarm priority set by using the Module Configuration Manager.
-

Variable readings occur

- Some arrhythmias may cause beat-to-beat pressure and NIBP readings.
 - Larger than normal influence of respiratory phases on blood pressure (inspiratory fall in blood pressure; expiratory rise).
- Document arrhythmia if present, verify pressure using another method, then follow hospital procedure for care of this type of patient.
 - NIBP software usually compensates for normal variation.
-

No NIBP readings or questionable values in the presence of shock

- Peripheral vascular changes experienced during shock may reduce the reliability of blood pressure readings obtained with any indirect method; peripheral pulses may be diminished or absent.
- Consider invasive pressure measurements in patients with symptoms of shock or in any patient who rapidly becomes unstable for unknown reasons.
-

90217 displays "LLL" and alarm sounds

- Low main battery condition.
- Turn off and replace batteries within 60-seconds after removal to continue monitoring.
-

Cuff too tight

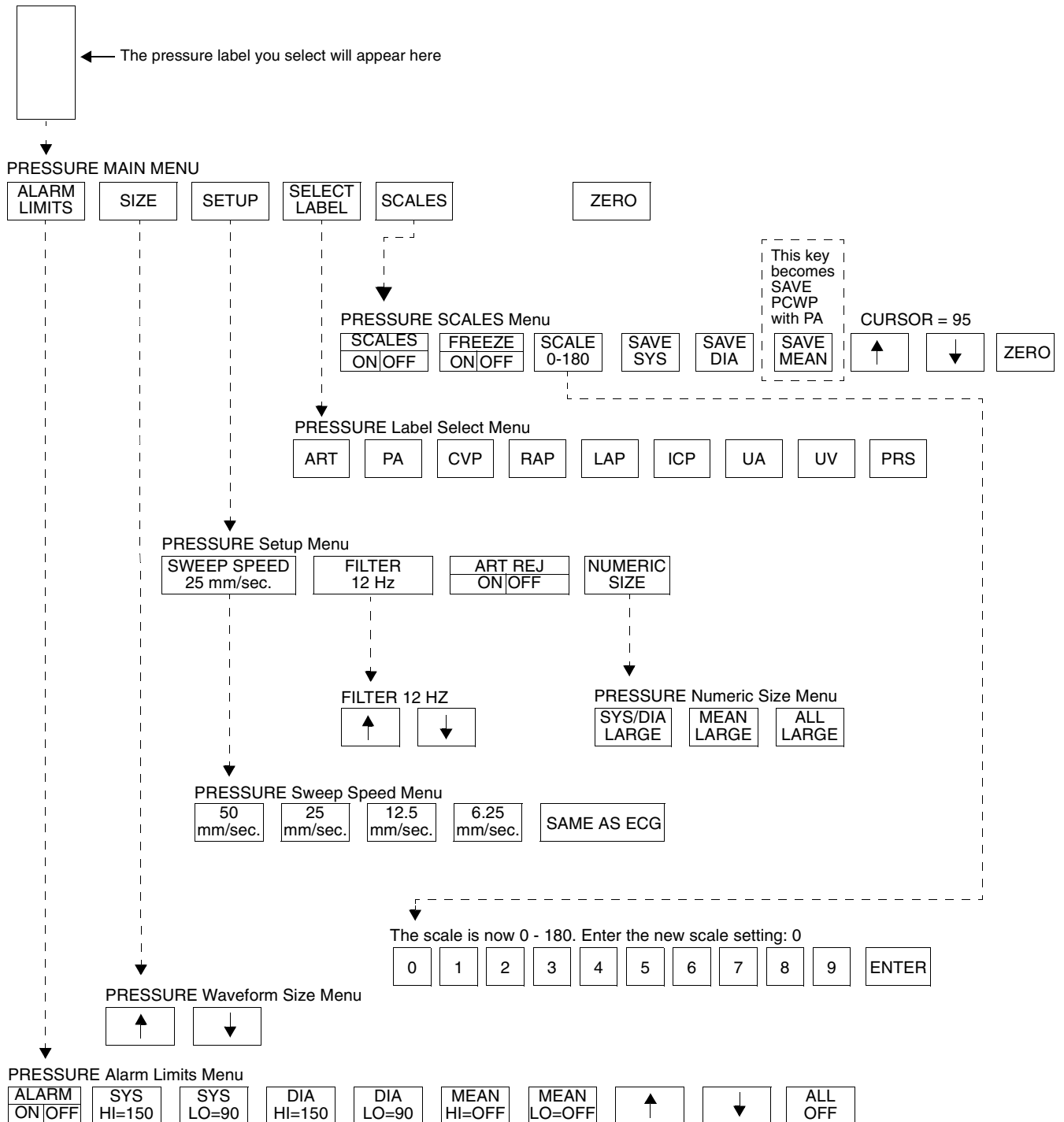
- Cuff placed on patient too tightly.
 - Air pump staying on too long.
- Reposition the cuff.
 - Return unit to Spacelabs Medical for service.
-

Cuff too loose

- Cuff placed on patient too loosely.
 - Air pump not staying on long enough.
- Reposition the cuff.
 - Return unit to Spacelabs Medical for service.
-

Pressure Directory

Directory of Keys



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

Contents

Directory of Keys	1
Overview	3
Setting Up Pressure Monitoring	4
Zeroing the Pressure Transducer	4
Display Detail	5
Setting and Adjusting Alarms	6
Adjusting Waveform Size	6
Selecting Numeric Display Size	6
Adjusting Sweep Speed	7
Displaying Waveforms with Scales	7
Freezing the Scaled Display	7
Changing the Waveform Scale	7
Selecting the Waveform Measurement Value	7
Storing Values for Trending	8
Recording Waveforms	8
Setting Artifact Rejection	8
Selecting a Filter Frequency	9
Restoring User-Defined Settings	9
Factory Default Pressure Alarm Settings	10
Invasive Pressure Troubleshooting Guide	11

Overview

A pressure key and waveform will automatically be displayed as soon as you connect a transducer to the module. Immediately after connection, you can relabel the catheter site or zero the system. Pressure labels may be pre-defined (refer to *Selecting Alarm Attributes* on page 7-7) or you can select from the following:

Pressure Label	Description
ART	arterial pressure
CVP	central venous pressure
ICP	intracranial pressure
LAP	left atrial pressure
PA	pulmonary artery pressure
RAP	right atrial pressure
PRS	generic pressure
UA	umbilical artery pressure
UV	umbilical vein pressure

Disconnecting the pressure cable or the transducer will cause the pressure key and waveform to disappear from the display.

Systolic, diastolic, and mean pressure values are displayed for arterial, pulmonary artery, umbilical artery, umbilical vein and generic pressures. Only the mean value is displayed for other pressure types. Refer to the *Display Detail* on page 18-5 for a sample arterial pressure and intracranial pressure display on the bedside monitor.



WARNING:

- ***Systolic and diastolic pressures displayed numerically for patients being treated with an Intra-Aortic Balloon Pump (IABP) therapy may not be accurate. Display the waveform with scales to verify or determine pressures for these patients.***



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

Setting Up Pressure Monitoring

Connect the cable end of either a reusable or disposable transducer to the pressure connector located on the front of the module using a Spacelabs Medical pressure cable.

When setting up an invasive pressure system, take all measures to maintain system sterility and to prevent the introduction of air into the system. Air bubbles are the most common cause of inaccurate pressure readings. The transducer, stopcocks, connectors and tubing must be completely free of air to ensure maximum performance.



- *Refer to the catheter, tubing, or transducer manufacturer's instructions or your hospital's protocol for specific instructions on removing air from the system.*
- *Invasive pressure systems specified by Spacelabs Medical are compatible with high-frequency electrosurgical and defibrillation equipment. No special precautions are required.*

Zeroing the Pressure Transducer

To zero the pressure transducer:

- 1 Touch the desired pressure parameter key.
- 2 Open stopcock to air/close to patient (at phlebostatic axis).
- 3 Touch ZERO.
- 4 Close stopcock to air/open to patient.
- 5 Begin monitoring after the pressure values appear.

Before you can begin monitoring you must zero the system. Zeroing has two purposes: 1) to establish atmospheric pressure as zero, and 2) to compensate for the hydrostatic effect of fluid in the catheter-tubing system.



- *If after you have followed the instructions to zero the pressure transducer and a ZERO REJECTED message appears, you may have a transducer problem. Follow the transducer manufacturer's directions to correct this problem before you continue.*

Display Detail

A pressure display appears once you select a pressure label and zero the transducer. *Figure 18-1* shows an example of the display for ART and ICP. The system identifies the specific pressure type in the parameter key and menu title (PA, CVP, LAP, etc.).

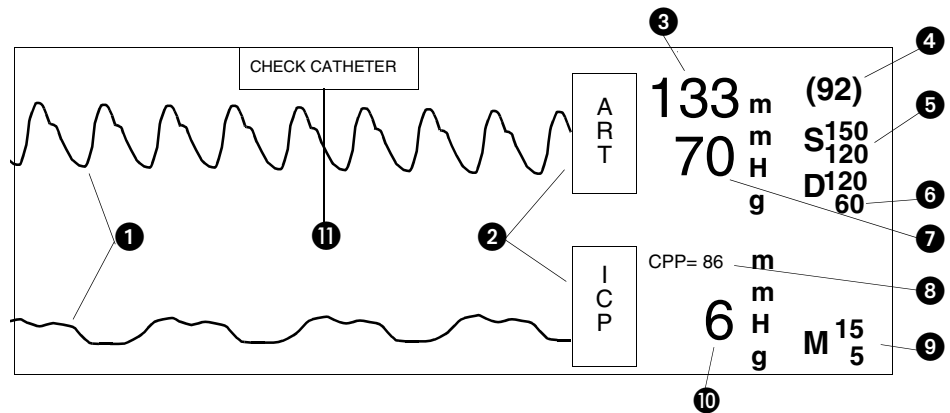


Figure 18-1: Bedside monitor pressure display

- ① Pressure waveforms
- ② Pressure parameter keys
- ③ Systolic pressure
- ④ Mean pressure
- ⑤ Systolic pressure alarm limits
- ⑥ Diastolic pressure alarm limits
- ⑦ Diastolic pressure
- ⑧ Cerebral perfusion pressure
- ⑨ Mean pressure alarm limits
- ⑩ Mean pressure
- ⑪ CHECK CATHETER key (for UA pressures only)

Setting and Adjusting Alarms

To set or adjust alarm limits:

- 1 Touch the desired pressure parameter key.
- 2 Touch ALARM LIMITS.
- 3 Select desired alarm.
- 4 Select ALARM ON.
- 5 Use arrow keys to adjust a limit value.

Pressure alarm limits can be defined for systolic, diastolic, and mean values for ART, PA, UA, UV, and PRS. Alarm limits can only be set for the mean value for all other pressures.

The Alarm Limits menu for ICP provides a cerebral perfusion pressure key (CPP) used to set CPP alarm limits. CPP is computed as mean arterial pressure minus intracranial pressure (MAP-ICP). The value CPP=xxx displays at the top of the digital zone above the ICP value if ICP *and* at least one peripheral invasive arterial pressure are being monitored. If the system cannot compute a pressure (for example, no mean arterial pressure is available), then the message CPP=??? displays.

Alarms can be independently set for each pressure channel.

The CHECK CATHETER alarm may be set when umbilical artery pressure is being monitored. This alarm will sound whenever the pulse rate drops below 60 BPM or the pressure approaches 0 mmHg. Touching the CHECK CATHETER key will silence the alarm.

Adjusting Waveform Size

To change the waveform size:

- 1 Touch the desired pressure parameter key.
- 2 Touch SIZE.
- 3 Select SIZE ↑ or SIZE ↓.

You can increase or decrease the size of the pressure waveform display. This only changes the displayed size and does not affect the signal gain. The waveform size may not be adjusted while the scales are displayed.

Selecting Numeric Display Size

To change the numeric display size:

- 1 Touch the desired pressure parameter key.
- 2 Touch SETUP.
- 3 Touch NUMERIC SIZE.
- 4 Select a display size.

You can select from three different display formats for pressure numerics (for ART, PA, PRS, UA and UV only). In each of the three display formats, mean pressure is 92, systolic pressure is 133 and diastolic pressure is 70.

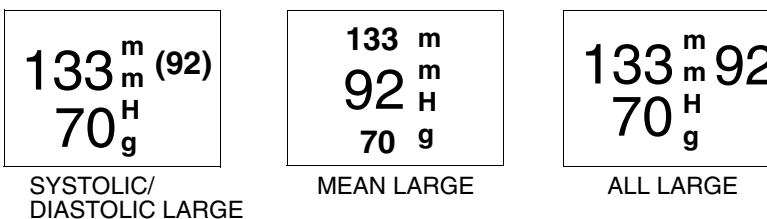


Figure 18-2: Display formats



- Specific alarm limits are not displayed in the All Large display format.

Adjusting Sweep Speed

To select a pressure waveform sweep speed:

- 1 Touch the desired pressure parameter key.
- 2 Touch SETUP.
- 3 Touch SWEEP SPEED.
- 4 Select a sweep speed.

The sweep speed determines the rate at which the pressure waveform moves across the screen. Sweep speed selections are: 50, 25, 12.5, 6.25 mm/second, or the same sweep speed as ECG.

Displaying Waveforms with Scales

To configure the display of pressure waveforms with a vertical scale:

- 1 Touch the desired pressure parameter key.
- 2 Touch SCALES.
- 3 Select SCALES ON if the pressure is to remain in scales.

You can superimpose a vertical reference scale over pressure waveforms. Up to four pressures can be scaled at one time.

Touching a parameter key and then the SCALES key displays scales when the pressure parameter key is activated. Selecting SCALES ON maintains the selected pressure display in scaled format until SCALES OFF is selected.

Freezing the Scaled Display

To freeze the pressure display:

- 1 Touch the desired pressure parameter key.
- 2 Touch SCALES.
- 3 Select FREEZE ON.

You can freeze a pressure waveform display to stabilize the waveform for obtaining measurements.

To unfreeze the waveform display, select FREEZE OFF or exit the pressure menu by touching either the PREVIOUS MENU or NORMAL SCREEN keys.

Changing the Waveform Scale

To change the pressure waveform scale:

- 1 Touch the desired pressure parameter key.
- 2 Touch SCALES.
- 3 Select SCALE 0-xxx.
- 4 Type a new scale.
- 5 Touch ENTER.

You can increase or decrease the pressure waveform scale. The bottom of the scale is always 0 (zero). You may set the top of the scale to be any value from 10 to 500 mmHg by typing in the desired value and touching ENTER.

Selecting the Waveform Measurement Value

To obtain a pulmonary capillary wedge pressure (PCWP):

- 1 Touch PA.
- 2 Inflate PA catheter balloon.
- 3 Touch SCALES.
- 4 Touch FREEZE ON.
- 5 Deflate PA catheter balloon.
- 6 Use arrow keys to position cursor.
- 7 Touch SAVE PCWP.

You can obtain a measurement at any part of the pressure waveform by using the horizontal cursor. The measurement value displays as CURSOR = xx in the message line above the Pressure menu. The most common use of this function is to obtain a pulmonary capillary wedge pressure (PCWP) value from the pulmonary artery catheter.

Storing Values for Trending

To store values in memory:

- 1 Touch the desired pressure parameter key.
- 2 Touch SCALES.
- 3 Use arrow keys to position cursor.

For ART, PRS, UA and UV

- 4 Select SAVE SYS, SAVE DIA or SAVE MEAN.

For CVP, RAP, LAP or ICP

- 5 Touch SAVE MEAN.

For PA

- 6 Touch SAVE PCWP.

You can store values into memory for pressure trend displays for use in clinical calculations.

Recording Waveforms

To print pressure waveforms:

- 1 Touch RECORD.
- 2 Touch flashing PRESSURE parameter key.

You can print pressure waveforms and values. Refer to *Printing* on page 4-5 for additional information.



- *The pressure scales should not be changed during a recording. This may lead to an annotation on the recorded strip that does not match the actual scale of the recording.*

Setting Artifact Rejection

To activate respiration artifact rejection:

- 1 Touch the desired pressure parameter key.
- 2 Touch SETUP.
- 3 Select ART REJ ON.

Variations in intrathoracic pressures during the respiratory cycle can influence invasive pressures; especially PA, PCWP and CVP. The respiratory artifact rejection feature minimizes the impact of such variations by automatically selecting data from waveform peaks that have little change in amplitude from peak to peak. End-expiration is typically the time with the least variation. The artifact rejection feature works equally well in both mechanically-ventilated and spontaneously-breathing patients.

In patients with chronic obstructive pulmonary disease, intrathoracic pressures during respiration are different than those in patients with normal lung function. Disable artifact rejection when monitoring these patients.

The factory default for artifact rejection is ON for PA pressure only, and OFF for all other pressure labels.

Selecting a Filter Frequency

To adjust the filter frequency:

- 1 Touch the desired pressure parameter key.
- 2 Touch SETUP.
- 3 Touch FILTER.
- 4 Touch the arrow keys to choose the desired setting.

When noise and other interference appears on the pressure waveform, you can adjust the filter frequency to minimize its effect.

A higher filter frequency shows greater detail, but can also produce more artifact. A lower filter frequency smooths the waveform and may help diagnose transducer or catheter problems such as under damping or ringing.

The filter frequency may be set within the range of 3 to 40 Hz.

Restoring User-Defined Settings

To restore user-defined settings:

Configurations with ECG

- 1 Touch ECG.
- 2 Touch SETUP.
- 3 Touch RESTORE SETTINGS.
- 4 Select YES.

With the Restore Settings feature, you can restore the user-configurable settings to the defaults previously stored as user settings. User-configurable settings are listed in *Setting User-Defined Default Values* on page 7-7.



- *RESTORE SETTINGS* changes the user-configurable settings for all parameters.
- Once restored, alarm ON/OFF status and alarm limits are reset to the previously stored user settings.

To restore user-defined settings:

Configurations without ECG

- 1 Touch TEMP.
- 2 Touch RESTORE SETTINGS.
- 3 Select YES.

Factory Default Pressure Alarm Settings

Arterial (ART), Generic Pressure (PRS), Umbilical Artery and Vein (UA and UV), Cerebral Perfusion (CPP-mean only)

Systolic *		
mmHg	High	Low
-50 to 79	+30	-05
80 to 109	+30	-10
110 to 119	+30	-15
120 to 129	+25	-20
130 to 139	+20	-20
140 to 149	+15	-20
150 to 159	+10	-20
160 to 169	+10	-25
170 to 179	+10	-30
180 to 189	+10	-35
190 to 300	+10	-40

Mean		
mmHg	High	Low
-50 to 69	+30	-05
70 to 79	+30	-10
80 to 99	+30	-15
100 to 109	+30	-20
110 to 119	+30	-25
120 to 129	+25	-30
130 to 139	+20	-30
140 to 149	+15	-30
150 to 179	+10	-30
180 to 300	+10	-35

Diastolic		
mmHg	High	Low
-50 to 69	+30	-05
70 to 79	+20	-10
80 to 89	+20	-15
90 to 99	+15	-15
100 to 109	+10	-20
110 to 119	+05	-25
120 to 300	+05	-30

* Example: If systolic is between 80 and 109 mmHg, then HI alarm defaults to 30 mmHg above actual value; LO alarm defaults to 10 mmHg below actual value.

Systolic *		
kPa	High	Low
-6.7 - 10.5	+4.0	-0.7
10.6 - 14.5	+4.0	-1.3
14.6 - 15.9	+4.0	-2.0
16.0 - 17.2	+3.3	-2.7
17.3 - 18.5	+2.7	-2.7
18.6 - 19.9	+2.0	-2.7
20.0 - 21.2	+1.3	-2.7
21.3 - 22.5	+1.3	-3.3
22.6 - 23.8	+1.3	-4.0
23.9 - 25.1	+1.3	-4.7
25.2 - 40.0	+1.3	-5.3

Mean		
kPa	High	Low
-6.7 - 9.2	+4.0	-0.7
9.3 - 10.5	+4.0	-1.3
10.6 - 13.2	+4.0	-2.00
13.3 - 14.5	+4.0	-2.7
14.6 - 15.8	+4.0	-3.3
15.9 - 17.2	+3.33	-4.0
17.3 - 18.5	+2.7	-4.0
18.6 - 19.8	+2.00	-4.0
19.9 - 23.8	+1.3	-4.0
23.9 - 40.0	+1.3	-4.7

Diastolic		
kPa	High	Low
-6.7 - 9.2	+4.0	-0.7
9.3 - 10.6	+2.7	-1.3
10.7 - 11.8	+2.7	-1.9
11.9 - 13.2	+2.00	-1.9
13.3 - 14.5	+1.3	-2.7
14.6 - 15.8	+0.7	-3.3
15.9 - 40.0	+0.7	-4.0

Pulmonary Artery (PA), Right Atrial (RAP), Central Venous (CVP), Left Atrial (LAP), and Intracranial (ICP-mean only)

Systolic, Diastolic, and Mean					
mmHg	High	Low	kPa	High	Low
-50 to 25	+05	-05	-6.7 - 3.3	+0.67	-0.67
26 to 300	+20%	-20%	3.4 to 40.0	+20%	-20%

Invasive Pressure Troubleshooting Guide

Clinical Situation	Possible Cause	Solution
Intermittent or no operation	<ul style="list-style-type: none"> Module error. 	<ul style="list-style-type: none"> Call a qualified service person.
No pressure key appears	<ul style="list-style-type: none"> Module not inserted correctly. Transducer not connected. 	<ul style="list-style-type: none"> Reinsert the module. Reconnect the transducer.
Numeric display does not settle	<ul style="list-style-type: none"> Respiration artifact too high. 	<ul style="list-style-type: none"> Select ART REJ ON.
Pressure display disappears	<ul style="list-style-type: none"> Cable disconnected from the module. Cable disconnected from the transducer. 	<ul style="list-style-type: none"> Reconnect cable. Reconnect cable.
Pressure shows NOT ZEROED	<ul style="list-style-type: none"> Pressure has not been zeroed. 	<ul style="list-style-type: none"> Zero pressure with the ZERO key after opening transducer to air.
Shows constant pressure	<ul style="list-style-type: none"> Stopcock(s) are positioned incorrectly. 	<ul style="list-style-type: none"> Reposition stopcock(s) to connect the patient to the transducer (a waveform will appear on the screen).
ZERO REJECTED message appears	<ul style="list-style-type: none"> Stopcock(s) are positioned incorrectly. Still unable to zero. 	<ul style="list-style-type: none"> Reposition stopcock(s) to open the transducer to air. Zero pressure with the zero key. Follow transducer manufacturer's instructions to correct the problem.
CHECK CATHETER key appears on the monitor	<ul style="list-style-type: none"> Stopcock(s) are positioned incorrectly. UA catheter has become dislodged or occluded. 	<ul style="list-style-type: none"> Reposition stopcock(s) to connect the patient to the transducer (a waveform will appear on the screen). Check UA catheter. Upon completion of the above, touch the CHECK CATHETER key to silence the alarm.

