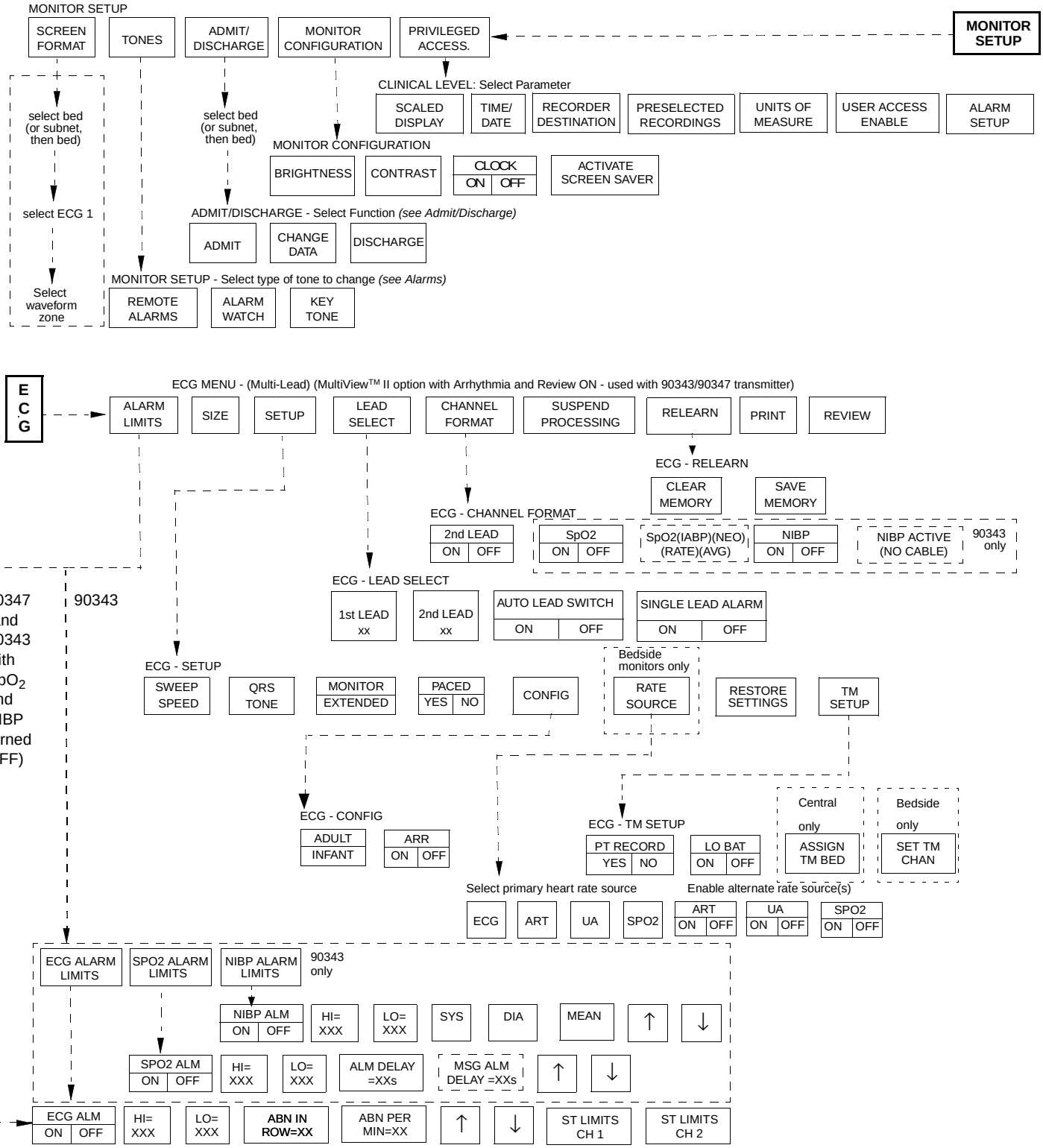
EXHIBIT C – User Manual 1

FCC ID CM676A90343-WMTS

Ultraview Digital Telemetry

Directory of Keys - UCW and Ultraview 1700



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

Ultraview Digital Telemetry

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General Telemetry Overview

The 90478-A 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 SpO_2 measurements and episodic noninvasive blood pressure (NIBP) measurements.

- *Spacelabs Medical's telemetry equipment complies with part 15 (602 to 620 MHz operation) and part 95 (608-614 MHz operation—Wireless Medical Telemetry Service) of the FCC Rules and with RSS-210 of Industry Canada. 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 intereference 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.*

- *Unlicensed low power operation of biomedical telemetry is on a no-protection and no-interference basis. Biomedical telemetry operations are listed as a secondary allocation to VHF/UHF television broadcast and are listed as co-primary allocation to radio astronomy services (608-614 MHz). Additionally, some frequency bands may be shared with amateur radio operations and other unlicensed low power devices.*

- *Operation of telemetry equipment in the 608-614 MHz band may be geographically restricted by government regulation. Spacelabs Medical Customer Service can assist in evaluating if a hospital's location requires coordination with a protected radio astronomy observatory that may be within 80 Km (50 mile) radius.*

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 pulse blood oxygen saturation signals in order to detect oxygen desaturation caused by abnormal pulmonary/circulatory functions.

The Spacelabs Medical 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 SpO_2/NIBP (90343 only) data, and transmits this information to the telemetry receiver module.

- 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 SpO_2 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 Medical customer service representative.*

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. Spacelabs Medical service representatives 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.*

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.*
- *The **LOW BATTERY** message appears and an alarm tone sounds (if LO BAT is set to ON) when the transmitter battery voltage falls below 7.0 volts. When this message appears, the transmitter has approximately three hours of operating time left, depending on transmitter type, selected options, and the type of battery.*
- *When the battery level falls below 7.0 volts, the low battery LED on the transmitter will flash once every 15 seconds. When the battery level falls below 6.0 volts, the low battery LED will flash once every two seconds. When the battery level falls below 5.5 volts, the SpO_2 and NIBP functions will shutdown.*

Battery Disposal

Both the 90343 and 90347 Ultraview Digital Telemetry transmitters are operated by 9-volt primary (non-rechargeable) batteries that must be properly disposed 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.

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.

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

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.

Digital Telemetry Receiver Module

The 90478 telemetry receiver module plugs into a bedside, central, 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 the *ECG, Arrhythmia,* and *ST Analysis* chapters, and in the *SpO_2* and *NIBP* sections of this chapter.

WARNING:

- ***Telemetry systems may be more susceptible to interference than hardwired systems, which may impact signal quality.***
- ***Operation of hand-held, wireless telephone equipment (e.g., 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 SpO_2 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 ten minutes of battery backup time.

Ultraview Care Network

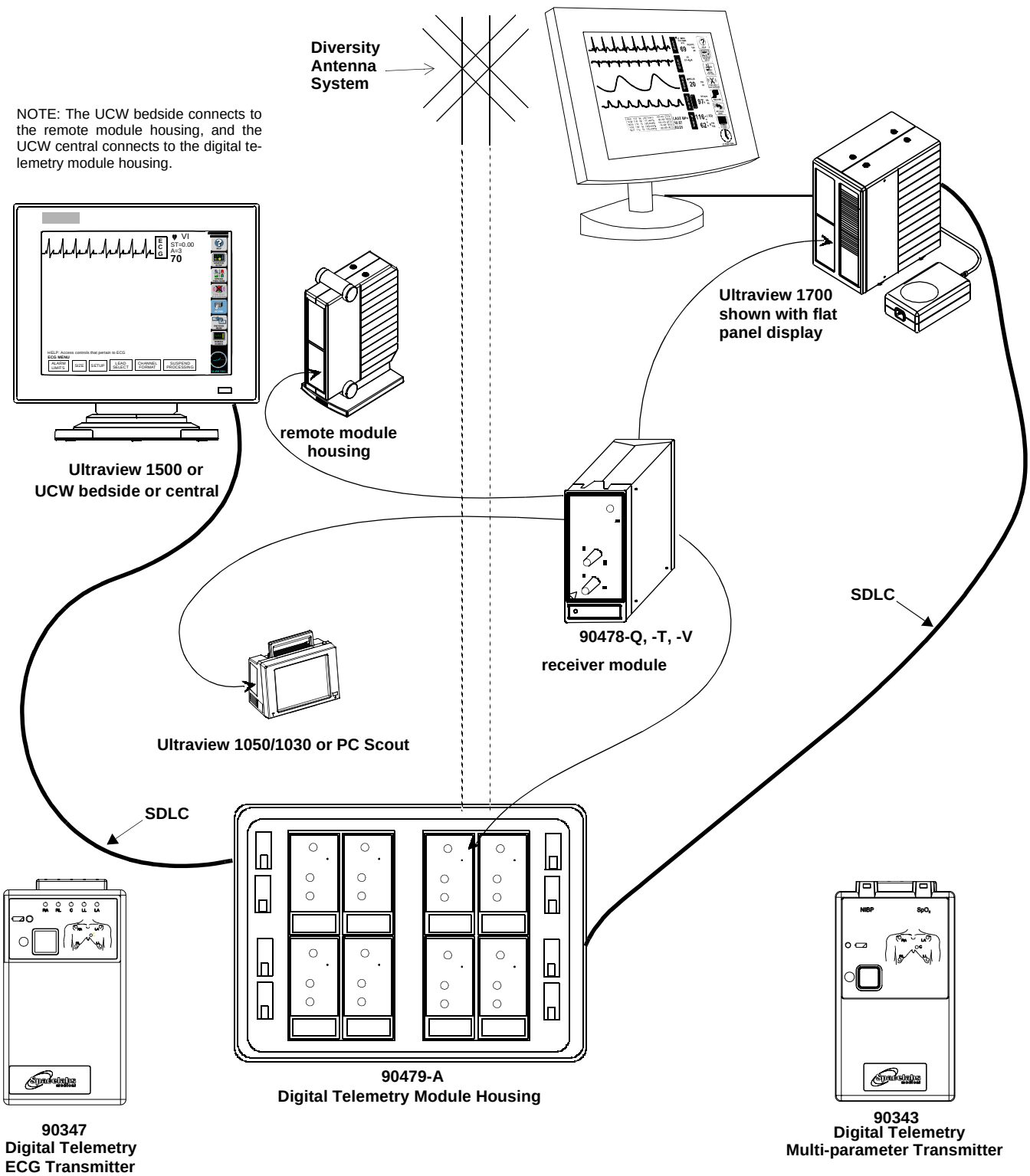

Figure Telemetry-1: Ultraview Digital Telemetry System

Cleaning

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

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.

Assigning a Telemetry Channel

Telemetry transmitters have preassigned channel frequencies. This channel number is identified on the back of the case and cannot be changed. To receive this telemetry channel, one of the receivers in the telemetry receiver housing must be tuned to its assigned frequency.

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- *Tuning telemetry receiver modules to transmitter channels at the central monitor must be done by a qualified service person.*
- *Your central monitor can 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 the* Module Configuration Manager *chapter.*

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 (UCW and 1700):

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

Tuning a Receiver for a Bedside

The central monitor must be tuned by a qualified service person, but the bedside monitor may be tuned using the ECG TM SETUP menu. You may use this menu to tune the receiver module to the pre-assigned channel frequencies on the telemetry transmitter.

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- *The module default is set for North America using UHF band operation.*

To tune a receiver module at bedside:

1. Touch ECG
2. Touch SETUP
3. Touch TM SETUP
4. Touch SET TM CHANNEL
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

Entering Patient Information

To admit a patient:

1. Touch MONITOR SETUP
2. Touch ADMIT/DISCH
3. Select subnet (UCW and 1700 only)
4. Select bed/room number for channel
5. Touch ADMIT
6. Select YES
7. Use keyboard to enter patient info (UCW and 1700 only)
8. Select ID, NAME, HEIGHT, WEIGHT, or BSA (PC Scout, UV1050/1500 only)
9. Enter data using pop-up keypad or keyboard (PC Scout, UV1050/1500 only)
10. Touch ENTER
11. Repeat steps 7 - 10 until all data has been entered
12. Touch ACCEPT (UCW and 1700 only)

The ADMIT/DISCHARGE menu enables you to enter a patient identification (ID) number, name, height, weight, and body surface area (BSA).

- *Admitting a new patient purges data from the previous patient on that telemetry channel.*

Discharging a Patient

To discharge a patient:

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

A patient is discharged by first removing the battery from the 90343/90347 Ultraview Digital Telemetry Transmitter. The monitor displays the squelch waveform followed by the message INTERMITTANT SIGNAL LOSS after a short delay. An alarm condition is displayed on the monitor because of the signal loss.

The message IS SIGNAL LOSS PERMANENT? appears with keys labeled YES and NO in the waveform zone. Touch YES to indicate that the signal loss is permanent. Touch NO to cancel the discharge operation.

The next message displayed is DISCHARGE THE PATIENT?. Touch YES to continue the discharge process. Touch NO to cancel the discharge operation.

The monitor displays PURGES DATA-ARE YOU SURE? Touch YES to discharge the patient and erase all patient data. The intermittent signal loss alarm is then canceled. Touch NO to cancel the discharge operation and cause the message IS SIGNAL LOSS PERMANENT? to appear in the waveform zone.

WARNING:

- ***During INTERMITTANT SIGNAL LOSS message activation, the display of SpO_2 and NIBP data is disabled.***

Acknowledging Signal Loss

When a telemetry signal is lost because the transmitter is out of range or the battery is removed, the receiver initiates a squelch condition indicated by a triangular waveform that replaces the normal ECG waveform and SQUELCH is included in the edge print for any strip chart recording. The ECG trace automatically begins again if the lost signal returns.

After eight seconds of signal loss, the IS SIGNAL LOSS PERMANENT? message appears. Selecting NO suspends alarm tones. Selecting YES displays the message DISCHARGE THE PATIENT? Selecting YES again, provides you with the message PURGES DATA-ARE YOU SURE? Selecting YES a third time, discharges the patient from the system and purges all data for that patient. Selecting NO at any point in this sequence returns you to the previous option.

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 in the ECG zone involved, alerts you to a low battery condition in the transmitter. You may disable the low battery alarm tone, if your bedside or central is configured to do so.

The factory default setting for low battery 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

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.

LOW BATTERY

A Low Battery Message indicates that the battery is weak. After this message appears, the battery has approximately three hours of useful life left (depending on the type of battery used). Install new battery.

SIGNAL INTERFERENCE

The Signal Interference message indicates, via the displayed triangle squelch waveform, that an interfering signal has been detected.

PERMANENT SIGNAL LOSS

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

ECG Overview

Digital telemetry ECG monitoring provides continuous monitoring of electrocardiographic signals in order to detect abnormal cardiac rhythms, including life-threatening arrhythmias such as asystole, ventricular fibrillation, and ventricular tachycardia.

Setting Up ECG Monitoring

To initiate 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 ECG monitoring, plug each lead wire into the transmitter, connect each to an electrode, and then attach the leads to the patient. Match the lead wire color to the color-coded connectors on the top of the transmitter case. Refer to the *ECG* chapter in this manual for details regarding electrode application. Telemetry patients are commonly ambulatory and require optimal skin preparation and lead application to minimize motion artifact. After the electrodes and lead wires have been attached, it is important to tape a loop of lead wire close to the electrode to minimize stress or pulling on the electrode itself. This is called stress-looping.

ECG monitoring begins when the telemetry receiver module detects a signal sent by a telemetry transmitter. The telemetry transmitter sends a signal as soon as its battery is installed.

ECG telemetry reception requires the following minimum conditions:

- The telemetry receiver module must be connected to an Ultraview or PCMS monitor, either directly or through a module housing, with the power ON and a Spacelabs Medical diversity antenna connected.
- ECG electrodes must be properly attached to the patient; and lead wires must be properly attached to the transmitter.
- The transmitter battery must be functional.
- The telemetry receiver module must be tuned to the telemetry transmitter's frequency (channel number).

- *All system connections must be made by Spacelabs Medical personnel only.*
- *Leakage currents are not affected by the high level output. The patient is electrically isolated from the patient monitor by the RF link.*

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.***
- ***Signals resulting from devices such as Automatic Implantable Cardiac Defibrillators (AICD) may momentarily blank the ECG trace rather than display an out-of-range signal. In such cases, it may not be apparent that the AICD has signaled and the condition of the patient should be checked. In all instances of AICD signaling, the bedside or central will redisplay the ECG waveform within 5 seconds.***

ECG monitoring in telemetry is identical to hardwired ECG monitoring. Refer to the *ECG*, *Arrhythmia*, and *ST Analysis* chapters of this manual for detailed descriptions of configurations, displays, and controls. A brief overview of ECG monitoring follows.

Electrodes

For ECG tracing with telemetry, use silver/silver-chloride electrodes or their equivalent. Always connect all the electrodes required for a particular lead. Missing electrodes may result in the loss of ECG tracing. Refer to the *ECG* chapter for information on placing the electrodes.

WARNING:

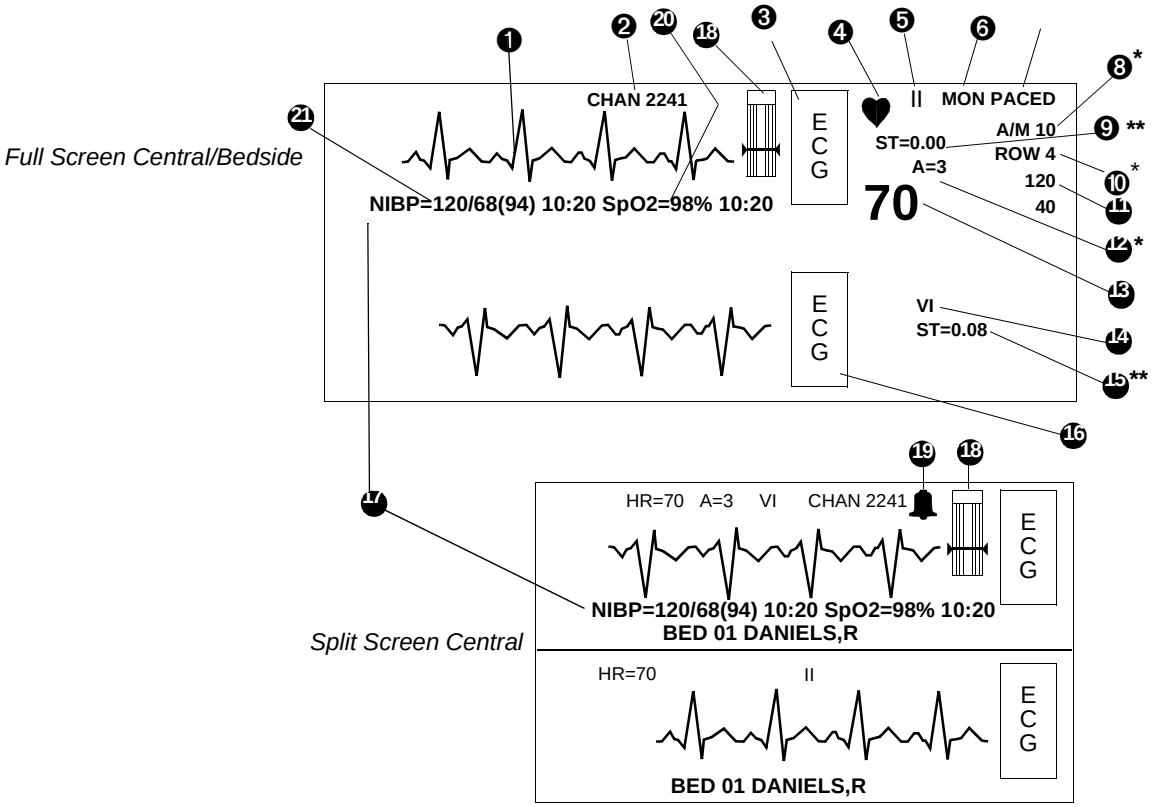
- ***Use only Spacelabs Medical recommended electrodes. Some electrodes may be subject to large offset potentials due to polarization. Recovery time after application of defibrillator pulses may be especially compromised. Squeeze bulb electrodes, commonly used for diagnostic ECG recording, may be particularly vulnerable to this effect.***

CAUTION:

- **Visually inspect each lead wire for obvious damage and replace them as needed.**
- **Only use patient cables and lead wires specified by Spacelabs Medical. Other cables and lead wires may degrade performance and may damage the monitor during defibrillation. Non-Spacelabs Medical cables and lead wires may also change the required input impedance and DC offset voltage, affecting monitor performance.**
- **Do not use stainless steel electrodes.**
- **Do not allow conductive parts of electrodes and connectors, including the reference electrode, to contact other conductive parts, including the ground.**
- **Poor cable dressing or improper electrode preparation may cause line isolation monitor transients to resemble actual cardiac waveforms and inhibit heart rate alarms. Refer to the *ECG* chapter in this manual for details on proper electrode preparation and application.**

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.



❶ ECG trace for first lead
❷ telemetry channel number
❸ ECG key for first lead
❹ QRS indicator (flashes once per detected beat)
❺ ECG lead designator
❻ display resolution (monitor or extended)
❼ paced operation indication (pacemaker detection is enabled)
❽ abnormals per minute alarm limit*
❾ ST segment level for first lead **
❿ abnormals in a row alarm limit *
⓫ ECG rate alarm limits; split screen centrals display a bell symbol when alarms are enabled; bedsides display the rate alarm limits (120/40)
⓬ abnormals per minute counter *
⓭ current heart rate
⓮ ECG lead designator for second lead
⓯ ST segment level for second lead**
⓰ ECG key for second lead

⓱ NIBP measurements: systolic/diastolic (mean) at hours:minutes; SpO_2 measurement at hours:minutes (90343 only; hh:mm not seen on continuous SpO_2). Depending on the patient monitor's display size, the title "NIBP" may not appear.

⓲ SpO_2 SensorWatch bar: shaded area (waveform index) expands up proportionally to signal strength; horizontal line is minimum signal level. Waveform Index (WFI) is used for displaying signal strength in SensorWatch.

⓳ Large size bell indicates ECG alarms enabled.

⓴ Equal sign becomes a bell when SpO_2 alarms enabled.

㉑ Equal sign becomes a bell when NIBP alarms enabled.

* 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.

Monitoring Paced ECG Patients

To monitor paced patients:

1 Touch ECG
2 Touch SETUP
3 Select PACED YES

When monitoring pacemaker patients, use the paced feature to automatically enhance pacemaker spikes for display and eliminate them from the heart rate counter. The last YES/NO setting of the paced feature you select is retained as the default.

If the interval between the pacemaker pulse and the QRS complex is greater than 150 milliseconds, the beat is considered to have originated in the atria and is not classified as a paced beat.

To prevent pacemaker pulses from being counted as actual beats, specialized circuitry removes the pacemaker pulses from the ECG signal and replaces them with pacemaker flags.

- *The optimal leads for monitoring paced patients may vary. In telemetry monitoring, pacemaker spikes are detected on lead II. If pacemaker spikes are not detected, change the electrode position.*

WARNING:

- ***ECG detection circuitry may continue to count the pacemaker rate during occurrences of cardiac arrest or some arrhythmias. Do not rely entirely upon ECG rate alarms. Keep pacemaker patients under close surveillance.***
- ***The system may insert pacemaker flags into the ECG signal in response to signals that are not pacemaker pulses. Therefore, if you use a Spacelabs Medical monitor to observe pacemaker performance, you must take into account all possible sources of pacemaker flags.***
- ***Use the pacemaker manufacturer's performance analyzer as the primary means of evaluating pacemaker operation.***

Restoring Default Settings

To restore default settings:

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

With the Module Configuration Manager feature, you can restore all default settings. User-configurable options are listed in the *Module Configuration Manager* chapter.

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

Changing the Display Resolution

To change the display resolution:

1. Touch ECG
2. Touch SETUP
3. Select MONITOR or EXTENDED

The MONITOR/EXTENDED key determines the display resolution of the two ECG traces, whether or not both traces are currently displayed on the monitor.

Table Telemetry-1: Display Resolution

Key	Display Resolution
Monitor	(0.5 – 30 Hz)
Extended	(0.05 – 30 Hz)

- *Changing the display resolution does not change the waveform bandwidth used to analyze the ECG signals for the arrhythmia and ST segment level.*

The factory default setting for display resolution is monitor mode.

Selecting Options for Lead Display

To select ECG leads:

1. Touch ECG
2. Touch LEAD SELECT
3. Touch 1ST or 2ND LEAD
4. Select the desired lead

One operational mode is available with the 90343 and 90347 multi-lead transmitters. When all electrodes are connected to the patient, leads I, II, III, AVR, AVL, AVF, and Vx, where x = 1 to 6, are available. When no chest lead is applied, leads I, II, III, AVR, AVL, and AVF are available using the remaining connected electrodes.

Table Telemetry-2: Lead Display Options

Connected Electrodes (X)					90343/90347 Valid Lead Vectors
RL	**C**	**LL**	**LA**	**RA**	
X	X	X	X	X	V1-6, I, II, III, AVR, AVL, AVF
X	X		X	X	I
X	X	X		X	II
X	X	X	X		III
X		X	X	X	I, II, III, AVR, AVL, AVF
X			X	X	I
X		X		X	II
X		X	X		III
	X	X	X	X	I, II, III, AVR, AVL, AVF
	X		X	X	I
	X	X		X	II
	X	X	X		III
		X	X	X	II

- *Combinations of leads not included above produce invalid lead vectors. In general, for at least one valid vector, either RL or C and two limb leads must be connected.*
- *The RA lead wire must be connected to the transmitter at all times. This lead wire also serves as the transmitter's antenna.*

ECG Alarm Message Summary

To set or adjust ECG alarms:

1. Touch ECG
2. Touch ALARM LIMITS
3. Touch ECG ALARMS
4. Select ECG ALARM ON
5. Select HI, LO, ABN IN ROW, and ABN PER MIN
6. Use arrow keys to adjust
7. Touch ST LIMITS CH1 or ST LIMITS CH2 to adjust ST segment alarm limits

Refer to the *ECG Problem Solving* section in the *ECG* chapter of this manual for additional conditions and solutions.

CHECK XX

Displayed in the waveform zone, where XX is the name of the faulted electrode. The message clears after 60 seconds for V1 – V6 and RL. It is not cleared for limb lead (RA, LA, LL) faults. If multiple electrodes have faulted, only the highest priority fault is displayed. The limb leads are highest, followed by RL, and then the Vx leads.

ABNORMAL/MINUTE ALARM

Displayed whenever the initial abnormal in minute count (A=XX) exceeds the ABN IN MIN alarm setting. This message is displayed for 10 seconds.

ASYSTOLE

Displayed whenever no beat is detected for 5 seconds. This message is displayed for 10 seconds or the duration of the alarm. An ASYSTOLE message means it has been 5 seconds or more since a QRS complex has been detected. Check the patient. If the patient is stable:

- Check that the lead wires are inserted into the proper receptacle.
- Using the continuity tester, check that there is no damage to the lead wires.
- If the amplitude is poor, check the appropriate lead with a 12-lead ECG.
- Check that the transmitter is more than 3 feet from any television receiver or CRT display.

COUPLET ALARM

Displayed for 10 seconds whenever a couplet is detected and the ABN IN ROW alarm limit is ON and is set to two.

ECG ALARMS OFF

Displayed in reverse video whenever ECG alarms are OFF.

ECG ALARMS SUSPENDED

Displayed in reverse video whenever alarms have been suspended by pressing the [TONE RESET/ALM SUSPEND] key.

ECG PROCESSING SUSPENDED

Appears whenever ECG and arrhythmia processing have been suspended by pressing the SUSPEND PROCESSING key and menu. This message is displayed until processing is resumed.

ECG VOLTAGE TOO LOW

Displayed whenever the ECG signal is below the detection threshold. This message only applies to the ADULT mode for QRS amplitudes in the range of 160 μV to 200 μV. After 10 seconds in this condition, an alarm tone sounds if ECG alarms are enabled and alarm tones have not been turned OFF or suspended.

The ECG amplitude may have dropped below the R-wave detector threshold level. Reposition the electrodes to obtain a QRS amplitude of at least 0.20 mV (adult) or 0.15 mV (neonate).

HI RATE ALARM

Displayed during high rate alarms for either 10 seconds or the duration of the alarm.

IN LEARN

Displayed when the software is in learn mode.

CHAN 1 & 2 LEADS OFF

Displayed when lead failures preclude ECG monitoring in both ECG channels 1 and 2. The message is displayed in the waveform zone for the first ECG channel. An alarm tone sounds if the module has completed its initial period of learning and ECG processing has not been suspended.

CHAN 1 LEADS OFF

Displayed when a lead failure occurs on ECG channel 1 when automatic lead switching is disabled.

CHAN 2 LEADS OFF

Displayed when a lead failure occurs on ECG channel 2. The message is displayed in the waveform zone for both ECG channels 1 and 2.

LO RATE ALARM

Displayed during low rate alarms for either 10 seconds or the duration of the alarm.

NEW DOMINANT

Displayed for 1 minute when a switch to a different dominant ECG morphology occurs.

NOISY SIGNAL

Displayed in ECG channel 1 when the ECG software suspends processing on either channel because of excessive noise on the ECG signal. After 10 seconds in this condition, an alarm tone sounds if ECG alarms are enabled and alarm tones have not been turned OFF or suspended. This message is displayed for the duration of the noisy signal condition plus approximately three seconds. The patient may be moving excessively. Secure the lead wires to the patient.

- Check the electrodes for good skin adhesion.
- Check lead wires at the transmitter for contact.

RUN ALARM

Displayed whenever a RUN of three or more beats is detected and the ABN IN ROW limit is set lower than or equal to the number of beats in the run. This message is displayed for either 10 seconds or the duration of the alarm.

V FIB

Displayed whenever ventricular fibrillation is detected. This message is displayed for either 10 seconds or the duration of the alarm.

ECG Troubleshooting Guide

Clinical Situation	Possible Cause	Solution
Noisy signal	■ ECG frequency response set to extended mode	■ Select monitor mode
	■ Electrodes dry or poor skin adhesion	■ Repeat skin preparation and apply new, moist electrodes
Baseline wanders	■ Patient moving excessively	■ Secure lead wires by stress-looping to the patient
	■ Respiration artifact	■ Re-position electrodes
	■ Electrodes dry or poor skin adhesion	■ Repeat skin preparation and apply new, moist electrodes
Low amplitude ECG	■ Skin improperly prepared	■ Abrade skin and reapply electrodes
	■ Lead selected not providing QRS complex with greatest amplitude	■ Select another lead for monitoring
	■ Electrodes could be positioned on bone or muscle mass	■ Re-position electrodes
ECG will not learn	■ ECG signal too noisy	■ Check lead wires and electrodes, then relearn patient rhythm
	■ ECG voltage not within threshold. ECG VOLTAGE TOO LOW message may be displayed	■ Select a different lead or adjust electrode location
Excessive alarms	■ Electrodes dry or poor skin adhesion	■ Repeat skin preparation and apply new, moist electrodes
	■ Alarm limits set too close to normal patient heart rate	■ Re-adjust alarm limit
	■ Excessive patient movement or muscle tremor	■ Reposition electrodes and secure electrodes with tape if necessary

Refer to the *Problem Solving* sections in this chapter and in the *ECG* chapter for further monitoring tips.

SpO_2 Overview (90343 only)

Pulse oximetry enables you to noninvasively monitor a patient's hemoglobin oxygen saturation either continuously or episodically. The oximetry sensor contains two light emitting diodes (LEDs) that transmit specific wavelengths (approximately 660 and 940 nanometers) of light that are received by a photodetector.

Oxygen saturated blood absorbs light differently than unsaturated blood. Thus, the amount of light absorbed by the blood can be used to calculate the ratio of oxygenated hemoglobin to total hemoglobin in arterial blood. This ratio is displayed as percent SpO_2. 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.***

- *With the Module Configuration Manager feature, you can define your own default settings for characteristics such as alarm limits and display configuration. Refer to the* Module Configuration Manager *chapter in this manual for further details.*

Setting Up SpO_2 Monitoring

The 90343 digital telemetry multi-parameter transmitter uses Spacelabs Medical sensors as well as those from other manufacturers.
Refer to *Accessories* on page -47 for information concerning specific sensors.

CAUTION:

- **Use only patient sensors specified by Spacelabs Medical. Using sensors other than those specified may degrade performance and damage the transmitter during defibrillation.**
- **Check the sensor site frequently. Do not allow the sensor to remain on one site for a prolonged time, especially when monitoring neonates. Refer to the sensor manufacturer's instructions.**
- **Never attach an SpO_2 sensor on a limb being monitored with a blood pressure cuff or a limb with restricted blood flow.**
- **A poorly applied sensor may give inaccurate saturation values.**
- **Choose a site with sufficient perfusion to ensure accurate oximetry values.**

To set up SpO_2 monitoring:

1. Open the battery cover and remove the battery
2. Confirm that the DIP switches 1 through 8 are in the correct setting (Switch 7 must be set to ON for neonatal use and to OFF for adult use)
3. Reinstall the battery and close the battery cover
4. Connect the SpO_2 adapter cable (P/N 700-0014-00) to the transmitter
5. Attach the sensor to the patient and connect the sensor cable to the SpO_2 adapter cable
6. Initiate ECG monitoring
7. Touch ECG
8. Touch CHANNEL FORMAT
9. Select SpO2 ON

All sensors require an adapter cable between the sensor and the transmitter. Because the adaptor cable is reusable, do not discard it when you have finished using a disposable oximetry sensor. Disconnect the sensor cable from the adapter cable before discarding the sensor.

To connect the SpO_2 adapter cable to the transmitter, align the cable with the notch on the front of the transmitter connector, and push the cable straight down into the transmitter. To remove the cable, press the latch release on the bottom of the cable, and pull the cable straight out.

CAUTION:
- **Never twist the cable.**

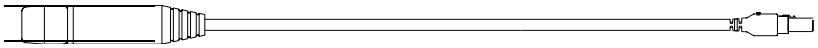


Figure Telemetry-2: SpO_2 Adapter Cable to Transmitter

To enable SpO_2 monitoring in the 90343 digital telemetry multi-parameter transmitter, choose an averaging interval of 4, 8, or 16, seconds by setting DIP switches 1 and 2 as explained in *Setting SpO2 Data Averaging Period and Sampling Interval* on page -26.

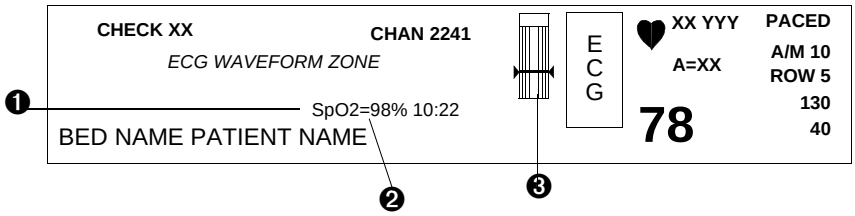


Figure Telemetry-3: Display Zone — Full Screen

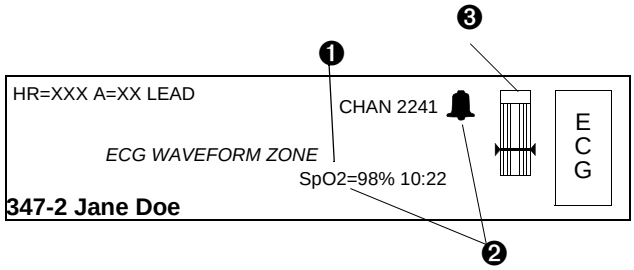


Figure Telemetry-4: Display Zone — Split Screen

❶ Current SpO_2 value (percent) and episodic time of reading. (Time is not displayed when using continuous mode of operation.)

❷ The bell indicates that alarms are enabled (equal sign turns to a small bell when SpO_2 alarms are enabled).

❸ SensorWatch bar: shaded area (waveform index — WFI) expands up proportionally to signal strength; horizontal line is minimum signal level.

Ensuring Accurate Monitoring

Each sensor requires site specific application procedures, and the following general points will aid oximetry monitoring success.

- Choose a site that provides proper alignment of the LEDs and receiving photodetector.
- Reduce light interference when monitoring under bright light by using a 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 (e.g., electrical cords).
- The SensorWatch bar should be above the minimum signal level.

Setting or Adjusting Alarm Limits

To set or adjust SpO_2 alarms:

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

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 the *Alarms* chapter for details concerning Ultraview Care Network alarm operation.

When SpO_2 alarms are enabled, a bell symbol will be displayed between the "SpO2" label and the SpO_2 measured saturation value.

Refer to the *Module Configuration Manager* chapter for SpO_2 parameter tables that list available user settings and factory defaults for this parameter.

ALM DELAY Key

This key sets the number of seconds the system will wait before it reports that an alarm limit has been violated. When this feature is OFF, the key label will read "ALM DELAY OFF". When it is on, the label will read "ALM DELAY xx", where "xx" is the value, in seconds, of the delay.

To set the delay time:

1. Touch ALM DELAY xx (or ALM DELAY OFF).
2. Touch the up and down arrow keys until the value is set as desired. Possible settings are OFF, 5, 10, 15, 20, 25, or 30 seconds.

- *If you press the down arrow key after the lowest value has been reached, the following message will appear on the prompt line:*

  Minimum alarm delay time has been reached.

- *If you press the up arrow key after the highest value has been reached, the following message will appear on the prompt line:*

  Maximum alarm delay time has been reached.

MSG ALM DELAY Key

This key sets the number of seconds the system will wait before it issues an alarm tone following any of the following messages:

- SpO2 UNAVAILABLE
- SpO2 FAULTY SENSOR
- SpO2 SENSOR DISCONNECTED
- SpO2 SENSOR OFF PATIENT
- SpO2 INSUFFICIENT SIGNAL
- SpO2 AMBIENT LIGHT INTF.
- SpO2 NOISY SIGNAL

When this feature is OFF, the key label will read “MSG ALM DELAY OFF”. When it is ON, the label will read “MSG ALM DELAY xx” where “xx” is the value, in seconds, of the delay.

To set the message delay time:

1. Touch MSG ALM DELAY xx (or MSG ALM DELAY OFF).
2. Touch the up and down arrow keys until the value is set as desired. Possible settings are OFF, 10, 20, 30, 40, 50, or 60 seconds.

!

- *If you press the down arrow key after the lowest value has been reached, the following message will appear on the prompt line:*

  Minimum message alarm delay time has been reached.

- *If you press the up arrow key after the highest value has been reached, the following message will appear on the prompt line:*

  Maximum message alarm delay time has been reached.

Setting SpO_2 Data Averaging Period and Sampling Interval

To set SpO_2 data averaging period and sampling interval, set transmitter DIP switches 1 through 4 to correct configuration

SpO_2 data averaging is used to smooth the oximetry saturation value by averaging the patient input values over 4, 8, or 16 seconds. This selection is made by setting the DIP switches 1 and 2 beneath the battery compartment in the 90343 digital telemetry multi-parameter transmitter. The default value is 8 seconds. Refer to *Figure Telemetry-5: DIP Switch Setting in Battery Compartment*.

- *Setting both DIP switches 1 and 2 to ON disables SpO_2 data transmission.*
- *To enable SpO_2, remove the battery, set the selected interval, and re-install the battery.*
- *Disabling SpO_2 operation in the 90343 transmitter lengthens battery life.*

CAUTION:

- **Use care when configuring the DIP switches. Avoid using pens or pencils to configure the DIP switches since they may cause contamination. Avoid using sharp cutting instruments which may cause physical damage.**

Table Telemetry-3: DIP Switch 1 and 2 Settings

DIP Switch 1	DIP Switch 2	Effect
OFF	OFF	4 seconds averaging enabled
OFF	ON	8 seconds averaging enabled (default)
ON	OFF	16 seconds averaging enabled
ON	ON	Disable SpO_2 operation

The current setting of the SpO_2 averaging period may be displayed by pressing the ECG CHANNEL FORMAT key and enabling SpO_2.

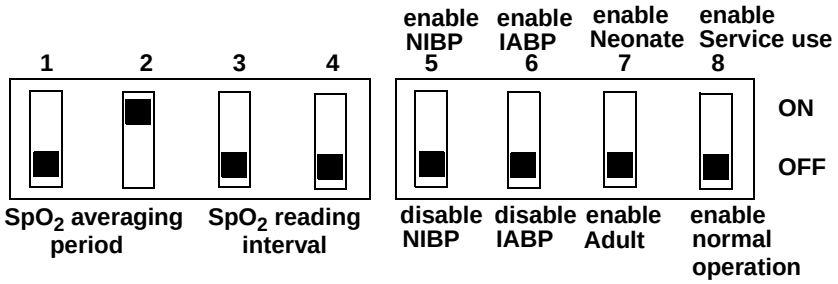


Figure Telemetry-5: DIP Switch Setting in Battery Compartment

The sampling interval selection enables you to determine how often an SpO_2 measurement will be taken. Less frequent SpO_2 readings can extend the usable life of the battery. (Refer to the Ultraview Digital Telemetry Products data sheet,

P/N 061-0801-xx, for more information on battery service life.) This selection is made by setting DIP switches 3 and 4 beneath the battery compartment. The default setting is in continuous.

CAUTION:
- **No SpO_2 monitoring occurs between episodic sampling intervals. Clinical practice or medical judgement should be used in selecting continuous or episodic SpO_2 monitoring mode for each specific patient.**

Table Telemetry-4: DIP Switch 3 and 4 Settings

DIP Switch 3	DIP Switch 4	Effect
OFF	OFF	Continuous sampling (default)
OFF	ON	2 minute sampling interval
ON	OFF	5 minute sampling interval
ON	ON	30 minute sampling interval

CAUTION:
- **DIP switch 8 must remain OFF for normal operation.**

Viewing Pulse Rate

In normal operations, the heart rate for display is obtained directly from the acquired ECG leads or an alternate rate source. SpO_2 can be used as the alternate source, if it is set for continuous measurement. When it is set for episodic measurement, SpO_2 cannot be used as an alternate rate source.

To display heart rate from SpO_2 sensor:

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

SpO_2 with Intra-Aortic Balloon Pumps

Enabling the intra-aortic balloon pump (IABP) feature informs the SpO_2 software that an IABP is in use. The 90343 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 SpO_2.

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 SpO_2 measurement.

To use with balloon pump:

1. Set transmitter DIP switch 6 to ON

To view the current setting of the IABP DIP switch:

1. Touch ECG
2. Touch CHANNEL FORMAT
3. Select SpO_2 ON

- *When the IABP feature is enabled, the pulse rate obtained from SpO_2 may not match the heart rate obtained from ECG.*
- *In cases of excessive patient motion or artifact, the accuracy of the SpO_2 measurement may be compromised when the IABP feature is enabled.*
- *When the IABP operation is selected, the SpO_2 status key in the Channel Format menu indicates IABP.*

Using SpO_2 with Neonates

Enabling neonatal operation, by setting transmitter DIP switch 7, changes the sensor detection operation in the transmitter, improving the signal quality for neonatal patients. This switch must be set ON for neonatal use and set OFF for adult use. When the neonate operation is selected the SpO_2 status key in the Channel Format menu indicates NEO.

SpO_2 Alarm Message Summary

WARNING:

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

- *When the SpO_2 SENSOR DISCONNECTED and SpO_2 UNAVAILABLE messages are displayed, the saturation value is immediately changed to ??? and an alarm is triggered, if your module has been configured with an alarm for that message. When any of the other messages appear, the monitor displays the saturation value alternately with the message* ***???*** *every two seconds. An alarm will begin after the message alarm delay time has elapsed. (Refer to the* Module Configuration Manager *chapter.)*

SpO_2 SENSOR DISCONNECTED

Displayed when the transmitter does not detect either an adapter cable or a sensor connected to an adapter cable. If the message persists and the adapter cable is secure, replace the adapter cable. The alarm will stop after approximately 10 seconds. On remote view, there may be no audible alarm on the remote mainframe before the local alarm stops.

SpO_2 FAULTY SENSOR

The 90343 SpO_2 processor has detected a defective sensor that will require replacement.

SpO_2 UNAVAILABLE

Displayed when the LED and/or photodiode have failed. Replace the sensor and/or SpO_2 adapter cable.

SpO_2 AMBIENT LIGHT INTF.

Displayed when:

- The sensor is receiving external light interference from a bright light source near the sensor. Shield the sensor from the external light source. If the condition persists for more than 30 seconds, ??? will replace the data display.
- The sensor photodiode and LEDs are misaligned on flexible sensors allowing light to enter. Realign the sensor photodiode with LEDs.
- If a message appears with finger clip, replace the sensor.

SpO_2 INSUFFICIENT SIGNAL

Displayed when:

- Insufficient signal for proper operation.

- Poor sensor application or site. Correctly re-apply or reposition to a more perfused site, massage the site, or apply a new sensor.

SpO_2 NOISY SIGNAL

Displayed when:

- The sensor signal is disturbed by motion or other interference. Eliminate sensor movement. The message disappears when a value is obtained.
- The sensor is placed adjacent to power cords or other electrically noisy devices. Move the noisy device or move the sensor to another site.

SpO_2 SENSOR OFF PATIENT

Displayed when:

- The transmitter is unable to detect a valid sensor input signal. Check the patient for proper sensor placement.This alarm is only available when the SpO_2 sensor is a reusable, finger-clip type.

  !

  - *This message is not available with disposable SpO_2 sensors or non-clip type sensors.*

- Tissue between the LED and photodiode is too transmissive. If sensor placement seems correct and the message persists, try a sensor site with a thicker tissue bed.

  !

  - *Adapter cables and sensors are ordered separately through the Spacelabs Medical Supplies Products Catalog.*

SpO_2 Troubleshooting Guide

Clinical Situation	Possible Cause	Solution
No SpO_2 label is displayed	■ SpO_2 is not enabled at the 90343	■ Be sure transmitter DIP switch 1 and 2 are set correctly
	■ SpO_2 is not enabled at the 90478 receiver	■ Be sure transmitter DIP switch 8 is OFF
SpO_2 value displays ???	■ Sensor not connected to patient	■ Re-attach sensor
	■ Adapter cable not connected to module properly	■ Correctly connect the adapter cable
	■ Sensor not connected to adapter cable	■ Correctly connect the sensor
	■ Excessive patient motion	■ Urge patient to remain still while reading is in progress
	■ Transmitter is in the initialization phase (the first 15 seconds after sensor application)	■ Wait until initialization is complete
	■ Low battery indicator constantly illuminated	■ Call qualified service person
Insufficient signal or noisy signal	■ Sensor placement not optimum	■ Move sensor to a site which has better perfusion
		■ Align LED with sensor photodetector
	■ Sensor placed below blood pressure cuff	■ Move sensor to an alternate limb
Intermittent or complete failure to operate	■ Depleted battery	■ Replace battery
	■ Low battery light constantly illuminated	■ Call qualified service person
Factors that cause significant variances in sensor accuracy	■ Presence of dysfunctional hemoglobins (COHb, MetHb)	■ Follow hospital procedure for determining oxygenation in these patients
	■ Presence of intravascular dyes (indocyamine green, methylene blue) depending on their concentration in the blood stream	■ Follow hospital procedure for determining oxygenation in these patients
	■ High ambient light level	■ Reduce light levels near patient; wrap sensor with light blocking material
	■ Electrosurgical interference	■ Ultraview digital telemetry is contra-indicated for electrosurgical use
	■ Patient is significantly anemic (Hb less than 5 gm/dl) or patient has received large amounts of IV solutions	■ Follow hospital procedure for determining oxygenation in these patients

NIBP Overview (90343 only)

The 90343 digital telemetry multi-parameter transmitter sends NIBP patient 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.

The 90217 ABP monitor is a small, lightweight, battery-powered unit designed to take blood pressure measurements. Please refer to the *90217 Operations Manual* (070-0137-xx) for more detailed information on this product, its initialization by a direct PC interface (*90121 ABP Report Management System Operations Manual* — P/N 070-0529-xx), 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 then includes the NIBP readings in the communications to the 90478 receiver using the radio frequency data link. Received NIBP measurements are checked to eliminate the possibility of erroneous readings and valid measurements are displayed on the patient monitor and stored in the patient monitor for trending. The Ultraview Care Network monitor displays valid measurements and the time the measurement was acquired. The most recent reading is displayed by the Ultraview Care Network monitor. The most recent 120 readings are stored and may be displayed by the monitor.

!

- *The 90217 ABP Monitor is intended for use with adult patients only.*
- *The 90217 ABP, when used with the 90343 Ultraview Digital Telemetry system, purges its measurements as they are successfully sent. This operation differs from when the 90217 ABP 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 twenty-four hours of their measurement are unavailable for patient monitor display or trending.*

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.

To set up NIBP monitoring:

1. Configure 90343 DIP switch 5 to ON (refer to *Figure Telemetry-5: DIP Switch Setting in Battery Compartment*)
2. Initialize 90217 with 90121 ABP report management system using the ABP Remote Management System adapter cable (P/N 012-0097-02)
3. Apply appropriate cuff to patient
4. Attach cuff to 90217 monitor
5. Connect NIBP adapter cable (700-0015-00) between 90217 and 90343
6. Touch ECG
7. Touch CHANNEL FORMAT
8. Select NIBP ON

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 SpO_2 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., ausculatory, 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

The 90217 ABP must be initialized prior to the monitoring of each patient. Initialization is accomplished using the 90121 ABP report management system. (Refer to the section *Setting Up the ABP Monitor* in the *90217 Operations Manual*, P/N 070-0137-xx.)

CAUTION:

- **Failure to initialize the 90217 as specified may result in the display and storage of measurements that are incorrect or that were acquired from a prior patient.**

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 Telemetry-5: Cuff Size by Limb Circumference*).

Table Telemetry-5: 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

4. 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.**

5. 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.
6. 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 Telemetry-6: Common Cuff Hose Positions* shows the most common positions for the cuff hose.

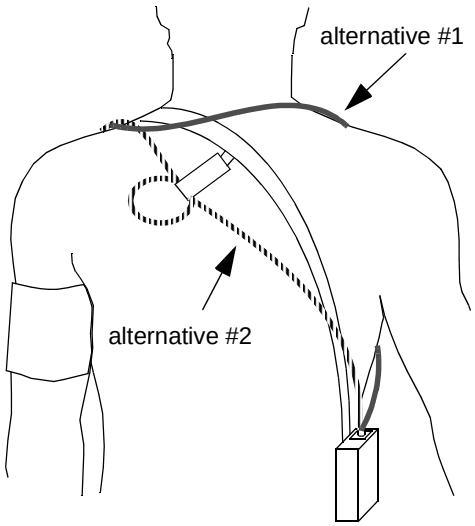


Figure Telemetry-6: Common Cuff Hose Positions

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 Telemetry-5: DIP Switch Setting in Battery Compartment*.
10. The 90478 receiver must be configured for operation with the 90343 transmitter and attached 90217 ABP. Touch the monitor ECG key to display

the main menu. Touch CHANNEL FORMAT, then 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 90217 and the NIBP port on the 90343 as shown in *Figure Telemetry-7: Transmitter and ABP Monitor Connections*.

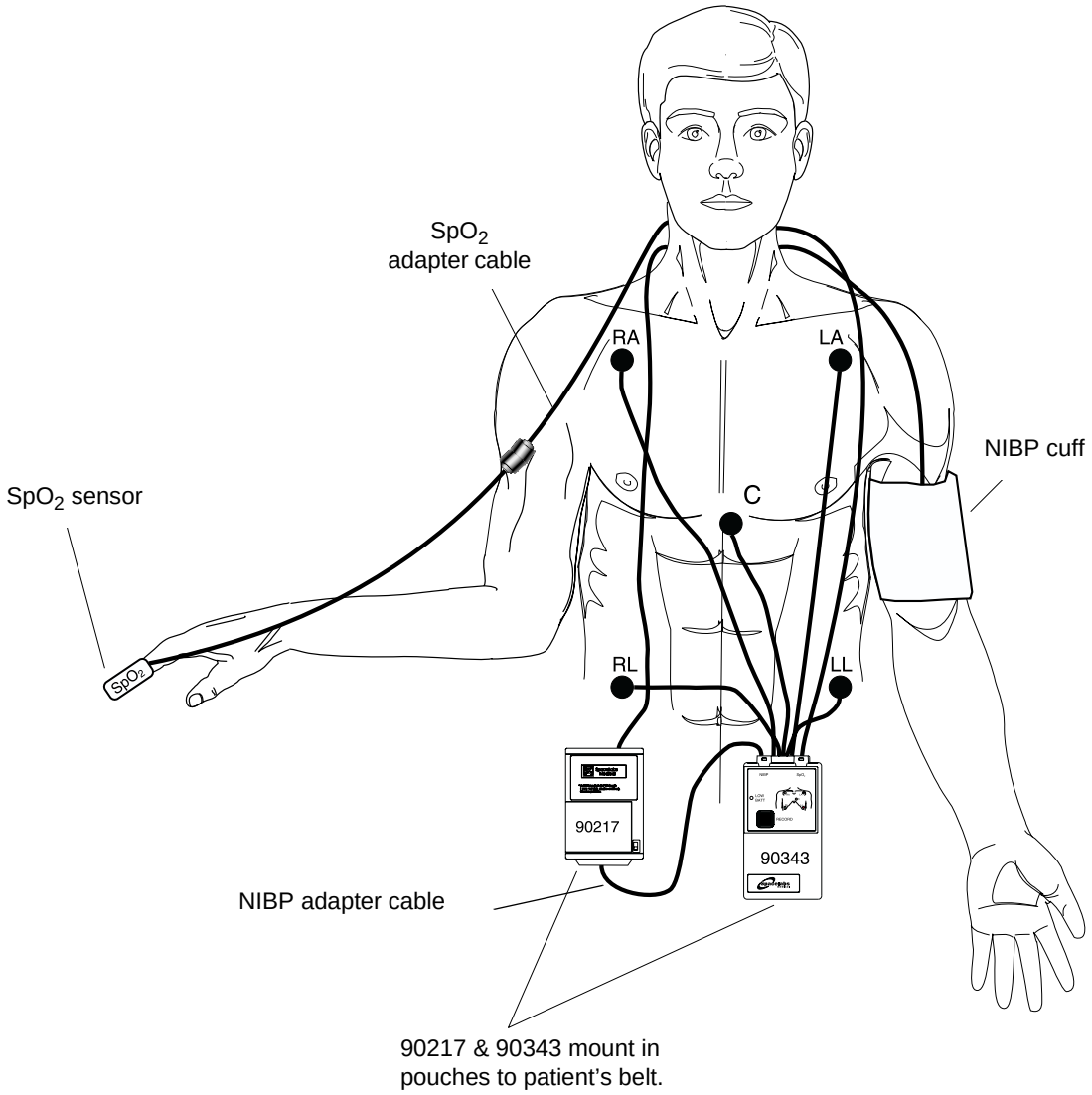


Figure Telemetry-7: Transmitter and ABP Monitor Connections

Figure Telemetry-8: Display Zone — Full Screen and *Figure Telemetry-9: Display Zone — Split Screen* 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. Depending on the patient monitor's display size, the title "NIBP" may not appear.

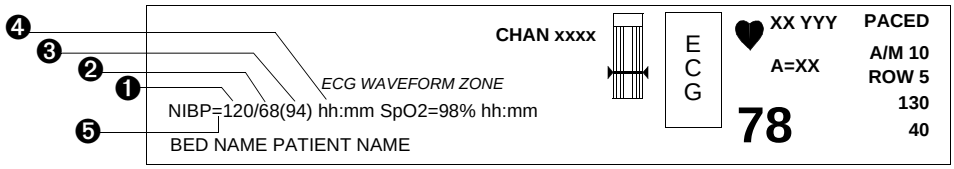


Figure Telemetry-8: Display Zone — Full Screen

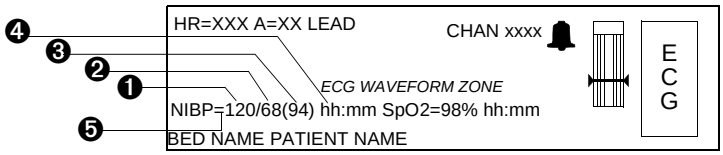


Figure Telemetry-9: Display Zone — Split Screen

❶ Last systolic reading
❷ Last diastolic reading
❸ Last mean reading
❹ Hour and minutes of last reading
❺ Equal sign becomes bell symbol when NIBP alarms are enabled

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

You can define pressure alarm limits for systolic, diastolic, and mean values. The default setting for alarms is OFF. Refer to the *Alarms* chapter in this manual for Ultraview system alarm functions. The alarm limits defaults are listed in *Table Telemetry-6: Alarm Limits*.

Table Telemetry-6: Alarm Limits

	High		**Low**	
systolic	180 mmHg	(24.0 kPa)	100 mmHg	(13.3 kPa)
diastolic	120 mmHg	(16.0 kPa)	60 mmHg	(8.0 kPa)
mean	130 mmHg	(17.3 kPa)	80 mmHg	(12.0 kPa)

Refer to the *Module Configuration Manager* chapter for NIBP parameter tables that list available user settings and factory defaults for this parameter.

Displaying New or Previous Readings

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 the *Trends* chapter for details.

To display the current reading:

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

To display previous readings in tabular format (PC Scout):

1. Touch SPECIAL FUNCTIONS
2. Select LOCAL TRENDS or REMOTE TRENDS
3. Select subnet and bed number
4. Touch TABULAR TRENDS
5. Select TIME INTERVAL or ARROWS to adjust the time interval and period

(UCW and 1700):

1. Touch SPECIAL FUNCTIONS
2. Touch TABULAR TRENDS
3. Select LOCAL BED or REMOTE BED
4. Select bed number
5. Select TIME INTERVAL or ARROWS to adjust the time interval and period

To display previous readings in graphic format (PC Scout):

1. Touch SPECIAL FUNCTIONS
2. Touch LOCAL TRENDS or REMOTE TRENDS
3. Touch GRAPHIC TRENDS
4. Touch TOP GRAPH of BOTTOM GRAPH
5. Touch desired parameter to graph

(UCW and 1700):

1. Touch SPECIAL FUNCTIONS
2. Touch GRAPHIC TRENDS
3. Select LOCAL BED or REMOTE BED
4. Select bed number
5. Touch desired parameter to graph

Tabular Trends Display

Bed: ICU1	Patient: John Smith			Date: 26 FEB 1999					
Time		11:32	11:33	11:34	11:35	11:36	11:37	11:38	11:39
HR (ECG)	b/min	60	60	59	60	61	60	59	60
ABN	b.min	0	0	0	0	0	0	0	0
SpO2	%	96	97	97	96	97	96	96	96
SpO2 PR	b/min	70	70	70	70	70	70	70	70
SpO2 (WFI)		363	364	362	365	367	285	300	340
NIBP/s	Time	11:32					11:37		
	mmHg	100					102		
NIBP/d	Time	11:32					11:37		
	mmHg	72					70		
NIBP/m	Time	11:32					11:37		
	mmHg	80					79		

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.

The following messages are displayed on the Ultraview monitor 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 may be found in the *90217 ABP Monitor Operations Manual* (P/N 070-0137-xx).

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 90217, 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 90217 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	■ Reinitialize 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
90217 ABP Display is incorrect	■ Data not retained	■ Replace backup battery
	■ Low or no power	■ Check the batteries for a full charge; if needed, replace or recharge the batteries
	■ 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	■ Isolate cause and correct

NIBP Troubleshooting Guide (continued)

Clinical Situation	Possible Cause	Solution
Variable readings occur	■ Some arrhythmias may cause beat-to-beat pressure and NIBP readings	■ Document arrhythmia if present, verify pressure using another method, then follow hospital procedure for care of this type of patient
	■ Larger than normal influence of respiratory phases on blood pressure (inspiratory fall in blood pressure; expiratory rise)	■ 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	■ Reposition the cuff
	■ Air pump staying on too long	■ Return unit to Spacelabs Medical for service
Cuff too loose	■ Cuff placed on patient too loosely	■ Reposition the cuff
	■ Air pump not staying on long enough	■ Return unit to Spacelabs Medical for service

Alarm Message Summary

Unless otherwise specified in their description, the following messages are left on the top line (full screen monitors, medium font) or second line (split screen monitors, small font) of the waveform zone. They are displayed for the duration of the condition that caused the message or for the period specified in their description unless replaced by a higher priority message. The conditions under which these messages can be displayed are outlined below. During alarms, alarm messages flash unless alarms are suspended.

ECG Alarm Messages

The following messages apply when either the 90343 or 90347 is in use.

CHECK XX

Displayed in the waveform zone, where XX is the name of the faulted electrode. The message clears after 60 seconds for V1 – V6 and RL. It is not cleared for limb lead (RA, LA, LL) faults. If multiple electrodes have faulted, only the highest priority fault is displayed. The limb leads are highest, followed by RL, followed by the Vx leads.

ABNORMAL/MINUTE ALARM

Displayed whenever the abnormal in minute count (A=XX) initially exceeds the ABN IN MIN alarm setting. This message is displayed for 10 seconds.

ASYSTOLE

Displayed whenever no beat is detected for 5 seconds. This message is displayed for the greater of 10 seconds or the duration of the alarm.

COUPLET ALARM

Displayed whenever a couplet is detected and the ABN IN ROW alarm limit is ON and set to 2. This message is displayed for 10 seconds.

ECG ALARMS OFF

Displayed in reverse video whenever ECG alarms are OFF.

ECG ALARMS SUSPENDED

Displayed in reverse video whenever alarms have been suspended with the monitor's TONE RESET/ALM SUSPEND hard key.

ECG PROCESSING SUSPENDED

Appears whenever ECG and arrhythmia processing have been suspended with the SUSPEND PROCESSING key and menu. This message is displayed until processing is resumed.

ECG VOLTAGE TOO LOW

Displayed whenever the ECG signal is below the detection threshold. This message only applies to ADULT mode for QRS amplitudes in the range of 160 µV to 200 µV. After 10 seconds in this condition, an alarm tone sounds if ECG alarms are enabled and alarm tones have not been turned OFF or suspended.

HI RATE ALARM

Displayed during high rate alarms for the greater of 10 seconds or for the duration of the alarm.

IN LEARN

Displayed when the module is in learning mode.

CHAN 1 & 2 LEADS OFF

Displayed when lead failures preclude ECG monitoring in both ECG channels 1 and 2. The message in displayed in the waveform zone for the first ECG channel. An alarm tone sounds if the module has completed its initial period of learning and ECG processing has not been suspended.

CHAN 1 LEADS OFF

Displayed when a lead failure occurs on ECG channel 1 when automatic lead switching is disabled.

CHAN 2 LEADS OFF

Displayed when a lead failure occurs on ECG channel 2. The message is displayed in the waveform zone for both ECG channels 1 and 2.

LO RATE ALARM

Displayed during low rate alarms for the greater of 10 seconds or the duration of the alarm.

NEW DOMINANT

Displayed for 1 minute when a switch to a different dominant ECG morphology occurs.

NOISY SIGNAL

Displayed in ECG channel 1 when the ECG software suspends processing on either channel due to excessive noise on the ECG signal. After 10 seconds in this condition, an alarm tone sounds if ECG alarms are enabled and alarm tones have not been turned OFF or suspended. This message is displayed for the duration of the noisy signal condition plus approximately three seconds.

RUN ALARM

Displayed whenever a RUN of three or more beats is detected and the ABN IN ROW limit is set lower than or equal to the number of beats in the run. This message is displayed for the greater of 10 seconds or the duration of the alarm.

V FIB

Displayed whenever ventricular fibrillation is detected. This message is displayed for the greater of 10 seconds or the duration of the alarm.

SpO_2 Alarm Messages

The following general messages apply only when the 90343 transmitter is in use and the SpO_2 option is enabled on the transmitter and receiver.

SpO_2 UNAVAILABLE

The 90343 has reported and internal error or the communications from the 90343 transmitter contain an excessive number of errors.

SpO_2 FAULTY SENSOR

The 90343 SpO_2 processor has detected a defective sensor that will require replacement.

SPO_2 SENSOR DISCONNECTED

The sensor is not connected properly to the adapter cable or the adapter cable is not connected properly to the 90343 transmitter.

SpO_2 AMBIENT LIGHT INTF.

The ambient light present is causing interference with the signal from the sensor. Attempt to reduce the amount of ambient light.

SENSOR OFF PATIENT

The sensor is not properly applied to the patient. (This alarm is available only with non-disposable, finger-clip type sensors.)

SpO_2 INSUFFICIENT SIGNAL

The signal amplitude from the sensor is not sufficient.

SpO_2 NOISY SIGNAL

The signal is sufficiently disrupted that it may cause erroneous saturation or heart rate data. This may be caused by patient motion, electrical interference, or other cause.

NIBP Alarm Messages

The following general messages apply only when the 90343 transmitter is in use and the NIBP option is enabled on the transmitter and receiver.

NIBP UNAVAILABLE (xx)

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

NIBP READING FAILURE (xx)

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

NIBP AIR LEAK

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

NIBP LOOSE OR NO CUFF

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

NIBP PATIENT CANCELLED

The patient has pressed the START/STOP button on the 90217, halting a reading in progress.

NIBP LOW BATTERY

The primary (3xAA) battery voltage is low. Replace with fresh batteries.

NIBP KINKED HOSE

The pressure value increased too rapidly indicating a kinked hose or other restriction.

NIBP EVENT CODE (xx)

The event code returned from the 90217 monitor is not defined as one of the other messages.

Telemetry Alarm Messages

The following are general telemetry messages and apply to both 90343 and 90347 transmitters.

INTERMITTENT SIGNAL LOSS

Displayed in the waveform zone whenever a minimum of the previous 100 samples were missed. A level 2/low priority alarm tone sounds after 10 seconds in this condition.

LOW BATTERY

Displayed in the waveform zone when the transmitter voltage is low. This message is accompanied by a level 2/low priority alarm tone if the SETUP menu's LOW BAT ON/OFF key is set to ON and displayed.

SIGNAL INTERFERENCE

Displayed in the waveform zone whenever a signal can no longer be detected because of interference from a stronger signal source lasting more than 0.5 seconds. A level 2/low priority alarm tone sounds whenever this message is displayed.

Accessories

Refer to the *Spacelabs Medical Supplies Products Catalog* for availability of accessories. Some of the more commonly used accessories are listed below.

Digital Telemetry Accessories

9034/90347 telemetry transmitter pouch	015-0500-00
Belt clip	344-0020-00
Receiver whip antenna (UHF)	117-0040-00
Receiver housing protective cover	200-0180-00

ECG Accessories

DIN standard safety lead wire set, 5 wire	012-0605-00
Adult general purpose electrode	015-0097-01
Holter/stress disposable electrode	392015-001

SpO_2 Accessories

Nellcor SpO_2 adapter cable	700-0014-00
Nellcor SpO_2 sensors	
Adult/Neonatal (N-25)	690-0006-00
Pediatric (P-20)	690-0007-00
Adult disposable (D-25)	690-0001-00
Finger clip (DS-100A)	690-0003-00
Nasal (R-15)	690-0005-00
Oxiband A/N	690-0004-00
Oxiband pediatric/infant reusable sensor P/I	690-0039-00

NIBP Accessories

ABP adapter cable	700-0015-00
ABP Pouch	015-0501-00
ABP Shoulder Strap	016-0262-00
ABP Waist Belt	016-0080-00
Cuff assembly, child (13-20 cm) w/ hose	015-0118-01
Cuff assembly, small adult (17-26 cm) w/ hose	015-0067-01
Cuff assembly, adult (24-32 cm) w/ hose	015-0068-02
Cuff assembly, large adult (32-42 cm) w/ hose	016-0077-01
Cuff assembly, extra-large adult (38-50 cm) w/ hose and cuff support harness	016-0109-01
ABP Report Management System	90121
ABP Report Management System Adaptor Cable	012-0097-02
90121 ABP Report Management System Operations Manual	070-0529-xx
90217 Operations Manual	070-0137-xx