HP Telemetry System

for the HP Viridia Information Center

User Guide

Part Number M2600-90201
Printed in the U.S.A. December 1999
Third Edition

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Hewlett-Packard
3000 Minuteman Road
Andover, MA 01810-1099
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Printing History

New editions of this document incorporate all material updated since the previous edition. Update packages may be issued between editions and contain replacement and additional pages to be merged by a revision date at the bottom of the page. Pages that are rearranged due to changes on a previous page are not considered revised.

The documentation printing date and part number indicate its current edition. The printing date changes when a new edition is printed. (Minor corrections and updates which are incorporated at reprint do not cause the date to change.) The document part number changes when extensive technical changes are incorporated.

First Edition..... August 1998

Model M2604A Viridia Mainframe, release D.01/D.02/D.03
Model M2601A Viridia Transmitter, release A.00/A.01/A.02
Model M2605A Viridia Wave Viewer, release A.00/A.01/A.02
Model M1403A Digital UHF Telemetry System with Option C03, release D.01/D.02/D.03

Second Edition..... February 1999

Model M2604A Viridia Mainframe, release D.01/D.02/D.03
Model M2601A Viridia Transmitter, release A.00/A.01/A.02
Model M2605A Viridia Wave Viewer, release A.00/A.01/A.02
Model M1403A Digital UHF Telemetry System with Option C03, release D.01/D.02/D.03

Third Edition..... December 1999

HP Telemetry System, Release B
Model M2604A Viridia Mainframe, release D.01/D.02/D.03
Model M2601A Viridia Transmitter, release A.00/A.01/A.02/A.03
Model M2605A Viridia Wave Viewer, release A.00/A.01/A.02
Model M1403A Digital UHF Telemetry System with Option C03, release D.01/D.02/D.03

Details about the specific releases are contained in Appendix C.

About this Book

This User's Guide covers the use of the HP Telemetry System with the HP Viridia Information Center. The HP Telemetry System comprises:

- HP M2600A Viridia Telemetry System
- HP M1403A Digital UHF Telemetry System with Option C03.

The User's Guide contains information on performing day-to-day tasks and troubleshooting common problems as well as detailed information about all clinical applications. It includes lists of alarm and inoperative (INOP) messages, and configuration choices. Your purchased system may not include all the functionality described in this manual.

User information for the HP Telemetry System is also contained in the HP Viridia Information Center On-line Help. Help focuses on how to complete basic tasks and troubleshoot problems.

Appendix C, "System Releases," summarizes the differences between the current version of the HP Telemetry System and earlier system releases.

THIS GUIDE DOES NOT COVER use of the HP Telemetry System with the HP OmniCare Component Central Monitor. If you are using the HP Telemetry System with the HP OmniCare Component Central Monitor, please refer to the following user documentation

- *HP Viridia Telemetry System/HP OmniCare Component Central Monitor User's Guide*, order number M2300-91930, publication date 5/97
- *HP Viridia Telemetry System User's Reference Manual*, order number M2600-90039, publication date 5/97
- *HP Viridia Telemetry System User's Addendum*, order number M2600-90060, publication date 11/97
- *HP Viridia Telemetry System User's Addendum #2*, order number M2600-90080, publication date August 1998
- *HP Viridia Telemetry System User's Addendum #3*, order number M2600-90099, publication date February 1999
- *HP Viridia Telemetry System User Addendum #4*, order number M2600-90222, publication date December 1999.

Document Conventions

Procedures

Procedures are indicated in text by the heading “Task Summary” followed by the following table:

Step	Action
1	
2	
3	

Bold Typeface

Objects of actions in procedures appear in **bold** typeface. Note the following example:

> Click the **Update** button.

Warnings

Warning
Warnings are information you should know to avoid injuring patients and personnel.

Cautions

Caution
Cautions are information you should know to avoid damaging your equipment and software.

Notes

Note—Notes contain additional information on the HP Telemetry System usage.

HP Telemetry System Warnings

The warnings and cautions described below refer to the following devices:

- HP M2600A Viridia Telemetry System
- HP M1403A Digital UHF Telemetry System with Option C03

Warning

Do not touch the patient, bed or transmitter during defibrillation. Keep transmitter battery cover closed during defibrillation.

Warning

Do not install or use power modules for analog output, antennas, and palmtop personal computers (HP Viridia Wave Viewer) within a 2.44 m (8 ft) radius of the patient.

Caution

Installation and setup must be performed by an HP service representative or designee according to the instructions in *HP Viridia Telemetry Installation & Configuration Guide* (part number M2600-90036).

Contents

1 Introduction to the HP Telemetry System

This chapter introduces the HP Telemetry System. It includes the following sections:

Indications for Use

The paragraphs below are the elements of the indications for use statement for the HP Telemetry System, which consists of the HP Viridia Telemetry System (M2600A) and the HP Digital UHF Telemetry System (M1403A) with Option C03.

Condition

The licensed clinician decides that the HP Telemetry System should be used to monitor the patient.

Prescription Versus Over-the-Counter

The HP Telemetry System is a prescription device.

Part of the Body or Type of Tissue with which the Device Interacts

The ECG signal is obtained from accessory electrodes in contact with the patient's skin. The SpO_2 signal is obtained from an accessory sensor in contact with the patient's skin.

Frequency of Use

The HP Telemetry System is indicated for use when prescribed by a licensed clinician.

Physiological Purpose

The HP Telemetry System is indicated when the physiological purpose is to monitor the ECG or SpO_2 of patients on the order of a licensed clinician.

Patient Population

Adult and pediatric patients.

Intended Use

The HP Telemetry System is a comprehensive ambulatory system solution for the intermediate care unit for adult and pediatric patients. The foundation of the system is a transmitter that can capture and transmit ECG signals and SpO_2 values (if available) that are then processed and displayed on the HP Viridia Information Center. The information center generates alarms and recordings, thus notifying clinicians of changes in patients' conditions. The Telemetry System communicates with other devices via the HP Viridia monitoring network.

Note—SpO_2 monitoring is only available with the HP Viridia Transmitter.

Warning

United States law restricts this device to sale by or on the order of a physician. This product is intended for use in health care facilities by trained health care professionals. It is not intended for home use.

System Overview

The HP Telemetry System includes the HP M2600A Viridia Telemetry System and/or the HP M1403A Digital UHF Telemetry System with Option C03. The Telemetry System is used with the HP Viridia Information Center to provide multi-parameter measurements for transitional care and other ambulatory monitoring environments. The system:

- Monitors adult and pediatric patients' ECG.
- Measures pulsatile arterial oxygen saturation (SpO_2) and pulse rate.
- Enables viewing of ECG and SpO_2 measurements and waveforms at the patient's side.
- Makes ST segment measurements.

The HP Telemetry System consists of:

- A transmitter for each patient.
- An antenna system.
- A receiver for each transmitter.
- A mainframe housing up to eight receivers.
- An HP Palmtop Personal Computer with HP Wave Viewer software (for use with Viridia transmitters only). See "Introducing the HP Viridia Wave Viewer" on page 5-5 for additional information

Dual-band Operation

In Release B, the frequency range of the HP Viridia Telemetry System (M2600A) has been expanded to allow operation in the 590-632 MHz frequency band in addition to the current band of 406-480 MHz. This enhancement is for use in countries where radio rule changes have made a higher band more desirable for providing operating frequencies for medical telemetry. For example, in the U.S.A., a FCC rule change provides primary operation for medical telemetry at UHF TV Channel 37 (608-614 MHz). A new antenna system, which is backwards compatible with existing systems, enables operation to 650 MHz, addressing the needs of these new rules, and allows operation of transmitters in both bands simultaneously.

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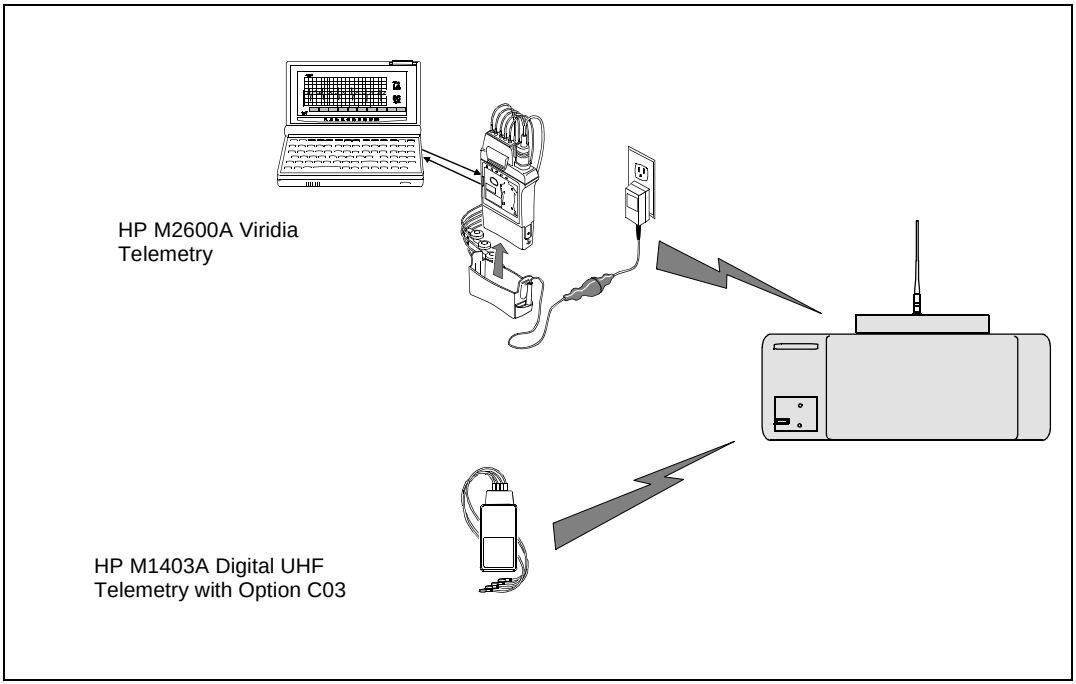


HP Telemetry System

Transmitters

The following transmitters can be used with the HP Telemetry System:

- HP Viridia Transmitter (ECG/SpO_2 or ECG-only versions).
- HP M1400A/B Transmitter (ECG only)

Warning

Pacemakers can be susceptible to radio frequency (RF) interference from devices such as telemetry transmitters which may temporarily impair their performance.

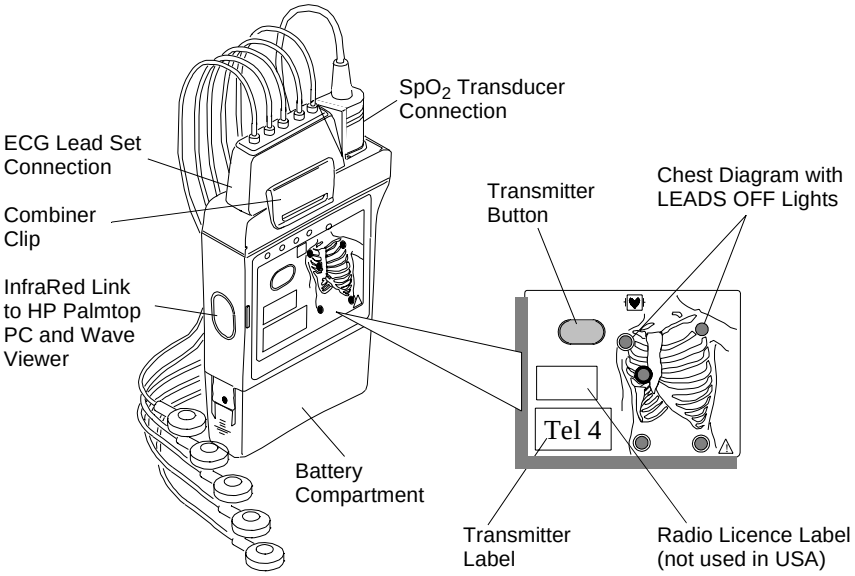
The output power of telemetry transmitters and other sources of radio frequency energy, when used in the proximity of a pacemaker, may be sufficient to interfere with the pacemaker's performance. Due to the shielding effects of the body, internal pacemakers are somewhat less vulnerable than external pacemakers. However, caution should be exercised when monitoring any paced patient.

In order to minimize the possibility of interference, position electrodes, electrode wires, and the transmitter as far away from the pacemaker as possible.

See the *HP Viridia Information Center User's Guide* for additional information on monitoring paced patients.

HP Viridia Transmitter

The HP Viridia Transmitter is battery powered and worn by the patient. It acquires the patient's ECG and SpO_2 signals (if available), processes them, and sends them via the antenna system to the receiver. Measurements are then displayed at the HP Viridia Information Center. The transmitter can also be connected via an infrared link to the HP Viridia Wave Viewer on a HP palmtop computer to provide display of patient measurements and waveforms at the patient's side.



ECG Connection: The Viridia Transmitter supports a 3- or 5-wire ECG cable compatible with HP Viridia CMS/24 ECG trunk cables. CMS trunk cables must include telemetry combiners. In addition to keeping dirt out of the connectors, the combiner has a locking mechanism to keep the lead set attached securely to the transmitter. For safety, every lead should be secured to an electrode on the patient.

Disconnection of Leadset: When you're ready to disconnect the leadset, lift the clip of the combiner to release the lock. Then, holding the combiner firmly, rock the leadset free. Do not pull on the lead wires.

SpO_2 Connection: In addition, the HP Viridia transmitter supports a SpO_2 transducer connection. SpO_2 can be measured continuously, intermittently at 1 or 5 minute intervals, or manually. Reusable sensors in adult finger, small adult/ pediatric finger, and ear clip models can be used, as well as Oxisensor II™ disposable sensors. See Appendix B, "Accessories and Ordering Information" for a list of sensors.

Chest Diagram & LEADS OFF Lights: The diagram on the front of the HP Viridia Transmitter shows standard lead placement for a 5-wire lead set. The white, black and red electrode positions represent standard AAMI 3-lead placement; the red, yellow and green electrode positions represent standard IEC 3-lead placement. Non-standard 3-wire lead placement diagrams are available at the HP Viridia Wave Viewer.

Each electrode position has a light that illuminates if the corresponding electrode becomes unattached. In a LEADS OFF situation, this indicator will help you identify quickly which leads are off and re-attach them. If the reference lead is off, after you correct the situation you may find other lights illuminated as well.

A second function of the Leads Off lights is to indicate successful power-up of the transmitter. When you insert a battery into the transmitter, all five lights should flash once. This indicates that the battery has adequate power for monitoring and that there is no transmitter malfunction. See “Inserting Batteries” on page 1-20 for details.

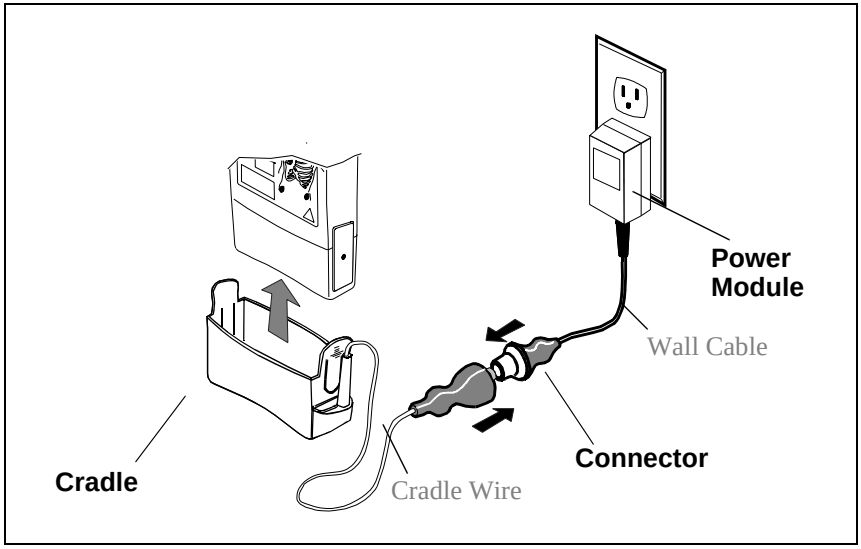
The electrode lights are also used as an indicator that a manual SpO2 measurement has been initiated at the transmitter.

HP Viridia Telemetry Battery Extender

The HP Viridia Telemetry Battery Extender (M2611A) enables operation of the HP Viridia transmitter with an external power source when a patient is not ambulating. The battery extender can be used with all HP Viridia transmitters shipped after December 1999, and any earlier transmitter that has been upgraded. (To identify an eligible transmitter, look for the opening at the base of the battery compartment.)

The battery extender consists of a cradle, which is fitted over the battery compartment of the transmitter, and a cable connecting to a wall-mounted DC power module. When the battery extender is in use, no battery power is used (battery save mode).

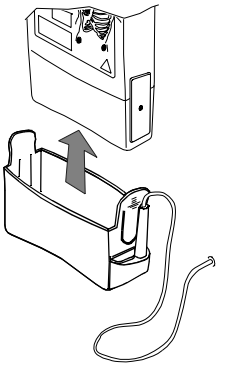
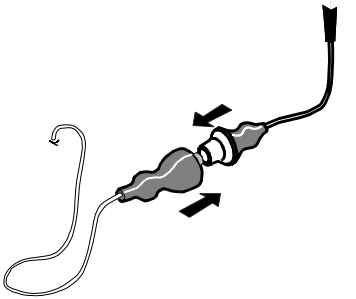
Note—The purpose of the battery extender is to conserve battery life; the extender does not recharge the battery.



HP Viridia Telemetry Battery Extender

Connecting to the Battery Extender

To use an HP Viridia transmitter in battery-save mode, connect the transmitter to the battery extender in the following steps:

Step	Action
1	Slip the cradle onto the base of the transmitter, aligning the extender prongs with the opening at the base of the transmitter. Press until you hear a click.  *Note*—For accurate functioning, the battery cover **must** remain closed when the extender is in use. In addition, Hewlett-Packard recommends that the battery remain in the transmitter while the extender is in use.
2	Connect the aqua connector between the cradle wire and the wall cable. Be sure the connection is secure; the yellow band of the connector should be completely covered. 
3	Insert the power module into a wall power source.

Disconnecting from the Battery Extender

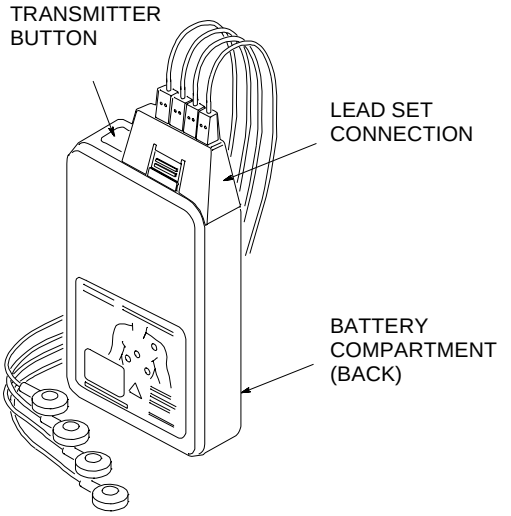
To disconnect a transmitter from the battery extender for ambulatory monitoring, perform the following steps:

Step	Action
1	Disconnect the aqua connector between the cradle wire and the wall cable. *Note*—The connector is designed to come apart on its own if the patient gets up without disconnecting the connector.
2	Tuck the loose end of the cradle wire into the pouch.

Note—Removing the power module from the wall receptacle during monitoring causes the transmitter to reset and reboot before switching to battery power. During this brief interval, data from the transmitter is not available at the central station. This interruption does not occur if the cable is disconnected or if the transmitter is removed from the cradle.

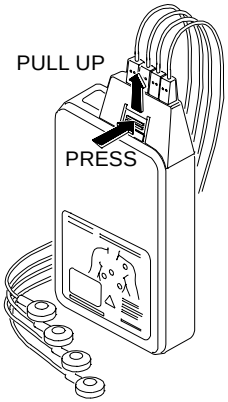
HP M1400A/B Transmitter

The HP M1400A/B telemetry transmitter acquires the patient's ECG signal, amplifies and digitizes it, detects pace pulses, then sends it via an Ultra High Frequency (UHF) channel to a receiver in the receiver mainframe.



Connecting/Disconnecting the Lead Set: The M1400A/B Transmitter supports 3, 4, or 5-lead sets. For safety, every lead should be secured to an electrode on the patient. To connect the lead set, push the lead block down firmly until it "locks."

To disconnect the lead set, press in the tab on the lead block (as shown below) and pull the block up. Do not pull on the lead wires.



Transmitter Features

Transmitter Button

Both the HP Viridia Transmitter (see page 1-6) and the M1400A/B Transmitter (see page 1-12) have a transmitter button. Depending on how it is configured, pressing this button produces:

- A “Nurse Call” message and tone
- A “Nurse Call” message and tone, plus a delayed recording
- A delayed recording
- No response at the HP Viridia Information Center.

Note—Delayed recordings generated by the transmitter button are stored in Alarm Review.

If desired, you can turn the transmitter button off for individual patients at the HP Viridia Information Center by using the Telemetry Setup Window. See “Turning the Transmitter Button On/Off” on page 2-11 for additional information.

On the HP Viridia transmitter, the transmitter button can also be used to initiate an SpO2 measurement. See “Making SpO2 Measurements” on page 4-6 for more information.

Water Resistance

The Release B HP Viridia transmitter and the battery extender (except the power module) can withstand submersion in water for 5 minutes and exposure in a shower for 10 minutes. If the battery compartment gets wet, remove the battery and wipe the compartment dry before monitoring. See “Chapter 7. Telemetry System Cleaning” for details.

Caution

Disconnect the battery extender cradle from the power module prior to a patient’s showering.

Earlier HP Viridia transmitters and the M1400A/B transmitters are also resistant to water. If either transmitter is exposed to liquids, remove the battery and dry the battery compartment thoroughly before monitoring.

If the transmitter or battery extender needs cleaning, follow the instructions in “Cleaning the HP Viridia Transmitter & Battery Extender” on page 7-4 or “Cross-infection Prevention for the HP Viridia Transmitter & Battery Extender” on page 7-8.

Pouch Use

During normal use, the HP Viridia transmitter should be worn over clothing, in a pocket, or preferably in a pouch.

Warning

Place the HP Viridia transmitter in a pouch or over clothing, or both, during patient use. The transmitter should not touch the patient’s skin during normal use.

Automatic Shutoff

A service feature of the HP Viridia Transmitter is RF Automatic Shutoff, which causes the transmitter to stop broadcasting a radio signal if there is no ECG signal for 10 minutes. This prevents interference with other transmitters in use. The INOP message at central is TRANSMITTER OFF. To restart monitoring, attached leads to the patient. Automatic Shutoff can be configured off. When configured off, batteries must be removed when the transmitters are not in use to prevent RF interference and unnecessary battery drain.

The M1400A/B transmitters do not have the Automatic Shutoff feature.

Battery Information

The HP Viridia Transmitter and the M1400A/B Transmitter battery compartments are capable of accommodating any type of standard 9 volt battery. An 8.4 volt Zinc-Air battery can be used with the M1400A/B transmitter and ECG-only version of the HP Viridia transmitter. The transmitter was not designed for use with rechargable batteries.

The battery compartment is located at the bottom of the HP Viridia Transmitter and the M1400A/B Transmitter. The length of time the battery lasts depends on:

- The type of transmitter.
- The battery.
- The parameters being monitored - ECG only, ECG and continuous SpO_2, or ECG and intermittent SpO_2.

When battery power is running low, the INOP message BATTERY WEAK appears in the patient sector to indicate the amount of battery life remaining:

- HP Viridia transmitter - at least 15 minutes
- M1400A/B transmitter - approximately 1 hour

When there is no battery life remaining, the INOP message REPLACE BATTERY is displayed.

Note—If the BATTERY WEAK message appears when you are making a STAT SpO_2 measurement, or changing the SpO_2 sample rate out of Manual, it may be necessary to replace the battery immediately in order to continue monitoring.

Be careful not to short circuit the battery. Short circuiting is caused when a piece of metal touches both buttons (positive and negative terminals) at the top of the battery simultaneously (for example, carrying batteries in a pocket with loose change). More than a momentary short circuit will generally reduce the battery life.

Warning

Certain failure conditions, such as extended short circuiting, can cause a battery to overheat during normal use. High temperatures can cause burns to the patient and/or user, or cause the battery to flame. If the transmitter becomes hot to the touch, place it aside until it cools. Then remove the battery and discard it. It's a good idea to place a piece of tape across the contacts of the battery to prevent inadvertent shorting. Have transmitter operation checked by service to identify the cause of overheating.

The battery should be removed when the transmitter is stored.

Warning

Batteries should be removed from the transmitter at the end of the battery's useful life to prevent leakage.

Warning

If battery leakage should occur, use caution in removing the battery. Avoid contact with skin. Clean the battery compartment according to instructions in "Chapter 7. Telemetry System Cleaning"**.**

Use of Zinc-Air Batteries

Zinc-Air batteries can be used with ECG-only models of the HP Viridia transmitter, release A.01 and later, and with M1400A/B transmitters. A Zinc-Air battery cannot be used with an ECG/SpO_2 transmitter.

For maximum performance, observe the following guidelines:

- Use Zinc-Air batteries within 1 year of manufacture.
- Use Zinc-Air batteries within three months of opening the sealed package.
- Store and use Zinc-Air batteries at near room temperature. They can lose 50% of their capacity at low temperatures (0^oC /32^oF and below).
- Do not put Zinc-Air batteries in an environment with restricted air flow (for example, a plastic bag). Serious restriction of air flow can affect battery capacity. During normal use, the battery compartment provides adequate air flow.

- Zinc-Air batteries may take up to one minute to get to working voltage after they are removed from the airtight wrapper. You can hasten this by shaking the battery.

Maximizing Battery Life

By observing the following guidelines, you can optimize battery life in the HP Viridia transmitter:

- REMOVE THE BATTERY (or turn it over/up-end it) when the transmitter is not in use.
  Note—Automatic Shutoff does not save battery life. In order to allow an automatic turn-on, the transmitter ECG and SpO_2 functions are not completely disabled in this mode.
- For SpO_2 transmitters, when the SpO_2 function is not in use, make sure the SpO_2 sample rate is set to Manual. See “Changing the SpO2 Sample Rate” on page 6-9 for directions.
- Be sure to press **End STAT** at the end of every STAT SpO_2 measurement that is initiated at HP Wave Viewer and wait for the red sensor light to go out before removing the transducer.

Disposal of Batteries

HP recommends that you remove the battery when the transmitter is not in use.

Caution

The battery must be removed if a transmitter will be stored for an extended period of time.

Important—When disposing of batteries, follow local laws for proper disposal. Dispose of batteries in approved containers. If local regulations require you to recycle batteries, recycle batteries in accordance with regulations.

Nominal Battery Life Expectancy

For the HP Viridia Transmitter

Recommended Battery Types	Nominal Life Expectancy - ECG Only	Nominal Life Expectancy - ECG & Continuous SpO_2[4]	Nominal Life Expectancy - ECG & Intermittent SpO_2	Nominal Life Expectancy - ECG with SpO_2 Transducer Detached
Lithium[1] (supplied)	3 days 20 hours	23 hours	*1 min. intervals:* 1 day 19 hours *5 min. intervals:* 2 days 22 hours	3 days
Alkaline[2]	1 day 18 hours	8 hours	*1 min. intervals:* 20 hours *5 min. intervals:* 1 day 10 hours	1 day 4 hours
Zinc-Air[3]	4 days 18 hours	Not Applicable	Not Applicable	Not Applicable

1 Tested with ULTRALIFE U9VL-J batteries.

2 Tested with DURACELL MN1604 batteries.

3 Tested with DURACELL DA146X batteries.

4 Life expectancy is based on transmitter current draw of 43.4 mA.

For the M1400A Transmitter:

Battery Type	Average Life Expectancy (days)*
Zinc-Air	8
Lithium	5
Mercury	4 1/2 (Not recommended due to hazardous waste disposal requirements.)
Alkaline	3
Carbon-Zinc	1 1/2

* Life expectancy is based on transmitter power consumption of 40 mW.

For the M1400B Transmitter:

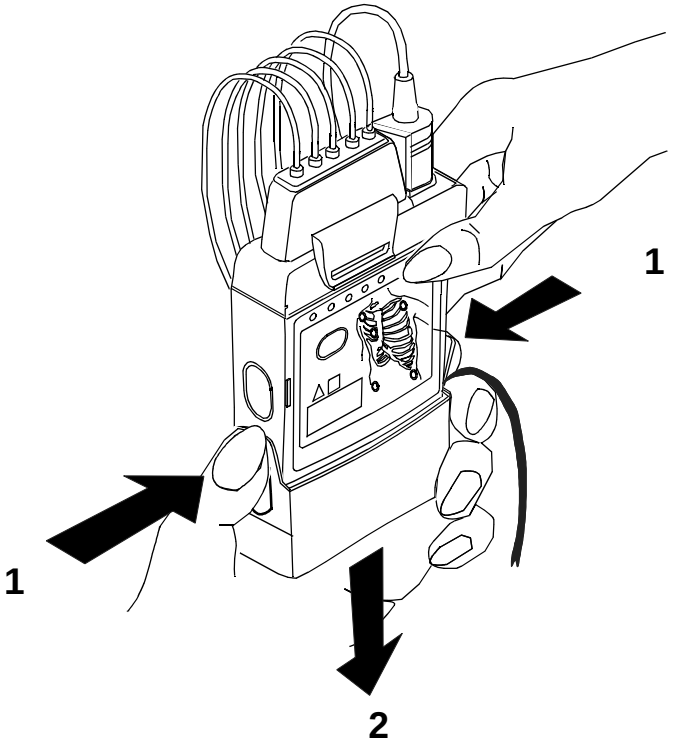
Battery Type	Average Life Expectancy (days)*
Zinc-Air	7
Lithium	4
Mercury	3 1/2 (Not recommended due to hazardous waste disposal requirements.)
Alkaline	2 1/2
Carbon-Zinc	1

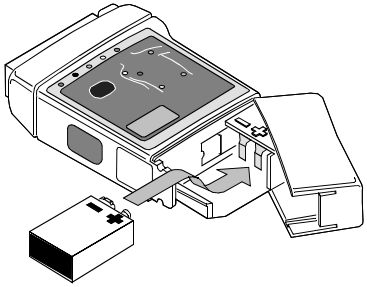
* Life expectancy is based on transmitter power consumption of 52 mW.

Inserting Batteries

Task Summary for HP Viridia Transmitter

Insert a battery into the HP Viridia Transmitter by performing the following steps:

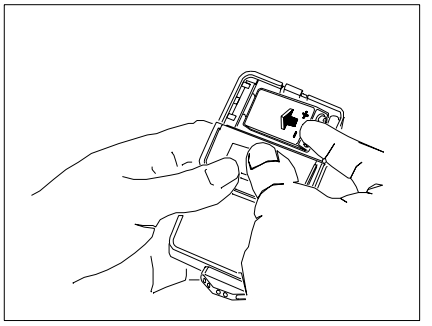
Step	Action
1	Remove the cradle, if present, by squeezing the tops of the tabs (1) and sliding the cradle away from the transmitter (2). 
2	Open the battery compartment by pressing down on the compartment door and swinging it into an open hinged position.

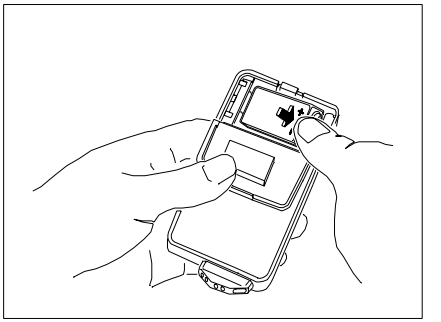
Step	Action
3	Insert the battery, matching the battery polarity with the +/- indication inside the compartment. 
4	When the battery is active after a few seconds, all five of the lights on the chest diagram flash once, then each light flashes individually. Next, if no leadset is attached, one light remains on, or if the transmitter is connected to a patient, no lights remain on. • *If no lights flash*, use a second new battery. If there are still no lights, the transmitter memory may be corrupt. Contact Service. • *If the lights come on but do not behave* as described above, the transmitter has malfunctioned. Contact Service. IMPORTANT: When you replace the battery in a transmitter connected to a patient, if either abnormal condition is in effect, no monitoring will be occurring for the patient until either a new battery or a replacement transmitter is used.

Task Summary for HP M1400A/B Transmitter

Insert the battery into the M1400A/B Transmitter by performing the following steps:

Step	Action
1	Open the compartment.
2	To remove the old battery, pry up the terminal end with your index finger (as shown below).
3	Insert a new battery by following the +/- diagram on the inside of the compartment. When you place the battery in the compartment, set the base of the battery against the leaf spring, and press the terminal end down (as shown in the following illustration). *Note*—It may take about a minute for a Zinc-Air battery to get to working voltage after it is removed from its airtight wrapper. This start up can be hastened by shaking it.

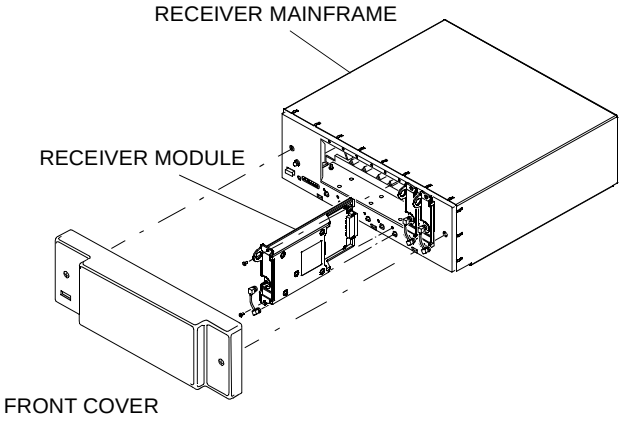




Important—Remove the battery when the transmitter is not in use to prevent interference with signals from other transmitters.

Receiver Module

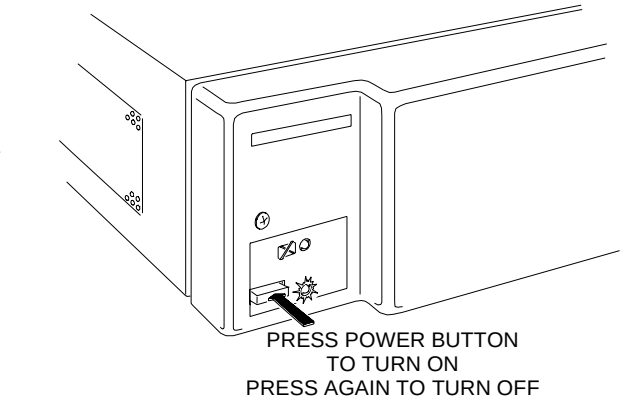
The HP receiver modules are housed in the receiver mainframe. Each receiver module is dedicated to a specific transmitter by an internal identity code. This prevents another patient's waveform from being erroneously transmitted and displayed. The receiver acquires the ECG and SpO_2 signals from the transmitter and sends them to the receiver mainframe.



Receiver Mainframe

The HP receiver mainframe houses up to eight receiver modules. For each receiver, the receiver mainframe calculates the heart rate, and sends the waveform, alarms, inoperative messages (INOPS), and status messages over the HP Viridia monitoring network to the HP Viridia Information Center for display and recording. If SpO_2 is available, the transmitter processes the data and sends it to the Viridia Information Center via the network as well.

Turning the Receiver Mainframe On or Off



The receiver mainframe must be turned on for individual transmitters and receivers to work. To turn the receiver mainframe on, press the button on the lower left corner of the front of the mainframe. A green light illuminates to signify the mainframe and all the receivers are on.

If the receiver mainframe is turned off, the light and all receiver modules are off.

Receiver Mainframe Malfunction Light

A red light on the front panel of the mainframe illuminates when either the mainframe or one of the receivers has malfunctioned. Depending on the problem, you may see the message, NO DATA FROM BED, in single or multiple patient sectors. Contact your Hewlett-Packard Service Representative.

When the mainframe is first turned on, the red light flashes. If no problems are detected, the flashing stops and the light turns off.

Channel Frequencies

The frequency of the HP Viridia transmitter and receiver are programmable, thus enabling changes in frequency if interference is detected. In case of interference, contact service.

Retaining Telemetry Settings

If power to the receiver mainframe is interrupted or turned off, settings controlled by the mainframe such as leads may be affected.

- If the receiver mainframe is turned off for less than three hours, your settings should still be in effect.
- If the mainframe is turned off for more than three hours, your settings revert to default, that is, to the configured settings at installation.

Antenna System

The telemetry antenna system is custom designed for your unit to ensure adequate coverage, therefore the telemetry signal can only be received where there are receiving antennas. After it is received by the antenna system, it is sent to the receiver which recovers the patient's ECG and optional SpO_2. This information is then sent to a monitoring display.

Turning Telemetry On/Off

Telemetry monitoring can be turned on or off in one of several ways:

- Automatically, if Auto Shutoff is enabled at the transmitter and if there is no ECG signal for 10 minutes. This situation creates a TRANSMITTER OFF inop at central. To restart monitoring, re-attach the lead wires.
- Manually, by removing the transmitter battery. This action creates a NO SIGNAL inop at central. To restart, insert the battery.
- Manually, by activating Monitoring Standby at the HP Viridia Information Center (click on **Patient Window**, then **Standby**). This action creates a MONITOR STANDBY message on the display. To restart monitoring, click on **Resume Monitoring** in the Patient Sector.

2
ECG Monitoring

This chapter provides information on setting up and managing ECG monitoring. It includes the following sections:

Lead Sets & Capabilities

HP Viridia Transmitter

The HP Viridia Transmitter supports 3- and 5-wire cables. The table below provides a summary of the capabilities of each cable.

Note—For details of electrode placement, see the HP Viridia Information Center Online Help. For 3-wire electrode placement with Lead Select turned off, see also the HP Viridia Wave Viewer Help.

Lead Set	Number of Leads	Lead/Label	Choices
3-wire -Lead Select Off	1	• Position electrodes for desired lead. Standard placement gives Lead II. See the on-line help in the HP Wave Viewer for information on electrode placement. • Select **Label** to match electrode placement. **Warning—Hewlett-Packard recommends you change the lead label only to reflect the physical placement of the electrodes. This ensures that the monitored lead and the label match, and prevents any possible confusion.**	**Primary** I, II, III, MCL **Secondary** Not available

Lead Set	Number of Leads	Lead/Label	Choices
3-wire -Lead Select On	1	• Position electrodes in standard placement. • Use the HP Wave Viewer to change the lead that is transmitted to the HP Viridia Information Center (see "Changing the Lead" on page 6-6). Lead selection at the Viridia Information Center is disabled.	**Primary** I, II, III **Secondary** Not available
5-wire	2	• Position electrodes in standard placement. Standard placement provides V1 or MCL1. To monitor a different chest lead, for example, V6 or MCL6, position chest electrode appropriately. • Select **Lead**.	**Primary** I, II, III, aVL, aVR, aVF, V, MCL **Secondary** I, II, III, aVL, aVR, aVF, V, MCL

HP M1400A/B Transmitter

The HP M1400A/B transmitter supports 3-, 4-, and 5-wire cables. The table below provides a summary of the capabilities of each cable.

Note—For information on electrode placement, see the HP Viridia Information Center online help.

Lead Set	Number of Leads	Lead/Label	Choices
3-wire	1	• Position electrodes for desired lead. *Note*—Using standard placement gives Lead II. • Select **Label** to match electrode placement. **Warning—Hewlett-Packard recommends you change the lead label only to reflect the physical placement of the electrodes. This ensures that the monitored lead and the label match, and prevents any possible confusion.**	**Primary** I, II, III, MCL **Secondary** should be set to OFF in the Telemetry Setup Window see “Turning On/Off the Second ECG Channel” on page 2-13).
4-wire	2	• Position electrodes in standard placement. • Select **Lead**.	**Primary** I, II, III, aVR, aVL, aVF **Secondary** I, II, III, aVR, aVL, aVF

Lead Set	Number of Leads	Lead/Label	Choices
5-wire	2	• Position electrodes for desired lead. • For each lead, select **Label** to match placement. **Warning—Hewlett-Packard recommends you change the lead label only to reflect the physical placement of the electrodes. This ensures that the monitored lead and the label match, and prevents any possible confusion.** If the receiver mainframe is configured for Swap Leads, no lead choices can be made in the Patient Window. The primary and secondary leads can be swapped in the Telemetry Setup Window, see “Swapping Leads” on page 2-9.	**Primary** I, II, III, MCL **Secondary** I, II, III, MCL, ECG

Preparing for ECG Telemetry Monitoring

Overview

The HP Telemetry System provides remote monitoring of the patient's ECG for adult and pediatric patients.

Note—For SpO_2 setup, see Chapter 4, "SpO2 Monitoring"

Task Summary

Perform the following steps to set up for telemetry ECG monitoring:

Step	Action
1	Insert a battery into the transmitter, following the +/- diagram on the inside of the compartment. See "Inserting Batteries" on page 1-20.
2	Connect the lead set to the transmitter by pushing it down firmly until it "locks." You should hear a CLICK.
3	Prepare the skin by: 1. Shaving the hair from electrode sites if necessary. 2. Washing the sites (preferably with soap and water), and rinsing well. 3. Drying briskly to remove skin cells and oils.
4	Attach the electrodes to the lead wires. *Note*—Use electrodes that are all the same brand and change all the electrodes every 24 hours.
5	Remove electrode backing and check for moist gel.
6	Apply electrodes to the skin by placing the edge down, then "rolling down" the rest of the pad. Press firmly around the adhesive edge toward the center. See the on-line help for information on electrode placement. Or, for Viridia 3-wire cables only with Lead Select off, see the HP Wave Viewer ECG screen for lead placement information. See"Changing the Lead" on page 6-6.

Step	Action
7	For Viridia transmitters only, verify the lead placement using the HP Wave Viewer. See “Checking SpO2 Signal Quality” on page 6-8.
8	Support the transmitter by using a pouch, and if necessary, tape the lead wires to the chest.
9	Teach the patient how and when to press the transmitter button.
10	Make adjustments to ECG wave(s) and alarm limits in the Patient Window. See “Making ECG Adjustments” on page 2-8.

During monitoring, respond promptly to INOP conditions to prevent loss of monitoring.

Making ECG Adjustments

Overview

You can make the following adjustments from the HP Viridia Information Center:

- Change the lead or the lead label.
- Change the wave size.
- Swap leads (M1400A/B with 5-wire lead set only).

With 4-(M1400A/B only) and 5-wire lead sets, you can monitor two leads. With a 3-wire lead set you can monitor one lead. When monitoring two leads, the first lead is the primary lead. Single lead arrhythmia analysis uses this lead. It is also the lead used for alarm and delayed recordings. Multilead analysis uses both leads.

If you are not receiving a good ECG wave and the electrodes are securely attached, you should try changing the lead in which you are monitoring.

Bandwidth

Bandwidth is not user adjustable, but is assigned automatically by the information center. The settings are:

	HP Viridia Transmitter	M1400A/B Transmitter
ST off	Monitor (0-40 Hz)	Monitor (0 to 40 Hz)
ST on	ST (0.67 to 40 Hz)	ST (0.67 to 40 Hz)

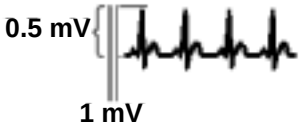
Changing Lead/Label

To change the lead/label place your cursor over the wave in the Patient Window and select the lead or label from the pop-up box to match the placement.

Adjusting Wave Size

To change the amplitude of the ECG wave on the display or for recordings, place your cursor over the wave in the Patient Window and select the size you want from the pop-up box. There are five sizes available: 1/4 (smallest), 1/2, 1, 2, and 4 (largest).

You can use the 1 mV cal bar on the Patient Window to check the height of the R-wave. If the wave is not at least 0.5 mV high (one-half the size of the cal bar), change the lead.



Swapping Leads

Swap leads is available for M1400A/B transmitters with 5-wire lead set only.

If Swap Leads is turned on in the telemetry mainframe configuration, you can swap the primary and secondary leads that are broadcast from a 5-wire lead set without moving electrodes. Clicking on Swap leads will cause the secondary wave to be displayed in the primary position, and the primary wave in the secondary position. For example, with standard electrode placement, swapping leads will display MCL as the primary wave and lead II as the secondary wave (or the reverse).

Important—To swap leads, you must access the Telemetry Setup Window. There is no swap control in the Patient Window.

Task Summary Swap leads by performing the following steps:

Step	Action
1	On the Patient Window click the **All Controls** button.
1	On the All Controls Window click the **Telemetry Setup** button.
1	On the Telemetry Setup Window, swap leads by clicking the **Swap leads** button. *Note*—The swap control is disabled after each use. To swap again, exit from the Telemetry Setup Window. Re-entering the window activates the control.

Making Other Monitoring Adjustments

Turning the Transmitter Button On/Off

Overview

You can turn the Transmitter Button on the transmitter on or off by using the Telemetry Setup Window. Turning the Transmitter Button off inhibits Nurse Call alarms and/or recordings depending on how your system is set up.

Task Summary

Turn the **Transmitter** Button on the transmitter on or off by performing the following steps:

Step	Action
1	On the Patient Window click the **All Controls** button.
1	On the All Controls Window click the **Telemetry Setup** button.
1	On the Telemetry Setup Window turn the **Transmitter** Button on or off by clicking in the **Transmitter Button Allow Calls** checkbox. A check mark in the checkbox indicates that the transmitter button is on.

Standby Mode

Overview

When a patient is temporarily off the unit or out of antenna range you can suspend monitoring by placing telemetry in Standby Mode. Standby suspends monitoring, and you won't get any waveforms or alarms.

If a patient leaves the unit without a transmitter, place telemetry in Standby.

Note—If you remove the leads before putting a patient into Standby, you'll get a LEADS OFF INOP, and reminders if configured.

Warning

If you put telemetry in Standby Mode, you *must* remember to turn monitoring back on when the patient returns to the unit.

If a patient leaves the unit while wearing a transmitter, there will be a NO SIGNAL INOP. You'll need to silence the inop, and when the patient returns to the unit, telemetry monitoring will resume automatically. Standby mode is not needed in this case.

Task Summary

Place a patient in Standby by performing the following steps:

Step	Action
1	**On the Patient Window click the Standby button.**
2	**Select the patient's location from the pre-defined list.**
3	**Click the Suspend Monitoring button. This indefinitely suspends all monitoring and displays the following messages in the Patient Sector "No Data From Bed" and "Monitor Standby" and the location (for example, X-Ray).** *Note*—**Be sure to take the bed out of Standby before discharging. Since Standby is associated with the equipment assigned to a bed, if a patient is discharged and the bed is in Standby Mode, that equipment will be in Standby for the next patient, and monitoring will continue to be interrupted.**
4	**When the patient comes back, restart monitoring by clickinig on Resume Monitoring in the Patient Sector.**

Turning On/Off the Second ECG Channel

Overview

If you have the M1400A/B Transmitter, you can turn the second ECG channel on or off by using the Telemetry Setup Window. Turning the second ECG channel off means that there will only be one ECG wave in Patient Sector, Patient Window, and for ST/AR analysis.

When you turn the second ECG channel on delayed/alarm recordings have two 20-mm waves. When you turn the ECG channel 2 off, delayed/alarm recordings have one 40-mm wave. For a 3-wire lead set, the second ECG channel must be off, otherwise a continuous LEADS OFF message displays.

Task Summary

Turn the second ECG channel on or off by performing the following steps:

Step	Action
1	On the Patient Window click the **All Controls** button.
2	On the All Controls Window click the **Telemetry Setup** button.
3	On the Telemetry Setup Window turn the second channel on or off by clicking in the **ECG Channel 2** checkbox. A check mark in the checkbox indicates that the channel is on.

Optimizing System Performance

While telemetry monitoring offers many advantages, it can be a challenge. The reliability and quality of the signal transmission through the air and hospital walls is governed by a number of variables which can be difficult to control. A telemetry system cannot be as dependable as a hardwired bedside monitor that transmits its signal through a wire.

The effect of interference on the telemetry system ranges from a momentary loss of ECG to complete inoperability, depending on the situation. The strength, frequency, and proximity of the source of interference to transmitters or the

antenna system are factors that determine the degree of severity. In cases where the source of interference is known - for example, cellular phones, magnetic equipment such as MRI, other radio or motorized equipment - removing or moving away from the source of interference will increase the system's dependability.

Warning

Telemetry should not be used for primary monitoring in applications where the momentary loss of the ECG is unacceptable.

In this section, we'll investigate some of the problems affecting ECG signal clarity and when possible, show you how you can greatly enhance performance.

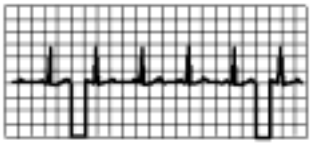
Note—The telemetry system also emits radio frequencies (defined in "System Specifications" on page 9-20) that may affect the operation of other devices. Contact the manufacturer of other equipment for possible susceptibility to these frequencies.

The Telemetry Signal

The transmitter worn by the patient acquires the patient's physiological data, amplifies and digitizes it, detects pace pulses and broadcasts this information via radio waves to the antenna system. Since the signal passes through the air, it is susceptible to interference from many sources.

Frequent Signal Strength and RF INOPS

Because the telemetry system is a wireless system, under certain conditions RF "dropouts" can occur. Dropouts result from a weak signal or RF interference. There will be signal drops to the bottom of channel for a minimum of 200 ms to indicate to the clinical user that it is a non-physiological event. If dropouts are frequent enough to affect the heart rate count, the TEL CANNOT ANALYZE INOP occurs. The following recording strip is an example of dropouts.



If frequent dropouts are occurring, the following section describes some steps you can take to improve performance.

Signal Strength

The antenna system is custom designed for your unit, so reliable signal reception is only possible where there are receiving antennas. When the signal is too low, the following INOPS occur:

- TEL CANNOT ANALYZE
- WEAK SIGNAL
- NO SIGNAL

To correct, first check the location of the patient. If not in the coverage area, do one of the following.

- Return the patient to the specified antenna coverage area.
- Put telemetry in Standby Mode. See “Standby Mode” on page 2-11.

Warning

If you put telemetry in Standby Mode, you *must* remember to turn monitoring back on when the patient returns to the unit. See “Standby Mode” on page 2-11**.**

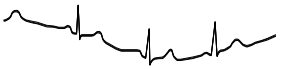
- If the patient is in the coverage area and is stationary, try moving the location of the transmitter or patient about six inches.

Radio Frequency Interference

Radio frequency (RF) interference is caused by anything that intrudes into the transmitted electrical signal, such as paging transmitters and walkie-talkies. We are all familiar with electrical interference in our homes and cars when it causes “snow” on the television and static on the radio station. These same types of interference can occur with the transmitted telemetry signal. Even though the HP Telemetry System is designed to resist these effects, interference can occasionally be seen in the form of “dropouts”. To improve performance, the source of the interference must be identified and eliminated.

Muscle and Movement Artifact

Muscle and movement artifact differ from radio frequency interference since you can prevent much of the occurrence. Noise on the ECG signal can be caused by many sources, such as interference from other electrical equipment, muscle artifact and respiration variation. It is up to the clinician to use certain techniques to minimize these types of noise. Use the following table to help you troubleshoot the most common sources of ECG noise.

Problem	Cause	Remedy
60-Cycle (AC) Interference 	Poor electrode placement. Possible non-grounded instrument near patient	Re-apply electrodes Disconnect electrical appliances near patient (one at a time) by pulling wall plugs, to determine faulty grounding. Have engineering check grounding.
Muscle Artifact 	Tense, uncomfortable patient. Poor electrode placement. Tremors. Diaphoresis	Make sure patient is comfortable. Check that electrodes are applied on flat non-muscular areas of the torso; dry the skin and re-apply the electrodes if necessary.
Irregular Baseline 	Poor electrical contact. Respiratory interference. Faulty electrodes. Dry electrodes.	Re-apply electrodes, using proper technique. Move electrodes away from areas with greatest movement during respiration.
Baseline Wander 	Movement of patient. Improperly applied electrodes. Respiratory interference.	Make sure patient is comfortable. Re-apply electrodes. Check that patient cable is not pulling electrodes. Move electrodes away from areas with greatest movement during respiration.
Poor Electrode Contact 	Loose electrodes. Defective cables. Lead set not firmly connected.	Change electrodes, using good skin prep. Replace cables.

Telemetry INOPs

The following table lists (in alphabetical order) the telemetry INOPs that can be announced at the HP Viridia Information Center. It also provides suggestions on what to do when an INOP occurs. For ST INOPs, see "ST Alarm and INOP Messages" on page 3-9.

Note—A Hard INOP is more severe than a soft INOP. Hard INOPS have an audible tone, and monitoring and alarms are disabled. In a soft INOP, no audible tone is generated; monitoring and alarms remain active.

Message	Type	Description	Action
BATTERY WEAK	Soft INOP	Battery low, at least 15 minutes left (HP Viridia Transmitter) or 1 hour (M1400A/B transmitter). *Note*—Certain **transient** conditions such as manual SpO_2 measurement, unaligned transmitter, or heavy infrared use may cause battery weak situation.	Replace battery.
ECG EQUIP MALF (HP Viridia Transmitter only)	Hard INOP	ECG PC board in the transmitter is malfunctioning	Replace transmitter. Contact Service.
INTERFERENCE	Hard INOP	Interference due to outside source.	Check that there are no transmitters stored with batteries inserted. Change the Viridia transmitter and receiver frequency. Contact service.

Message	Type	Description	Action
INVALID LEADSET (HP Viridia transmitter only)	Hard INOP	Leadset invalid for the transmitter type, or leadset is connected improperly.	Attach correct leadset. Reconnect leadset, pressing until latch clicks. If problem persists, call service.
INVALID SIGNAL E01	Hard INOP	Receiver is picking up a duplicate frequency.	When the transmitter is not being used, turn telemetry monitoring off for the bed. If the situation continues, contact service. If this is a new transmitter, the system must learn the new transmitter ID code - contact service.
LEADS OFF	Hard INOP	Lead(s) not connected.	Reconnect lead(s). For HP Viridia transmitter, use transmitter lights or the HP Wave Viewer to confirm.
NO RECEIVER	Hard INOP	Receiver absent or malfunctioning.	This message appears after the mainframe is turned on and indicates the absence of a receiver or a receiver is faulty. Contact service.
NO SIGNAL	Hard INOP	Patient beyond antenna range, no battery, or battery is inserted backwards.	Return patient to antenna range/check battery for correct insertion.
RECEIVER MALF	Hard INOP	Receiver is malfunctioning.	Contact service.
REPLACE BATTERY	Hard INOP	Battery is unable to power the transmitter, or battery is inserted backwards.	Replace battery/check battery for correct insertion.

Message	Type	Description	Action
RF INOP	Soft INOP	Used by service in troubleshooting the radio signal.	Contact service.
TEL CANNOT ANALYZE	Hard INOP	Shorts bursts of data corruption inhibiting an accurate HR count. (Often accompanied by WEAK SIGNAL, NO SIGNAL, or INTERFERENCE INOPs.)	Check that there are no transmitters stored with batteries. Check to see if the patient is in the coverage area, and return patient if needed. If the patient is in the coverage area and is stationary, move the transmitter or patient about 6 inches (15 cm.). If the situation persists, contact service.
TRANSMITTER MALF (HP Viridia transmitter only)	Hard INOP	Transmitter malfunctioning	Replace transmitter. Contact service.

Message	Type	Description	Action
TRANSMITTER OFF (HP Viridia transmitter only)	Hard INOP	Transmitter detected all leads off for 10 minutes and turned itself off.	Connect leadset to patient.
WEAK SIGNAL	Soft INOP	Patient at outer range of the antenna system.	Check to see if the patient is in the coverage area, and return patient if needed. If the patient is in the coverage area and is stationary, move the transmitter or patient about 6 inches (15 cm.). If the situation persists, contact service.

Overview

The SpO_2 parameter measures the arterial oxygen saturation. That is, the percentage of oxygenated hemoglobin in relation to the total hemoglobin.

If, for example, a total of 97% of the hemoglobin molecules in the red blood cells of the arterial blood combine with oxygen, then the blood has an oxygen saturation of 97%. The SpO_2 numeric that appears on the monitor will read 97%. The SpO_2 numeric indicates the percentage of hemoglobin molecules which have combined with oxygen molecules to form oxyhemoglobin.

- The oxygen saturation is measured using the pulse oximetry method. This is a continuous, noninvasive method of measuring the arterial hemoglobin oxygen saturation. It measures how much light, sent from light sources on one side of the transducer, travels through patient tissue (such as a finger or an ear), to a receiver on the other side.
- The amount of light getting through depends on many factors, most of which are constant, such as tissue or venous blood). However one of the factors, the blood flow in the arterioles, varies with time - because it is pulsatile.

  This measurement principle is used to derive the SpO_2 measurement. The numeric that is displayed at the HP Viridia Information Center is the Oxygen saturation of the arterial blood - the measurement of light absorption during a pulsation.

Warnings

- **When the specified NELLCOR® transducers are used, the application must be consistent with the manufacturer's own guidelines.**
- **Prolonged, continuous monitoring may increase the risk of changes in skin characteristics, such as irritation, reddening, blistering or pressure necrosis, particularly on patients with impaired perfusion and varying or immature skin morphology. Specific attention must be given to sensor site inspection for changes in skin quality, proper optical path alignment and attachment. Check the application site at regular intervals and change the site if any compromise in skin quality should occur. More frequent checking may be required due to an individual patient's condition.**
- **Setting the high SpO_2 alarm limit to 100% is equivalent to switching off the high alarm limit. Therefore the upper alarm limit for oxygen saturation must be carefully selected in accordance with accepted clinical practices.**
- **Pulse oximetry can overestimate the SpO_2 value in the presence of Hb-CO, Met-Hb or dye dilution chemicals.**

Note—The SpO_2 alarm delay built into the system is ten seconds. That means that the monitor generates an alarm if the averaged numeric value on the display stays beyond the alarm limit for more than 10 seconds.

Preparing for Telemetry SpO_2 Monitoring

Overview

The HP Viridia Telemetry System provides remote monitoring of SpO_2 measurement for adult and pediatric patients. You need to prepare your telemetry patient and perform setup tasks for the measurement to display at either the HP Viridia Information Center or at the HP Wave Viewer.

Task Summary

Perform the following steps to set up for telemetry SpO_2 monitoring:

Step	Action
1	Select the site and appropriate transducer (see “Selecting the Appropriate Transducer” on page 4-10). • Adult Finger - use for most adults. • Small Adult/Pediatric - use for small adults. • Ear Clip - use when neither hand has an appropriate site.
2	Attach the transducer cable to the transmitter. Plug *reusable* transducers directly into the transmitter. Plug *disposable* transducers into the adapter cable, then plug the adapter cable into the transmitter.

Step	Action
3	Prepare the transducer (if disposable, remove the protective backing), and attach the transducer to the appropriate part of the patient's body. Avoid sites with: • **Decreased Arterial Flow**, such as edematous tissue or distal to arterial catheters, intravenous catheters and blood pressure cuffs • **Poor Skin Integrity**, such as skin discoloration or nail polish. • **Excessive Motion** Additionally, avoid: • Placing the sensor in an environment with bright lights. If necessary, cover the sensor with opaque material. • Use of excessive pressure at the application site, for example, transducer applied too tightly, excessive adhesive tape to secure the transducer, clothing or restraints that are too tight. These result in venous pulsations and inaccurate measurements, and may severely obstruct circulation.
4	Use the pleth wave to check the signal quality at the patient's side using the HP Wave Viewer (see "Checking SpO2 Signal Quality" on page 6-8.
5	If necessary, change the SpO_2 sample rate using the HP Wave Viewer (see "Changing the SpO2 Sample Rate" on page 6-9.)
6	Adjust SpO_2 alarms in the Patient Window.
7	Make other adjustments in the Telemetry Setup Window.
8	Inspect the site regularly to ensure skin integrity and correct optical alignment. Proper sensor placement is critical to accurate SpO_2 monitoring.

Making SpO_2 Measurements

SpO_2 measurements can be made automatically at pre-determined times, or manually on an as-needed basis.

Automatic Measurements

Automatic SpO2 measurements can be generated on a continuous basis, or intermittently at 1 or 5 minute intervals. Automatic measurement intervals are set at the HP Wave Viewer. Please see “Changing the SpO2 Sample Rate” on page 6-9 to set up the transmitter for automatic measurements.

Manual Measurements

Manual measurements can be initiated at the transmitter or at HP Wave Viewer. SpO_2 must be turned on at central for alarms, and for display and trending. For measurements at the transmitter or HP Wave Viewer, the sample rate must be set to any choice except “Continuous”.

To initiate an SpO_2 measurement at HP Wave Viewer, see “Making a STAT SpO2” on page 6-10.

Note—The HP Wave Viewer should not be connected to the transmitter when you are using the transmitter button to initiate an SpO_2 measurement.

Task Summary

To initiate a manual SpO_2 measurement at the transmitter, perform the following steps.

Step	Action
1	Plug the transducer cable into the transmitter.
2	Attach the transducer to the patient.
3	Press and hold (~6 seconds) the Transmitter Button until the LA light begins flashing.

Step	Action
4	When the transducer light turns off (~ 30 seconds later), the measurement value and time stamp will be displayed at central for up to one hour or until the next measurement is made, whichever comes first.
5	Remove the transducer from the patient after the transducer light goes out.

Note—When an SpO_2 measurement is initiated, if the transmitter button is turned ON in the Patient Window, the transmitter button will also function according to its function defined during system configuration. For example, if the patient button is configured for Nurse Call/Record or Record, a recording will be generated when a manual SpO_2 reading is initiated at the transmitter. The recording will include the *last* SpO_2 reading, but not the current reading, which is still in process.

Note—If the transmitter button is turned OFF in the Patient Window, a manual SpO_2 measurement can still be made.

Note—No measurement will be made if a Battery Weak condition exists. A measurement initiated before a Battery Weak INOP is displayed will be completed, but no further manual measurements can be made until the battery is replaced.

Note—If a LEADS OFF condition occurs during a manual SpO_2 measurement, the appropriate lead light will be lit upon completion of the measurement.

Measurement Limitations

Refer to this section on problem situations if you have difficulty getting a signal or obtaining accurate measurements.

Distortion

Ambient light, motion, perfusion or incorrect sensor placement may affect the accuracy of the derived measurements.

Arterial Blood Flow

The measurement depends on the pulsatile nature of blood flow in the arteries and arterioles; with the following conditions arterial blood flow may be reduced to a level at which accurate measurements cannot be made:

- shock
- hypothermia
- use of vasoconstrictive drugs
- anemia

Wavelength Absorption

The measurement also depends on the absorption of particular light wavelengths by the oxyhemoglobin and reduced hemoglobin. If other substances are present which absorb the same wavelengths, they will cause a falsely high, or falsely low SpO_2 value to be measured. For example:

- carboxyhemoglobin
- methemoglobin
- methylene blue
- indocyanine green*
- indiocarmine*

*These chemicals are used in dye dilution cardiac output calculations.

Ambient Light

Very high levels of ambient light can also affect the measurement; an SpO_2 INTERFERENCE message will appear on the display. The measurement quality can be improved by covering the transducer with suitable non see-through material.

Note—If you are using NELLCOR® transducers, see the directions for use supplied with these transducers.

For care and cleaning instructions, see “HP Reusable Transducers” on page 7-19.

SpO_2 Transducers

Disposable Transducers

Only use disposable transducers once and then discard. However, you can relocate them to a different patient-site if the first location does not give the desired results. Do not reuse disposable transducers on different patients. Disposable transducers are not available as HP parts in the USA or Canada. Contact NELLCOR® Incorporated.

Reusable Transducers

You can use reusable transducers on different patients after cleaning and disinfecting them. See “HP Reusable Transducers” on page 7-19 for cleaning instructions. Reusable sensors should be changed to another site regularly.

See Appendix B, “Accessories and Ordering Information” for ordering information.

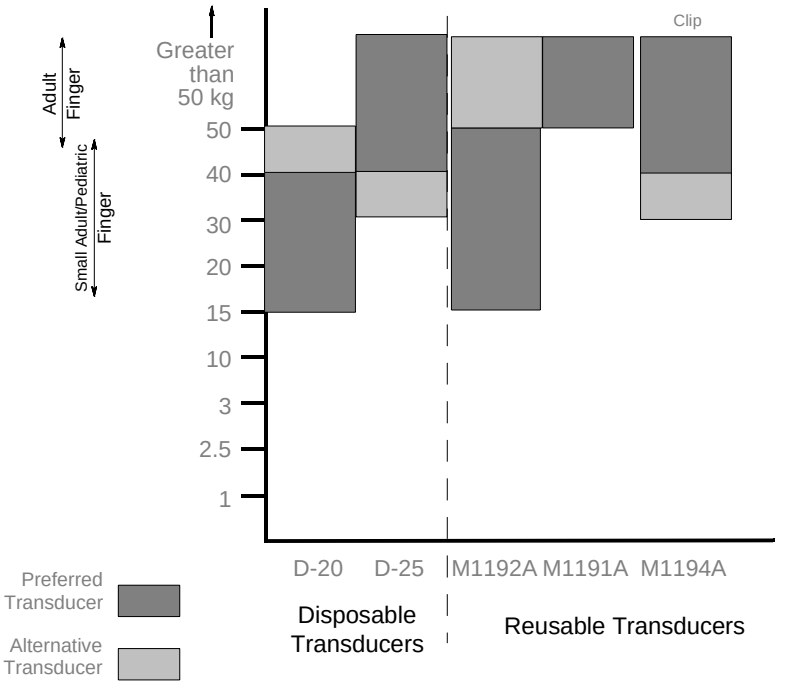
Selecting the Appropriate Transducer

The following chart provides a guideline to select the most appropriate transducer for your patient.

Select the most appropriate transducer by finding the patient's weight on the vertical axis, and drawing a horizontal line across the chart. Each shaded area that the line passes through represents a transducer that you can use on this patient.

Areas of dark shading indicate that the transducer is the most appropriate one in that weight range.

Areas of light shading indicate that you can use the transducer in this weight range, even though it is not the most appropriate transducer.



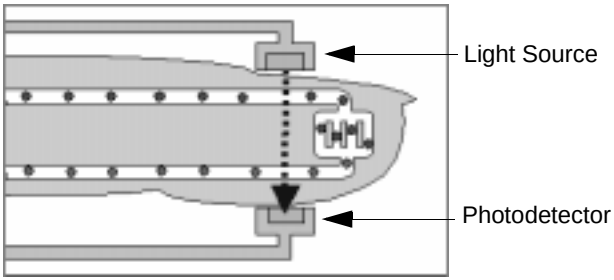
Applying the Transducer

Overview

A minimum pulsatile flow must be present at the application site of your patient to obtain measurements.

Select an appropriate transducer and apply the transducer properly to avoid incorrect measurements. Applying a small amount of pressure at the application site can improve the measurement. Use one of the preferred application sites for your transducer. Selecting the most suitable transducer and application site will help you to ensure that:

- The light emitter and the photodetector are directly opposite each other and that all the light from the emitter passes through the patient's tissues,
- The application site is of the correct thickness for light to pass through. If the application site is too thick or too thin, an SpO_2 NON-PULSATILE INOP will occur. You should then select another site as appropriate.



Positioning of the Light Emitters and Photodetector

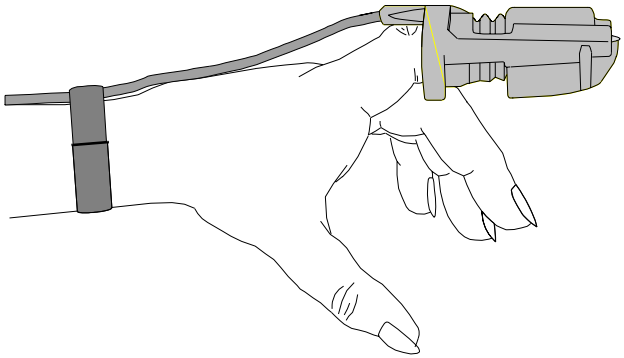
Inspect the application site every 2 to 3 hours to ensure skin integrity and correct optical alignment. If skin integrity changes, move the transducer to another site.

Warnings

- **Failure to apply the transducer properly may cause incorrect measurement of SpO_2.**
- **Specific attention must be given to sensor site inspection for changes in skin quality, proper optical path alignment and attachment. Check the application site at regular intervals and change the site if any compromise in skin quality should occur.**
- **Using a transducer during MR imaging can cause severe burns. To minimize this risk, ensure that the cable is positioned so that no inductive loops are formed. If the transducer does not appear to be operating properly, remove it immediately from the patient.**
- **Using a transducer in the presence of bright lights may result in inaccurate measurements. In such cases, cover the site with opaque material.**
- **Injected dyes, such as methylene blue, or intravascular dyshemoglobins, such as methemoglobin, may lead to inaccurate measurements.**
- **Performance may be compromised by excessive motion. This can lead to inaccurate SpO_2 readings.**
- **Avoid placing the SpO_2 transducer on any extremity with an arterial catheter, or intravascular venous infusion line.**
- **Do not use disposable transducers on patients who exhibit allergic reactions to the adhesive.**

Adult Finger Transducer (M1191A)

Push the transducer over the fingertip in such a way that the fingertip touches but does not protrude from the end of the transducer. The fingernail must be uppermost and the cable must lie on the back of the hand. This ensures that the light sources cover the base of the fingernail giving the best measurement results. The cable can be held in place by the accompanying wristband.

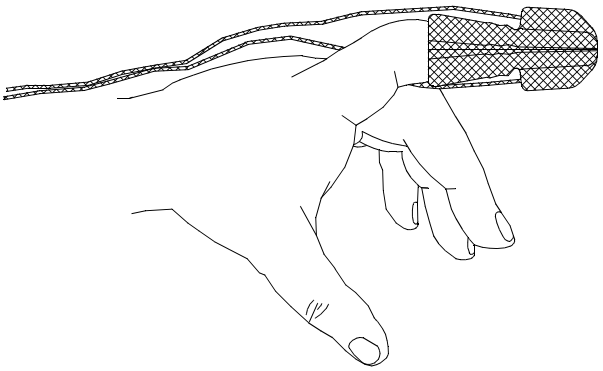


Warning

Failure to apply the transducer properly may cause incorrect measurement of SpO_2. For example, not pushing the transducer far enough over the finger can result in inaccurate SpO_2 readings. Pushing the transducer too far, so that the finger protrudes from the transducer, can pinch the finger, resulting in inaccurately low SpO_2 readings.

Small Adult/ Pediatric Finger Transducer (M1192A)

Push the transducer over the fingertip in such a way that the fingertip touches but does not protrude from the end of the transducer.

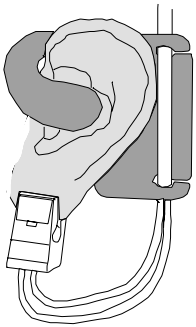


Warning

Failure to apply the transducer properly may reduce the accuracy of the SpO_2 measurement.

Ear Clip Transducer (M1194A)

Clip the probe onto the fleshy part of the ear lobe as shown in the diagram below. The plastic fixing mechanism helps to minimize artifact generated by patient motion. Do not position the probe on cartilage or where it presses against the head.



The clip transducer can be used as an alternative if the adult finger transducer does not provide satisfactory results. The preferred application site is the ear lobe, although other application sites with higher perfusion (such as the nostril) can be used. Due to the physiologically lower perfusion in the ear lobe, you should be aware of the reduced accuracy of the measurement and more frequent INOPs.

Warning

Failure to apply the clip transducer properly may reduce the accuracy of the SpO_2 measurement.

Disposable Transducers

See the Directions for Use supplied by NELLCOR® Incorporated for instructions on preparation and application of disposable transducers.

Warning

When the specified NELLCOR® transducers are used, the application must be consistent with the manufacturer's own guidelines.

Optimizing Transducer Performance

To get the best results from your SpO_2 reusable transducer:

- Always handle the transducer and cable with care. The soft finger sleeve houses a sensitive electronic device that can be damaged by harsh treatment. Always protect the cable from sharp-edged objects.
- Use the wristband that is supplied with your M1191A transducer. By keeping the cable between the finger transducer and the wristband fairly loose, you will maintain good monitoring conditions.

Normal wear and tear associated with patient movement and regular transducer cleaning naturally mean that your transducer will have a limited lifetime. However, provided you handle the transducer and its cable with care, you can expect useful service from it for up to two years. Harsh treatment will drastically reduce the lifetime of the transducer. Moreover, HP's warranty agreement shall not apply to defects arising from improper use.

Turning the SpO_2 Parameter On/Off

Overview

The SpO_2 parameter is turned on or off at the HP Viridia Information Center by using the Telemetry Setup Window.

Turning the SpO_2 parameter off at the Information Center also turns off:

- SpO_2 alarms
- SpO_2 display of numerics
- SpO_2 trending.

After you turn SpO_2 on, you should adjust the sample rate to match your patient's acuity by using the Wave Viewer.

After you turn SpO_2 off, setting the sample rate to Manual using the Wave Viewer will help you conserve the transmitter's battery life.

Task Summary

Turn the SpO_2 parameter on or off by performing the following steps:

Step	Action
1	On the Patient Window click the **All Controls** button.
2	On the All Controls Window click the **Telemetry Setup** button.
3	On the Telemetry Setup Window, turn SpO_2 parameter on or off by clicking in the **Parameter ON** checkbox. A check mark in the checkbox indicates that SpO_2 monitoring is on.

Turning SpO_2 Alarms On/Off

Overview

You can turn SpO_2 alarms on or off by using the Telemetry Setup Window.

Task Summary

Turn SpO_2 alarm on or off by performing the following steps:

Step	Action
1	On the Patient Window click the **All Controls** button.
2	On the All Controls Window click the **Telemetry Setup** button.
3	On the Telemetry Setup Window turn SpO_2 alarms on or off by clicking in the **Alarm ON** checkbox. A check mark in the checkbox indicates that SpO_2 alarms are on.

Turning the Pulse Parameter On/Off

Overview

You can turn the SpO_2 pulse parameter on or off by using the Telemetry Setup Window.

Task Summary

Turn the pulse parameter on or off by performing the following steps:

Step	Action
1	On the Patient Window click the **All Controls** button.
2	On the All Controls Window click the **Telemetry Setup** button.
3	On the Telemetry Setup turn pulse parameter on or off by clicking in the **Parameter ON** checkbox. A check mark in the checkbox indicates that pulse monitoring is on.

SpO_2 Alarm and INOP Summary

SpO_2 alarms are latching or non-latching, depending on the release of the HP Viridia Receiver Mainframe. For release D.02 and above mainframes, SpO_2 alarms are non-latching. That is, when an SpO_2 limit is exceeded, if the alarm is not silenced, it will reset automatically if the patient's alarm condition returns within the limits. This reduces the number of times you will need to reset alarms at the information center when an alarm condition has been corrected at the patient's side (for example, movement-induced artifact alarms).

In the D.01 release of the HP Viridia Receiver Mainframe, SpO_2 alarms are latching - meaning that they must be silenced by a clinician. Silencing an alarm manually is the only way to reset the alarm indicators (sound, message, and highlighting in the patient sector).

To find out which release HP Viridia Receiver Mainframe your unit uses, see your service department.

The following table lists the SpO_2 alarms and the description of the conditions required to generate these alarms.

Message	Level	Sound	Description
**SpO_2 > upper limit	Yellow	Continuous	SpO_2 value greater than the upper SpO_2 measurement limit. *Important*—Setting the high SpO_2 alarm limit to 100% is equivalent to switching off the high alarm.
**SpO_2 < low limit	Yellow	Continuous	SpO_2 value less than the lower SpO_2 measurement limit.

The following table lists the SpO_2 INOPs. The Action column includes recommendations on what to do when one of these INOPs occurs.

Message	Description	Action
SpO_2 EQUIP MALF	Malfunction in the SpO_2 hardware, or transducer/adapter cable damaged	Change transducer. Change adapter cable. If INOP persists, replace transmitter.
SpO_2 ERRATIC	Erratic SpO_2 measurements, often due to a faulty transducer or incorrect positioning of the transducer May also be caused by optical shunting if sensor too big or too small.	Line up light source and photodetector - they must be opposite each other and light must pass through the arteriolar bed. Reposition transducer to site with higher perfusion. Replace transducer or adapter cable. Use different sensor with correct fit.
SpO_2 INTERFERENCE	Level of ambient light is so high that the SpO_2 transducer cannot measure SpO_2 or pulse rate. Transducer or adapter cable is damaged. May also be due to electrical interference. May also be generated by a defective transmitter.	Cover sensor with non-white opaque material (for example, pulse oximeter probe wraps - Posey wrap or equivalent) to reduce ambient light. If INOP persists, inspect and replace transducer or adapter cable as needed. Reduce sources of electrical interference. If the above corrective actions are ineffective, use a different transmitter, and call service to replace the defective one.
SpO_2 NO TRANSDUCER	SpO_2 transducer is disconnected. SpO_2 connector on transducer or transmitter is dirty.	Reconnect sensor. Replace sensor. Replace transmitter and call service.

Message	Description	Action
SpO_2 NOISY SIGNAL (no sound)	Excessive patient movement or electrical or optical interference is causing irregular pulse patterns	Locate sensor at site with less movement. Reduce sources of electrical or optical interference. Call service.
SpO_2 NON-PULSATILE	Pulse too weak or not detectable May also be generated by a defective transmitter.	Relocate sensor to site with improved circulation. Warm area to improve circulation. Try another sensor type. If the above corrective actions are ineffective, use a different transmitter, and call service to replace the defective one.
SpO_2 TRANS MALFUNC	The SpO_2 transducer is malfunctioning. SpO_2 connector on the transducer or transmitter is dirty or corroded.	Replace the transducer or adapter cable. Change the transmitter and call service to repair.

5
HP Viridia Wave Viewer Basics

This chapter provides information about the HP Viridia Wave Viewer, which consists of the supplied HP flash disk card, HP palmtop computer, and light pipe. It includes the following sections:

Note—For information about other aspects of Wave Viewer, please refer to the following documentation:

Cleaning of palmtop	Chapter 7
Configuration	Chapter 8
Using palmtop for non-Wave Viewer applications	Palmtop User's Guide (F1060-90001)

Indications for Use

The paragraphs below are the elements of the indications for use statement for the HP Viridia Wave Viewer.

Condition

HP Wave Viewer is generally indicated when the clinician decides to assess the ECG or SpO_2 vital signs of adult and pediatric patients while at the patient location and does not need a diagnostic quality display.

Prescription Versus Over-the-Counter

HP Wave Viewer is a prescription device.

Part of the Body or Type of Tissue with Which the Device Interacts

HP Wave Viewer does not contact the body or tissue of the patient.

Frequency of Use

HP Wave Viewer is indicated for use when prescribed by a clinician.

Physiological Purpose

HP Wave Viewer is indicated when the physiological purpose is to gain information for treatment, to assess adequacy of treatment, or to rule out causes of symptoms. HP Wave Viewer is not suitable for continuous patient monitoring or detailed diagnostics.

Patient Population

Adult and pediatric ambulatory and non-ambulatory patients.

Intended Use

HP Wave Viewer is intended to be used as a patient assessment tool as an adjunct to the monitoring provided at the central station, not as a substitute. Uses are limited to gross assessment of a patient's condition and intermittent reading of ECG/pleth waveforms and pulse/SpO_2 values. Indicated categories of use include but are not limited to:

- Determination of a patient's tolerance to exercise during ambulation.
- Patient assessment while waiting for information from the central station or for monitoring, diagnostic or therapeutic equipment to arrive.
- Additional input to a routine physical assessment of a patient such as reading and recording SpO_2 values while on rounds.
- Gross assessment of a patient that can be clearly determined by visual interpretation of physiological waveforms of monitoring bandwidth by a trained clinician, such as asystole and ventricular fibrillation.
- Other standard uses of portable SpO_2 monitors, such as assessment of ventilation and/or O_2 therapy.

HP Wave Viewer uses specifically excluded are:

- Continuous monitoring of a patient. (HP Wave Viewer is not intended as a bedside monitor since alarms and ECG algorithms are not provided.)
- Determining detailed ECG diagnosis such as ST segment values, R-R variability, or other diagnostic ECG values. (Signals are of monitoring quality only, NOT diagnostic quality. Automated algorithms such as arrhythmia and a cardiotach are not provided.)
- Monitoring a patient during therapeutic procedures such as defibrillation or electrosurgery.
- HP Wave Viewer should never be used outside the coverage area provided by the antenna system and central station.

Warning **HP Wave Viewer is not intended for the following purposes:**

- **A diagnostic patient monitoring tool. The HP Wave Viewer should not be used for detailed ECG diagnosis, such as ST segment values, R-R variability, or any other diagnostic ECG values.**
- **A bedside monitor. Continuous monitoring (10 minutes or more) of a patient is not supported.**
- **Monitoring a patient during therapeutic procedures, such as defibrillation or electrosurgery.**

No patient alarms are articulated at the HP Wave Viewer. Telemetry alarms are presented at the central monitor only, and all alarm adjustments must be made at central.

Do not use the HP Wave Viewer outside the coverage area provided by the antenna system and the central station.

Do not use the palmtop AC power adapter in the patient care vicinity. The AC power adapter meets standard electrical safety requirements, but not the stricter requirements for medical equipment used near patients.

Introducing the HP Viridia Wave Viewer

The HP Viridia Wave Viewer is a patient assessment tool that allows you to determine the basic cardio-pulmonary condition of a patient while at the patient's side. HP Wave Viewer enables "snapshot" views of a patient's condition, thus contributing to nursing productivity. HP Wave Viewer is designed for uses such as:

- Verification of correct placement of ECG electrodes and the SpO_2 sensor.
- Patient assessment while waiting for other monitoring, diagnostic or therapeutic equipment to arrive.
- Gathering additional input during a routine physical assessment of an ambulatory or non-ambulatory patient.

HP Wave Viewer provides the following functionality:

- Displays the realtime ECG and pleth waveforms, as well as SpO_2 and pulse values.
- Enables choice of SpO_2 measurement times - continuous, 1 or 5 minute intervals, or manual (on demand). In intermittent and manual modes, STAT measurements can be made at any time.
- Displays ECG and SpO_2 measurement INOPs at the point of care.
- Allows configuration of parameters, transmitter, and transmitter frequencies (under password control).
- Enables configuration of replacement transmitters and transfer of settings from one transmitter to another (under password control).
- Consists of the supplied HP flash card, HP palmtop computer, stick-on label, and light pipe.

Use of HP Wave Viewer as a patient assessment tool is intended as an adjunct to the monitoring provided at the HP Viridia Information Center, not as a substitute. HP Wave Viewer is not intended for continuous monitoring.

HP Wave Viewer cannot be used for making adjustments to SpO_2 or ECG (if lead select is enabled) outside the coverage area provided by the antenna system and the information center.

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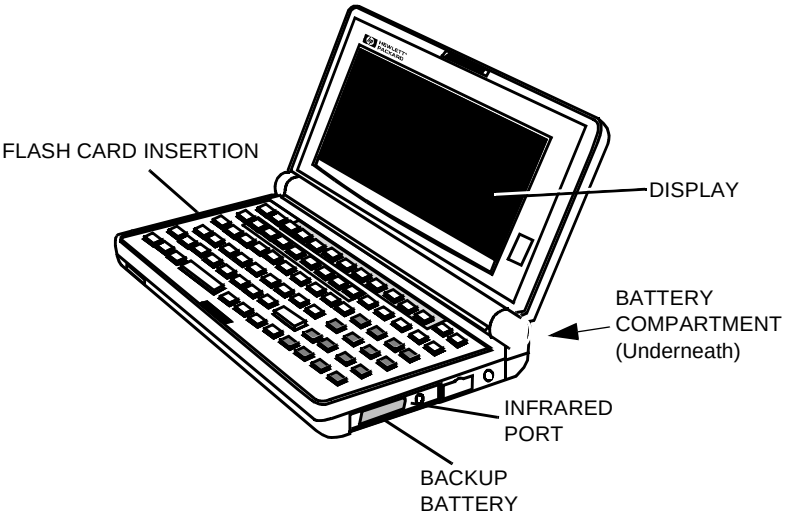


Environmental Limits

To maintain product reliability, avoid getting the equipment wet and observe the temperature and humidity limits for the palmtop as listed in “Environmental Conditions” on page 9-21. If the environmental limits are exceeded, performance may no longer meet specifications.

Installing the HP Wave Viewer

Overview

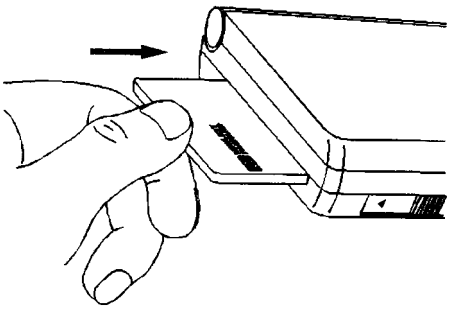
Before installing the HP Wave Viewer, the palmtop must be operational. if the palmtop is not operational, see the palmtop user documentation for start-up instructions.

Caution

Hewlett-Packard does not guarantee correct operation of the HP Wave Viewer when other applications are active on the palmtop computer. Rebooting while files or other applications are open can cause file or directory corruption.

Task Summary

Install the HP Wave Viewer by performing the following steps:

Step	Action
1	Turn the palmtop on. If any applications are open, close them until your personal information screen appears Turn the palmtop off.
2	Insert the HP Wave Viewer flash disk card - red arrow side up - into the left end of the palmtop. Turn the palmtop on. 

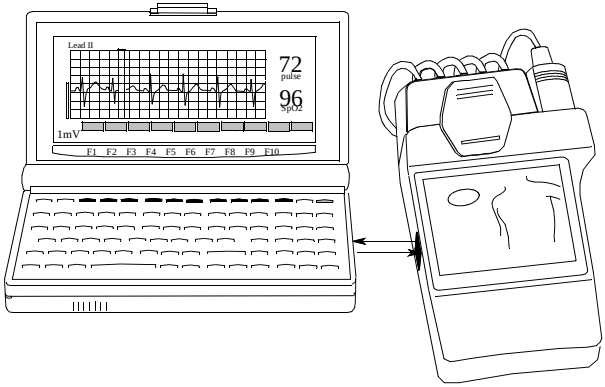
Step	Action
3	Press the CTRL+ALT+DEL keys simultaneously to reset (reboot) the system. The “Welcome to the HP Wave Viewer” screen displays, followed by the “Communication Disrupted” screen. *Note*—If the HP Wave Viewer does not start up when you insert the disk card, the palmtop may be out of batteries, or the palmtop may have insufficient memory. Two (2) megabytes of memory are required to run the HP Wave Viewer.
4	To access patient measurements, continue by connecting the palmtop to the transmitter.

Connecting to the Transmitter

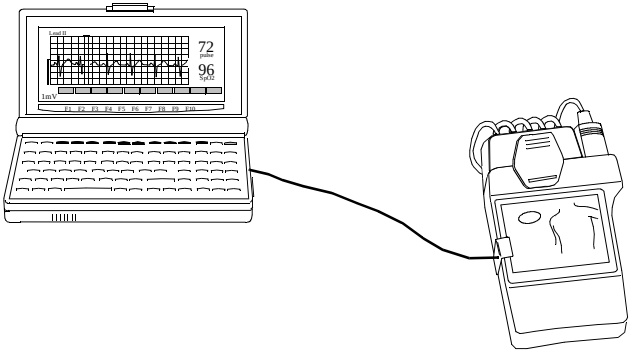
Overview

The palmtop connects to the transmitter through the infrared port. The connection can be made in either of two ways.

- Directly, by alignment only.The palmtop is positioned within the infrared cone of the transmitter. No additional equipment is needed.

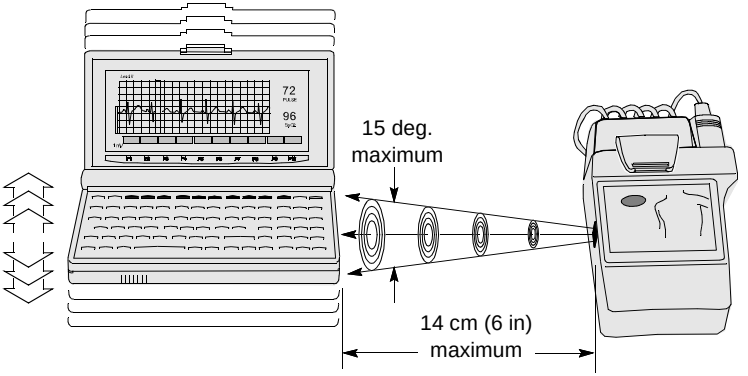


- Through a physical connection using a fiber-optic light pipe. When connected, the transmitter can be moved freely within the light-pipe range.



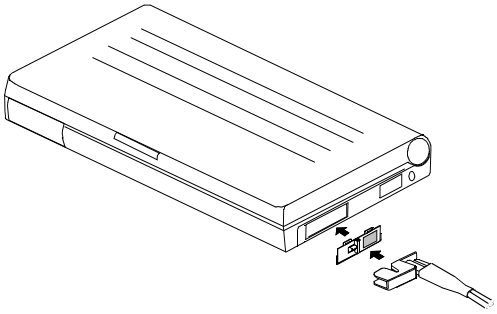
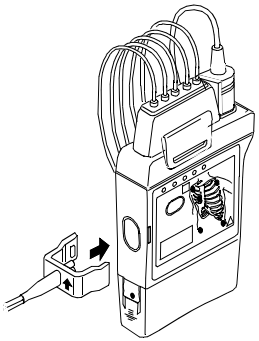
Connecting Directly

To connect the palmtop to the HP Viridia Transmitter directly, perform the following steps:

Step	Action
1	Turn the palmtop on.
2	Align the infrared port on the palmtop with the infrared port on the transmitter. Make sure that the palmtop port is positioned inside the infrared cone generated at the transmitter. A distance between 1 and 6 inches gives optimum results.  The Main Screen displays.

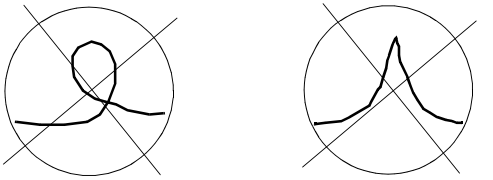
Connecting with a Light Pipe

To connect the palmtop to the HP Viridia Transmitter with a fiber optic light pipe, perform the following steps:

Step	Action
1	*Note*—In order to be used with a light pipe, the palmtop must have a special cover over the infrared port. This cover is packaged with the light pipe. If the palmtop is missing the cover, contact service for assistance. Connect the small end of the light pipe to the protrusion on the cover over the infrared port of the palmtop. 
2	Attach the clip end of the light pipe to the transmitter, covering the infrared port completely. 
3	Turn the palmtop on. The Main Screen displays.

Caution

The light pipe is made of optical-grade plastic and is therefore subject to breakage. Always handle the light pipe with care. Do not coil the light pipe smaller than 10 cm (4 in) in diameter. Do not kink or bend the pipe sharply, or otherwise handle it roughly.



Battery Information

Battery Types and Battery Life

Main Battery Type. Any brand of 1.5-volt, size AA Alkaline batteries or Nickel-Cadmium or Nickel-Metal Hydride (NiMH) rechargeable batteries.
Backup Battery Type. 3-volt CR2032 lithium coin cell. If fresh main batteries are maintained, the backup battery should last a year before you replace it.

The battery life you get with your palmtop depends on:

- The type and quality of batteries you use.
- How you use your palmtop. (Things like IR and serial communications, modems, and flash-disk memory cards all require higher current and therefore drain your batteries faster.)
- Whether you use the AC adapter.

For typical use without the AC adapter, fresh Alkaline batteries should last from 2 to 8 weeks. Rechargeable batteries used without the AC adapter will get less life than Alkalines--how much less depends on the quality and type of the rechargeable batteries you use.

The best way to extend battery life is to use the AC adapter whenever possible.

Warning

Do not use the palmtop AC power adapter in the patient care vicinity. The AC power adapter meets standard electrical safety requirements, but not the stricter requirements for medical equipment used near patients.

When you see the message telling you that the main batteries are low, replace them as soon as possible. This will help you get the most out of your backup battery.

Battery Status

The HP Wave Viewer software monitors the palmtop battery voltage and informs you of the need to replace the batteries via a screen message.

You can also use the battery monitor in the "setup" program within the palmtop System Manager to predict the remaining battery capacity. When the indicator falls below the 1/4 level, fresh alkaline batteries should be installed.

Additionally, the palmtop has a self test (**ESC** **ON**) that includes reading the battery voltage. This self test procedure necessitates rebooting of the palmtop.

When to Replace Palmtop Batteries

When you see a low-battery message in the display, replace the indicated batteries as soon as possible. If the palmtop beeps and turns off immediately after you turn it on, replace the main batteries.

The backup battery, which prevents data loss when the main batteries are dead or out of the unit, should be changed a year after it is installed even if a low backup-battery message doesn't appear.

Removing and Installing Palmtop Batteries

Caution

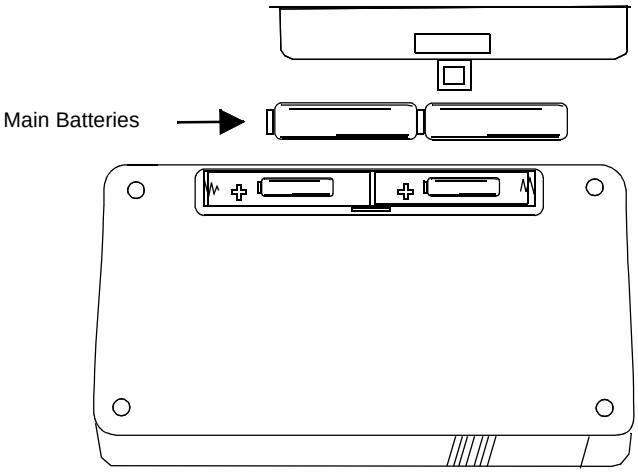
Do not remove the main batteries if the backup battery is dead--complete memory loss will result. Replace the backup battery first in this case.

Warning

Do not mutilate, puncture, or dispose of batteries in fire. The batteries can burst or explode, releasing hazardous chemicals. Replace batteries with only the types recommended in this manual. Discard used batteries according to the manufacturer's instructions. The back-up (lithium) battery can explode if it is inserted incorrectly.

Changing the Main Batteries

Change the main batteries by performing the following steps.

Step	Action
1	Close all open applications before changing batteries.
2	**Important:** Turn your palmtop off and close the case.
3	Remove the battery cover and old batteries. 
4	Install two fresh AA batteries, orienting them as shown by the symbols in the battery compartment.

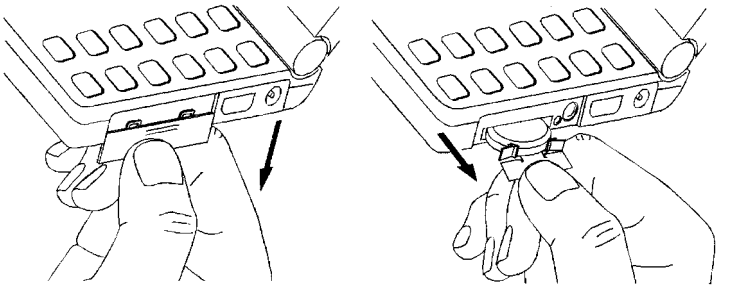
Step	Action
5	Replace the cover and turn your palmtop on. If the palmtop won't turn on after you replace the batteries, go back over the procedure and check the orientation of the batteries as shown in Step3--you may have put the batteries in backwards.
6	If you replaced rechargeable batteries (either with Alkalines or another set of rechargeables) be sure to go into Setup and set or verify your battery type and charging setting. (Battery charging is automatically disabled whenever you remove rechargeable batteries.) See the palmtop *User's Guide* for more information.

Changing the Backup Battery

Caution

Do not remove both the main batteries and the backup battery at the same time--complete memory loss will result.

Change the backup battery by performing the following steps.

Step	Action
1	**Important**: Turn the palmtop off.
2	Remove the backup-battery cover and pull out the battery tray. 

Step	Action
3	Remove the old battery from the tray and insert a fresh, 3-volt CR2032 coin cell. *Be sure the "+" on the battery is facing down in the tray.*
4	Insert the battery tray back into the palmtop and replace the cover.
5	Turn the palmtop on. If the battery-low message is still present in the display, go back over the procedure and check the battery orientation as shown in Step 3--you may have put the battery in the tray upside down.

6
HP Viridia Wave Viewer Operation

This chapter provides directions for operating the HP Viridia Wave Viewer. It includes the following sections:

HP Wave Viewer Controls

Keys

HP Wave Viewer can be operated with only 11 keys - the 10 function keys **F1** through **F10** - and the **ON** key. Functions are defined by the corresponding label on the screen.

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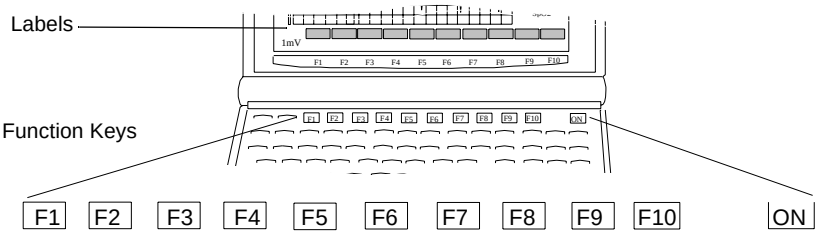
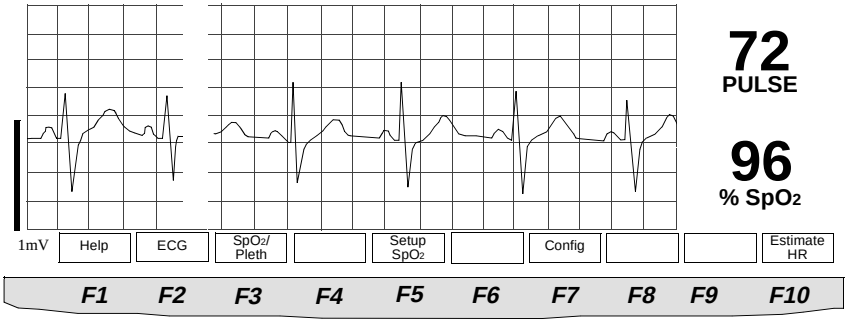


Main Screen

The Main Screen displays the realtime ECG waveform and the SpO_2 status. Labels at the bottom of the display provide access to other screens where you can view data and change settings.



Main Screen with ECG and Continuous SpO_2

8
Telemetry System Configuration

This chapter provides information on telemetry system configuration. It includes the following sections:

About Configuration

How your telemetry system performs depends in large part on the configuration choices made during system installation. This chapter provides a summary of the factory-set defaults and the alternative configuration choices that relate to clinical practice. Configuration is performed at the receiver mainframe, except for the Viridia transmitters, which are configured at the HP Wave Viewer, and all settings except frequency pertain to all receivers in the mainframe.

Two of the most frequently performed configuration procedures are also included in this chapter.

For complete configuration information, including the impact of individual choices, refer to the *HP Viridia Telemetry System Installation and Configuration Guide* (M2600-90036).

Configuration Settings

M2604A Mainframe

The following table lists the mainframe configuration settings used by the HP Viridia Information Center.

Note—The HP Viridia Information Center does not use the following settings:

- HR Alarm Limits
- Lead Fallback
- Bandwidth
- ST Settings

Item	Factory Default	User Choices
GENERAL ALARM PARAMETERS		
Alarm Suspend	3 Minutes	3 Minutes, Infinite
Alarm Reminder (SpO_2 only)	ON	ON, OFF
GENERAL ECG PARAMETERS		
Extended Monitoring	ON	ON, OFF
M1400X SERIES TRANSMITTERS ECG PARAMETERS		
Lead Selection - 4 Electrode	Primary = II Secondary = I	Primary = I, II, III, aVR, aVL, aVF Secondary = I, II, III, aVR, aVL, aVF, Off *Note*—The primary and secondary ECGs must be different lead types and primary cannot be off.
Lead Labelling - 5 Electrode	Primary = II Secondary = OFF	Primary = I, II, III, MCL Secondary = I, II, III, MCL, ECG, OFF
Lead Labelling - 3 Electrode	Primary = II Secondary = OFF	Primary = I, II, III, MCL
Lead Swap	OFF	ON, OFF

Item	Factory Default	User Choices
M2601X SERIES TRANSMITTERS ECG PARAMETERS		
Lead Selection - 5 Electrode	Primary = II Secondary = V	Primary = I, II, III, aVR, aVL, aVF, MCL, V Secondary = I, II, III, aVR, aVL, aVF, MCL, V, OFF *Note*—The ECG primary and secondary must be different lead types, and the primary cannot be OFF.
Lead Labelling - 3 Electrode	Primary = II	Primary = I, II, III, MCL
SpO_2 PARAMETERS		
SpO_2 Alarm Limits	High: 100 percent Low: 90 percent	High Range = 51-100 percent Low Range = 50-99 percent (increment of 1)
GENERAL PARAMETERS		
Transmitter Button Function	Nurse Call and Record	Nurse Call, Record, Both, Disabled
Language	English	English, German, French, Dutch, Spanish, Swedish, Italian, Japanese, Norwegian, Danish, Finnish, Portuguese

For configuration of the following items, see *HP Viridia Telemetry System Installation and Configuration Guide*

- Auto Self Test
- Self-test Strip
- SDN Unit Number
- SDN Branch Number
- Country Code
- Locale Code
- Frequencies

HP M2601X Series Transmitter

The following table lists the configuration settings for the HP Viridia Transmitter.

Item	Factory Default	User Choices
Lead Selection 3-wire lead set	No	Yes, No
Automatic Shutoff (after 10 minutes)	Yes	No, Yes
User Change Frequency	Yes	No, Yes

For configuration of the following items, see H*P Viridia Telemetry System Installation and Configuration Guide*

- Country Code
- Locale Code
- Frequencies

Changing the Configuration

In general, configuration changes are best made by the service department. However, occasionally you may be called on to resolve a troublesome situation. For that reason, we have included directions for two of the most commonly performed configuration procedures:

1. Configuring a replacement HP Viridia transmitter to match others in the unit.

2. Changing the frequency in case of excessive interference or if you have a spare transmitter.

Both these procedures require an HP Wave Viewer. Consult the service documentation or service representative for more information.

Configuring Replacement HP Viridia Transmitters

Note—Before configuring a replacement transmitter, check that the status of the transmitter allows a frequency change. To check the status, use HP Wave Viewer and select **Config** from the Wave Viewer Main Screen. Then, under **Xmtr Info1**, check for a Freq. Option of 020; under **Xmtr Info2**, check for USER CHANGE FREQ = NO. If either condition is true, the following Task Summary for reconfiguring a replacement transmitter does not apply; call service for assistance.

Note—Setting the frequency to one already in use can cause interference with another transmitter/receiver pair.

Task Summary

Configure a replacement transmitter by performing the following steps:

Step	Action
1	Obtain a transmitter with an existing configuration you want to copy.
2	At the Viridia Information Center, obtain the frequency and check code for the replacement transmitter's associated bed found in the Telemetry Frequency Unit Settings Window. See the *Viridia Information User's Guide* for details.
3	Insert battery in replacement transmitter.
4	At the HP Wave Viewer, set the frequency of the replacement transmitter by: 1. Selecting **Config** from the HP Wave Viewer Main Screen. 2. Selecting **Setup**. 3. Entering the password and pressing **Enter**. 4. Selecting **Chang Freq**. 5. Entering the frequency for the replacement transmitter from Step 2, followed by **ENTER**. 6. Entering the check code from Step 2, followed by **ENTER**. 7. Selecting **Confirm** to set the new frequency.

Step	Action
5	At the HP Wave Viewer, copy the configuration from the existing transmitter into the replacement transmitter by: 1. Selecting **Setup Menu**. 2. Selecting **Copy Config**. 3. Connecting the transmitter with the existing configuration you want to copy. 4. Selecting **Save Config**. 5. Connecting the replacement transmitter. 6. Selecting **Copy Config**.
6	On the Telemetry Frequency Window at the Viridia Information Center, click **Learn XMIT Code** for the highlighted bed. See the *Viridia Information User's Guide* for details.
7	Within 10 seconds, press the **Patient Button** on the replacement transmitter to enable the system to learn the new ID code.

Changing Frequencies for HP Viridia Transmitters

Note—Before configuring a replacement transmitter, check that the status of the transmitter allows a frequency change. To check the status, use HP Wave Viewer and select **Config** from the Wave Viewer Main Screen. Then, under **Xmtr Info1**, check for a Freq. Option of 020; under **Xmtr Info2**, check for USER CHANGE FREQ = NO. If either condition is true, the following Task Summary for reconfiguring a replacement transmitter does not apply; call service for assistance.

Note—Setting the frequency to one already in use can cause interference with another transmitter/receiver pair.

Task Summary

Change the frequency by performing the following steps:

Step	Action
1	From the Viridia Information Center, set the new frequency for the receiver by: 1. Accessing the Telemetry Frequency Window by clicking on the **Telem Freq** button on the Unit Settings Window. 2. Entering a password in the **Password** field. 3. Highlighting the bed/receiver. 4. Entering the new frequency for the receiver in the **New Frequency** field. *Note*—The check code and frequency choices were distributed during shipment. See service for assistance. 5. Entering the check code in the **New Check Code** field. 6. Clicking on the **Set Frequency** field.
2	From the HP Wave Viewer Main Screen, set the new frequency for the transmitter by: 1. Selecting **Config**. 2. Selecting **Setup**. 3. Entering a password, followed by **ENTER**. 4. Selecting **Chang Freq**. 5. Entering the new frequency for the transmitter, followed by **ENTER**. 6. Entering the check code, followed by **ENTER**. 7. Selecting **Confirm** to set the new frequency.

9
System Safety and Specifications

This chapter provides information on regulatory requirements compliance for patient safety, safety-oriented installation and maintenance procedures, and specifications for the HP Telemetry System. It includes the following sections:

Safety Requirements

Declaration

CE 0123

The HP Telemetry System, comprising the HP M2600A Viridia Telemetry System and/or the HP M1403A Digital UHF Telemetry System, Option C03, complies with the requirements of the Council Directive 93/42/EEC of 14 June 1993 concerning medical devices and carries CE-marking accordingly.

The HP Telemetry System (except the HP Wave Viewer) also complies with the following international safety requirements for medical electrical equipment:

- UL 2601-1
- CAN/CSA C22.2 NO. 601.1-M90
- EN 60601-1/IEC 60601- 1
- EN 60601-1-1/IEC 60601-1-1
- EN 60601-1-2/IEC 60601-1-2
- EN 865:1997
- AAMI voluntary performance standards for cardiac monitors sections: 3.1.2.1.c, 3.2.6.1.a-c, 3.2.6.2, 3.2.6.3, 3.2.7, 3.2.8.3, 3.2.8.4, 3.2.8.7, 3.2.9.2, 3.2.9.3 and 3.1.4.1

The system is protected against the effects of defibrillation and electrosurgery.

This system provides continuous operation when in use.

The HP Viridia Wave Viewer complies with EN 60601-1/IEC 60601-1.

The following accessories and system components are independently CE marked to the Medical Device Directives. They are not covered by the CE marking of the HP Viridia Telemetry System:

- All SpO_2 accessories and equipment
- Electrodes
- ECG Lead Sets

Authorized EU Representative:

Hewlett-Packard GmbH
Medical Production
71034 Boeblingen
Germany
FAX: (+49) 7031 14 2346

Electromagnetic Compatibility

The electromagnetic compatibility (EMC) validation of the HP Telemetry System (comprising the HP M2600A Viridia Telemetry System and/or the HP M1403A Digital UHF Telemetry System with Option C03) included testing performed according to the international standard for EMC with medical devices. See the Manufacturer's Declaration for details.

HP M2600A Viridia Telemetry System Testing

During the test program the M2600A was subjected to many EMC tests, both international standard and HP proprietary tests. During most of the testing no anomalies were observed. For three of the tests, EN 61000-4-3 Radiated Immunity, IEC 801-4 Fast Transients, and IEC 801-2 Electrostatic Discharge, some reduced performance was observed.

EN61000-4-3 EN61000-4-3 specifies that the product be subjected to a field of 3 V/m over a frequency range of 26 to 1000 MHz with no degradation of performance. At most of the test frequencies over the specified range, no anomalies were observed. However at the transmit/receive frequencies, and a few others, the radiated field caused interference with a resulting drop-out of signal. For these test points the radiated field was reduced to the level at which communication was restored. These reduced levels are shown in the following table.

Table 4: Minimum Immunity Level (V/m)

	In Band Radiation (Transmit freq. +/- 1 MHz)	Out of Band Radiation
Transmitter	0.03	1.81 (380 MHz - 400 MHz) 2.83 (at 571 MHz)
Receiver	0.01	Pass at 3 V/m

IEC 801-4 IEC 801-4 specifies that the product be subjected to high speed pulses up to 1000 V applied to the power cord and 500 V applied to all I/O cables greater than 3 m. During all of this testing no anomalies were observed on the central station display. However at pulse levels of 300 V and above applied to the power cord, occasional spikes appeared on the monitor connected to the analog output of the receiver mainframe. These spikes sometimes caused the heart rate reading (on the analog output monitor only) to change momentarily.

HP M1403A Digital UHF Telemetry System with Option C03 Testing

During the test program, the M1403A with Option C03 was subjected to many (EMC) tests, both international standard and HP proprietary tests. During most of the testing, no anomalies were observed. For two of the tests, IEC 801-3 Radiated Immunity and IEC 801-4 Fast Transient/Burst Immunity, some reduced performance was observed.

IEC 801-3 IEC 801-3 specifies that the product be subjected to a field of 3 V/m over a frequency range of 26 to 1000 MHz with no degradation of performance. At many of the test frequencies over the specified range, no anomalies were observed. At +/- 10 MHz of the transmitter operating frequency, radiated levels were reduced to 0.01 V/m to avoid M1402A receiver channel dropout.

During radiated immunity testing of the M1400B transmitter, there were some test points where increased width of the ECG trace was observed. For those test points, the radiated field was reduced to the level at which the ECG trace returned to normal. The reduced passing levels for the M1400B transmitter are as follows:

- 0.382 to 1.5 V/m from 80 MHz to 140 MHz
- 0.439 to 2.9 V/m from 300 MHz to 610 MHz

IEC 801-4 IEC 801-4 specifies that the product be subjected to high speed pulses up to 1000 V to the power cord and 500 V to all I/O cables greater than 3 m. During and after most of the test pulses, no anomalies were observed. However, at pulse levels above 300 V applied to the power cord, spurious pulses were observed. There was no degradation of performance when 500 V was applied to the input/output cables.

HP Telemetry System Characteristics

The phenomena discussed above are not unique to the M2600A or M1403A with Option C03, but are characteristic of wireless patient monitors in use today. This performance is due to the very sensitive high gain front end amplifiers used to display the physiological signals and the nature of wireless communication. Among the many similarly performing monitors already in use by customers, interference from electromagnetic sources is rarely a problem.

Avoiding EMI

When electromagnetic interference (EMI) is encountered, there are a number of things that can be done to mitigate the situation.

- Eliminate the source. Possible sources of EMI can be turned off or moved away to reduce their strength.
- Attenuate the coupling. If the coupling path is through the patient leads, the interference may be reduced by moving and/or rearranging the leads. If the coupling is through the power cord, connecting the M2600A or M1403A with Option C03 to a different circuit may help.
- Reduce the sensitivity of the system. In all of the EMC testing, the M2600A and M1403A were adjusted to maximum sensitivity. For the ECG amplifier the gain was four times what is normally required. By reducing the gain of the system receiving the EMI, the interference can often be eliminated.
- Add external attenuators. If EMI becomes an unusually difficult problem, external devices such as an isolation transformer or a transient suppressor may be of help. An HP Customer Engineer can be of help in determining the need for external devices.

System Symbols

The following is an explanation of the symbols found on the hardware components of the HP Telemetry System:

Symbol	Explanation
	AC Line Current.
	Active Antenna Combiner.
	Antenna Input.
	Attention. See instructions for use.
	Bandpass Filter
	Battery Polarity
REF	Catalog Number

Symbol	Explanation
	Class 2 Equipment
	Cradle Connection
	Data In
	Data In, Data Out
	Data Out
	DC Voltage
	Date of Manufacture
	Do Not Reuse. Use Only Once. Dispose of properly after use in accordance with local regulations.

Symbol	Explanation
	Electrical Input
	Electrical Output.
	Equipotential Grounding System.
	Frequency Converter
	Fuse Input.
	Grounding system.
	Indoor Use Only
	Line Amplifier
	Mainframe. For future use.

Symbol	Explanation
	Non-ionizing Radiation
	Palmtop. Power Polarity
	Power On/Off
OPT	Product Option
	Protective Earth (Ground)
	Power Tee
SN	Serial Number
	Type CF Defibrillation Proof

Type CF Defibrillation Proof

The following symbol indicates that the various instruments connected to the HP Telemetry System are Type CF Defibrillation Proof.

TYPE CF
DEFIBRILLATION PROOF

Type CF Defibrillation Proof equipment is designed to have special protection against electric shocks for intracardiac application (particularly regarding allowable leakage currents by having an F-type isolated or floating applied part), and is defibrillator proof.

Installation and Maintenance Safety

Caution

Installation and setup must be performed by an HP service representative or designee, except for transmitters and wave viewers purchased individually. These can be installed by hospital personnel according to instructions in the *Installation and Configuration Guide* included in the *Service Training Kit.*

Installation

Environment

Follow the instructions below to ensure a completely safe electrical installation. The environment where the HP Telemetry System will be used should be relatively free from vibration, dust, corrosive or explosive gases, extremes of temperature, humidity, and so on. For a cabinet mounted installation, allow sufficient room at the front for operation and sufficient room at the rear for servicing with the cabinet access door open.

The HP Telemetry System operates within specifications at ambient temperatures between 0ºC (32^{o}F) and 55ºC (131^{o}F). The transmitter ambient temperature specification is between 0ºC (32^{o}F) and 45^{o}C (113^{o}F). Ambient temperatures which exceed these limits could effect the accuracy of the instrument and cause damage to the components and circuits. Allow at least 5 cm (2 inches) clearance around the instrument for proper air circulation.

Grounding

To protect hospital personnel, the cabinet of the HP Telemetry System must be grounded. Accordingly, the system is equipped with a detachable 3-wire cable which grounds the instrument to the power line ground (protective earth) when plugged into an appropriate 3-wire receptacle. If a 3-wire receptacle is not available, consult the hospital electrician.

Warning

Do not use a 3-wire to 2-wire adapter with this instrument.

Condensation

Make sure that during operation, the instrument is free of condensation. Condensation can form when equipment is moved from one building to another, thus being exposed to moisture and difference in temperature.

Warning

Possible explosive hazard if used in the presence of flammable anesthetics.

Maintenance

Before beginning monitoring on a patient:

- Check for any mechanical damage.
- Check all the external leads, plug-ins and accessories.
- Check all the functions of the instrument which are needed to monitor the patient.
- Ensure that the instrument is in good, working order.

Important—Do not use the HP Telemetry Monitoring System for any monitoring procedure on a patient if you identify features which demonstrate impaired functioning of the instrument. Contact the hospital biomedical engineer, or your HP Service Representative.

Warning

Failure on the part of the responsible individual hospital or institution employing the use of this equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards

HP Receiver Mainframe

Rear Panel

The rear panel of the receiver mainframe is shown below. The back of the mainframe should only be removed by qualified service personnel.

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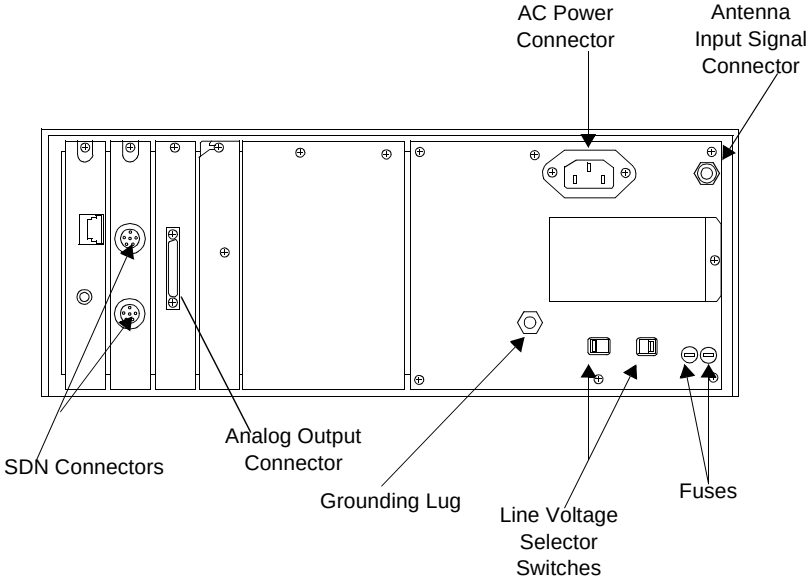
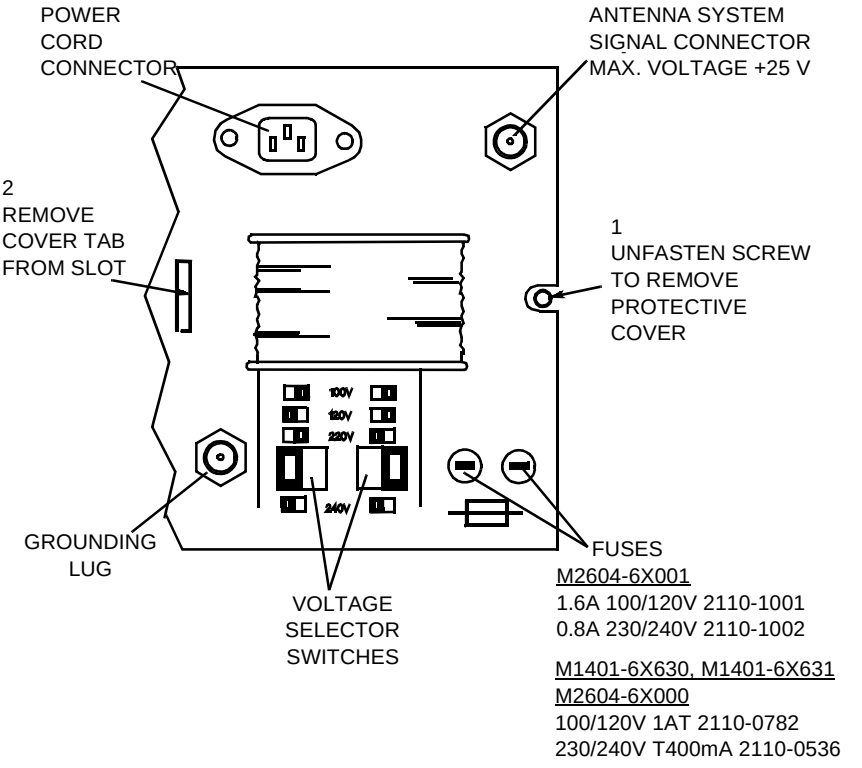


This is an enlarged view of the right side of the rear panel:



Connectors

The connectors on the rear panel of the receiver mainframe are:

Connector	Description
Fuses	The input voltage line is protected as follows: On the M1401A: • 100/120V xx 1.0 AT fuse • 100/120V xx 1.6 A fuse (Japan) • 230/240V xx 400 mA fuse On the M2604A: • 100/120V xx 1.6 A • 230/240V xx 0.8 A.
AC Power Connector	This is a 3 pin connector, used to input the local line voltage. Mainframe plug is a standard IEC mains inlet receptacle.
Antenna Input Signal Connector	This is a BNC coaxial connector.
SDN Connectors	These are upstream and downstream connectors that connect to the HP Viridia monitoring network.
Patient Monitor/Holter Interface (Analog Output) Option	High Density 50-pin SCSI-type to connect to output connector box.
Grounding Lug	This is a grounding stud connector, used to equalize the grounding potential between products.

Secondary Ground Wire

A secondary ground wire is provided with this instrument to comply with IEC-601-1-1. This wire ensures against excessive chassis leakage current in the event of a single fault in the health care facility's primary grounding means.

It is recommended that the secondary ground wire be connected to a ground source separate from the primary grounding source found in the instrument's power source.

Note—After servicing, be certain to reconnect the secondary ground wire.

Warning

Removal of the secondary grounding wire from the rear of the product voids the IEC approval.

Lifting the Receiver Mainframe

The weight of the receiver mainframe is 45 lbs (20.4 kg) for the M1401A and 37 lbs. (16.9 kg) for the M2604A. When carrying the mainframe, hold it firmly from underneath. For safety reasons, it is **strongly** recommended that at least two people lift the mainframe. One person should not attempt it.

Antenna Amplifiers

The antenna amplifiers must be operated only with the Power Supply (AC/DC Adapter), and must be operated at a minimal distance of 2.43 meters (8 feet) from the patient.

M26XXA Series Antenna Components

For all voltages, use Part Number 0950-3221.

M14XXX Series Antenna Components

For 220/230-240 Volt operation, use Part Number, HP 0950-3221 (CE Marked).

For 100 - 120 Volt operation, use Model 7323-000-01922; Part Number, HP 0950-2038.

Patient Monitor/Holter Interface Option

If using the optional Patient Monitor/Holter Interface (Analog Output), the connector box must only be operated with the appropriate power supply (see table below), and must be operated at a minimum distance of 2.43 meters (8 feet) from the patient.

Power Supply for Output Connector Box		
Location	**Voltage**	**Part Number**
U.S./Canada	120V	0950-3221
Europe	220/230-240V	0950-3221
United Kingdom	220/230-240V	0950-3221
Australia	240V	0950-3221
South Africa	220/230-240V	0950-3221

Note—At this time, Hewlett-Packard will make available on request, and in English only, such circuit diagrams, component part lists, descriptions, calibration instructions or other information which will assist the user's appropriate qualified technical personnel to repair those parts of the equipment which are classified by Hewlett- Packard to be repairable.

Preventive Maintenance

Preventive maintenance should be performed by a qualified service person. The Safety and Performance Tests, and what to do if the equipment does not meet these specifications, are described in the *Service Training Kit* (HP Part Number M2600-90032). Contact your biomedical department if your equipment needs testing for safety or performance.

End of Life

There is no specific, predetermined end of life to the HP Viridia Telemetry System or any of its component products. Hewlett-Packard provides service, support and replacement parts and assemblies throughout the support life of the products that allow them to be repaired should any component of the system fail. Please refer to the *HP Viridia Telemetry System Service Training Kit* for instructions on how to obtain service or replacement parts and for instructions on preventative maintenance. Your local HP sales or service representative can provide you information regarding the support life of your products.

Additional Safety Information

Warning

The equipment is not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.

Warning

Strangulation Hazard! Under no circumstances should any pouch be tied solely around a patient's neck.

Warning

Do not use patient cables with detachable lead wires that have exposed male pins. Electrocution could result if these pins are plugged into AC power.

Software Hazard Prevention

The minimization of hazards arising from errors in the software program is documented in the following reports:

1. Hazard Analysis Report, Revision 1.0, 16 June 1995.
2. Whitebox Test Report, Revision 0.1, 16 June 1995. Includes Safety Fault Tree Analysis.
3. Quality Demonstration Test, 3 January 1997.
4. Clinical Investigations Report, Revision 1.0, 16 May 1997.
5. White Paper Cover Document, Revision B, 19 August 1998.

System Specifications

This section lists the system classification, and the environmental and electrical power specifications for the hardware components of the system. For complete specifications, see *HP Telemetry System Service Guide*, part number M2600-90033. For full power specifications for HP Wave Viewer, see the HP palmtop documentation.

System Classification

Class I Equipment

M2604A Receiver Mainframe
M1401A Receiver Mainframe

Class II Equipment

0950-2038, 0950-3221 Power Supplies

Internally Powered Equipment

M2601A Transmitter (Type CF Defibrillation Proof relative to ECG and SpO_2 patient applied parts)
M1400A/B/J Transmitter (Type CF Defibrillation Proof relative to ECG patient applied parts)

All equipment is Ordinary Equipment, IPX0, and provides continuous operation.

In addition, the M2601A transmitter withstands submersion in 30 cm (1 ft.) of water for 5 minutes or 10 minutes of water exposure in a shower without degradation of performance. The transmitter has not been investigated to IEC 529.

Environmental Conditions

FOR ALL HARDWARE COMPONENTS OF THE HP TELEMETRY SYSTEM EXCEPT WAVE VIEWER, HP VIRIDIA TRANSMITTERS, AND REUSABLE PULSE OXIMETRY TRANSDUCERS

Operating

Temperature Range: 0 to 55ºC (32 to 131ºF)
Altitude Range: Up to 4570 m (15,000 ft.)
Humidity Range: 15 to 95% relative humidity

Storage

Temperature Range: -40 to +70ºC (-40 to +158ºF)
Altitude Range: Up to 4570 m (15, 000 ft.)
Humidity Range: 90% relative humidity maximum

For HP Viridia Transmitter

Operating

Temperature Range: For ECG ONLY, 0-45ºC (32-113º F); For SpO_2, 0-37ºC (32-99º F)
Altitude Range: Up to 4570 m (15,000 ft.)
Humidity Range: 15 to 95% relative humidity, non-condensing

Storage

Temperature with Data Retention: -40 to +70º C (-40 to 158º F)
Altitude Range: Up to 4570 m (15,000 ft.)
Humidity Range: 15 to 95% relative humidity, non-condensing

For Wave Viewer

Operating

Temperature Range: 0-50ºC (32-122º F)
Altitude Range: Up to 4570 m (15,000 ft.)
Humidity Range: 90% relative humidity at 40º C (104º F) maximum

Storage

Temperature with Data Retention: 0-60º C (32-140º F)
Altitude Range: Up to 4570 m (15,000 ft.)
Humidity Range: 90% relative humidity at 40º C (104º F) maximum

For Reusable Pulse Oximetry Sensors

Operating

Temperature Range: 15-37ºC (50-98.6º F)
Altitude Range: Up to 4570 m (15,000 ft.)
Humidity Range: 95% relative humidity at 37º C (98.6º F) maximum

Storage

Temperature Range: -40 to 70º C (-40 to 158º F)
Altitude Range: Up to 4570 m (15,000 ft.)
Storage Humidity: 95% relative humidity at 65º C (150º F) maximum

Electrical Power Specifications

Note—Specifications for earlier releases of the product may vary slightly.

HP M2601A Viridia Transmitter

RF Power Output

+6.5 dBm, +1.6/-2.0 dB (2.8 to 6.5 milliwatts)
For Japan: -3 to 0.8 dBm (0.5 to 1.2 milliwatts) nominal

Carrier Frequency Range

Option #001: 406 to 412.5 MHz
Option #002: 412.5 to 421.5 MHz
Option #003: 421.5 to 430 MHz
Option #004: 430 to 440 MHz
Option #005: 440 to 450 MHz
Option #006: 450 to 460 MHz
Option #007: 460 to 470 MHz
Option #008: 470 to 480 MHz
Option #020: 590 to 632 MHz

For M2601A - #ABJ, AR0: Japan only
Option #02J: 412.5 to 421.5 MHz
Option #03J: 421.5 to 430 MHz
Option #05J: 440 to 450 MHz

Radio Channel Spacing

25 kHz

Defibrillator Protection

Transmitter ECG input protected against 5 KV d.c. discharge into a 100 Ohm load

Warning

Battery door must be closed during defibrillation.

Batteries

9V Alkaline, Lithium
8.4 Zinc-Air (ECG-only transmitters)

Current Draw

12.0 mA (ECG only), 43.4 mA (ECG and SpO_2) typical

HP M1400A/B/J Transmitters

Unless otherwise indicated, specifications apply to all three transmitters.

RF Power Output

HP M1400A	+3 dBm (2 milliwatts) nominal.
HP M1400B	+6 dBm (4 milliwatts) nominal.
HP M1400J	0 dBm (1 milliwatt) nominal

Carrier Frequency Range

406 to 512 MHz (exact frequency fixed by option), VCXO controlled.

Radio Channel Spacing

25 kHz

Defibrillator Protection

Transmitter ECG input protected against 5 KV d.c. discharge into a 100 Ohm load

Warning

Battery door must be closed during defibrillation.

Batteries

9V Alkaline, Lithium
8.4 or 9V Alkaline, Carbon-Zinc, Lithium, Mercury, Zinc Air.

Current Draw

HP M1400A — 4.5 mA, nominal
HP M1400B — 6.0 mA, nominal
HP M1400J -— 4.5 mA, nominal

HP M2604A/ M1401A Receiver Mainframe

Power Supply

For the M2604A: M2604-60001
For the M1401A: M2604-60001, M2604-60000, or M1401-60631

Input Voltage

100/120/220/230-240 VAC selectable +/- 10%.

Frequency Range
47 to 63 Hz

Power Consumption
For M2604A: 110 VA maximum, 95 VA average, 81 W maximum, 72 W average with 8 M2603A receiver modules
For M1401A with #C03: 102 VA maximum, 87 VA average, 75 W maximum, 66 W average with 8 M1402A receiver modules.

Controls
Front Panel: Power On/Off
Rear Panel: Line voltage selector.

Indicators
Front Panel: Power On (indicator light and mechanical indicating lines on POWER button), Instrument Malfunction, Receiver Status (internally via LED).

Connections (rear)
Antenna Input Signal connector (BNC)
Downstream SDN connector
Upstream SDN connector
Analog Output Connector
AC Power Connector (4 selectable line voltages)
Grounding Lug

Radiated Immunity
3 Volts/Meter outside of operating receiver bands

HP M2603A Receiver Module

Frequency Tuning
Programmable, synthesizer, PLL controlled.

Channel Spacing
25 kHz.

Carrier Frequency Range
Option #001: 406 to 412.5 MHz
Option #002: 412.5 to 421.5 MHz
Option #003: 421.5 to 430 MHz
Option #004: 430 to 440 MHz
Option #005: 440 to 450 MHz
Option #006: 450 to 460 MHz
Option #007: 460 to 470 MHz

Option #008: 470 to 480 MHz

HP M1402A Receiver Module

Frequency Range
RF Carrier 406 to 512 MHz (exact frequency fixed by option), VCXO controlled.

Channel Spacing
25 kHz.

Channel RF Bandwidth
10 kHz.

HP M2611A Battery Extender

Input Voltage
100/120/220/230-240 VAC +/- 10%, based on country needs

Frequency Range
47 to 63 Hz, based on country needs

Output Voltage
9.5 to 10 VDC

Output Current Limit
300 mA max

Patient Monitor Holter Recorder Interface (Analog Output) Option J01

Input Voltage
CE Mark Power Module 0950-3221: 100-240 VAC +/- 10%

Frequency Range
47 - 63 Hz.

Power
CE Mark Power Module 0950-3221: 33 VA maximum

Output Voltage
CE Mark Power Module 0950-3221: 24 VDC regulated 0 to 1.4 A current range

Output Current
CE Mark Power Module 0950-3221: 1.4 ampere DC maximum

Analog Output Gain (from output of receiver module)
High-level outputs: 500 $\pm$ 5%

Low-level outputs: 1 +7%/-6%

Inoperative Mode (INOP Condition) Output Level

High-level output: 10.8 volts ± 1.2 volts
Low-level output: >100 megohms with respect to reference electrode

Delay from Transmitter Input to Analog Output

40 milliseconds max - M1400A/B/J Transmitter
400 milliseconds max -- HP Viridia Transmitter
Not intended for use with synchronized cardioversion due to processing delay.

Indicators

Output Connector Box; Status and Power LEDs

Connections

Output Connector Box: Input (50-pin jack); Input (Power Module); Output (8 pairs of 9-pin D connectors)

Analog Output Card: Output (50-pin jack)

Bedside Attenuator: Output (3-conductor phone jack)

Holter Attenuator: Output (set of 5-button connectors)

ECG Bandwidth

M2601A: 0.05 - 40 Hz
M1400A/B/J: 0.05-100 Hz

To ensure proper operation, installation and setup must be performed by an HP service representative or designee according to the instructions in Patient Monitor/Holter Recorder Interface (Analog Output) Installation Note (part number M2600-90017) and the *Patient Monitor/ Holter Recorder Option M1440A #J01 Upgrade Kit* (part number M2600-90031).

Antenna System Specifications

HP M1406A Line Amplifier

Input Voltage
19 - 40 VDC

RF Frequency Range
406-512 MHz

Current Requirements
50 mA

Average Power Consumption
About 1.1 Watts.

RF Gain
12.5 dB typical, at 465 MHz

Indicator
Green Power On LED

HP M1407A Multiple Unit Power Supply

Input Voltage
CE Mark Power Module 0950-3221: 100-240 VAC +/- 10%

RF Frequency Range
406-512 MHz

Power
CE Mark Power Module 0950-3221: 33 VA maximum

Frequency Range
47 - 63 Hz

Output Voltage
CE Mark Power Module 0950-3221: 24 VDC 0 to 1.4 A

Output Current
CE Mark Power Module 0950-3221: 1.4 ampere DC

Indicator
Green Power On LED

HP M1408A Active Antenna Combiner

Input Voltage
19 - 32 VDC

Current Requirements
50 mA

Power Consumption
Approximately 1.5 Watts, average

RF Frequency Range
406-512 MHz

RF Gain
Antenna: 9.7 dB typical, at 465 MHz
Line: 3.5 dB typical, at 465 MHz.

Indicators
Green LED indicates DC power/signal cable connected correctly.
Red LED indicates DC power/signal cable connected incorrectly.

HP M2606A Line Amplifier

Input Voltage
19-32 VDC

Current Requirements
38 mA, maximum

Power Consumption
0.75 Watts, average

RF Frequency Range
406-650 MHz

RF Gain
12.8 dB typical at 406 MHz
12.7 dB typical at 465 MHz
11.8 dB typical at 650 MHz

Indicators
Green LED indicates DC power/signal cable connected correctly.
Red LED indicates DC power/signal cable connected incorrectly.

HP M2607A Multiple Unit Power Supply

Note—M2607A specifications cover both power module and power tee.

Input Voltage
CE Mark Power Module 0950-3221: 100-240 VAC +/- 10%

RF Frequency Range
406-650 MHz

Power Consumption
33 VA maximum

Frequency Range
47-63 Hz

Output Voltage
23 VDC nominal

Output Current
1 Amp maximum (Limited by the circuit breaker in the power tee)

Indicators
Green LED is on when power is present.

HP M2608A Active Antenna/ Combiner

Input Voltage
19 - 32 VDC

Input Current
62 mA maximum

Power Consumption
1.1 Watts average (2.0 Watts maximum)

RF Frequency Range
406-650 MHz

RF Gain
Antenna: 9.7 dB at 406 MHz; 10.2 at 465 MHz; 9.7 at 650 MHz
Line: 3.2 dB at 406 MHz; 3.5 dB at 465 MHz; 4.0 at 650 MHz

Indicators
Green LED indicates DC power/signal cable connected correctly.
Red LED indicates DC power/signal cable connected incorrectly.

HP M2609A Attenuator

Current Carrying Capacity
Maximum DC Voltage: +30 VDC maximum
Maximum DC Current: 1 A maximum

RF Frequency Range:
400-660 MHz

RF Attenuation
1-9 dB in increments of 1 dB, based on option

HP M2612A Bandpass Filter

Current Carrying Capacity
Maximum DC Voltage: 32 Volts
Maximum DC Current: 1 A

Power Requirements
Negligible

RF Frequency Range

#004	430-440 MHz
#005	440-450 MHz
#006	450-460 MHz
#007	460-470 MHz
#034	590-596 MHz
#035	596-602 MHz
#036	602-608 MHz
#037	608-614 MHz
#038	614-620 MHz
#039	620-626 MHz
#040	626-632 MHz

Indicators
Green LED is ON when power is present.

HP M2616A External Frequency Converter

Input Voltage
100-240 VAC +/- 10%

Frequency Range
47-63 Hz

Power Consumption
14.0 VA maximum

RF Input Frequency Range
590-632 MHz

RF Output Frequency Ranges

#130	460-502 MHz
#136	454-496 MHz
#142	448-490 MHz
#148	442-484 MHz
#154	436-478 MHz
#160	430-472 MHz
#166	424-466 MHz

Indicators
Green LED is ON when power is present.

Measurement Specifications

SpO_2

Measurement Range (Calibration and Display)
0-100%

Accuracy (1 standard deviation)
With HP re-usable transducers M1191A, M1192A: 70-100% +/- 2.5%

With HP re-usable transducer M1194A: 70-100% +/- 4%

With NELLCOR sensors D-25, D-20: 80-100% +/- 3%

Test methods are available from Hewlett-Packard Company upon request.

Resolution
1%

SpO_2 Numerics Averaging
10 seconds

Calibration

Automatic self-calibration when device is turned on. The pulse oximeter is calibrated to display functional saturation.

Pulse Rate

Measurement Range (Calibration and Display)

30 - 300 b/min.

Accuracy

+/- 2%

Test methods are available from Hewlett-Packard Company upon request.

Resolution

1 b/min.

Display (at HP Viridia Wave Viewer only)

Pulse waveform. The waveform is inversely proportional to the pulse volume.

ECG

Range

Input Dynamic: +/- 9 mV
DC Offset: +/- 320 mV
Cardiotach Alarm: Central station selectable, in 5 b/min. increments.
High: 20 - 250 b/min.
Low: 15 - 245 b/min.
Cardiotach Display: 15 - 300 b/min.

Accuracy

Gain: +/- 5% at 25^{o} C (77^{o} F)
Cardiotach: +/- 3 beats *plus* +/- 2% of heart rate for constant rate input.
At fewer than 15 b/min., the heart rate indication is 0.
Cardiotach Alarm: +/- 1 b/min., of displayed value

Display

Displayed values are presented in whole numbers.

B

Accessories and Ordering Information

This appendix provides a list of telemetry accessories you can order through your Hewlett Packard representative. For a list of sales offices, see “Appendix D. Sales and Support Offices”.

Accessories for HP Viridia Transmitter

Description	HP Part Number
Battery • 9 V Lithium (box of 10) • 8.4 V Zinc-Air (box of 12) - for use with ECG-only transmitters only	 ULBU9VLJ 40455A
3-wire ECG Lead Set • Snap, AAMI for M2601A, 0.7 m (30 inch) • Grabber, AAMI for M2601A, 0.7 m (30 inch) • Snap, IEC for M2601A, 0.7 m (30 inch) • Grabber, IEC for M2601A, 0.7 m (30 inch)	 M2590A M2591A M2594A M2595A
5-wire ECG Lead Set • Snap, AAMI for M2601A , 0.7 m (30 inch) • Grabber, AAMI for M2601A , 0.7 m (30 inch) • Snap, IEC for M2601A, 0.7 m (30 inch) • Grabber, IEC for M2601A, 0.7 m (30 inch)	 M2592A M2593A M2596A M2597A
Combiner Shield • 3-wire • 5-wire	 M2598A M2599A
ECG Electrodes • High Performance Foam,1/pack, 200/case • High Performance Foam,3/pack, 300/case	 14445A 14445C
ECG Electrode Kit	M2202A

Description	HP Part Number
ECG Electrode Kit • 30 electrodes • Foam, 5/pack, 300/case • Foam, 30/pack, 300/case	 40489E 40493D 40493E
Transmitter Pouch • Disposable, 50 /case • Disposable, 200/case	 9300-0768-050 9300-0768-200
SpO_2 Transducer • HP Reusable Adult Finger • HP Reusable Pediatric/Small Adult Finger • HP Reusable Adult/Pediatric Ear Clip	 M1191A M1192A M1194A
Wristband	M1627A
Nellcor Oxisensor™ • D-20 • D-25	 M1903A/B M1904A/B
Adapter Cable for use with Nellcor Oxisensor™ disposable transducers	M1943A

OXISENSOR II™ is a trademark of NELLCOR® Incorporated.

Note—Disposable transducers are not available as HP parts in the USA or Canada. In those countries, contact NELLCOR® Incorporated directly.

Accessories for M1400A/B/J Transmitter

Description	HP Part Number
Battery	
• 8.4 volt Zinc air	1420-0340
• Box of 12 Zinc air batteries	40455A
3-wire ECG Lead Set	
• Snap, AAMI	M1420A
• Grabber, AAMI	M1421A
• Snap, IEC	M1430A
• Grabber, IEC	M1431A
4-wire ECG Lead Set	
• Snap, AAMI	M1422A
• Grabber, AAMI	M1423A
• Snap, IEC	M1432A
• Grabber, IEC	M1433A
5-wire ECG Lead Set	
• Snap, AAMI	M1424A
• Grabber, AAMI	M1425A
• Snap, IEC	M1434A
• Grabber, IEC	M1435A
Electrode Set	
• Disposable, 1 per pack/200 per box	14445A
• Disposable, 3 per pack/300 per box	14445C
Transmitter Pouch	
• Reusable	1530-1693
• Disposable	9300-0768

C
System Releases

This appendix summarizes the enhancements made during each release of the HP Telemetry System. Releases are identified by date and release codes. For assistance in identifying the release codes of your equipment, see your service department.

Also in this appendix you'll find summary notes about some of the system enhancements made in previous releases.

System Releases

Release B (December '99)

Release Codes

- HP Viridia Transmitter: A.03
- HP Viridia Wave Viewer: A.02
- HP Viridia Mainframe: D.03

Enhancements

- Dual RF Frequency Bands
- HP Viridia Battery Extender
- HP Viridia Transmitter Battery Life Improvement
- HP Viridia Transmitter Shower Resistance
- Manual SpO_2 Measurement from Transmitter without HP Wave Viewer

August ‘98

Release Codes

- HP Viridia Transmitter: A.02
- HP Viridia Wave Viewer: A.02
- HP Viridia Mainframe: D.03

Enhancements

- HP Viridia Wave Viewer as Patient Assessment Tool
- HP Viridia Transmitter Cross-infection Prevention Available
- Initial SpO_2 Sample Rate changed from 1-minute to manual
- Battery Life Improvement

November ‘97 (US only)

Release Codes

- HP Viridia Transmitter: A.01
- HP Viridia Wave Viewer: A.01
- HP Viridia Mainframe: D.02

Enhancements

- SpO_2 Parameter Default OFF at Admit
- SpO_2 Alarms Non-latching
- Battery Life Improvement
- Zinc-Air Batteries with ECG-only HP Viridia Transmitters

May ‘97 (US Only)

Release Codes

- HP Viridia Transmitter: A.00
- HP Viridia Wave Viewer: A.00
- HP Viridia Mainframe: D.01

Enhancements

- First release of system
- HP Viridia Transmitter with ECG-only and ECG/SpO_2 measurements measurements)
- HP Wave Viewer as Productivity Tool

Enhancement Details

HP Viridia Transmitter Battery Life

August 1998

Recommended Battery Types	Nominal Life Expectancy - ECG Only	Nominal Life Expectancy - ECG & Continuous SpO_2[4]	Nominal Life Expectancy - ECG & Intermittent SpO_2	Nominal Life Expectancy - ECG with SpO_2 Transducer Detached
Lithium[1] (supplied)	3 days 20 hours	14 hours	1 min. intervals: 1 day 19 hours 5 min. intervals: 2 days 22 hours	2 days 12 hours
Alkaline[2]	1 day 18 hours	8 hours	1 min. intervals: 20 hours 5 min. intervals: 1 day 10 hours	1 day 4 hours
Zinc-Air[3]	4 days 18 hours	Not Applicable	Not Applicable	Not Applicable

1 Tested with ULTRALIFE U9VL batteries.
2 Tested with DURACELL MN1604 batteries.
3 Tested with DURACELL DA146 batteries.
4 Life expectancy is based on transmitter current draw of 52.4 mA.

November 1997

Recommended Battery Types	Nominal Life Expectancy - ECG Only	Nominal Life Expectancy - ECG & Continuous SpO_2	Nominal Life Expectancy - ECG & Intermittent SpO_2
Lithium (supplied)	3 days	16 hours	1.5 - 2.5 days
Alkaline*	1 day 8 hours	8 hours	1 day
Zinc-Air*	3 days 18 hours	Not Applicable	Not Applicable

* Tested with DURACELL battery

May '97

Battery Type	ECG Only	ECG & SpO_2 Continuous	ECG & SpO_2 Intermittent
Lithium	3 days 6 hours	16 hours	1.5 - 2.5 days
Alkaline1	1 day 8 hours	8 hours	1 day

1 Tested with DURACELL battery

Latching/ Non-latching SpO_2 Alarms

This enhancement reduces the number of times you need to reset alarms at the central station when a condition such as movement-induced artifact has already been corrected at the patient's side. With Release D.02 HP Viridia receiver mainframes, SpO_2 alarms are non-latching; that is, an active SpO_2 alarm or inop automatically resets when the patient's condition returns within limits or the inop is corrected, without silencing the alarm.This change affects SpO_2 alarms in all modes - continuous, intermittent, and manual.

Note—Other telemetry alarms behave differently. For example, ECG telemetry alarms are considered as arrhythmia alarms at the HP Viridia Information Center. Telemetry ST alarms are non-latching.

In the D.01 and earlier releases of the HP Viridia Receiver Mainframe, SpO_2 alarms are latching - meaning that they must be silenced by a clinician. With latching alarms, silencing an alarm manually is the only way to reset the alarm indicators (sound, message, and highlighting in patient sector).

See also "Alarm Management and Setup: Silencing Alarms" in *HP Viridia Information Center User Guide*.

D
Sales and Support Offices

For more information, please call your local HP sales office listed in your telephone directory or an HP regional office listed below for the location of your nearest sales office.

United States:
Hewlett-Packard Company
Medical Products Group Headquarters
3000 Minuteman Road
Andover, MA 01810

Medical Customer Information
1-800-934-7372

Canada:
Hewlett-Packard (Canada) Ltd.
5150 Spectrum Way
Mississauga, Ontario L4W 5G1
(905) 206-4725

Latin America:
Hewlett-Packard Latin America
5200 Blue Lagoon Drive
Suite 900 M/S 1208
Miami, FL 33126
(305) 267-4220

Asia Pacific Headquarters:
Hewlett-Packard Asia Pacific Ltd.
18-19/F & 24-25/F Cityplaza One
1111 King's Road
Taikoo Shing
Hong Kong
(+852) 2599 7777

Australia:
Hewlett-Packard Australia Ltd.
(A.C.N. 004 394 763)
(+61 3) 9272-2698

China:
China Hewlett-Packard Co., Ltd.
(+86 10) 6 505 3888

India:
Hewlett-Packard India Ltd.
(+91 11) 682-6000

Japan:
Hewlett-Packard Japan Ltd.
(+81 3) 3335-8154

Korea:
Hewlett-Packard Korea
(+82 2) 769-0114

Singapore/Southeast Asia:
Hewlett-Packard Singapore (Sales)
Pte. Ltd.
(+65) 275-3888

South Africa:
Hewlett-Packard South Africa
(+27) 11 806 10 00

Taiwan:
Hewlett-Packard Taiwan Ltd.
(+886 2) 712-0404

Marketing Center Europe:
Hewlett-Packard GmbH
Herrenberger Str. 110-140
71034 Boeblingen
Germany
Fax: (+49) 7031 14 4096

Medical Distribution:
Europe, Middle East, Africa
Geneva, Switzerland
(+41) 22 780 4111

Austria/Central Europe:
Austria Office
(+43) 1 25000 6448

Belgium/Luxembourg:
Belgium Office
(+32) 2 778 31 11

Czech Republic:
(+42) 2 613 07 427

Finland:
(+358) 9 887 21

France:
(+33) 1 69 29 43 43

Germany:
(+49) 7031 14 5640
0180 5 32 62 77

Italy:
(+39) 2 92 121

Netherlands:
(+31) 20 547 63 38

Poland:
(+48) 22 608 7700

Russia:
(+7) 095 797-3870

Spain:
(+34) 93 401 9100

Sweden:
(+46) 8 444 20 00

Switzerland:
(+41) 1 735 71 11 (German Swiss)
(+41) 22 780 41 11 (Suisse Romande)

United Kingdom:
(+44) 1344 369 269

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