

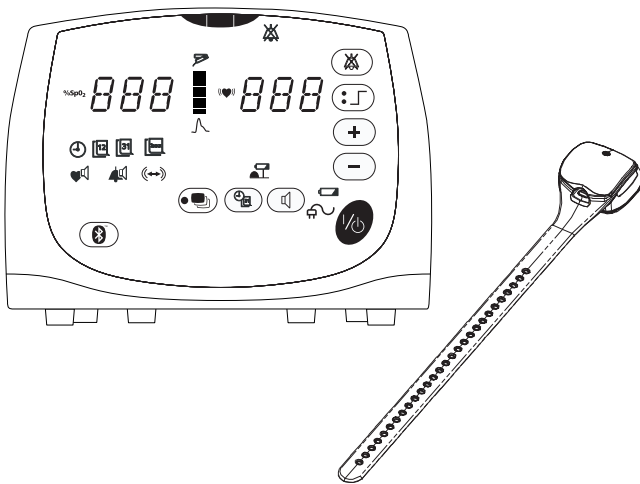
# Using the Freedom 2 Digital Pulse Oximetry System

This chapter describes how to use the Freedom 2 Digital Pulse Oximetry System. The system includes the following components:

- Freedom 2 display unit with rechargeable battery pack
- Wrist-Worn Patient Module with AA batteries
- Finger-clip sensor
- Operator's manual
- 3 wrist bands

## Indications for Use

The XYZ Freedom 2 Digital Pulse Oximetry System is indicated for measuring and displaying functional oxygen saturation of arterial hemoglobin (SpO<sub>2</sub>) and pulse rate of adult, pediatric, and infant patients. It is indicated for spot checking and/or continuous monitoring.

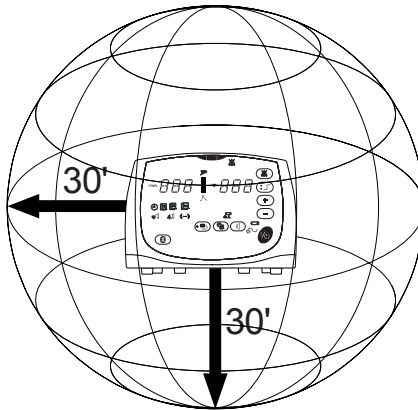


The Freedom 2 Digital Pulse Oximetry System: Display Unit and Patient Module.

## General Information about GreenEye Technology

*GreenEye* is a technology that enables automatic wireless connections between a variety of electronic communications and computing devices, making it possible to connect any compatible devices without cables or wires. The technology is based on a radio link that offers fast and reliable transmissions of voice, video, and data. *GreenEye* uses a license-free, globally available frequency range in the ISM band—intended to ensure communication compatibility worldwide.

XYZ's use of *GreenEye* Technology allows SpO<sub>2</sub>, pulse rate, and plethysmographic data to be transmitted through a *GreenEye* radio to a compatible *GreenEye*-enabled device. XYZ's system removes the connection from the sensor cable to the display unit, giving patients increased ability to move freely—without being hindered by cables. XYZ's patient module uses a class II *GreenEye* radio with a battery life of about 120 hours and a range of about 30 feet (spherical radius). The display unit has a minimum operating battery life of 18 hours.

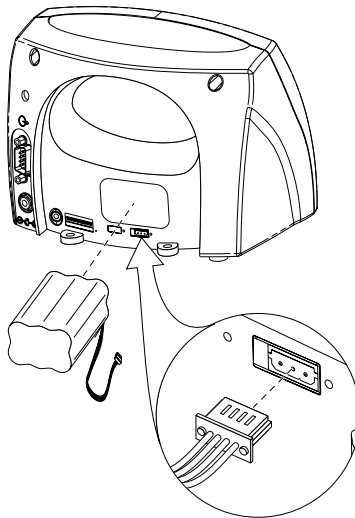
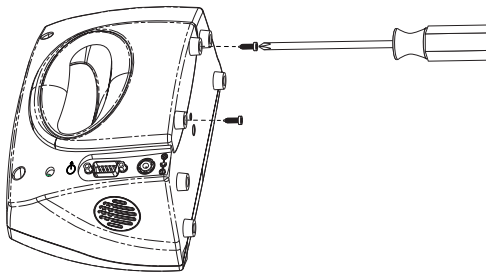


## Point-to-Point Communications

The Freedom 2 System features point-to-point communications, allowing one master device (the display unit) to be paired to one slave device (the patient module). Once connected, neither device is detectable by any other *GreenEye*-enabled device, which reduces the risk of interference and preserves data integrity.

## Installing the Battery Pack in the Display Unit

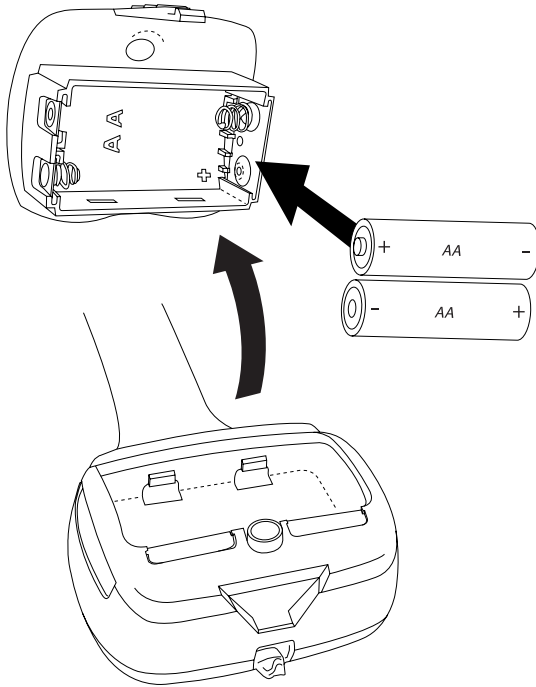
**WARNING:** The battery pack must be installed at all times while the device is operating—even when operating on AC power. If it is necessary to operate the device without batteries, audible alarms and memory functions may not be available. **DO NOT** use the device without batteries when patient safety relies upon audible alarms.

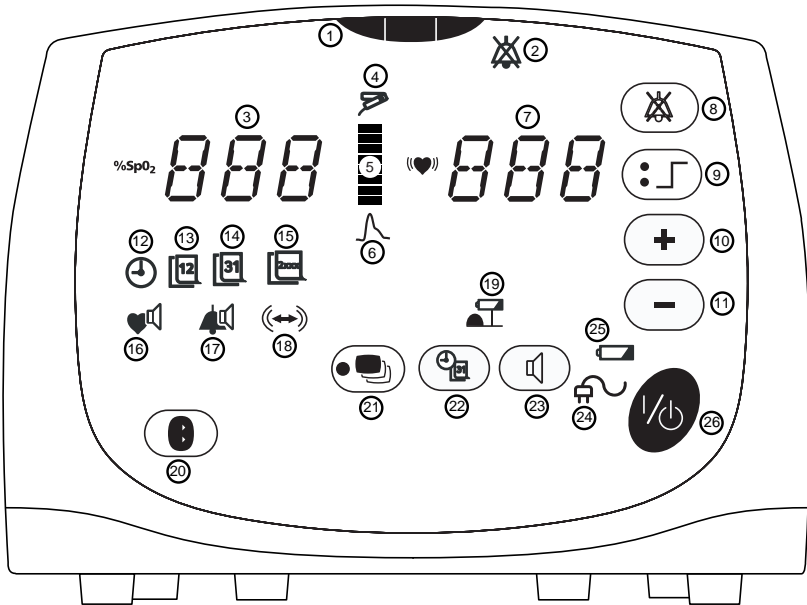


**NOTE:** Contact your distributor to purchase or replace battery packs.

**NOTE:** Reposition the back cover carefully, and tighten the screws firmly—being careful not to over-tighten.

## Installing Batteries in the Patient Module





- |    |                                   |    |                           |
|----|-----------------------------------|----|---------------------------|
| 1  | Main Alarm LED                    | 14 | Day LED                   |
| 2  | Alarm Silence LED                 | 15 | Year LED                  |
| 3  | Numeric LEDs for %SpO2 data       | 16 | Pulse Volume LED          |
| 4  | Pulse Oximeter Sensor LED         | 17 | Alarm Volume LED          |
| 5  | Pulse Strength Bargraph LED       | 18 | Connection Status LED     |
| 6  | Pulse Quality LED                 | 19 | Remote Battery Status LED |
| 7  | Numeric LEDs for Pulse Rate data  | 20 | GreenEye Control Button   |
| 8  | Alarm Silence Button              | 21 | Memory Button             |
| 9  | Alarm Limits Button and Indicator | 22 | Time/Date Button          |
| 10 | Plus Button                       | 23 | Volume Button             |
| 11 | Minus Button                      | 24 | AC Power Adapter LED      |
| 12 | Time LED                          | 25 | Battery LED               |
| 13 | Month LED                         | 26 | ON/STANDBY Button         |

## Displays, Indicators, and Controls


This section describes the Freedom 2 System's displays, indicators, and controls.

### *Parameter Displays*

#### **%SpO<sub>2</sub> Display**

Numeric light-emitting diodes (LEDs) on the upper left-hand corner of the Freedom 2 display unit display blood oxygen saturation in percent.

#### **Pulse Rate Display**

The pulse rate display is located on the upper right-hand corner of the Freedom 2 display unit and is identified by the  symbol. This display shows the pulse rate in beats per minute.

#### **Numeric LEDs**



Numeric LEDs display %SpO<sub>2</sub> and pulse rate values. When setting the device, these LEDs also display values for alarm limits, volume, year, month, day, hour, and minute displays. They also display device identification numbers and error codes.

Under normal conditions, these LEDs display in green. For high priority (patient) alarms, the corresponding values are displayed in red, blinking fast. The values are displayed in amber for medium priority alarms and when reviewing or changing limits, volumes, date, or time.

### *Front Panel Buttons*



#### **ON/STANDBY Button**

Pressing this button once turns on the Freedom 2 display unit. Holding this button for at least 1 second shuts down the display unit. Briefly pressing this button while the unit is on displays the battery charge in 10% increments for 4 seconds in green. This button also controls the device's event marker and print-on-demand features. See this manual's "Communication" section for more information.



#### **Time/Date Button**

This button displays the time and date. Year, month, day, hour, and minute can be set using the Plus (+) and Minus (-) buttons.



#### **Volume Button**

This button allows users to set and review the pulse or alarm volume, depending upon which corresponding LED is illuminated. This button cycles users between alarm volume and pulse volume.



### Alarm Silence Button

This button toggles the alarm between silenced and audible. Pressing the Alarm Silence button will silence the alarm for two minutes.



### Alarm Limits Button and Indicator

This button displays the upper and lower limits for alarm indications for SpO<sub>2</sub> and heart rate measurements. These limits can be adjusted using the Plus (+) and Minus (-) buttons. The Alarm Limits button cycles users through the display unit's alarm settings, allowing users to both set and review alarm limits.

The upper LED on the Alarm Limits button indicates the upper alarm limit, and the lower LED indicates the lower alarm limit.



### Plus Button and Minus Button

These buttons adjust values for many functions. The Plus and Minus buttons are used to adjust time, date, volume, and upper and lower alarm limits. Pressing either of these buttons alone, when the display unit is not in any setting mode, adjusts the intensity of the LED displays. These buttons are also used to select from multiple wrist-worn patient modules during pairing.



### Memory Button

This button is used to enter Memory Playback mode.



### GreenEye Control Button

Press and hold this button while turning on the display unit to begin the device pairing process. A maximum of five “pairable” patient modules may be displayed separately, with the device identification number appearing in the pulse rate and SpO<sub>2</sub> display area. While five devices may be shown, only one may be selected (paired).

Select the patient module you want to pair with by using the Plus or Minus buttons to scroll through the available modules. When the identification number of the patient module you wish to pair with is shown—and is *not flashing*—press the GreenEye Control button again. When the pairing process is complete, normal operation resumes automatically. After the device is paired to a patient module, it will remain paired until the above process is repeated.

During normal operation, pressing the GreenEye Control button displays the selected patient module's device identification number for three seconds in the pulse rate and SpO<sub>2</sub> display area. See “Device Pairing” for more information.

## Indicators and Icons



### Main Alarm LED

This LED indicates all alarm conditions. For high priority (patient) alarms, the indicator is displayed in red, blinking fast. For medium priority alarms, the indicator is displayed in amber, blinking slowly.



### Pulse Quality LED

This LED blinks to indicate a poor pulse signal. If there is a sustained period of poor quality signals, this LED will illuminate steadily.



### Pulse Oximeter Sensor LED

This LED indicates when a sensor has become disconnected, has failed, or has not been applied correctly.



### Pulse Strength Bargraph LED

This 10-segment tricolor bargraph indicates pulse strength as determined by the oximeter. The height of the Pulse Strength Bargraph LED is proportional to the pulse signal, and the color is determined by pulse strength:

**Green** = a good pulse strength

**Amber** = a marginal pulse strength

**Red** = a low pulse strength, high priority alarm

When displaying battery charge, this LED indicates charge in 10% increments in green, displaying the depleted portion in amber.



### Alarm Silence LED

This amber LED indicates that the audible alarm is silenced for two minutes when it blinks. When lit steadily, the Alarm Silence LED indicates that the audible alarm volume is set to zero.



### Time, Month, Day, and Year LEDs

These amber LEDs indicate that the display unit's *Time*, *Month*, *Day*, or *Year* displays can be reviewed or adjusted using the Plus (+) and Minus (-) buttons.



### Pulse Volume LED

This amber LED indicates that the Pulse Volume can be reviewed or adjusted using the Plus (+) and Minus (-) buttons.



### Alarm Volume LED

This amber LED indicates that the Alarm Volume can be reviewed or adjusted using the Plus (+) and Minus (-) buttons.



### Connection Status LED

This LED is lit green when a patient module is connected with the display unit. It is lit amber when no devices are connected, and it blinks during device pairing. The Connection Status LED works in sync with the patient module's connection status indicator.



### Remote Battery Status LED

This amber LED alerts users to marginal or critical battery conditions for the wrist-worn patient module. When the patient module's batteries are marginal, this LED blinks. When battery capacity is critical, it remains lit steadily.



### AC Power Adapter LED

This green LED is displayed when an external power supply is providing power to the display unit.



### Battery LED

This amber LED indicates a marginal battery charge when blinking. In addition, this LED—when lit steadily—indicates that the battery charge is being displayed. *This LED does not indicate that the display unit is running on battery power.* The battery charge indication will not be accurate before one full charge/discharge/recharge cycle with a new battery pack.

**WARNING:** The battery pack must be installed at all times while the device is operating—even when operating on AC power. If it is necessary to operate the device without batteries, audible alarms and memory functions may not be available. **DO NOT** use the device without batteries when patient safety relies upon audible alarms.

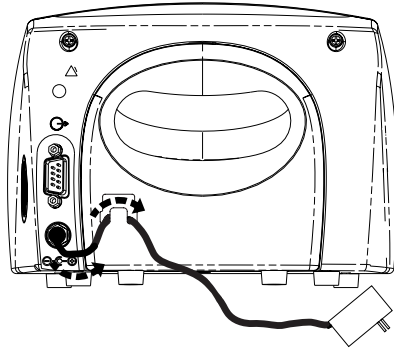
## Setting Up the Freedom 2 Digital Pulse Oximetry System

Use the following procedure to set up the Freedom 2 Digital Pulse Oximetry System. (Refer to the Patient Module instruction insert for additional information about using that product.)

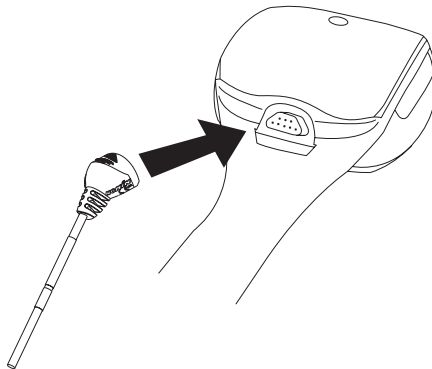
1. Ensure that batteries are installed in the display unit and wrist-worn patient module.

**WARNING:** The battery pack must be installed at all times while the device is operating—even when operating on AC power. If it is necessary to operate the device without batteries, audible alarms and memory functions may not be available. **DO NOT** use the device without batteries when patient safety relies upon audible alarms.

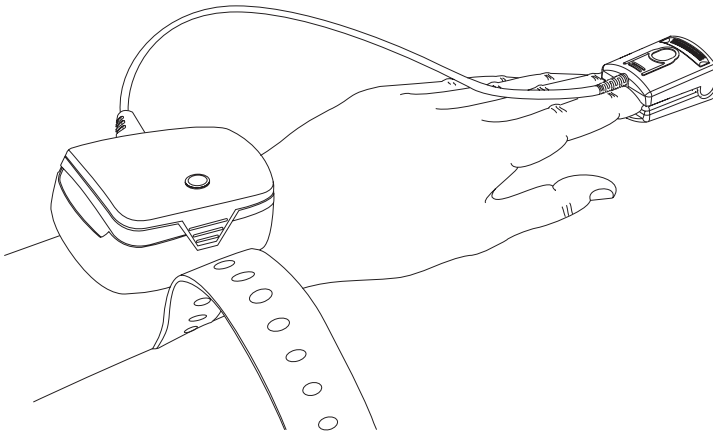
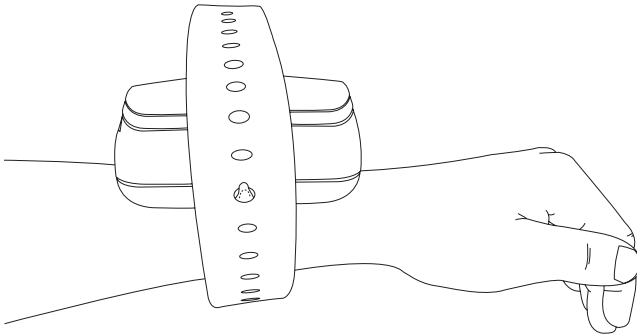
2. Plug in and connect the AC adapter for the display unit.



3. Attach a sensor to the patient module. (The patient module is automatically activated when a sensor is connected.)



4. Press the ON/STANDBY button to turn on the display unit.
5. Verify operation of the display unit, and pair the display unit with the desired wrist-worn patient module. (See “Verifying System Operation” and “Device Pairing” for more information.)
6. Secure the wristband to the patient’s wrist.



**NOTE:** If desired, any excess strap material may be trimmed and discarded.

## Verifying System Operation

When the display unit is first turned on, it performs a brief startup (initialization) sequence. Verify that all LEDs illuminate and the unit beeps three times during the first phase of the startup sequence. If any LED is not lit (except the AC Power Adapter LED), do not use the device. Contact your distributor or XYZ Customer Support for assistance.

After this initialization sequence, the amber Connection Status LED and amber dashes are displayed, turning green when communication is established and a GreenEye connection is made (devices must be paired before a GreenEye connection can be established; see “Device Pairing” on the next page). The Main Alarm LED and Pulse Oximeter LED blink amber until the oximeter produces valid readings.

**CAUTION: Verify all alarm settings during system startup to ensure that they are set as intended.**

Use the procedure below to monitor SpO<sub>2</sub> and pulse rate readings in order to verify that the device is functioning properly.

1. Ensure that the display unit is turned on, and that the unit has been paired with the desired wrist-worn patient module. (See “Device Pairing” for more information.)
2. Connect a sensor to the patient module, pressing firmly to make sure it is securely connected.
3. Apply the patient module around the wrist, and attach the sensor to the patient’s finger. Connecting the sensor automatically activates the patient module; there are no buttons to press.
4. Verify that the Connection Status LEDs on both the display unit and the patient module are green.
5. Verify that a good SpO<sub>2</sub> reading is displayed, that a pulse rate value appears, and that the Pulse Strength Bargraph LED is active.

## Device Pairing

Use the following procedure to pair the display unit with a desired wrist-worn patient module.

**NOTE:** To ensure proper pairing, disconnect and then reconnect the sensor from the patient module before beginning.

**NOTE:** The Freedom 2 display unit must be OFF before pairing devices.

1. Press and hold the GreenEye Control button while turning on the display unit to begin the device pairing process. Notice that amber dashes flash in the SpO<sub>2</sub> and Pulse Rate display areas as the system searches for patient modules available for pairing. (If a patient module is available, its identification number will appear on the display unit screen within 10 seconds.)
2. When available patient module(s) are detected, a maximum of five “pairable” patient modules will be displayed separately, with the device identification number appearing in the SpO<sub>2</sub> and Pulse Rate display areas. (A unique device identification number is included on the sides of each patient module.)
3. If multiple patient modules are available for pairing, use the Plus or Minus buttons to scroll through the available modules. (While five devices may be available, only one may be selected for pairing.)
4. When the identification number of the patient module you wish to pair with is shown—and is not flashing—press the GreenEye Control button again to complete the pairing process. Normal operation resumes automatically when the pairing process is complete.
5. To confirm that the pairing process was successful, ensure that the Connection Status LED is lit green.

**NOTE:** After the display unit is paired to a patient module, it will remain paired until the above process is repeated.

## Default Settings

The Freedom 2 display unit features Factory Default and User-Defined Default settings.

**WARNING:** The battery pack must be installed at all times while the device is operating—even when operating on AC power. If it is necessary to operate the device without batteries, audible alarms and memory functions may not be available. **DO NOT** use the device without batteries when patient safety relies upon audible alarms.

**CAUTION:** Verify all alarm settings during system startup to ensure that they are set as intended.

### Factory Default Setting

In Factory Default setting, all adjustable alarm and volume parameters are set at their default values. Factory Default setting is the system's default operating setting. It is indicated by DIP switch 8 in the DOWN position. For more information about default alarm values, refer to this manual's "Alarms and Limits" section.

**NOTE:** Any alarm and volume adjustments made while the device is operating in Factory Default Setting will be lost when the device is shut down. The last adjusted values can be recalled by pressing and holding both the Alarm Limits and ON/STANDBY buttons when turning on the display unit.

### User-Defined Default Setting

In User-Defined Default Setting (DIP switch 8 in the UP position), alarm limit settings must be adjusted. When this setting is first activated, valid limit settings must be entered for SpO<sub>2</sub> and pulse rate alarm limits; the system will not return to normal operating mode until all limits have been set. Once set, the adjusted values are used as defaults until the system is turned on with DIP switch 8 in the DOWN position, at which time the device restarts in Factory Default setting.

**NOTE:** In order to initiate User-Defined Defaults, the unit must be turned on with DIP switch 8 in the UP position.









**NOTE:** Once User-Defined Default Settings are entered, any alarm and volume adjustments made while operating the device will be lost when the device is shut down.

## Accessing User Functions

This system includes Basic, Set, and Advanced Functions.










### Basic Functions

Basic functions are generally easy to use and involve only a single button. The Freedom 2 display unit has several basic functions.

<i>Function</i>	<i>Button</i>	<i>Instruction</i>
Turn the display unit on and off.		Press the ON/STANDBY button to turn on the display unit. Press and hold the button for at least one second to turn off the display unit.
Check the battery charge.		Press the ON/STANDBY button while the unit is on. Battery charge is displayed (in 10% increments, for 4 seconds in green) on the Pulse Strength Bargraph.
Mute the audible alarms (2 minutes—toggle).		Press the Alarm Silence button.
Adjust the display intensity (brightness).	 or 	Press the Plus or Minus button.
View the patient module identification number currently in use.		Press the GreenEye Control button during normal operation.
Invoke the print-on-demand feature.		With DIP switch 4 in the DOWN position, press the ON/STANDBY button.
Invoke the event marker.		Press the ON/STANDBY button during real-time printing.



## Set Functions

Set functions are those that require multiple buttons to alter a measurement or device parameter for normal operation.

<i>Function</i>	<i>Button</i>	<i>Instruction</i>
Set alarm limits.	 then  or 	Press the Alarm Limits button to step through the Limits menu. Use the Plus or Minus buttons to adjust alarm limits.
Set pulse and alarm volumes.	 then  or 	Press the Volume button to select pulse or alarm volume. Use the Plus or Minus buttons to adjust the selected volume.
Set time and date.	 then  or 	Press the Time/Date button to step through the Time/Date menu. Use the Plus or Minus buttons to adjust the time and date values.

## Advanced Functions

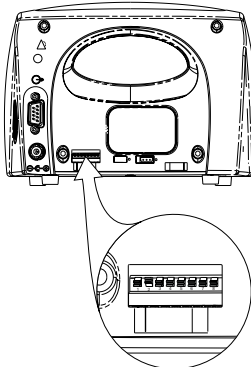
Advanced functions are restricted to trained users; they require multiple button presses in order to prevent accidental activation.

<i>Function</i>	<i>Button</i>	<i>Instruction</i>
Retain Previous User-Defined Alarm Limit Settings		Press and hold both the Alarm Limits and ON/STANDBY buttons when turning on the display unit.
Enter Patient Playback and Memory Clear Menu		Press and hold the Memory button while turning on the display unit. This menu functions with XYZ's Beur software.

## Display Unit DIP switches

The Freedom 2 display unit contains eight DIP switches that are located behind the back cover of the unit. The UP position is toward the top of the unit, and the DOWN position is toward the bottom of the unit. *The factory setting for all DIP switches is the DOWN position.*

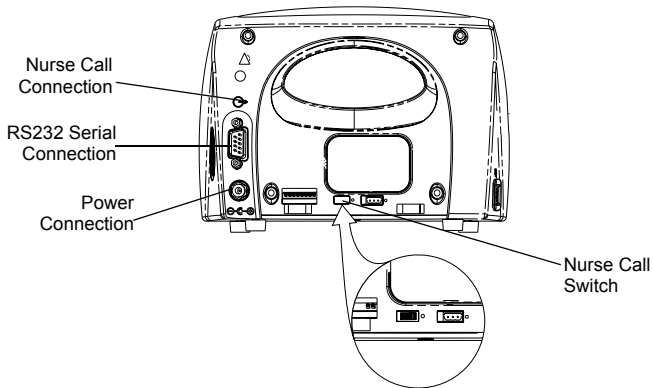
Switch	Function
Switch 1	<i>Reserved for Future Use</i>
Switch 2	<i>Alarm Disable Lock</i> <b>Up</b> —Alarm volume may be disabled <b>Down</b> —Alarm volume cannot be disabled
Switch 3	<i>Date Format</i> <b>Up</b> —International Date format (Day-Month-Year) <b>Down</b> —U.S.A. Date format (Month-Day-Year)
Switch 4	<i>Data Output</i> <b>Up</b> —Real-time (once per second) data output <b>Down</b> —Print on demand
Switch 5	<i>Normal / Fast Responding SpO<sub>2</sub> Output</i> <b>Up</b> —Fast responding SpO <sub>2</sub> serial output <b>Down</b> —Normal SpO <sub>2</sub> serial output
Switch 6	<i>Normal / Slow SpO<sub>2</sub> and Pulse Rate Averaging</i> <b>Up</b> —Slow Averaging (8 beat exponential average) <b>Down</b> —Normal Averaging (4 beat exponential average)
Switch 7	<i>Nurse Call Output</i> <b>Up</b> —Continuous <b>Down</b> —Momentary
Switch 8	<i>Factory / User-Defined Defaults</i> <b>Up</b> —User-Defined Defaults for Alarm Limits and Volume Settings <b>Down</b> —Factory Defaults for Alarm Limits and Volume Settings



## Nurse Call Feature

The Freedom 2 features a Nurse Call circuit that can be connected to a hospital nurse call system, allowing alarm conditions to be recognized at a central monitoring location and on the Freedom 2.

DIP switch 7 allows users to select the duration output of a signal. In the DOWN position, a one-second signal is output when an audible alarm starts. In the UP position, the nurse call signal is active during the entire duration of an audible alarm.



**WARNING:** It is the user's responsibility to implement the interface between the Nurse Call system and the Freedom 2 display unit, and to adequately test the interface between the Freedom 2 and the Nurse Call system to ensure that the desired function is operational.

## Care and Maintenance

The advanced digital circuitry within the pulse oximeter of this system requires no calibration or periodic maintenance other than battery replacement.

Field repair of system circuitry is not possible. Do not attempt to open the case or repair the electronics. Opening the case will damage the unit and void the warranty. If the system is not functioning properly, see “Troubleshooting.”

### Cleaning the Freedom 2 Digital Pulse Oximetry System

Clean all system components with a soft cloth dampened with isopropyl alcohol. Do not pour or spray any liquids onto components, and do not allow any liquids to enter any openings in the device. Allow the unit to dry thoroughly before reuse.

**IMPORTANT! Do not immerse the device in liquid, and do not use caustic or abrasive cleaning agents on the device.**

Clean the device separately from its associated sensors. For instructions regarding cleaning pulse oximeter sensors, refer to the appropriate pulse oximeter sensor package inserts.

# Troubleshooting

Problem	Possible Cause	Possible Solution
<b>The display unit will not activate.</b>	The unit has no power.	Plug in the AC adapter.
<b>The display unit will not operate on batteries.</b>	The battery pack is not connected.	Check the battery pack connection.
	The battery pack is not charged.	Plug in the AC Adapter to charge the battery pack.
	The battery pack is inoperable.	Contact your distributor or XYZ Customer Support for repair or replacement.
<p><b>You are unable to obtain a green pulse display on the bargraph.</b></p> <p><i>NOTE: In some instances, patient perfusion may be inadequate for pulse detection.</i></p>	The patient pulse strength is low or perfused poorly.	Reposition the digit or insert a different digit, and keep the sensor motionless for at least 10 seconds.
		Warm the digit by rubbing or covering with a blanket.
		Position the sensor at a different site.
	Circulation is reduced because of excess pressure on the sensor (e.g., between the sensor and a hard surface).	Allow the hand to rest comfortably without squeezing or pressing the sensor on a hard surface.
	The digit is cold.	Warm the digit by rubbing or covering with a blanket.
		Position the sensor at a different site.
	The patient module is not paired to the display.	Make sure the patient module is paired with the display.
Verify that the Connection Status LED is green on both the display unit and the patient module.		

<b>Problem</b>	<b>Possible Cause</b>	<b>Possible Solution</b>
<b>Unable to obtain a green pulse display on the bargraph, cont'd.</b>	The sensor is applied incorrectly.	Apply the sensor correctly.
	There is possible interference from one of the following sources: <ul style="list-style-type: none"> <li>• arterial catheter</li> <li>• blood pressure cuff</li> <li>• electrosurgical procedure</li> <li>• infusion line</li> </ul>	Reduce or eliminate any interference. Make sure that the sensor is not placed on the same arm being used for other patient therapies or diagnostics (e.g, blood pressure cuff).
	The red LED is not illuminated in the finger insertion area.	Ensure that the sensor is securely attached to the patient module.
		Check the batteries.
		Check the sensor for any visible signs of deterioration.
Contact your distributor or XYZ Customer Support.		
<b>Frequent or steady pulse quality indication.</b>	There is excessive ambient light.	Shield the sensor from the light source.
	The sensor is applied to a polished or artificial fingernail.	Apply the sensor to a finger without artificial or polished nails.
		Position the sensor at a different site.
	The red LED is not illuminated in the finger insertion area.	Ensure that the sensor is securely attached.
		Check the sensor for any visible signs of deterioration.
		Contact your distributor or XYZ Customer Support.
	Patient motion is excessive.	Reduce patient motion.

<b>Problem</b>	<b>Possible Cause</b>	<b>Possible Solution</b>
<b>A dash (-) appears in the %SpO<sub>2</sub> display.</b>	A poor signal from the digit is being detected.	Reposition the digit or insert a different digit and keep the sensor motionless for at least 10 seconds.
		Position the sensor at a different site.
	The digit was removed from the sensor.	Reinsert the digit and keep the sensor motionless for at least 10 seconds.
	The system is not functioning.	Turn off the unit, check all connections, and retry.
		Verify that the patient module is paired with the display.
		Verify that the Connection Status LED is green on both the display unit and the patient module.
Contact your distributor or XYZ Customer Support.		
<b>An error code appears in the display area.</b>	The system encountered an error.	<ol style="list-style-type: none"> <li>1. Turn the unit off and then back on again to remove the error code.</li> <li>2. If the error persists, disconnect all power (AC and battery), and then reconnect the power and turn the unit back on.</li> <li>3. If the error still persists, note the error code and contact your distributor or XYZ Customer Support.</li> </ol>

Problem	Possible Cause	Possible Solution
<b>The unit is in Alarm mode, but no audible alarms can be heard.</b>	The 2-minute Alarm Silence button is activated.	Press the Alarm Silence button to re-engage alarm volume, or wait for two minutes—and alarm tones will automatically re-engage.
	DIP switch 2 is in the UP position, and the unit's volume is set to zero.	Adjust the alarm volume, or return DIP switch 2 to the DOWN position if you desire audible alarms.
	The system is not functioning correctly.	Contact your distributor or XYZ Customer Support.
<b>The devices will not pair.</b>	The sensor has not been disconnected and reconnected.	Disconnect and reconnect the sensor to the patient module.
	The patient module is out of range.	Ensure that the patient module is in range while being paired (approximately 30 feet—spherical radius).
	The GreenEye Control button was not pressed and held while turning on the display unit.	Starting with the display unit turned off, press and hold the GreenEye Control button while turning on the display unit. (See “Device Pairing” for more information.)

If these solutions do not correct the problem, please contact your distributor, or contact XYZ Customer Support at **(800) 333-5555** (USA and Canada) or **+1 (555) 333-4445**.