

# VivoMetrics® LifeShirt® System Technology

The LifeShirt System brings gold standard monitoring technology into the real-world environment. With 10+ patents covering wearable sensor design and proprietary software algorithms, the LifeShirt System by VivoMetrics is a miniaturized, ambulatory version of an in-patient system currently used in more than 1,000 hospitals worldwide and cited in hundreds of peer-reviewed scientific papers.

## Underlying Technology

The LifeShirt System is based on a miniaturized, ambulatory version of inductive plethysmography, the only technology cited in a recent FDA Apnea Guideline Report capable of differentiating between obstructive and central sleep apnea. It monitors breathing patterns by passing a continuous, low-voltage electrical current through externally placed sinusoidal arrays of wires that surround the rib cage and abdomen. By virtue of its design, inductive plethysmography reduces the signal interference and distortion that is often associated with other technologies, enabling clinicians to obtain a more accurate measurement of patients' respiratory functions.

## LifeShirt System Components

The LifeShirt System consists of the LifeShirt garment, LifeShirt Recorder and VivoLogic® analysis and reporting software. The system continuously measures more than 30 parameters of cardiopulmonary function during daily activities. After processing the data with patented algorithms, the system integrates subjective patient input from an on-board digital diary. Results can be viewed as full-disclosure, high-resolution waveforms or as summary reports.

## LifeShirt Garment

The LifeShirt is a lightweight (8 oz.), machine washable, comfortable, easy-to-use shirt with embedded sensors. To measure respiratory function, sensors are woven into the shirt around the patient's chest and abdomen. A single channel ECG measures heart rate, and a three-axis accelerometer records patient posture and activity level. Optional peripheral devices measure blood pressure, blood oxygen saturation, end tidal CO<sub>2</sub> and other physiologic parameters.

## LifeShirt Recorder and VivoLog® Digital Patient Diary

The LifeShirt System includes an integrated PDA that continuously encrypts and stores the patient's physiologic data on a compact flash memory card. Patients may also record time/date-stamped symptom, mood and activity information in the recorder's digital diary, allowing researchers and clinicians to correlate subjective patient input with objectively measured physiologic parameters.

## VivoLogic Software

VivoMetrics proprietary PC-based software decrypts and processes recorded data using patented algorithms. Vivologic includes viewing and reporting features that enables researchers and clinicians to examine full-disclosure, high-resolution waveforms, or look at trends over time. In addition, summary reports can be generated that present processed data in concise, easy-to-interpret graphical and numeric formats.

# Technical Specification

<b>Battery Charger Power Req.</b>	120 VAC, 60 Hz, 15 W
<b>Battery Capacity:</b>	1800 mA
<b>Hours:</b>	Provides up to 24 hours continuous use before recharging
<b>Voltage:</b>	7.4 Volts

## Environmental Limits

<b>Altitude:</b>	<b>Operating:</b>	15,000 ft @ 25° C
	<b>Storage:</b>	30,000 ft @ 25° C
<b>Humidity:</b>	<b>Operating:</b>	5% to 90% RH Power Off
	<b>Storage:</b>	5% to 90% RH
<b>Temperature:</b>	<b>Operating:</b>	-10° C to 50° C
	<b>Power Off</b>	<b>Storage:</b>

## Dimensions

<b>Recorder:</b>	5.4 x 3.25 x 1.95 in
<b>Garment:</b>	Standard unisex sizes: Ages 5 - 17 and (XS) - (XXXXL)
<b>Data Cable Length:</b>	33.5 in

## Weight

<b>Recorder:</b>	350 g with battery, 239 g without battery
<b>Shirt:</b>	-260 g, 8 oz
<b>Data Cable:</b>	93 g

## Data Card Type:

	Compact Flash
<b>Capacity:</b>	64 MB to 512 MB (minimum 24 hrs recording)
<b>Data Card Reader Interface:</b>	USB

## ECG

<b>Digitizing Rate:</b>	200 Hz
<b>Digital Resolution:</b>	12 bits
<b>Input Dynamic Range:</b>	+/- 5.8 mV
<b>Input Offset Dynamic Range:</b>	+/- 300 mV
<b>Input Lead-Off Sensing Current:</b>	0.055 uA
<b>Input Impedance</b>	60 M ohms
<b>Input Noise:</b>	17 uV rms
<b>Common-mode Rejection Ratio:</b>	83 dB @ 60 Hz
	70 dB @ 120 Hz
<b>Gain Stability, 8 hours:</b>	< 1% deviation
<b>Baseline Stability, 8 hours:</b>	< 1% deviation
<b>Frequency Response:</b>	0.67 to 40 Hz, -3 dB
<b>Timing Accuracy:</b>	0.012%
<b>Logic Board Spread:</b>	96 MHz

## Sampling Rate

<b>ECG:</b>	200 Hz
<b>Accelerometer:</b>	10 Hz
<b>Plethysmographs:</b>	50 Hz

## Measurement Ranges

<b>Heart Rate:</b>	30 to 250 BPM
<b>Respiration:</b>	0 to 150 BPM
<b>Position:</b>	+/- 2 g horizontal, +/- 2 g vertical

## Accuracy

<b>Plethysmograph:</b>	+/- 5% of rate or 2 BPM, whichever is greater
<b>Heart Rate:</b>	+/- 10% or +/- 5 BPM



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 FM 79314

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