WHAT IS DIGITAL PULSE OXIMETRY?

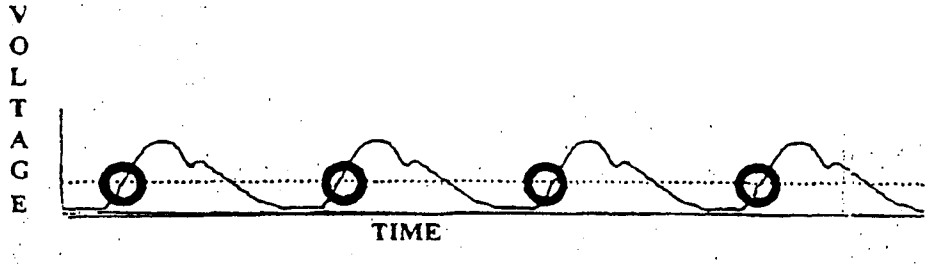
General Theory of Operation

Pulse oximetry combines the principles of optical plethysmography and spectrophotometry to determine arterial oxygen saturation values. Optical plethysmography uses light absorbency technology to reproduce waveforms produced by pulsating blood. Spectrophotometry uses various wavelengths of light to perform quantitative measurements about light absorption through given substances.

Using these two principles, a sensor is attached to a patient which uses two LED's - a red (660 nm) and an infrared (940 nm) light emitting diode - to transmit light through the vascular bed to a photodetector. The difference in the intensity of transmitted light between red and infrared light is caused by the differences in the absorption of light by oxygenated (saturated) and deoxygenated (desaturated) hemoglobin. The resulting voltage difference is used to calculate the amount of oxygen saturation by comparing the value against the tables contained in the pulse oximeter's memory.

Traditional Pulse Detection

Traditional pulse detection looks at the dynamic signal voltage outputs as pulsatile only if they surpass a predetermined threshold. The following illustration may assist one in understanding this concept.

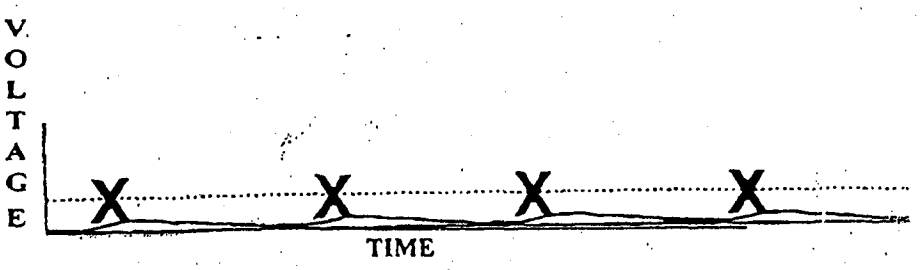


= Point of pulse detection at which signal voltage crosses a predetermined threshold

WHAT IS DIGITAL PULSE OXIMETRY?, cont.

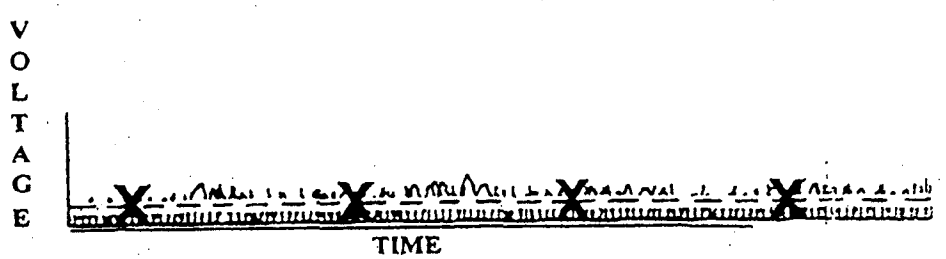
Limitations of Traditional Pulse Detection

Minimal Pulse Amplitude (Decreased Blood Perfusion)
Minimal pulse amplitude is encountered in patients with poor peripheral perfusion due to hypothermia, increased systemic vascular resistance, or disease processes such as diabetes. The following illustrates this condition.



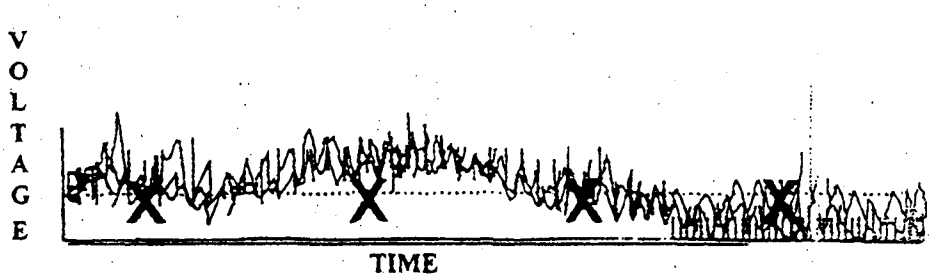
X = Point of missed pulse detection

One might conclude that the solution would be to lower the voltage detection threshold. Unfortunately, this assumption is incorrect. Both oximeter self-generated and environmental electrical noise are added obstacles to accurate readings. The weak pulse signal along with electrical noise results in inaccurate pulse signals. Note the following illustration.



X = Point of missed pulse detection

Motion Artifact
Adding to the issue of background electrical noise, motion artifact can also obstruct pulse signal detection. The following illustrates this combination.



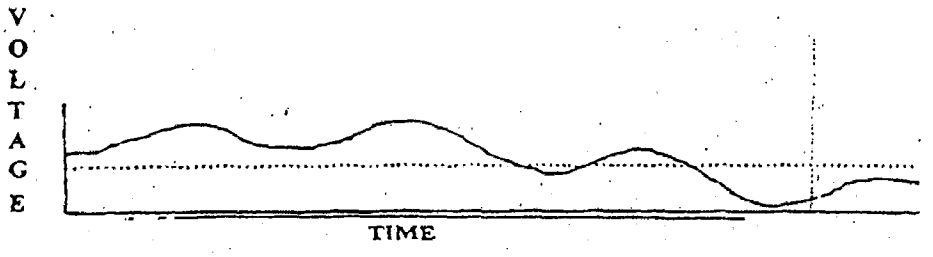
X = Point of missed pulse detection

WHAT IS DIGITAL PULSE OXIMETRY?, cont.

A New Perspective

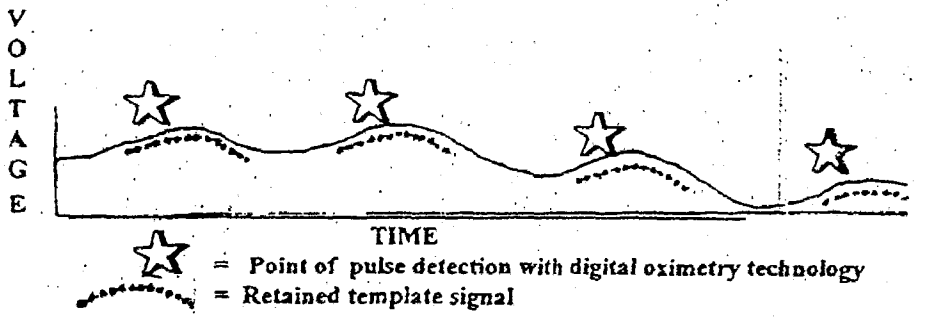
Refined Hardware

Enhanced hardware with exceptional insulating capability is the key to environmental and oximeter self-generated electrical noise reduction. Note the following improved signal to noise ratio illustration.



Serial Autocorrelation

Blood pulse detection using Serial Autocorrelation (SAC™) looks at pulse oximetry data in a new way. Instead of utilizing a voltage threshold as a means to determine a pulse, SAC™ analyzes a digitized signal (generated via a digital signal processing chip) in real time and compares it with previous pulse data. If similar characteristics to previous data are found, the device confirms a valid pulse. Basically, pulse data is remembered and used as a template to accept or reject future pulse signals. Both SpO_2 and pulse rate determinations logically follow. The following illustrates this concept.



Selling Points

- Greatly improved signal to noise ratio.
- Accurate data output when used with mobile and / or poorly perfused patients.
- Reduction of false alarms that are annoying to the patient and distracting to the operator.