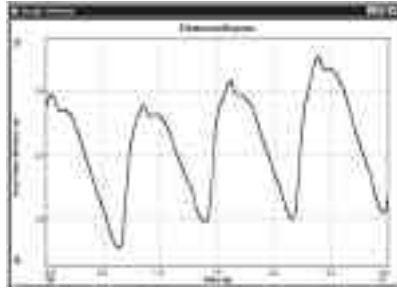

Heart Rate Monitor

(Order Code HRM-BTA or HRM-DIN)

This sensor monitors a person's heart beat. Unlike an electrocardiograph (EKG), which monitors the electrical signal of the heart, this sensor monitors the flow of blood through the ear lobe. As the heart forces blood through the blood vessels in the ear lobe, the amount of blood in the ear changes with time. This sensor shines a light¹ through the ear lobe and measures the light that is transmitted. The clip can also be used on a fingertip or on the web of skin between your thumb and index finger. By graphing this signal, the heart rate can be determined, and some details of the pumping action of the heart can be seen on the graph. A sample graph is shown below:



Heart Rate Monitor Graph Using Logger Pro

This Heart Rate Monitor is designed for use with the following interfaces:

- Vernier LabPro™ (for use with computers or TI Graphing Calculators)
- Texas Instruments CBL™ 2 or CBL System
- Universal Lab Interface (ULI)
- Serial Box Interface

In general, you can use the Heart Rate Monitor as you would any other sensor connected to your interface. You can display a waveform showing the heart beat and analyze the time between the peaks to determine the pulse rate. Often it is more convenient to use a program that simply displays the pulse rate in beats per minute on the screen. Our programs can do this using any of our interfaces.

NOTE: This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.

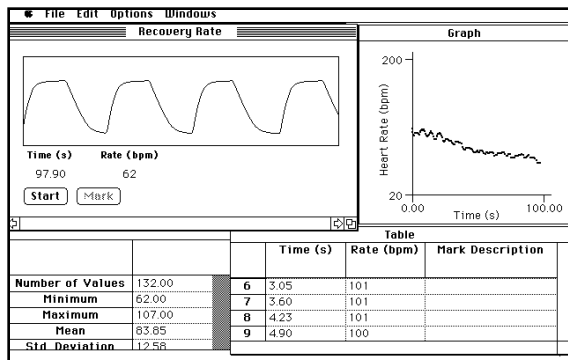
If you purchased the HRM-BTA, you will find a DIN to BTA adapter in the box with your sensor. Use the adapter to connect the sensor to a LabPro, CBL 2 or CBL.

¹ The source is a small incandescent lamp. The wearer will notice a slight warming.

Suggestions for Experiments Using the Heart Rate Monitor

- Compare the heart rate of different individuals.
- Compare the heart rate of athletes and sedentary people.
- Check a person's heart rate before and after a short period of vigorous activity (such as doing jumping jacks). Note that the Heart Rate Monitor cannot be used during the activity. The movement will cause shifting of the ear clip and erroneous readings.
- Monitor the recovery rate; that is, how fast a person's heart rate returns to normal after exercise.
- Check for *baroreceptor reflex*; that is, changes in heart rate for a person when reclined, sitting, and standing caused by the need for the heart to pump blood to different levels.
- Check a person's heart rate before and after caffeine consumption.
- Check a person's heart rate before and after eating.
- Check your own heart rate at different times of the day.
- Monitor a person's heart rate as they start holding their breath. Apparently in some people, the heart rate will slow down briefly as the body attempts to conserve oxygen.

Using the Heart Rate Monitor with a Computer



This sensor can be used with a Macintosh or PC computer and any of the following lab interfaces: LabPro, Universal Lab Interface, or Serial Box Interface. Follow these general procedures to use the Heart Rate Monitor with a computer:

1. Connect the Heart Rate Monitor to the appropriate port on the interface.
2. Start the data collection software on the computer. If you are using a Power Macintosh or Windows computer, run the *Logger Pro™* software. If you are using an older Macintosh, DOS, or Windows 3.1 computer, run the Heart Rate Monitor program.
3. Open an experiment file in the *Logger Pro* or *Data Logger* folder. You are now ready to collect data.

Using the Heart Rate Monitor with TI Graphing Calculators

This sensor can be used with a TI Graphing Calculator and any of the following lab interfaces: LabPro, CBL 2, or CBL. Follow these general procedures to use the Heart Rate Monitor with a graphing calculator:

1. Load a data-collection program onto your calculator:
 - LabPro or CBL 2: Use the DataMate program. This program can be transferred directly from LabPro or CBL 2 to the TI Graphing Calculator. Use the calculator-to-calculator link cable to connect the two devices. Put the calculator into the Receive mode, and then press the Transfer button on the interface.
 - Original CBL: Vernier has several programs that support this sensor and other sensors. When using the sensor with the original CBL, we recommend the CHEMBIO program. This program is available free on our web site at www.vernier.com. Our programs can also be obtained on disk. (Contact us for more information.) Load the program into a calculator using TI-GRAPH LINK.
2. Use the calculator-to-calculator link cable to connect the interface to the TI Graphing Calculator using the I/O ports located on each unit. Be sure to push both plugs in firmly.
3. Connect the Heart Rate Monitor to any of the analog ports on the interface. In most cases, channel CH 1 is used.
4. Start the data-collection program. You are now ready to collect data.

Troubleshooting

If the system is not functioning properly, try the following:

- If you do not get a good pattern, try adjusting the position of the clip. Try moving the clip to a different part of your ear lobe or perhaps try the tip of one of your fingers or the web skin between your thumb and index finger.
- Hold still while using the Heart Rate Monitor. If you want to study how exercise affects your heart rate, move around and then stop and take a pulse reading.
- Be a little patient when using the Heart Rate Monitor. When you move the ear clip, it takes a few seconds for the signal to adjust to the new conditions.
- If you are using the CBL, it takes 15 seconds to collect and display a reading. Allow two to three readings to be taken before adjusting the ear clip.
- We often get better results when the person being tested is seated, rather than standing.
- If you are in a room with bright overhead lighting, you may need to block some of this light from the clip. Otherwise, it may pick up the flickering of the artificial light, which distorts the signal. Try holding your hand to block the light from the clip, or turndown the room lights.
- Adjust the sensitivity potentiometer. The hole in the black amplifier box allows access to this adjustment. Insert a small jeweler's screwdriver and adjust the potentiometer until the signal improves. For an optimal signal, you may need to reposition the ear clip, as well as adjust the sensitivity.
- Make sure that the lab interface is working properly by connecting a 1.5-volt battery directly to the voltage measurement test leads of the interface. The positive terminal of the battery should be connected to the input lead. Connect and disconnect the leads and make sure the program responds accordingly.



Vernier Software & Technology
13979 S.W. Millikan Way
Portland, Oregon 97005-2886
(503) 277-2299 • FAX (503) 277-2440
info@vernier.com • www.vernier.com

Rev. 3/2/00

LabPro and Logger *Pro* are trademarks of Vernier Software & Technology.
CBL and TI-GRAPH LINK are trademarks of Texas Instruments.