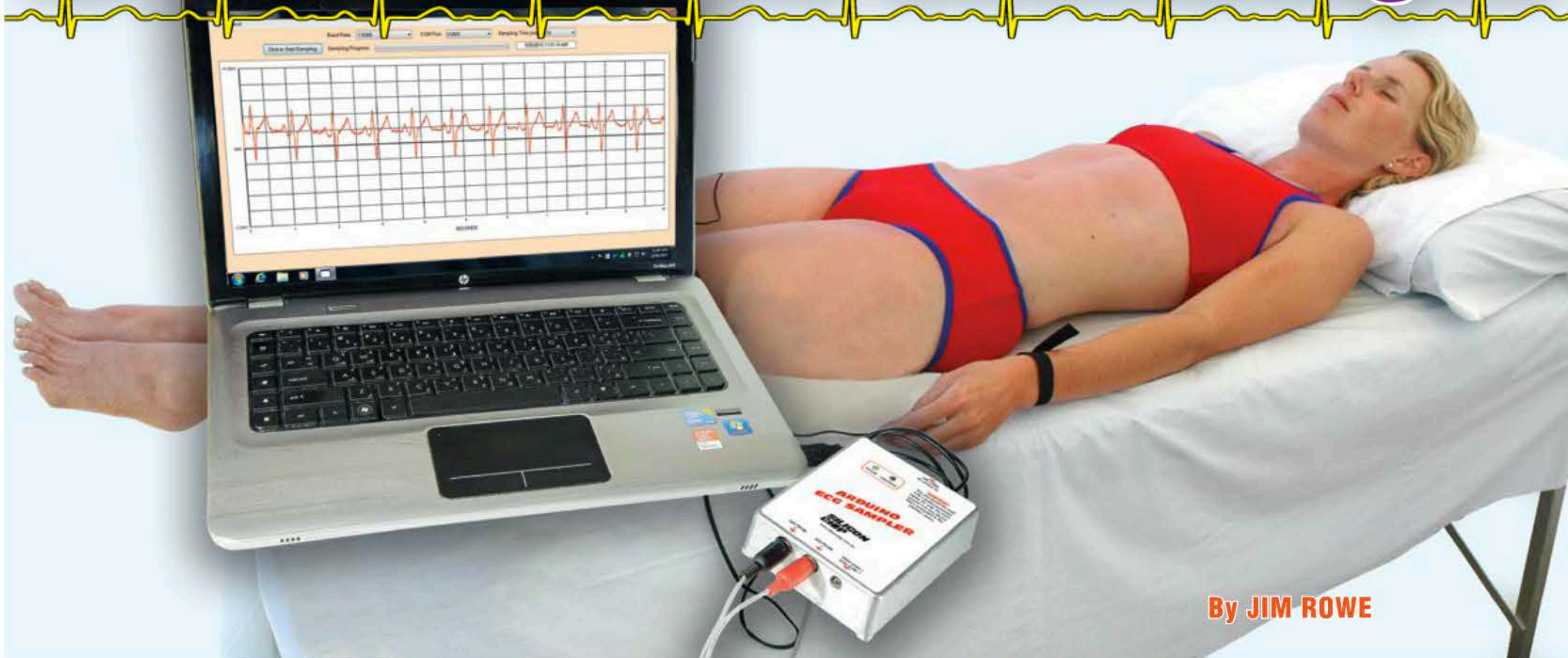


An Arduino-based USB electrocardiogram



By JIM ROWE

Here's an easy-to-build Arduino project which will let you take your own electrocardiogram (ECG) and display it on a laptop PC. The software lets you read, display, save and print the electrical waveform generated by your heart – or anyone else's. It connects to your laptop via a USB cable, which also provides the low power it needs to operate.

AN ELECTROCARDIOGRAM or “ECG” is a piece of medical equipment used to measure and record the voltages produced as a result of heart muscle activity.

By attaching a pair of electrodes (or “leads” as they are known in the trade) to the skin of your wrists, ankle or chest, this PC-Driven ECG project can display, record or print out the same kind of ECG waveform via your personal computer.

Why would you want to build one?

Just looking at the waveforms generated by your heart can be both fun and educational. You can monitor changes to your heart under various conditions, as your heart is affected by many things including emotions and mental and physical activity – even breathing.

All of these factors have a demonstrable effect on the heart's ECG waveform. Being able to show this easily, safely and at low cost is an added bonus.

Professional ECG machines can cost

anything from \$5000 up and while this project is not intended to be used as a diagnostic device, the displayed, recorded and printed waveforms are of a quality approaching that of professional machines.

In many ways, this new ECG Sampler can be seen as a much improved Mk2 version of the project described in the February 2005 issue of SILICON CHIP. The new design is based on a low-cost Arduino Uno/Freetronics Eleven microcomputer module, which

controls the actual sampling and sends the samples back to the laptop.

Note that to ensure complete safety, the unit should only be used with a laptop PC running on batteries. It should not be used with a PC (desktop or laptop) connected to the 230V mains supply – see warning panel later in this article.

Arduino shield

It does this under the direction of a small firmware program “sketch” stored in the micro's flash memory. To adapt the Arduino module for sampling the low-level signals picked up by ECG electrodes, we have designed a front-end “shield” module which plugs into the top of the Arduino module in the usual way.

The shield provides a high-gain (1000x/2000x) differential amplifier

input stage, plus a 3-pole low-pass filter to reduce the sampler's susceptibility to 50Hz hum.

The Arduino and our ECG Sampler

DISCLAIMER

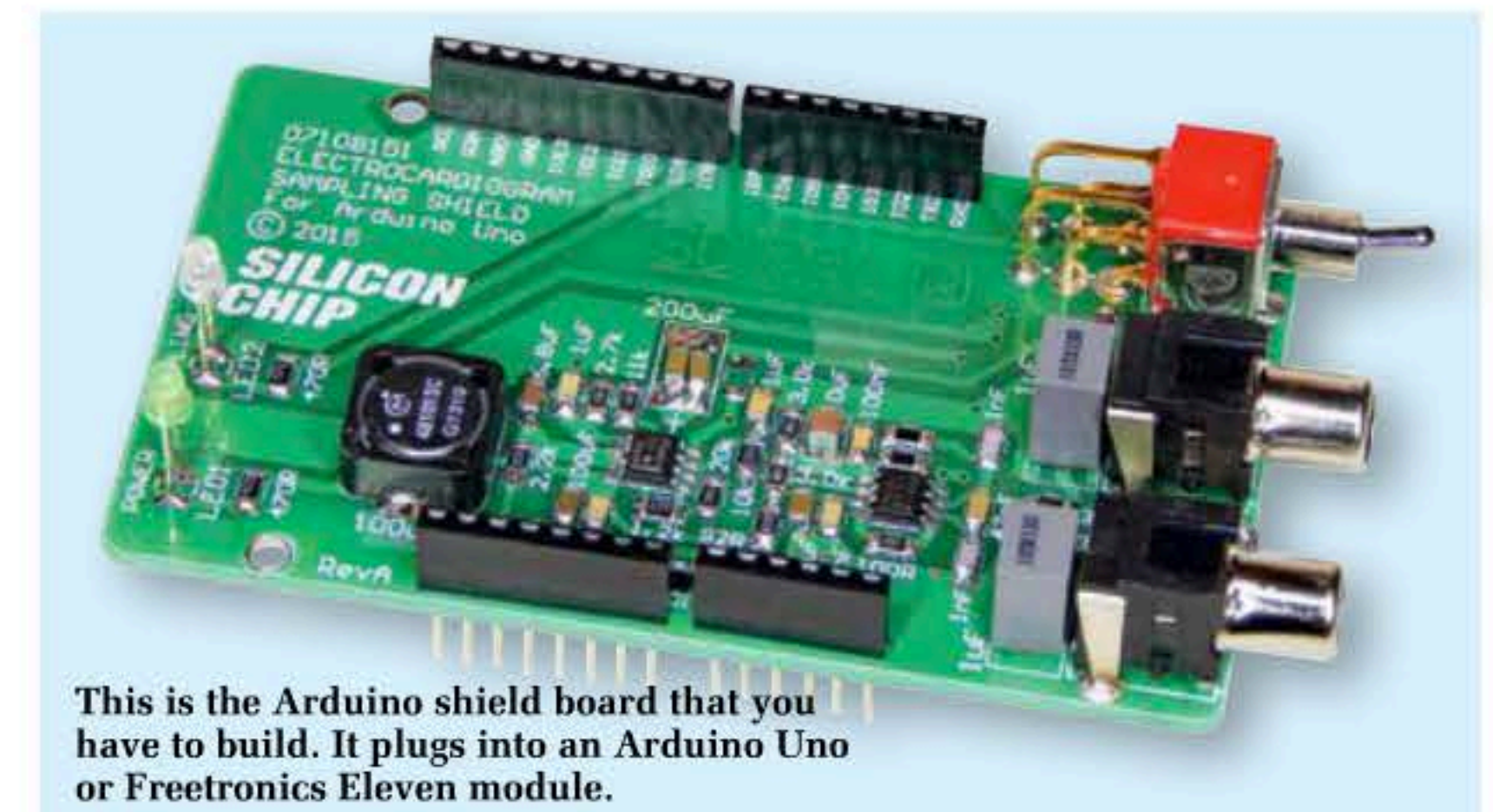
This project has not been designed for medical diagnosis. Correct interpretation of ECG waveforms and tracings is a complex and skilled procedure and requires proper medical training. The USB/ECG is presented here as an instructive and educational device only. If you are concerned about the health of your heart, consult your GP or a heart specialist.

Shield are both powered from the laptop PC via the USB cable, so there's no need for a separate power supply. The total current drawn by the sampler is less than 65mA.

It's easy to use, with all the Sampler's functions controlled by a Windows-based GUI program running on the laptop PC and written in Visual C++. Both the Arduino micro's firmware program sketch and the Visual C++ PC program executable can be downloaded (free for subscribers) from the SILICON CHIP website: www.siliconchip.com.au

To allow the laptop to communicate with the Arduino via a USB cable, you'll also have to download and install a special USB virtual COM port driver. This can be downloaded from either the main Arduino website or the Freetronics website.

While you're hooked up to the Arduino website, you'll also need to download and install the latest version of the Arduino IDE (integrated development environment) package. That's because you'll need this to



This is the Arduino shield board that you have to build. It plugs into an Arduino Uno or Freetronics Eleven module.