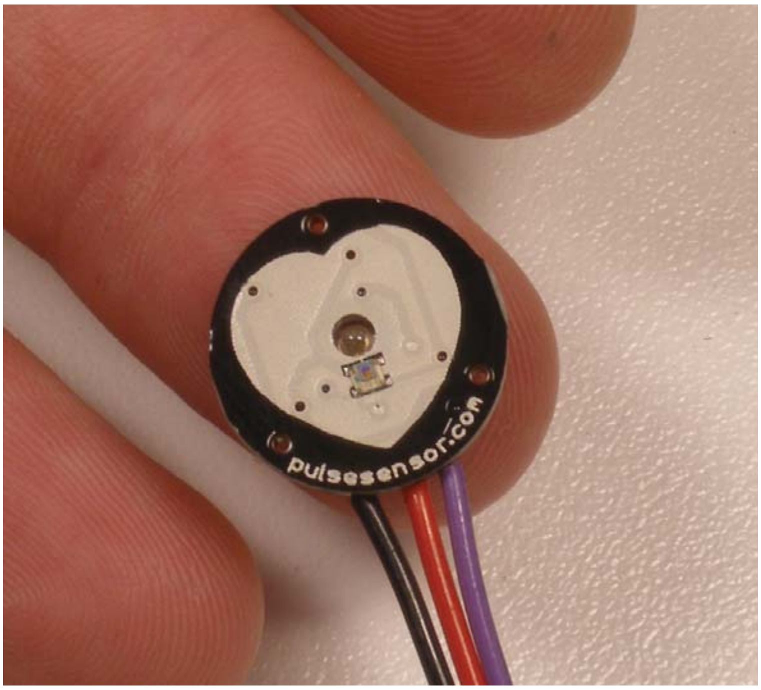
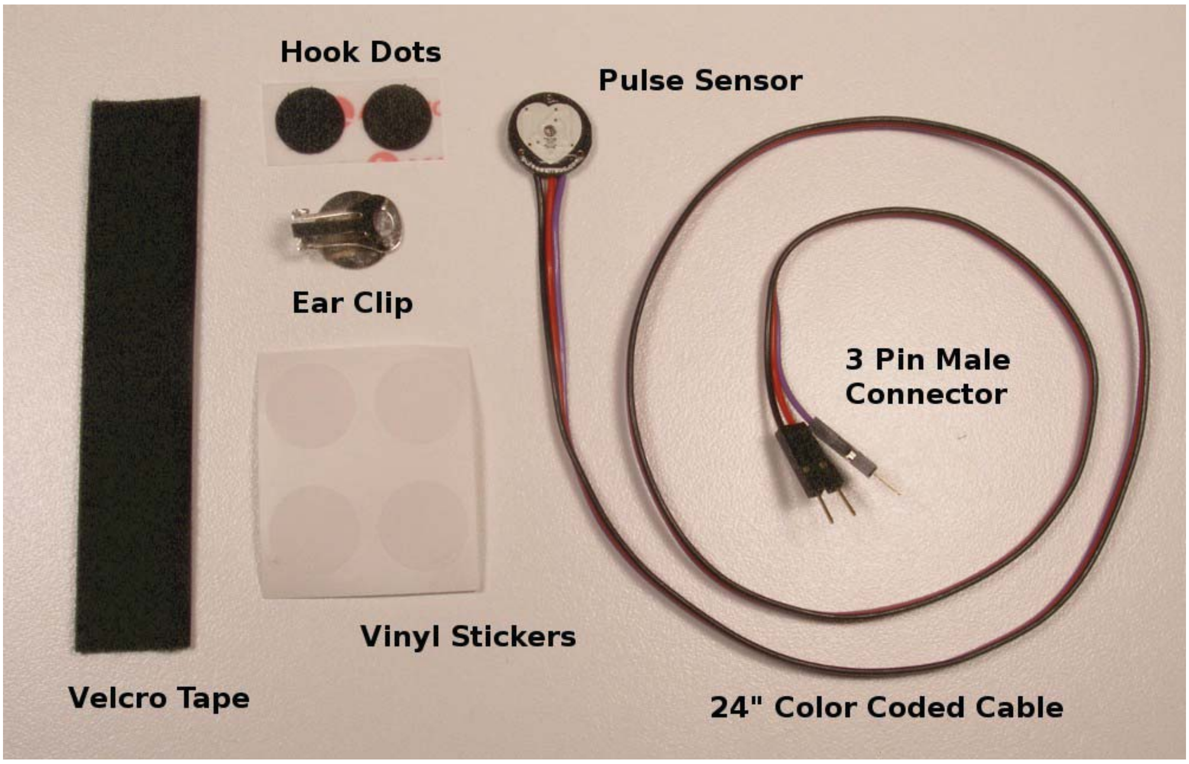
# Pulse Sensor Getting Started Guide



## Introduction:

Pulse Sensor is a well-designed plug-and-play heart-rate sensor for Arduino. It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart-rate data into their projects. The sensor clips onto a fingertip or earlobe and plugs right into Arduino with some jumper cables. It also includes an open-source monitoring app that graphs your pulse in real time.



The Pulse Sensor Kit includes:

1) A 24-inch Color-Coded Cable, with (male) header connectors. You'll find this makes it easy to embed the sensor into your project, and connect to an Arduino. No soldering is required.

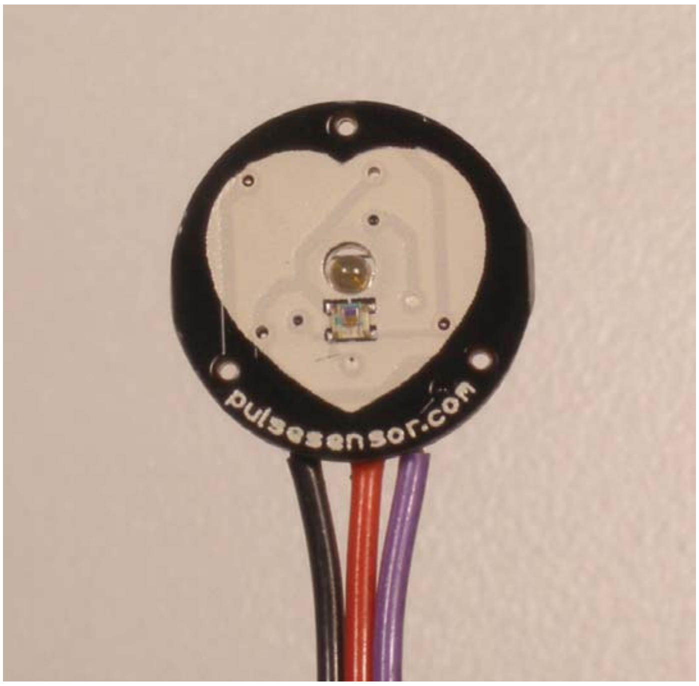
2) An Ear Clip, perfectly sized to the sensor. We searched many places to find just the right clip. It can be hot-glued to the back of the sensor and easily worn on the earlobe.

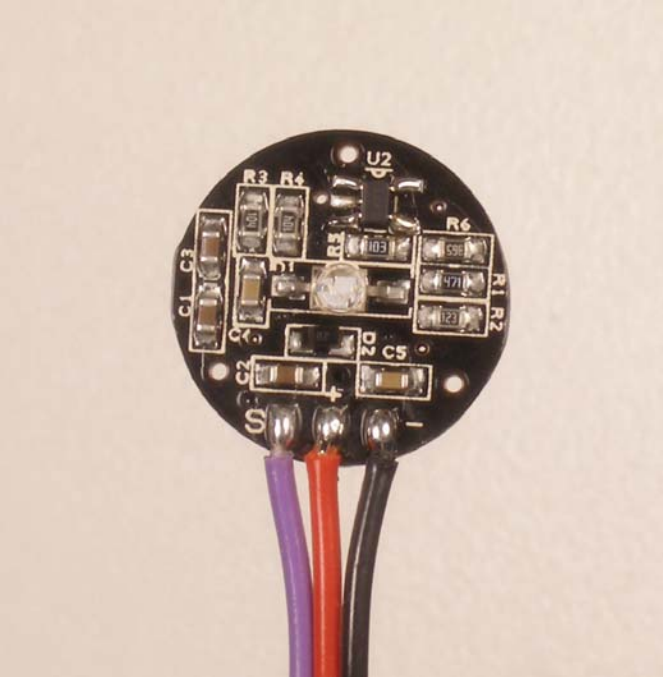
3) 2 Velcro Dots. These are 'hook' side and are also perfectly sized to the sensor. You'll find these velcro dots very useful if you want to make a velcro (or fabric) strap to wrap around a finger tip.

4) Velcro strap to wrap the Pulse Sensor around your finger.

4) 3 Transparent Stickers. These are used on the front of the Pulse Sensor to protect it from oily fingers and sweaty earlobes.

5) The Pulse Sensor has 3 holes around the outside edge which make it easy to sew it into almost anything.



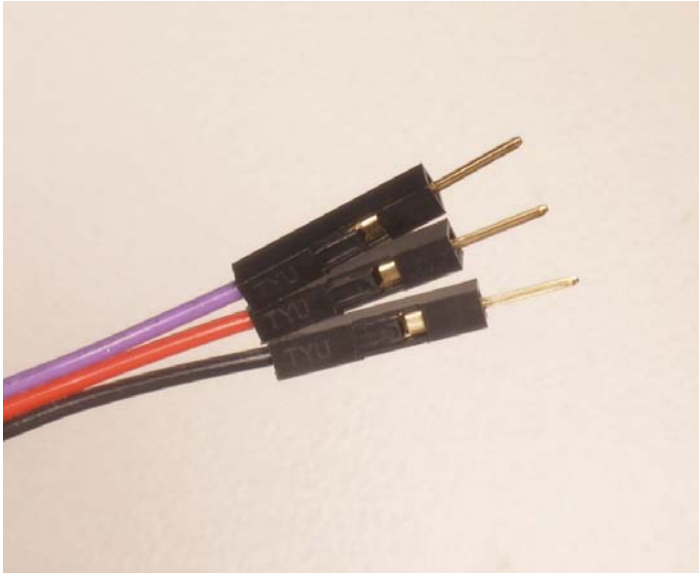


# Let’s get started with Pulse Sensor Anatomy

The front of the sensor is the pretty side with the Heart logo. This is the side that makes contact with the skin. On the front you see a small round hole, which is where the LED shines through from the back, and there is also a little square just under the LED. The square is an ambient light sensor, exactly like the one used in cellphones, tablets, and laptops, to adjust the screen brightness in different light conditions. The LED shines light into the fingertip or earlobe, or other capillary tissue, and sensor reads the light that bounces back. The back of the sensor is where the rest of the parts are mounted. We put them there so they would not get in the way of the of the sensor on the front. Even the LED we are using is a reverse mount LED. For more about the circuit functionality, check out the Hardware page.[needs link]

The cable is a 24” flat color coded ribbon cable with 3 male header connectors.

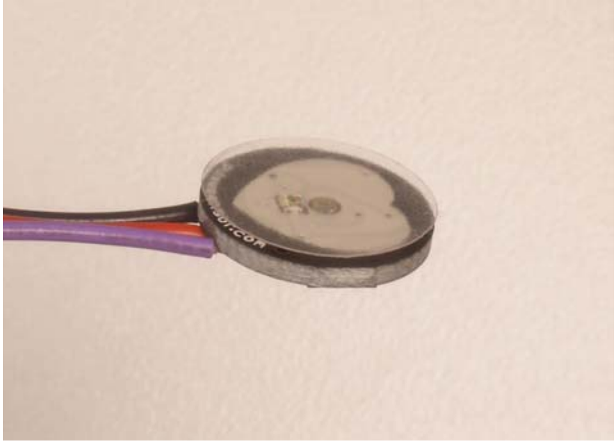
RED wire = +3V to +5V
BLACK wire = GND
PURPLE wire = Signal



The Pulse Sensor can be connected to arduino, or plugged into a breadboard. Before we get it up and running, we need to protect the exposed circuitry so you can get a reliable heart beat signal.

## Preparing the Pulse Sensor

Before you really start using the sensor you want to insulate the board from your (naturally) sweaty/oily fingers. The Pulse Sensor is an exposed circuit board, and if you touch the solder points, you could short the board, or introduce unwanted signal noise. We will use a thin film of vinyl to seal the sensor side. Find the small page of four clear round stickers in your kit, and peel one off. Then center it on the Pulse Sensor. It should fit perfectly.



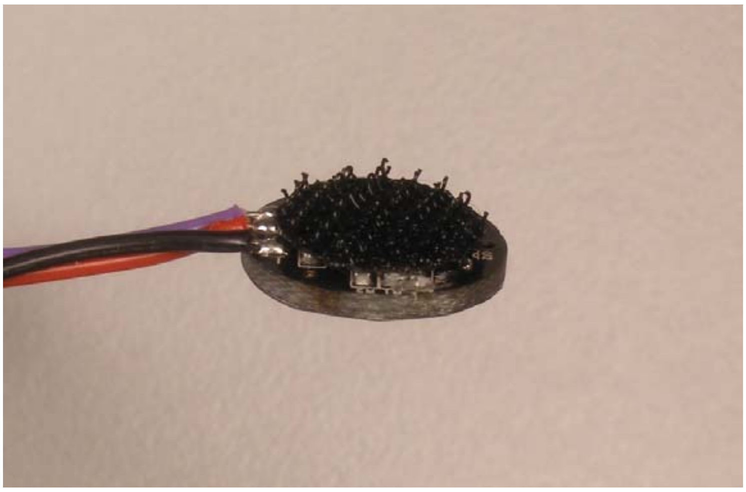
When you are happy with the way it’s lined up, squeeze it onto the face all at once! The sticker (made of vinyl) will kind of stretch over the sensor and give it a nice close fit. If you get a wrinkle, don’t worry, just press it down really hard and it should stick. We gave you 4, so you can replace it if necessary.

That takes care of the front side. The vinyl sticker offers very good protection for the underlying circuit, and we rate it ‘water resistant’. meaning: it can stand to get splashed on, but don’t throw it in the pool!

If this is your first time working with Pulse Sensor, you’re probably eager to get started, and not sure if you want to use the ear-clip or finger-strap (or other thing). The back of the Pulse Sensor has even more exposed contacts than the front, so you need to make sure that you don’t let it touch anything conductive or wet.

The easiest and quickest way to protect the back side from undesireable shorts or noise is to simply stick a velcro dot there for now. The dot will keep your parts away from the Pulse Sensor parts enough for you to get a good feel for the sensor and decide how you want to mount it. You'll find that the velcro dot comes off easily, and stores back on the little strip of plastic next to the other one.

Notice that the electrical connections are still exposed! We only recommend this as a temporary setup so you can get started. We show you how to better seal the Pulse Sensor later in this document.



## Running The Pulse Sensor Code

Get the latest Arduino and Processing Pulse Sensor software here http://pulsesensor.com/downloads/

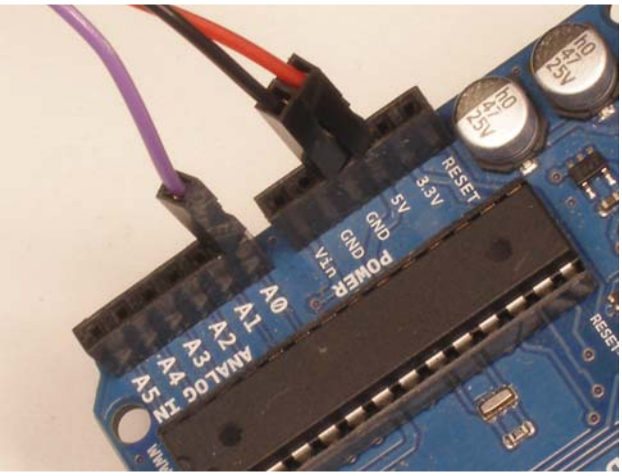
Arduino code is called "PulseSensorAmped_Arduino-xx"
The Processing code is called "PulseSensorAmped_Processing-xx"

We strongly advise that you DO NOT connect the Pulse Sensor to your body while your computer or arduino is being powered from the mains AC line. That goes for charging laptops and DC power supplies. Please be safe and isolate yourself from from the power grid, or work under battery power.
Connect the Pulse Sensor to: +V (red), Ground (black), and Analog Pin 0 (purple) on your favorite Arduino, or Arduino compatible device, and upload the 'PulseSensoAmped_Arduino-xx' sketch.

**note:** If you want to power Pulse Sensor Amped with low voltage (3.3V for example), make sure you have this line of code in the setup()

```
analogReference(EXTERNAL);
```

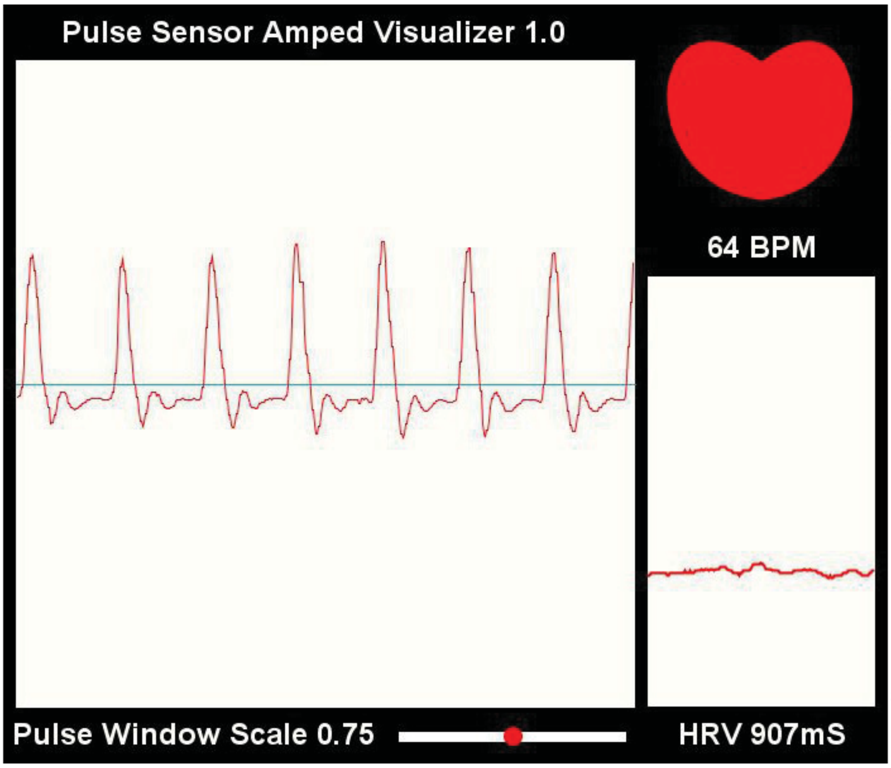
Also, make sure that you apply the lower voltage to the Arduino Aref pin (next to pin 13).



After it's done uploading, you should see Arduino pin 13 blink in time with your heartbeat when you hold the sensor on your fingertip. If you grip the sensor too hard, you will squeeze all the blood out of your fingertip and there will be no signal! If you hold it too lightly, you will invite noise from movement and ambient light. Sweet

Spot pressure on the Pulse Sensor will give a nice clean signal. You may need to play around and try different parts of your body and pressures. If you see an intermittent blink, or no blink, you might be a zombie or a robot.

To view the heartbeat waveform and check your heart rate, you can use the Processing sketch that we made. Start up Processing on your computer and run the 'PulseSensorAmped_Processing-xx' sketch. This is our data visualization software, and it looks like this.



Pulse Sensor Amped Visualizer 1.0

64 BPM

Pulse Window Scale 0.75

HRV 907mS

Heart beats with your pulse!

Pulse window with live heartbeat waveform

Heart rate window updates every beat

Use scrollbar to scale the Pulse window

Time between heartbeats

***note***: If you get an error when starting this code, you may need to make sure you are selecting the right serial port.  Check the Troubleshooting section below..

The large main window shows a graph of raw sensor data over time. The Pulse Sensor Data Window can be scaled using the scrollbar at the bottom if you have a very large or very small signal. At the right of the screen, a smaller data window graphs heart rate over time. This graph advances every pulse, and the Beats Per Minute is updated every pulse as a running average of the last ten pulses. The big red heart in the upper right also pulses to the time of your heartbeat. When you hold the Pulse Sensor to your fingertip or earlobe or (fill in body part here) you should see a nice heartbeat waveform like the one above. If you don't, and you're sure you're not a zombie, try the sensor on different parts of your body that have capillary tissue. We've had good results on the side of the nose, middle of the forehead, palm, and lower lip. We're all different, original organisms. Play around and find the best spot on you and your friends. As you are testing and getting used to the sensor. You may find that some fingers or parts of fingers are better than others. For example, I find that when I position the sensor so that the edge of the PCB is at the bottom edge of my earlobe I get an awesome signal. Also, people with cold hands or poor circulation may have a harder time reading the pulse. Run your hands under warm water, or do some jumping-jacks!

Arduino and Processing programming environments available for download here:
www.arduino.cc    www.processing.org