



*Al-mustaqbal University College
Biomedical Engineering Dep.
Biomedical sensors Lab 2*



EXP. 2 : AD8232 ECG SENSOR



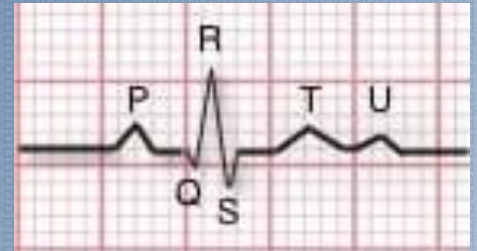
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AD8232 ECG Sensor

This sensor is a cost-effective board used to measure the electrical activity of the heart.

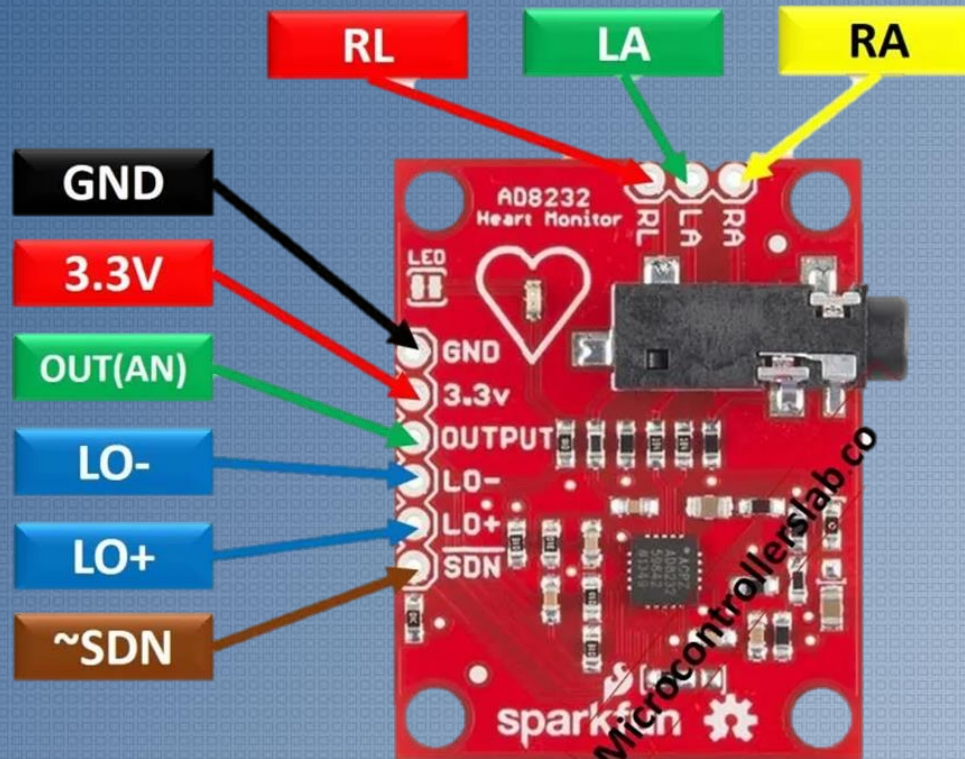
This electrical activity can be charted as an ECG or Electrocardiogram and output as an analog reading. ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op-amp to help obtain a clear signal from the PR and QT Intervals easily.

The AD8232 is an integrated signal conditioning block for ECG and other biopotential measurement applications. It is designed to extract, amplify, and filter small biopotential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement



AD8232 ECG module Pinout Diagram

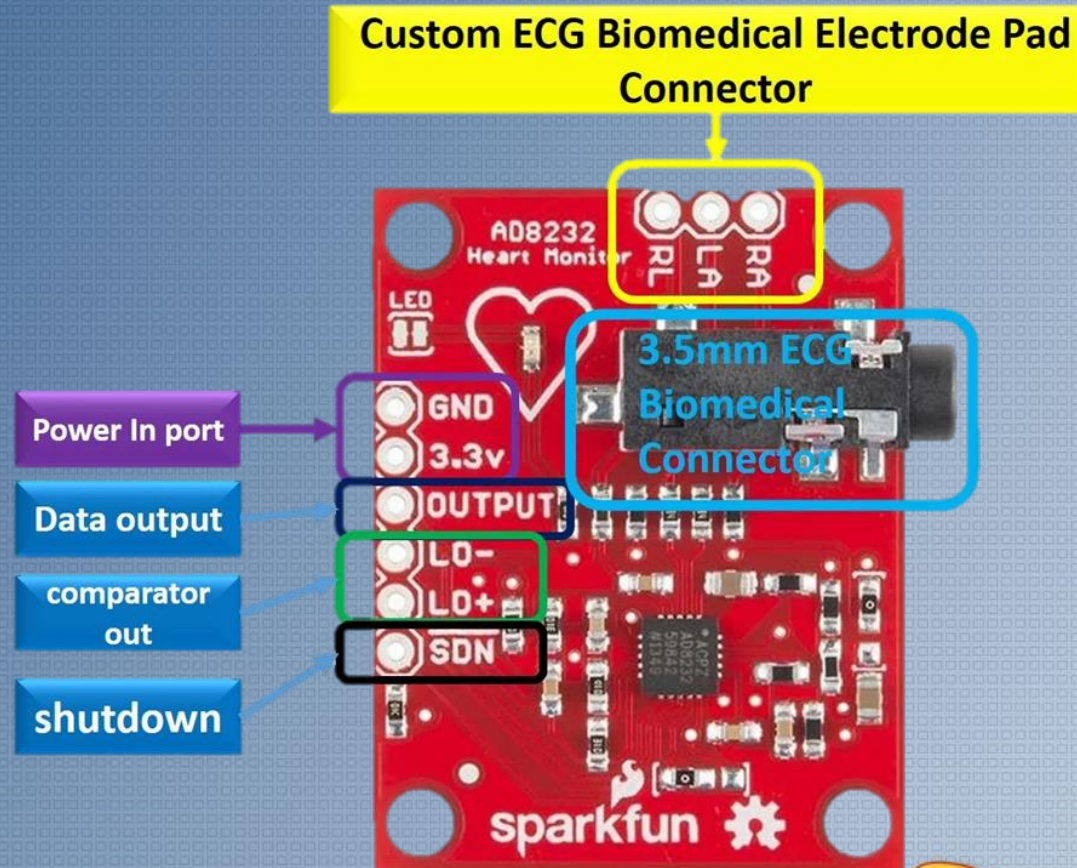
The following figure shows the pinout diagram of the ECG module. From this IC total of nine pins have been exposed on the pinout and provided in the form of an AD8232 ECG module for user-friendly interface and proper safety protection to IC.



Pin Configuration

The ECG module AD8232 components can be divided into the following categories.

- Power Input Pins (3.3, GND)
- Electrode pad connector pins (RA, LA, RL, 3.5 mm female jack)
- Data output pin (Output)
- Leads off detection output pins(LO-, LO+)
- Shutdown control pin(~SND)
- LED



ECG Electrode Connector Pins

LA (Left ARM)

LA is the positive input (+IN) of the instrumentation amplifier of IC AD8232. A signal from the electrode connected to the left arm of the human body is received here

RA (Right ARM)

RA is the negative input (-IN) of the instrumentation amplifier of IC AD8232. A signal from the electrode connected to the right arm of the human body is received here.

RL (Right LEG)

RL is a green color biomedical electrode acts as an electrode input and connected to the right leg of the human body.

3.5 mm Female Biomedical Electrode Connector Jack

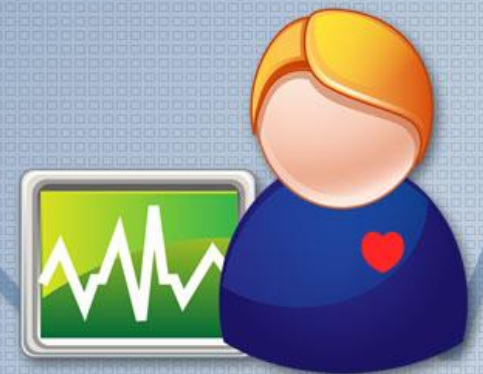
This connector has been provided as an alternate of RA, LA, RL pins. We can connect three electrodes to this connector instead of RA, LA, and RL pins



using a 3.5mm male jack. There are two methods to detect the heartbeat: the two-electrode method and Three electrode method. Two Electrodes method uses the AC signal, and the Three Electrodes method uses DC signal. To detect which method is being used, LEAD OFF DETECTION is implemented in this module.

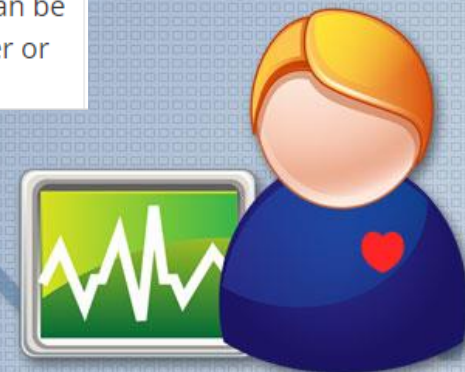
Power supply Pins

Pin Name	Function
3.3 V	This is + ve Pin of 3.3V to power up the module.
GND	This is the Ground Pin of 3.3V to power up the module.
~SDN (Shut Down)	When ~SDN pin is set to low, the module enters low power shutdown mode.



ECG Module Data Output and Comparator Pins

Pin Name	Function	Details
LO+	Lead OFF Positive	In DC Lead Off Detection mode, LO+ is LOW when electrode at +IN (of IC AD8232), i.e., LA (of module AD8232) is connected, and LO+ is HIGH when electrode at +IN (of IC AD8232) i.e. LA (of module AD8232) is disconnected. In AC Lead Off Detection mode, LO+ is LOW when electrodes at both +IN and -IN (of IC AD8232) i.e. LA and RA (of module AD8232) are connected, and LO+ is HIGH when the electrode at LA or RA is disconnected.
LO-	Lead OFF Negative	In DC Lead Off Detection mode LO- is LOW when electrode at -IN (of IC AD8232) i.e. RA (of module AD8232) is connected and LO- is HIGH when electrode at -IN (of IC AD8232) i.e., RA (of module AD8232) is disconnected. In AC Lead Off detection mode LO- is always LOW.
OUTPUT		This is an output pin at which a filtered analog signal is present, and it gives the electrical activity of the heart. This signal can be feed as an analog input to the Analogue to digital converter or microcontroller for analysis and visualization.



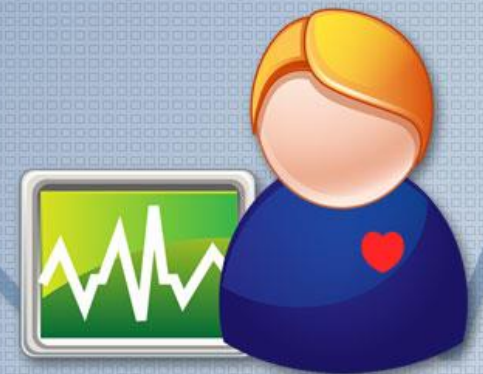
AD8232 ECG module Features

- Analog easy to read output signal with Arduino
- Operating voltage: 2.5 to 3.3 V_{DC}
- Operating current: 170 μ A.
- Conventional ECGs are quite noisy. This module act as an operational amplifier to extract clear signal during PR and QT interval of the heartbeat..
- Detect which lead is connected or disconnected.
- It has a shutdown pin which can be used to enter in energy-saving mode.
- working temperature range from -40 to 85 degrees centigrade.
- Dimensions of 3.5 cm x 3 cm.



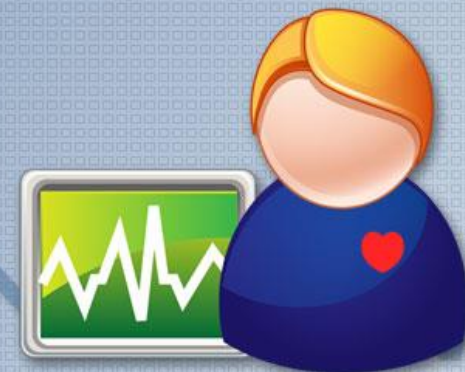
Applications

- Cost-effective alternative to conventional ECG.
- Fitness-related devices.
- Bioelectricity signal collection
- It can be used in monitoring heartbeats during exercises
- Portable ECG



AD8232 ECG Module interfacing with Arduino

Board Label	Pin Function	Arduino Connection
GND	Ground	GND
3.3v	3.3v Power Supply	3.3v
OUTPUT	Output Signal	A0
LO-	Leads-off Detect -	11
LO+	Leads-off Detect +	10
SDN	Shutdown	Not used



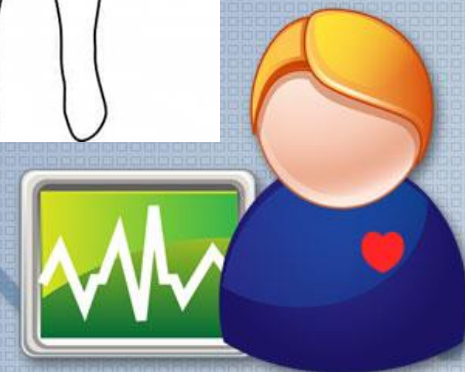
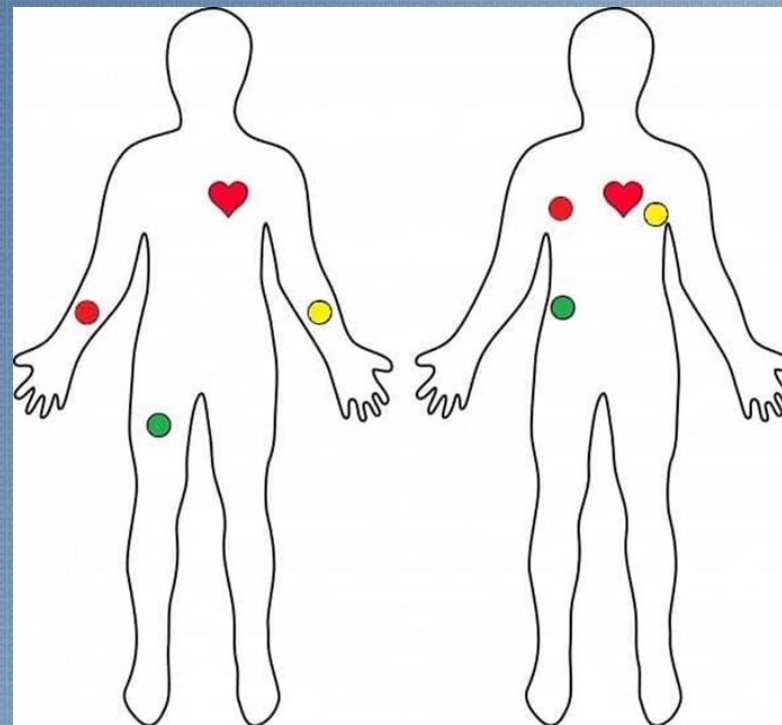
AD8232 ECG Sensor Placement on Body

It is recommended to snap the sensor pads on the leads before application to the body. The closer to the heart the pads are, the better the measurement. The cables are color-coded to help identify proper placement.

Red: RA (Right Arm)

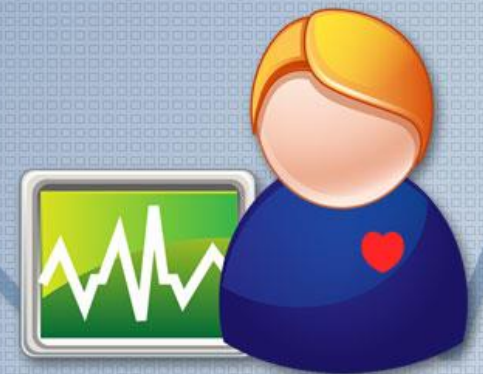
Yellow: LA (Left Arm)

Green: RL (Right Leg)



Arduino Code

```
void setup() {  
  // initialize the serial communication:  
  Serial.begin(9600);  
  pinMode(11, INPUT); // Setup for leads off detection LO +  
  pinMode(10, INPUT); // Setup for leads off detection LO -  
  
}  
  
void loop() {  
  
  if((digitalRead(10) == 1) || (digitalRead(11) == 1)){  
    Serial.println("!");  
  }  
  else{  
    // send the value of analog input 0:  
    Serial.println(analogRead(A0));  
  }  
  //Wait for a bit to keep serial data from saturating  
  delay(1);  
}
```



Thanks

