All in one Sensor
MaM Sense

Features
- Acquisition of EOG-EMG-ECG in a single circuit
- Can be used as an Arduino Nano Shield
- Powerful Noise Rejection
- Resistance to high input voltage
- Compatible with other microcontrollers

What is MaM Sensor?
MaM Sense allows makers and developers to process 3 different kinds of signals with a single board, namely EOG, ECG and EMG. Each three signals are measured as the desired mode for the signal is selected by a three-way switch. Then, the board can be connected to analog to digital converter to obtain output and make Digital Signal Processing. The sensor can also be used as Arduino Nano Expansion Board as Arduino Nano is plugged on top of the sensor and it gives output signal to the A7 port of Arduino while it powers both itself and the Arduino Nano via a common DC jack. Also, Arduino codes have been shared by our engineers to help developers.

Sensor Layout

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**Input Layer**
- Vin+: Positive electrode connected
- Vin-: Negative electrode connected
- VRef: Reference electrode

**Output Layer**
- Out: Output signal (ranges between 0 to Vsupply/2)
- Gnd: Ground for common grounding

**Power Supply**
- Vsupply+: Positive pole of the supply voltage
- Vsupply-: Negative pole of the supply voltage

**Arduino Nano Expansion Board**
- Vin: Voltage to feed Microcontroller (M560)
- Gnd: Ground for common grounding
- Out: Output signal (ranges between 0 to Vsupply/2)
- Nc: Not Connected

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Setup Configurations

1- Place the electrodes as shown in the figures in electrode placement section. (You can also place the electrodes with the other placement methods as in literature)

2- Connect electrode cables to the electrodes and electrode jack.

3- Select the signal mode that you want to obtain.

4- Supply 9V power by DC Jack

5- Obtain the output signals from output using oscilloscope or a development board. (Do not forget to connect grounds of the sensor and the development board)

If you use Arduino Nano Shield, do not forget the supply MaM Sense before connecting with the Arduino Nano.
Signals

EOG

EMG

ECG
Connection to the microcontrollers

Arduino Nano Plugin to the Expansion Board

Do not forget to supply Mam Sense before connecting with the Arduino Nano
**Block Diagram**

- **Channel 1**
  - **Switch**
  - **EOG**
  - **Instrumentational Amplifier** (Gain=21)
  - **f0 = 0.1 Hz**
  - **High-Pass Filter**
  - **2nd Order Sallen-Key Low-Pass Filter**
  - **Gain=30**
  - **DC Offset & Final Amplification**
  - **EOG Signal**

- **Channel 2**
  - **EOG**
  - **Instrumentational Amplifier** (Gain=21)
  - **f0 = 20 Hz**
  - **High-Pass Filter**
  - **2nd Order Sallen-Key Low-Pass Filter**
  - **Gain=30**
  - **DC Offset & Final Amplification**
  - **EMG Signal**

- **Channel 3**
  - **EOG**
  - **Instrumentational Amplifier** (Gain=21)
  - **f0 = 0.3 Hz**
  - **High-Pass Filter**
  - **2nd Order Sallen-Key Low-Pass Filter**
  - **Gain=30**
  - **DC Offset & Final Amplification**
  - **EOG Signal**

**Mode of operation**

<table>
<thead>
<tr>
<th>Supply Current</th>
<th>EOG</th>
<th>EMG</th>
<th>ECG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Arduino Nano</td>
<td>3.70 mA</td>
<td>3.66 mA</td>
<td>3.68 mA</td>
</tr>
<tr>
<td>With Arduino Nano Supplied (minimum supplied current)</td>
<td>16.7 mA</td>
<td>16.3 mA</td>
<td>16.4 mA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supply Voltage</th>
<th>Min</th>
<th>Ideal</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Arduino Nano</td>
<td>8V</td>
<td>9V</td>
<td>12V</td>
</tr>
<tr>
<td>With Arduino Nano Supplied (minimum supplied current)</td>
<td>8V</td>
<td>9V</td>
<td>10V</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output Signal Voltage</th>
<th>EOG</th>
<th>EMG</th>
<th>ECG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2V</td>
<td>4V</td>
<td>1.6V</td>
</tr>
</tbody>
</table>
The case for the Sensor

MAM High Tech PCB case (Suitable for 3D Printing)

TOP VIEW

TRIMETRIK VIEW

FRONT VIEW

RIGHT VIEW

Detail
Scale 1:1

The Holes are drilled for the lead wires