EKG Sensor DT189A

An electrocardiogram – abbreviated as EKG or ECG – is a test that measures the electrical activity of the heartbeat. With each beat, an electrical impulse (or *wave*) travels through the heart. This wave causes the muscle to squeeze and pump blood from the heart.

The EKG (Electrocardiogram) sensor measures cardiac electrical potential waveforms (voltages produced during contractions of the heart).

The EKG sensor enables students to investigate the electrical signals generated by their heart.

Note: This product is to be used for educational purposes only. It is not appropriate for medical or research applications. **Specifically, it may not be used for patient diagnosis.**

The sensor consists of Fourier Systems plastic sensor case and three electrode leads.

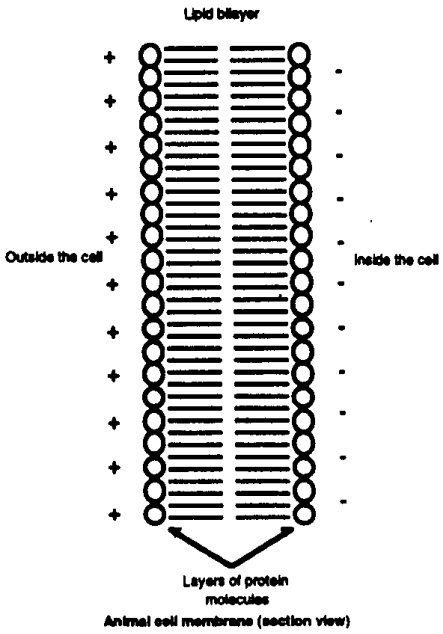
The sensor comes with a package of one hundred silver/silver chloride electrode patches that can be attached to the skin.

The sensor's circuitry isolates the user from the possibility of electrical shock.

Typical Experiments

- Monitoring personal EKG
- Comparing EKG graphs at rest and after activity
- Investigating EKG with different body positions

How it Works



Heart muscle cells are polarized at rest. This means the cells have slightly unequal concentrations of ions across their cell membranes. An excess of positive sodium ions on the outside of the membrane causes the outside of the membrane to have a positive charge relative to the inside of the membrane. The inside of the cell is at a potential of about 90 millivolts (mV) less than the outside of the cell membrane. The 90 mV difference is called the resting potential. The typical cell membrane is relatively impermeable to the entry of sodium. However, stimulation of a muscle cell causes an increase in its permeability to sodium. Sodium ions migrate into the cell through the opening of voltage-gated sodium channels. This causes a change (depolarization) in the electrical field around the cell. This change in cell potential from negative to positive and back is a voltage pulse called the action potential. In muscle cells, the *action potential* causes a muscle contraction. The sum action potential generated during the depolarization and repolarization of the cardiac muscle can be recorded by electrodes at the surface of the skin.

A recording of the heart's electrical activity is called an electrocardiogram (EKG).

Sensor Specification

Range:	0 – 5 V
Resolution (12-bit):	1.23 mV
Recommended Sample Rate:	100 samples/sec
Voltage Protection:	4 kV
Isoelectric Line (Gain):	1mV body potential = 1V sensor out put
Maintenance:	The electrodes should be kept refrigerated in a clean, dry, airtight container for storage

Technical Notes

- The electrodes should be kept refrigerated in a clean, dry, airtight container for storage. Even with airtight storage, opened electrode packages cannot be stored from one year to the next.
- The presence of metal or magnets on the body can disturb the EKG signal.
- The sensor's circuitry isolates the user from the possibility of electrical shock in two ways:
  a. The sensor signal is transmitted through an opto-isolation circuit.
  b. Power for the sensor is transferred through a transformer. The circuitry protects against accidental over-voltages of up to 4,000 Volts.

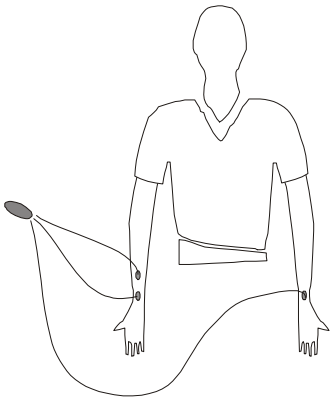
Equipment List – DT-189A

- EKG sensor
- A package of 100 silver/silver chloride electrode patches

Connecting the EKG Sensor to a Person

Use three electrode patches per subject. The electrodes can be reused, but since they tend to absorb moisture (they are very hygroscopic), reuse is not recommended.

- Remove watches, jewelry, belts and rings.
- Because the electrical signal produced by the heart and detected at the body's surface is so small, it is very important that the electrode patch makes good contact with the skin.
- Clean the areas of skin where the patches will be attached with a paper towel to remove dead skin and oil.



- Peel three electrode patches from the backing paper. Firmly place the first electrode on the right wrist.
- Place a second electrode a few centimeters above the first one.
- Place a third electrode on the inside of the left wrist.
- Place each electrode so it is on the inside part of the arm (closer to the body) and the tab on the edge of the electrode patch is pointing down. This way, the wire of the sensor can hang freely without twisting the edge of the electrode patch.

- Connect the micro alligator clips of the three sensor's leads to the tabs on the edges of the electrode patches:
  a. Connect the two leads labeled R.A. (right arm) to the right arm electrode patches.
  b. Connect the lead labeled L.A. (left arm) to the left arm electrode patch.

Calibration

The EKG sensor requires no calibration.

It is designed to produce a signal between 0 and 5 V, with 1 V being the isoelectric line.

Safety Instructions

- This product is to be used for educational purposes only. It is not appropriate for medical or research applications. Specifically, it may not be used for patient diagnosis.
- Always connect the ground lead (black) on the body before connecting the negative or positive lead.
- If the isolation of the lead is broken do not use the sensor.
- Never place an EKG sensor, patches, clips or leads near or in water or other liquids.
- Do not put the positive lead on the right forearm or the negative lead on the left forearm.

Using the EKG Sensor with Fourier Data Loggers and MultiLab Software

1. Launch the MultiLab software (from either your PC or Nova5000).
2. Connect the EKG sensor to the data logger's sensor input (starting from I/O-1). The sensor is automatically recognized by the MultiLab software.
3. Click **Setup** on the main toolbar and program the data logger's sample rate and number of samples. Click **Run** on the main toolbar to start the measurement.
4. The EKG sensor is affected by body movement. The subject must keep still during the EKG measurement.

An Example of using the EKG Sensor

EKG Diagram

Below is a typical graph showing data obtained using an EKG sensor.

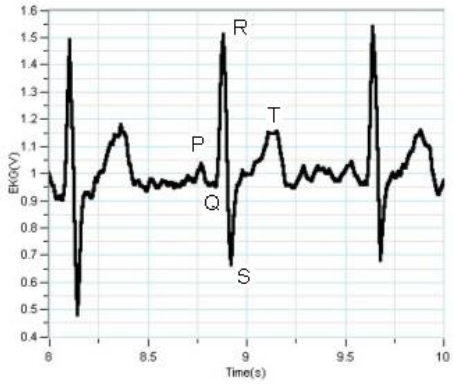


Figure 1: EKG data

Troubleshooting

- If the EKG signal is unclear with no recognizable pattern, check:
  1. Electrode is off or defective
  2. Dirt on skin interfering with the signal
  3. Metal object on the body interfering with the signal
  4. Leads are twisted
  5. Electrode patch is loose
- No signal displays on the screen:
  1. The EKG sensor is not connected to the data logger
  2. Electrodes are loose
  3. Leads are misplaced
- Baseline drifts up and down:

  Moving the arms or the leads during measurement
- R wave appears upside down

  Leads are misplaced

Technical Support

Please contact Fourier technical support as follows:

Web: http://www.fourier-sys.com/support_support.html
Email: support@fourier-sys.com

Consult the FAQs before contacting technical support:
http://www.fourier-sys.com/support_faq.html

Copyright and Warranty

All standard Fourier Systems sensors carry a one-year warranty, which states that for a period of twelve months after the date of delivery to you, it will be substantially free from significant defects in materials and workmanship.
This Warranty does not cover breakage of the product caused by misuse or abuse.
This Warranty does not cover Fourier Systems consumables such as electrodes, batteries, EKG stickers, cuvettes and storage solutions or buffers.