

Purpose

This application note describes how Plessey Semiconductor's Electric Potential Integrated Circuit (EPIC) sensor can be used as a wrist-mounted device for simple and effective personal monitoring of electrocardiograph (ECG) signals.

Introduction

EPIC is an electrometer capable of sensing ECG signals through insulated sensors in contact with the skin. The sensors are dry-contact, so that the gels or other contact-enhancing substances normally associated with wet-electrode ECG pads are not necessary. As well as offering exciting possibilities for simplified ECG monitoring by medical professionals, this technology also makes it possible for individuals to view and collect their own detailed ECG signals by use of a simple device no larger than a wrist watch, or even by a device built into a wrist watch.

The ECG trace ideally requires two sensors to measure electric signals from parts of the body on opposite side of the heart. Users familiar with the EPIC demonstration kit will know that this can be easily be achieved by touching one sensor electrode with each hand. The differential signal that can be obtained is shown in figure 1.



Figure 1: Differential signal from two sensors in contact with the skin showing ECG trace

Wrist-mounted Application

A straightforward extension of the "sensor in each hand" method can be achieved by use of a wrist-mounted device containing two electrodes.

One electrode is situated on the rear of the device, and is thus in permanent contact with the wearer's wrist. The second electrode is front-facing. To provide the second signal for the ECG, the wearer simply has to touch this second sensor with a finger from the opposite hand. A representation of this configuration is shown in figure 2.

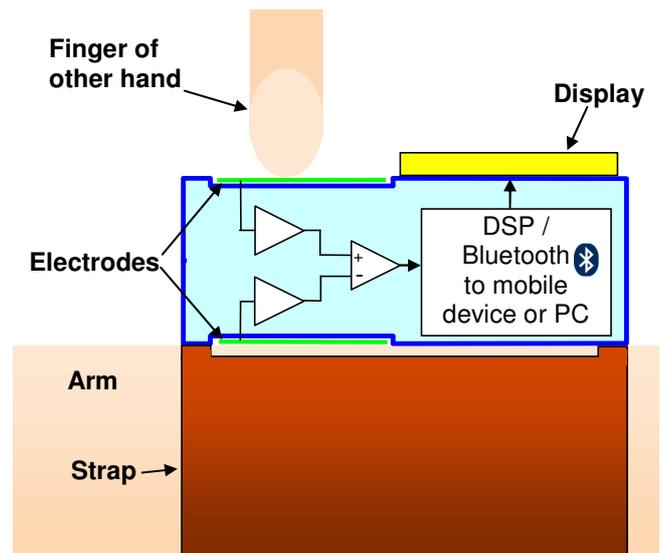


Figure 2: Diagrammatic representation of wrist-mounted EPIC configuration for taking ECG measurements

There are a number of advantages in using this configuration rather than separate sensors:

- The method is as simple as taking a pulse measurement.
- Signal collection and processing can be performed within a single unit
- Cost is reduced by use of a signal housing, rather than needing one per sensor.
- There is no need for a second sensor on the end of a cable that could easily become lost or damaged.

Signal processing

The collected signals would ideally be filtered and differentially amplified by circuitry within the wrist-mounted device to produce the ECG signal. Full ECG generally requires a bandwidth of 50mHz to 150Hz; basic monitoring – for instance of heart rate – could use a much smaller bandwidth.

Once the signal has been digitised, numerous methods of analysing, displaying or transmitting the data are obviously possible. These could include:

- Data output to a display on the device itself, for example displaying the heart rate, or more detailed parameters from the PQRST pattern that are indicators of the health of the heart.
- Data transmission via Bluetooth to a mobile device (e.g. SmartPhone) for display of the full ECG trace.

- Incorporating the device into a cloud computing network.

The low power requirements of the EPIC sensor allow the biasing for the sensor and the filtering and amplification circuitry to be battery operated.

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