

## Plessey PS25000A and PS25001A EPIC Demonstration Kit.



### Demonstration Kit Standard Components

#### PS25000A

- One (**50Hz**) control and interface box (CIB)
- Control and interface box software (download from website)
- USB cable
- 2xPS25013 connector cables
- User guide

#### PS25001A

- One (**60Hz**) control and interface box (CIB)
- Control and interface box software (download from website)
- USB cable
- 2xPS25013 connector cables
- User guide

### Demonstration Kit Optional Components

The PS25000A or PS25001A are supplied with a choice of one of the following options:

- 2x PS25101 sensors, or
- 2x Single channel demonstration boards with EPIC sensors\*, or
- 1x Dual channel demonstration board with two EPIC sensors\*

\* Various EPIC sensors are available on these demonstrator boards.

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## 1.0 Introduction

The EPIC technology provides active electric potential sensors that may be used in a range of applications.

This demonstration unit comprises a pair of EPIC active sensors and a Control and Interface box (CIB). It is a flexible system that may be used to explore a range of applications from electrophysiological signal detection such as ECG (EKG) and EEG through to local electric field detection for applications such as motion sensing.

## 2.0 The EPIC sensors

The demonstration sets are supplied with either:

- 2x PS25101 sensors, or
  - 2x Single channel demonstration boards with EPIC sensors\*, or
  - 1x Dual channel demonstration board with two EPIC sensors\*
- \* Various EPIC sensors are available on these demonstrator boards

### 2.1 PS25101 sensors

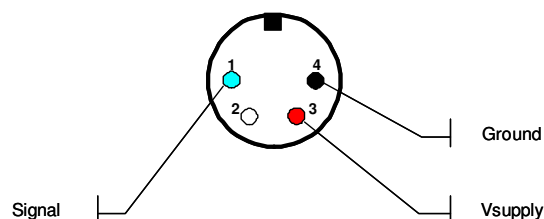


*PS25101 Sensors and plug*

A PS25101 EPIC active sensor detects electric potential. The surface of the electrode is coated with a dielectric providing a capacitive coupling to a surface in contact with it. The capacitance of the dielectric rapidly becomes insignificant when coupling to objects out of contact with the electrode surface.

The sensor has a screened wire lead that is terminated in a 4 pin DIN plug. The connections of the plug are shown below:

## PS25101 Plug



The sensor may be used independently of the associated control and interface box by providing a DC supply voltage of 5.0V with respect to ground. The output from the sensor is DC coupled and is available on the signal pin.

A short specification of the sensor for stand alone use is:

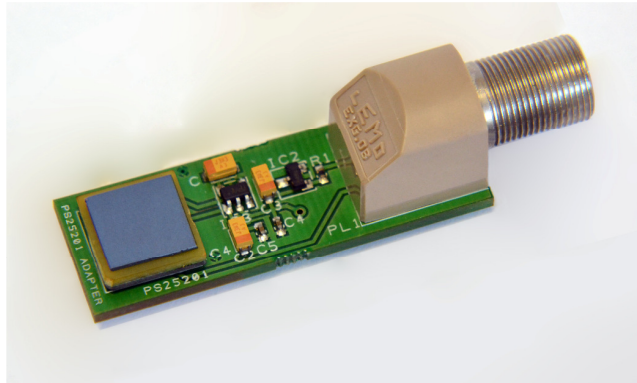
Parameter	min	typ	max	Units	Notes
Supply voltage	4.75	5.0	8.0	V	
Supply current ( $V_{\text{supply}} = 5.0\text{V}$ )		4.5		mA	(1)
Input coupling capacitance		1.0		nF	(2)
Bandwidth (-3dB)	0.1		10000	Hz	
Output impedance		10		$\Omega$	
Output voltage swing	-2.5		2.5	V	(3)

## Notes:

- (1) Current consumption is slightly supply voltage dependent.
- (2) Coupling capacitance is to a surface in intimate contact with the electrode.
- (3) The active sensor incorporates a -ve rail generator and voltage regulation to +/- 2.5V. This limits the output swing.

A more detailed specification for the sensor is provided in the datasheet for the PS25101 (document #291346)

## 2.2 Single channel demonstration board with EPIC sensor



*Typical single channel demonstration board with EPIC sensor*

The single channel demonstration boards carry a single EPIC active sensor that detects electric potential. In the case of EPIC sensors for contact electrophysiological signal detection the surface of the electrode is coated with a dielectric providing a capacitive coupling to a surface in contact with it. In the case of EPIC sensors that have been optimised for non-contact sensing of movement the electrode is coated with PCB resist. The capacitance of the dielectric rapidly becomes insignificant when coupling to objects out of contact with the electrode surface.

The single channel board is terminated by a precision socket. The PS25013 cables supplied with the demonstration unit are designed to mate with this connector type.

The sensor may be used independently of the associated control and interface box by providing a DC supply voltage of 5.0V with respect to ground. The output from the sensor is DC coupled and is available on the signal pin.

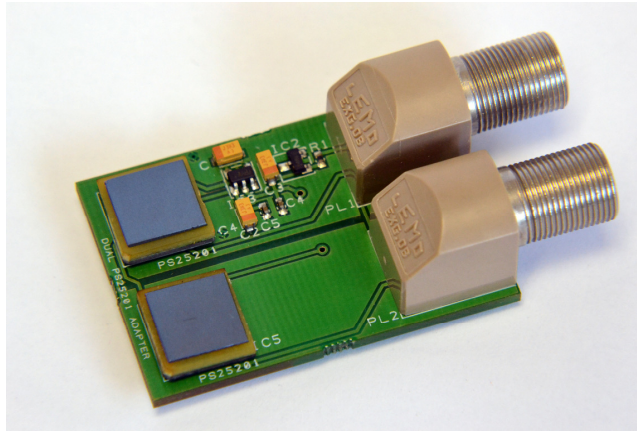
A short specification of the single channel demonstration board is:

Parameter	min	typ	max	Units	Notes
Supply voltage	4.75	5.0	8.0	V	
Supply current ( $V_{\text{supply}} = 5.0\text{V}$ )		6.0		mA	(1)
Output drive capability		500		pF	
Output voltage swing	-2.5		2.5	V	(2)

Notes:

- (1) Current consumption is slightly supply voltage dependent.
- (2) The active sensor incorporates a -ve rail generator and voltage regulation to +/- 2.5V. This limits the output swing.

### 2.3 Dual channel demonstration board with EPIC sensors



*Typical dual channel demonstration board with two EPIC sensors*

The dual channel demonstration boards carry two EPIC active sensor that detects electric potential. In the case of EPIC sensors for contact electrophysiological signal detection the surface of the electrode is coated with a dielectric providing a capacitive coupling to a surface in contact with it. In the case of EPIC sensors that have been optimised for non-contact sensing of movement the electrode is coated with PCB resist. The capacitance of the dielectric rapidly becomes insignificant when coupling to objects out of contact with the electrode surface.

The dual channel board is terminated by two precision sockets. The PS25013 cables supplied with the demonstration unit are designed to mate with this connector type.

The sensor may be used independently of the associated control and interface box by providing a DC supply voltage of 5.0V with respect to ground. The output from the sensor is DC coupled and is available on the signal pin.

A short specification of the dual channel demonstration board is:  
:

Parameter	min	typ	max	Units	Notes
Supply voltage	4.75	5.0	8.0	V	
Supply current ( $V_{\text{supply}} = 5.0\text{V}$ )		9.0		mA	(1)
Output drive capability (each channel)		500		pF	
Output voltage swing	-2.5		2.5	V	(2)

Notes:

- (1) Current consumption is slightly supply voltage dependent.
- (2) The active sensor incorporates a -ve rail generator and voltage regulation to +/- 2.5V. This limits the output swing.

### 3.0 The Control and Interface Box (CIB)

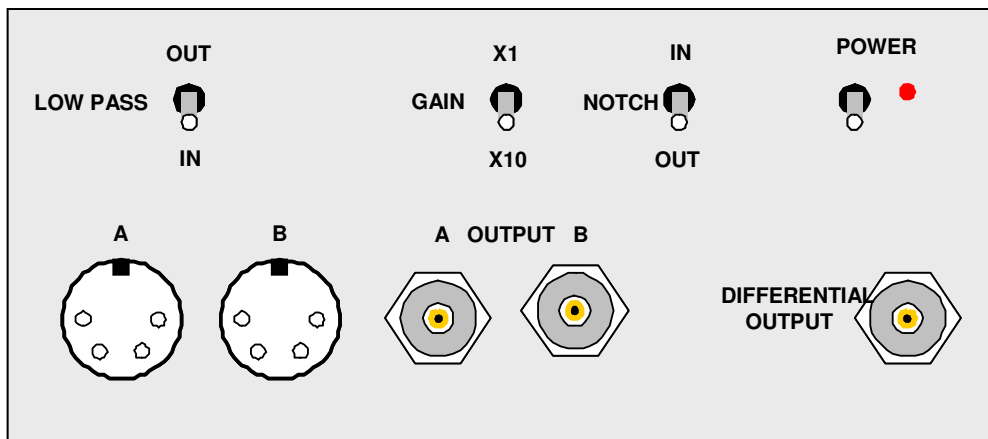


Control and Interface box

The Control and Interface box (CIB) provides an easy interface for the evaluation of EPIC sensors. The box provides the following functions:

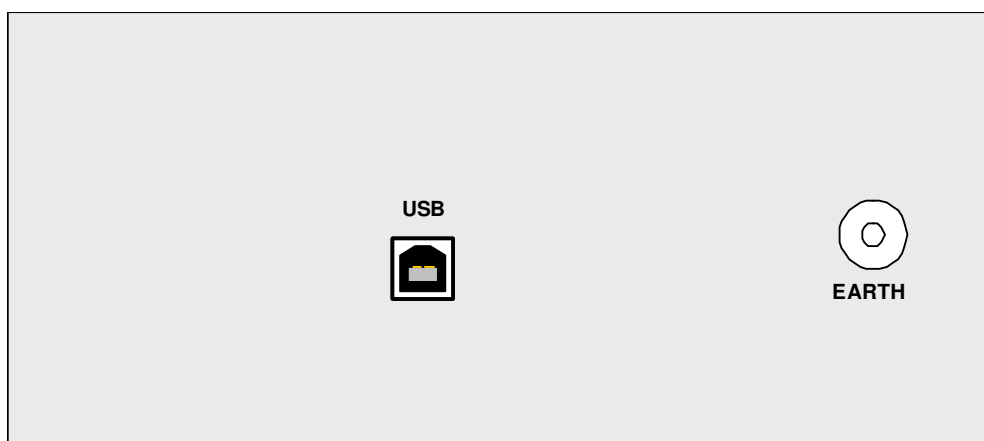
- Power and signal socket for two sensors (channel A and B).
- Switchable gain of x1 and x10.
- Switchable low pass filtering
- Switchable notch filtering
- Analogue outputs for each sensor (channel A and B)
- Analogue difference output for the two sensors (channel A - channel B)
- A data acquisition (DAQ) card.
- A USB 2.0 interface

The front panel of the box is detailed below:



Control and Interface box front panel

The rear panel of the box is detailed below:



*Control and Interface box rear panel*

A short specification of the control and interface box is:

Parameter	min	typ	max	Units	Notes
Supply voltage – USB 2.0		5.0		V	
Low pass filter		30		Hz	(4)
Notch filter	frequency	50/60		Hz	(5)
	attenuation	30		dB	
	Q	4			
Analogue output impedance		10		$\Omega$	
Data acq'n	resolution	12		bit	
	Sampling rate		10	kS/s	
	Output rate		150	Hz	

Notes:

- (4) A simple first order filter.
- (5) The frequency of the notch filter is factory pre-set to either 50 Hz (PS25000A) or 60Hz (PS25001A) depending on the line frequency at the intended location of use.

The power for the internal electronics of the box is provided by the data acquisition card. This is a National Instruments card, USB-6008. The internal electronics can only be powered by connection of the USB port to a computer with the driver for the DAQ installed.



## 4.0 The Control and Interface Box (CIB) Software

The CIB requires a connection to a laptop with the associated CIB software installed. The protocols provided by the software enable the internal data acquisition card within the CIB and this, in turn, provides power to the other electronics within the box.

The enabled USB connection is also required if the analogue output signals from the box are to be sent to an oscilloscope since the acquisition card is the only method of applying power to the CIB electronics.

The CIB software provides a rolling oscillogram and a chart recorder capability.

### 4.1 System Requirements

The system requirements for a Windows/PC system are:

Processor	Pentium III/Celeron 866 MHz or equivalent
RAM	256 MB
Screen Resolution	1024 x 768 pixels
Operating System	Windows 7/Vista/XP/Windows Server 2003 R2 (32-bit)/Windows Server 2008 R2 (64-bit)

### 4.2 Software Installation

The software can be downloaded from the customer portal found on the internet at:

<http://www.plesseysemiconductors.com/>

Download and install the software before connection of the CIB to the computer.

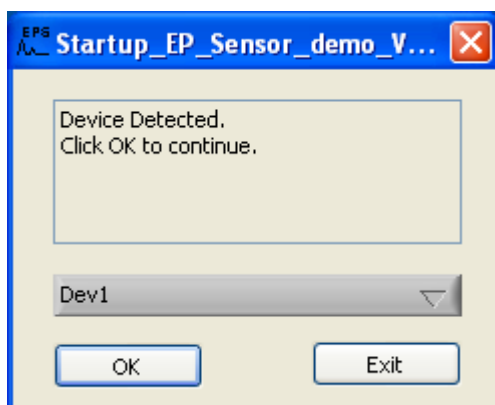
Follow the on-screen installation instructions.

After installation has been performed a reboot of the system is required to complete the installation process.

### 4.3 Software Use

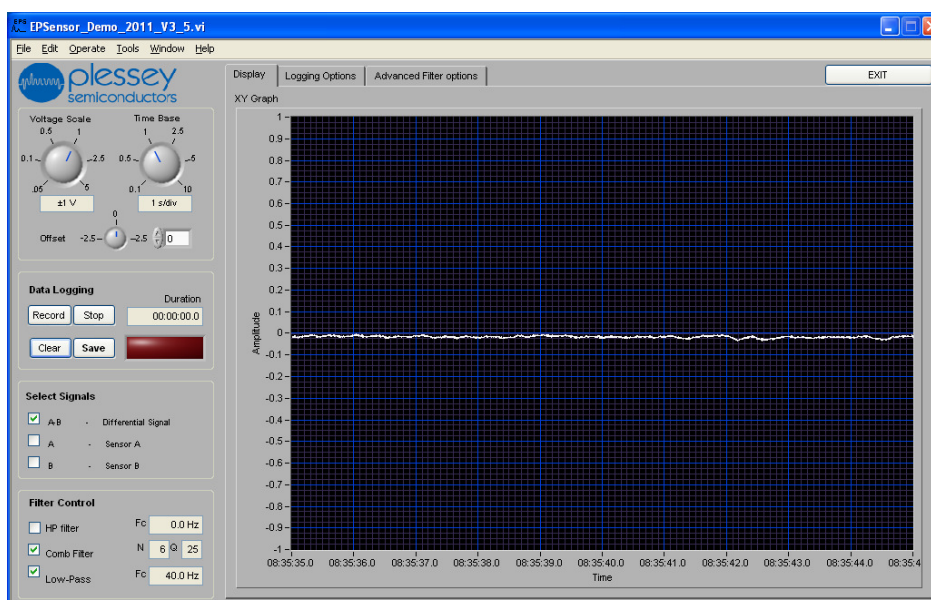
Once the software is installed the CIB may be connected to a USB socket. The CIB will be automatically detected and the driver loaded.

The software may now be started. Provided the CIB is connected and the drivers loaded then the software will display the box:



Confirmation CIB is connected correctly - Click "OK".

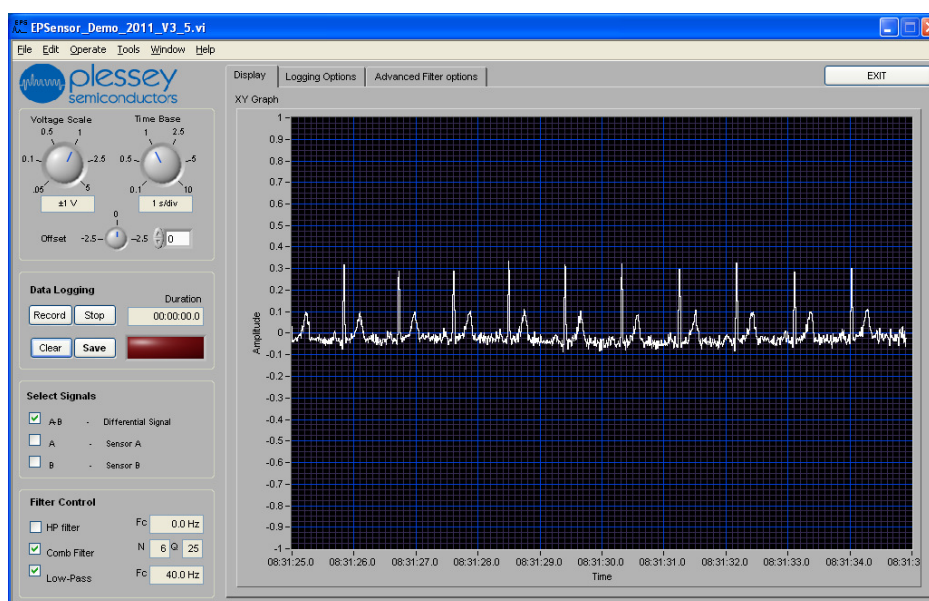
The soft oscilloscope and data logger will now be displayed:



Start-up Screen with CIB switched off – CIB data acquisition card is active.

The CIB can now be switched on using the power switch on the CIB front panel. The red power LED should light.

After settling an oscillogram should be generated. The example below shows a typical difference trace (A-B) that will be obtained from a sensor held in each hand:



*Initial Signal (ECG type) generated by two EPIC sensors, left and right hand.*

The software has the following controls:

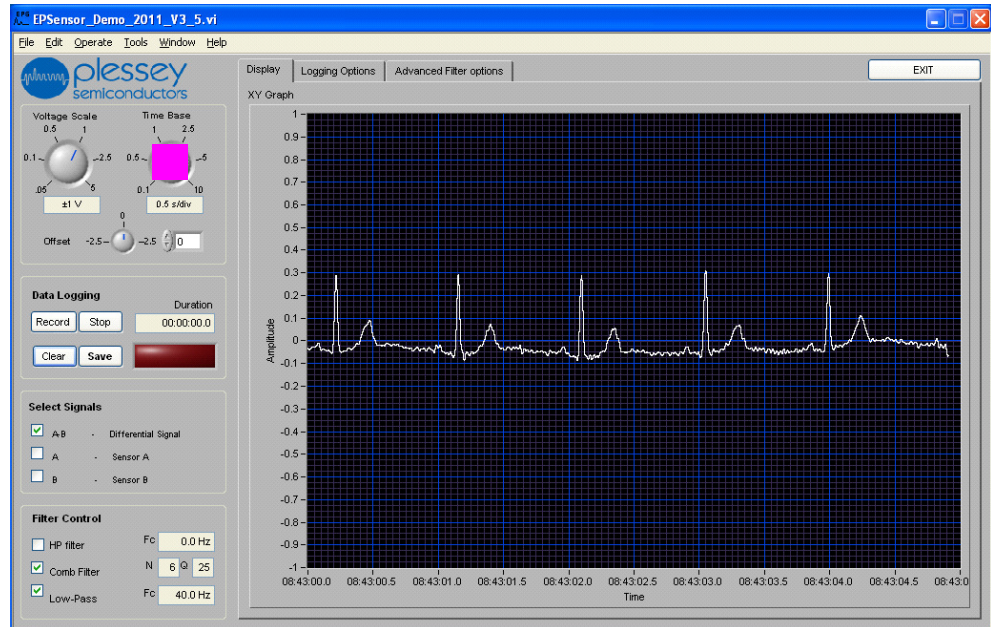
- Voltage Scale
- Time Base
- Offset

and the following features:

- Data Logging
- Select Signal
- Filter Control

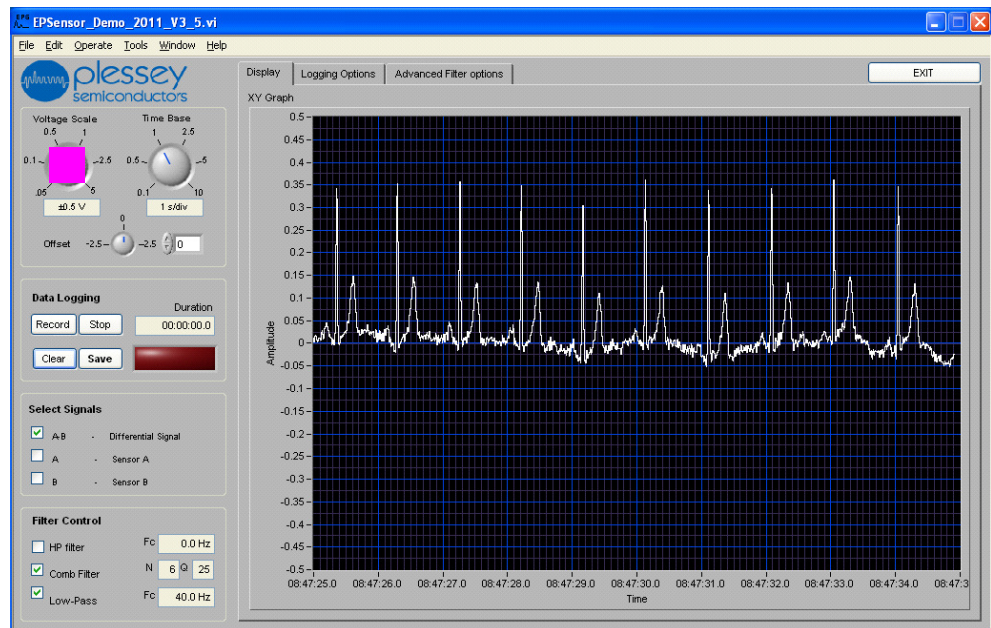
### Time Base

This may be adjusted to increase or decrease the time (x) axis of the oscillogram:



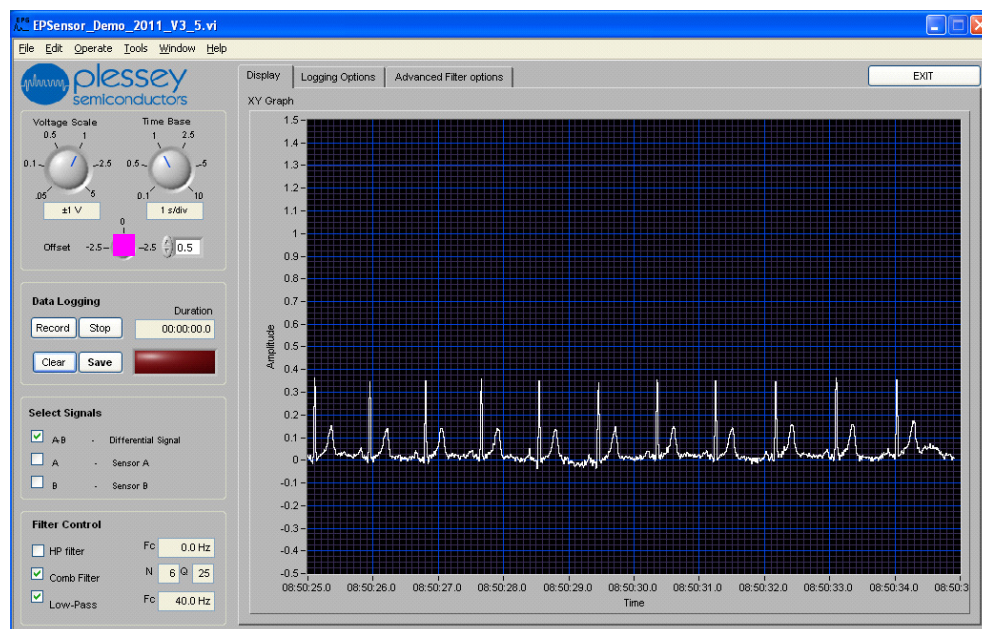
### Voltage Scale

This may be adjusted to increase or decrease the voltage (y) axis of the oscillogram:



## Offset

This may be adjusted to apply an offset to the voltage (y) axis of the oscillogram:



## Select Signals

The Select Signals check boxes allow the displayed signals to be selected. The signal options are:

- A-B This is a difference signal between the two sensors, A and B.
- A This is sensor A signal.
- B This is sensor B signal.

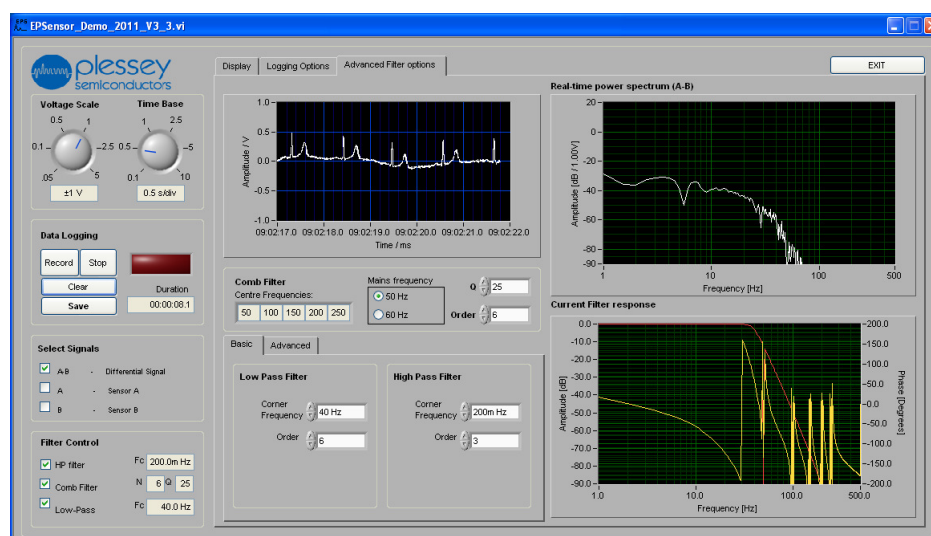
None, one, two or all may be selected.

## Filter Control

The Filter Control check boxes allow the following digital filters to be applied and modified:

- High Pass (HP) filter
- Comb filter
- Low Pass filter

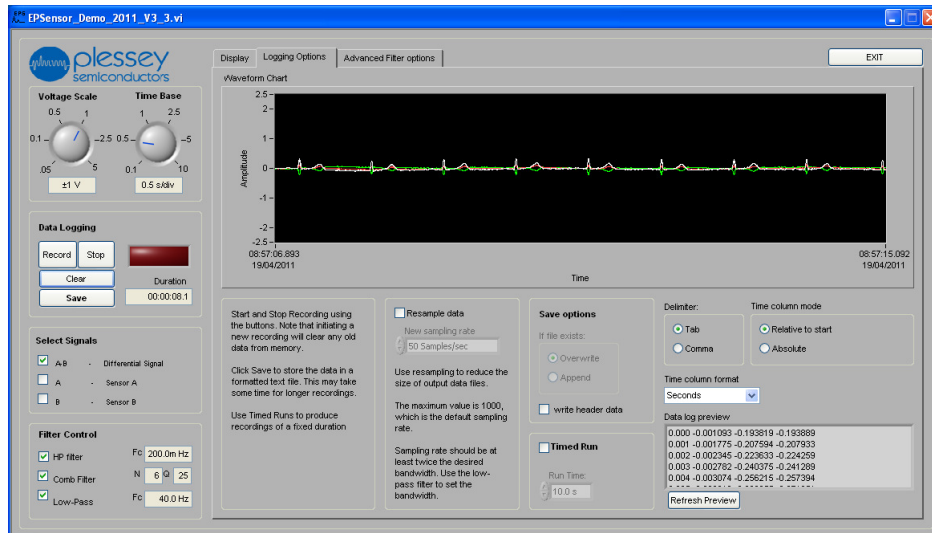
The effect of these filters may be further modified or adjusted using the Advanced Filter options tab at the top of the screen:



These filters are applied to the digitised signal by the local processing of the signals in the PC. These controls do not adjust or override the internal filtering options of the CIB.

### Data Logging

The data logging controls on the soft front panel of the oscilloscope allow the start, stop, save and clear functions of the data recorder. Further, the Logging Options tab at the top of the screen provides additional control over the data logging function.



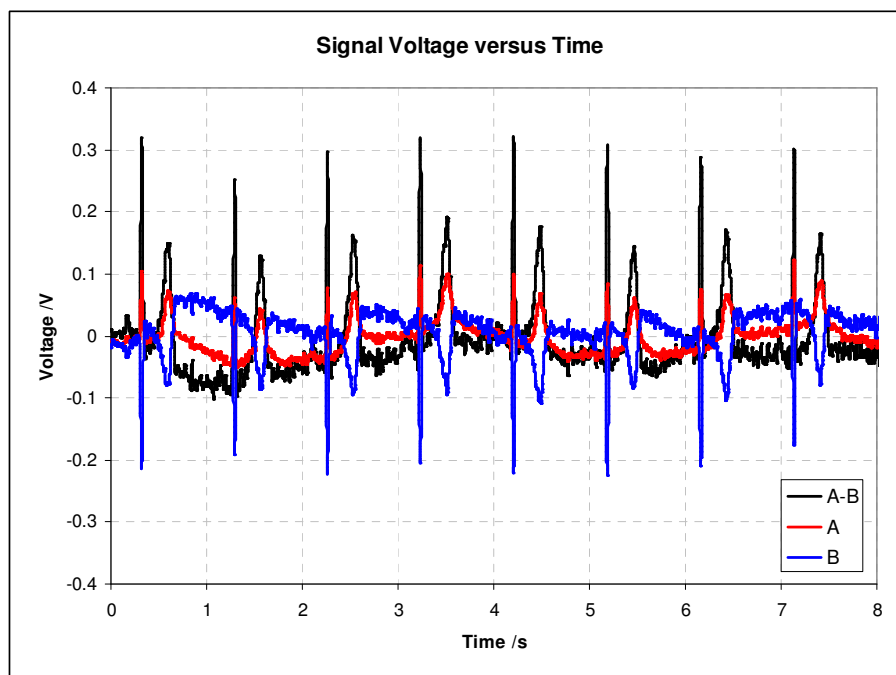
The data can be saved as a text file that is either comma or tab delimited. The data is tabulated in the form:

0.000	0.008346	-0.008809	-0.018999
0.001	0.009432	-0.008183	-0.019048
0.002	0.010199	-0.007738	-0.018926
0.003	0.010598	-0.007477	-0.018621
0.004	0.010596	-0.007394	-0.018130

The columns represent for following:

Time (s)    A-B (V)                      A (V)                      B(V)

The data may be opened with a text editor and may be readily processed in a spread sheet. Below are example graphs made in a spread sheet.



#### 4.4 Software Shutdown

The CIB software is closed by use of the EXIT button. Once the software is closed the CIB may be switched off and then the USB connection may be broken.

It is inadvisable to disconnect the USB connection while the CIB software is running.



## 5.0 Applications

### 5.1 Obtaining an electrocardiogram (ECG) signal:

Start by setting:

- Gain to "x10"
- Low pass "in"
- Notch filter "in"

Oscilloscope:

If using an oscilloscope connect the control and interface box differential output to an oscilloscope using a standard BNC cable, set the time base to 0.5secs/cm and Y gain to 0.5Volts/cm dc coupled.

Virtual instrument:

If using the soft virtual instrument then drag the voltage setting to about 1.5, select "Differential A-B" from the channel selection and click on the "Start" button, the time axis should start to scroll.

Switch on the module power and hold one sensor in each hand (hands should be clean and dry) with the tips of the thumbs resting lightly (do not squeeze) on the contact surface of the sensor. It is important that both the violet coloured electrode face and outer metal case of the sensor contact the skin. After a few seconds settling time your ECG should be displayed by the oscilloscope/PC centred on 0 volts. Everyone's ECG is different so you may need to adjust the scope setting/voltage scale for an optimal display; if the ECG appears inverted swap the sensors over to opposite hands. If you now squeeze the sensor between your thumb and forefinger you should still see your ECG but the level of baseline noise will increase noticeably; this is an electromyogram (EMG) signal caused by nerve impulses to the muscles in the forearm. The EMG signal can also be seen more clearly by placing both sensors next to each other on one forearm and then clenching the fist; no ECG signal should be present and the EMG signal level should increase the harder you clench your fist.

It is also possible to detect the ECG signal through clothing if the subject is wearing a shirt that is predominantly made of a natural fibre such as cotton. An ECG can be obtained by holding one sensor over the mid sternum and the other on the left hand side of the chest. The shape of the signal may be different to the finger tip ECG and will change depending on the relative positions of the sensors.

It is possible but not recommended to connect the sensors directly to your own equipment.

## 5.2 Obtaining other physiological signals:

Start by setting:

- Gain to “x10”
- Low pass “in”
- Notch filter “in”

Oscilloscope:

If using an oscilloscope connect the module’s differential output to an oscilloscope using a standard BNC cable, set the timebase to 0.5secs/cm and Y gain to 0.5Volts/cm dc coupled.

Virtual instrument:

If using the soft virtual instrument then drag the voltage setting to about 1.5 select “Differential A-B” from the channel selection and click on the “Start” button, the time axis should start to scroll.

Switch on the module power:

An electrooculogram (EOG) signal can be seen by placing a sensor on each temple, look straight ahead and wait for the output to stabilise then by looking left then right you should see a step response as the eyeball moves. Placing the sensors above and below one eye should enable you to see up and down movement of the eye and also blinking.

It is also possible to detect electroencephalogram (EEG) signals from the head. As these signals are very small, additional amplification and filtering may be needed. By using spectrum analysis in conjunction with the EPS system it has been possible to detect alpha waves within the EEG signal.

It is possible but not recommended to connect the sensors directly to your own equipment.

## TERMS and CONDITIONS

Use of the EPIC Demonstration Set ( "the Set") is subject to the terms of the Evaluation Agreement ( "Agreement") entered into between the Recipient and Plessey Semiconductors Ltd . The following outlines certain key provisions;

### 1) DISCLAIMER

The Set is a test product and neither Plessey nor its Licensor the University of Sussex ("Sussex") makes any representation or gives any warranty or undertaking in relation to it, and so far as permitted by law, all conditions, warranties, representations and other obligations on the part of Plessey and Sussex are excluded. Without prejudice to the generality of the above, no representation, warranty or undertaking is given;

- (a) that the Set is of satisfactory quality or is fit for any particular purpose, has been developed with reasonable care and skill, or is safe to use;
- (b) that the Set is suitable for monitoring or diagnosing any physiological function, condition or illness;
- (c) that the Set has been manufactured or tested in accordance with applicable laws and regulations governing the manufacture and testing of medical devices;

**The EPIC Demonstration Set must not, in any circumstances be used , nor data arising from its use be used to inform any decision about the health, welfare, monitoring or treatment of any human being .**

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ISO/TS 16949:2009

OHSAS 1:8001:2007

ISO 9001:2008

ISO 14001:2004

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