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EOG100C – ELECTROOCULOGRAM AMPLIFIER MODULE

The electrooculogram amplifier module (EOG100C) is a single-channel, high-gain, differential input, biopotential amplifier designed for tracking eye movement. The EOG100C is designed for use in the following applications:

Sleep studies	Nystagmus testing	Vertigo investigations
Eye motion and tracking	REM activity analysis	Vestibular function studies

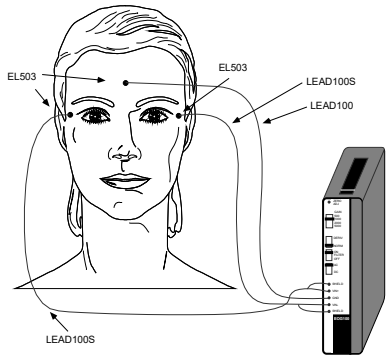
The EOG100C senses the corneal-retinal potential inherent in the eyeball. As the eyes move in the horizontal and vertical planes, these potentials are superimposed to generate a DC voltage variation in the region immediately surrounding the eye sockets.

The EOG100C will connect directly to any of BIOPAC's Ag-AgCl series lead electrodes. For most EOG applications, EL503 electrodes are used. Use two shielded electrode leads (LEAD110S) for the signal inputs and one unshielded electrode lead (LEAD110) for ground.

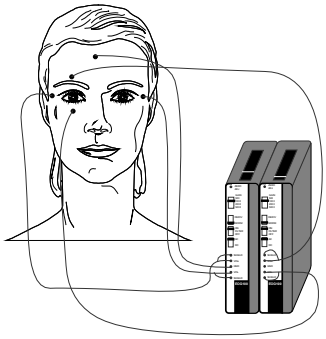
The EOG100C has built-in drive capability for use with shielded electrode leads. If high bandwidth (resolution) EOG measurements are required, then shielded electrode leads are recommended. When the interference filter is switched on, shielded leads are typically not necessary. The EOG100C is designed to pass the EOG signal to accommodate a large velocity range with minimal distortion.

This module includes an HP selection switch, which permits either absolute (DC) or relative (AC: 0.05 Hz HP) eye motion measurements. When performing absolute eye motion measurement, the eye position signal will still decay, but the time constant will be significantly longer than when performing relative eye motion measurement.

The EOG100C also has an EOG derivative function. When enabled, the output signal will produce a wave that will be directly proportional to the velocity of eye movement. Eye velocity measurement is useful for performing Nystagmus testing. The derivative function is obtained through the use of a specially designed bandpass filter (center frequency of 30 Hz, Q=0.8).



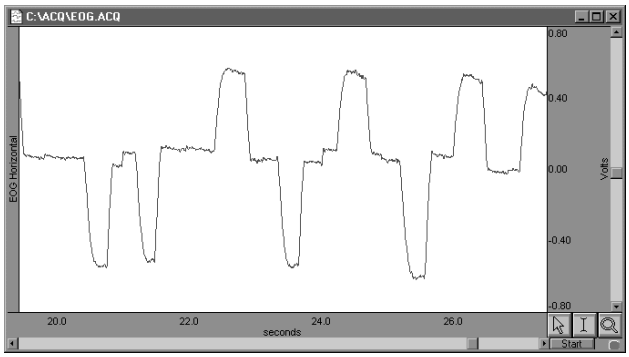
Setup to record horizontal eye movement



Setup for two EOG100C modules to record vertical and horizontal eye movement

To increase accuracy, use electrodes above and below each eye and parallel them with JUMP100C Jumper leads when connecting to the vertical track EOG100C module.

This graph shows a horizontal eye movement recording. The positive peaks indicate eyes looking left. The negative peaks indicate eyes looking right. The derivative of this waveform would indicate the speed of eye motion during this time.



Typical EOG signal

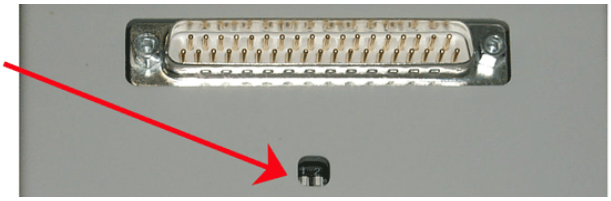
FREQUENCY RESPONSE CHARACTERISTICS

The 0.05 Hz high pass lower frequency response setting is a single pole roll-off filter.

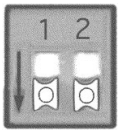
Modules can be set for 50 Hz or 60 Hz notch options to match the wall-power line frequency of the destination country. The proper setting reduces noise from interfering signals when the notch filter is engaged. Generally, wall-power line frequency is 60 Hz in the United States and 50 Hz in most of Europe and China; if necessary, contact BIOPAC to determine the appropriate line frequency. To reset the line frequency setting, adjust the bank of switches on the left panel of the amplifier module.

The 50/60 Hz notch is only engaged when the 35 Hz LPN filter switch on the EOG100C amplifier is set to ON.

Line Frequency switch bank is on the left panel of biopotential and transducer amplifiers

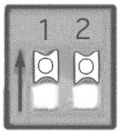


50 Hz



Both switches DOWN

60 Hz



Both switches UP

See also: Sample frequency response plots.

35 Hz LPN (with 50 Hz notch) 100 Hz LP

35 Hz LPN (with 60 Hz notch)

EOG100C CALIBRATION

The EOG100C is factory set and does not require calibration. To confirm the accuracy of the device, use the CBLCALC.

EOG100C SPECIFICATIONS

Gain:	500, 1000, 2000, 5000
Output Selection:	Normal, Derivative output
Output Range:	±10 V (analog)
Frequency Response	Maximum bandwidth (DC – 100 Hz)
Low Pass Filter:	35 Hz, 100 Hz
High Pass Filter:	DC, 0.05 Hz
Notch Filter:	50 dB rejection @ 50/60 Hz
Noise Voltage:	0.1µV rms – (0.05-35 Hz)
Signal Source:	Electrodes (three electrode leads required)
Z (input)	
Differential:	2 MΩ
Common mode:	1000 MΩ
CMRR:	110 dB min (50/60 Hz); see also: Shield Drive Operation
CMIV–referenced to	
Amplifier ground:	±10 V
Mains ground:	±1500 VDC
Input Voltage Range	Gain Vin (mV)
	500 ±20 1000 ±10
	2000 ±5 5000 ±2
Maximum Over-voltage for Differential Input: ±25 V	
Weight:	350 grams
Dimensions (WxDxH):	4 cm x 11 cm x 19 cm
Input Connectors:	Five 1.5 mm male Touchproof sockets (Vin+, Ground, Vin-, 2 of shield)

See also: JUMP100C and MEC series

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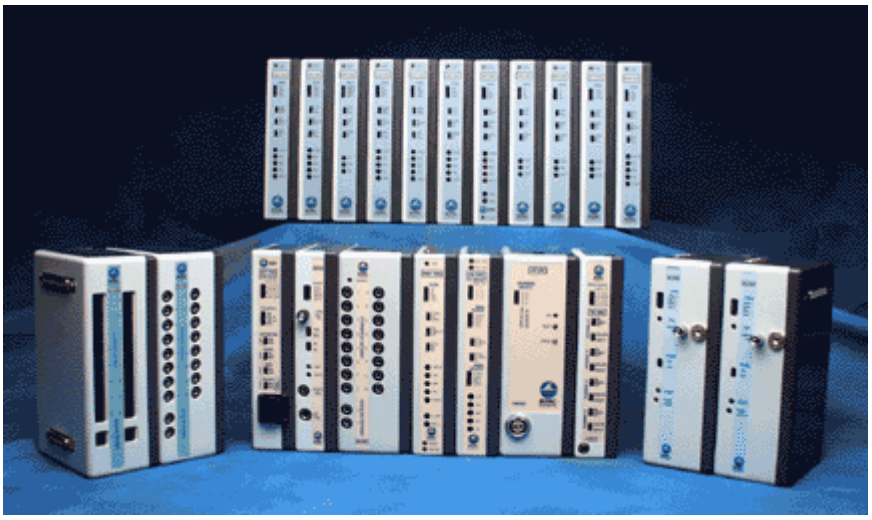
AMPLIFIER MODULES



100C series modules

The 100C series biopotential/transducer amplifier modules are single channel, differential input, linear amplifiers with adjustable offset and gain. These modules are used to amplify smaller voltage signals coming from raw electrodes and transducers (typically less than ±0.01 volt). In addition to amplifying signals, most of the 100C series modules include selectable signal conditioning ability so that data may be filtered or transformed as it is being collected.

- **Biopotential modules**: ECG100C, EEG100C, EGG100C, EMG100C, EOG100C, ERS100C
- **Transducer modules**: EDA100C; PPG100C; RSP100C; SKT100C
- **MRI Smart modules**—advanced signal processing circuitry removes spurious MRI artifact from the source physiological data: ECG100C-MRI; EDA100C-MRI; EEG100C-MRI; EMG100C-MRI; PPG100C-MRI.

Modules can be cascaded by snapping the modules together. Up to sixteen 100C series modules can be connected to the MP System at any one time.

IMPORTANT

When cascading modules, it is important to remember that **no two amplifiers may be set to the same channel**. If two connected amplifier modules are left on the same channel, then contention will result and both amplifier outputs will give erroneous readings.

Amplifier offset Set by the zero adjust control trim potentiometer near the top of the module. The offset control can be used to adjust the zero point or "baseline" of a signal.

Gain Switch The four-position slide Gain switch controls sensitivity. Lower gain settings will amplify the signal to a lesser extent than higher gain settings. If the signal plotted on the screen appears to be very small for a given channel, increase the Gain for that particular channel. Conversely, if the signal seems to be "cropped" at +10 Volts or −10 Volts, decrease the Gain.

Connections Transducers and electrodes connect to the amplifiers using 1.5 mm female Touchproof connectors.

Electrodes

The biopotential amplifier modules use a three-electrode arrangement (VIN+, GND, VIN–). Although certain applications may require different arrangements of electrodes and/or transducers, some generalizations about electrode and transducer connections can be made. Electrodes measure the electrical activity at the surface of the skin, and since electricity flows from – to +, measuring the flow of a signal requires that there be (at least) one "-" electrode and (at least) one "+" electrode. An additional electrode, a "ground" (or earth) electrode is used to control for the general level of electrical activity in the body.

Leads

Typically, electrode leads are used to connect individual electrodes to the *xxx*100C amplifier. Most electrode leads are shielded, which means they introduce less noise than an unshielded lead. A shielded electrode lead has an extra jack on one end that plugs into the SHIELD input on the amplifier modules. A standard electrode lead configuration consists of two LEAD110S electrode leads (one connected to the VIN + input and one to the VIN – input on the amplifier) and a single LEAD110 (connected to the GND input on a biopotential amplifier).

Transducers

Transducers, on the other hand, are not designed to measure electrical activity directly and usually involve simpler connections. The transducers discussed in this manual translate physical changes (in temperature, for instance) into electrical signals. Connections for individual transducers are discussed in each section.

Channel

The active channel is selected using the channel select switch on the top of the module. The channel select switch can direct the amplifier output to one of sixteen possible MP System input channels. *Remember to make sure that each amplifier module is set to a unique channel.*

Zero Adjust

On input signals, a limited range in baseline level (DC offset) can be "zeroed out" using the zero adjust potentiometer. Typically, the zero adjust will not have to be used (as it is preset at the factory). However, some of the 100C series modules can measure DC signals and, in certain circumstances, signal "zeroing" may be required.

Setup

All 100C Series biopotential or transducer amplifiers incorporate specific gain, coupling and filtering options that are appropriate for the biopotential type or transducer signal that requires measurement. Generally, when an electrode or transducer is inserted into the corresponding 100C series module, the amplifier will immediately produce a useful output, with no user adjustments necessary.

Certain functionality is added to each module to optimize its performance with its intended signal measurement. For example, all 100C series biopotential amplifiers incorporate a selectable interference filter. When the interference filter is on, 50/60 Hz interfering signals are suppressed.

Filters

All 100C series amplifiers are constructed with filters that have a high degree of phase linearity. This means the 100C series modules will filter signals with as little distortion as possible. These modules also incorporate protection circuitry to limit input current in the event of input signal overload. Notch and bandstop filters have the potential to cause distortion, especially in the form of "ringing" in the data stream; biopotential hardware notch filters are implemented in conjunction with LP or HP functions to minimize distortion.

Line Freq

Line Frequency is set using the recessed switch boxes on the left panel of the amplifier module (50 Hz = all switches down, 60 Hz = all switches up). It is important to select the correct line frequency for your geographical region. Typically, U.S. line frequency is 60 Hz; Europe and China 50 Hz. Contact BIOPAC for additional line frequency information. All MP biopotential amplifier modules which contain a 50/60 Hz notch filter only engage the filter when the pass filter is also ON:

- ECG100C, EEG100C, EOG100C amplifiers: the 50/60 Hz notch is only engaged when the 35 Hz LPN low pass notch filter switch is set to ON.
- EMG100C, ERS100C amplifiers: the 50/60 HZ notch is only engaged when the 100 Hz HPN high pass notch filter switch is set to ON.

See individual module sections for details.