

CABLE CALIBRATORS FOR BIOPOTENTIAL AMPLIFIERS



CBLCALC Calibration Cable for 100C-series Biopotential Amplifiers.

CBLCAL Calibration Cable for 100B-series Biopotential Amplifiers. Use the CBLCAL to verify the signal calibration of the DA100C.

REFCAL Used to check the reference voltage of the DA100C.

Use CBLCAL/C to verify the calibration of the any of the Biopotential amplifiers. The cable (1.8m) connects between the amplifier input and the UIM100C or AMI100D/HLT100C D/A output 0 or 1. To verify the amplifier's frequency response and gain settings, create a stimulus signal using *AcqKnowledge* and monitor the output of the amplifier connected to the Calibration Cable. The Calibration Cable incorporates a precision 1/1000 signal attenuator.

Amplifier specification tests are performed at the factory before shipping, but a Calibration Cable can ensure users peace of mind by permitting precise frequency response and gain calibrations for exact measurements.

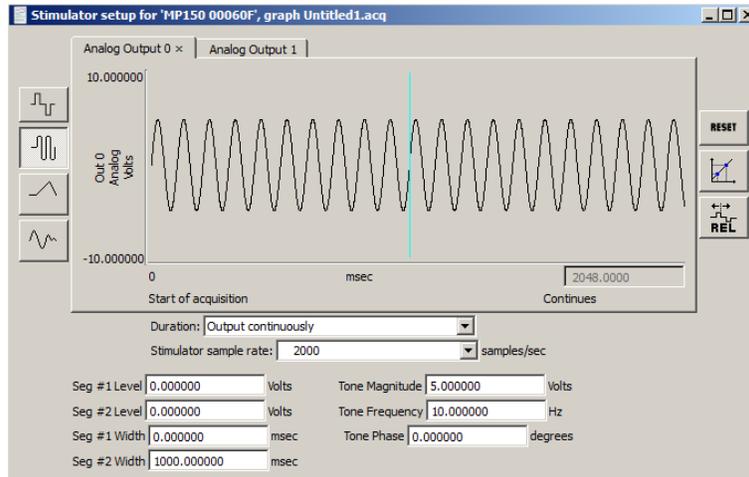
CBLCAL/C CALIBRATION

Hardware Setup

1. Connect the MP160 to the AMI100D/HTL100C (or MP150 to UIM100C) and biopotential amplifiers as normal.
2. Connect the CBLCAL/C between the selected amplifier and the UIM100C, inserting the single 3.5mm plug into the UIM100C Analog Output "0" port.
 - **To connect CBLCAL/C to the AMI100D or HLT100C**, a BIOPAC CBL122 adapter cable is required. This adapter cable consists of a 3.5 mm jack and an RJ11 plug. Connect the CBLCAL/C to the 3.5 mm jack, and plug the RJ11 end into the AMI100D/HLT100C Analog Output "0" port.
3. Connect the end containing several 2 mm pins into the corresponding holes on the face of the biopotential amplifier.
4. Select a Gain setting of 1,000 for DA, ECG, EGG, EMG, and EOG, or 5,000 for EEG and ERS.
5. Turn all filters to the desired position.
6. Select an appropriate channel on the top of the amplifier being tested (usually channel one, as this is the default setup in the software).

Software Setup

1. Under **Channel Setup**, insure that the default is set to analog channel one (A1).
2. Under **Acquisition Setup**
 - a) Choose a sampling rate of 2000 Hz (or higher).
 - b) Choose an acquisition period of at least 5 seconds.
 - c) Choose Record Last mode.
3. Under **Stimulator Setup** (see figure below)

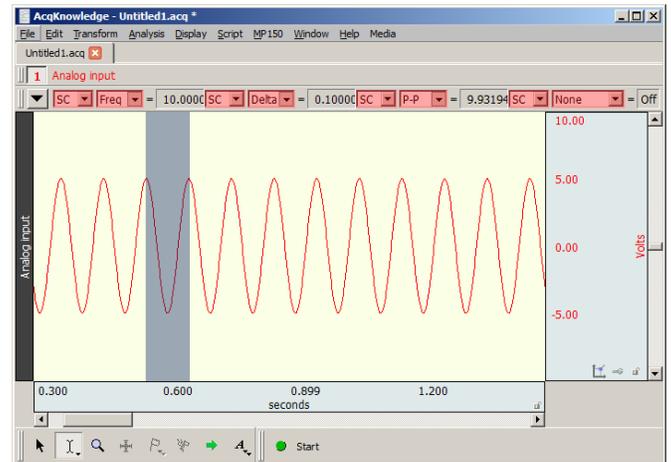


- a) Select the sine wave for the shape of the output signal.
- b) Set the “Seg. #1 Width” to zero. This means that the signal will be transmitted continuously starting at time-point zero.
- c) Set “Seg. #2 Width” to 1,000 msec (one second). This is the length of the output signal.
- d) Select “Analog Output: 0.”
- e) Select “Output continuously.”
- f) The most important settings are the signal magnitude and frequency. Set the magnitude to 5 Volts (i.e., 10 V p-p) if the module gain setting is 1,000. If the lowest module gain setting available is 5,000, choose 1 Volt.
- g) Set the frequency to 10 Hz to check the gain calibration (on a sinusoidal signal, this setting is appropriate for all biopotential amplifiers).

CALIBRATION PROCEDURE

AcqKnowledge is now set-up to check for the proper calibration of biopotential amplifiers.

1. Start the acquisition. Theoretically, since **record last** mode is enabled signal output is continuous, AcqKnowledge could acquire data forever.
2. Stop the acquisition when the waveform has stabilized.
3. Use the “I-beam” cursor to select the latter part of the record.
4. Perform all the calibration measurements on the latter part of the collected record.
 - a) Scale the waveform into some semblance of the one in the following figure.
 - b) Select the Pk-Pk (peak to peak) measurement to determine amplitude. The measured voltage depends on the voltage input and the gain setting on the amplifier. Use the following formula to determine this number.



Measured Voltage =
(Stimulator Input Voltage) * (1/1,000) * (Biopotential Amplifier Gain Setting)

If the amplifier gain setting is 1,000, it will cancel the CBLCAL/C attenuation (1/1,000). Therefore, the measured voltage will equal the stimulator input voltage. In this example, assuming a gain setting of 1,000 and a stimulator input of 10 V (pk-pk), the expected signal will be very close to 10 V (p-p).

- c) It is important to measure the amplitude of the acquired waveform correctly. Highlight several peaks with the “I-beam” cursor.
- d) Click the “peak detection” icon at the top of the graph window twice. This will precisely highlight one of the many peak-to-peak amplitudes.
- e) Open one of the pop-up measurement, windows and select “p-p” to measure the amplitude of the waveform. This result indicates the vertical distance of the waveform between the two selected peaks (see figure above).
- f) To verify the consistency of the difference in peak-to peak values, click the “peak detection” icon again. This will move the cursor to the next available peak below.
- g) Repeat this several times to verify the subsequent peak heights. If the measured peak-to-peak height is 10.04 Volts, the acquired signal can be ascertained as ± 5.02 Volts. If the stimulator outputs a 5 Volt magnitude signal, then measuring 5.02 Volts (0-pk) is considered accurate for any biopotential amplifier (the analog output stimulator is accurate to within $\pm .5\%$). To best determine the accuracy of the amplifier, consider an average of measurements.

REFCAL REFERENCE CALIBRATOR FOR THE DA100C



The **REFCAL** is used to check the reference voltage of the **DA100C**. It connects to the DA100C and displays the reference voltage as an analog input signal. This makes it very easy to adjust the reference voltage of the DA100C to suit the transducer.

The REF CAL connects the VREF1 and VREF2 voltage reference outputs directly to the DA100C inputs via a precision attenuator of value (1/50). When using the REF CAL to set the DA100C references, the DA100C should be set to DC with a gain of 50.

The voltage output on the selected channel of the DA100C will be the voltage difference between VREF1 and VRREF2:

$$V_{OUT} = V_{REF1} - V_{REF2}$$