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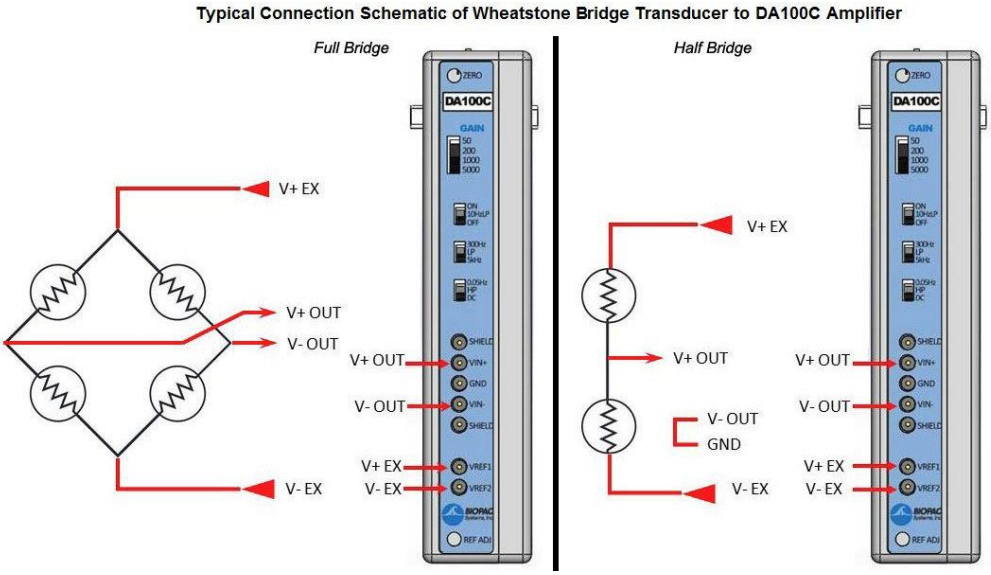
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DA100C – DIFFERENTIAL AMPLIFIER MODULE





The differential amplifier module (DA100C) is a general purpose, single channel, differential amplifier. The DA100C is designed for use in the following measurement applications:

- Blood pressure (hemodynamics)
- Displacement (linear or angular)
- Muscle strain or force (pharmacology)
- Physiological sounds
- Temperature
- Humidity

The DA100C has one differential input linear amplifier with adjustable offset and gain. The DA100C is used to amplify low-level signals from a variety of sources. The DA100C has built-in excitation capability, so it can work directly with many different types of transducers, such as:

- Pressure transducers
- Strain gauges
- Accelerometers
- Microphones
- Electrogoniometers
- Piezo sensors
- Wheatstone bridges
- Photocells
- Thermistors

Compatible BIOPAC Transducers are:

TRANSDUCER	*TYPE*	*TRANSDUCER*	*TYPE*
TSD104A	Precision Pressure	TSD121C	Hand Dynamometer
TSD105A	Variable Range Force	TSD125 Series	Fixed Range Force
TSD107B	High Flow Pneumotach	TSD127	Low Flow Pneumotach
TSD108	Physiological Microphone	TSD130 Series	Goniometers & Torsiometers
TSD117	Medium Flow Pneumotach	TSD137 Series	Very Low Flow Pneumotach
TSD120	Noninvasive BP cuff	TSD160 Series	Differential Pressure

If the input signal is applied differentially between the VIN+ and VIN- inputs, the Input Signal Range can be centered on any voltage from -10 V to +10 V with respect to GND. If the signal is applied to a single input (with the other input grounded), then that signal can range over the selected Input Signal (pk- pk) with respect to GND.

The DA100C can be used to directly connect existing transducers. The DA100C can be outfitted with connector assemblies for easy interfacing to a variety of ñoff the shelfò pressure transducers, force gauges, and strain gauges.

Updated: 3.25.2019

TRANSDUCER CONNECTOR INTERFACES



These transducer connector interfaces (TCIs) have pin plugs on one side and the transducer mating connector on the other. The following TCIs are available. Or the TCI Kit can be used to make a custom adapter.

TCI100 Grass/Astromed transducers ï 6 pin

TCI101 Beckman transducers ï 5 pin

TCI102 World Precision Instrument transducers ï 8 pin

TCI103 Lafayette Instrument transducers ï 9 pin

TCI104 Honeywell transducers ï 6 pin

TCI105 Modular phone jack connector ï 4 pin

TCI106 Beckman transducers ï 12 pin

TCI107 Nihon Koden transducers ï 5 pin

TCI108 Narco transducers ï 7 pin

TCI109 Fukuda transducers ï 8 pin

TCI110 **Gould transducers – 12 pin: Discontinued → use Fogg Cable and an available BIOPAC TCI**

TCI111A Liquid metal transducers ï 1.5 mm Touchproof male plugs (two)

TCI112 Hokanson transducers ï 4 pin

TCI113 Hugo Sachs/Harvard Apparatus ð 6 pin

TCI114 ñSSò Series Transducers

Important Notes when using TCI114

- Set REF ADJ pot. On the DA100C: VREF1 to +5V, VREF2 to ï 5V
- The following SS Series Transducers require multiple channel inputs and therefore require a corresponding number of TCI114 with a DA100C each:
  - SS20L and SS21L Twin-axis Goniometers (2 channels)
  - SS26L and SS27L Tri-Axial Accelerometers (3 channels)
- The TCI114 interface is designed for SS Series Transducers only
  - SS1L, SS1LA, SS2L, or SS29L Electrode Leads and Adapters ï not recommended: signal may be obtained but quality may be impaired.
  - SS53L, SS54L, and SS55L Digital Switches ï not supported: digital interface required; use TSD116 Series Switches & Markers.
  - SS58L Low-Voltage Stimulator ï not supported.
  - OUT1 Headphones ï not supported.

TCI115 Interface XLR Microphone

The TCI115 will operate with a balanced (differential output) or unbalanced (single-ended output) XLR microphone. Interface all standard XLR microphones to the BIOPAC DA100C for use with a Research System. Accommodates a six meter XLR microphone cable. Input signal level maximum is 400 mv (p-p).

Microphones must be dynamic or have battery-powered condenser (the MP system does not provide 48 V phantom powering).

TCIPPG1 Geer to PPG100C only ð 7 pin

DA100C VOLTAGE REFERENCES

The DA100C has two adjustable voltage sources (VREF1 and VREF2) for activating passive sensors like pressure transducers, strain gauges, thermistors and photocells. The references can be set anywhere from -5.0 to +5.0 V. GND is at 0 V. VREF1 and VREF2 track each other with opposite polarity, thus a maximum differential of 10 V is obtainable for driving external transducers. For example, if VREF1 is set to +1.0 V (with respect to GND), then VREF2 will automatically be set to ï 1.0 V.

The references can be adjusted using the REF ADJ potentiometer near the bottom of the module. The voltage references can handle up to 20 mA sourcing or sinking to each other or GND. Pay close attention to the sensor drive requirements so as to minimize overall current consumption.

FREQUENCY RESPONSE CHARACTERISTICS

Use the **10 Hz LP** lowpass filter for connecting the DA100C to most pressure, force, and strain transducers (i.e., TSD104A, TSD105A, TSD120, TSD121C, TSD125 Series, and TSD130 Series).

Use the **300 Hz LP** lowpass filter for connecting the DA100C to devices with higher frequency output signals (i.e., TSD107B, TSD108, TSD117).

Use the **5,000 Hz LP** lowpass filter for connecting the DA100C to devices with the highest frequency signals, such as microphones and clamp signals (patch, voltage or current).

See also: the sample frequency response plots. 10 Hz LP, 300 Hz LP, 5000 Hz LP

DA100C CALIBRATION

A. Reference calibration
B. Amplifier gain calibration
C. Transducer calibration if applying physical variable
D. Transducer calibration if not applying physical variable

A. Reference Calibration

The **REFCAL** is used to check the reference voltage of the **DA100C**. The ref voltage is used to provide excitation to passive transducers.

B. Amplifier Gain Calibration

Use the CBLCAL.

C. Transducer Calibration if applying physical variable

1. Plug transducer it into the DA100C.
2. Set the gain switch on the DA100C to the desired level.
3. Apply the physical variable to the transducer on the low end of the expected range.
4. Press on Cal 1 in the scaling window in Acq*Knowledge*.
5. Apply the physical variable to the transducer on the high end of the expected range.
6. Press on Cal 2 in the scaling window in Acq*Knowledge*.
7. Review the Input Voltage differential (provided in the scaling window as a consequence of pressing CAL1 and CAL2) and adjust if necessary.
    - If the Input Voltage differential signal is less than +/- 50 mV it may be appropriate to increase the gain setting on the DA100C.
    - If either Input Voltage differential signal is higher than 9.9 V or less than ï 9.9 V, then reduce the gain setting on the DA100C.

NOTE: If the Gain switch setting on the DA100C is adjusted, steps 3-7 will need to be repeated.

The **physical variable** for calibration varies based on the transducer type. See the appropriate transducer specification for details:

TRANSDUCER	*TYPE*	*TRANSDUCER*	*TYPE*
TSD104A	Precision Pressure	**TSD121C**	Hand Dynamometer
TSD105A	Variable Range Force	**TSD125 Series**	Fixed Range Force
TSD107B	High Flow Pneumotach	**TSD127**	Low Flow Pneumotach
TSD108	Physiological Microphone	**TSD130 Series**	Goniometers & Torsiometers
TSD117	Medium Flow Pneumotach	**TSD137 Series**	Very Low Flow Pneumotach
TSD120	Noninvasive BP cuff	**TSD160 Series**	Differential Pressure

D. Transducer Calibration if not applying physical variable

Use this procedure to calibrate the transducer if the required physical variable changes can't easily be generated.

1. Calculate the de-normalized voltage calibration factor, V_Y.
    a) Note the factory calibration constant "K" (generally listed as "Output" in the transducer specifications), expressed in the form of voltage/physical variable per volt excitation ((V/P)/V),
    b) Multiply K ((V/P)/V) by the reference voltage (RV) of the DA100C (2 V factory preset).
    c) Multiply the result [K((V/P)/V)* RV] = V_Y by the Gain switch setting value on the DA100C.
2. Plug the transducer into the DA100C.
3. Place the transducer in the ambient or zero state.
4. Press CAL1 – this will generate a value Vzero in the Input Voltage box
5. Enter the ambient or zero physical value in the Cal 1 Map/Scale window
6. Enter CAL2 Input Voltage as $V_{zero} + V_Y$
7. Enter the ambient + delta physical value in the Cal 2 Map/Scale window

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DA100C SPECIFICATIONS

Gain:	50, 200, 1000, 5000
Output Range:	±10 V (analog)
Frequency Response	Maximum bandwidth (DC-5,000 Hz)
Low Pass Filter:	10 Hz, 300 Hz, 5000 Hz
High Pass Filter:	DC, 0.05 Hz
Input Voltage (max):	±200 mV (protected)
Noise Voltage:	0.11 µV rms ï (0.05-10 Hz)
Temperature Drift:	0.3 µV/°C
Z (Differential input):	2 MÝ
CMRR:	90 dB min
CMIVð referenced to	
Amplifier ground:	±10 V
Mains ground:	±1500 VDC
Voltage Reference:	variable: up to ±5 V excitation (10 V delta) maximum @ 20 MA (max) (preset to 2 volts excitation)
Signal Source:	Variety of transducers

Input Voltage Range

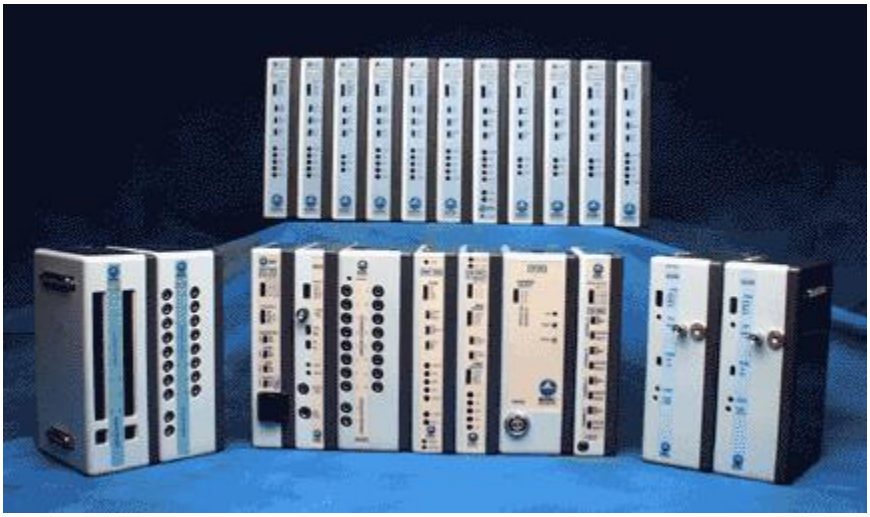
Gain	Vin (mV)
50	±200
200	±50
1000	±10
5000	±2

Maximum Over-Voltage for Differential Input: ±25 V

Weight:	350 grams
Dimensions:	4 cm (wide) x 11 cm (deep) x 19 cm (high)
Input Connectors:	Seven 2 mm female sockets: (Vin+, Ground, Vin-, 2 of shield, 2 of signal excitation)

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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**ð 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 ñbaselineò 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 ñcroppedò 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 ï to +, measuring the flow of a signal requires that there be (at least) one ñ-ò electrode and (at least) one ñ+ò electrode. An additional electrode, a ñgroundò (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 ï 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 ñzeroed outò 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 ñzeroingò 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 back of the amplifier module (50 Hz = all switches down). 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.

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