Chapter 3 General Purpose Transducer Amplifier Module

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

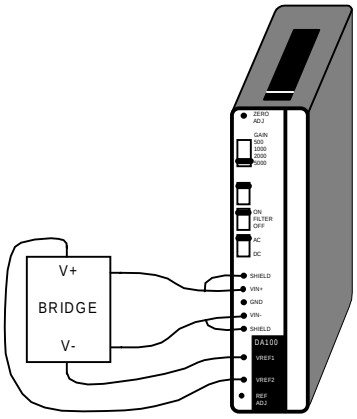
Compatible BIOPAC Transducers are:

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 volts to +10 volts 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 "off the shelf" pressure transducers, force gauges, and strain gauges.

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 you can use the TCI Kit to make a custom adapter.



TCI100	Grass/Astromed transducers – 6 pin
TCI101	Beckman transducers – 5 pin
TCI102	World Precision Instrument transducers – 8 pin
TCI103	Lafayette Instrument transducers – 9 pin
TCI104	Honeywell transducers – 6 pin
TCI105	Modular phone jack connector – 4 pin
TCI106	Beckman transducers – 12 pin
TCI107	Nihon Koden transducers – 5 pin
TCI108	Narco transducers – 7 pin
TCI109	Fukuda transducers – 8 pin
TCI110	Gould transducers – 12 pin
TCI111	Liquid metal transducers – two 2mm sockets
TCI112	Hokansen transducers – 4 pin
TCIPPG1	Geer to PPG100C only — 7 pin

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 volts. GND is at 0 volts. VREF1 and VREF2 track each other with opposite polarity, thus a maximum differential of 10 volts 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 –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 your sensor drive requirements so as to minimize overall current consumption.

Frequency Response Characteristics

Use the **10Hz 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 **300Hz LP** lowpass filter for connecting the DA100C to devices with higher frequency output signals (i.e., TSD107B, TSD108, TSD117).

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

Modules are factory preset for 50 or 60Hz notch options, depending on the destination country.

See the sample frequency response plots beginning on page 186: 10Hz LP, 300Hz LP, 5000Hz 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** (see page 40) 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.

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 your expected range.
4. Press on Cal 1 in the scaling window in AcqKnowledge.
5. Apply the physical variable to the transducer on the high end of your expected range.
6. Press on Cal 2 in the scaling window in AcqKnowledge.
7. Review the Input Voltage differential (provided in the scaling window as a consequence of pressing cal 1/cal2) and adjust if necessary
   - ❖ If the Input Voltage differential is less than +/- 100 mV it may be appropriate to increase the gain setting on the DA100C.
   - ❖ If either Input Voltage signal is higher than 9.9V or less than –9.9V, then reduce the gain setting on the DA100C.

If you adjust the Gain switch setting on the DA100C, then you will need to repeat steps 3-7.

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

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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 if you can't easily generate the required physical variable changes in order to calibrate the transducer.

1. Calculate the de-normalized calibration factor, VY.
    a) Note the factory calibration constant (generally listed as "Output" in the transducer specifications), expressed in the form of voltage/physical variable (V/P),
    b) Multiply V/P by the reference voltage (RV) of the DA100C (2V factory preset).
    c) Multiply the result [(V/P) * RV] by the Gain switch setting value on the DA100C.
2. Plug the transducer into the DA100C.
3. Press Cal 1 …this will generate VB in the Input Voltage box
4. Enter the ambient physical value in the Cal 1 Map/Scale window
5. Enter Cal 2 Input Voltage as VY+VB
6. Enter the ambient + delta physical value in the Cal 2 Map/Scale window

DA100C Specifications

Gain:	50, 200, 1000, 5000
Output Range:	±10V (analog)
Frequency Response	
Low Pass Filter:	10Hz, 300Hz, 5000Hz
High Pass Filter:	DC, 0.05Hz
Input Voltage (max):	±200mV (protected)
Noise Voltage:	0.11µV rms - (0.05-10Hz)
Temperature Drift:	0.3µV/°C
Z (Differential input):	2MΩ
CMRR:	90dB min
CMIV—referenced to	
Amplifier ground:	±10V
Mains ground:	±1500 VDC
Voltage Reference:	-10 to +10V infinitely adjustable @ 20ma (max) (Factory preset to 2 volts excitation)
Signal Source:	Variety of transducers
Input Voltage Range	Gain — Vin (mV) 50 — ±200 200 — ±50 1000 — ±10 5000 — ±2
Weight:	350 grams
Dimensions:	4cm (wide) x 11cm (deep) x 19cm (high)