

Instrumentation Amplifier

(Order Code INA-BTA or INA-DIN)



Our instrumentation amplifier is used to condition signals to be compatible with Vernier interface products. The amplifier provides the necessary gain and offset to allow you to connect a wide variety of measurement equipment to your interface and electronically collect, store, and analyze the data.

Although you may calibrate your software to display otherwise, your interface unit can only measure a potential difference (voltage). Many laboratory instruments produce a voltage which varies as the instrument reading changes. Examples include gas chromatographs, spectrophotometers, light meters, and sound meters. If you are familiar with electronics, you may be able to go inside the instrument and find out where to measure this voltage signal. Some instruments seen have chart recorder terminals that are designed for just this kind of thing. Test the voltage range of this signal. If the voltage happens to vary over a range that matches your interface, then the signal can be fed directly to the interface and monitored by the software. More likely, the voltage signal will need to be amplified before it can be monitored.

How the Instrumentation Amplifier Works

The amplifier is a monolithic instrumentation amplifier with variable gain and offset settings. An instrumentation amplifier contains precision feedback components and circuitry that is necessary for small signal amplification.

The Instrumentation Amplifier does three primary tasks:

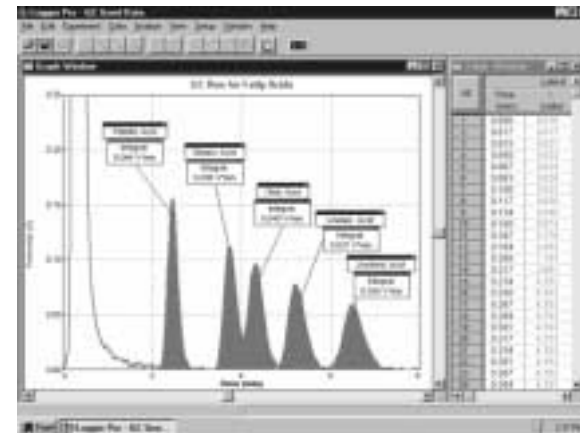
- Provides six different gain settings to amplify small signals to levels appropriate for our interfacing equipment.
- Offsets the voltage so it is always in the range of 0 to 3.5 volts. This allows the amplifier to be used with negative signals even though some of our interfaces only use 0-5 V inputs.
- Provides filtering of high frequency signals. Wires that connect the instrument to the amplifier are prone to pick up electrical noise much like a radio antenna. By filtering out these signals, only the data of interest are left.

When set to the 20 mV, 200 mV and 1 V positions, the amplification is set to 150, 15, and 3 respectively. The difference in voltage at the red and black terminal is amplified and output with reference to ground.

When set to ± 20 mV, ± 200 mV, and ± 1 V setting, the amplification is set to 75, 7.5 and 1.5 respectively. The difference in voltage at the red and black terminal is amplified and output with reference to 1.85 V.

Amplify an Instrument's Chart Recorder Output

Many lab instruments provide a low voltage output designed for interfacing to a chart recorder. You may use these outputs with the Instrumentation Amplifier to interface to a computer. This graph shows the output of a gas chromatograph processing a sample of fatty acids dissolved in toluene solvent.¹



Tips for Using the Instrumentation Amplifier with a Gas Chromatograph

If your voltage readings are noisy, you should connect the Earth ground of the Gas Chromatograph to the LabPro ground. To do this, first connect the Voltage Probe that was shipped with your interface to another channel (e.g., CH 2). Then connect the Earth ground to the black lead of the Voltage Probe.

Instrumentation Amplifier Specifications

Gain settings; 150, 75, 7.5, 15, 3, and $1.5 \pm 5\%$

Linearity: 1%

Power = 2.5 mA @ 5VDC

Frequency Response: 0-250Hz (f3dB)

Impedance : $1M\Omega$ to ground

Calibration values:

+/-1V	slope = 0.471648	intercept = -0.8584
+/-200mV	slope = 0.117912	intercept = -0.2146
+/-20mV	slope = 0.013181	intercept = -0.02399
0-1V	slope = 0.308642	intercept = 0
0-200mV	slope = 0.062617	intercept = 0
0-20mV	slope = 0.006636	intercept = 0

Note: This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.

Using the Instrumentation Amplifier with a Computer

This sensor can be used with a computer and any of the following lab interfaces: LabPro, Go!Link, Universal Lab Interface, or Serial Box Interface.

1. Connect the Instrumentation Amplifier to the computer interface and computer.

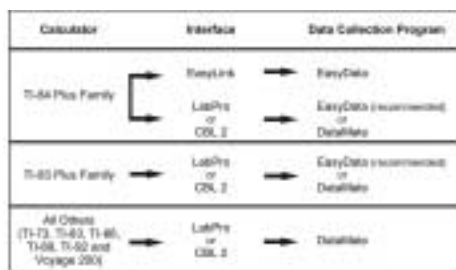
¹ Data collected using an Instrumentation Amplifier and GOW-Mac Series 350 Gas Chromatograph.

2. Start the *Logger Pro*[®] or *Logger Lite*[®] software.
3. The program will automatically identify the Instrumentation Amplifier, and you are ready to collect data.²

Using the Instrumentation Amplifier with TI Graphing Calculators

This sensor can be used with a TI graphing calculator and any of the following lab interfaces: LabPro, CBL 2[™], and Vernier EasyLink[™]. Here is the general procedure to follow when using the Instrumentation Amplifier with a graphing calculator:

1. Connect the data-collection interface to the graphing calculator.
2. Connect the Instrumentation Amplifier to any of the analog ports on the interface or to EasyLink.
3. Start the EasyData[®] or DataMate App—the application you choose to use depends on your calculator and interface. See the chart for more information.



4. The Instrumentation Amplifier will be identified automatically³, and you are ready to collect data.

If the data-collection application is not on your calculator, use the following instructions to load it onto the calculator.

- **EasyData App**—This program may already be installed on your calculator. Check to see that it is EasyData version 2.0 or newer. If it is not installed or is an older version, it can be downloaded to your computer from the Vernier web site, www.vernier.com/easy/easydata.html. It can then be transferred from the computer to the calculator using TI-Connect and a TI unit-to-computer cable or TI-GRAPH LINK cable. See the Vernier web site, www.vernier.com/calc/software/index.html for more information on the App and Program Transfer Guidebook.
- **DataMate program**—This program can be transferred directly from LabPro or CBL 2 to the TI graphing calculator. Use the calculator-to-calculator link cable to connect the two devices. Put the calculator into Receive mode, and then press the Transfer button on the interface.

² If your system does not support auto-ID, open an experiment file in *Logger Pro*, and you are ready to collect data.

³ If your system does not support auto-ID, choose **SETUP** and then **Other Sensors**. See the EasyData Guidebook for information on setting up a sensor manually, www2.vernier.com/manuals/easydata_guidebook.pdf

Using the Instrumentation Amplifier with Palm Powered[™] Handhelds

This sensor can be used with a Palm Powered handheld and the LabPro.

1. Connect the Palm Powered handheld, LabPro, and the 25-g Instrumentation Amplifier.
2. Start Data Pro[®].
3. Tap New, or choose New from the Data Pro menu. Tap New again. The 25-g Instrumentation Amplifier will be identified automatically.⁴
4. You are now ready to collect data.

Use as a Current Meter

The Instrumentation Amplifier can be used to monitor current instead of voltage. By placing a resistor between the terminals, the voltage amplified becomes proportional to the current according to

$$I = (V/G)/R$$

Where V is the voltage read, G is the gain setting of the amplifier, and R is the resistor value. To monitor current in a circuit, you want to choose a small resistor value; for example 0.1Ω or 1Ω resistor with a rating of at least 1W.

For monitoring a current output device, you will need to choose a termination resistor that is appropriate for that device (call for details or consult the manufacturers specifications). For best accuracy, perform a calibration using an open circuit and a known current source. Vernier also sells a Current Probe, Order code DCP-BTA, which has a range of ±600 mA.

Warranty

Vernier warrants this product to be free from defects in materials and workmanship for a period of five years from the date of shipment to the customer. This warranty does not cover damage to the product caused by abuse or improper use.



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⁴ If your sensor does not auto-ID, tap Setup and set up an experiment.