PIEZO FILM LAB AMPLIFIER

SPECIFICATIONS

- **Charge or Voltage Mode Operation**
- **BNC Input and Output**
- **0.01 to 1000 mV/pC Sensitivity Range in Charge Mode**
- **1M to 1G Input Resistance, -40 to 40dB Gain in Voltage Mode**
- **Multi-Pole, Low-Pass and High-Pass Filtering with -3dB Frequencies Ranging from 0.1Hz to 100kHz**
- **Internal Battery (2 x 9V) or external 24VDC Power Supply Operation**

FEATURES

- Wide Dynamic Range
- Charge and Voltage Modes
- Response to 0.1Hz
- Active HP and LP Filters

APPLICATIONS

- Low Frequency Dynamic Strain
- Pyroelectric Signals
- Audio-band and Acoustic Signals
- Machine Vibration
- Piezo Cable and Traffic Sensor Interface

The Piezo Film Lab Amplifier is a versatile preamplifier for use with piezoelectric sensors. The electric signal from the piezo film is generated within the electrodes of a capacitor. It is important to arrange an input that controls the rate of charge leakage appropriately for the application. Simply connecting a piezo film element to the input of an oscilloscope will usually create a high-pass filter that removes any low frequency content of the original piezo signal, and this can lead to disappointment or incorrect evaluation of the material's true potential. This has led MEAS to develop a new low-cost Piezo Film Lab Amp, specifically aimed at developers and engineers exploring the material. Both first-time users and seasoned professionals will benefit from the wide range of sensitivity adjustment in either voltage or charge modes, and the functionality of the high- and low-pass filters.

PERFORMANCE SPECIFICATIONS

ELECTRICAL

Supply Voltage	Internal 2 x 9 V Battery or External 24 VDC (using the supplied 100-240 VAC 50/60 Hz power supply unit)
Max Input Voltage	30 V
Max Linear Output Swing	±4 V (battery), ±5 V (ext)
Voltage Mode:	
Input Resistor Values	1M, 10M, 100M, 1G Ω
Gain	0 to +40 dB in 10 dB Increments with -40 dB Switch
Noise	30 mV_{rms} (0.20 V_{pp}) typ, 1 Hz to 100 kHz, 1 GΩ Input, +40dB (lower on battery power)
Charge Mode:	
Feedback Capacitor Values	100pF, 1nF, 10nF, 100nF
Sensitivity Range	0.01 to 1000 mV/pC
Noise	20 mV_{rms} (0.13 V_{pp}) typ, 1 Hz to 100 kHz, 100pF, +40 dB Gain (lower on battery power)

ENVIRONMENTAL

Operating Temperature	0 to 50°C
Operating Humidity	5 to 95% RH Non-Condensing
Survival Temperature	-20°C to +60°C, Power Off
Linearity	<1%

DESCRIPTION OF CONTROLS

Mode Selector Switch

The setting of this switch determines whether the amplifier is functioning in “charge mode” or “voltage mode.” In charge mode, the input appears like a short-circuit sensor and all charge that is generated by the sensor goes into the input and appears on a feedback capacitor within an op-amp circuit. In “voltage mode,” the input appears like an open circuit and no charge flows. The settings of the various input and filter controls then modify the actual performance in either setting.

Feedback Capacitance Selector (charge mode)

When the amplifier is operating in charge mode, this control changes the sensitivity of the initial amplifier stage. In typical use, it will be set to the value closest to the sensor under test. Selecting a feedback capacitance lower than that of the sensor will create further apparent gain, while selecting a higher feedback capacitance will reduce overall gain. A quantity of charge applied to the input numerically equal to the feedback capacitance value (for example, 100 pC of charge, with 100 pF setting of feedback capacitance) will generate one volt from the initial stage, before further modification by the filters and gain control.

Input Impedance Selector (voltage mode)

When the amplifier is operating in voltage mode, this control changes the electrical resistance seen at the input of the amplifier. For a given value of sensor capacitance (C), different values of input resistance (R) create different low-frequency response characteristics. The simple RC filter network forms a high-pass filter, which operates independently from the low frequency selector switch. The influence of this impedance selector must therefore be considered separately from the low frequency selector (see Appendix B).

Input Attenuator Switch (voltage mode)

This switch allows the input signal to be attenuated by 40 dB (linear factor of 100), when the amplifier is operating in voltage mode. This can be useful in cases where the open-circuit voltage being monitored is very high, and would cause the output voltage to clip. The setting of this switch does not affect the input impedance seen by the sensor.

Low Frequency Selector

The function of this control is to apply a multi-pole high-pass filter to the signal. Frequencies below the selected limit will be progressively attenuated. In charge mode operation, the signal will be -3 dB down (or approximately 0.7 X) at the selected frequency. In voltage mode, the influence of the RC filter must also be considered (see Input Impedance Selector). Reducing the low-frequency content of a signal may be useful when the signals of interest are relatively high in frequency and low in amplitude.

High Frequency Selector

This control applies a multi-pole low-pass filter to the signal. It can be used in conjunction with the Low Frequency selector to form a band-pass filter, where noise outside a selected band of frequency can be strongly attenuated.

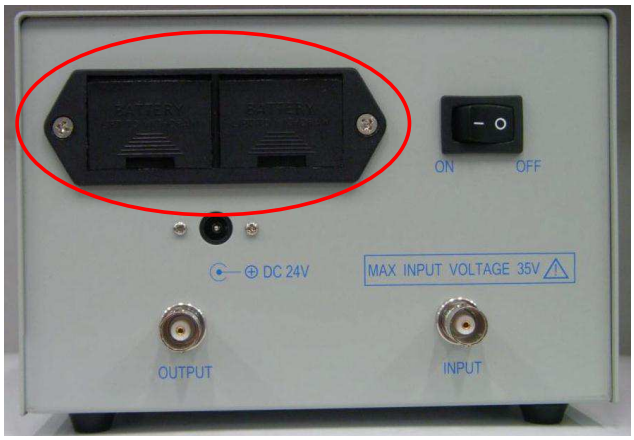
Gain Selector

The purpose of this control is to allow selection of a final gain to be applied to the output of the filter stages. Selecting "0 dB" in voltage mode means that the overall gain of the amplifier is zero dB (linear 1X), when the Input Attenuator is also set to "0 dB". The gain is adjustable in 10 dB steps up to 40 dB (linear 100 X).

APPENDIX

Power Indicator

The green power indicator LED lights when the power switch is switched to "1" (ON position), using either the internal batteries or when the external 24 V power supply is connected.



Batt Low

The red low battery LED lights when the voltage of the internal batteries falls below approximetly 8 V. When the battery power is no longer sufficient for correct operation, neither "Power" nor "Batt Low" will be illuminated when power switch is switched to "I".

Battery Compartments

The battery compartments are accessible from the rear panel. To open a compartment, the battery tray should be lifted up slightly, then pulled outwards. Batteries can be left in the amplifier while it is being operated on external power.

External Power Input

Just below the battery compartments lies the input connector for 24 VDC (center pin +). Use only the power supply provided with the amplifier.

Power Switch

This switches power (from internal batteries or from external 24 VDC supply) to the amplifier on or off. To conserve battery life, power should be switched off when unit is not in use.

Input BNC

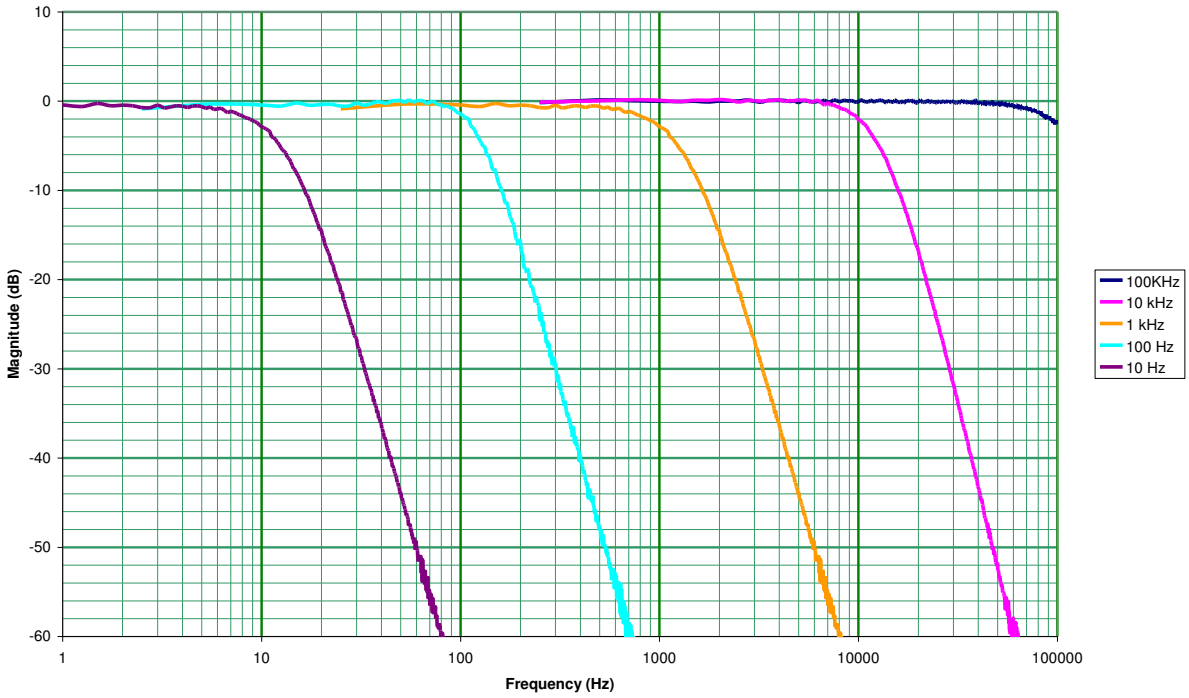
Signal input (for either voltage mode or charge mode operation) should be connected to the Input BNC. Input voltage should not exceed 30 V, and this voltage should not appear across a sensor capacitance in excess of 100 nF. The input adds approx 50 pF shunt capacitance, which must be borne in mind when calculating RC filter frequencies for low-value sensor capacitance in voltage mode.

Output BNC

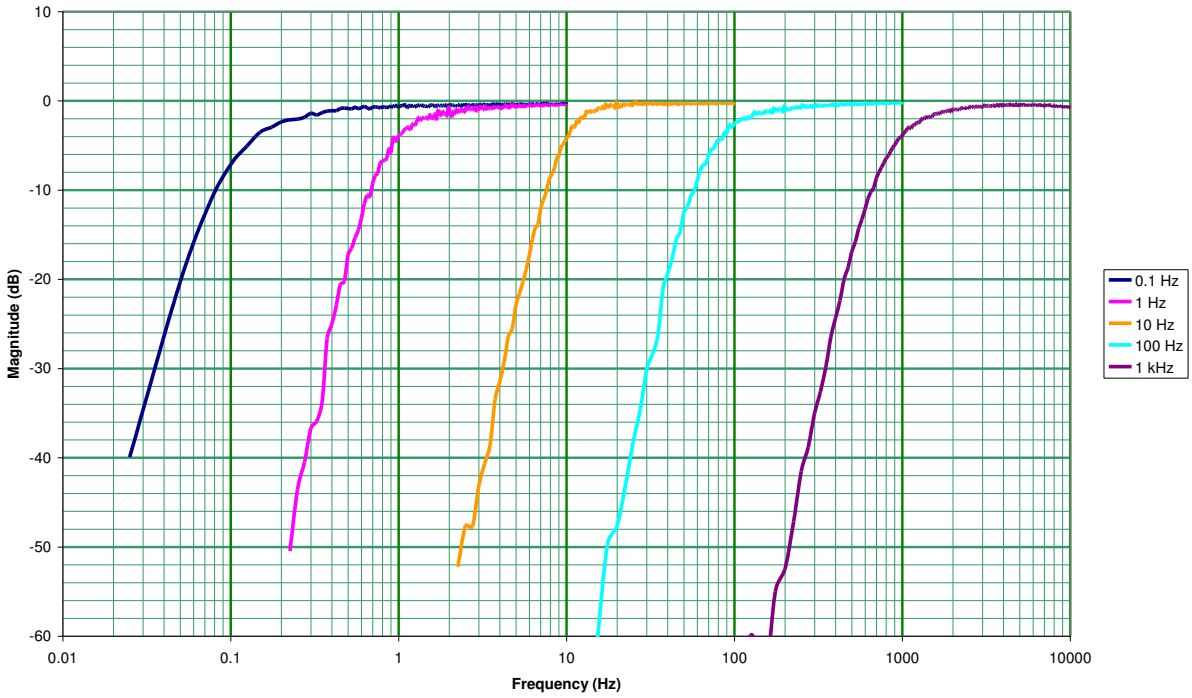
Impedance of 50 Ω max. The output of the amplifier is intended to drive the input of an oscilloscope, signal analyzer, or data acquisition system.

Appendix A: Filter response plots

Upper Limiting Frequency Control



Lower Limiting Frequency Control



Appendix B: Influence of Input Impedance selection on low frequency response (voltage mode)

The table below shows the theoretical -3 dB frequency (in Hz) of the high-pass filter that is formed when a sensor of capacitance listed in first column is connected to the specified input impedance.

		1 M	10 M	100 M	1 G
100	p	1592	159	16	1.6
220	p	723	72	7.2	0.72
470	p	339	34	3.4	0.34
1	n	159	16	1.6	0.16
2.2	n	72	7.2	0.72	0.072
4.7	n	34	3.4	0.34	0.034
10	n	16	1.6	0.16	0.016
22	n	7.2	0.72	0.072	0.0072
47	n	3.4	0.34	0.034	0.0034
100	n	1.6	0.16	0.016	0.0016

Note: the shaded cells have a -3 dB frequency that is below the range of the Low Frequency Selector, and in this case, the Low frequency Selector will determine the performance. In the case of the unshaded cells, the low frequency limit will be determined either by the Low Frequency selector, or by the data above, whichever is the higher.

INCLUDED IN PACKAGE

1) Piezo Film Lab Amplifier:

2) Power Supply:

Input: 100-240VAC, 50/60Hz, 1.8A

Output: 24VDC 1A

Connector: IEC 60320 C14 (inlet)

3) Power Supply Cable/Plug

MUST BE ORDERED SEPARATLY

Connector: IEC 60320 C13

Regional Versions Available:

1007232-1 - Power Supply Plug, EU

1007232-2 - Power Supply Plug, UK

1007232-3 - Power Supply Plug, USA

1007232-4 - Power Supply Plug, Japan

4) Accessories

a) 2 x 9V Batteries, Type 1604A (6LF22/6LR61/MN1604), Mercury and Cadmium Free

b) Piezo Sensor (modified SDT1-028K), p/n 1-1000288-1, 1m Shielded Cable, BNC Connector

c) BNC “Tee” adapter

d) 2 x BNC Cable, 0.58m Nominal, Bare End

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