

Welcome to Viking Industrial Products**Makers of the PiezoMaster™**

Piezo amplifier, located in Marlboro, Massachusetts, has been chosen by NASA, LTS, Sandia, Argonne, Fermi Lab, MIT, Yale, Harvard, Corning: The PiezoMaster™ product line is a family of OEM Piezo amplifiers, that combine the amplifier with the power supply, to offer an extremely low cost piezoelectric actuator controller. Viking Industrial Products has been a leader in power management for over 40 years. Our expertise is analog high voltage, 0-5 amps, Dc-1 Mhz, 0-1200 volts, +/-800 volts. Design, test, manufacture, service of standard and custom OEM products for our customers. Contract manufacturing services are available as well. PLEASE CALL 1-508-481-4600 ext 14 or Email sales@piezomaster.com with your questions, we can help you order the correct model! The PiezoMaster is low enough in cost (\$380.00 units 1-9) to be used either in open loop driver applications, or closed loop proportional control applications.

The efficient design of the PiezoMaster series (7206 and 7210) provides a unique small package, that can be board or chassis mounted. The PiezoMaster can be located close to the actuator.

The PiezoMaster amplifiers have the high peak power to control actuators of many sizes, and there are options available to match specific system requirements. The strength of the PiezoMaster is its ability to be customized to bring a simple, effective and economical solution to controlling piezoelectric actuators. Viking now offers a low noise, bipolar Model VP7210 and high frequency/high power drivers (DC-1 Mhz, 1-4 amps) and amplifiers. We have many customers that are using our amps for Interferometry, laser tuning, mirror positioning, de-icing of aircraft and flow control, spectroscopy, cytometry. Please do not hesitate to inquire regarding your special application. All questions are welcomed and kept confidential.

**APPLICATIONS**

Micro/Nano Positioners Mirror Alignment Scanning Precision Valves Photonics Microscopes Fiber Optics
 Test and Inspection Tuning and Focusing Embossing and Engraving Micro Dispensing Micro Machining

Low Price Efficient Requires No Power Supply Fully Customizable Ultra Small Size

PiezoMaster Products



Standard Models Various standard selections are available to match the PiezoMaster with system requirements. Selection of the best product for a particular application is easily accomplished with the following guidelines.

The input power is either 48VDC or 24VDC. This can be regulated, loosely regulated or unregulated DC power. For best noise performance, the amplifier power input should be isolated from the system power. If there is no existing system power supply available, then 48VDC power is slightly more efficient and is therefore the better choice.

The voltage range selection is dictated by the maximum piezoelectric stack voltage limit. In order to obtain the highest performance from the stack, the amplifier should drive the stack to its highest voltage without exceeding its limit. For this reason, the range is selected to match the maximum allowable stack voltage.

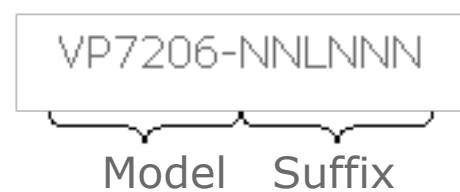
The bias voltage is that output voltage that is across the stack with 0VDC input. In order to maintain the stack at or near its midpoint of travel, the bias voltage is usually selected to be one half of the range voltage.

Finally, the gain is selected to match the available input signal operating voltage range. The gain is defined as the change in output voltage divided by the change in input signal voltage. As an example, selecting model VP7206-48H805, the range is 800V, the bias is 400V and the gain is 200. For this model an input signal change from 0V to +2V will cause the output voltage to change from +400V to +800V.

MODEL	POWER	RANGE	BIAS	GAIN
VP7206-48H805	48V	800V	400V	200
VP7206-48M605	48V	600V	300V	100
VP7206-48M405	48V	400V	200V	100
VP7206-48L205	48V	200V	100V	50
VP7206-48L105	48V	100V	50V	50
VP7206-24H805	24V	800V	400V	200
VP7206-24M605	24V	600V	300V	100
VP7206-24M405	24V	400V	200V	100
VP7206-24L205	24V	200V	100V	50
VP7206-24L105	24V	100V	50V	50

Tailored Models If any application requires a selection of range, bias or gain not available with standard models, then any of these parameters may be independently tailored as required. The range can be any voltage from zero volts to 800V. The bias can be any voltage from zero volts to 800V and must be lower or equal to the range. The gain can be any value between 5 and 450; however, the maximum signal input voltage of $\pm 15\text{VDC}$ must be considered. With this flexibility, any input signal range including positive or negative unipolar ranges can be matched for optimum performance with any stack voltage up to 800V. As an example, if the required range is 800V, the bias is zero volts and the gain is 100, then a unipolar input signal change from zero volts to +8V will result in an output stack voltage change from zero volts to +800V. In this case, a signal input voltage of +4V will maintain the stack at the midpoint of its displacement.

Model Number Assignment To define a model number for a specific tailored unit, change the suffix as follows:



The first two numbers of the suffix specify the input power-either 48VDC or 24VDC.

The third letter specifies the gain of the amplifier according to the code list below:

Gain Code List

GAIN	CODE	GAIN	CODE	GAIN	CODE
5	A	50	L	160	T
7	B	60	K	180	U
10	C	70	N	200	H
15	D	80	P	250	V
20	E	90	Q	300	W
25	F	100	M	350	X
30	G	120	R	400	Y
40	J	140	S	450	Z

The fourth and fifth numbers specify the range in tens of volts. For example, an 800V range is indicated by "80" and 150V range is indicated by "15".

The sixth number specifies the bias as a percentage of the range. In other words, "1" is 10% of the range and "5" is 50% of the range. If the range needs to be specified more precisely, then a seventh number "15" would specify a bias that is 15% of the range. Zero bias and 100% bias are both available. For zero percentage bias, the sixth number is "0". For 100% bias use "00" as the sixth and seventh numbers.

Custom Models Some applications require features beyond the scope of standard and tailored models. These custom models are routinely developed at Viking Industrial Products to fulfill almost any set of requirements. Some possible custom features are:

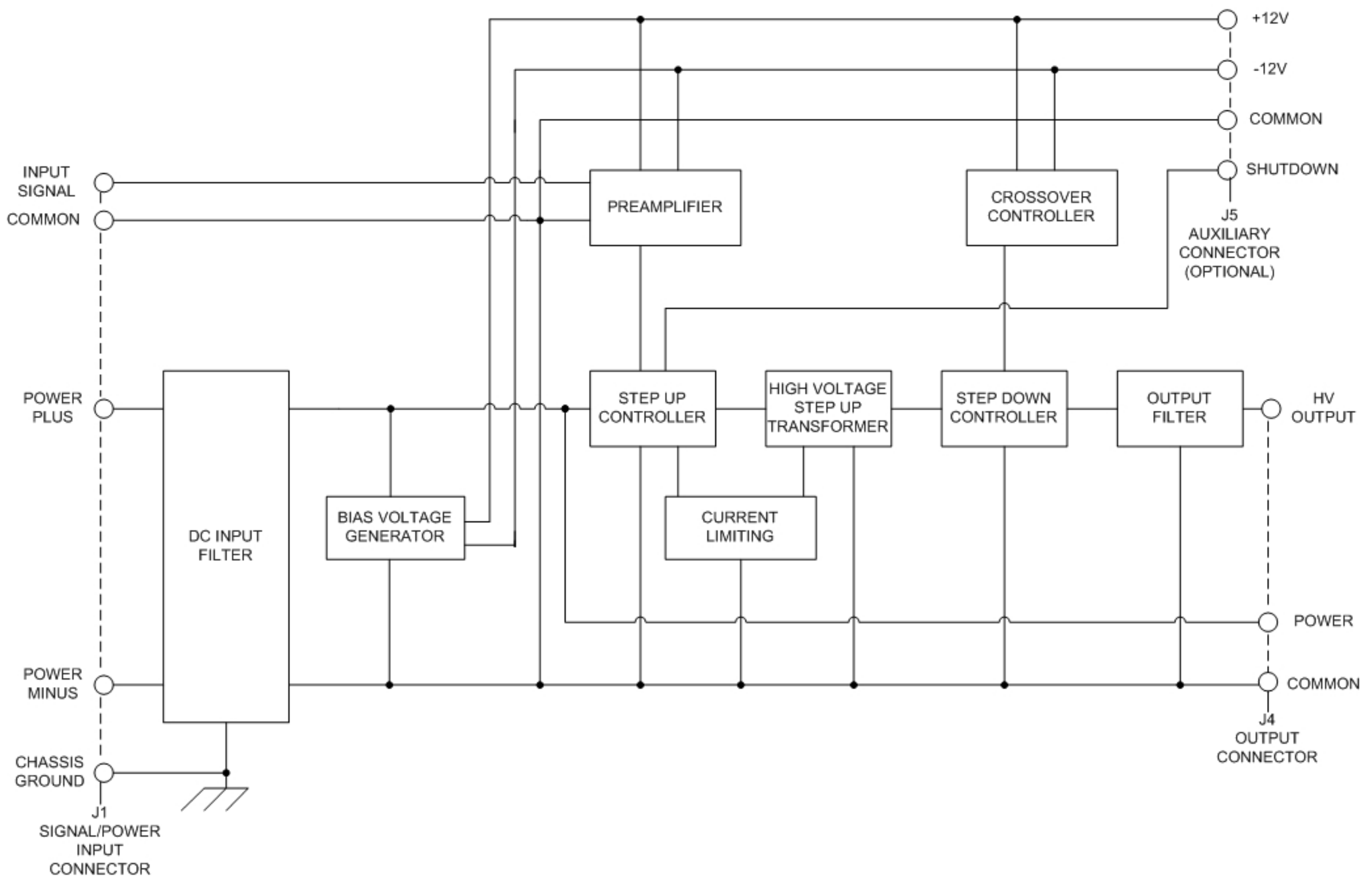
- **HIGHER OUTPUT POWER**
- **VARIOUS DC POWER INPUTS**
- HIGHER OUTPUT VOLTAGE**
- DIFFERENT SIZE or SHAPE**
- MULTIPLE OUTPUTS**
- BRIDGE CONFIGURED DUAL OUTPUTS**

VP7206 Technical Information

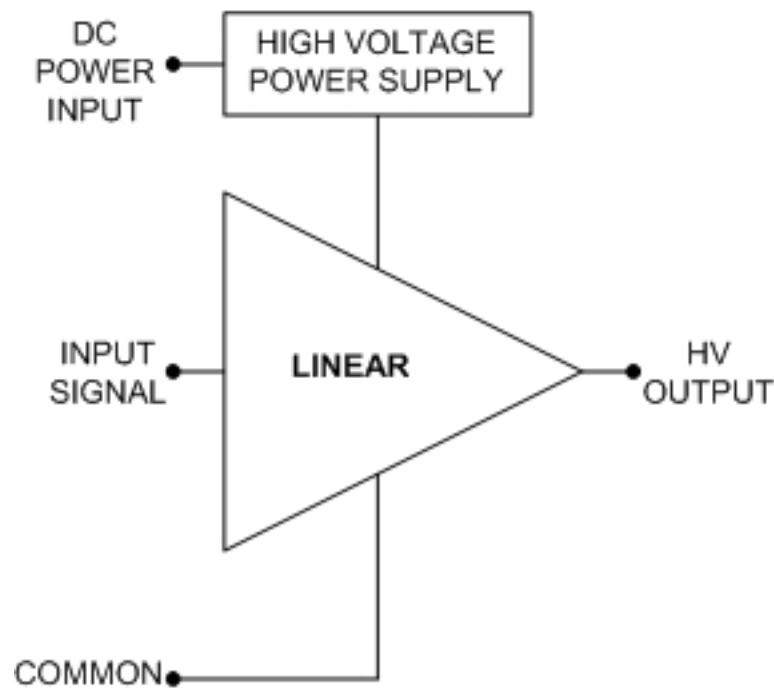
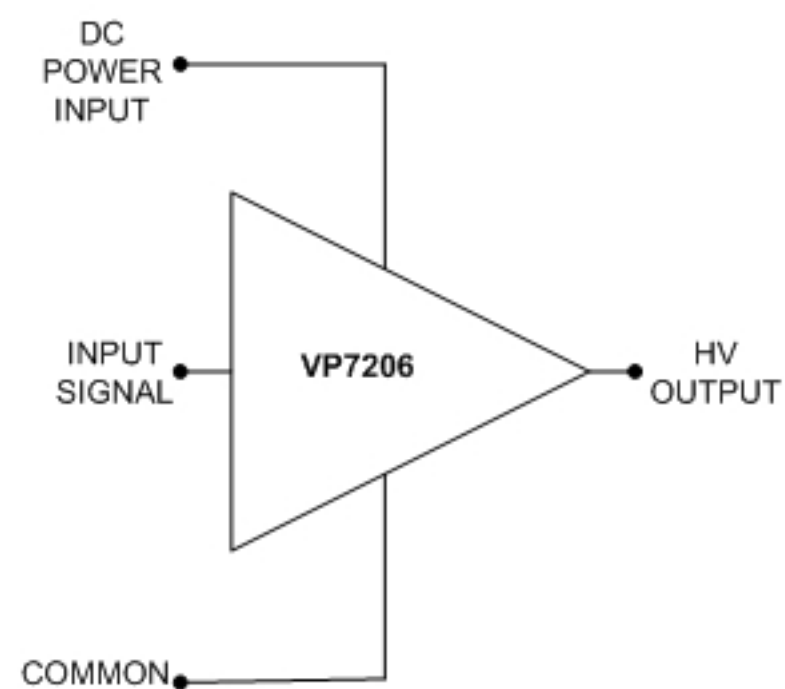
Description of Operation This amplifier combines switching and linear circuitry to gain additional power with small size. The high voltage output is proportional to the signal input with direct coupling and wide bandwidth. The output is equally capable of sourcing and sinking current to drive capacitive loads.

With reference to the block diagram below, the input signal is first preamplified and the signal output of the preamplifier drives the switch mode step up controller which, in conjunction with the step up transformer, provides a high voltage output proportional to the signal input. Before this DC output is applied to the output filter, the linear step down controller provides sinking current to the output as necessary. The crossover controller smoothes the output between the step up and step down controllers. Current limiting is included for output overload protection and the bias voltage generator provides $\pm 12V$ internal power following the DC input power filter.

VP7206 BLOCK DIAGRAM



Efficiency Comparison The overall efficiency of the VP7206 amplifier series is approximately twice as good as a linear amplifier. Shown below is a typical linear amplifier with an external high voltage power supply compared with the PiezoMaster amplifier that does not require a high voltage power supply. Since the PiezoMaster amplifier steps up the output voltage to precisely that voltage demanded by the signal input, there is no need for a high voltage power supply and no corresponding loss of efficiency.

Linear Amplifier**PiezoMaster**

Because the high voltage power supply is generally selected with a voltage 10% higher than the maximum required output voltage of the linear amplifier, the resulting efficiency of the linear amplifier is typically 45%. With a 75% efficiency for the high voltage power supply, the resulting overall efficiency for the combination is 34% versus 70% for the PiezoMaster. For an application that varies below 50% of its maximum output voltage, the improvement in efficiency is even more significant.

Mounting and Cooling With the small size of this amplifier, it can be mounted close to the high voltage load which limits access to hazardous wiring. The various connector and cover options allow mounting to the internal or external surface of an enclosure or directly to a PC board. Refer to the outline drawings below for dimensions and mounting screw requirements. The mounting surface of the amplifier is the heat sink for the internal components. For many applications, this heat sink is sufficient to maintain the amplifier temperature below the level that will initiate the internal thermal protection. For some applications, additional heat sinking or forced air cooling will be needed. For additional heat sinking, the amplifier can be mounted to a larger metal surface or supplementary heat sinks can be attached.

Outline drawing of [open frame with top access connectors.pdf](#) This version is intended to be mounted within an enclosure with all three connectors accessible from the top.

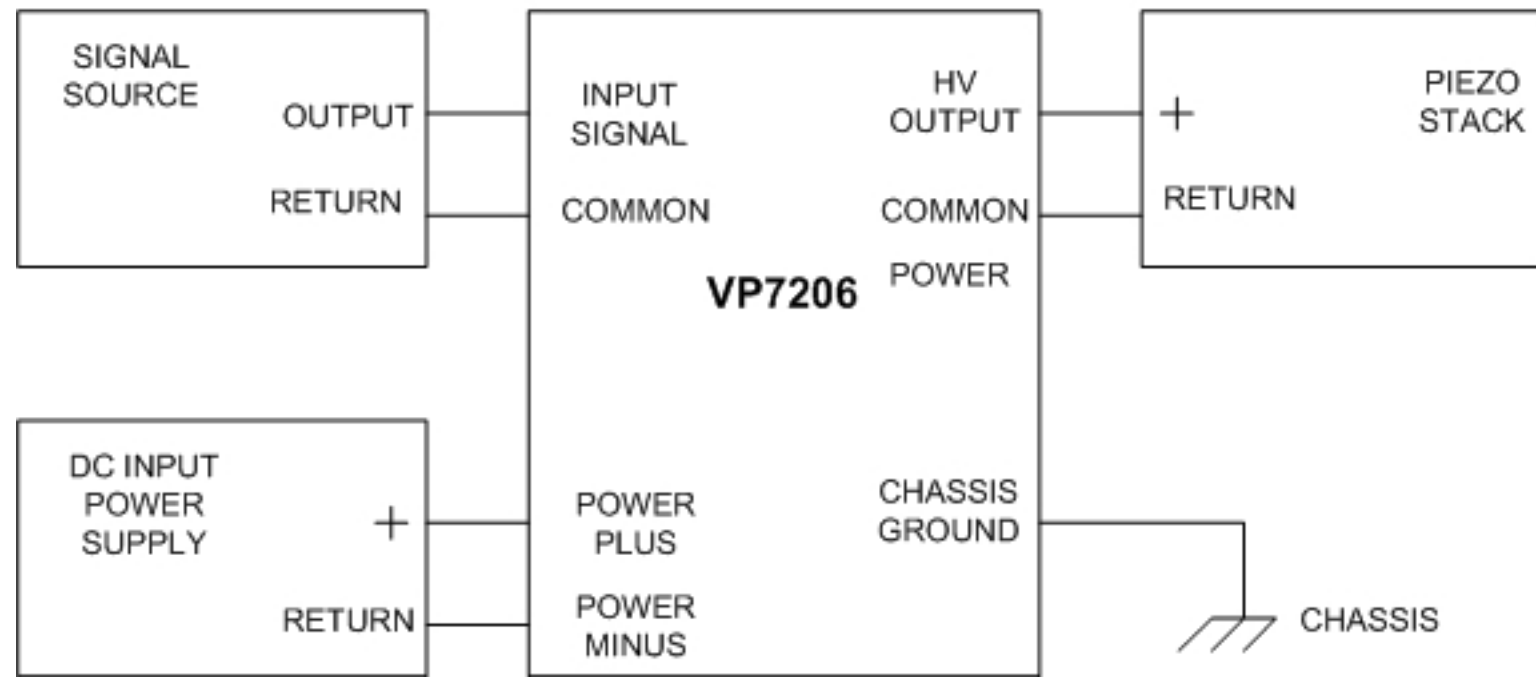
Outline drawing of [fully enclosed with end access connectors.pdf](#) This version is intended to be mounted within an enclosure with access to the J1 and J4 connectors. Otherwise, this unit is fully covered. The J5 connector option is not available with this version.

Outline drawing of [fully enclosed with bottom access connectors.pdf](#) This version is intended to be mounted externally to an enclosure with access to all three connectors through the bottom of the unit and through the enclosure wall. Note that the J4 connector pins are reassigned for this version only.

Outline drawing of [fully enclosed with PC mounting.pdf](#) This version is intended to be directly mounted onto a PC board with the connectors directly soldered to the PC board. The unit can be mounted against the board or raised above the board to save space for other small components.

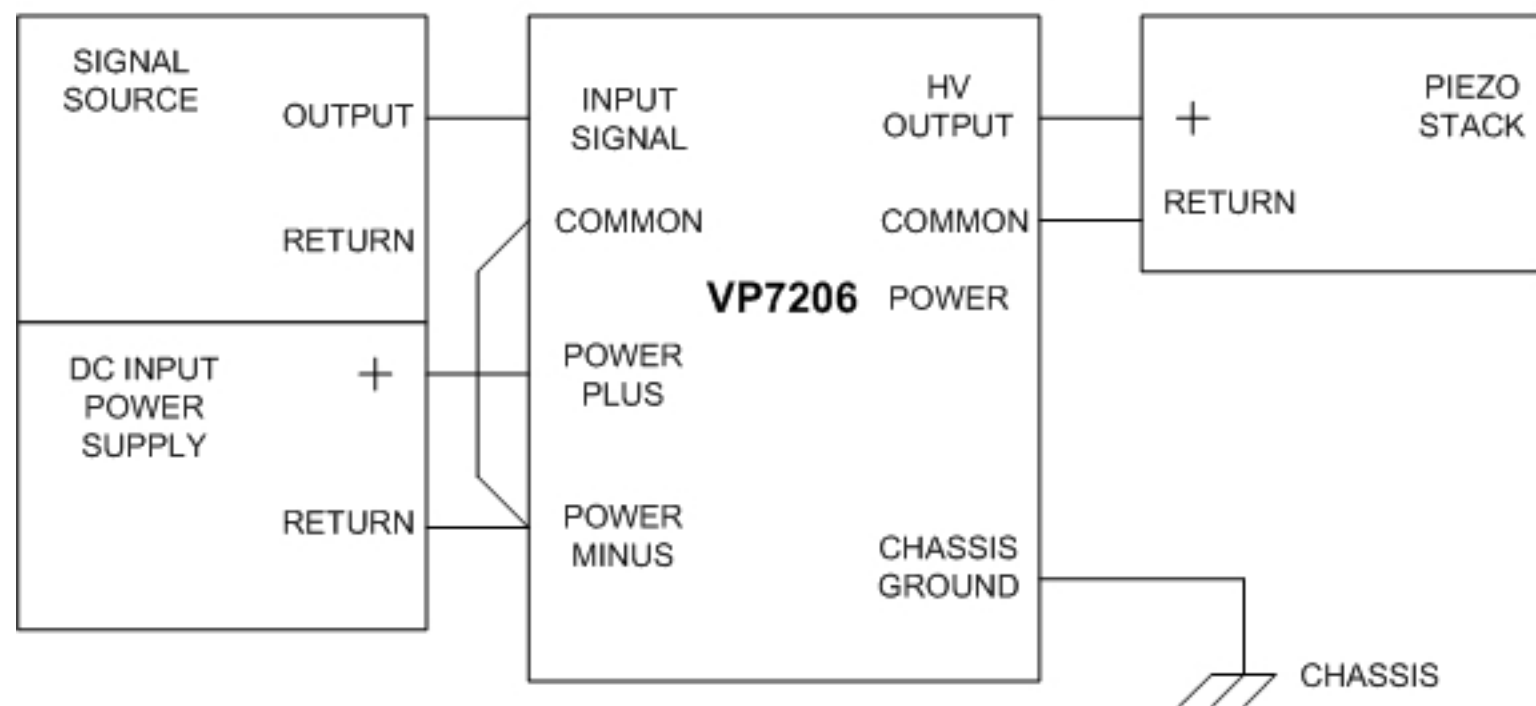
Wiring and Connections To use the PiezoMaster amplifier, it must be connected to an input signal source, a DC power source and an output piezo stack. For best operation, the DC power source should be isolated from the signal source with both signal and power source having a separate return connection as shown by the wiring diagram #1. This is best because the signal source wiring does not share any of the power supply noise which is reduced by a common mode filter within the VP 7206 amplifier.

WIRING DIAGRAM #1



If the signal source and the power source share the same common due to a non-isolated system power supply, then the connections should be made per wiring diagram #2 . A single wire should be used for the common return to avoid a ground loop. Also, the connection at the VP7206 between power minus and common should be short.

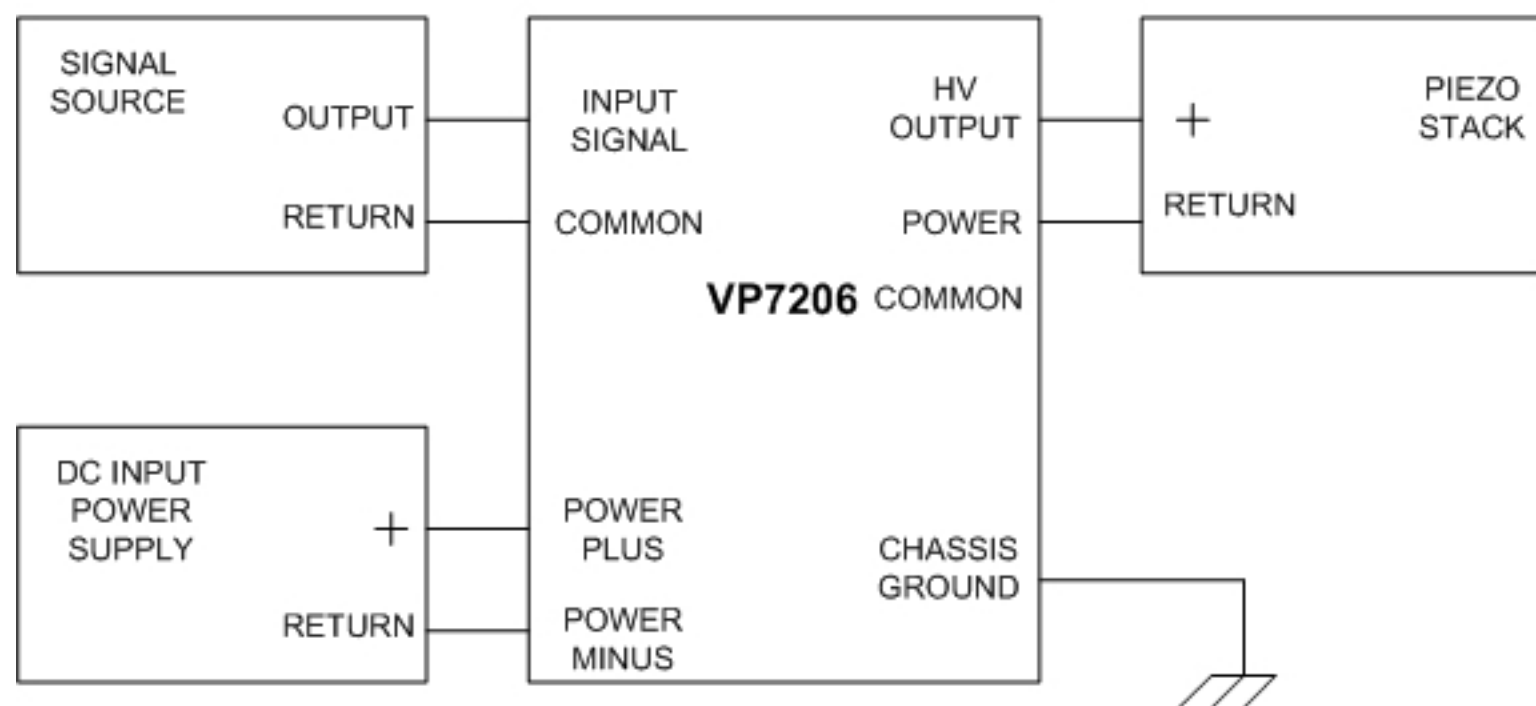
WIRING DIAGRAM #2



With a slight change in connections to the stack as shown by wiring diagram #3, the VP7206 amplifier will shift the output voltage range negatively by the voltage of the DC power source. This will allow the amplifier to apply a small negative voltage (up to the DC power supply voltage limit) to the piezo stack.

As an example, if the range is 400V and the bias is 50% and the piezo stack return is connected to common, then with 0 VDC input signal, the output will be at +200VDC with a range of 0 VDC to +400 VDC. If the piezo stack return is reconnected to the power pin and the DC input power supply is 50 VDC, then with 0 VDC input signal, the output will be at +150 VDC with a range of -50 VDC to +350 VDC.

WIRING DIAGRAM #3



The chassis ground is an important connection for safety and noise performance. This connection can best be made to a central chassis ground point. If a chassis ground connection is not available, then this pin should be connected to the common return for the DC input power source.

VP7206 Options

Various options are offered to allow the PiezoMaster amplifier to easily fit into most applications. These options mostly involve connector variations, to allow access from different directions and to allow access to standard internal features.

The standard VP7206 amplifier models have the following features:

Top Access Connectors
Open Frame Construction
J5 Connector Position Empty
RoHS-5 Compliance

Optional features are:

J5 Optional Connector This connector provides access to the shutdown control input and internal ± 12 VDC power. Up to ± 30 mA can be used externally from the internal ± 12 V power outputs. These can be used for sensors, preamplifiers or other analog circuits and may eliminate the need for these outputs at the system power supply.

The shutdown control input can be used to turn off the high voltage output with external control. This can provide off time during system startup and settling or provide an interlocking control. If the control input is left open, normal operation results. To shutdown the output, the control pin must be pulled up to at least +2.0 VDC with an internal 150Ω load to common. This can be accomplished with a 680Ω resistor (to the +12 VDC output) held down to common with an external transistor for normal operation.

The J5 connector can be provided as a top access, bottom access or PC mount connector. Refer to the outline drawings for information.

Optional Covers There are two versions of an additional cover that can be added to the basic VP7206 open frame unit. The open ended cover provides added protection but still allows the input and output connectors to be accessed through one end of the amplifier. The full cover provides overall protection when the connectors are accessed from the bottom of the amplifier.

End Access Connectors The input (J1), the output (J4) connectors can be provided as right angle connectors with access from the end of the amplifier. Mating connectors and pin assignments are the same as the standard top access connectors.

Bottom Access Connectors The input (J1), the output (J4) and the optional (J5) connectors can be mounted on the bottom of the amplifier with access through the aluminum housing. Mating connectors are the same as the standard top access connectors. The pin assignments for J1 and J5 are the same as the standard top access connectors. The pin assignments for J4 are reversed for this version. Refer to the specific [Outline Drawings](#) for J4 pin assignments.

Printed Circuit Mount Connectors The input (J1), the output (J4) and the optional (J5) connectors can be mounted on the bottom as male headers with 0.025 inch square pins. These protrude through the aluminum housing and can be soldered directly to a PC board. Refer to the specific outline drawing for pin assignments. The header pins are long enough for the VP7206 amplifier to be mounted directly on the PC board or spaced above the board by as much as 0.25 inch.

RoHS Compliance The standard VP7206 amplifier is RoHS-5 compliant with the exemption for lead in solder. As an option, the amplifier can be fully RoHS compliant with no usage of any of the six banned substances.

Evaluation Kit The evaluation kit consists of a set of instructions and a set of mating connectors for J1, J4, and J5. The mating connectors are provided with 6 inch pigtail leads to allow easy connections for test and evaluation.