

# Single Channel High Voltage Linear Amplifiers

## DATA SHEET

- Single-Channel High Voltage Linear Amplifiers from 70Vp-p up to 1600Vp-p
- Ultra-linear amplification
- High output power, up to 2A output current
- High Bandwidth, up to 5 MHz
- High Slew rate, up to 500V/ $\mu$ s
- Low output impedance, down to 0.1 Ohm
- Wide range of models to suit any performance and/or budget demand



## Overview

Pendulum Instruments High Voltage Linear Amplifiers are general purpose broadband linear amplifiers having a fixed or variable amplification and capable of bipolar or unipolar output. The amplifiers outputs are linear from DC up to Megahertz range, and exist in Single-Channel and Dual-Channel versions.

Pendulum Instruments High Voltage Linear Amplifiers are valuable tools, for research institutes, R&D labs and component manufacturing industries, in a wide range of applications. Common examples are driving piezo actuators, MEMS, OLEDs, liquid crystals, etc.

The amplifiers are designed to drive resistive and/or small capacitive loads. The output is equipped with a current limiting circuit that withstands accidental short-circuits.

## Single-channel Amplifier selection

We offer a wide range of Single-Channel Hi-Voltage Linear Amplifiers to suit any performance demand for Output voltage, Output current, Speed/Bandwidth and/or budget.

Select your Amplifier from one of our 4 series:

**F-series (F10A, F20A) – Low Cost series**

**A-series (A400, A600, A800) – High Voltage series**

**P-series (P100, P150, P200) – High Power series**

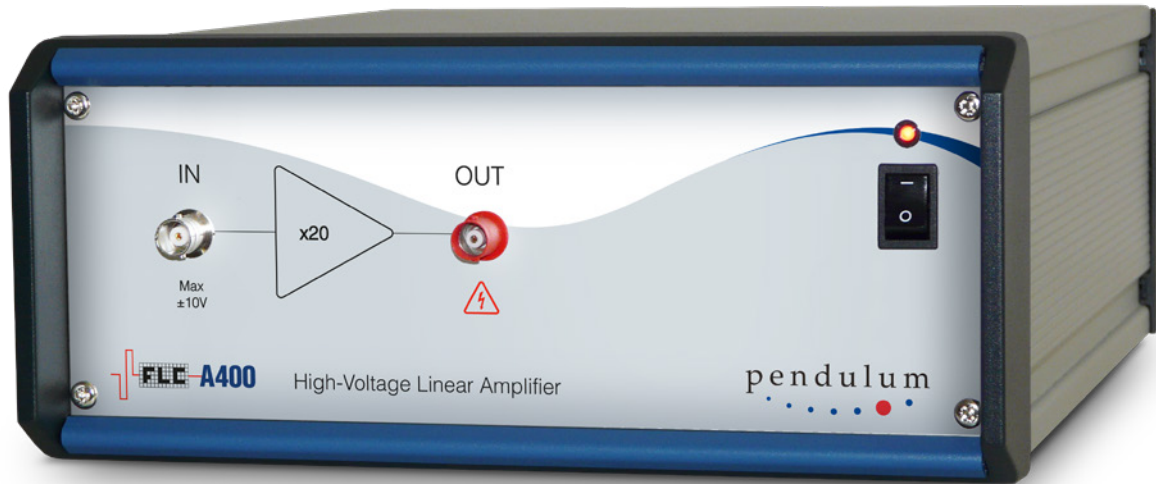
**PV-series (F30PV, F70PV) – High Speed series**

Explore details of the individual models on the follow pages.

For Dual-Channel Amplifiers, we refer to our [Dual Channel High Voltage Linear Amplifiers Datasheet](#).

| Model | Output Voltage | Output Current | Bandwidth | Gain          |
|-------|----------------|----------------|-----------|---------------|
| F10A  | -100 to +100V  | 185 mA         | 1 MHz     | x10, fixed    |
| F20A  | -150 to +150V  | 150 mA         | 500 kHz   | x20, fixed    |
| A400  | -200 to +200V  | 150 mA         | 500 kHz   | x20, fixed    |
| A600  | -300 to +300V  | 75 mA          | 350 kHz   | x100, fixed   |
| A800  | -400 to +400V  | 60 mA          | 300 kHz   | x100, fixed   |
| P100  | -50 to +50V    | 2A             | 100 kHz   | x10, fixed    |
| P150  | -0 to +150V    | 1A             | 100 kHz   | x20, fixed    |
| P200  | -100 to +100V  | 1A             | 80 kHz    | x20, fixed    |
| F30PV | -35 to +35V    | 2A             | 5 MHz     | x10, variable |
| F70PV | 0 to +70V      | 1A             | 5 MHz     | x10, variable |

# Single Channel High Voltage Linear Amplifier A400

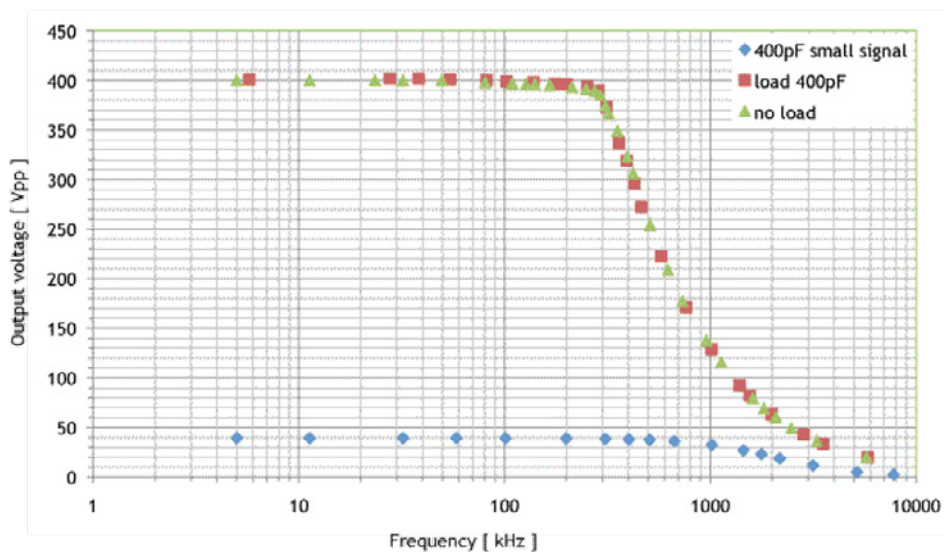


The Pendulum Instruments High Voltage Linear Amplifier A400 has a fixed amplification of 20 times and capable of bipolar high voltage output of  $\pm 200$ . Any other signal source with amplitude up to  $\pm 10$  V can be used as an input device. The A400 High Voltage Linear Amplifier is equipped with a microfuse rated at 40 mA, which will be blown if the input voltage exceeds 300% of the maximum.

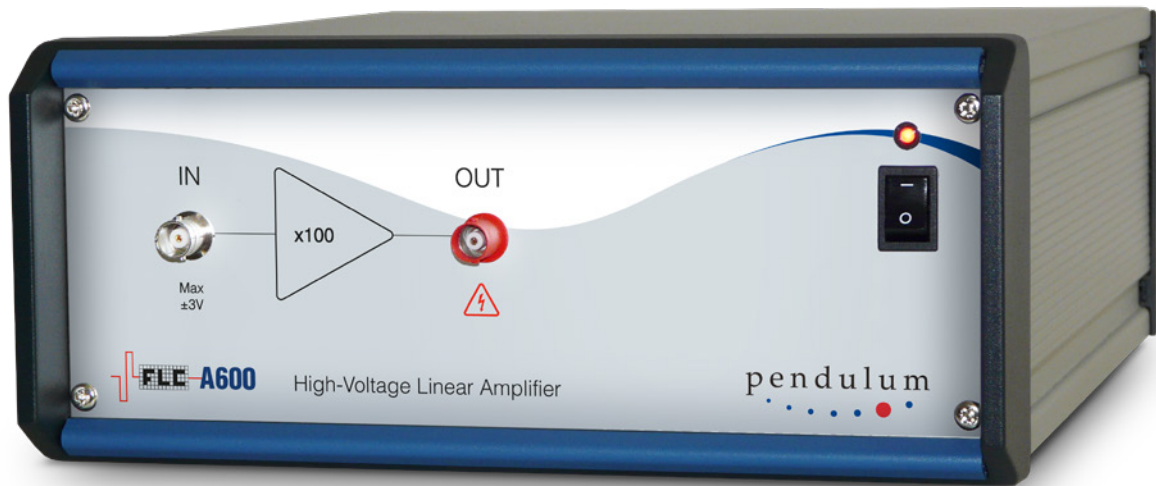
The maximum capacitive load is set at the factory to 400 V/ $\mu$ s which yields the load limit of ca 400 pF. The continuous output current limit is 185 mA and the output power limit is ca 30 W.

## Frequency response

Full scale frequency response with small load (purple marks) and with 300 pF (blue) are shown in the diagram below. A small signal response is also shown using green marks.



# Single Channel High Voltage Linear Amplifier A600

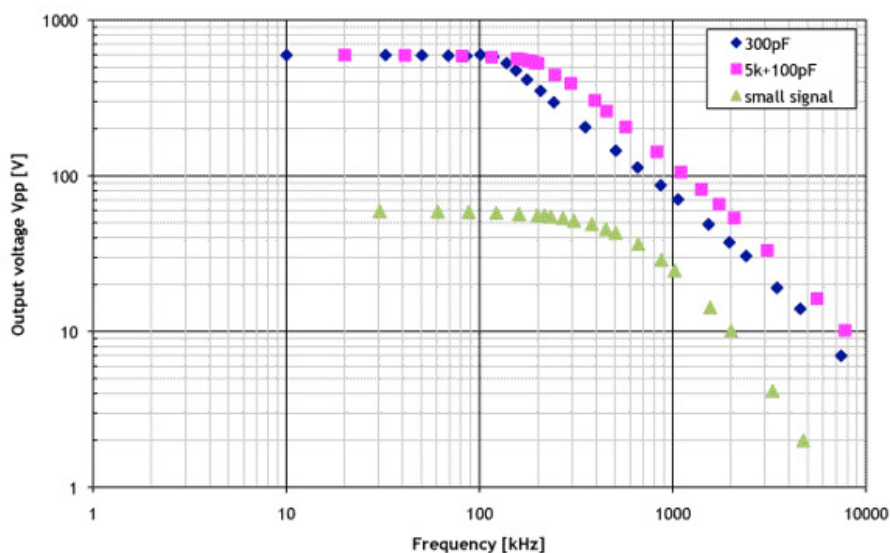


The Pendulum Instruments High Voltage Linear Amplifier A600 has a fixed amplification of 100 times and capable of bipolar high voltage output of  $\pm 300\text{V}$ . Any signal source with amplitude up to  $\pm 3\text{V}$  can be used as an input device. The input amplitude should normally be kept within  $\pm 3\text{V}$ . The A600 High Voltage Linear Amplifier is equipped with a microfuse rated at 40 mA, which will be blown if the input voltage exceeds 500% of the maximum.

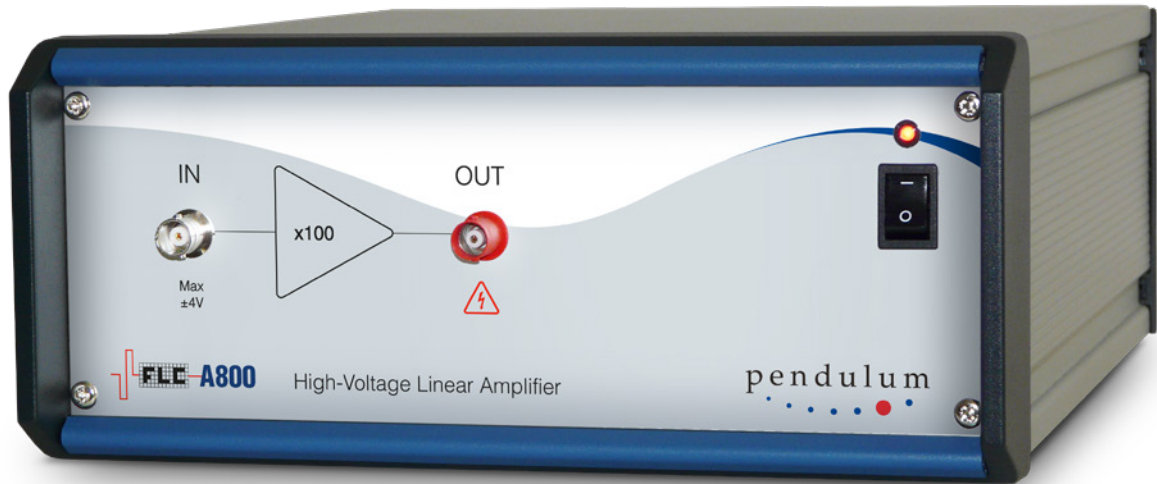
The maximum capacitive load is set at the factory to  $300\text{V}/\mu\text{s}$  which yields the load limit of  $300\text{pF}$ . The continuous output current limit is 75 mA and the output power limit is ca 30 W.

## Frequency response

Full scale frequency response with small load (purple marks) and with  $300\text{pF}$  (blue) are shown in the diagram below. A small signal response is also shown using green marks.



# Single Channel High Voltage Linear Amplifier A800



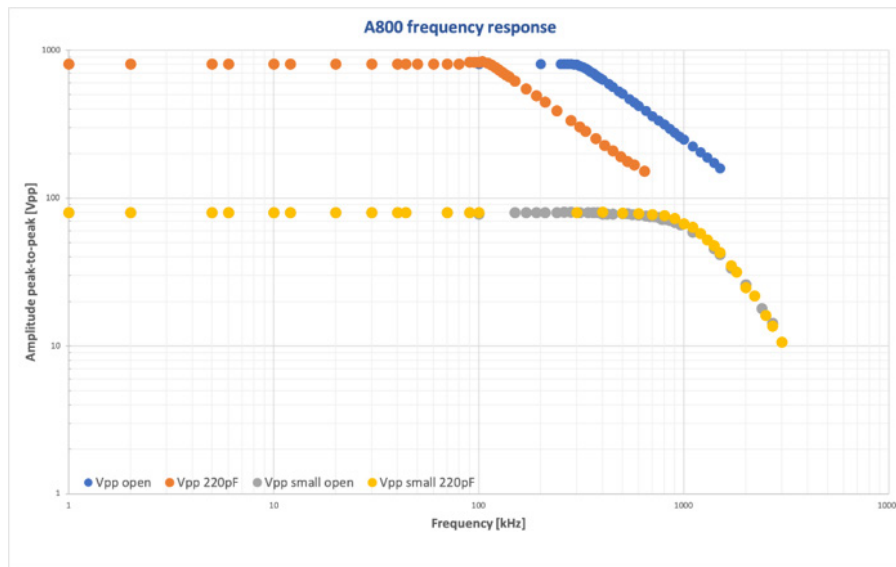
The Pendulum Instruments High Voltage Linear Amplifier A800 has a fixed amplification of 100 times and capable of bipolar high voltage output of  $\pm 400\text{V}$ . Any signal source with amplitude up to  $\pm 4\text{V}$  can be used as an input device. The input amplitude should normally be kept within  $\pm 4\text{V}$ . The A800 High Voltage Linear Amplifier is equipped with a microfuse rated at 40 mA, which will be blown if the input voltage exceeds 500% of the maximum.

The maximum speed (slew rate) of the amplifier depends on the load. If the amplifier operates within its output current limit then its speed, the slew rate, is 500 V/us. This is now the standard setting of A800-series amplifiers.

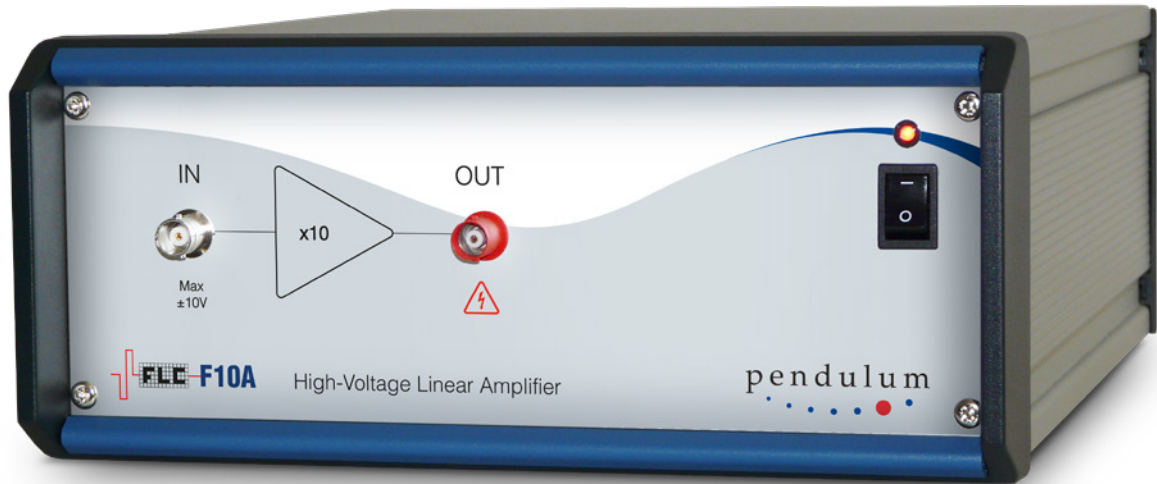
The continuous output current limit is 60 mA and the output power limit is ca 30 W. When the load requires more than 60mA current the amplifier will reduce the voltage accordingly in order to stay within the current limit.

## Frequency response

Full and small-signal frequency responses without load and with 220 pF capacitive load, respectively, are shown in the diagram below:



# Single Channel High Voltage Linear Amplifier F10A

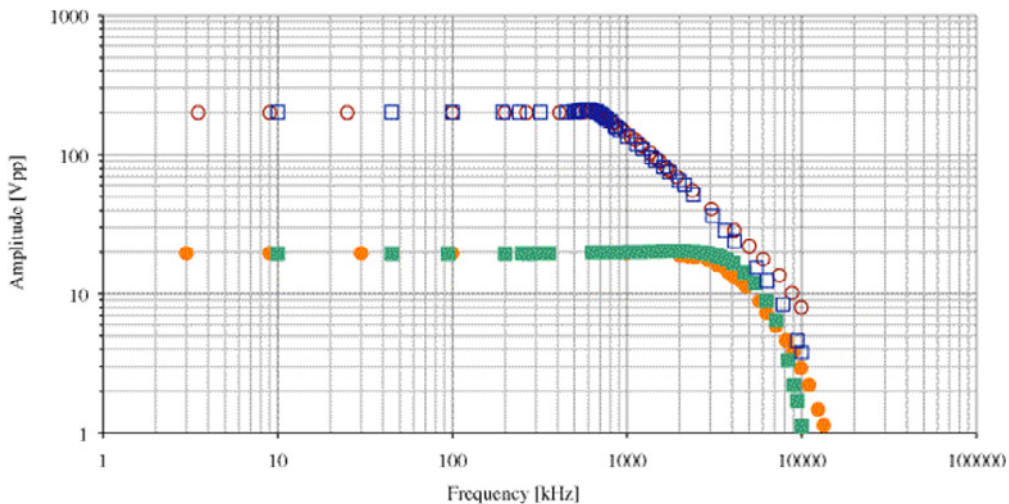


The Pendulum Instruments High Voltage Linear Amplifier F10A has a fixed amplification of 10 times and capable of bipolar high voltage output of  $\pm 100\text{V}$ . Any signal source with amplitude up to  $\pm 10\text{V}$  can be used as an input device. The input amplitude should normally be kept within  $\pm 10\text{V}$ .

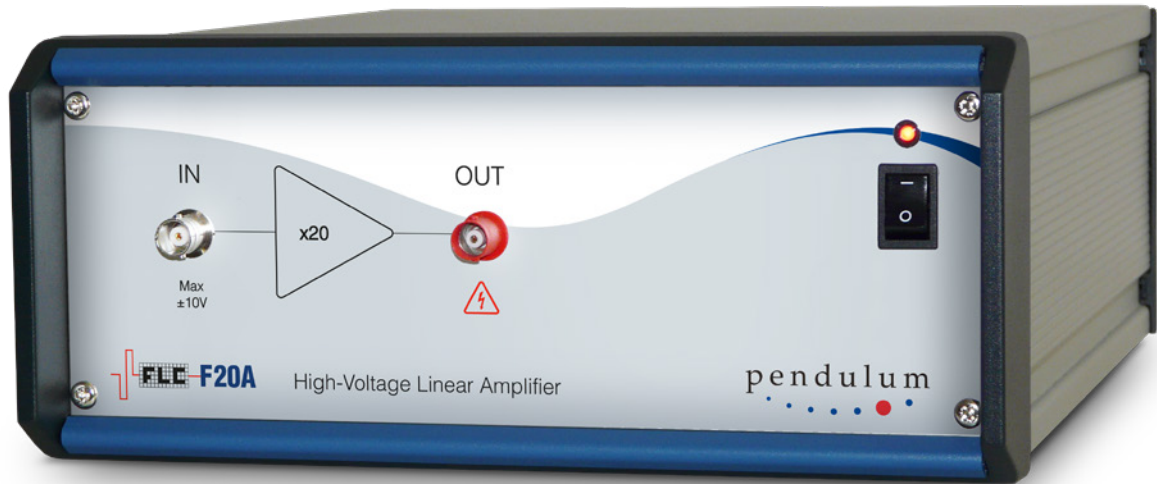
The maximum capacitive load is set at the factory to  $400\text{V}/\mu\text{s}$  which yields the load limit of ca  $400\text{pF}$ . The continuous output current limit is  $185\text{mA}$  and the output power limit is ca  $30\text{W}$ .

## Frequency response

Full and small-signal frequency responses without load (red and orange marks) and with  $400\text{pF}$  capacitive load (blue and green marks), respectively, are shown in the diagram below:



# Single Channel High Voltage Linear Amplifier F20A

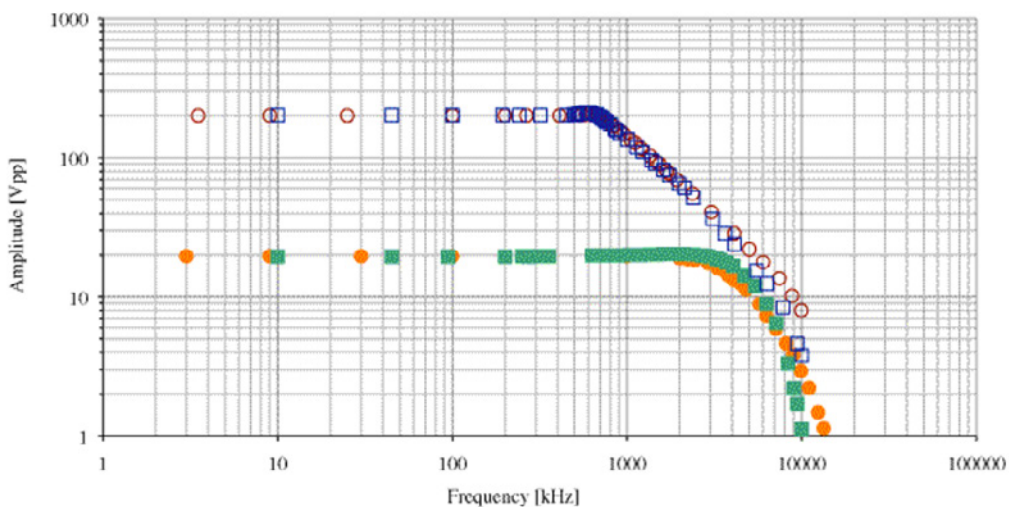


The Pendulum Instruments High Voltage Linear Amplifier F20A has a fixed amplification of 20 times and capable of bipolar high voltage output of  $\pm 150\text{V}$ . Any signal source with amplitude up to  $\pm 10\text{V}$  can be used as an input device. The input amplitude should normally be kept within  $\pm 7.5\text{V}$ . This is most important since the input protection network will limit the signal amplitude and cause clipping. The F20A High Voltage Linear Amplifier is equipped with a microfuse rated at 40 mA, which will be blown if the input voltage exceeds 300% of the maximum.

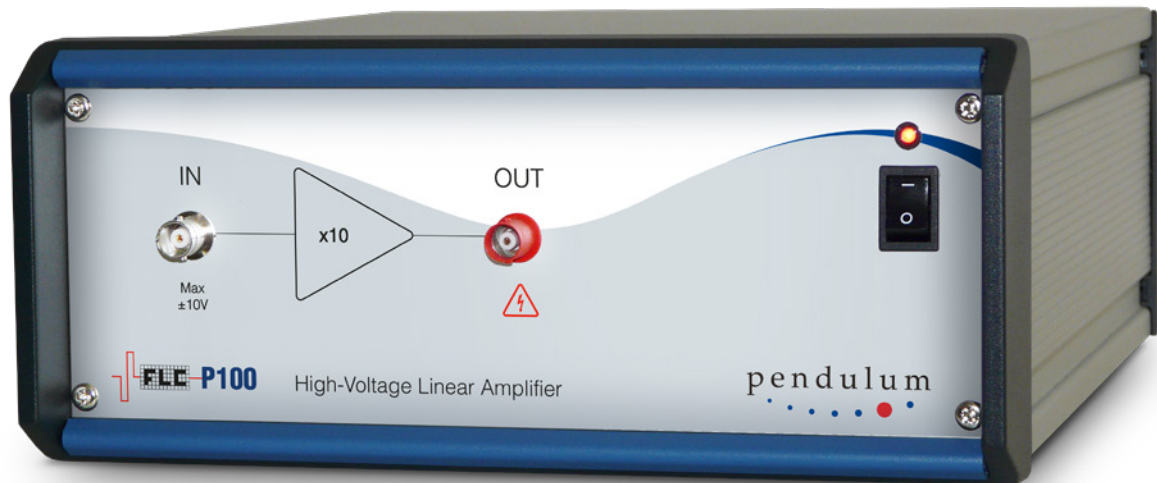
The maximum capacitive load is set at the factory to  $400\text{V}/\mu\text{s}$  which yields the load limit of  $400\text{pF}$ . The continuous output current limit is 150 mA and the output power limit is ca 30 W.

## Frequency response

Full and small-signal frequency responses without load (red and orange marks) and with  $400\text{pF}$  capacitive load (blue and green marks), respectively, are shown in the diagram below:



# High Voltage High Current Linear Amplifier P100

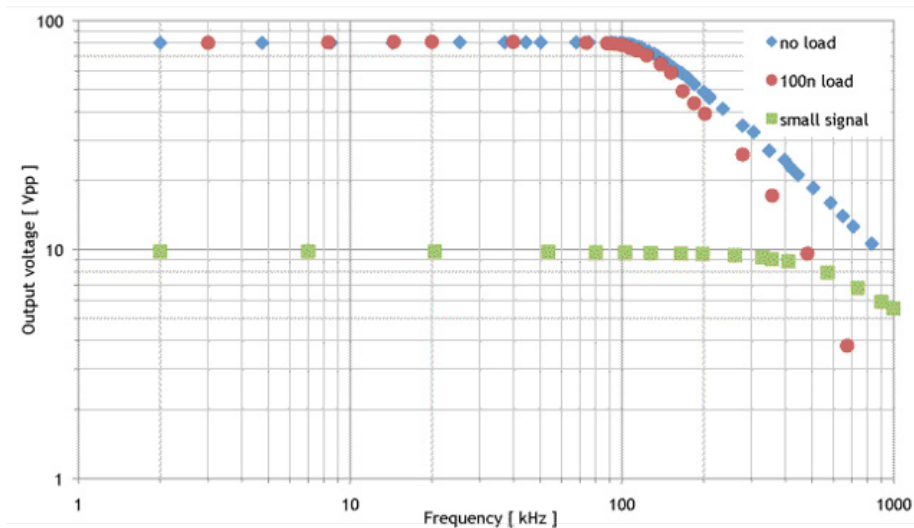


The Pendulum Instruments High Voltage High Current Linear Amplifier P100 has a fixed amplification of 10 times and capable of bipolar high voltage output of  $\pm 50\text{V}$ . Any signal source with amplitude up to  $\pm 10\text{V}$  can be used as an input device. The input amplitude should normally be kept within  $\pm 10\text{V}$ .

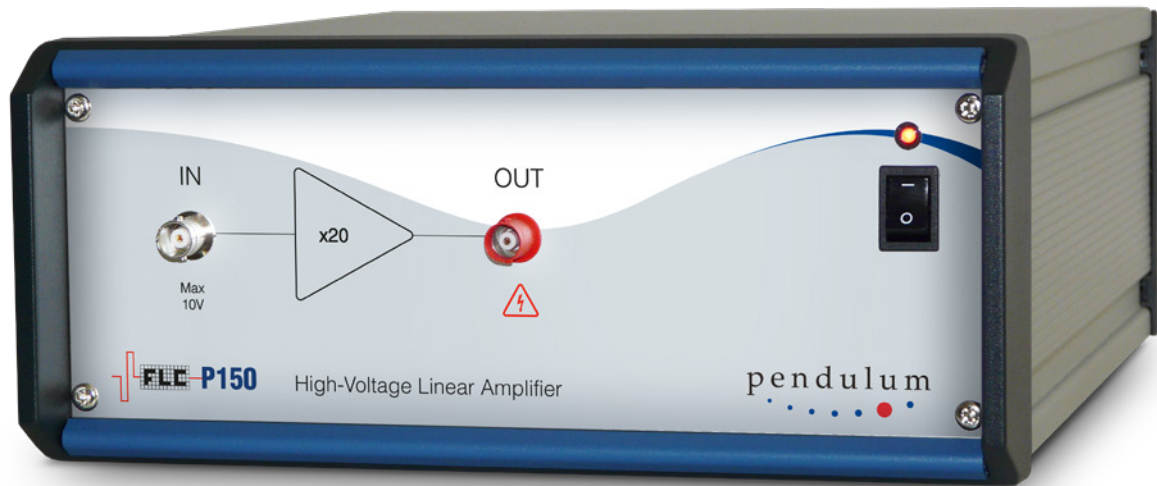
The maximum capacitive load is set at the factory to  $30\text{V}/\mu\text{s}$  which yields the load limit of  $200\text{ nF}$ . The continuous output current limit is  $2\text{ A}$  and the output power limit is ca  $128\text{ W}$ .

## Frequency response

Full and small-signal frequency responses without load (blue and green marks) and with  $100\text{ nF}$  capacitive load (red marks), respectively, are shown in the diagram below:



# Unipolar High Voltage Linear Amplifier P150

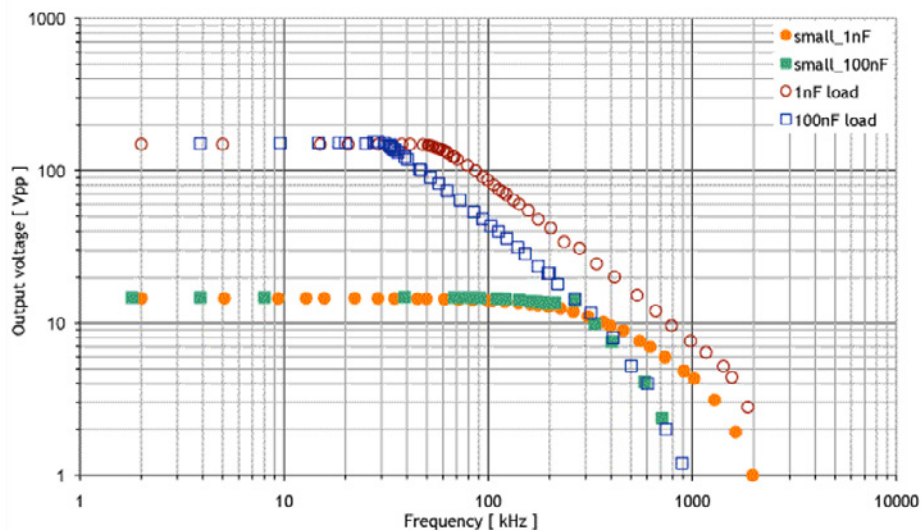


The Pendulum Instruments Unipolar High Voltage High Current Linear Amplifier P150 has a fixed amplification of 20 times and capable of unipolar high voltage output of +150V. The amplification can be set to x15 (or other value) on request. Any signal source with amplitude up to +10V can be used as an input device. The input amplitude should normally be kept positive and below +10 V. The Unipolar High Voltage High Current Linear Amplifier P150 is equipped with a microfuse rated at 40 mA, which will be blown if the input voltage exceeds 300% of the maximum.

The maximum capacitive load is set at the factory to 30 V/ $\mu$ s which yields the load limit of 100 nF. The continuous output current limit is 1 A and the output power limit is ca 128 W.

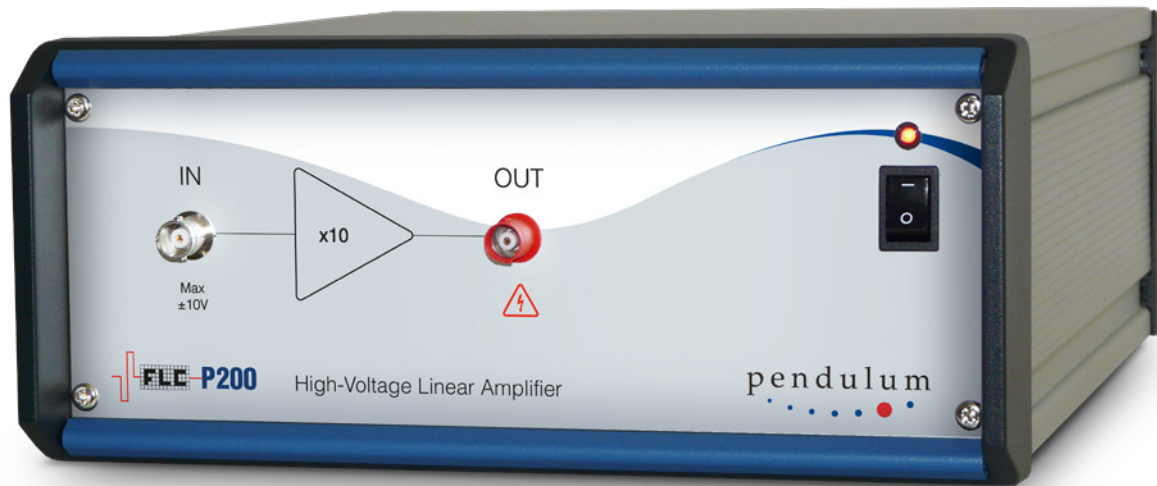
## Frequency response

Full and small-signal frequency responses with small load (1 nF, green and orange marks) and with 100 nF capacitive load (open red and blue marks), respectively, are shown in the diagram below:





# High Voltage High Current Linear Amplifier P200

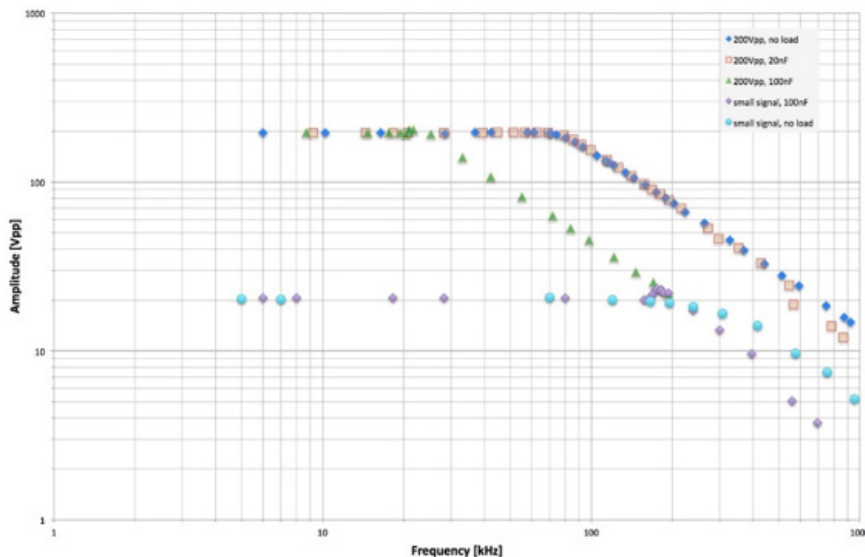


The Pendulum Instruments High Voltage High Current Linear Amplifier P200 has a fixed amplification of 10 times and capable of bipolar high voltage output of  $\pm 100V$ . Any signal source with amplitude up to  $\pm 10V$  can be used as an input device. The input amplitude should normally be kept within  $\pm 10V$ . The High Voltage High Current Linear Amplifier P200 is equipped with a microfuse rated at 40 mA, which will be blown if the input voltage exceeds 300% of the maximum.

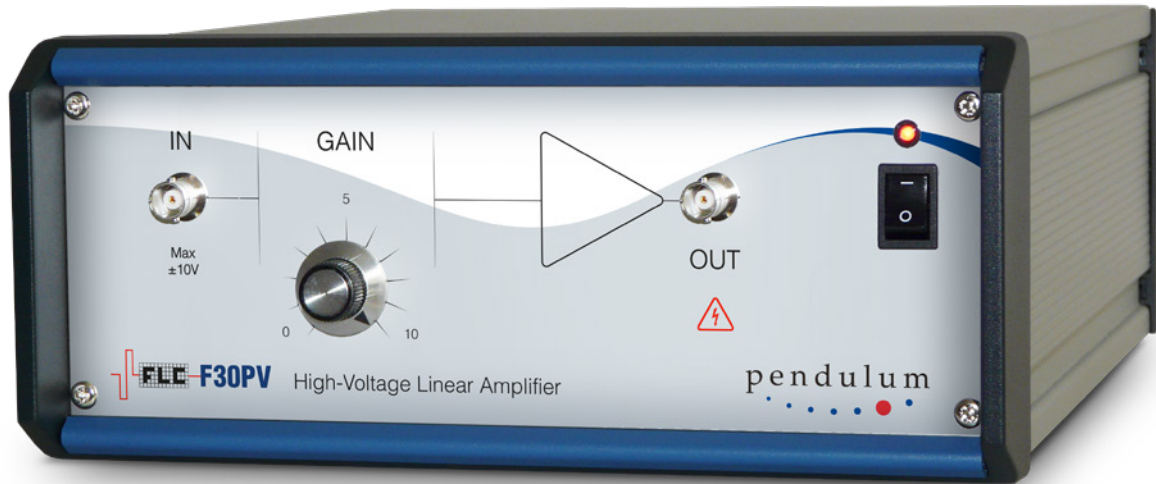
The maximum capacitive load is set at the factory to 30 V/ $\mu s$  which yields the load limit of 100 nF. The continuous output current limit is 1 A and the output power limit is ca 128 W.

## Frequency response

Full and small-signal frequency responses without load (blue marks) and with 20 nF capacitive load (orange marks) and with 100 nF capacitive load (green and violet marks), respectively, are shown in the diagram below:



# Variable Gain High Speed Linear Amplifier F30PV



The Pendulum Instruments Variable Gain High Speed Linear Amplifier F30PV is a very fast general purpose linear amplifier having a variable amplification of 0-10 times and capable of bipolar voltage output of  $\pm 35V$ . The amplifier has an attenuator at the input. At the knob position "10" the amplification is equal to 10x. Standard value is 500 ohm, but other values like 50 ohm, 1kohm, etc., can be fitted in on request. Any signal source with amplitude within  $\pm 3.5 V$  can be used as an input device. A typical output voltage range of a function generator will not harm the amplifier but the input protection network will limit the signal amplitude to  $\pm 3.5 V$  (after attenuator) and may cause clipping. The Variable Gain High Speed Linear Amplifier F30PV is equipped with a microfuse rated at 40 mA, which will be blown if the input voltage exceeds 300% of the maximum.

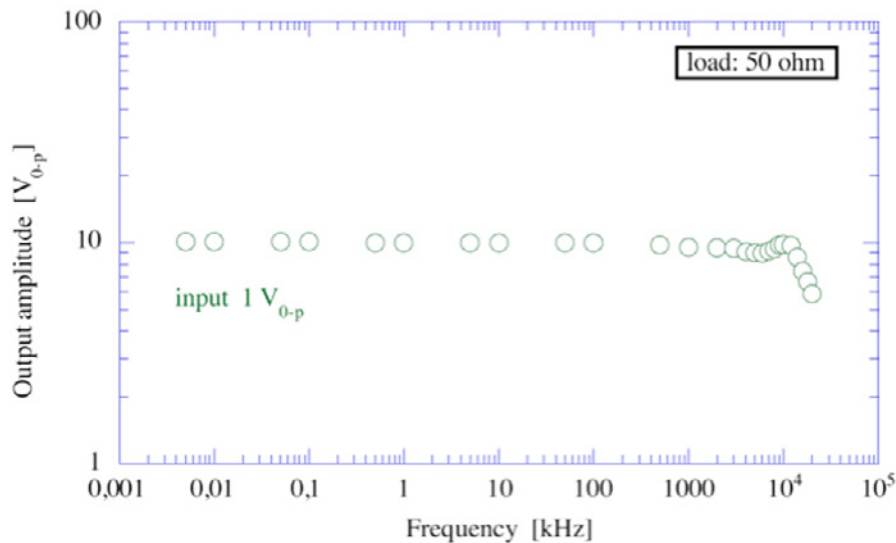
The maximum capacitive load is set at the factory to 500 V/ $\mu s$  which yields the load limit of 1 nF. The output current limit is set to ca 1.5 A. The output is equipped with a current limiting circuit that withstands accidental short-circuits and with a protective 1  $\Omega$  resistance. However, prolonged short-circuiting or overload should be avoided.

Total noise at the output with short-circuited input is:

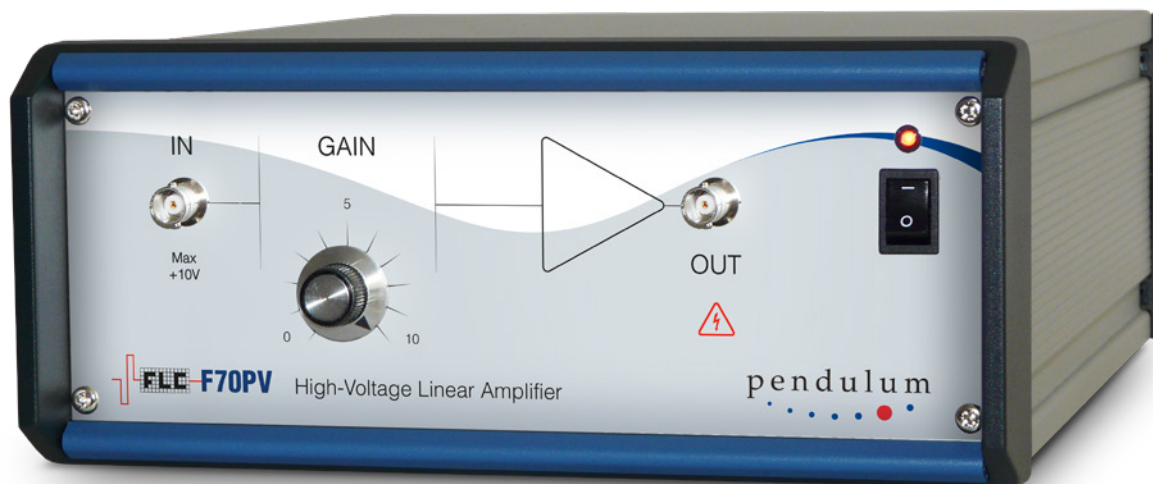
| Frequency [kHz]             | 0.5  | 1     | 10    | 50    |
|-----------------------------|------|-------|-------|-------|
| Noise [ $\mu V/\sqrt{Hz}$ ] | <1.3 | <0.32 | <0.06 | <0.05 |

## Frequency response

The frequency response to 1 V<sub>p-p</sub> input amplitude and with 50 ohm load is shown in the following diagram:



# Unipolar Variable Gain High Speed Amplifier F70PV



The Pendulum Instruments Unipolar Variable Gain High Speed Linear Amplifier F70PV is a very fast, unipolar, linear amplifier having a variable amplification of 0-10 times and capable of voltage output of +70V. The amplifier has an attenuator at the input. At the knob position “10” the amplification is equal to 10x. Standard value is 500 ohm, but other values like 50 ohm, 1kohm, etc., can be fitted in on request. Any signal source with amplitude within 0 and +7V can be used as an input device. A typical output voltage range of a function generator will not harm the amplifier but the input protection network will limit the signal amplitude to +7 V (after attenuator) and may cause clipping. The Unipolar Variable Gain High Speed Linear Amplifier F70PV is equipped with a microfuse rated at 40 mA, which will be blown if the input voltage exceeds 300% of the maximum.

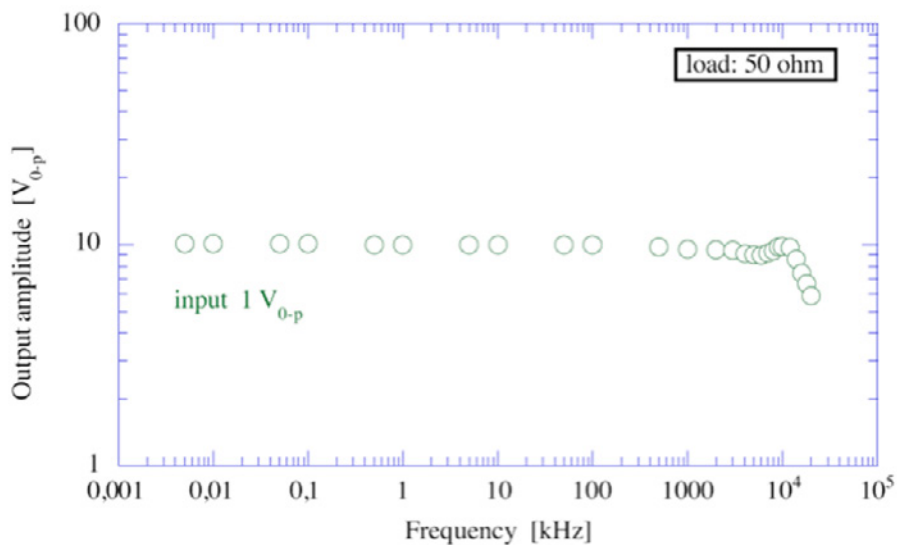
The maximum capacitive load is set at the factory to 500 V/μs which yields the load limit of 1 nF. The output current limit is set to ca 1.5 A. The output is equipped with a current limiting circuit that withstands accidental short-circuits and with a protective 2 Ω resistance. However, prolonged short-circuiting or overload should be avoided.

Total noise at the output with short-circuited input is:

| Frequency [kHz] | 0.5  | 1     | 10    | 50    |
|-----------------|------|-------|-------|-------|
| Noise [μV/√Hz]  | <1.3 | <0.32 | <0.06 | <0.05 |

## Frequency response

The frequency response to 1 V<sub>pp</sub> input amplitude and with 50 ohm load is shown in the following diagram:



# Single Channel High Voltage Linear Amplifiers

|                               |  | A400                        | A600             | A800             | F10A              | F20A              | P100  | P150                | P200   | F30PV            | F70PV                 |      |
|-------------------------------|--|-----------------------------|------------------|------------------|-------------------|-------------------|---|---------------------|--|------------------|-----------------------|------|
| Bandwidth                     | at 100 Vpp   | DC to 1 MHz                 | DC to 1 kHz      | DC to 1 MHz      | DC to 1 MHz       | DC to 1 MHz       | DC to 100 kHz                                     | DC to 100 kHz       | DC to 80 kHz                                       | -                | -                     |      |
|                               | at max. Vpp  | DC to 500 kHz               | DC to 350 kHz    | DC to 300 kHz    | DC to 1 MHz       | DC to 500 kHz     | DC to 100 kHz                                     | DC to 60 kHz        | DC to 60 kHz                                       | DC to 5 MHz      | DC to 5 MHz           |      |
| Amplification                 | type   | fixed                       |                  |                  |                   |                   |   |                     |  |                  | variable              |      |
|                               | level  | x 20                        | x 100            | x 100            | x 10              | x 20              | x 10  | x 20                | x 10   | x 10             | x 10                  | x 10 |
| Load                          | type   | resistive    capacitive     |                  |                  |                   |                   |   |                     |  |                  |                       |      |
|                               | full band-width  | 400 pF                      | 150 pF           | 120 pF           | 400 pF            | 400 pF            | 200 nF  | 100 nF              | 100 nF   | 1 nF             | 1 nF                  |      |
| Impedance                     | input  | 1 Mohm    30 pF             |                  |                  |                   | 50 kohm    30 pF  | 1 Mohm    30 pF                                   |                     |  | 500 ohm    30 pF |                       |      |
|                               | output   | <0.1 ohm in the linear mode |                  |                  |                   |                   | 1 ohm in the linear mode                          |                     |  |                  |                       |      |
| Voltage                       | input  | nominal ±10V                | nominal ±3V      | nominal ±4V      | nominal ±10V      | nominal ±7.5V     | nominal ±5V                                       | nominal ±5V         | nominal ±10V                                       | nominal ±3.5V    | nominal +7V, unipolar |      |
|                               | output   | max ±200V                   | max ±300V        | max ±400V        | max ±100V         | max ±150V         | max ±50V  | max +150V, unipolar | max ±100V  | max ±35V         | max +70V, unipolar    |      |
| Current                       | output   | 150 mA continuous           | 75 mA continuous | 60 mA continuous | 185 mA continuous | 150 mA continuous | max 2 A continuous                                | max 1 A continuous  | max 1 A continuous                                 | 1.5 A continuous | 1.5 A continuous      |      |
| Slew Rate without load        | output   | 400V/μs                     | 500V/μs          | 500V/μs          | 400V/μs           | 400V/μs           | 30V/μs  | 30V/μs              | 30V/μs   | 500V/μs          | 500V/μs               |      |
| Operating Ambient Temperature | 0°C to 30°C  |                             |                  |                  |                   |                   |   |                     |  |                  |                       |      |
| Storage Temperature           | 0°C to 60°C  |                             |                  |                  |                   |                   |   |                     |  |                  |                       |      |
| Relative Humidity             | up to 90% (operation), 30% to 50% (storage)                  |                             |                  |                  |                   |                   |   |                     |  |                  |                       |      |
| Power Requirements            | 100V or 110 V or 220 V, 50/60 Hz or 110/220V selector switch |                             |                  |                  |                   |                   |   |                     |  |                  |                       |      |
| Fuse                          | 100/110 V: 3.15 A (slow),<br>220/230 V: 2 A (slow)           |                             |                  |                  |                   |                   | "100/110 V: 4 A (slow),<br>220/230 V: 2 A (slow)" |                     | 100/110 V: 3.15 A (slow),<br>220/230 V: 2 A (slow) |                  |                       |      |
| Dimensions (H/W/L)            | 102 x 257 x 262 mm ( 4.0" x 10.1" x 10.3")                   |                             |                  |                  |                   |                   |   |                     |  |                  |                       |      |
| Weight                        | 4 kg (8.8 lbs)   |                             |                  |                  |                   |                   | 6 kg (13.2 lbs)                                   |                     |  | 4 kg (8.8 lbs)   |                       |      |
| Country of Origin             | Poland   |                             |                  |                  |                   |                   |   |                     |  |                  |                       |      |