

# Dual Channel High Voltage Linear Amplifiers

DATA SHEET

- Dual-Channel High Voltage Linear Amplifiers from 100Vp-p up to 1600Vp-p
- Two amplifiers in one box
- Ultra-linear amplification
- High Bandwidth, up to 1 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.

## Dual-channel Amplifier selection

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

The Dual-Channel Amplifiers comes in two basic design versions: the D-models with two independent amplifiers in one box, and the DI-models, which include an additional input signal inverter for the second amplifier. The DI-models can either be used as a dual output amplifier, like the D-models, OR as a single-output amplifier with doubled nominal amplitude

In models 400DI or 800DI, the first amplifier outputs the amplified in-phase input signal, and the second amplifier outputs the inverted signal (180 degrees phase shift). By combining the outputs of the two individual amplifiers you will effectively double the output p-p Voltage, compared to the output of individual amplifiers.



Select your Amplifier from one of our two series:

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

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

Explore details of the individual models on the follow pages.

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

Model	Output Voltage per channel	Output Current per channel	Bandwidth	Gain
F10AD	-100 to +100V	185 mA	1 MHz	x10, fixed
F20AD	-150 to +150V	150 mA	1 MHz	x20, fixed
A400D	-200 to +200V	150 mA	500 kHz	x20, fixed
A400DI	-200 to +200V or -400 to +400V	150 mA	500 kHz	x20, fixed
A600D	-300 to +300V	75 mA	350 kHz	x100, fixed
A800D	-400 to +400V	60 mA	300 kHz	x100, fixed
A800DI	-400 to +400V or -800 to +800V	60 mA	300 kHz	x100, fixed

# Dual Channel High Voltage Linear Amplifier A400D

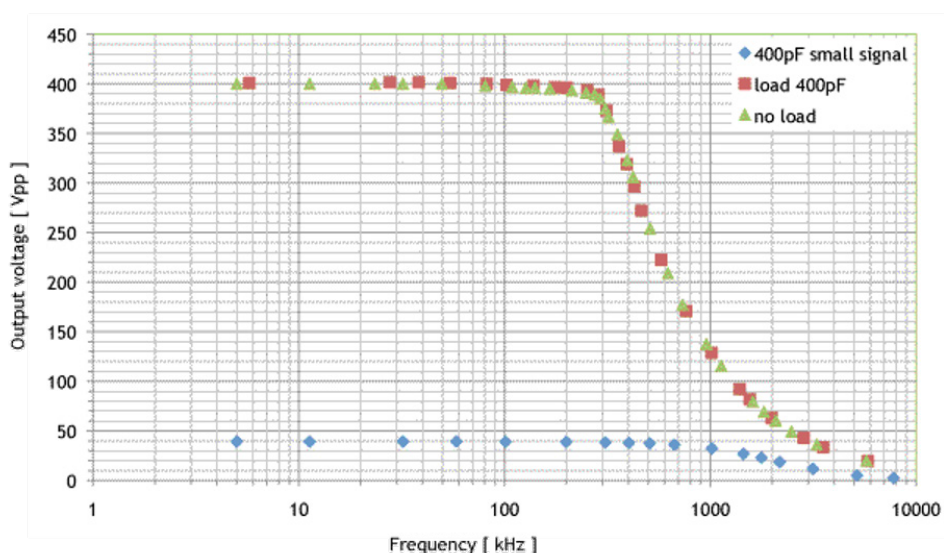


The Pendulum Instruments Dual Channel High Voltage Linear Amplifier A400D contains two independent A400 amplifiers that share common ground reference and power supply. This unit has a fixed amplification of 20 times and capable of bipolar high voltage output of  $\pm 200$ . Any other signal source with amplitude up to  $\pm 10$  V can be used as an input device. The input amplitude should normally be kept within  $\pm 7.5$  V. The A400 High Voltage Linear Amplifier is equipped with a microfuse rated at 15 mA, which will be blown if the input voltage exceeds 300% of the maximum.

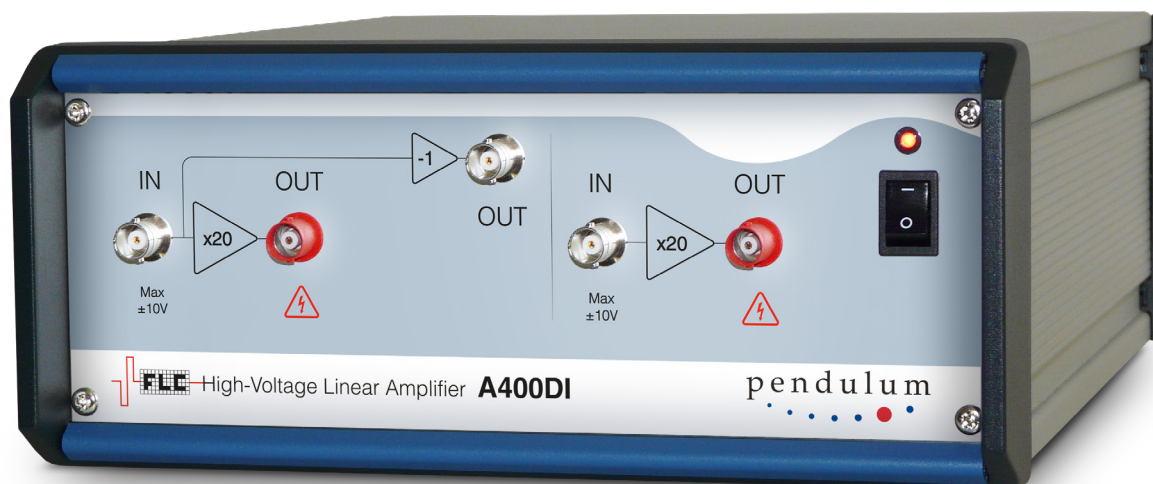
The maximum capacitive load is set at the factory to  $400 \text{ V}/\mu\text{s}$  which yields the load limit of ca  $400 \text{ pF}$ . The continuous output current limit is 185 mA and the output power limit is ca 30 W.

## 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:



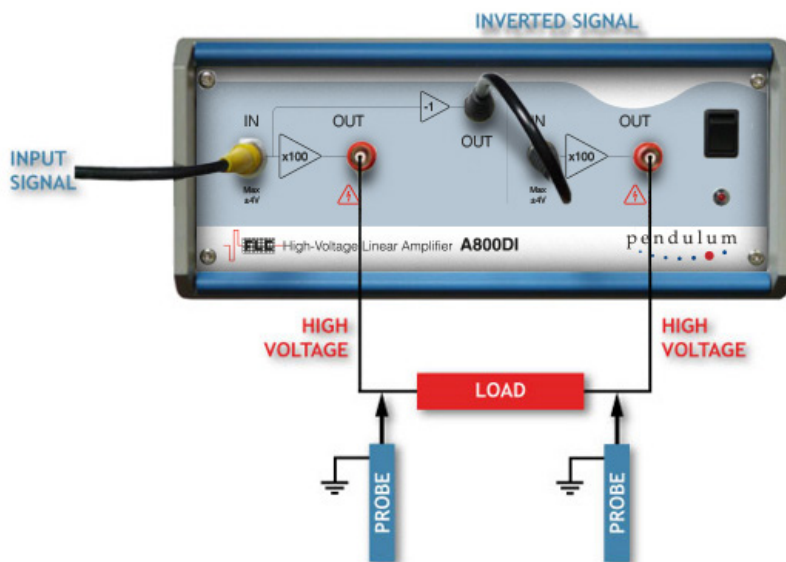
# Dual Channel HV Amplifier with Phase Inverter A400DI



The Pendulum Instruments Dual Channel High Voltage Linear Amplifier A400DI contains two independent A400 amplifiers that share common ground reference and power supply. It features also a low voltage phase inverter that inverts the signal applied to the input of channel 1. The resulting signal can then be connected to the input of channel 2 by means of a short BNC cable (supplied).

As a result the two outputs operate in counter-phase. Connecting a load between the outputs effectively doubles the amplitude range. Please note that the load cannot have any connection to ground. Also, in order to see the signal over the load you must use two oscilloscope probes and use the math function.

The phase inverter is present in models [A400DI](#) and [A800DI](#). The idea is illustrated below:



# Dual Channel High Voltage Linear Amplifier A600D

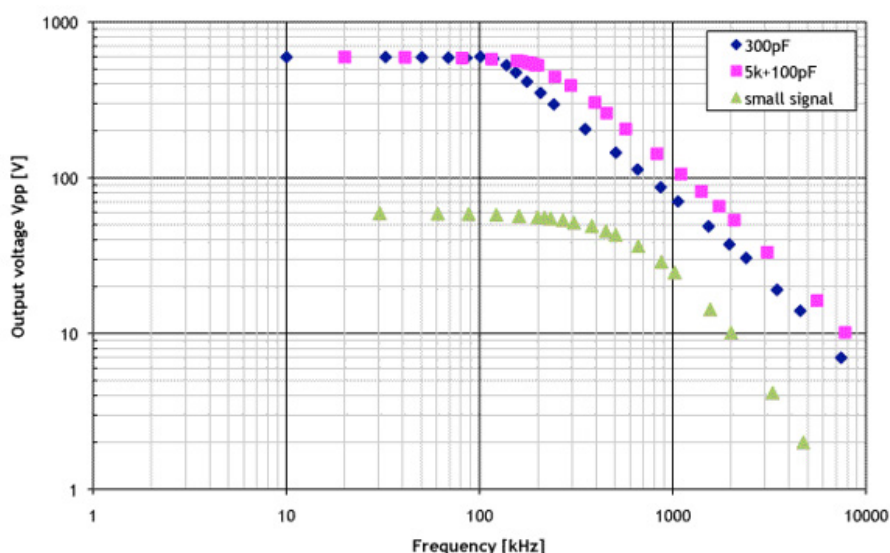


The Pendulum Instruments Dual Channel High Voltage Linear Amplifier A600D contains two independent A600 amplifiers that share common ground reference and power supply. This unit has a fixed amplification of 100 times and capable of bipolar high voltage output of  $\pm 300\text{V}$ . Any signal source 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 15 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 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:



# Dual Channel High Voltage Linear Amplifier A800D



The Pendulum Instruments Dual Channel High Voltage Linear Amplifier A800D contains two independent A800 amplifiers that share common ground reference and power supply. This unit 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 15 mA, which will be blown if the input voltage exceeds 500% of the maximum.

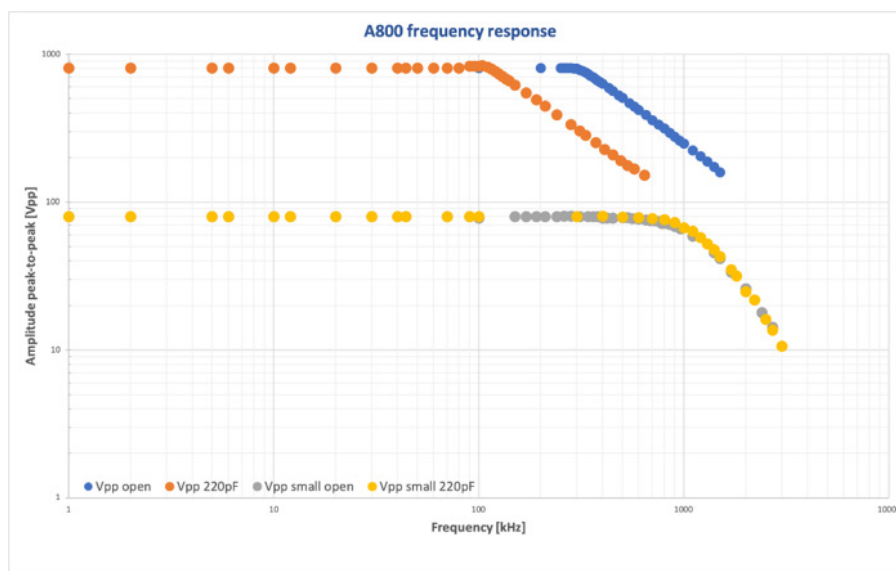
The maximum speed (slew rate) of the amplifier depends on the load. If the amplifier operates within its output

current limit then its speed, the slew rate, is 500 V/us. This is now the standard setting of A800-series amplifiers.

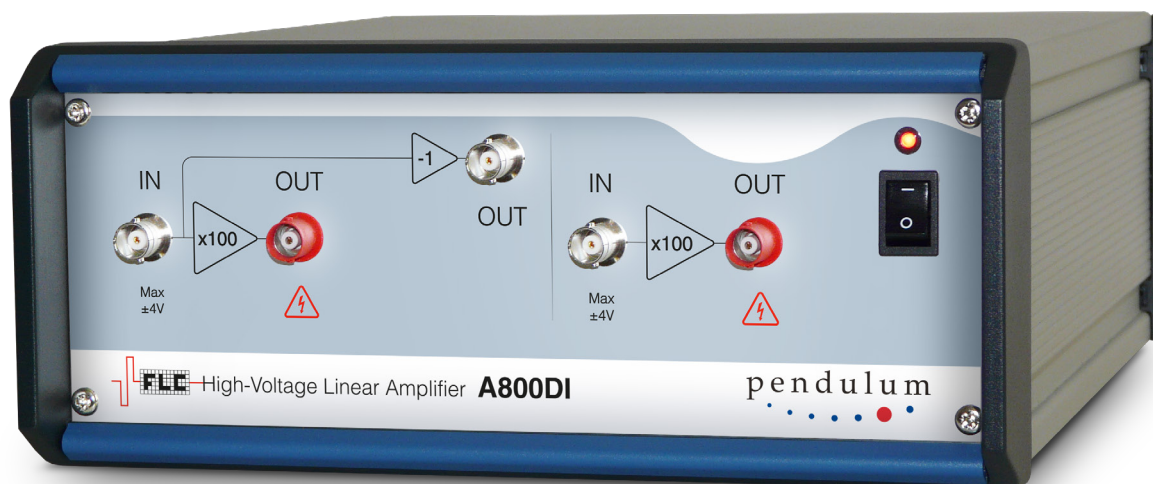
The continuous output current limit is 60 mA and the output power limit is ca 30 W. When the load requires more than 60mA current the amplifier will reduce the voltage accordingly in order to stay within the current limit.

## Frequency response

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



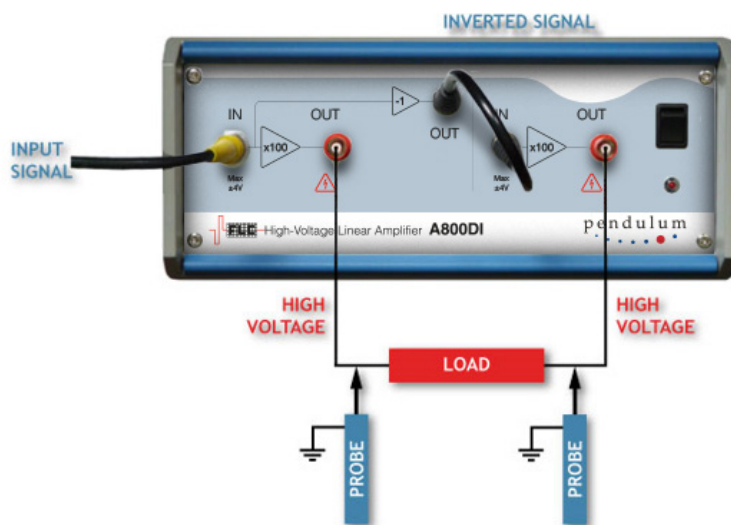
# Dual Channel HV Amplifier with Phase Inverter A800DI



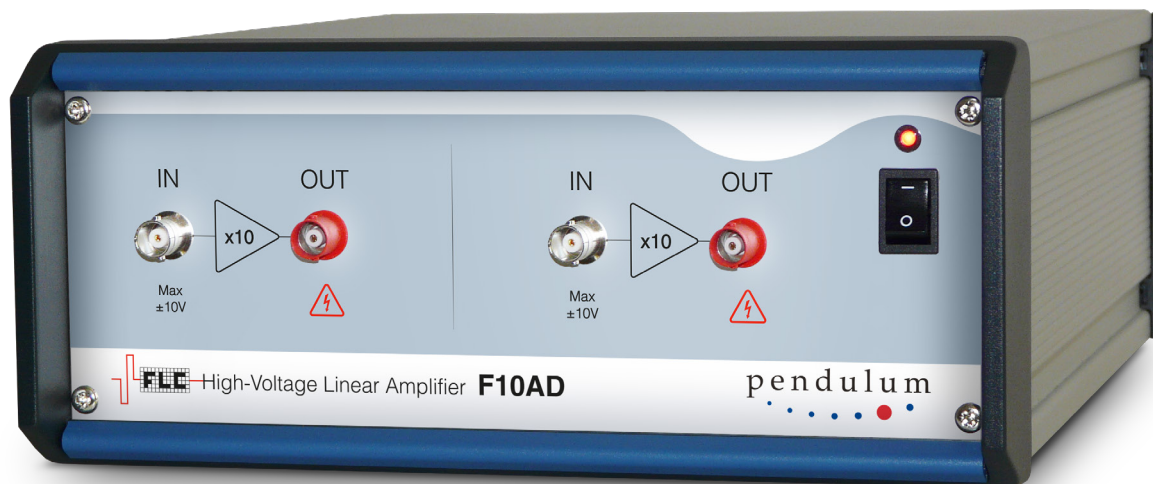
The Pendulum Instruments Dual Channel High Voltage Linear Amplifier A800DI contains two independent A800 amplifiers that share common ground reference and power supply. It features also a low voltage phase inverter that inverts the signal applied to the input of channel 1. The resulting signal can then be connected to the input of channel 2 by means of a short BNC cable (supplied).

As a result the two outputs operate in counter-phase. Connecting a load between the outputs effectively doubles the amplitude range. Please note that the load cannot have any connection to ground. Also, in order to see the signal over the load you must use two oscilloscope probes and use the math function.

The phase inverter is present in models [A400DI](#) and A800DI. The idea is illustrated below:



# Dual Channel High Voltage Linear Amplifier F10AD

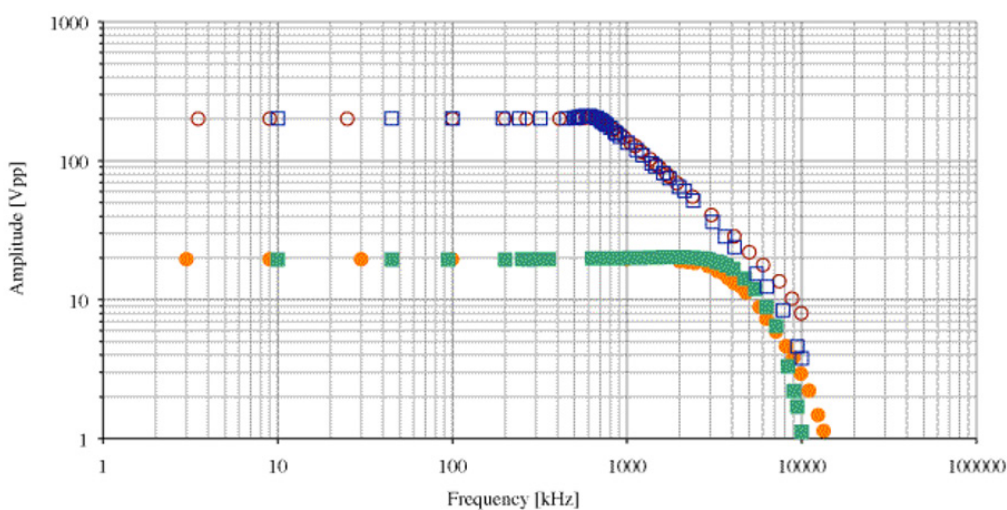


The Pendulum Instruments Dual Channel High Voltage Linear Amplifier F10AD contains two independent F10A amplifiers that share common ground reference and power supply. This unit has a fixed amplification of 10 times and capable of bipolar high voltage output of  $\pm 100\text{V}$ . Any signal source 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 F10A High Voltage Linear Amplifier is equipped with a microfuse rated at 15 mA, which will be blown if the input voltage exceeds 300% of the maximum.

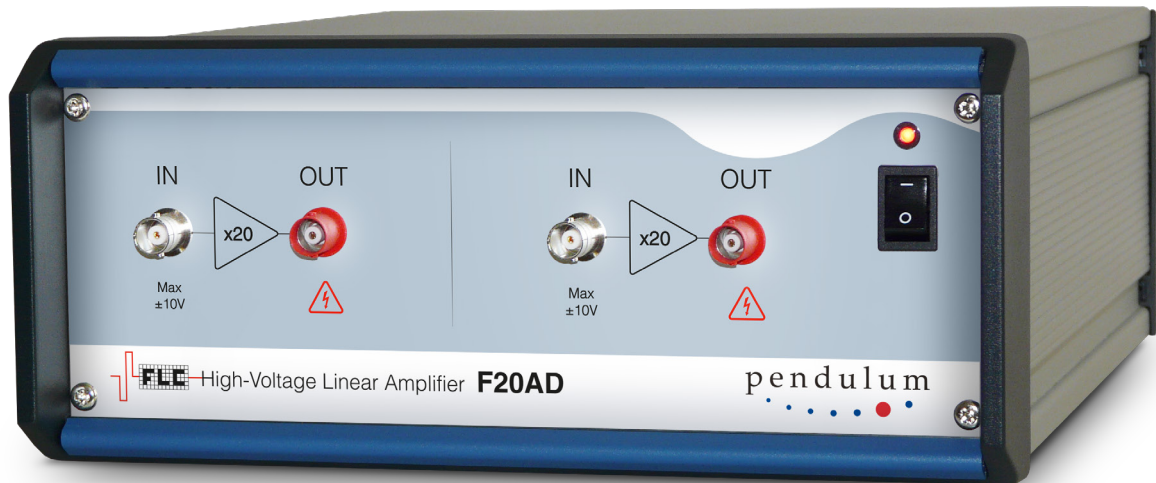
The maximum capacitive load is set at the factory to  $400\text{V}/\mu\text{s}$  which yields the load limit of ca  $400\text{pF}$ . The continuous output current limit is 185 mA and the output power limit is ca 30 W.

## 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: respectively, are shown in the diagram below:



# Dual Channel High Voltage Linear Amplifier F20AD

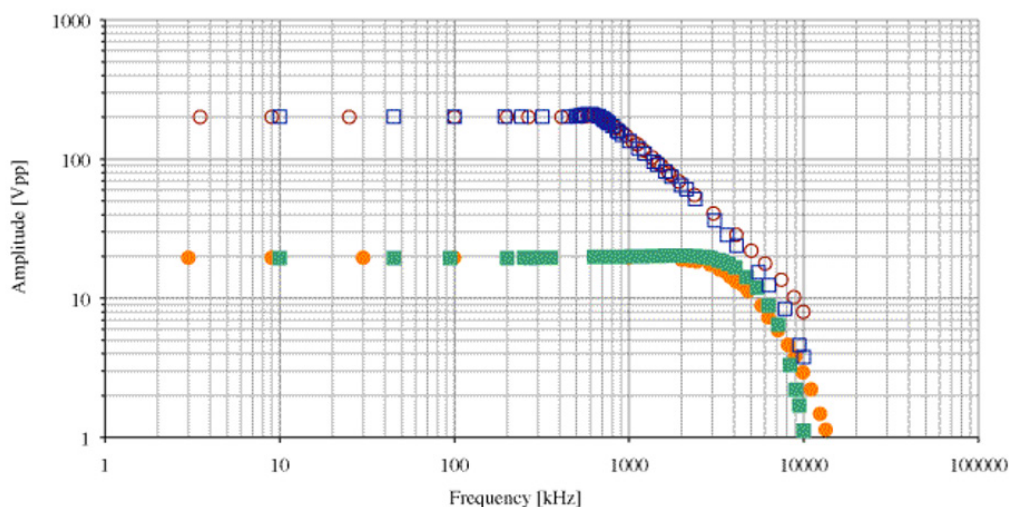


The Pendulum Instruments High Voltage Linear Amplifier F20AD contains two independent F20A amplifiers that share common ground reference and power supply. This unit has a fixed amplification of 20 times and capable of bipolar high voltage output of  $\pm 150\text{V}$ . Any signal source with amplitude 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 15 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 185 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: respectively, are shown in the diagram below:





# Dual Channel High Voltage Linear Amplifiers

		A400DI	A600D	A800D/DI	F10AD	F20AD
Bandwidth	at 100 Vpp	DC to 1 MHz	DC to 500 kHz	DC to 1 MHz	DC to 1 MHz	DC to 1 MHz
	at max. Vpp	DC to 500 kHz	DC to 350 kHz	DC to 300 kHz	DC to 1 MHz	DC to 1 MHz
Amplification	type	fixed				
	level	x 20	x 100	x 100	x 10	x 20
Load	type	resistive    capacitive				
	full bandwidth	400 pF	300 pF	200 pF	400 pF	400 pF
Impedance	input	1 Mohm    30 pF				
	output	<0.1 ohm in the linear mode				
Voltage	input	nominal ±10 V	nominal ±3 V	nominal ±4 V	nominal ±10 V	nominal ±7.5 V
	output	max ±200V	max ±300 V	max ±400 V	max ±100 V	max ±150 V
Current	output	150 mA continuous	75 mA continuous	60 mA continuous	185 mA continuous	150 mA continuous
Slew Rate	output	400 V/μs	400 V/μs	500 V/μs	400 V/μs	400 V/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), 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)				
Country of Origin		Sweden				