

NEW

Ultra High Speed High Voltage Amplifier

**AMS/AMT
series**



Optional on
available models



AMS/AMT series

High Voltage Amplifier



AMS/AMT series are a rack mountable, fast response, high voltage operational amplifier that has been developed based on our many years of experience and expertise in high voltage. With a fast response up to 100 kHz, the AMS/AMT series can output high voltage in sine, triangle, sawtooth, and square waves proportional to the input waveform. We have eight models with output voltage ranging from ± 0.6 kV to ± 10 kV, which are all solid-state.

FEATURES

- ▶ Output ± 0.6 kV to ± 10 kV
- ▶ High speed response, max 100 kHz
- ▶ Various types of output wave forms according to the input wave
- ▶ DC bias (DC offset voltage) function
- ▶ DC output voltage monitor (3.5-digit digital meter)

APPLICATIONS

IMPORTANT: For applications involving capacitive loads or electrical discharge, please refer to page 07, "For capacitive loads and discharge loads"

- ▶ Beam deflection
- ▶ Corona discharge
- ▶ Dielectric withstand test
- ▶ Electrostatic chuck
- ▶ Electrophotography process
- ▶ Electrorheological fluid (ER fluid)
- ▶ Lighting test for discharge tubes
- ▶ Various electrostatic testing

MODELS ★: Conform to CE marking with -CE option selected. (see "Options" on page 05.) * Typical value at sine wave.**AMS series: High speed model**

Output voltage [kVdc]	Output current [mA max]	Max output power [W]	Model	Slew rate	Frequency response* (-3 dB)	
					Full scale	10% of full scale
-5 to +5	±6	30	AMS-5B6 ★	30 V/μs	DC to 2 kHz	DC to 4 kHz
-10 to +10	±2	20	AMS-10B2 ★		DC to 1 kHz	DC to 2 kHz

AMT series: Ultra high speed/High power model

Output voltage [kVdc]	Output current [mA max]	Max output power [W]	Model	Slew rate	Frequency response* (-3 dB)	
					Full scale	10% of full scale
-0.6 to +0.6	±100	60	AMT-0.6B100	250 V/μs	DC to 100kHz	DC to 100kHz
-1 to +1	±60		AMT-1B60		DC to 60kHz	
-1.5 to +1.5	±40		AMT-1.5B40		DC to 40kHz	DC to 80kHz
-3 to +3	±20		AMT-3B20	360 V/μs	DC to 30kHz	DC to 60kHz
-5 to +5	±20	100	AMT-5B20 ★		DC to 20kHz	DC to 40kHz
-10 to +10	±10		AMT-10B10 ★		DC to 10kHz	DC to 20kHz

SPECIFICATIONS The specifications, unless otherwise indicated, are at the maximum rated output after warm-up.

Input voltage	Standard: 115 Vac ±10%, 50 Hz/60 Hz, single phase -L(230V) option: 230 Vac ±10%, 50 Hz/60 Hz, single phase -CE option: 100 Vac to 240 Vac ±10%, 50 Hz/60 Hz, single phase
Output voltage control	External control voltage, Vcon-in: -10 V to +10 V (input impedance 10 kΩ or more)*1
DC bias (DC offset voltage)	Settable in the range of -100% to +100% by 10-turn potentiometer on the front panel
Regulation	Line: ±0.05% (±10% input change) Load: 0.05% (10% to 100% load change)*2
Ripple	AMS: 0.1% p-p or less *2, AMT: 0.02% +1 Vp-p or less *2
Stability	0.016%/hr (typical) *2
Digital panel meter	3.5-digit display *3
Voltage monitor	-10 V to +10 V output from the BNC terminal on the front panel (output impedance 1 kΩ)
External output ON/OFF	Output ON/OFF by external contact signal (short: ON, open: OFF)
Protections	• Overcurrent protection with high voltage output cutoff • Overvoltage protection • Output short-circuit protection • Arc protection • Output state auto-recovery prevention (former: power failure protection)
Operating temperature	0 to +40°C
Storage temperature	-20°C to +60°C
Relative humidity	20% to 80%, non-condensing
Included accessories	• AC input cable 2.5 meters length × 1 • High voltage output cable (flying lead) 1.5 meters length × 1 • Instruction manual × 1

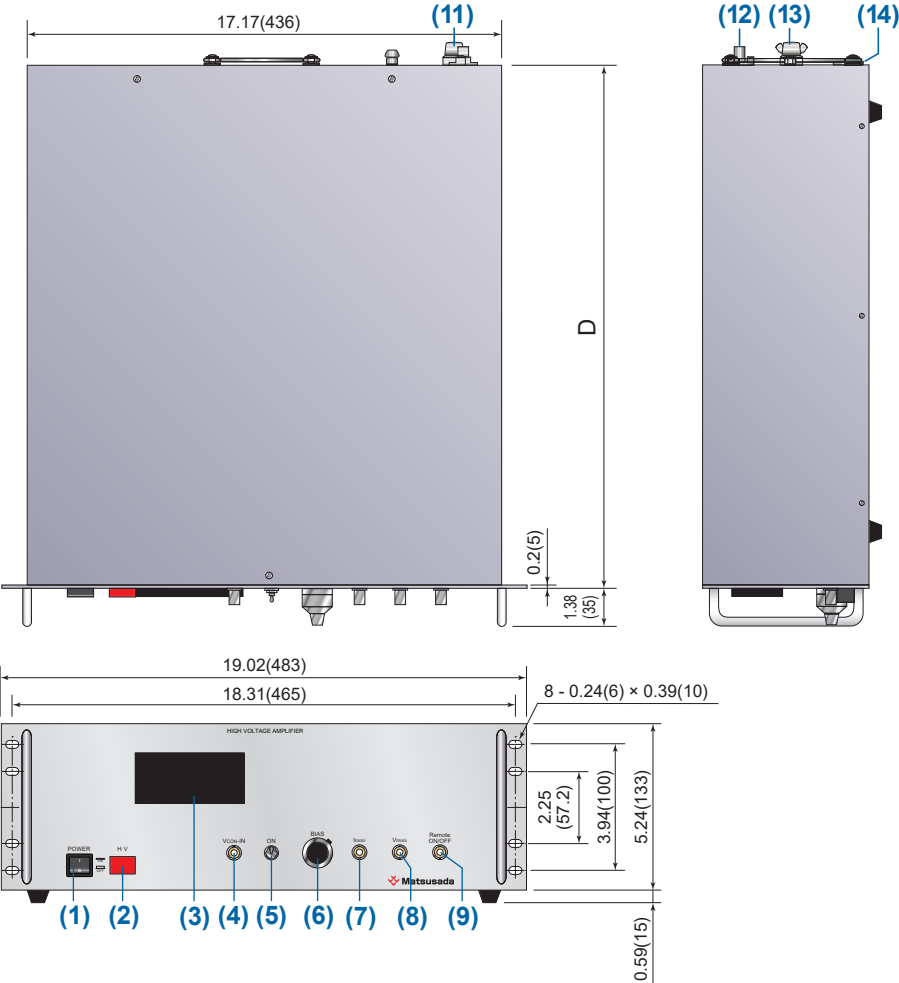
*1 Offset voltage: within 0.5% of rated output at Vcon-in = 0 V

*2 The values are at DC operation with resistance loads maximum rating.

*3 DC voltage display at DC output Average voltage display at 10 Hz or more output

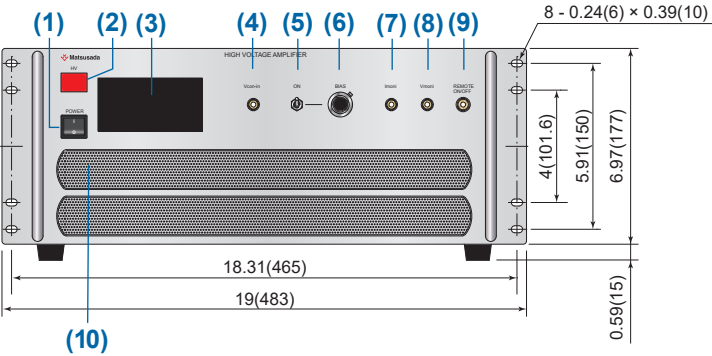
DIMENSIONS [inch (mm)]

[AMS]



Model	Depth	Weight [kg]
AMS	19.06(483)	14 to 18
AMT		14 to 23

[AMT]



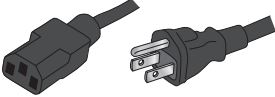
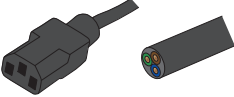
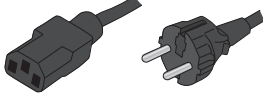
- (1) POWER ON/OFF switch**
This has priority overall operations for safety reasons.
- (2) High voltage ON/OFF switch**
"This is used to not only the OUTPUT ON/OFF but also reset the output turnoff caused by output overcurrent, output short-circuit protection, output state auto-recovery prevention (former: power failure protection). In addition, external output ON/OFF operation is only available in the OUTPUT switch set to ON.
- (3) OUTPUT voltage meter**
- (4) External control voltage (Vcon-in) input connector**
BNC receptacle
- (5) Bias ON/OFF switch**
- (6) Bias setting dial** 10-turn potentiometer
- (7) OUTPUT current monitor terminal (option)** BNC receptacle
- (8) OUTPUT voltage monitor terminal** BNC receptacle
- (9) External output ON/OFF terminal** BNC receptacle
- (10) Air intake**
- (11) FUSE**
- (12) OUTPUT connector**
- (13) Ground terminal** M6
- (14) AC inlet**

* Design of rear panel can be slightly different from model to model.
Please contact our sales office if details are required.

INPUT/OUTPUT CABLE

AC input cable

Select an appropriate AC input cable according to your operating environment and region.
Please note that other than AC input cables that correspond to the following are to be prepared by customers.

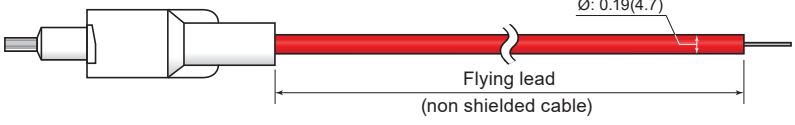
Standard	Standard with -L(230V) option	Sold separately with -L(230V) option
CABLE TYPE 1	CABLE TYPE 3	CABLE TYPE 4
Rated voltage: 125 V Maximum current: 10 A (For Japan or North America)	Rated voltage: 250 V Maximum current: 10 A (For Europe)	Rated voltage: 250 V Maximum current: 10 A (For Europe)
		

The length of each cable is 2.5 meters. (See CABLE series catalog for details)

High voltage output cable

Standard	Standard with -L(5m) option
CN-40-AHVP	CN-40-AHVP(5)
High voltage output cable 1.5 meters length	High voltage output cable 5 meters length

[To power supply] **[To load]**



Flying lead
(non shielded cable)

OPTIONS

- LC Current limit** Limits the output current at time of overload
- LN Output state auto-recovery (former: no power failure protection)**
- L1 Output current monitor** -10 V to +10 V from BNC connector on front panel (output impedance 1 kΩ up to 2 kHz bandwidth)
- L(230V) Input voltage 230 Vac ±10% single phase** (unavailable with -CE option selected)
- L(5m) High voltage output cable 5 meters length**
Note that phenomena such as reduced slew rate or response speed, or output waveform distortion may occur.
- CE Conform to CE marking with input voltage 100 Vac to 240 Vac** (for available models, see "MODELS" ★ on page 03.)
Conforms to CE marking safety standards with the input voltage 100 Vac to 240 Vac ±10%, 50 Hz/60 Hz, single phase.
* The product is designed to be installed in the customer's system and so as to meet the requirements of CE marking regarding chassis mounting, noise control, proper protections, and isolated devices. It is not designed to perform alone.

How to order When placing an order, please add the option code(s) after the model name. If adding two or more options, omit the "-L" from the second and subsequent option codes, and list them in alphabetical order, with the input voltage and output cable length options placed at the end. If the -CE option is selected, add it after all other options.

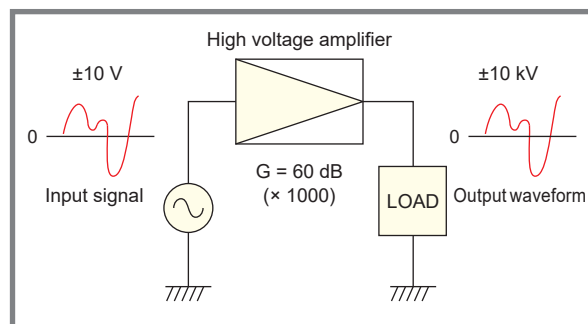
<Example> **AMS-5B6-LC, AMS-5B6-LCN1(230V)(5m)** <Example of ordering -CE option> **AMS-5B6-CE, AMS-5B6-LCN1(5m)-CE**

HIGH SPEED HIGH VOLTAGE AMPLIFIER

High Voltage Amplifier

A high-voltage amplifier converts a low-voltage input signal into a high-voltage output waveform (Figure 1). Demand for these amplifiers is growing as they become indispensable tools for research, development, and system integration in fields such as electronics, physics, biochemistry, and medicine. Leveraging our advanced high-voltage technology, Matsusada Precision offers a diverse range of high-voltage amplifiers designed to meet a wide variety of customer requirements.

* In addition to the models featured here, we also develop amplifiers specifically for applications such as electrostatic chucks (E-chucks) and PZT drivers. For more information, please contact our sales team.



(fig. 1)

Four-Quadrant Output Range

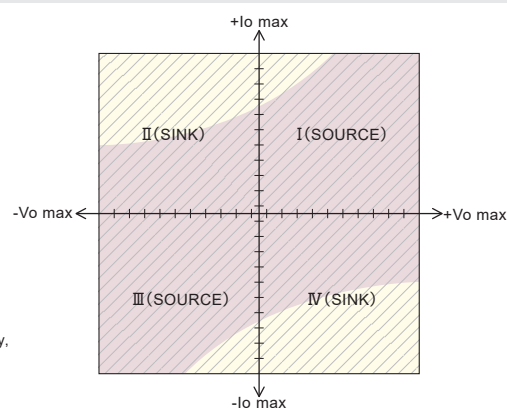
Our high-voltage amplifiers feature a four-quadrant output, meaning they can both source (supply) and sink (absorb) current. This capability ensures stable voltage operation regardless of the load type (e.g., capacitive or inductive). Their fast response makes them ideal for applications requiring high-speed AC or arbitrary waveform outputs.

All Matsusada Precision high-voltage amplifiers are bipolar, enabling true four-quadrant operation (Figure 2). (Excluding some models)

Vomax : Rated output voltage
Iomax : Rated output current

■ AC operation range (with 50 Hz or more frequency, 50% of duty cycle and without any DC bias)

■ DC operation range

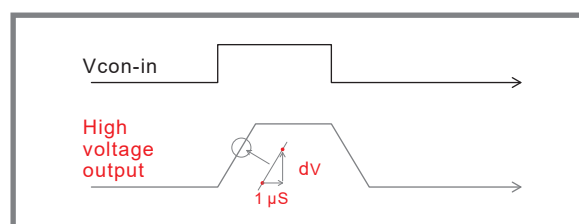


(fig. 2) Voltage and Current operation range

Slew Rate

The slew rate is the maximum rate of change of the output voltage and is a key indicator of an amplifier's response speed. It is expressed as dV/dt , typically in $V/\mu s$. For a given slew rate, a smaller output amplitude results in a shorter response time.

Our highest-performing AMPS series, for example, achieves a slew rate of over $1200 V/\mu s$.



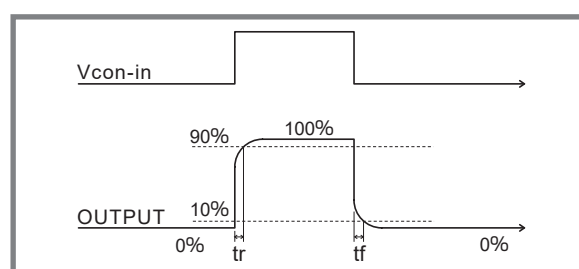
(fig. 3)

Rise Time (step response)

Step response can be indicated by the rise time, as shown in Figure 4. The rise time of an amplifier with a frequency response (= bandwidth) of f_c (Hz) is typically given by the following formula.

$$tr \approx 0.35/f_c$$

The fall time (tf) is equal to tr .

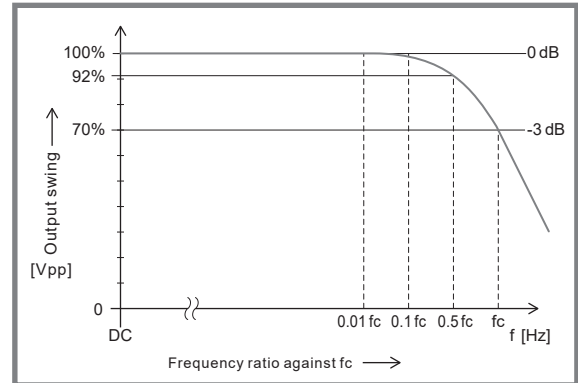


(fig. 4)

Frequency Response

The response of Matsusada Precision amplifiers is described as "Frequency Response (Bandwidth)." When the output is driven with a sinusoidal waveform into a rated resistive load, the output swing (amplitude) decreases as the input frequency increases. In the specifications, the frequency response refers to the frequency f_c at which the output swing is reduced to approximately 70.7% (-3 dB). (fig. 5) To ensure accurate waveform reproduction, select an amplifier with a bandwidth sufficiently higher than the operating frequency. As a rule of thumb, a bandwidth 3 to 5 times higher is recommended for sinusoidal waveforms, and at least 10 times higher for square waveforms. An insufficient bandwidth will not only reduce the output amplitude but also introduce significant phase shift. Therefore, it is crucial to monitor the output waveform to confirm it meets your application's requirements.

Important: Avoid operating the amplifier continuously at frequencies beyond its specified bandwidth (i.e., where the output amplitude begins to roll off). This can cause excessive internal power dissipation and may lead to permanent damage.



(fig. 5) Declination of output swing by frequency

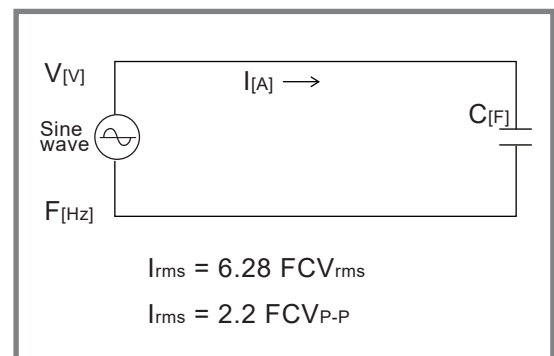
For capacitive Loads and discharge loads

When a capacitive load of 100 pF or more (including the stray capacitance of the output wire) is connected to the power supply, the output voltage may oscillate.

In this case, insert a high-voltage resistor of 100 Ω (at 0.1 μ F) to 1000 Ω (at 1000 pF) in series with the output. Note that with a capacitive load, the frequency bandwidth is limited according to the equation on the right. Additionally, applications involving electrical discharge, such as corona discharge, can generate excessive currents that exceed the amplifier's rating, which may cause damage. To protect the amplifier in these applications, always connect a series protection resistor to the output to limit the current.

This practice helps ensure a long product life.

Important: Avoid operating the amplifier continuously at frequencies beyond its specified bandwidth (i.e., where the output amplitude begins to roll off). This can cause excessive internal power dissipation and may lead to permanent damage.



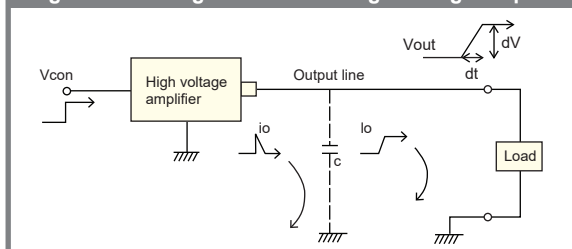
Optimizing Performance: Cabling and Connections

We strongly recommend using non-shielded cables for the high-voltage output. When the output waveform is a sine wave, square wave, or other AC waveform, stray capacitance can form between the output cable and any nearby metal objects. This capacitance leads to the flow of excess charging and discharging currents.

This additional capacitive current flows in parallel with the load, causing the following problems:

1. Reduced slew rate and response speed. 2. Distortion of the output waveform.

Diagram of Leakage Current in a High Voltage Amplifier



Leakage current due to stray capacitance "C" from the output cable.

$$i_o = \frac{dQ}{dt} = C \frac{dV}{dt} \quad Q: \text{capacity [C]}$$

Solution

Minimizing Stray Capacitance
To minimize the effects of stray capacitance from the output cable:

- (1) Keep the cable as short as possible.
- (2) Route the cable away from any conductive surfaces such as floors, desks, or metal chassis.
- (3) Use non-shielded high-voltage cables.

About Us

Matsusada Precision Inc. has been manufacturing high-voltage power supplies in Japan for more than 50 years. Renowned for meeting the stringent quality demands of the Japanese market, we have become the leading high-voltage power supply manufacturer with the highest market share in Japan.

Our product portfolio has expanded beyond high-voltage power supplies to include DC power supplies, AC power sources, electronic loads, high-voltage amplifiers, bipolar power supplies, and X-ray inspection equipment. These products are widely used in fields such as semiconductor production, photomultiplier tubes, electrostatic chucks, electron beam processing, medical equipment, automotive, and aerospace.

With our direct sales and experienced technical support teams in Japan, we ensure a swift and thorough response to customer needs worldwide. Our mission is to deliver products that meet Japan's rigorous quality standards to customers across the globe. Contact us to discover the ideal power solution for your application.

Matsusada Precision



Matsusada Precision Inc.

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