

NEW

Ultra High Speed HV Amplifier

AMP
series




(Some models only)

AMP series

Ultra High Speed HV Amplifier

Additional output ranges for solar battery panel evaluations!



AMP series is an ultra high speed high voltage amplifier. It realized as fast as $700 \text{ V} / \mu\text{s}$ even with load, and approximately 2 times faster than existing models. With the capability of peak current output of 3 times, it suppress the distortion of waveform when with capacitive load.

CE (Low Voltage Directive) approved.

For measuring voltage and / or current

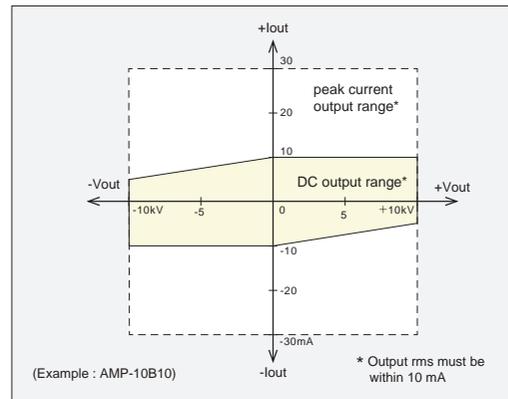
When the voltage at load is lower than the rated maximum output of AMP series, constant voltage and high speed operation is possible by sinking the output current with current sink feature.

As example of solar battery application, cell / panel voltage and current data can be obtained by logging the change of current sink by changing the voltage to solar battery cell / panel gradually. At that time with its high slew rate of $300 \text{ V} / \mu\text{s}$ AMP can get more detailed sampling. AMP is a bi-polar power supply with 0 crossing, and so, it can measure the output short current at 0V. Moreover, it can output peak current of 3 times more than rated current(at DC). (see right chart)

Suitable for the trend to higher voltage for cell / panel evaluation

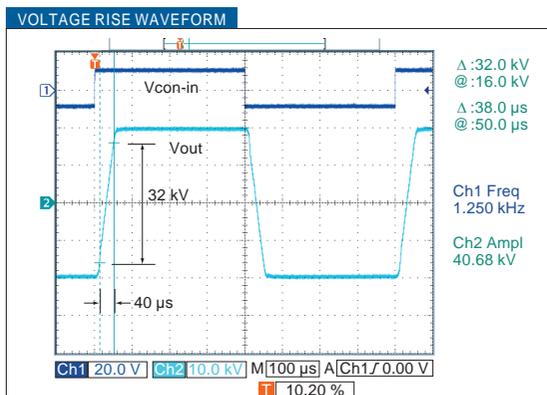
Voltage rating required for solar battery(panel) evaluation is getting higher and higher. AMP series added more lineups ranging from $\pm 600 \text{ V}$ to $\pm 30 \text{ kV}$ to meet the demand for evaluation of higher voltage solar battery panel as well as evaluation of cell / panel with wider output range.

OUTPUT RANGE



High speed response of slew rate $700 \text{ V} / \mu\text{s}$ *

*Change model to model



Slew rate with actual load is as high as $700 \text{ V} / \mu\text{s}$, and solve the problem of "When actual operation with load, the response become slow."

Ideal for higher speed printer or material evaluation testing.

Example of waveform : model AMP-20B20
 Operation condition : $V_{con-in} = \pm 10 \text{ V}$ $V_{out} = \pm 20 \text{ V}$
 $R_L = 1 \text{ M}\Omega$ $F = 1.25 \text{ kHz}$
 Slew rate : $SR = 32 \text{ kV} / 40 \mu\text{s} > 700 \text{ V} / \mu\text{s}$

LINEUP

Output Voltage	Output Current (DC+AC)	Max. output power	MODEL	Slew Rate	Frequency Response(-3 dB)*1	
					Full scale *2	Small bandwidth (10 % of full scale)
-600 V to +600 Vdc	±2000 mA max and ±4000 mApk 1 mS max	1200 W	AMP-0.6B2000	≥ 300 V / μs	DC to 40 kHz	DC to 60 kHz
-1 kV to +1 kVdc	±1200 mA max and ±2400 mApk 1 mS max	1200 W	AMP-1B1200		DC to 30 kHz	DC to 50 kHz
-2 kV to +2 kVdc	±200 mA max and ±400 mApk 1 mS max	400 W	 *3 AMP-2B200	≥ 700 V / μs	DC to 20 kHz	DC to 50 kHz
-5 kV to +5 kVdc	±80 mA max and ±160 mApk 1 mS max	400 W	 *3 AMP-5B80		DC to 10 kHz	DC to 30 kHz
-10 kV to +10 kVdc	±10 mA max and ±30 mApk 1 mS max	100 W	 *3 AMP-10B10		DC to 7 kHz	DC to 25 kHz
	±40 mA max and ±120 mApk 1 mS max	400 W	 *3 AMP-10B40			
-20 kV to +20 kVdc	±20 mA max and ±60 mApk 1 mS max	400 W	 *3 AMP-20B20		DC to 4 kHz	DC to 20 kHz
-30 kV to +30 kVdc	±10 mA max and ±30 mApk 1 mS max	300 W	AMP-30B10	≥ 360 V / μs	DC to 1 kHz	DC to 5 kHz
-40 kV to +40 kVdc	±20 mA max and ±40 mApk 1 mS max	800 W	AMP-40B20		DC to 1 kHz	DC to 5 kHz

*1 Typical value at sine wave operation with resistive load.

*2 At frequency of full scale, output voltage may be clipped by power limitation.

*3 They comply with the low voltage directive.

SPECIFICATIONS

Input voltage / current 230 VAC ±10% 50 / 60 Hz single phase 8 A typ (AMP-0.6B2000, AMP-1B1200)
230 VAC ±10% 50 / 60 Hz single phase 5 A typ (AMP-2B200, AMP-5B80, AMP-10B40, AMP-20B20, AMP-30B10)
200 V to 240 VAC ±10% 50 / 60 Hz single phase 10 A typ (AMP-40B20)
100 V to 240 VAC ±10% 50 / 60 Hz single phase 3.5 A typ@100 VAC (AMP-10B10)

Output voltage control External control voltage Vcon-in = -10 V to +10 V *1
(Input Impedance greater than 10 kΩ)

DC Bias Front panel 10-turn potentiometer enables setting between -100% and +100%

Regulation Line : ±0.05% (115 V or 230 V ±10% input change)
Load : 0.05% (10% to 100% load change) *2

Ripple Less than 0.02% +1 Vp-p *2

Stability 0.016% / Hr typ *2

DC output voltage display 3.5-digit digital meter *3

Output voltage monitor -10 V to +10 V from front panel BNC terminal
(Output impedance 1 kΩ)

Output current monitor -10 V to +10 V (10 Vpeak) from front panel BNC terminal
(Output impedance 1 kΩ. Up to 3 kHz bandwidth)

Remote switch ON/OFF Output ON / OFF with external contact signal
(Short : ON, Open : OFF)

Protection Over current protection with cut off, over voltage protection
output short circuit protection, arc protection and blackout protection.

Operating Temp. 0°C to +40°C

Storage Temp. -20°C to +60°C

Humidity 20% to 75%RH (no condensation)

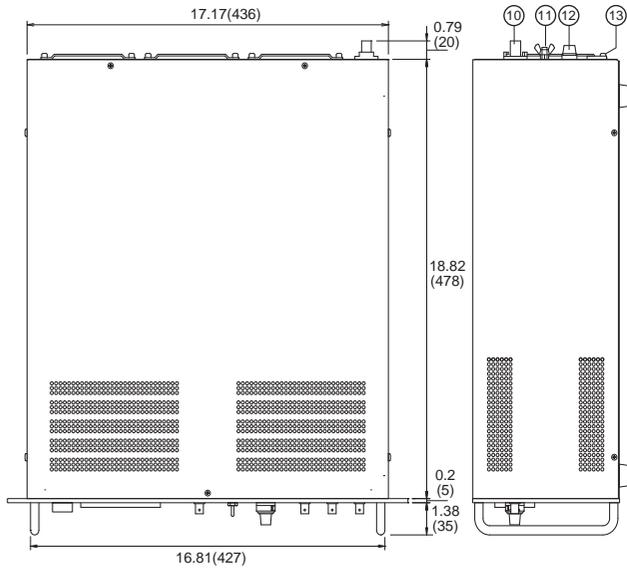
Accessories Input AC cable 2.5 m (1)
■ With 3-pin connector for 115 VAC input ■ Flying lead (open end) for 230 VAC input
Output HV cable flying lead 1.5 m (1)
Instruction Manual (1)

*1 Offset voltage at Vcon-in = 0 V is less than 0.1% of rated output.

*2 At DC operation with resistive load maximum rated output.

*3 At DC output : DC voltage display. At more than 10 Hz output : Average voltage display

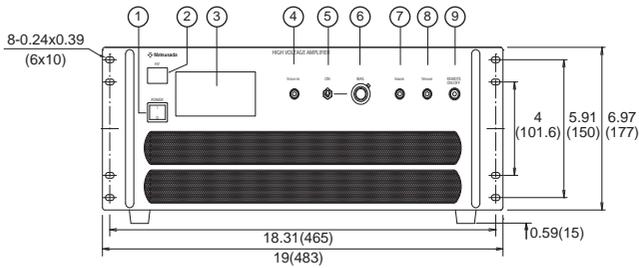
DIMENSIONS inch(mm)



- ① **POWER ON / OFF switch** Have priority to all other operations for safety reason.
- ② **HV ON / OFF switch** To be also used to reset output cutoff status due to output over load, output short circuit protection or black out protection. Remote switch operation is possible only when output switch is 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** BNC receptacle
- ⑧ **OUTPUT voltage monitor terminal** BNC receptacle
- ⑨ **Remote ON/OFF terminal** BNC receptacle
- ⑩ **OUTPUT connector**
- ⑪ **Ground terminal** M6
- ⑫ **FUSE**
- ⑬ **AC inlet**

AMP-10B10
D=19.06(484)*
Weight : 23 kg approx.

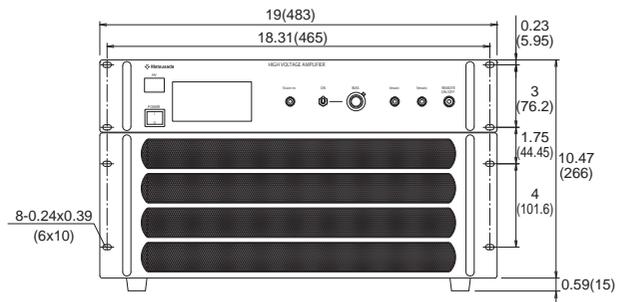
*Except projection



AMP-2B200, AMP-5B80
AMP-10B40, AMP-20B20
D=21.65(550)*
Weight : 28 kg approx.

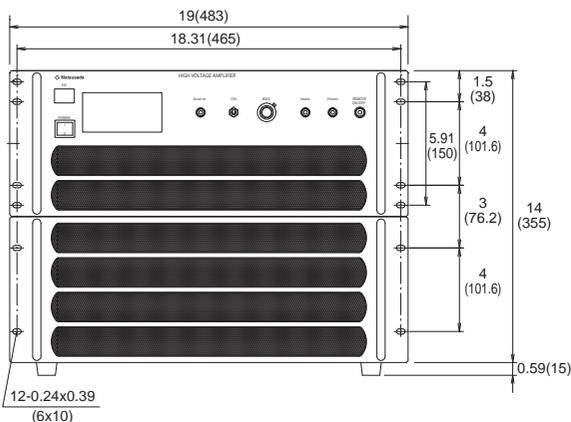
AMP-0.6B2000
D=24.02(610)*
Weight : 45 kg approx.

*Except projection



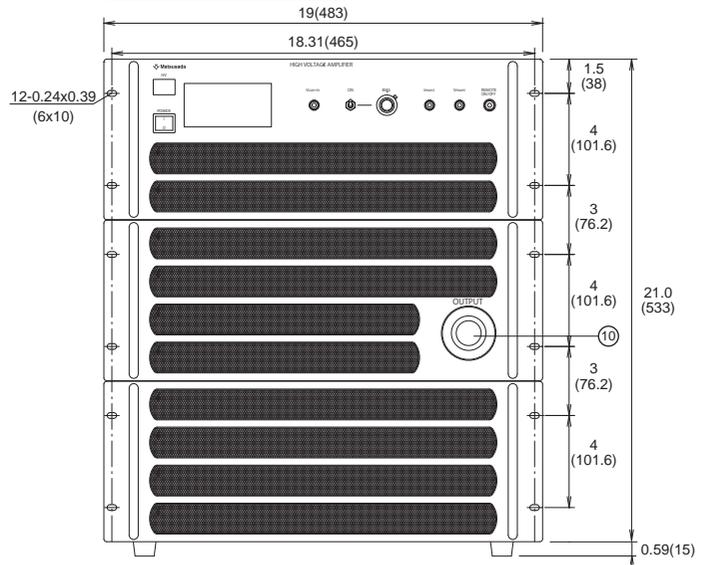
AMP-1B1200
D=24.02(610)*
Weight : 50 kg approx.

*Except projection



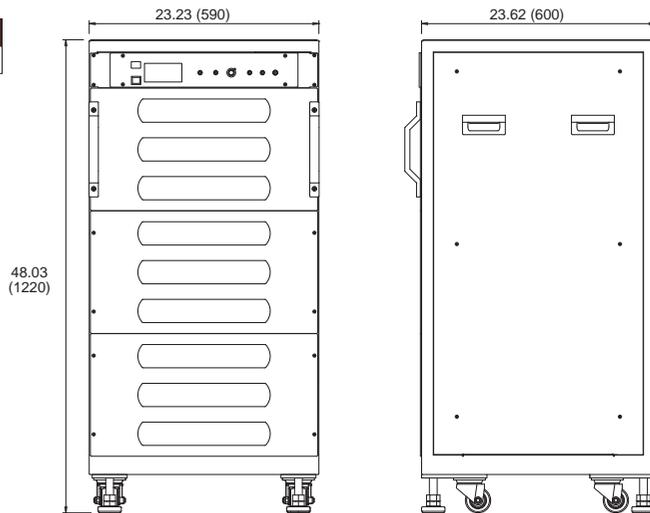
AMP-30B10
D=21.65(550)*
Weight : 50 kg approx.

*Except projection



AMP-40B20
Weight : 100 kg approx.

*Except projection



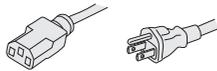
INPUT / OUTPUT CABLE

Input cable

[AMP-10B10]

CABLE TYPE 1 (Standard)*

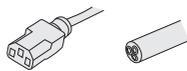
3-pin plug (Type-A) / Inlet type / 125 V rated / Single phase (3-core) / Black



[300 W and 400 W models]

CABLE TYPE 3 (Standard)

Inlet type / Flying lead / 250 V rated / Single phase (3-core) / Black



[800 W, 1200 W models]

CABLE TYPE 5 (Standard)

M4 round terminalx3 / Flying lead / 250 V rated / Single phase (3-core) / Black



The length is 2.5 m for both. (Please see CABLE series catalog for details)

*CABLE TYPE 3 is needed separately when the input voltage is 200 V to 240 VAC.

Output cable

- 2 kV to 10 kV models
 - ➔ CN-40-AHVP HV output cable 1.5 m (standard)
 - ➔ CN-40-AHVP(5) HV output cable 5 m (-L(5m) option)
- AMP-20B20
 - ➔ CN-40-AHVP TU* HV output cable 1.5 m (standard)
 - ➔ CN-40 AHVP TU(5)* HV output cable 5 m (-L(5m) option)
- AMP-30B10, AMP-40B20
 - ➔ CN-50-AHVP HV output cable 3 m (standard)
- Less than 1 kV models
 - ➔ using terminal board output line 1.5 m (standard)

*TU : With silicon tube

OPTION

-LOc	Adjustable cut-off current setting value * Limit setting value to trigger to cut off the output current becomes variable by adjusting the potentiometer on the front panel between the range 10% to 105% of the rated current.
-LC	Current limit * Output current will not be cut off but will be regulated by lowering the output voltage at a occurrence of overcurrent.
-LCc	Variable current limit * Output current will not be cut off but will be regulated by lowering the output voltage at a occurrence of overcurrent. The setting value to trigger to regulate the output current becomes variable by adjusting the potentiometer on the front panel between the range 10% to 105% of the rated current.
-LN	Cancellation of blackout protection
-L(5m)	HV output cable 5 m (more than 2 kV models except AMP-30B10 and AMP-40B20) Please note that using 5-meter long cable may decrease slew rate, response time, and distort output waveforms. Please see Page 07 "Capacitive load" for details.

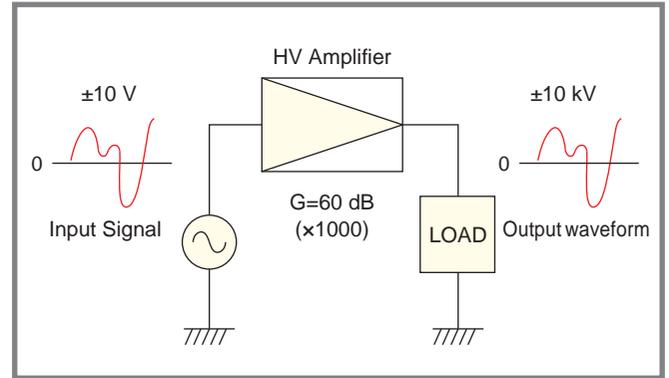
* These options cannot be selected together. Need to be selected either one.
When ordering, suffix -L mark (option mark) to the model number.
<e.g.> AMP-10B10-LCN(5m), AMP-2B200-LNOc(5m)

HIGH SPEED HIGH VOLTAGE AMPLIFIER

HV Amplifier

High voltage amplifier converts input voltage to high voltage waveform as it is as shown in fig. 1. These days the demand of HV amplifier is growing more and more, and now becoming an indispensable tool for research and development, experiments and integrating to a system for such fields as electronics, physics, biochemical and medical industries. With high voltage technologies Matsusada Precision Inc. manufactures various HV amplifiers to meet all requirements from customers.

* In addition to these models in this catalog we have amplifiers developed specially for electrostatic chuck or PZT. Please ask for details to our sales staff.



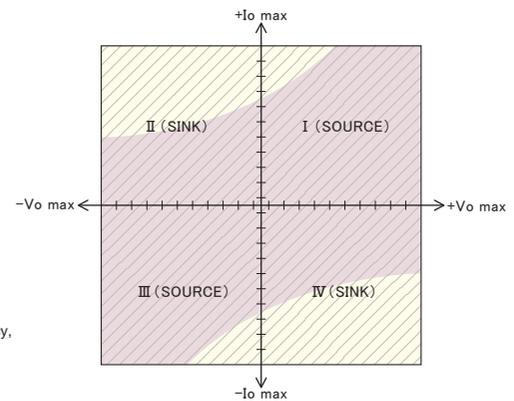
(fig.1)

Four-quadrant Output Range

HV amplifier is generally equipped with the "sink" function for output currents that provides constant voltage operation without regard to the type of load whether it is capacitive or conductive. (Fig.2) As it gives fast response, it is an ideal power supply for applications which require AC output.

Matsusada HV amplifiers are all bi-polar type and can be operated in full four-quadrant area. (I · II · III · IV area)

- 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



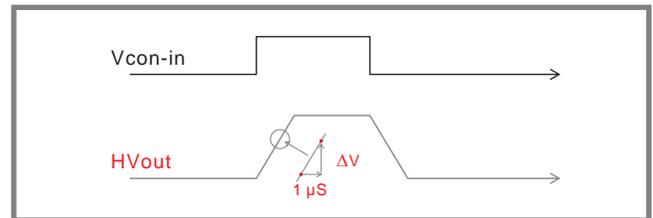
(fig.2) Voltage and Current operation range

Slew Rate

The responsibility of our high speed amplifier is determined with slew rate (SR). The step responsibility of our amplifier is as shown in fig. 3.

$SR = \Delta V / \mu S$ In case of output amplitude is smaller the response time become shorter.

AMP series reach to greater than $SR = 700 V / \mu S$ at maximum.



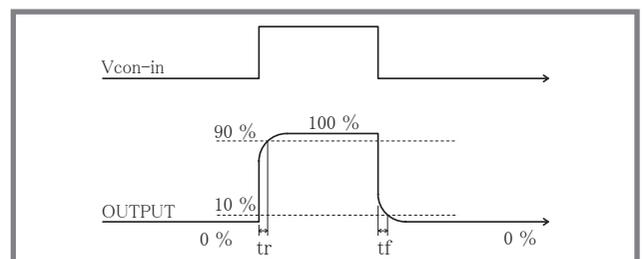
(fig.3)

Rise Time(step response)

Step response can be indicated with rise time. (fig.4) Usually the rise time of amplifier of response (= bandwidth) f_c (Hz) is given by a formula below.

$$tr \doteq 0.35 / fc$$

The fall time tf is equals to tr .

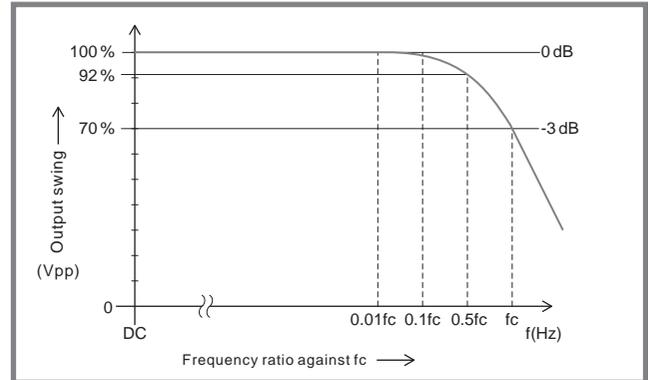


(fig.4)

Frequency Response

Response of Matsusada amplifiers are described as "frequency bandwidth". When swing the output with sinusoidal waveform with rated resistive load, output swing (amplitude) is reduced as input frequency become faster. Frequency response in the specification is the frequency f_c is where output swing is 70% (-3 dB). (fig. 5)

In case clear output waveform is required, please select a HV amplifier which has high enough frequency bandwidth against required frequency. In general 3 to 5 times more frequency bandwidth for sinusoidal waveform, and about 10 times more for rectangular waveform, is required. In case of insufficient frequency bandwidth the output swing shall be reduced, and also the phase difference be large, so some solutions, such as monitoring output waveform, shall be required.



(fig.5) Declination of output swing by frequency

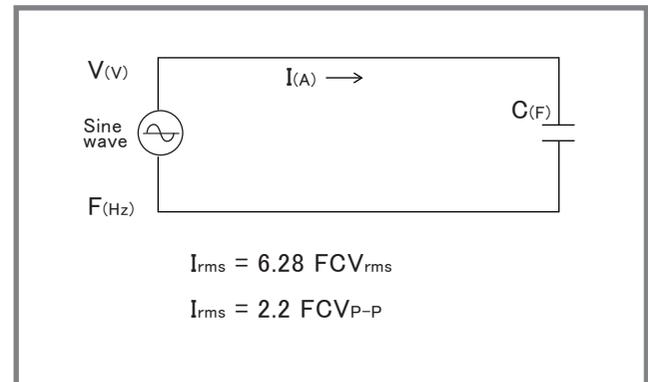
*Please avoid continuous inputting of high frequency signal which reduces output frequency of an amplifier. An amplifier will be broken because of increase of internal loss.

Capacitive Load

When a capacitive load is more than 100 pF (including a stray capacitance of output wire), the resonance in the output may occur.

In that case, install 100-ohm (@0.1 μ F) to 1000-ohm (@1000 pF) of high voltage resistance in the output in series. Please note that the frequency band will be limited as the formula written in the right figure when an amplifier is used with a capacitive load.

In addition, when an amplifier is used for the use such as a corona discharge, the current which is higher than rating will flow and it will affect the amplifier badly. In this case, as well as the time to use an amplifier with a capacitive load, please install the output resistance and limit the current.

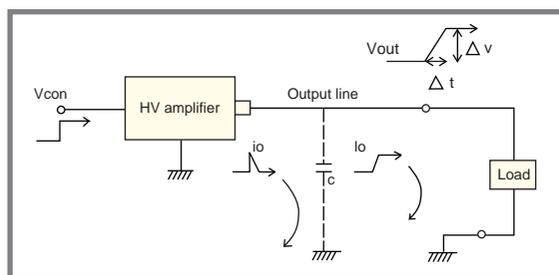


*Please avoid continuous inputting of high frequency signal which reduces output frequency of an amplifier. An amplifier will be broken because of increase of internal loss.

Important note to utilize the full performance of high speed HV amplifier

Output cable of HV amplifiers is not shielded. If the output cable has some stray capacity against ground (earth ground or metal objects), output voltage will be sinusoidal or step waveform and extra current will be drawn. As this current draw parallel to load, the following appearance might be happened.

- (1) Slew rate or response frequency drop (2) The waveform is distorted or changed



When there is output stray capacitance C the leak current by C will be as below.

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

Solution

Make sure to have proper connection to make stray capacitance of HV cable as low as possible.



- (1) Keep the length of output cable as short as possible.
- (2) Keep the output cable away from floor, desks, or metal objects.
- (3) Have no shielding on the output cable.

