AMERICAN HIGH VOLTAGE
POWER SUPPLIES FOR THE WORLD

AC Series
High Voltage Power Supply

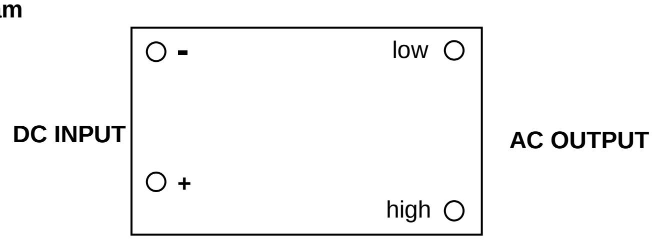
General Description

The AC Series high voltage power supplies are a line of DC to AC converters. They provide isolated outputs of up 3kVpeak-peak and 5 Watts in power (depending on model). The output voltage of the AC power supply is directly proportional to the input voltage. The output waveform is a quasi-sinewave. The two output leads are floating and fully isolated from the input power leads by over 1T Ohm (@ 25 deg C) with less than 50 pF of coupling capacitance. This permits the AC unit to be floated upon a DC potential with isolation up to 5kVDC. All AC's are reverse input voltage and short circuit protected.

Features

- Output proportional to Input
- Encapsulated
- 500 Vpp to 3,000 Vpp available
- 3 and 5 Watt power levels available
- Various input voltages available

Connection Diagram



Bottom View

Available Models: (other input voltages available):

3 Watt Models:

Name	Maximum Output Voltage Vpp	Maximum Output Current	1st Year
AC-5 3W	500 (Vin = 12 VDC)	15 mA RMS	1995
AC-15 3W	1,500 (Vin = 12 VDC)	5 mA RMS	1995
AC-30 3W	3,000 (Vin = 12 VDC)	2.5 mA RMS	1997

5 Watt Models:

Name	Maximum Output Voltage Vpp	Maximum Output Current	1st Year
AC-5 5W	500 (Vin = 12 VDC) 1995	25 mA RMS	
AC-15 5W	1,500 (Vin = 12 VDC) 1995	8 mA RMS	
AC-30 5W	3,000 (Vin = 12 VDC) 1997	4 mA RMS	

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Electrical Characteristics

(at 25 degrees C unless otherwise specified)

Parameter	Conditions	Value Min	Value Typical	Value Max	Units
Supply Voltage*:	(all power models)	2 VDC	12VDC	18 VDC	VDC
Input Current:	No Load (3W model): No Load (5W model):	90 160	100 190	125 190	mA mA
	Full Load (3W model): Full Load (5W model):	400 600	420 650	440 750	mA mA
Output Waveform:	No Load (all models): Full Load (all models):	trapezoidal trapezoidal			
Load Regulation:	No Load to Full Load Half Load to Full Load	25% 20%	25% 20%	30% 30%	V_{NL}/V_L VNL/VL
Output Linearity	No Load		1%		ΔV_{OUT} / ΔV_{OUT} (ideal)
Output Linearity	Full Load (all models):		1%		ΔV_{OUT} / ΔV_{OUT} (Ideal)
Short Circuit Current:			200	300	mA
Power Efficiency:	Full Load	60%	70%	75%	P_{OUT} / P_{IN}
Reverse Input Polarity	Protected to 20 VDC				
Temperature Drift:	No Load Full Load			1,000 1,000	ppm/DegC ppm/Deg C
Thermal Rise:	No Load (case) Full Load (case)			15 25	degrees C degrees C
Slew Rate (10% - 90%)	No Load Full Load			10 12	mS mS
Slew Rate (90% - 10%)	No Load Full Load			20 10	mS mS
Drain Out Time	No Load (5 TC)			1	mS

* Other input voltages available: 5VDC, 15VDC, 24VDC, 28VDC and 48VDC

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Physical Characteristics

(at 25 degrees C unless otherwise specified)

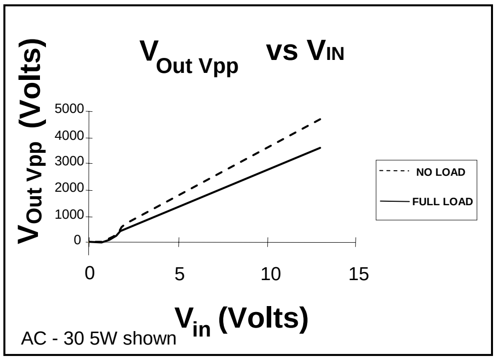
Parameter	Conditions	Value	Units
Dimensions	MKS	38.1 W x 63.5 L x 19 H	mm
	English	1.5 W x 2.5 L x 0.75 H	inches
Volume:	MKS	46	cm^3
	English	2.8	$inch^3$
Mass:	MKS	120	grams
	English	4.3	oz
Packaging:	Solid Epoxy Thermosetting		
Finish	Smooth Dial-Phthalate Case		
Terminations:	Gold Plated Brass pins (4)		

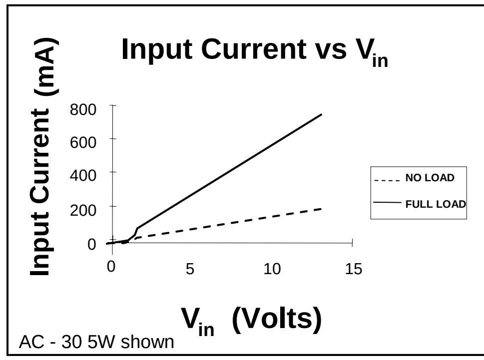
Environmental Characteristics

(at 25 degrees C unless otherwise specified)

Parameter	Conditions	Value	Units
Temperature Range	case temperature	-40 degrees to + 71 degrees	Celsius
	case temperature	-40 degrees to + 160 degrees	Fahrenheit
Shock:	MIL-STD-810 Method 516	40 g's	Proc IV
Altitude:	pins sealed against corona	-350 to + 16,700	meters
	pins sealed against corona	-1,000 to +55,000	feet
Vibrations:	MIL-STD-810 Method 514	20 g's	Curve E
Thermal Shock	MIL-STD-810 Method 504	-40 deg C to + 71 deg C	Class 2

AC Series Performance Charts





AC Series Application Notes

The AC Series high voltage power supplies are driven by an input voltage of 2 to 12 VDC. The input current and output voltage as a function of input is shown in the above graphs. There are NO internal connections between the input and output pins. As can be seen from the above, the output voltage is approximately linear with respect to input except near the lower input voltage region. Here, the output drops off rapidly as the input voltage approaches zero with the absolute minimum input voltage needed for reliable starting being 0.9 VDC. As shown in Figure 1 below, the simple connection of a AC unit to a DC source of voltage will provide a high voltage stepped-up output. The input AC bypass capacitor C1 is optional and is utilized to prevent switching spikes from riding back on the input power lines. Values of 0.1 uF to 10 uF are commonly used.

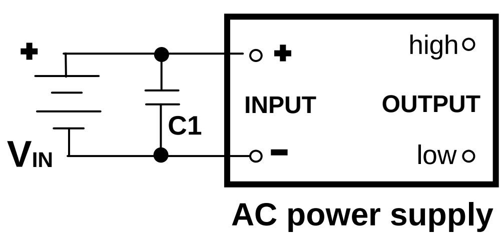


Figure 1: Basic AC hookup schematic (top view of AC shown)

The output voltage of the AC unit may be regulated by incorporating a simple op-amp circuit and linear control device such as an NPN transistor. Here, the output voltage is rectified and compared against an external reference control voltage. For single supply operation, the circuit of Figure 2 may be used output regulation. A high voltage divider is made up of R5 and R6 to divide down the rectified output to a value comparable with the control voltage. The resistor R5 is value is determined by power considerations. A good rule of thumb is to be 10% of the full output load. Too high a value may lead to output drift problems due to operational amplifier input bias current drift. The resistor R5 must be rated for the voltage that it is to step down. Simple high value carbon film resistors are usually avoided because their maximum voltage is limited to 300 VDC. Precision metal film resistors are more stable but also have limiting maximum voltages. It is possible to series several metal film resistors to build up the voltage rating of R5. Capacitor C4 likewise must be rated for the proper voltage. It serves to provide a feed-forward pole in the feedback loop for stability. Capacitor C5, the ground mirror capacitor serves as a lower end of the AC divider formed with C4 and prevents excessive voltage from being fed to the operational amplifier in the case of a shorted output. R6 is selected by calculating the resistance divider ration with R5, providing a 5 volt feedback at full output voltage. The input reference bypass capacitor C1 is used to remove any noise feeding to the non-inverting signal pin of the operational amplifier. For maximum temperature stability, R1 should be identical in value to R6.

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AC Series Application Notes (continued)

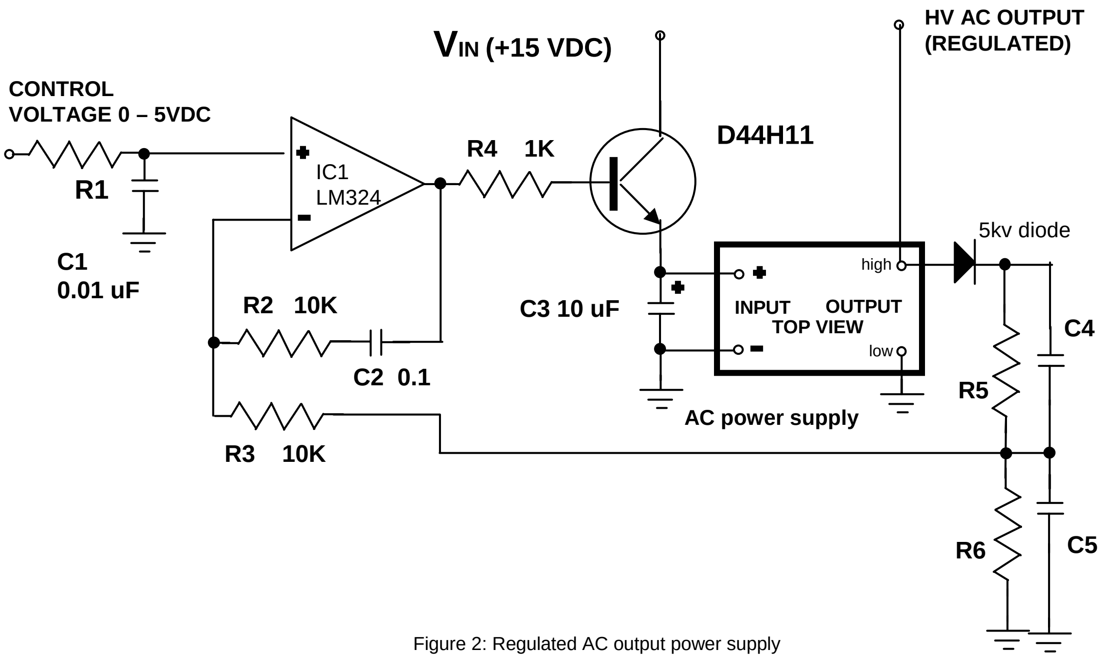


Figure 2: Regulated AC output power supply

Resistor R2 and capacitor C2 provide frequency compensation for the amplifier IC1 a common bipolar amplifier is used since its outputs and signal inputs can reach almost to ground. R3 provides protection to the signal inverting input of the opamp in case of a short circuit or arcing condition exists on the HV output. R4 protects the output of the opamp in case of a shorted NPN transistor. Typical values for an 1,000 volt peak-peak AC supply are as follows:

TC:	AC-15
R1:	62.9K Ohm
R5:	500 Kohms (Slimox 102 – Ohmite)
R6:	4.99 K Ohm 1%
C4:	2200 pF 3kV disc
C5:	0.1 uF 50 V ceramic
IC1:	LM324
Q1:	Power NPN such as D44H11 or equivalent
HV Diode:	5kV PIV fast recovery

Typical voltages seen during operation are as follows:

Voltage at junction of R5 and R6:	5V
Voltage at opamp output:	11.3V
Voltage into + supply AC:	10V (depends somewhat on output load)
Voltage of base of Q1:	10.7 V

The power supply feeding the opamp is not shown however it may be connected to the +15V supply and ground. It is a good idea to bypass the input power pins of the opamp with a 0.1 uF capacitor to reduce the EMI that may damage the opamp if an output arcing condition is suddenly encountered. By varying the control voltage from 1 to 5V, the AC high voltage output of the AC power supply may be regulated. Line and load regulation as good as 0.01% are achievable depending upon physical layout and quality of feedback resistor.

AC Series Waveform

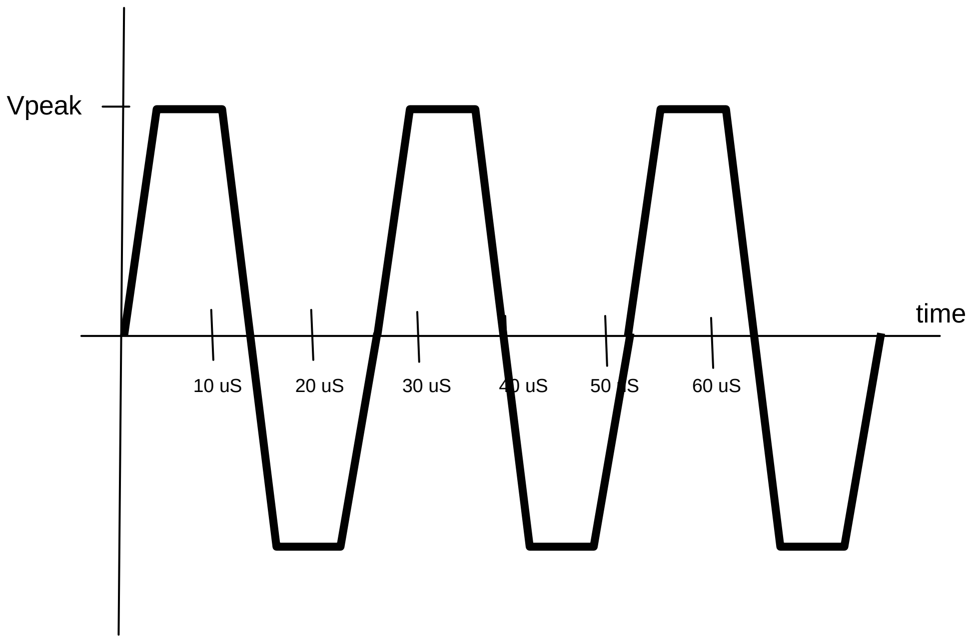
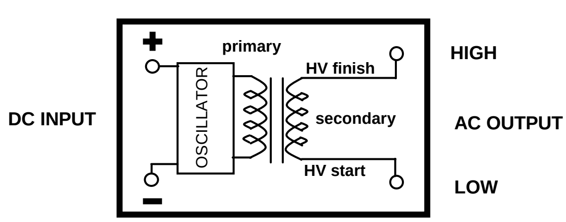


Figure 3: Typical Output Waveform

OUTPUT PIN DESCRIPTION:

The AC series is characterized by having a floating output. This means that the output pins are not galvanically connected to the power input pins of the power supply. The actual isolation is over 1×10^{12} Ohms at room temperature. Coupling capacitance between the input and output is less than 50 pF.

If the AC module is to be utilized in a floating output configuration, it is important to connect the LOW pin to the point electrically closest to ground. For example, if the output of the AC unit is to be floated on a DC potential, connect the DC potential to the LOW pin. The LOW pin has the least dynamic coupling between the output and input. It is the start of the high voltage transformer secondary winding. The HIGH pin is the finish of the high voltage secondary winding. This is shown in Figure 4 below.



TOP VIEW

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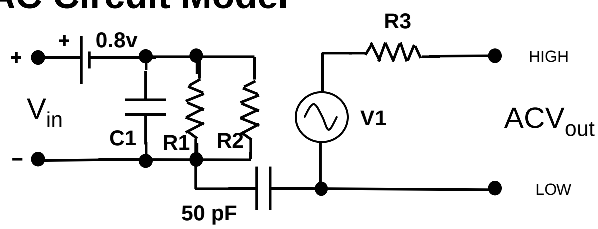
Equivalent AC Circuit Model



Equivalent AC HVPS Circuit Model

R1 = (13 x Pout $_{max}$) *Ohms*
R2 = (100 / Pout) *Ohms*
R3 = (0.068 x Vout pp$_{max}$ / Iout pp$_{max}$) *Ohms*

C1 = (10 x 10^{-6}) *Farads*

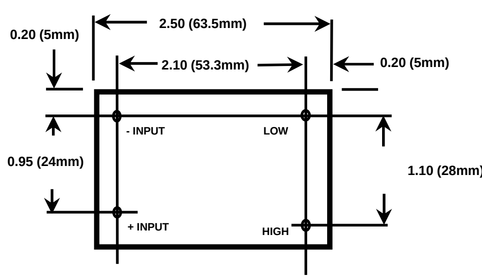
V1 = (V$_{R2}$ x Vout$_{max}$ / 12) *Volts*

For example, for an AC-30 5W:

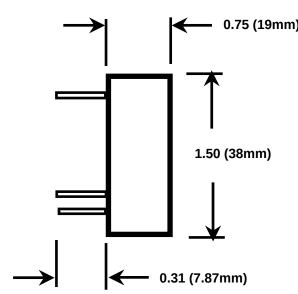
Vout**max pp** = 3,000 VAC
Pout**max** = 5 W
Iout**max pp** = 0.0017 A
R1 = 65 Ohms
R2 = 20 Ohms
R3 = 120K Ohms

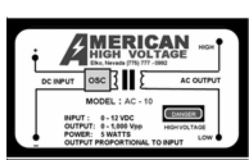
C1 = 10 uF

Outline Drawing: (inches (millimeters))

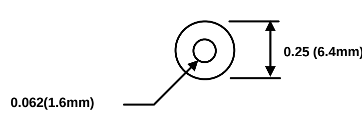


BOTTOM VIEW





TOP VIEW



RECCOMENDED SOLDER PAD DIMENSIONS

Ordering Information:

AC – XX Y Watt / Z

XX = Output voltage
Y = Maximum power
Z = Input voltage (blank if 12VDC)

Example:

AC – 30 5W: Maximum output = 3,000 Vpp 5 Watts 12 VDC input
AC – 30 3W/5V: Maximum output = 3,000 Vpp 3Watts 5VDC input