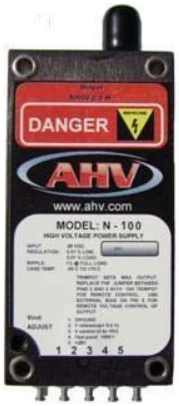
AMERICAN HIGH VOLTAGE
POWER SUPPLIES FOR THE WORLD

# N Series
# High Voltage Power Supply



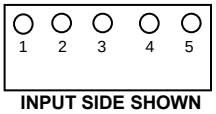

## General Description

The N Series high voltage power supplies are regulated high voltage power supplies. They provide outputs of up 10kV and power levels to 3 Watts. The output of each power supply is tightly regulated against line and load changes to better than 0.01%. The output voltage of the N may be varied either with the unit trimpot, an external trimpot, or via an external control signal. The output ripple is typically less than 0.1% at full power. Each power supply may be programmed down to 0% of the maximum output voltage. All N models provide a buffered voltage monitor output. All N's are reverse input voltage and short circuit protected.

## Features

Regulated Output
Buffered voltage monitor
100 VDC to 10,000 VDC models available
3 Watt power
24 VDC input
Trimpot, Resistance or Voltage program

### Connection Diagram

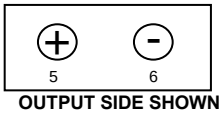


INPUT SIDE SHOWN

Pins:

1. Ground
2. +5.0V Reference
3. Vcontrol
4. Test Point
5. +24 VDC input

INPUT SIDE SHOWN



OUTPUT SIDE SHOWN

Pins:

5. + HV output
6. - HV output

### Available Models:

### Positive output models:

| Name | Maximum Output Voltage | Maximum Output Current | 1st Year |
|---|---|---|---|
| N – 1P | 100 | 30 mA | 2003 |
| N – 2P | 200 | 15 mA | 1991 |
| N – 6P | 600 | 5 mA | 1997 |
| N – 12P | 1,250 | 2.4 mA | 1998 |
| N – 25P | 2,500 | 1.2 mA | 1999 |
| N – 50P | 5,000 | 0.6 mA | 1993 |
| N – 100P | 10,000 | 0.3 mA | 1997 |

**Available Models:**

**Negative output models:**

| Name | Maximum Output Voltage | Maximum Output Current | 1st Year |
|---|---|---|---|
| N – 1N | 100 (negative) | 30 mA | 2004 |
| N – 2N | 200 (negative) | 15 mA | 1997 |
| N – 6N | 600 (negative) | 5 mA | 1999 |
| N – 12N | 1,250 (negative) | 2.4 mA | 1998 |
| N – 25N | 2,500 (negative) | 1.2 mA | 1989 |
| N – 50N | 5,000 (negative) | 0.6 mA | 1989 |
| N – 100N | 10,000 (negative) | 0.3 mA | 1993 |

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# Electrical Characteristics

**(at 25 degrees C unless otherwise specified)**

| Parameter | Conditions | | Value | | | Units |
|---|---|---|---|---|---|---|
| | | | Min | Typical | Max | |
| Supply Voltage*: | 24 Vin models | | 21 | 24 | 27 | VDC |
| Input Current: | No Load: | | 50 | 60 | 75 | mA |
| | Full Load: | | 250 | 275 | 300 | mA |
| Output Ripple: | No Load (all models):<br>Full Load (all models): | | 0.08%<br>0.08% | 0.09%<br>0.09% | 0.1%<br>0.1% | Vpp<br>Vpp |
| Load Regulation: | No Load to Full Load<br>Half Load to Full Load | | | | 0.1%<br>0.1% | $V_{NL}/V_L$<br>VNL/VL |
| Output Linearity | No Load | | | 1% | | $\frac{\Delta V_{OUT}}{\Delta V_{OUT\ (ideal)}}$ |
| Output Linearity | Full Load (all models): | | | 1% | | $\frac{\Delta V_{OUT}}{\Delta V_{OUT\ (Ideal)}}$ |
| Short Circuit Current: | | | | 250 | 350 | mA |
| Power Efficiency: | Full Load: | | 55% | 60% | 65% | $P_{OUT}/P_{in}$ |
| Reverse Input Polarity | Protected to 50 VDC | | | | | |
| Temperature Drift: | No Load<br>Full Load | | | | 100<br>100 | ppm/DegC<br>ppm/Deg C |
| Thermal Rise: | No Load (case) (15W)<br>Full Load (case) (15W) | | | | 15<br>25 | degrees C<br>degrees C |
| Slew Rate (10% - 90%) | No Load<br>Full Load | | | | 100<br>120 | mS<br>mS |
| Slew Rate (90% - 10%) | No Load<br>Full Load | | | | 300<br>200 | mS<br>mS |
| Drain Out Time | No Load (5 TC) | | | | 150 | mS |

* Other input voltages available: 15VDC, 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 76.2L x 20.6 H mm | |
| | English | 1.5 W x 3.0 L x 0.81 H | inches |
| Volume: | MKS | 60 | $cm^3$ |
| | English | 3.65 | $inch^3$ |
| Mass: | MKS | 120 | grams |
| | English | 4.3 | oz |
| Packaging: | Black anodized aluminum case with RTV elastomer encapsulation | | |
| Finish | Smooth brushed aluminum | | |
| Terminations: | Input and control: Teflon terminals (5) | | |
| | HV Output: Teflon terminals (2) (1 AMP LGH-1/2 on Models >5kV) | | |

# 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 |

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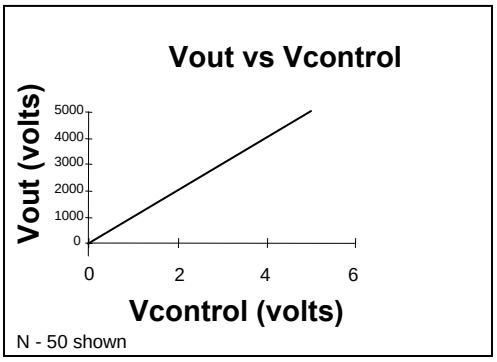
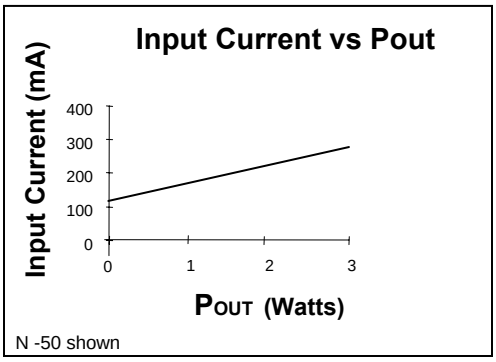
## N Series Performance Charts



N - 50 shown



N -50 shown

## N Series Application Notes

The N Series high voltage power supplies are powered by an input voltage of 24 VDC. They can be adjusted to provide a set output voltage or they can be controlled either by an external resistance or an external voltage. By connecting the Vcontrol pin to the +5.0 volt reference pin the maximum output voltage of the power supply is obtained and is adjustable via the trimpot located on the top of the power supply. Reductions in output voltage to 0% of maximum are possible by this method. This is shown in Figure 1 below. The maximum voltage is fixed by the model and is a regulated output. In this configuration, the output voltage will not vary with input line fluctuations or output load changes up to the maximum power rating for the power supply. For standard 24 VDC input models, the input line may vary from 21 VDC to 27 VDC and the output voltage will remain regulated within 0.01%. Standard output loads may be as high as 3 Watts of power. 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.

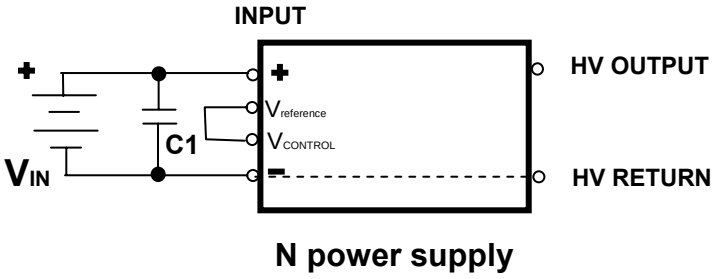



Figure 1: Basic N hookup schematic for maximum output

The output voltage of the N unit may be programmed from an external voltage. It may be reduced in magnitude by placing a voltage lower than the +5.0 volt reference voltage onto the Vcontrol pin (Pin 3). By placing a voltage of +2.5 VDC onto the control voltage pin the output will be reduced in half. Figure 2 details a simple method of using an external voltage source to vary the output voltage of the N power supply. Typical values of input impedance for the N are 5K Ohms. This makes programming via a DAC or operational amplifier an easy chore for the N power supply. The control voltage is referenced to the input ground. The input ground and output grounds are internally connected together in the N series.

# N Series Application Notes (continued)

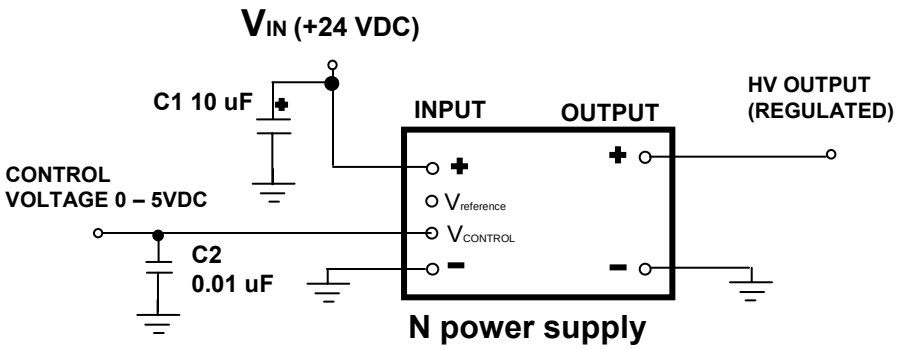
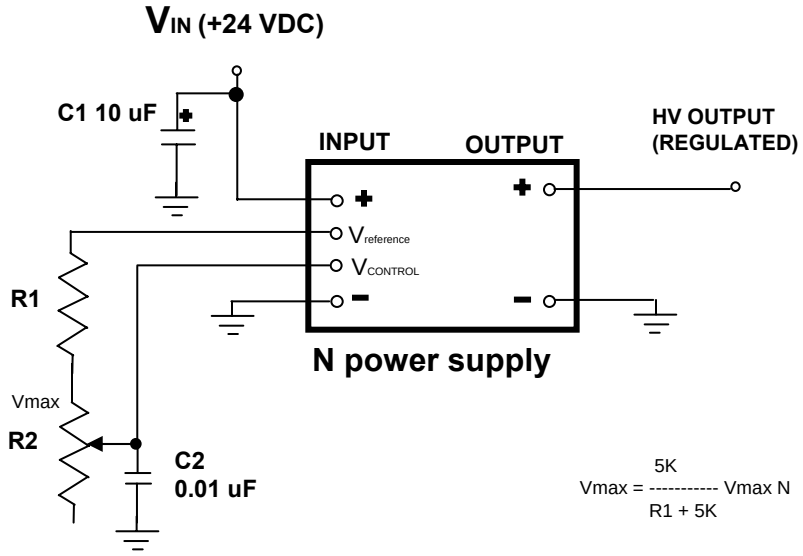



Figure 2: Voltage programming

Capacitor C1 removes switching spikes from the input line and C2 is an AC bypass to insure smooth voltage control levels.

The N power supply may also be programmed by using a simple trimpot and the internal +5.0 volt reference. Figure 3 shows this topology. Because the input impedance of the control voltage pin is 5K Ohms, the output of the N may be controlled between minimum and maximum values using the formulas given. The output in both configurations can always be lowered or adjusted via the internal trimpot located on the top surface of the power supply.




$$V_{max} = \frac{5K}{R1 + 5K} \text{ Vmax N}$$

$$V_{min} = \frac{5K}{R1 + R2 + 5K} \text{ Vmax N}$$

Figure 3: Resistance Programming

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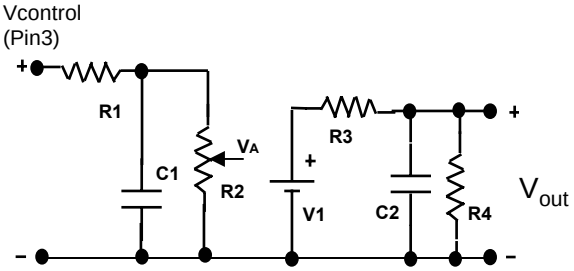
**Note: R2 is internal trimpot accessible via top of power supply**

# Equivalent N Circuit Model



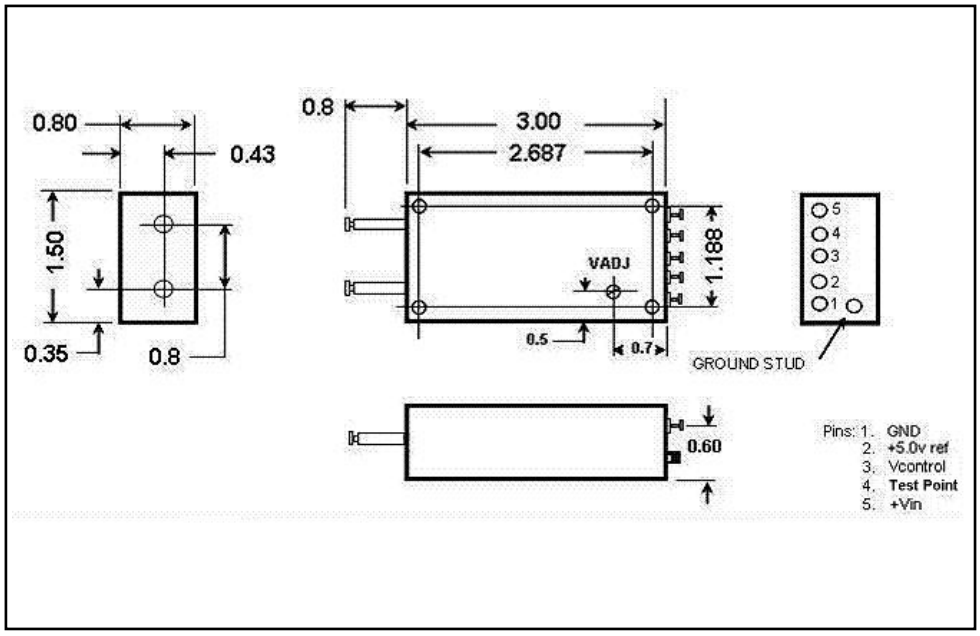

**Equivalent N HVPS Circuit Model**

R1 = 100 *Ohms*
R2 = 5K *Ohms (timpot)*
R3 = (5 x Vout $_{max}$) *Ohms*
R4 = (0.15 x Vout $_{max}^{2}$) *Ohms*
C1 = (0.01 x $10^{-6}$) *Farads*
C2 = (0.008 x Iout$_{max}$ / Vout$_{max}$) *Farads*
V1 = (VA x Vout$_{max}$ / 5.0) *Volts*

For example, for an N – 50P :

Vout**max** = 5,000 V
Pout**max** = 3 W
Iout**max** = 0.0006 A
R1 = 100 Ohms
R2 = 5K Ohms
R3 = 750 Ohms
R4 = 250 Megohm
C1 = 0.01 uF
C2 = 960 pF

## Outline Drawing: (inches)




## Ordering Information:

**N – XY**

**XX = Output voltage** **1 = 100v**
**2 = 200v**
**6 = 600v**
**12 = 1250v**
**25 = 2500v**
**50 = 5000v**
**100 = 10kV**

**Y = Polarity (P or N)**

**Example:**

**N – 6P Maximum output = 600 V 3 Watts Positive**