TC SERIES

1,000 VDC to 6,000 VDC available

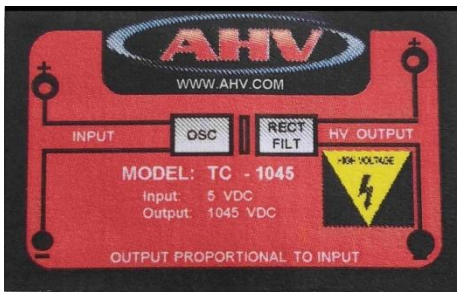
AMERICAN HIGH VOLTAGE

TC-60

- ***Output Proportional to Input***
- ***Encapsulated***
- ***1 Watt***
- ***Input Voltage 0-12 VDC***

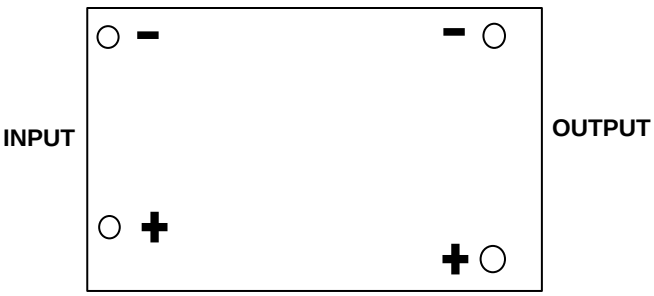
The G Series high voltage power supplies are designed to provide floating high output voltages. Their outputs are isolated to up to 50 kV with power levels to 20 Watts depending on model selected. The output voltage of the G power supply is directly proportional to the input voltage (0 – 24 VDC). The output ripple is typically less than 1% at full power load. The two output leads are fully isolated from the input power leads. This permits either positive or negative polarity operation. All models are encapsulated in an RTV elastomer for high reliability. The G series are reverse input voltage and short circuit protected

CONNECTION DIAGRAM

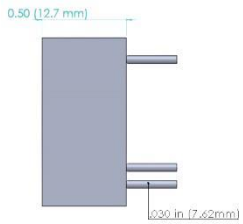


TOP VIEW

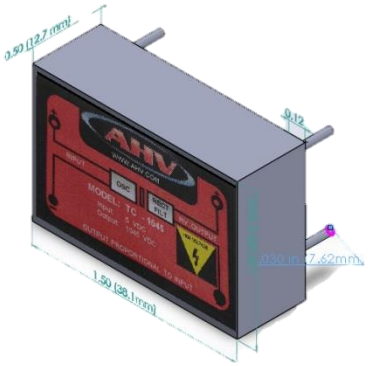
BOTTOM VIEW



SIDE VIEW



Outline Drawing: Inches (millimeters)



BOTTOM VIEW

AHV AMERICAN HIGH VOLTAGE

General Inquiries –
Phone: (775) 777-0992, ext. 22
Fax: (775) 777-3631
Email: sales@americanhighvoltage.com

www.americanhighvoltage.com
American High Voltage is an ISO 9001: 2015 registered company
RoHS Compliant

ELECTRICAL CHARACTERISTICS (at 25° C unless otherwise specified)

Parameter	Conditions		Value		Units
		Min	Typical	Max	
Supply Voltage*	(all models)	2	12	18	VDC
Input Current	No load Full 1 Watt load	40 155	50 160	60 165	mA mA
Output Ripple	No load Full 1 Watt load	0.6% 0.9%	0.7% 1.0%	1% 1.2%	Vpp Vpp
Load Regulation	No load to full load Half load to full load	25% 10%	30% 15%	35% 20%	V_{NL}/V_L V_{NL}/V_L
Output Linearity	No load		1%		ΔVout ---------- ΔVout (ideal)
Output Linearity	Full load (all models)		1%		ΔVout ---------- ΔVout (ideal)
Short Circuit Current				200	mA
Power Efficiency	Full load		60%		POUT -------- PIN
Reverse Input Polarity	Protected to 20 VDC				
Temperature Drift	No load			1,000	ppm/Deg C
	Full load			1,000	ppm/Deg C
Thermal Rise	No load (case)			10	Degrees C
	Full load (case)			15	Degrees C
Slew Rate (10%-90%)	No load Full load			10 120	mS mS
Slew Rate (90%-10%)	No load Full load			150 50	mS mS
Drain Out Time	No load (5 TC)			150	mS

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

1,000 VDC to 6,000 VDC available

ENVIRONMENTAL CHARACTERISTICS
(at 25° C unless otherwise specified)

Parameter	Conditions	Value	Units
Temperature Range	Case temperature	-40° to +71°	Celsius
	Case temperature	-40° to +160°	Fahrenheit
Shock	MIL-STD-810 Method 516	40 Gs	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 Gs	Curve E
Thermal Shock	MIL-STD-810 Method 504	-55° C to +71°C	Class 2

PHYSICAL CHARACTERISTICS
(at 25° C unless otherwise specified)

Parameter	Conditions	Value	Units
Dimensions	MKS	25.4W x 38.1L x 12.7H	mm
	English	1W x 1.5L x 0.5H	inches
Volume	MKS	12.3	cm^3
	English	0.75	$inch^3$
Mass	MKS	55	grams
	English	2	ounces
Packaging	Solid Epoxy Thermosetting		
Finish	Smooth Dial – Phthalate Case		
Terminations: Input:	Gold Plated Brass Pins (4)		

AHV AMERICAN HIGH VOLTAGE

General Inquiries –
Phone: (775) 777-0992, ext. 22
Fax: (775) 777-3631
Email: sales@americanhighvoltage.com

www.americanhighvoltage.com
American High Voltage is an ISO 9001: 2015 registered company
RoHS Compliant

TC SERIES

AMERICAN HIGH VOLTAGE

1,000 VDC to 6,000 VDC available

MODEL SELECTION TABLE

Model	Input Voltage Range	Ripple (max)	Power
TC-1	0 – 100 VDC	1 Vpp	1 Watt
TC-2	0 – 200 VDC	2 Vpp	1 Watt
TC-3	0 – 300 VDC	3 Vpp	1 Watt
TC-5	0 – 500 VDC	5 Vpp	1 Watt
TC-10	0 – 1,000 VDC	10 Vpp	1 Watt
TC-12	0 – 1,200 VDC	12 Vpp	1 Watt
TC-15	0 – 1,500 VDC	15 Vpp	1 Watt
TC-20	0 – 2,000 VDC	20 Vpp	1 Watt
TC-30	0 – 3,000 VDC	30 Vpp	1 Watt
TC-40	0 – 4,000 VDC	40 Vpp	1 Watt
TC-50	0 – 5,000 VDC	50 Vpp	1 Watt
TC-60	0 – 6,000 VDC	60 Vpp	1 Watt

TC SERIES APPLICATION NOTES

The TC Series high voltage power supplies are driven by an input voltage of 0.8 to 12 VDC. The input current and output as a function of input voltage is shown in the above graphs. There is NO internal connection between the input and output pins of a TC power supply. The output is floating. 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 approximately 0.8 VDC. As shown in Figure 1 below, the simple connection of a TC unit to a DC source of voltage will provide a high voltage 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.

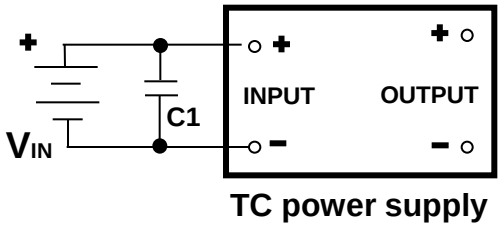


Figure 1: Basic TC hookup schematic **(top view of TC shown)**

General Inquiries –
Phone: (775) 777-0992, ext. 22
Fax: (775) 777-3631
Email: sales@americanhighvoltage.com

www.americanhighvoltage.com
American High Voltage is an ISO 9001: 2015 registered company
RoHS Compliant

TC SERIES APPLICATION NOTES (continued)

The output voltage of the TC 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 sensed and compared against an external reference control voltage. For single supply operation, the circuit of Figure 2 may be used for positive output regulation. A high voltage divider is made up of R5 and R6 to divide down the output to a value comparable with the control voltage. The resistor R5 value is determined by power considerations. It cannot be lower in value such that it would dissipate 1 Watt since this is the maximum power output capability of the TC unit and nothing would be left over for the load. A good value to consider is a dissipation of 0.1 Watts since this provides a preload on the TC unit insuring greater loop stability. 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 lower output ripple and 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 sudden output short. R6 is selected by calculating the resistance divider ratio 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.

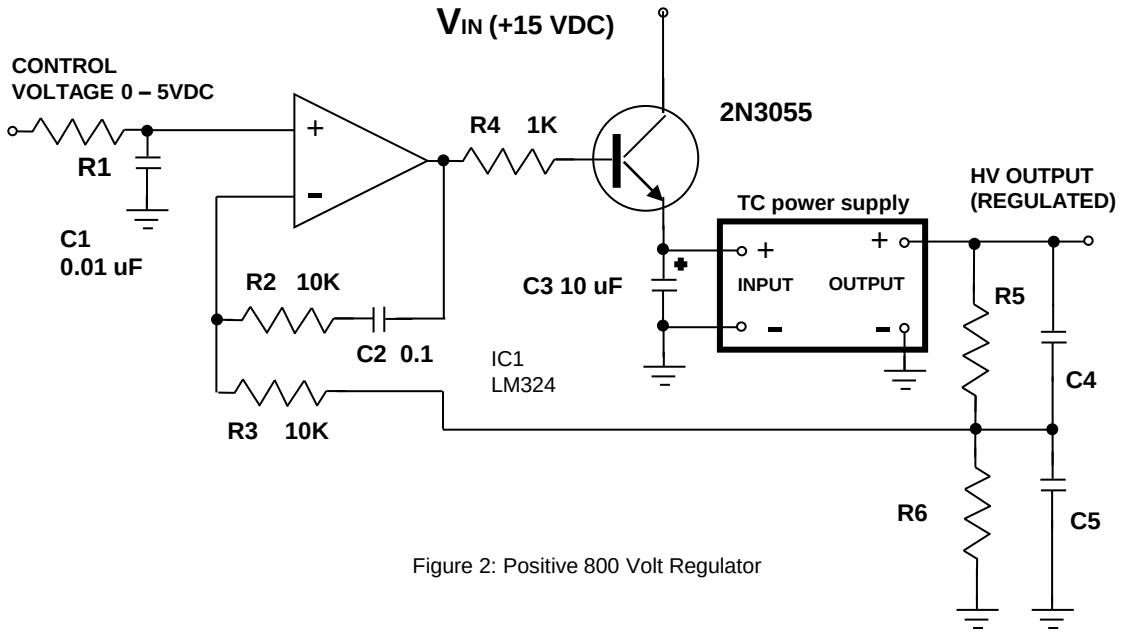


Figure 2: Positive 800 Volt Regulator

TC SERIES APPLICATION NOTES (continued)

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 800 volts Geiger counter power supply are as follows:

TC:	TC-10
R1:	62.9K Ohm
R5:	10 Megohms (Slimox 102 – Ohmite)
R6:	62.9K Ohm
C4:	2200 pF 3kV disc
C5:	0.1 uF 50 V ceramic
IC1:	LM324
Q1:	Power NPN such as 2N3055 or D44H11 or equivalent

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 TC:	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. 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 high voltage output of the TC power supply may be regulated. Line and load regulation as good as 0.01% is achievable depending upon physical layout and quality of the feedback resistor. To lower the output ripple further, an resistor (carbon composition type) of a high value may be inserted in series with the HV output of the TC unit before it continues on in the circuit. A value of 100K Ohm will drop the output ripple to less than 0.2 Vpp . Here the 100 K Ohm resistor works as a filter in conjunction with C4. Higher ripple reduction is achievable with a capacitor added directly to the output pin and ground.

A regulated negative high voltage output is easily obtained using the floating output feature of the TC unit. Figure 3 utilizes much of the same topology as the positive regulator except that a summing junction is made for operational amplifier IC1. Again, the values of R7 and C3 are selected with respect to the proper HV output parameters. Dissipation in R7 should be limited to less than 0.1 Watts. C3 must be a high voltage capacitor, capable of working at the full output voltage. Diode D1 provides a return path in cast the output is suddenly shorted, protecting IC1 from a huge positive spike on the signal input. Resistors R2 and R3 form a simple divider, their values should be equal. The voltage drop in R1 should be such that at full output voltage the signal at the non-inverting input of IC1 should be exactly half the control voltage. R4 is a simple 10K Ohm limiter. The values of R2 and R3 should be twice that of R1 for good thermal stability. Typical values for a negative 800 volts Geiger counter are as follows:

TC:	TC-10
R1:	31.3K Ohm
R7:	10 Megohms (Slimox 102 – Ohmite)
R2:	62.9K Ohm
R3:	62.9K Ohm
R5:	10K
C3:	2200 pF 3kV disc
C4:	0.1 uF 50 V ceramic
IC1:	LM324
Q1:	Power NPN such as D44H11 or equivalent
D1:	1N4148

Typical voltages seen during operation are as follows: Voltage at junction of R7 and D1: 2.5V

TC SERIES APPLICATION NOTES (continued)

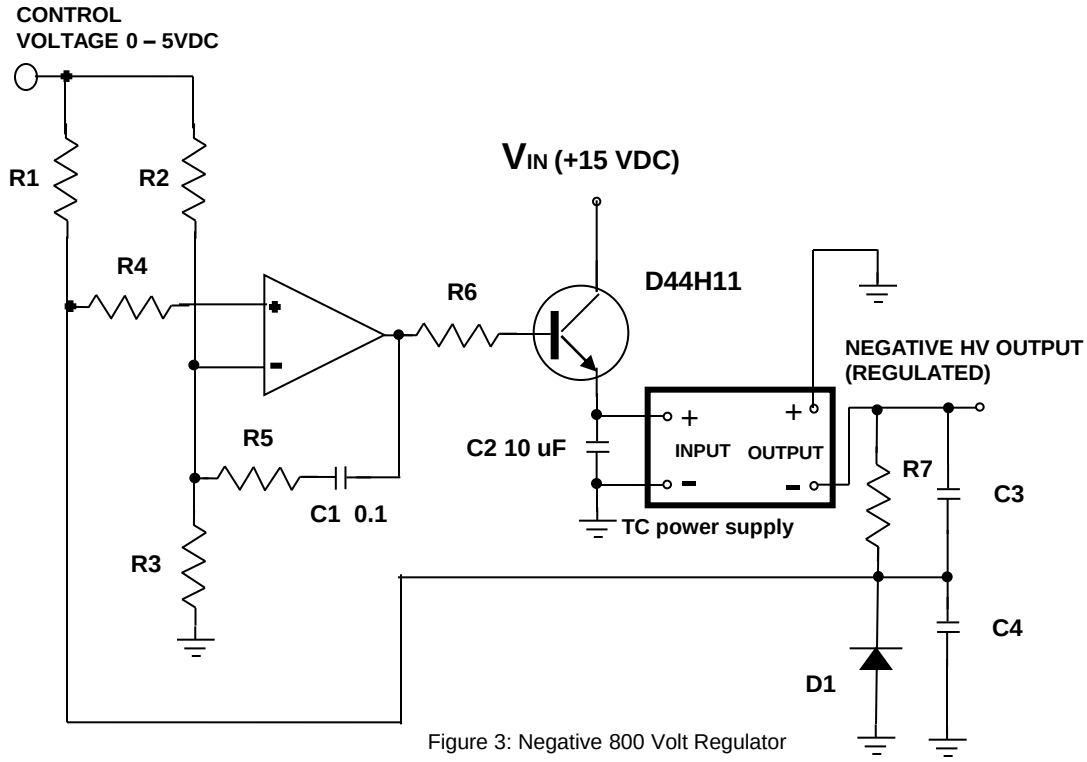
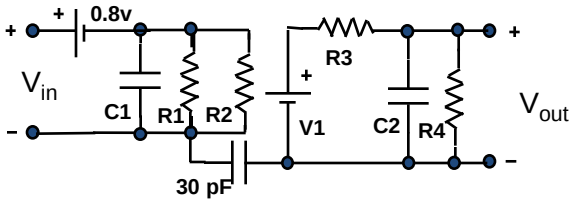


Figure 3: Negative 800 Volt Regulator

EQUIVALENT TC SERIES CIRCUIT MODEL



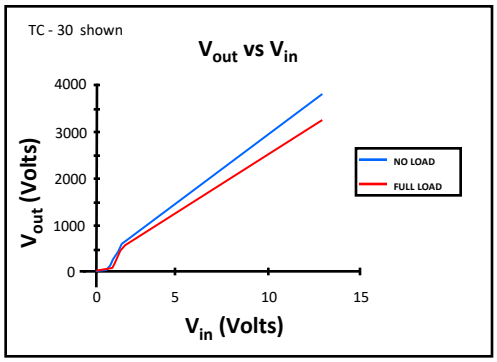
Equivalent TC Model

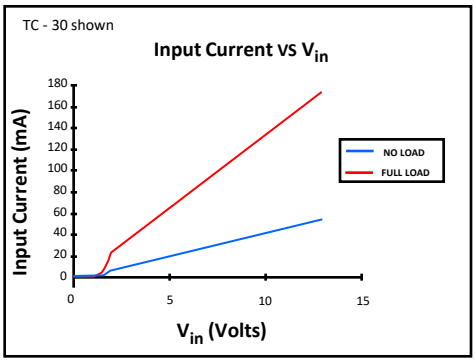
From this information:

R1 = (250) *Ohms*
R2 = (171 / Pout) *Ohms*
R3 = (0.3 **x** $Vout_{max}$ / $Iout_{max}$) *Ohms*
R4 = (20 **x** $Vout_{max}^{2}$) *Ohms*

C1 = (10 x 10^{-6}) *Farads*
C2 = (0.002 **x** $Iout_{max}$ / $Vout_{max}$) *Farads*
V1 = (VR2 **x** $Vout_{max}$ / 12) *Volts*

EC SERIES PERFORMANCE CHARTS
(at 25 degrees C unless otherwise specified)





AHV
AMERICAN HIGH VOLTAGE

General Inquiries –
Phone: (775) 777-0992, ext. 22
Fax: (775) 777-3631
Email: sales@americanhighvoltage.com

www.americanhighvoltage.com
American High Voltage is an ISO 9001: 2015 registered company
RoHS Compliant