AMERICAN HIGH VOLTAGE

CTC Series – Split Supply
Micro High Voltage Power Supply

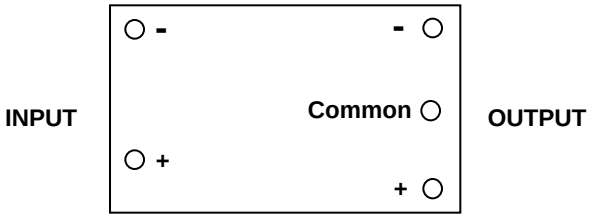
General Description

The CTC Series offers both positive and negative output voltages connected to a common return. These power supplies are smaller versions of the popular CT series and provide output voltages that are isolated from the input power. Voltages up to +/- 3,000 VDC are available with a maximum power output of 1 Watt. Like the bigger CT, the output voltage of the CTC is directly proportional to the input voltage, starting at approximately 0.9 VDC. The output ripple is typically less than 1% at full power. The two output polarity pins fully isolated from the input power leads by over 1T Ohm (@ 25 deg C) with less than 30 pF of coupling capacitance. All CTCs are reverse input voltage and short circuit protected.

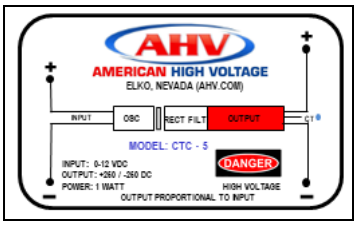
Features

- Output proportional to Input
- Split polarity output
- +/-50 VDC to +/-3,000 VDC models available
- 1 Watt
- Input voltage range: 0 – 12VDC

Connection Diagram



Bottom View



Top View

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Electrical Characteristics

(at 25 degrees C unless otherwise specified)

Parameter	Conditions		Value			Units
			Min	Typical	Max	
Supply Voltage*:			0.9	12	15	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% 0.8%	0.7% 0.9%	1% 1%	Vpp Vpp
Load Regulation:	No Load to Full Load Half Load to Full Load		25% 10%	30% 15%	35% 20%	V_{NL}/V_L VNL/VL
Output Linearity	No Load			1%		ΔV_{OUT} / $\Delta V_{OUT\ (ideal)}$
Output Linearity	Full 1 Watt Load			1%		ΔV_{OUT} / $\Delta V_{OUT\ (ideal)}$
Short Circuit Current:					200	mA
Power Efficiency:	Full Load			60%		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)				10 15	degrees C degrees C
Slew Rate (10% - 90%)	No Load Full Load				10mS 120	 mS
Slew Rate (90% - 10%)	No Load Full Load				150 50	mS mS
Drain Out Time	No Load (5 τ)				150	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	25.4 W x 38.1 L x 12.7 H	mm
	English	1 W x 1.5 L x 0.5 H	inches
Volume:	MKS	12.3	cm^3
	English	0.75	$inch^3$
Mass:	MKS	55	grams
	English	2	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	-55 deg C to + 71 deg C	Class 2

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Models Available (as of May 2019):

(Vin = 0 – 12 VDC)

Model	Output Voltage Range	Power	Ripple (max)
CTC-1	0 – +/- 50 VDC	1 Watt	1 Vpp
CTC-2	0 – +/- 100 VDC	1 Watt	2 Vpp
CTC-3	0 – +/- 150 VDC	1 Watt	3 Vpp
CTC-5	0 – +/- 250 VDC	1 Watt	5 Vpp
CTC-8	0 – +/- 400 VDC	1 Watt	8 Vpp
CTC-10	0 – +/- 500 VDC	1 Watt	10 Vpp
CTC-15	0 – +/- 750 VDC	1 Watt	15 Vpp
CTC-20	0 – +/- 1,000 VDC	1 Watt	20 Vpp
CTC-30	0 – +/- 1,500 VDC	1 Watt	30 Vpp
CTC-40	0 – +/- 2,000 VDC	1 Watt	40 Vpp
CTC-50	0 – +/- 2,500 VDC	1 Watt	50 Vpp
CTC-60	0 – +/- 3,000 VDC	1 Watt	60 Vpp

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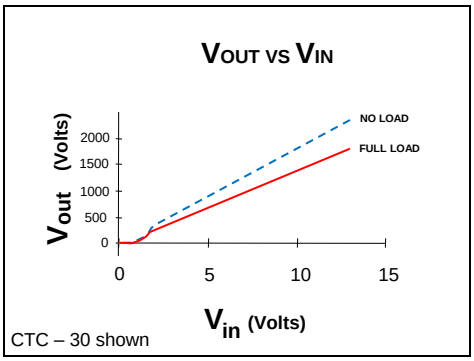
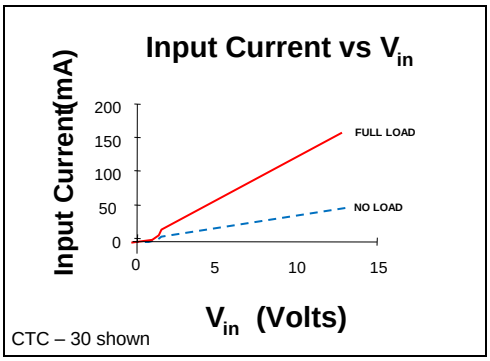
CTC Series Performance Charts



CTC – 30 shown



CTC – 30 shown

CTC Series Application Notes

The CTC Series high voltage power supplies are driven by an input voltage of 0.9 to 12 VDC. The input current and output voltage as a function of input voltage as shown in the above graphs. There is NO internal connection between the input and output pins. As can be seen from the above chart the output voltage is approximately linear with respect to input voltage except near the lower input voltage region with the absolute minimum input voltage needed for reliable starting being approximately 0.9 VDC. As shown in Figure 1 below, the simple connection of a CTC unit to a DC source of voltage will provide a high voltage stepped-up output offering both positive and negative polarity. 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.

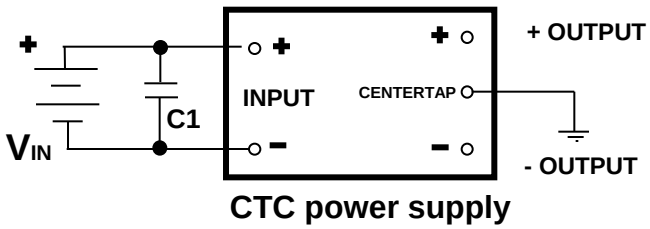


Figure 1: Basic CT hookup schematic (top view of CT shown)

The output voltage of the CTC unit may be regulated by incorporating a simple op-amp circuit and linear control device such as an NPN transistor. In this circuit the positive output voltage is sensed and compared against an external reference voltage. For single supply operation, the circuit of Figure 2 may be used for output voltage regulation. Because the negative output is not regulated it typically tracks the positive output within 10% - depending upon the loads placed on each output.

A high voltage divider is made up of R5 and R6 to divide down the positive 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. Precision metal film resistors are generally used because they are more stable. It is possible to place several metal film resistors in series to build up the voltage rating. Capacitor C4 likewise must be rated for the proper voltage. It serves to lower output ripple 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 and prevents excessive voltage from hitting the operational amplifier in the case of a shorted output. 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.

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CTC Series Application Notes (continued)

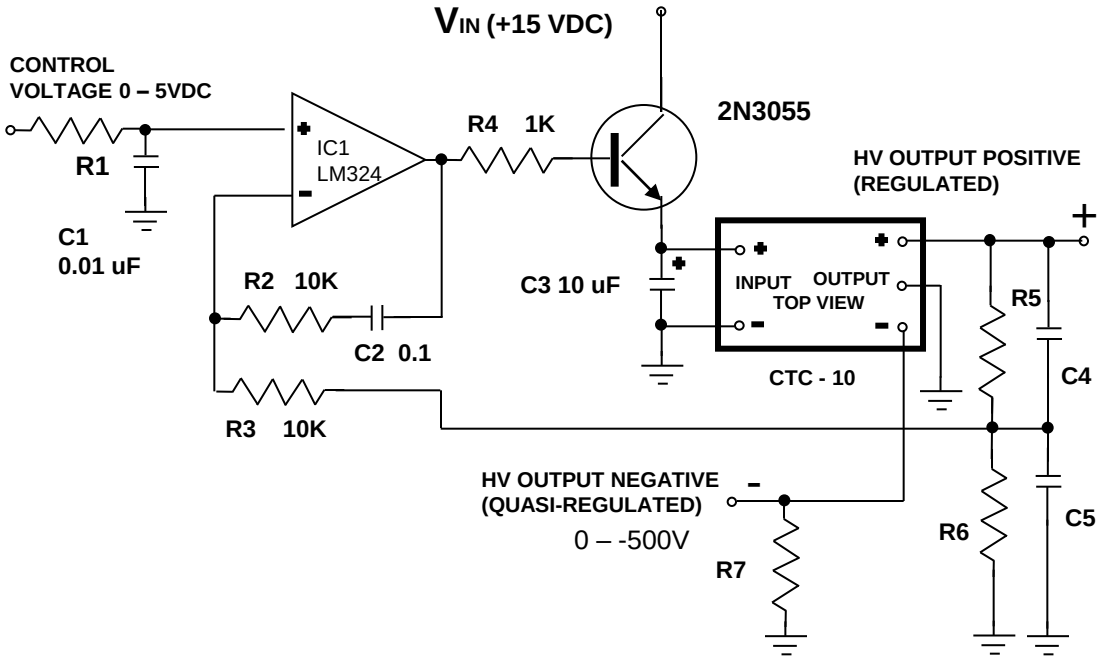

Figure 2: +/- 500 Volt Regulator

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. R7 provides a preload on the negative output leg of the converter. Typical values for an +/- 500 volt piezoelectric driver power supply are as follows:

CT:	CT-10
R1:	62.9K Ohm
R5:	10 Megohms (Slimox 102 – Ohmite)
R6:	62.9K Ohm
R7:	10 Megohms (Slimox-102)
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 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 high voltage output of the CT power supply may be regulated. Line and load regulation as good as 0.01% are achievable depending upon physical layout and quality of components used. 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 CT 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 more capacitance added directly to the output pin and ground.

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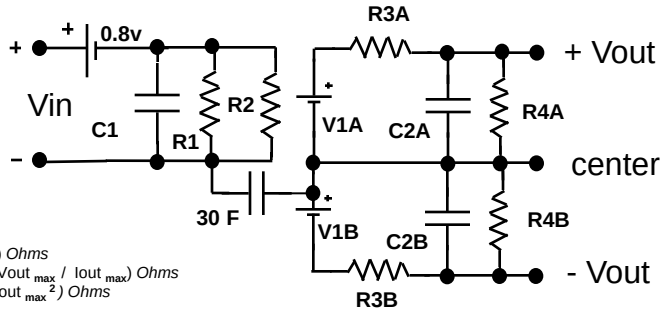
Equivalent CTC circuit model



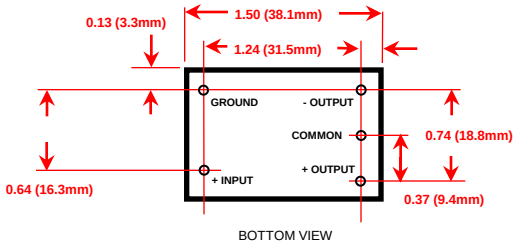
R1 = 240 *Ohms*
R2 = (120 / Pout) *Ohms*
R3A & B = (0.1 x $Vout_{max}$ / $Iout_{max}$) *Ohms*
R4A & B = (5 x $Vout_{max}^2$) *Ohms*

C1 = (10 x 10^{-6}) *Farads*
C2A & B = (0.005 x $Iout_{max}$ / $Vout_{max}$) *Farads*
V1 = (V_{R2} x $Vout_{max}$ / 24) *Volts*

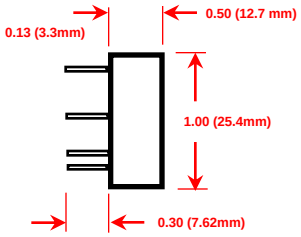
Equivalent CTC Circuit Model

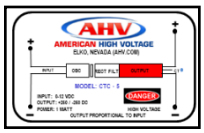
For example, for a: CTC - 10
Vout **max** =1,000 V (total)
Iout **max** = 0.001 A
Pout **max** = 1 W
If run at 1 Watt output power:
From this information: R1 = 240 , R2 = 120, R3A & B = 100K, RA4 & B = 5 M, C2A & B = 0.005 uF

Outline Drawing: inches (millimeters)

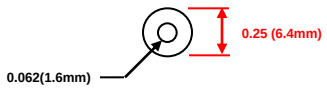


BOTTOM VIEW





TOP VIEW



RECOMMENDED SOLDER PAD DIMENSIONS

Ordering Information:

CTC – XX

XX = Output voltage in hundreds

Example:

CTC – 30: Maximum output = 3,000V (provides +/- 1,500 volts)
CTC – 5: Maximum output = 500V (provides +/- 250 volts)