

High Voltage, 1.5A, Three Terminal Adjustable Positive Regulators

PRELIMINARY

FEATURES

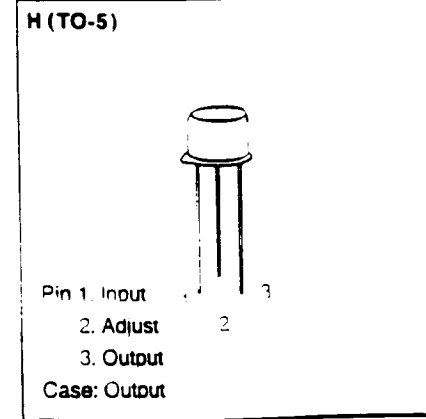
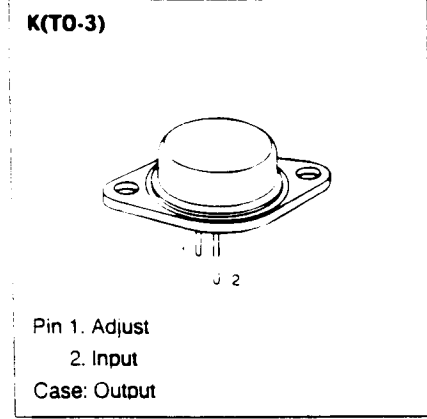
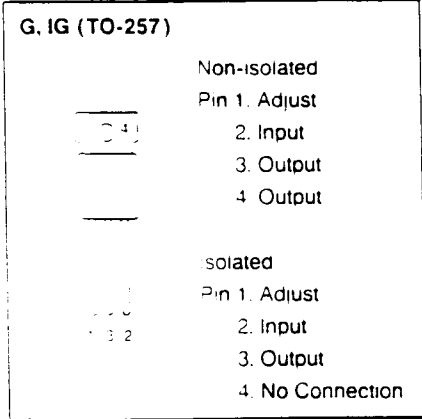
- Output voltage adjustable from 1.2 to 57V
- Guaranteed 1.5A output current
- Line regulation typically 0.01%/V
- Load regulation typically 0.1%
- Temperature-independent current limit
- Standard 3-lead transistor packages (TO-3, TO-5, isolated TO-257, non-isolated TO-257)
- Also available with screening to DESC SMD number 77034

DESCRIPTION

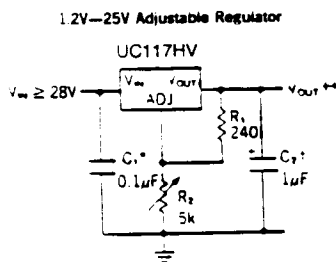
This monolithic integrated circuit is a high voltage version of the popular UC117. It is an adjustable 3-terminal positive voltage regulator designed to supply more than 1.5A of load current with an output voltage adjustable over a 1.2 to 57V range. Although ease of setting the output voltage to any desired value with only two external resistors is a major feature of this circuit, exceptional line and load regulation are also offered. In addition, full overload protection consisting of current limiting, thermal shutdown and safe-area control are included in this device which is packaged in TO-3, TO-5 and TO-257 (isolated and non-isolated) packages. The UC117HV is rated for operation from -55°C to +150°C and the UC317HV from 0°C to +125°C.

ABSOLUTE MAXIMUM RATINGS

Power Dissipation	Internally limited
Input—Output Voltage Differential	+60V, -0.3V
Operating Junction Temperature Range	
UC117HV	-55°C to +150°C
UC317HV	0°C to +125°C
Storage Temperature	-65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	300°C

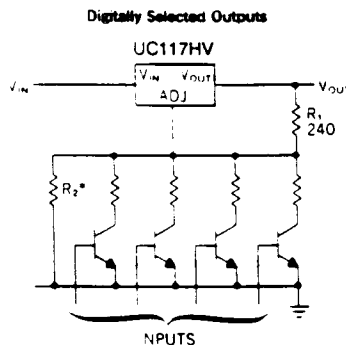


TYPICAL APPLICATIONS

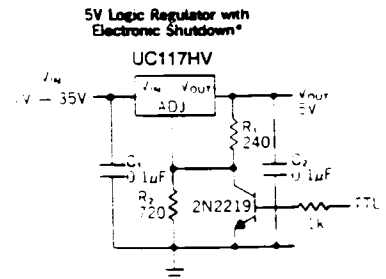


*Needed if device is far from filter capacitors
 *Optional—improves transient response

$$V_{out} = 1.25V \left(1 + \frac{R_2}{R_1} \right)$$



*Value determines maximum Vout



*Min output = 1.2V

Electrical Characteristics (Note 1, 2) $T_A = T_J$

Parameter	Symbol	Conditions	883 Group A Subgroups	UC117HV			UC317HV			Units
				Min	Typ	Max	Min	Typ	Max	
Line Regulation	R_{LINE}	$T_J = 25^\circ\text{C}$, $3\text{V} \leq V_{IN} - V_{OUT} \leq 60\text{V}$ (Note 2) $I_L = 10\text{mA}$	1	0.01	0.02		0.01	0.04		%/V
Load Regulation	R_{LOAD}	$T_J = 25^\circ\text{C}$, $10\text{mA} \leq I_{OUT} \leq I_{MAX}$	1	0.1	0.3		0.1	0.5		%
Thermal Regulation	V_{RTH}	$T_J = 25^\circ\text{C}$, 20 ms Pulse	1	0.03	0.07		0.04	0.07		%/W
Adjustment Pin Current	I_{ADJ}		1,2,3	50	100		50	100		μA
Adjustment Pin Current Change	ΔI_{ADJ}	$10\text{mA} \leq I_L \leq I_{MAX}$ $3.0\text{V} \leq (V_{IN} - V_{OUT}) \leq 60\text{V}$	1,2,3	0.2	5		0.2	5		μA
Reference Voltage	V_{REF}	$3.0\text{V} \leq (V_{IN} - V_{OUT}) \leq 60\text{V}$, $10\text{mA} \leq I_{OUT} \leq I_{MAX}$, $P \leq P_{MAX}$	1,2,3	1.20	1.25	1.30	1.20	1.25	1.30	V
Line Regulation (Note 2)	R_{LINE}	$3.0\text{V} \leq (V_{IN} - V_{OUT}) \leq 60\text{V}$, $I_L = 10\text{mA}$	2,3	0.02	0.05		0.02	0.07		%/V
Load Regulation	R_{LOAD}	$10\text{mA} \leq I_{OUT} \leq I_{MAX}$ (Note 2)	2,3	0.3	1		0.3	1.5		%
Temperature Stability		$T_{MIN} \leq T_J \leq T_{MAX}$		1			1			%
Minimum Load Current	I_{LMIN}	$(V_{IN} - V_{OUT}) = 60\text{V}$	1,2,3	3.5	7		3.5	12		mA
Current Limit	I_{CL}	$(V_{IN} - V_{OUT}) \leq 15\text{V}$ K, G, IG Packages H Package	1,2,3	1.5	2.2	3.5	1.5	2.2	3.7	A
				0.5	0.8	1.8	0.5	0.8	1.9	A
					0.1			0.1		A
					0.03			0.03		A
RMS Output Noise, % of V_{OUT}		$T_J = 25^\circ\text{C}$, $10\text{Hz} \leq f \leq 10\text{kHz}$		0.003			0.003			%
Ripple Rejection Ratio	R_N	$V_{OUT} = 10\text{V}$, $f = 120\text{Hz}$ $C_{ADJ} = 10\mu\text{F}$	4,5,6	66	65		66	65		dB
					66	80		66	80	
Long-Term Stability		$T_J = 125^\circ\text{C}$, 1000 Hrs. (Note 3)		0.3	1		0.3	1		%
Thermal Resistance, Junction to Case		H Package		12	15		12	15		$^\circ\text{C}/\text{W}$
		K Package	(Note 3)	2.3	3		2.3	3		$^\circ\text{C}/\text{W}$
		G Package		2.5	3.5		2.5	3.5		$^\circ\text{C}/\text{W}$
		IG Package		3	4.2		3	4.2		$^\circ\text{C}/\text{W}$

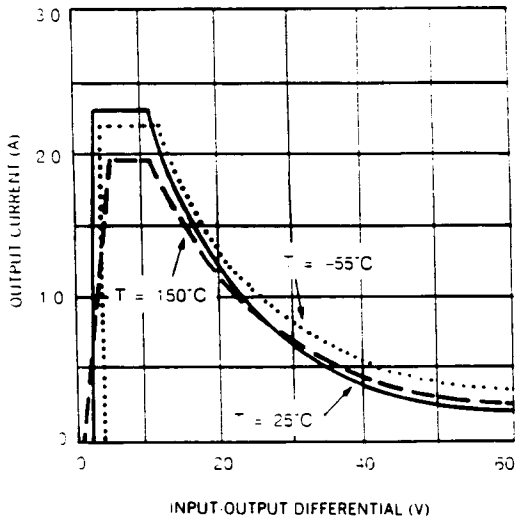
Note 1: Unless otherwise specified, these specifications apply: $-55^\circ\text{C} \leq T_J \leq 150^\circ\text{C}$ for the UC117HV, and $0^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ for the UC317HV; $V_{IN} - V_{OUT} = 5\text{V}$ and $I_{OUT} = 0.1\text{A}$ for the H package and $I_{OUT} = 0.5\text{A}$ for the K, G, IG packages. Although power dissipation is internally limited, these specifications are applicable for power dissipations of 2W for the H and 20W for the K, G, IG. I_{MAX} is 1.5A for the K, G, IG and 0.5A for the H package.

Note 2: Regulation is measured at constant junction temperature. Changes in output voltage due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.

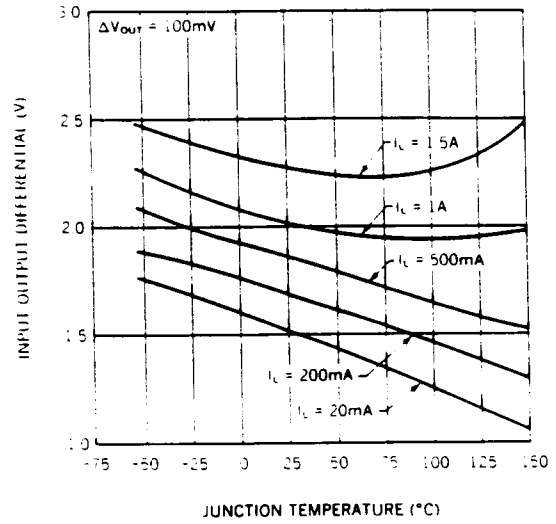
Note 3: Guaranteed by design, not 100% tested in production.

TYPICAL PERFORMANCE CHARACTERISTICS

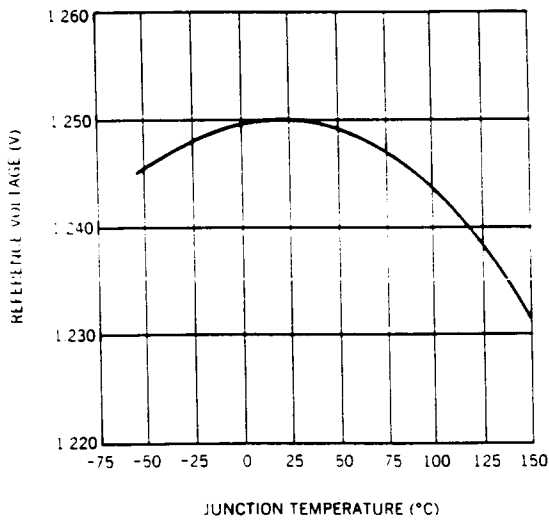
Current Limit



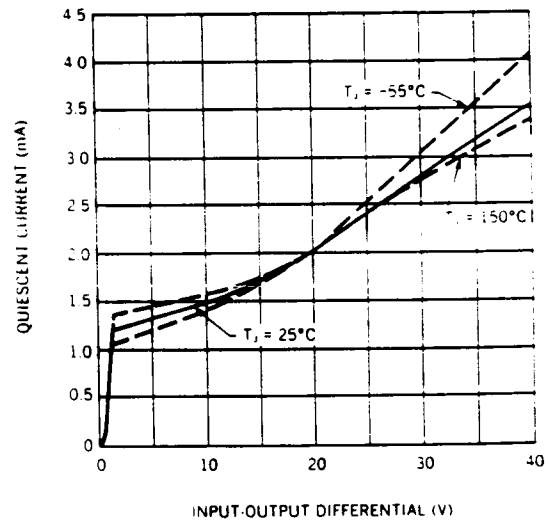
Dropout Voltage



Temperature Stability



Minimum Operating Current



APPLICATION HINTS

In operation, the UC117HV develops a nominal 1.25V reference voltage, V_{REF} , between the output and adjustment terminal. The reference voltage is impressed across program resistor R_1 and, since the voltage is constant, a constant current I_1 then flows through the output set resistor R_2 , giving an output voltage of

$$V_{OUT} = V_{REF} \left(1 + \frac{R_2}{R_1} \right) + I_{ADJ}R_2$$

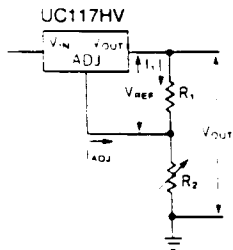


Figure 1

Since the 100µA current from the adjustment terminal represents an error term, the UC117HV was designed to minimize I_{ADJ} and make it very constant with line and load changes. To do this, all quiescent operating current is returned to the output establishing a minimum load current requirement. If there is insufficient load on the output, the output will rise.

External Capacitors

An input bypass capacitor is recommended. A 0.1µF disc or 1µF solid tantalum on the input is suitable input bypassing for almost all applications. The device is more sensitive to the absence of input bypassing when adjustment or output capacitors are used but the above values will eliminate the possibility of problems.

The adjustment terminal can be bypassed to ground on the UC117HV to improve ripple rejection. This bypass capacitor prevents ripple from being amplified as the output voltage is increased. With a 10µF bypass capacitor 80 dB ripple rejection is obtainable at any output level.

In general, the best type of capacitors to use are solid tantalum. Solid tantalum capacitors have low impedance even at high frequencies. Depending upon capacitor construction, it takes about 25µF in aluminum electrolytic to equal 1µF solid tantalum at high frequencies.

Although the UC117HV is stable with no output capacitors, like any feedback circuit, certain values of external capacitance can cause excessive ringing. This occurs with values between 500pF and 5000pF. A 1µF solid tantalum (or 25µF aluminum electrolytic) on the output swamps this effect and insures stability.

Load Regulation

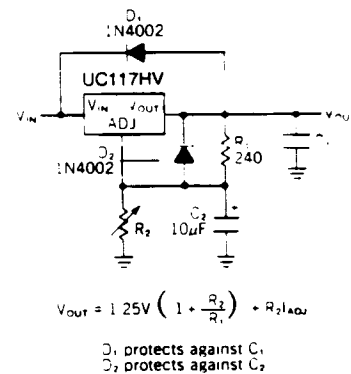
The UC117HV is capable of providing extremely good load regulation but a few precautions are needed to obtain maximum performance. The current set resistor connected between the adjustment terminal and the output terminal (usually 240Ω) should be tied directly to the output of the regulator rather than near the load. This eliminates line drops from appearing effectively in series with the reference and degrading regulation. With the TO-3 package, it is easy to minimize the resistance from the case to the set resistor by using 2 separate leads to the case. The ground of R_2 can be returned near the ground of the load to provide remote ground sensing and improve load regulation.

Protection Diodes

When external capacitors are used with any IC regulator it is sometimes necessary to add protection diodes to prevent the capacitors from discharging through low current points into the regulator. Most 10µF capacitors have low enough internal series resistance to deliver 20A spikes when shorted. Although the surge is short there is enough energy to damage parts of the IC.

When an output capacitor is connected to a regulator and the input is shorted, the output capacitor will discharge into the output of the regulator. The discharge current depends on the value of the capacitor, the output voltage of the regulator, and the rate of decrease of V_{IN} . In the UC117HV this discharge path is through a large junction that is able to sustain 15A surge with no problem. This is not true of other types of positive regulators. For output capacitors of 25µF or less, there is no need to use diodes.

The bypass capacitor on the adjustment terminal can discharge through a low current junction. Discharge occurs when either the input or output is shorted. Internal to the UC117HV is a 50Ω resistor which limits the peak discharge current. No protection is needed for output voltages of 25V or less and 10µF capacitance. Figure 2 shows a UC117HV with protection diodes included for use with outputs greater than 25V and high values of output capacitance.



$$V_{OUT} = 1.25V \left(1 + \frac{R_2}{R_1} \right) + R_2 I_{ADJ}$$

D₁ protects against C₁
D₂ protects against C₂

Figure 2. Regulator with Protection Diodes