

# LM117HV,LM317HV

*LM117HV/LM317HV 3-Terminal Adjustable Regulator*



Literature Number: SNVS773B

# LM117HV/LM317HV

## 3-Terminal Adjustable Regulator

### General Description

The LM117HV/LM317HV are adjustable 3-terminal positive voltage regulators capable of supplying in excess of 1.5A over a 1.2V to 57V output range. They are exceptionally easy to use and require only two external resistors to set the output voltage. Further, both line and load regulation are better than standard fixed regulators. Also, the LM117HV is packaged in standard transistor packages which are easily mounted and handled.

In addition to higher performance than fixed regulators, the LM117HV series offers full overload protection available only in IC's. Included on the chip are current limit, thermal overload protection and safe area protection. All overload protection circuitry remains fully functional even if the adjustment terminal is disconnected.

Normally, no capacitors are needed unless the device is situated more than 6 inches from the input filter capacitors in which case an input bypass is needed. An optional output capacitor can be added to improve transient response. The adjustment terminal can be bypassed to achieve very high ripple rejections ratios which are difficult to achieve with standard 3-terminal regulators.

Besides replacing fixed regulators, the LM117HV is useful in a wide variety of other applications. Since the regulator is "floating" and sees only the input-to-output differential voltage, supplies of several hundred volts can be regulated as long as the maximum input to output differential is not exceeded, i.e. do not short the output to ground.

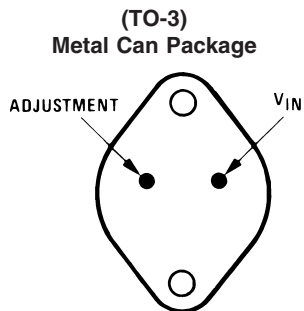
Also, it makes an especially simple adjustable switching regulator, a programmable output regulator, or by connecting a fixed resistor between the adjustment and output, the LM117HV can be used as a precision current regulator. Supplies with electronic shutdown can be achieved by clamping the adjustment terminal to ground which programs the output to 1.2V where most loads draw little current.

The LM117HVK STEEL and LM317HVK STEEL are packaged in standard TO-3 transistor packages, while the LM117HVH and LM317HVH are packaged in a solid Kovar base TO-39 transistor package. The LM317HVT uses a TO-220 plastic package. The LM117HV is rated for operation from -55°C to +150°C, and the LM317HV from 0°C to +125°C.

### Features

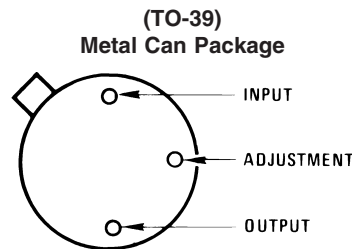
- Adjustable output down to 1.2V
- Guaranteed 1.5A output current
- Line regulation typically 0.01%/V
- Load regulation typically 0.1%
- Current limit constant with temperature
- 100% electrical burn-in
- Eliminates the need to stock many voltages
- Standard 3-lead transistor package
- 80 dB ripple rejection
- Output is short-circuit protected
- P+ Product Enhancement tested

### Connection Diagrams (See Physical Dimension section for further information)



00906229

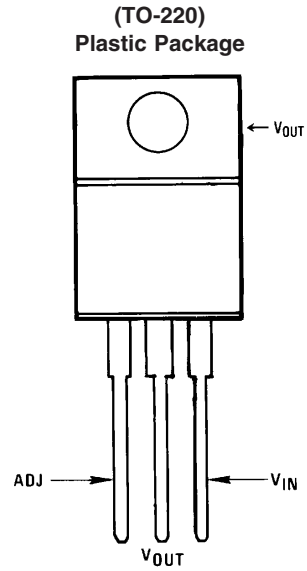
Case is Output  
Bottom View  
Order Number LM117HVKSTL/883  
See NS Package Number K02C  
Order Number LM317HVK STEEL  
See NS Package Number K02A



00906230

Case is Output  
Bottom View  
Order Number LM117HVH,  
LM117HVH/883  
or LM317HVH  
See NS Package Number H03A

## Connection Diagrams (See Physical Dimension section for further information) (Continued)

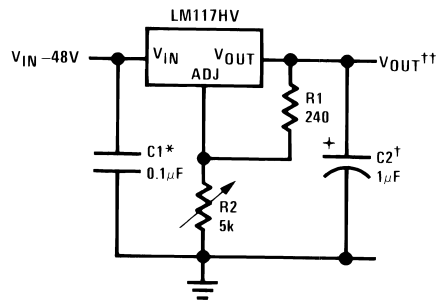


00906231

Front View  
Order Number LM317HVT  
See NS Package Number T03B

## Typical Applications

### 1.2V-45V Adjustable Regulator



00906201

Full output current not available at high input-output voltages

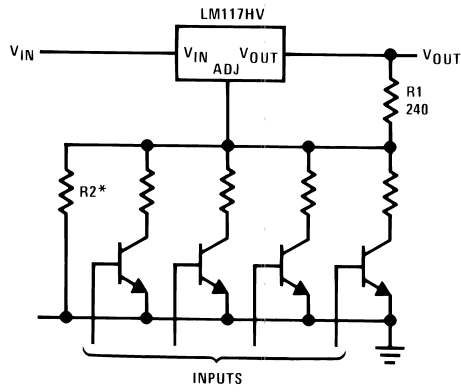
†Optional—improves transient response. Output capacitors in the range of 1 μF to 1000 μF of aluminum or tantalum electrolytic are commonly used to provide improved output impedance and rejection of transients.

\*Needed if device is more than 6 inches from filter capacitors.

$$\dagger\dagger V_{OUT} = 1.25V \left( 1 + \frac{R2}{R1} \right) + I_{ADJ} R2$$

Typical Applications (Continued)

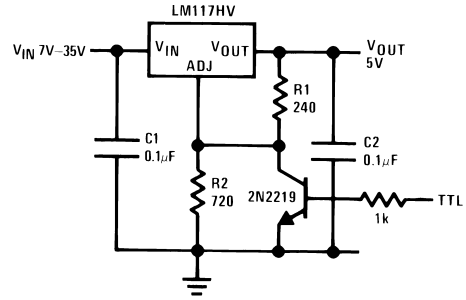
Digitally Selected Outputs



00906202

\*Sets maximum  $V_{OUT}$

5V Logic Regulator with Electronic Shutdown\*



00906203

\*Min. output  $\approx 1.2V$

**Absolute Maximum Ratings** (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

(Note 4)

Power Dissipation	Internally limited
Input—Output Voltage Differential	+60V, -0.3V

Operating Junction Temperature Range

LM117HV	-55°C to +150°C
LM317HV	0°C to +125°C
Storage Temperature	-65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	300°C
ESD Tolerance (Note 5)	2000V

**Electrical Characteristics** (Note 2)

Parameter	Conditions	LM117HV			LM317HV			Units
		Min	Typ	Max	Min	Typ	Max	
Line Regulation	$T_J = 25^\circ\text{C}$ , $3\text{V} \leq V_{\text{IN}} - V_{\text{OUT}} \leq 60\text{V}$ (Note 3) $I_L = 10\text{ mA}$		0.01	0.02		0.01	0.04	%/V
Load Regulation	$T_J = 25^\circ\text{C}$ , $10\text{ mA} \leq I_{\text{OUT}} \leq I_{\text{MAX}}$		0.1	0.3		0.1	0.5	%
Thermal Regulation	$T_J = 25^\circ\text{C}$ , 20 ms Pulse		0.03	0.07		0.04	0.07	%/W
Adjustment Pin Current			50	100		50	100	$\mu\text{A}$
Adjustment Pin Current Change	$10\text{ mA} \leq I_L \leq I_{\text{MAX}}$ $3.0\text{ V} \leq (V_{\text{IN}} - V_{\text{OUT}}) \leq 60\text{V}$		0.2	5		0.2	5	$\mu\text{A}$
Reference Voltage	$3.0\text{ V} \leq (V_{\text{IN}} - V_{\text{OUT}}) \leq 60\text{V}$ , (Note 4) $10\text{ mA} \leq I_{\text{OUT}} \leq I_{\text{MAX}}$ , $P \leq P_{\text{MAX}}$	1.20	1.25	1.30	1.20	1.25	1.30	V
Line Regulation	$3.0\text{V} \leq (V_{\text{IN}} - V_{\text{OUT}}) \leq 60\text{V}$ , $I_L = 10\text{ mA}$ , (Note 3)		0.02	0.05		0.02	0.07	%/V
Load Regulation	$10\text{ mA} \leq I_{\text{OUT}} \leq I_{\text{MAX}}$ (Note 3)		0.3	1		0.3	1.5	%
Temperature Stability	$T_{\text{MIN}} \leq T_J \leq T_{\text{MAX}}$		1			1		%
Minimum Load Current	$(V_{\text{IN}} - V_{\text{OUT}}) = 60\text{V}$		3.5	7		3.5	12	mA
Current Limit	$(V_{\text{IN}} - V_{\text{OUT}}) \leq 15\text{V}$ K, T Packages	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
	$(V_{\text{IN}} - V_{\text{OUT}}) \leq 60\text{V}$ K, T Packages		0.3			0.3		A
			0.03			0.03		A
RMS Output Noise, % of $V_{\text{OUT}}$	$T_J = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 10\text{ kHz}$		0.003			0.003		%
Ripple Rejection Ratio	$V_{\text{OUT}} = 10\text{V}$ , $f = 120\text{ Hz}$ $C_{\text{ADJ}} = 10\text{ }\mu\text{F}$		65			65		dB
		66	80		66	80		dB
Long-Term Stability	$T_J = 125^\circ\text{C}$		0.3	1		0.3	1	%
Thermal Resistance, Junction to Case	H Package		12	15		12	15	$^\circ\text{C/W}$
	T Package					4	5	$^\circ\text{C/W}$
	K Package		2.3	3		2.3	3	$^\circ\text{C/W}$
Thermal Resistance, Junction to Ambient (no heat sink)	H Package		140			140		$^\circ\text{C/W}$
	T Package					50		$^\circ\text{C/W}$
	K Package		35			35		$^\circ\text{C/W}$

**Note 1:** "Absolute Maximum Ratings" indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits.

**Note 2:** Unless otherwise specified, these specifications apply:  $-55^\circ\text{C} \leq T_J \leq +150^\circ\text{C}$  for the LM117HV, and  $0^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$  for the LM317HV;  $V_{\text{IN}} - V_{\text{OUT}} = 5\text{V}$  and  $I_{\text{OUT}} = 0.1\text{A}$  for the TO-39 package and  $I_{\text{OUT}} = 0.5\text{A}$  for the TO-3 and TO-220 packages. Although power dissipation is internally limited, these specifications are applicable for power dissipations of 2W for the TO-39 and 20W for the TO-3 and TO-220.  $I_{\text{MAX}}$  is 1.5A for the TO-3 and TO-220 and 0.5A for the TO-39 package.

**Note 3:** 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.

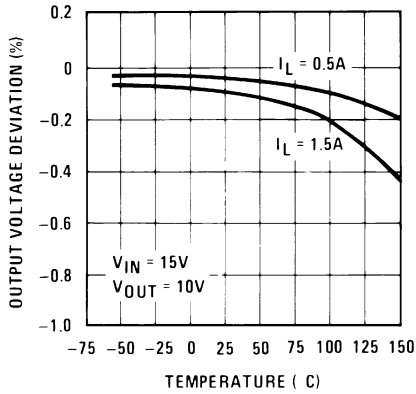
**Note 4:** Refer to RETS117HVH for LM117HVH or RETS117HVK for LM117HVK military specifications.

**Note 5:** Human body model, 1.5 k $\Omega$  in series with 100 pF.

# Typical Performance Characteristics

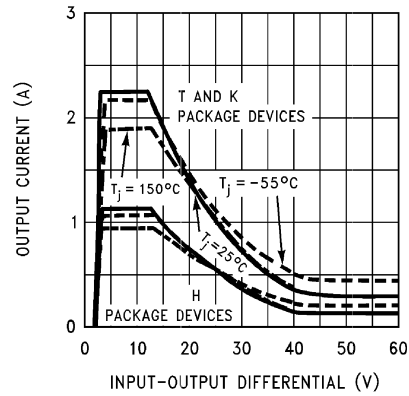
Output capacitor = 0  $\mu$ F unless otherwise noted.

**Load Regulation**



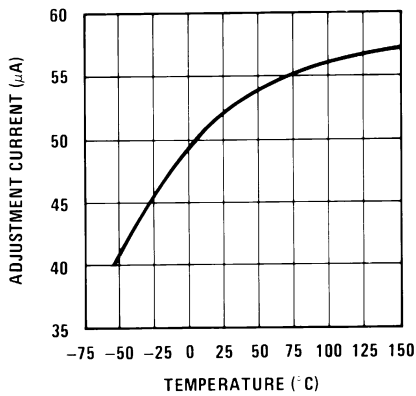
00906232

**Current Limit**



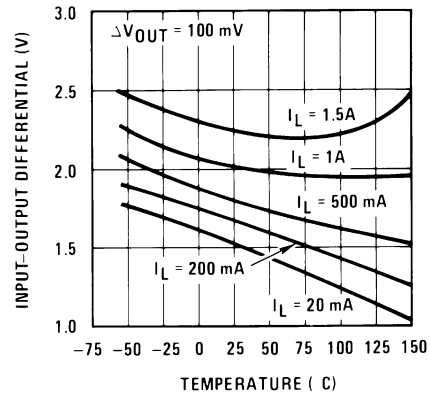
00906233

**Adjustment Current**



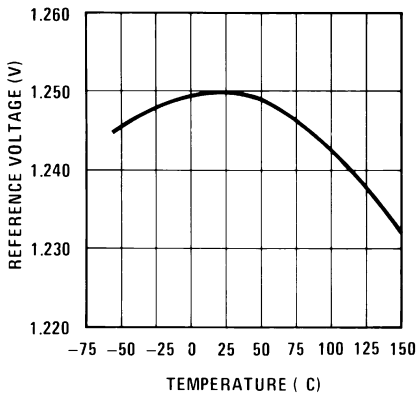
00906234

**Dropout Voltage**



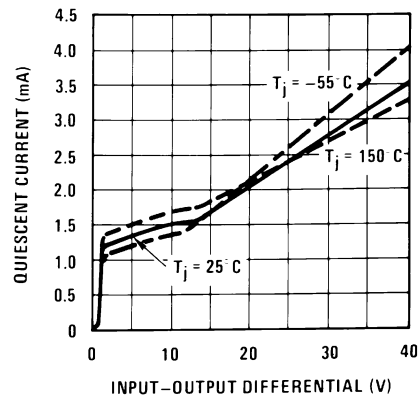
00906235

**Temperature Stability**



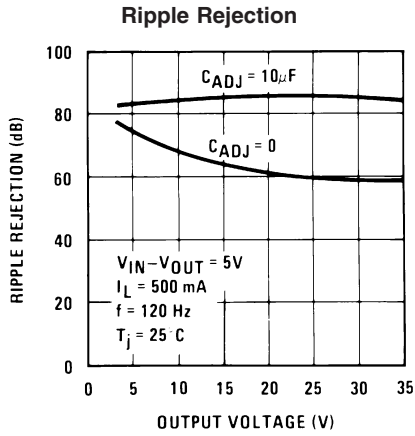
00906236

**Minimum Operating Current**

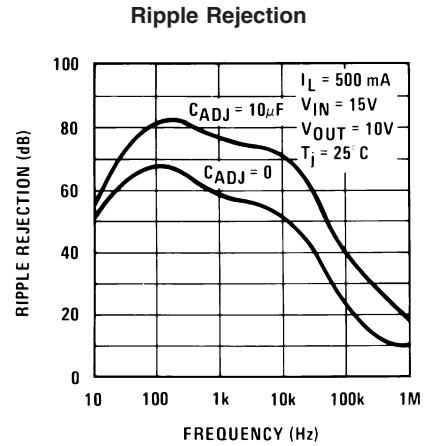


00906237

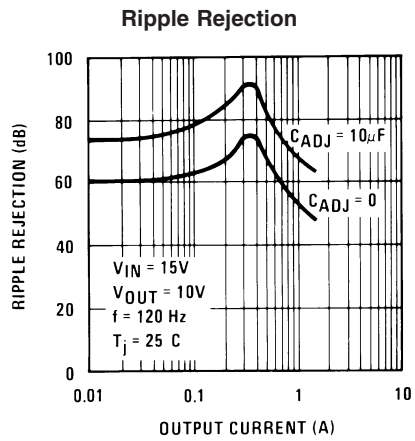
**Typical Performance Characteristics** Output capacitor = 0  $\mu\text{F}$  unless otherwise noted. (Continued)



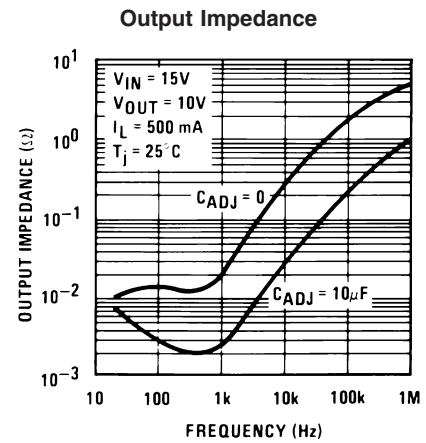
00906238



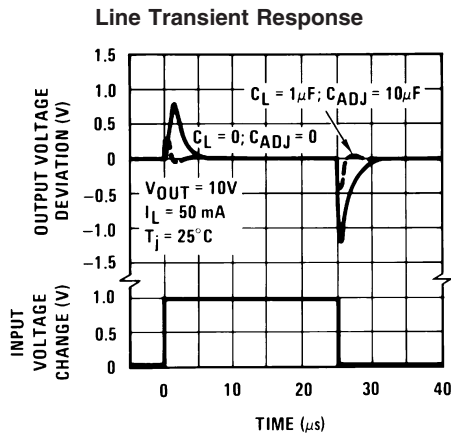
00906239



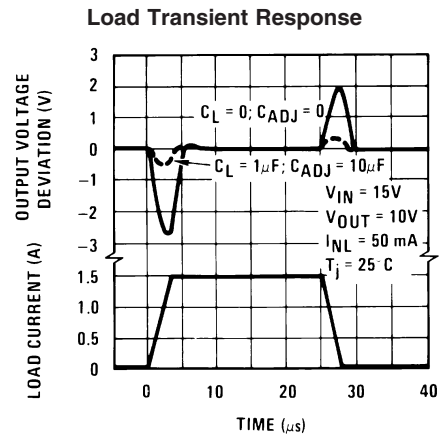
00906240



00906241



00906242



00906243

## Application Hints

In operation, the LM117HV develops a nominal 1.25V reference voltage,  $V_{REF}$ , between the output and adjustment terminal. The reference voltage is impressed across program resistor R1 and, since the voltage is constant, a constant current  $I_1$  then flows through the output set resistor R2, giving an output voltage of

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

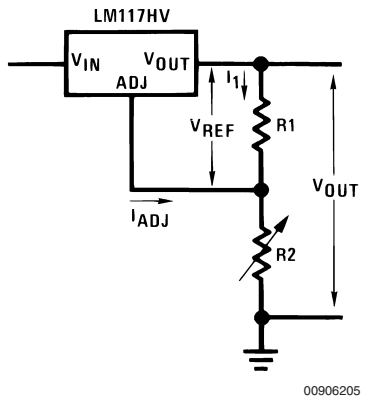


FIGURE 1.

Since the 100  $\mu$ A current from the adjustment terminal represents an error term, the LM117HV 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 0.1  $\mu$ F disc or 1  $\mu$ F 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 LM117HV to improve ripple rejection. This bypass capacitor prevents ripple from being amplified as the output voltage is increased. With a 10  $\mu$ F bypass capacitor 80 dB ripple rejection is obtainable at any output level. Increases over 10  $\mu$ F do not appreciably improve the ripple rejection at frequencies above 120 Hz. If the bypass capacitor is used, it is sometimes necessary to include protection diodes to prevent the capacitor from discharging through internal low current paths and damaging the device.

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 25  $\mu$ F in aluminum electrolytic to equal 1  $\mu$ F solid tantalum at high frequencies. Ceramic capacitors are also good at high frequencies; but some types have a large decrease in capacitance at frequencies around 0.5 MHz. For this reason, 0.01  $\mu$ F disc may seem to work better than a 0.1  $\mu$ F disc as a bypass.

Although the LM117HV is stable with no output capacitors, like any feedback circuit, certain values of external capacitance can cause excessive ringing. This occurs with values between 500 pF and 5000 pF. A 1  $\mu$ F solid tantalum (or 25  $\mu$ F aluminum electrolytic) on the output swamps this effect and insures stability. Any increase of load capacitance larger than 10  $\mu$ F will merely improve the loop stability and output impedance.

### LOAD REGULATION

The LM117HV 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 240 $\Omega$ ) 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. For example, a 15V regulator with 0.05 $\Omega$  resistance between the regulator and load will have a load regulation due to line resistance of  $0.05\Omega \times I_L$ . If the set resistor is connected near the load the effective line resistance will be  $0.05\Omega (1 + R_2/R_1)$  or in this case, 11.5 times worse.

Figure 2 shows the effect of resistance between the regulator and 240 $\Omega$  set resistor.

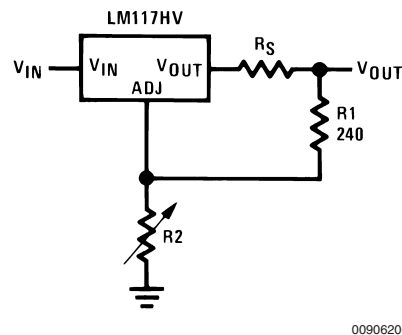


FIGURE 2. Regulator with Line Resistance in Output Lead

With the TO-3 package, it is easy to minimize the resistance from the case to the set resistor, by using two separate leads to the case. However, with the TO-5 package, care should be taken to minimize the wire length of the output lead. The ground of R2 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 10  $\mu$ F 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 LM117HV, 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 25  $\mu$ F or less, there is no need to use diodes.



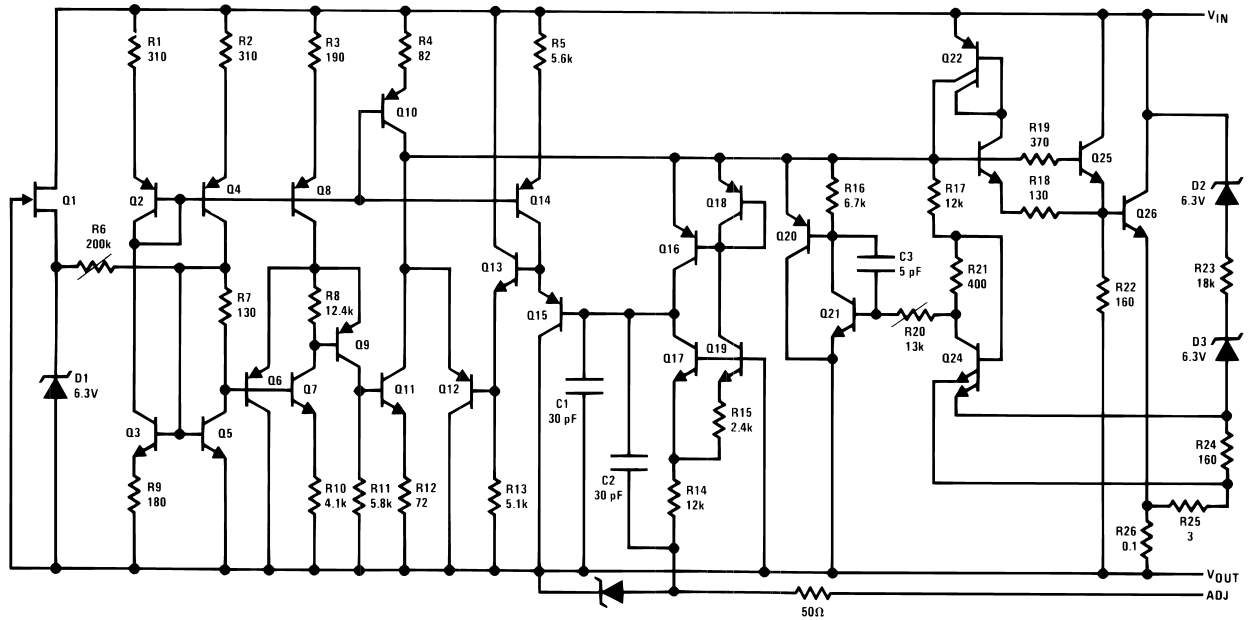
## Application Hints (Continued)

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 LM117HV is a 50Ω resistor which limits the peak discharge current. No protection is needed for output voltages of 25V or less and 10 μF capacitance. *Figure 3* shows an LM117HV with protection diodes included for use with outputs greater than 25V and high values of output capacitance.

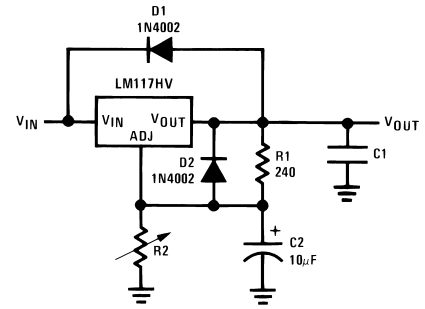
### CURRENT LIMIT

Internal current limit will be activated whenever the output current exceeds the limit indicated in the Typical Performance Characteristics. However, if during a short circuit condition the regulator's differential voltage exceeds the Absolute Maximum Rating of 60V (e.g.  $V_{IN} \geq 60V$ ,  $V_{OUT} = 0V$ ), internal junctions in the regulator may break down and the device may be damaged or fail. Failure modes range from an apparent open or short from input to output of the regulator, to a destroyed package (most common with the TO-220 package). To protect the regulator, the user is advised to be aware of voltages that may be applied to the regulator during fault conditions, and to avoid violating the Absolute Maximum Ratings.

### Schematic Diagram



00906208



00906207

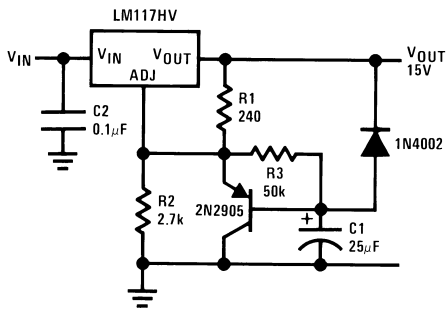
FIGURE 3. Regulator with Protection Diodes

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

**Note:** D1 protects against C1  
D2 protects against C2

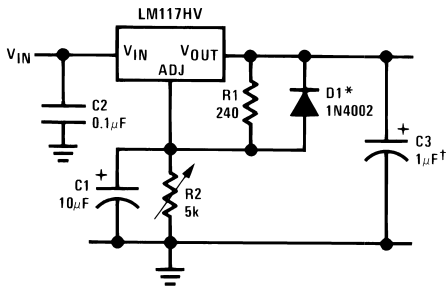
# Typical Applications

### Slow Turn-On 15V Regulator



00906209

### Adjustable Regulator with Improved Ripple Rejection

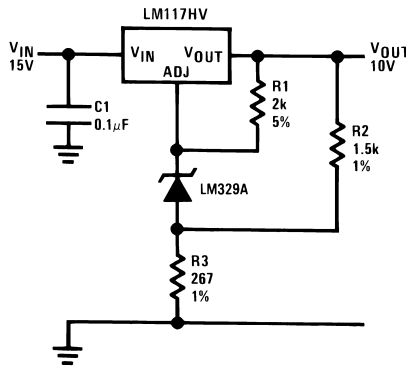


00906210

†Solid tantalum

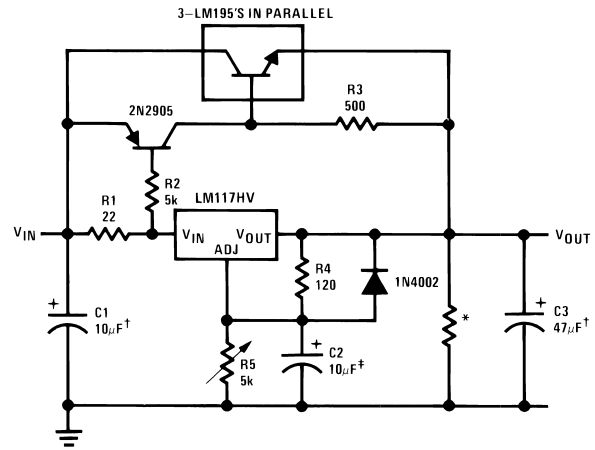
\*Discharges C1 if output is shorted to ground

### High Stability 10V Regulator



00906211

### High Current Adjustable Regulator



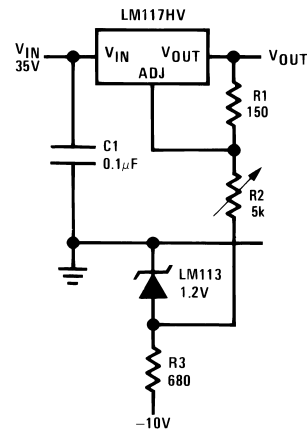
00906212

†Solid tantalum

\*Minimum load current = 30 mA

‡Optional — improves ripple rejection

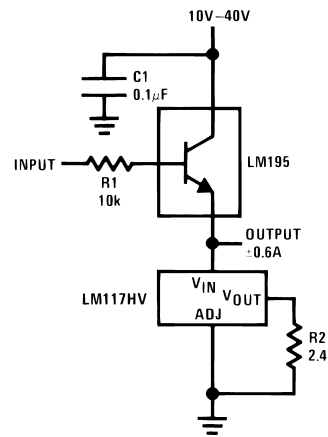
### 0 to 30V Regulator



00906213

Full output current not available at high input-output voltages

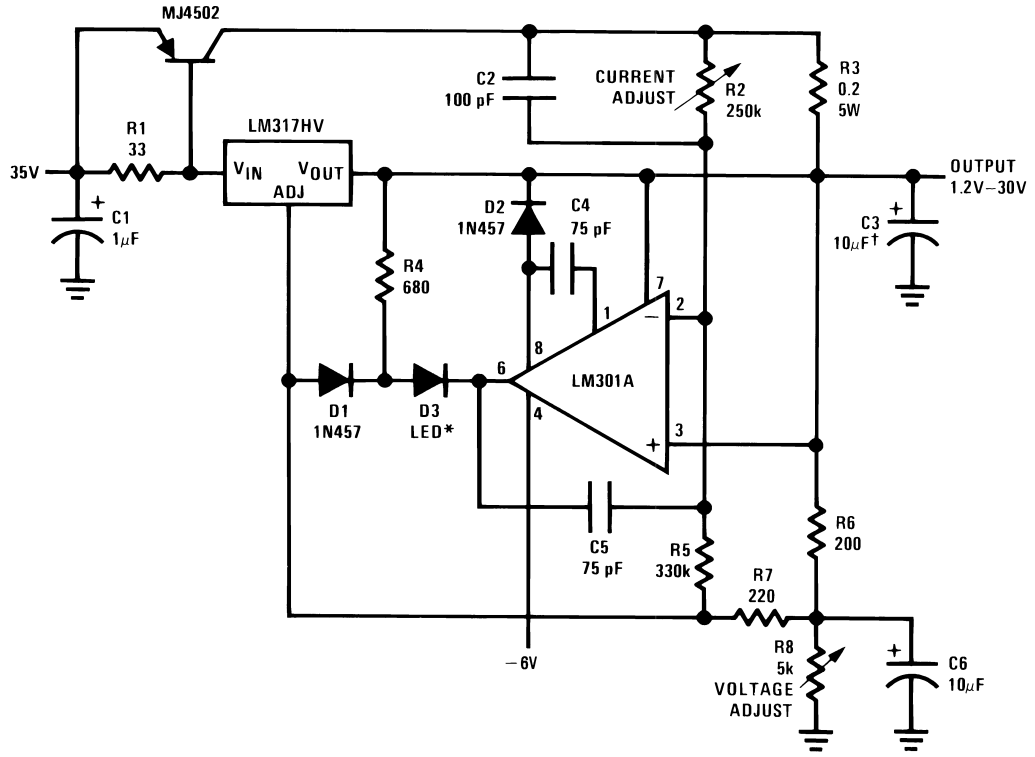
### Power Follower



00906214

Typical Applications (Continued)

5A Constant Voltage/Constant Current Regulator

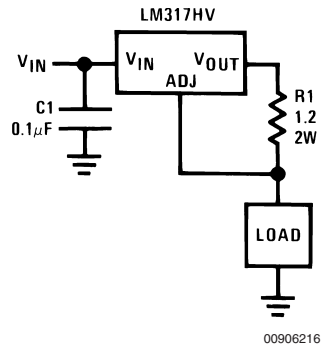


†Solid tantalum

\*Lights in constant current mode

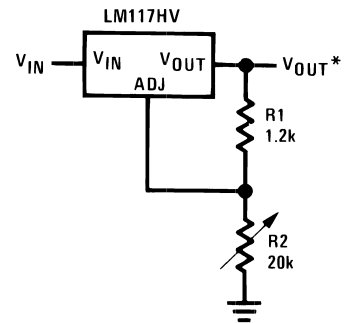
00906215

1A Current Regulator



00906216

1.2V-20V Regulator with Minimum Program Current

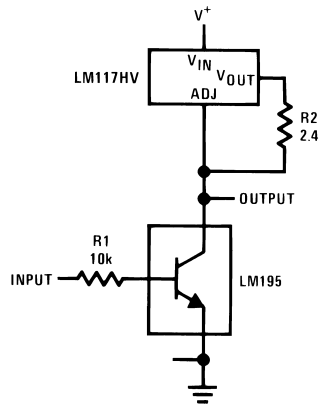


00906217

\*Minimum load current = 4 mA

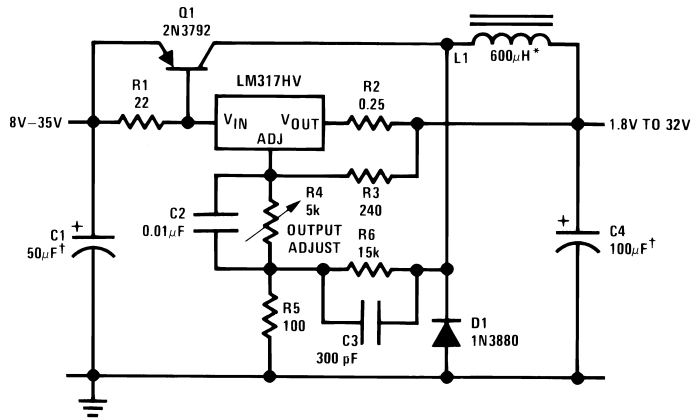
Typical Applications (Continued)

High Gain Amplifier



00906218

Low Cost 3A Switching Regulator



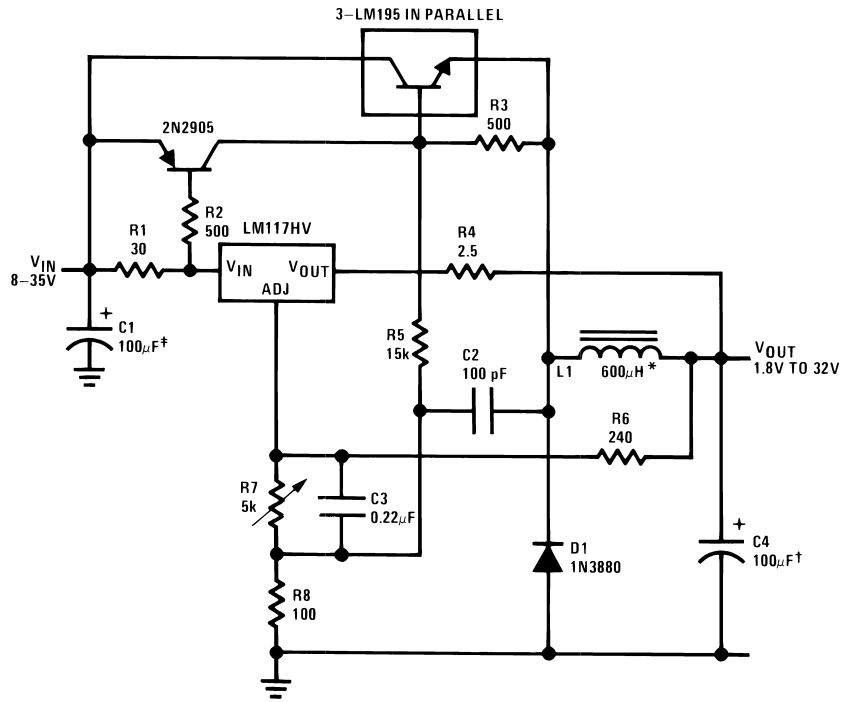
00906219

†Solid tantalum

\*Core—Arnold A-254168-2 60 turns

## Typical Applications (Continued)

### 4A Switching Regulator with Overload Protection

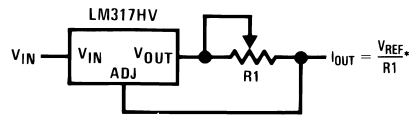


00906220

†Solid tantalum

\*Core—Arnold A-254168-2 60 turns

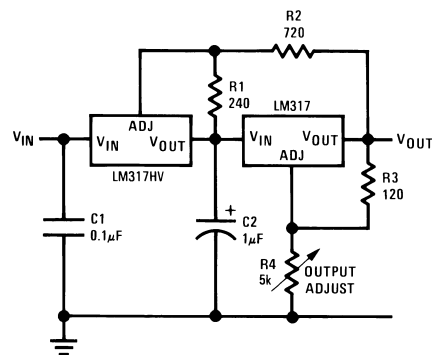
### Precision Current Limiter



00906221

\*  $0.8\Omega \leq R_1 \leq 120\Omega$

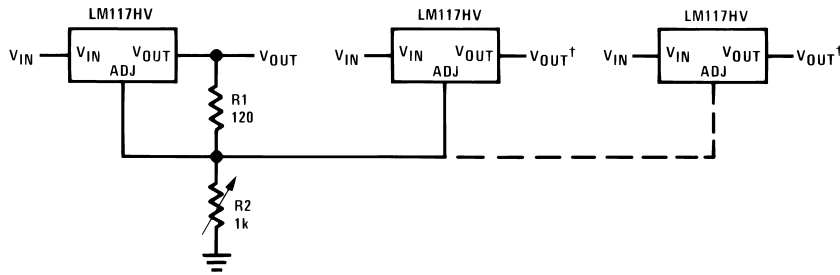
### Tracking Preregulator



00906222

# Typical Applications (Continued)

## Adjustable Multiple On-Card Regulators with Single Control\*

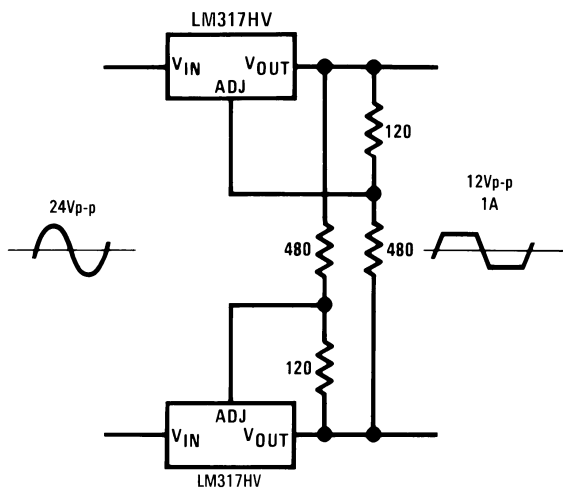


00906223

\*All outputs within  $\pm 100$  mV

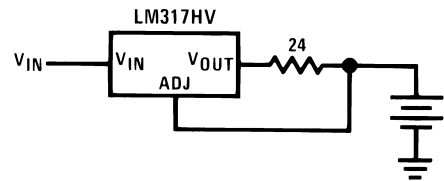
†Minimum load — 10 mA

### AC Voltage Regulator



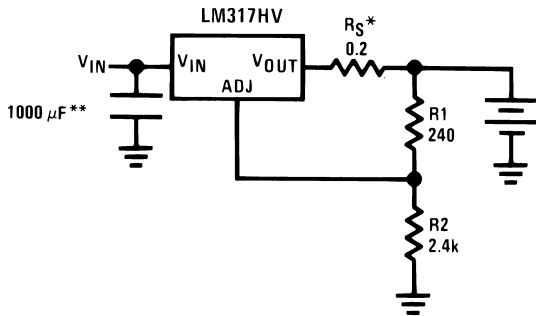
00906224

### 50 mA Constant Current Battery Charger



00906226

### 12V Battery Charger



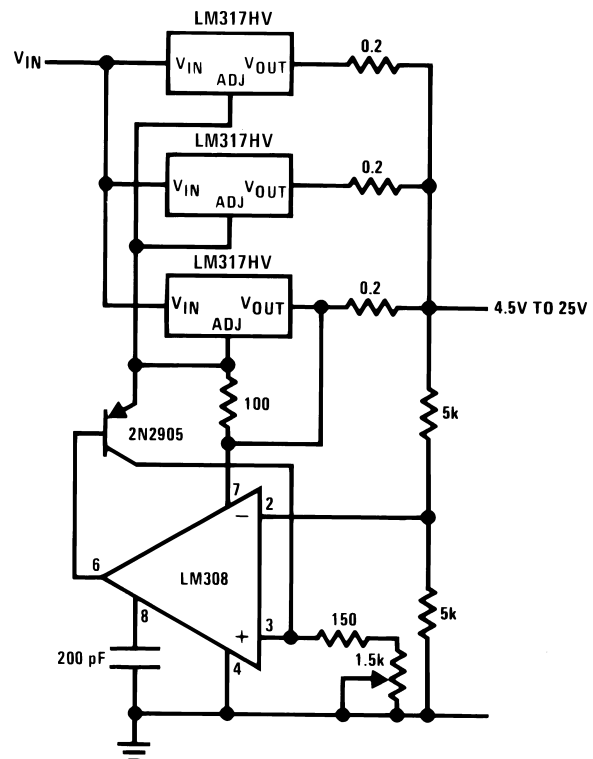
00906225

$$*R_S \text{—sets output impedance of charger } Z_{OUT} = R_S \left( 1 + \frac{R_2}{R_1} \right)$$

Use of  $R_S$  allows low charging rates with fully charged battery.

\*\*The 1000  $\mu$ F is recommended to filter out input transients

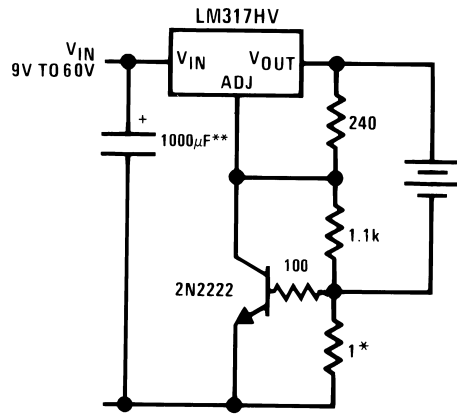
### Adjustable 4A Regulator



00906227

## Typical Applications (Continued)

### Current Limited 6V Charger



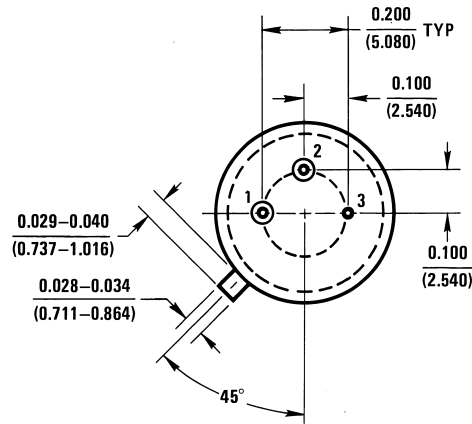
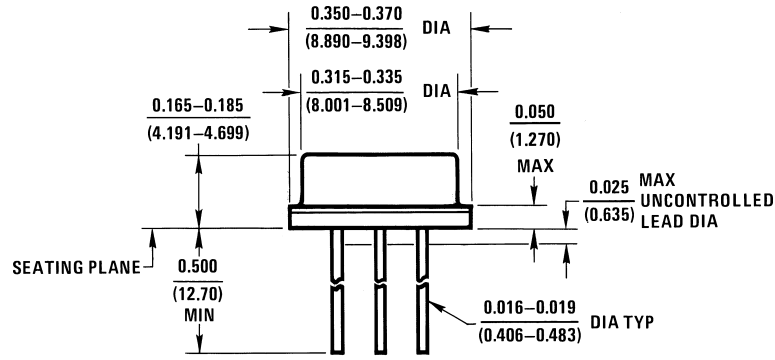
00906228

\*Sets peak current (0.6A for 1 $\Omega$ )

\*\*The 1000  $\mu F$  is recommended to filter out input transients

**Physical Dimensions** inches (millimeters)

unless otherwise noted

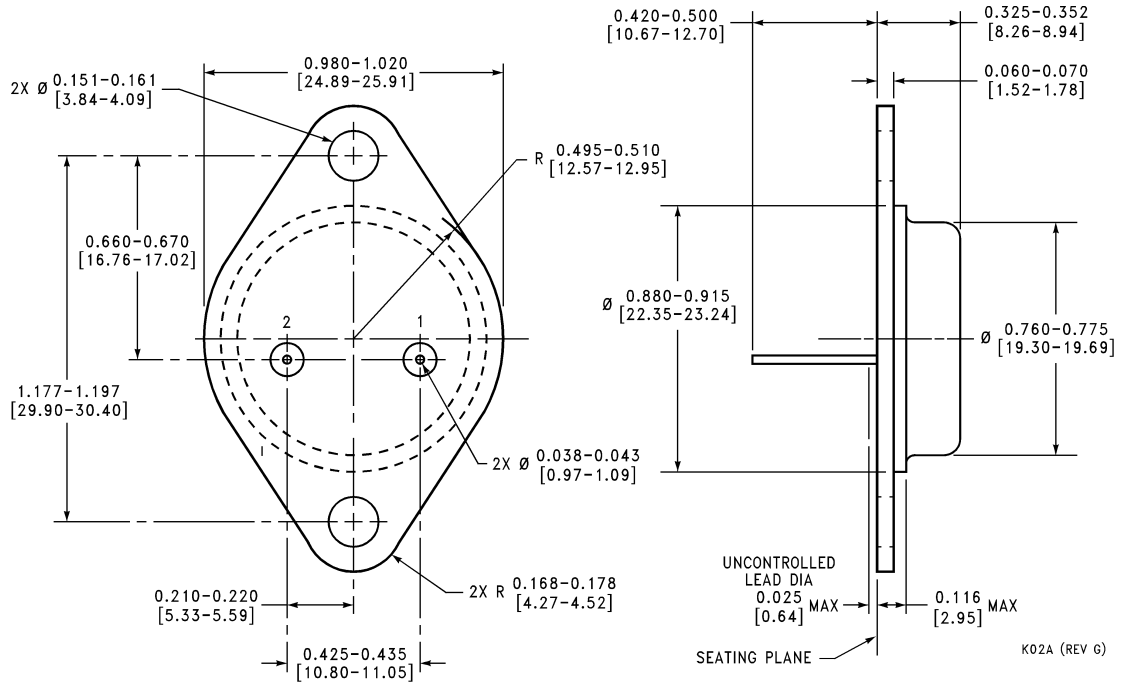


H03A (REV B)

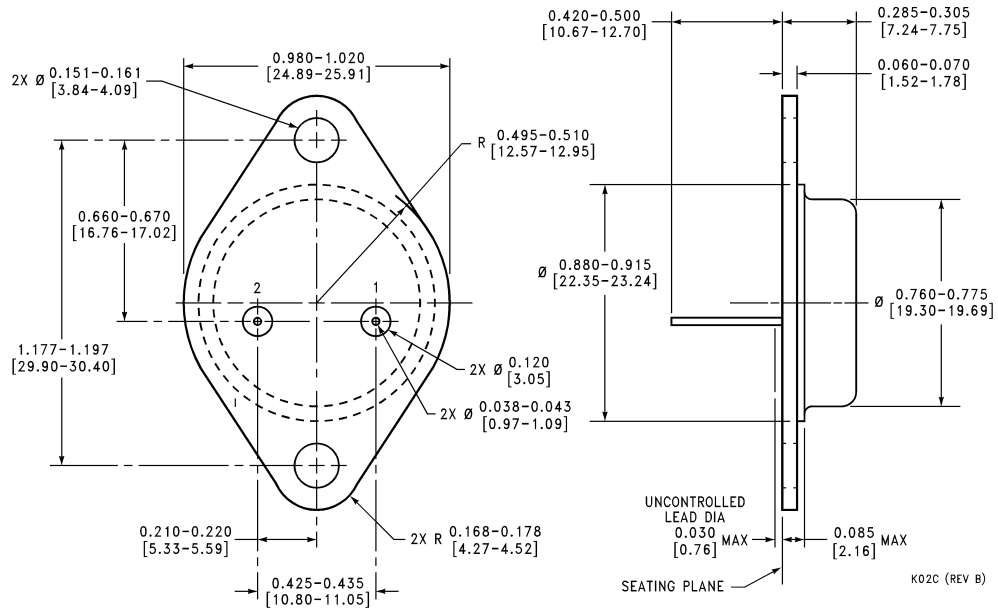
Order Number LM117HVH, LM117HVH/883, or LM317HVH  
NS Package Number H03A



**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)

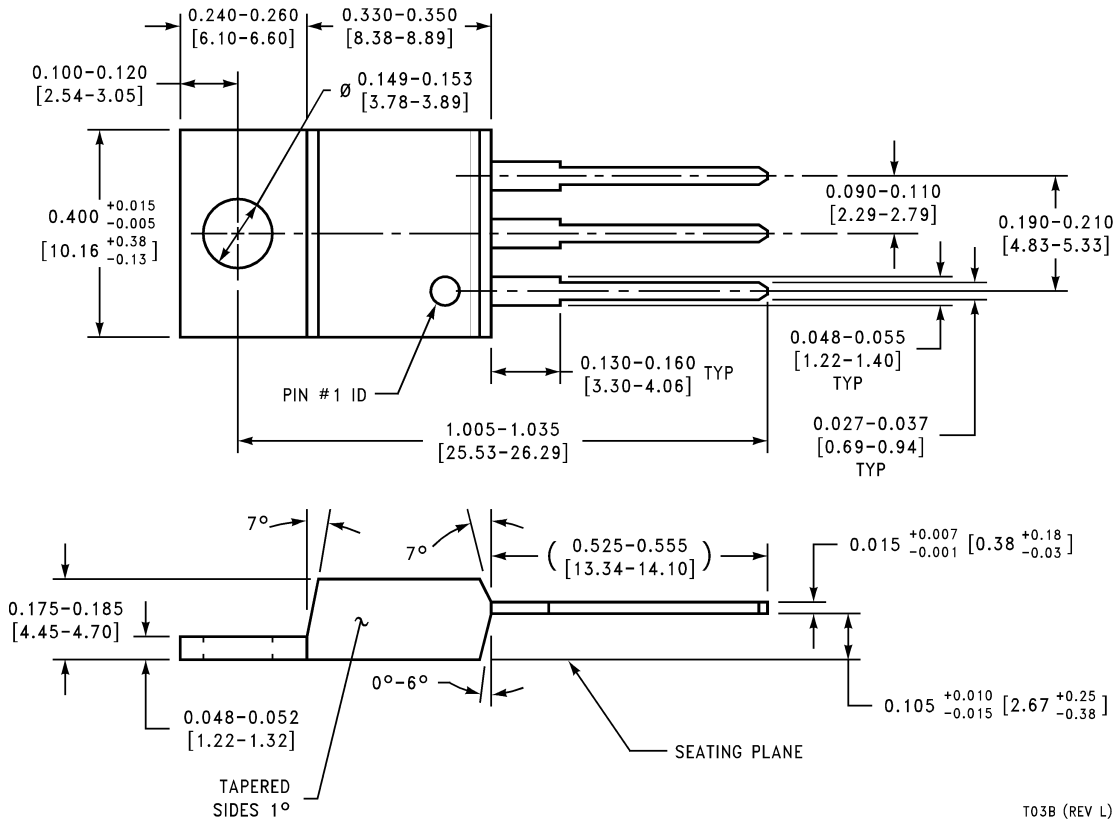


**Metal Can Package (K)**  
**Order Number LM317HVK STEEL**  
**NS Package Number K02A**



**Metal Can Package (K)**  
**Mil-Aero Product**  
**Order Number LM117HVKSTL/883**  
**NS Package Number K02C**

**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



**Order Number LM317HVT  
NS Package Number T03B**

T03B (REV L)

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.

For the most current product information visit us at [www.national.com](http://www.national.com).

**LIFE SUPPORT POLICY**

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

**BANNED SUBSTANCE COMPLIANCE**

National Semiconductor certifies that the products and packing materials meet the provisions of the Customer Products Stewardship Specification (CSP-9-111C2) and the Banned Substances and Materials of Interest Specification (CSP-9-111S2) and contain no "Banned Substances" as defined in CSP-9-111S2.



**National Semiconductor**  
Americas Customer  
Support Center  
Email: [new.feedback@nsc.com](mailto:new.feedback@nsc.com)  
Tel: 1-800-272-9959

**National Semiconductor**  
Europe Customer Support Center  
Fax: +49 (0) 180-530 85 86  
Email: [europe.support@nsc.com](mailto:europe.support@nsc.com)  
Deutsch Tel: +49 (0) 69 9508 6208  
English Tel: +44 (0) 870 24 0 2171  
Français Tel: +33 (0) 1 41 91 8790

**National Semiconductor**  
Asia Pacific Customer  
Support Center  
Email: [ap.support@nsc.com](mailto:ap.support@nsc.com)

**National Semiconductor**  
Japan Customer Support Center  
Fax: 81-3-5639-7507  
Email: [jpn.feedback@nsc.com](mailto:jpn.feedback@nsc.com)  
Tel: 81-3-5639-7560

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Mobile Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Transportation and Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

TI E2E Community Home Page

[e2e.ti.com](http://e2e.ti.com)

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2011, Texas Instruments Incorporated