LM137HV,LM337HV

LM137HV/LM337HV 3-Terminal Adjustable Negative Regulators (High Voltage)

Texas Instruments

Literature Number: SNVS777C

National Semiconductor

LM137HV/LM337HV

OBSOLETE
September 22, 2011

3-Terminal Adjustable Negative Regulators (High Voltage)

General Description

The LM137HV/LM337HV are adjustable 3-terminal negative voltage regulators capable of supplying in excess of −1.5A over an output voltage range of −1.2V to −47V. These regulators are exceptionally easy to apply, requiring only 2 external resistors to set the output voltage and 1 output capacitor for frequency compensation. The circuit design has been optimized for excellent regulation and low thermal transients. Further, the LM137HV series features internal current limiting, thermal shutdown and safe-area compensation, making them virtually blowout-proof against overloads.

The LM137HV/LM337HV serve a wide variety of applications including local on-card regulation, programmable-output voltage regulation or precision current regulation. The LM137HV/LM337HV are ideal complements to the LM117HV/LM317HV adjustable positive regulators.

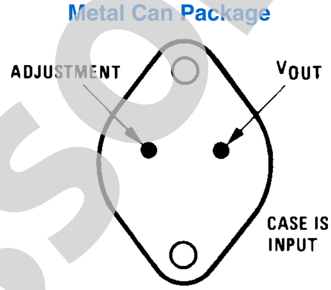
Features

- Output voltage adjustable from −1.2V to −47V
- 1.5A output current guaranteed, −55°C to +150°C
- Line regulation typically 0.01%/V
- Load regulation typically 0.3%
- Excellent thermal regulation, 0.002%/W
- 77 dB ripple rejection
- Excellent rejection of thermal transients
- 50 ppm/°C temperature coefficient
- Temperature-independent current limit
- Internal thermal overload protection
- P+ Product Enhancement tested
- Standard 3-lead transistor package
- Output short circuit protected

Connection Diagram

See Physical Dimensions section for further information)

TO-3
Metal Can Package



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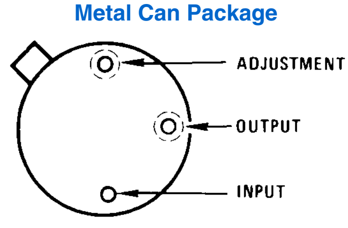
Bottom View
Order Number LM137HVK/883, LM137HVK-QMLV, or SMD #7703404
See NS Package Number K02C
Order Number LM337HVK STEEL
See NS Package Number K02A

TO-39
Metal Can Package



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Bottom View
Order Number LM137HVH/883, LM137HVH-QMLV, SMD #7703404
or LML337HVH
See NS Package Number H03A

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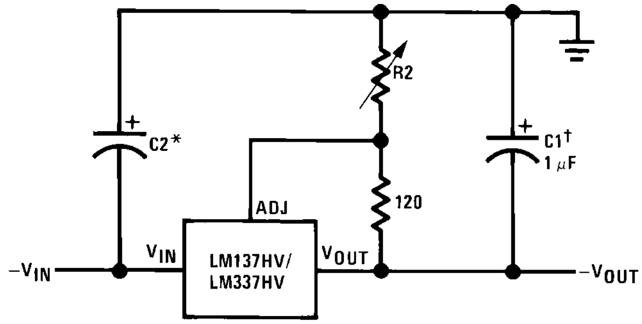
Typical Applications

Adjustable Negative Voltage Regulator



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$$-V_{OUT} = -1.25V\left(1 + \frac{R2}{120\Omega}\right) + \left[-I_{Adj}\left(R_2\right)\right]$$

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†C1 = 1 μF solid tantalum or 10 μF aluminum electrolytic required for stability. 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.

*C2 = 1 μF solid tantalum is required only if regulator is more than 4″ from power-supply filter capacitor.

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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	50V
Operating Junction Temperature Range	
LM137HV	−55°C to +150°C
LM337HV	0°C to +125°C
Storage Temperature	−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	300°

ESD rating is to be determined.

Electrical Characteristics (Note 2)

Parameter	Conditions	LM137HV Min	LM137HV Typ	LM137HV Max	LM337HV Min	LM337HV Typ	LM337HV Max	Units
Line Regulation	T_J = 25°C, 3V ≤ $\lvert V_{IN}-V_{OUT}\rvert$ ≤ 50V, (Note 3) I_L = 10 mA		0.01	0.02		0.01	0.04	%/V
Load Regulation	T_J = 25°C, 10 mA ≤ I_{OUT} ≤ I_{MAX}		0.3	0.5		0.3	1.0	%
Thermal Regulation	T_J = 25°C, 10 ms Pulse		0.002	0.02		0.003	0.04	%/W
Adjustment Pin Current			65	100		65	100	μA
Adjustment Pin Current Change	10 mA ≤ I_L ≤ I_{MAX} 3.0V ≤ $\lvert V_{IN}-V_{OUT}\rvert$ ≤ 50V, T_J = 25°		2 4	5 6		2 3	5 6	μA μA
Reference Voltage	T_J = 25°C, (Note 4) 3V ≤ $\lvert V_{IN}-V_{OUT}\rvert$ ≤ 50V, (Note 4) 10 mA ≤ I_{OUT} ≤ I_{MAX}, P≤ P_{MAX}	−1.225 −1.200	−1.250 −1.250	−1.275 −1.300	−1.213 −1.200	−1.250 −1.250	−1.287 −1.300	V V
Line Regulation	3V ≤ $\lvert V_{IN}-V_{OUT}\rvert$ ≤ 50V, (Note 3) I_L = 10 mA		0.02	0.05		0.02	0.07	%/V
Load Regulation	10 mA ≤ I_{OUT} ≤ I_{MAX}, (Note 3)		0.3	1		0.3	1.5	%
Temperature Stability	T_{MIN} ≤ T_j ≤ T_{MAX}		0.6			0.6		%
Minimum Load Current	$\lvert V_{IN}-V_{OUT}\rvert$ ≤ 50V $\lvert V_{IN}-V_{OUT}\rvert$ ≤ 10V		2.5 1.2	5 3		2.5 1.5	10 6	mA mA
Current Limit	$\lvert V_{IN}-V_{OUT}\rvert$ ≤ 13V K Package H Package	 1.5 0.5	 2.2 0.8	 3.2 1.6	 1.5 0.5	 2.2 0.8	 3.5 1.8	 A A
	$\lvert V_{IN}-V_{OUT}\rvert$ = 50V K Package H Package	 0.2 0.1	 0.4 0.17	 0.8 0.5	 0.1 0.050	 0.4 0.17	 0.8 0.5	 A A
RMS Output Noise, % of V_{OUT}	T_J = 25°C, 10 Hz ≤ f ≤ 10 kHz		0.003			0.003		%
Ripple Rejection Ratio	V_{OUT} = −10V, f = 120 Hz C_{ADJ} = 10 μF	 66	60 77		 66	60 77		dB dB
Long-Term Stability	T_A = 125°C, 1000 Hours		0.3	1		0.3	1	%
Thermal Resistance, Junction to Case	H Package K Package		12 2.3	15 3		12 2.3	15 3	°C/W °C/W
Thermal Resistance, Junction to Ambient	H Package K Package		140 35			140 35		°C/W °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°C ≤ T_j ≤ +150°C for the LM137HV, 0°C ≤ T_j ≤ +125°C for the LM337HV; $V_{IN}-V_{OUT}$ = 5V; and I_{OUT} = 0.1A for the TO-39 package and I_{OUT} = 0.5A for the TO-3 package. 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. I_{MAX} is 1.5A for the TO-3 package and 0.2A for the TO-39 package.

Note 3: Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output voltage due to heating effects are covered under the specification for thermal regulations. Load regulation is measured on the output pin at a point ″ below the base of the TO-3 and TO-39 packages.

Note 4: Refer to RETS137HVH drawing for LM137HVH or RETS137HVK for LM137HVK military specifications.

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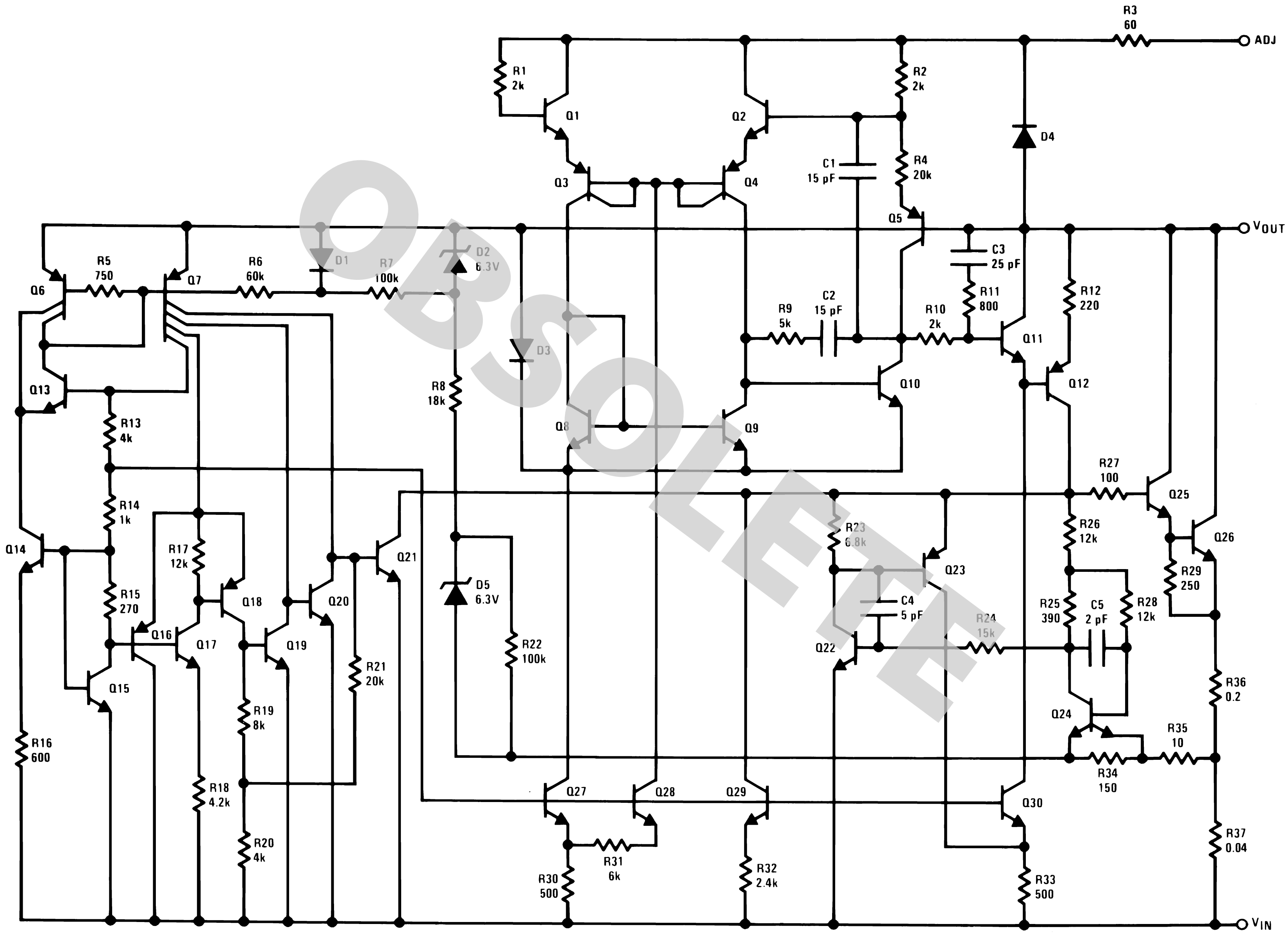
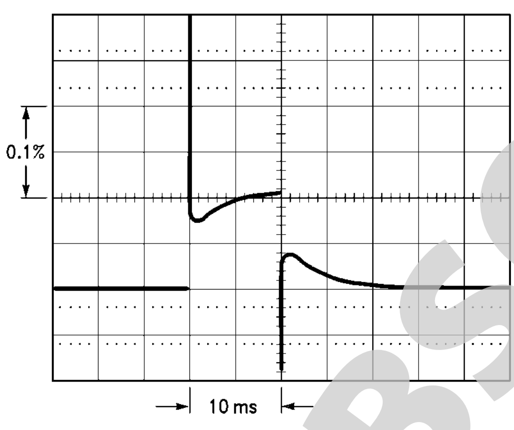
Schematic Diagram



Thermal Regulation

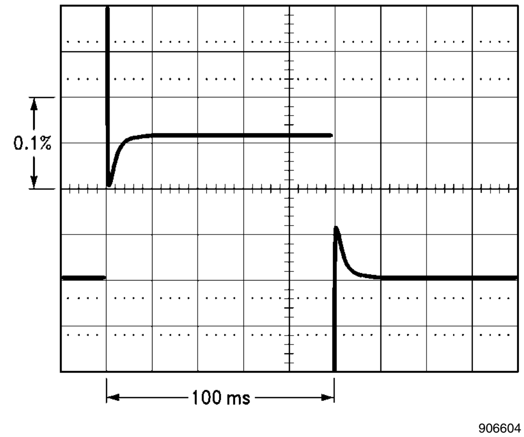
When power is dissipated in an IC, a temperature gradient occurs across the IC chip affecting the individual IC circuit components. With an IC regulator, this gradient can be especially severe since power dissipation is large. Thermal regulation is the effect of these temperature gradients on output voltage (in percentage output change) per Watt of power change in a specified time. Thermal regulation error is independent of electrical regulation or temperature coefficient, and occurs within 5 ms to 50 ms after a change in power dissipation. Thermal regulation depends on IC layout as well as electrical design. The thermal regulation of a voltage regulator is defined as the percentage change of V_{OUT}, per Watt, within the first 10 ms after a step of power is applied. The LM137HV's specification is 0.02%/W, max.

In *Figure 1*, a typical LM137HV's output drifts only 3 mV (or 0.03% of V_{OUT} = −10V) when a 10W pulse is applied for 10 ms. This performance is thus well inside the specification limit of 0.02%/W x 10W = 0.2% max. When the 10W pulse is ended, the thermal regulation again shows a 3 mV step as the LM137HV chip cools off. Note that the load regulation error of about 8 mV (0.08%) is additional to the thermal regulation error. In *Figure 2*, when the 10W pulse is applied for 100 ms, the output drifts only slightly beyond the drift in the first 10 ms, and the thermal error stays well within 0.1% (10 mV).



LM137HV, V_{OUT} = −10V
V_{IN}–V_{OUT} = −40V
I_L = 0A→0.25A→0A
Vertical sensitivity, 5 mV/div

FIGURE 1.



LM137HV, V_{OUT} = −10V
V_{IN}–V_{OUT} = −40V
I_L = 0A→0.25A→0A
Horizontal sensitivity, 20 ms/div

FIGURE 2.

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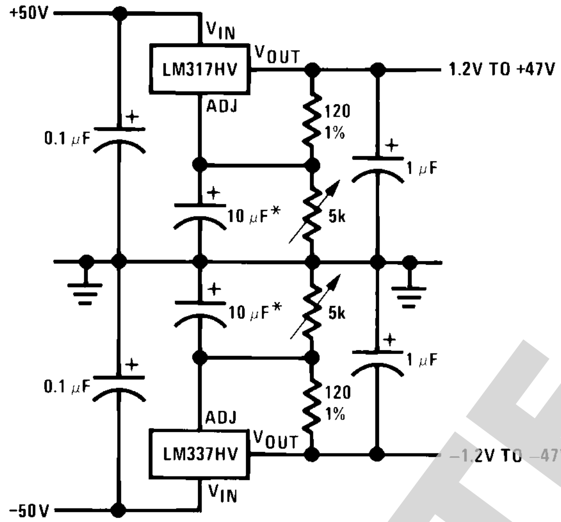
Typical Applications

Adjustable High Voltage Regulator



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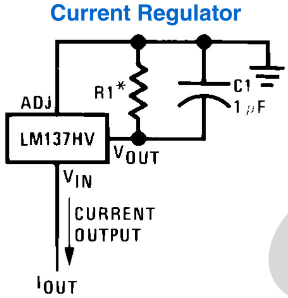
Full output current not available at high input-output voltages

*The 10 µF capacitors are optional to improve ripple rejection

Current Regulator



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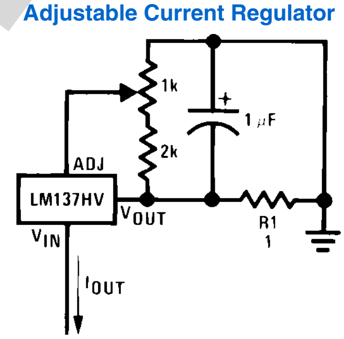
$$I_{OUT} = \frac{V_{REF}}{R1}$$

* 0.8Ω ≤ R1 ≤ 120Ω

Adjustable Current Regulator



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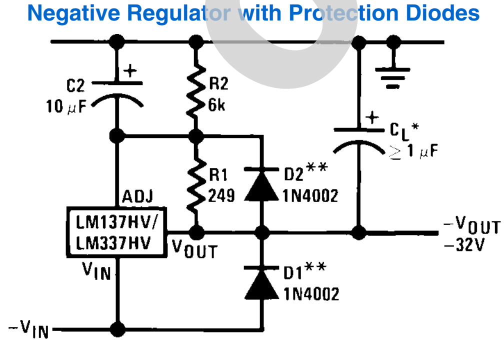
$$I_{OUT} = \left(\frac{1.5V}{R1}\right) \pm 15\% \text{ adjustable}$$

Negative Regulator with Protection Diodes



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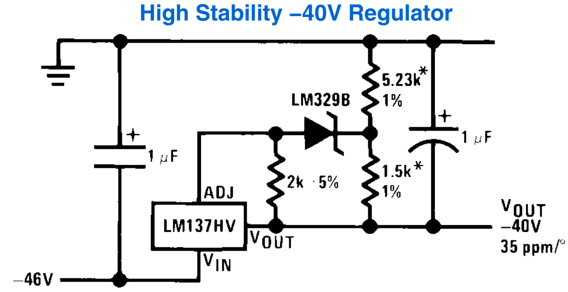
*When C_L is larger than 20 µF, D1 protects the LM137HV in case the input supply is shorted

**When C2 is larger than 10 µF and $-V_{OUT}$ is larger than −25V, D2 protects the LM137HV is case the output is shorted

High Stability −40V Regulator



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*Use resistors with good tracking TC < 25 ppm/°C

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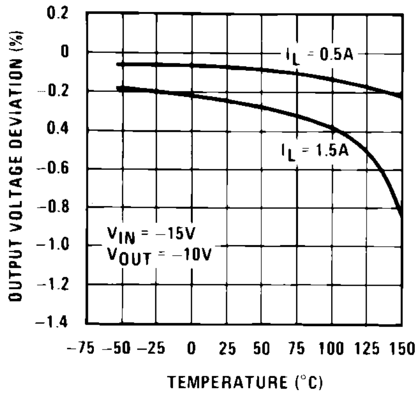
Typical Performance Characteristics (H and K-STEEL Package)

Load Regulation



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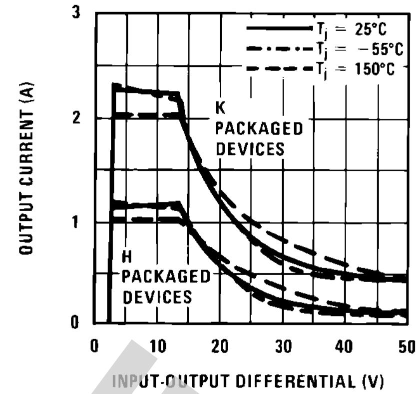
Current Limit



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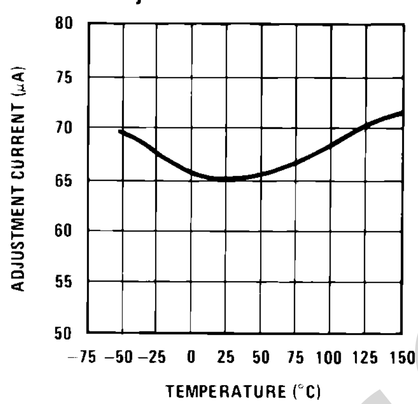
Adjustment Current



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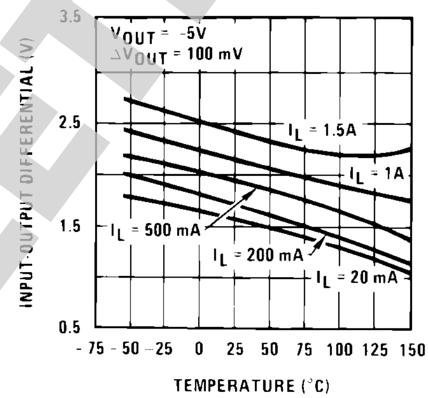
Dropout Voltage



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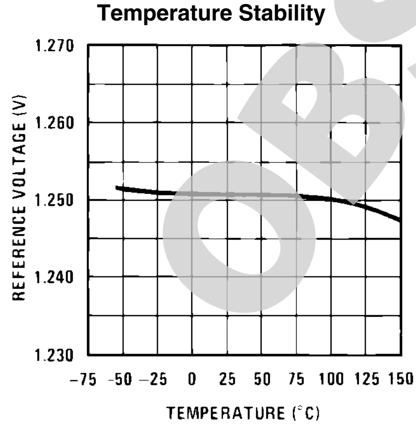
Temperature Stability



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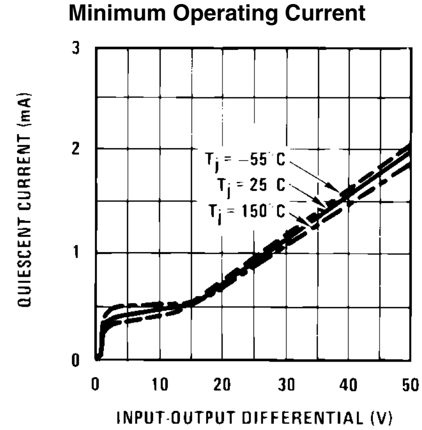
Minimum Operating Current



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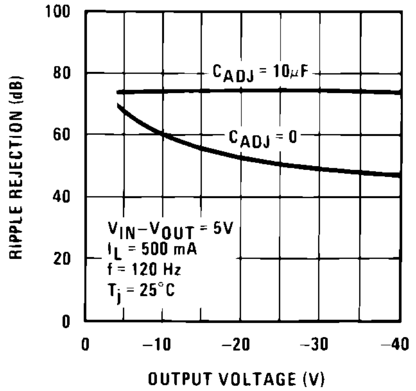
Ripple Rejection



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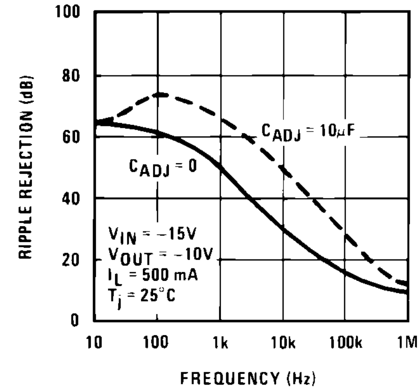
Ripple Rejection



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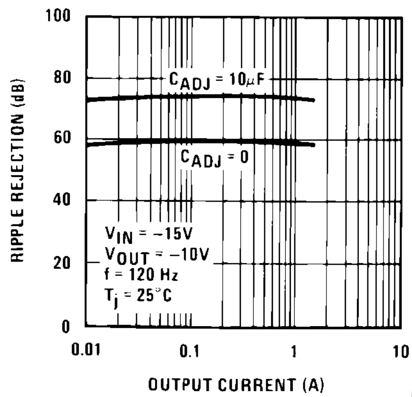
Ripple Rejection



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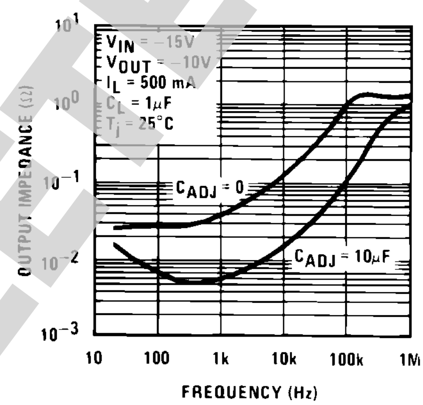
Output Impedance



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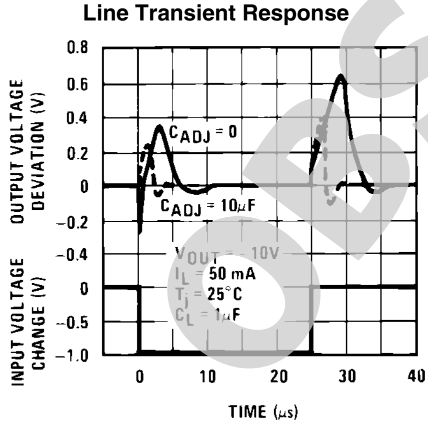
Line Transient Response



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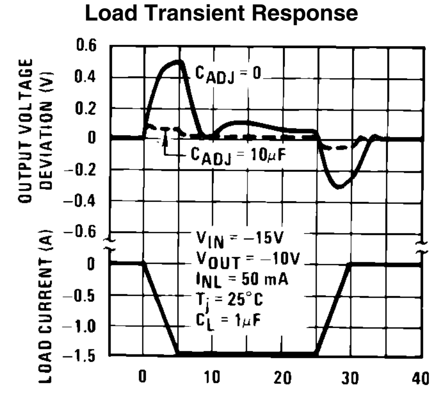
Load Transient Response



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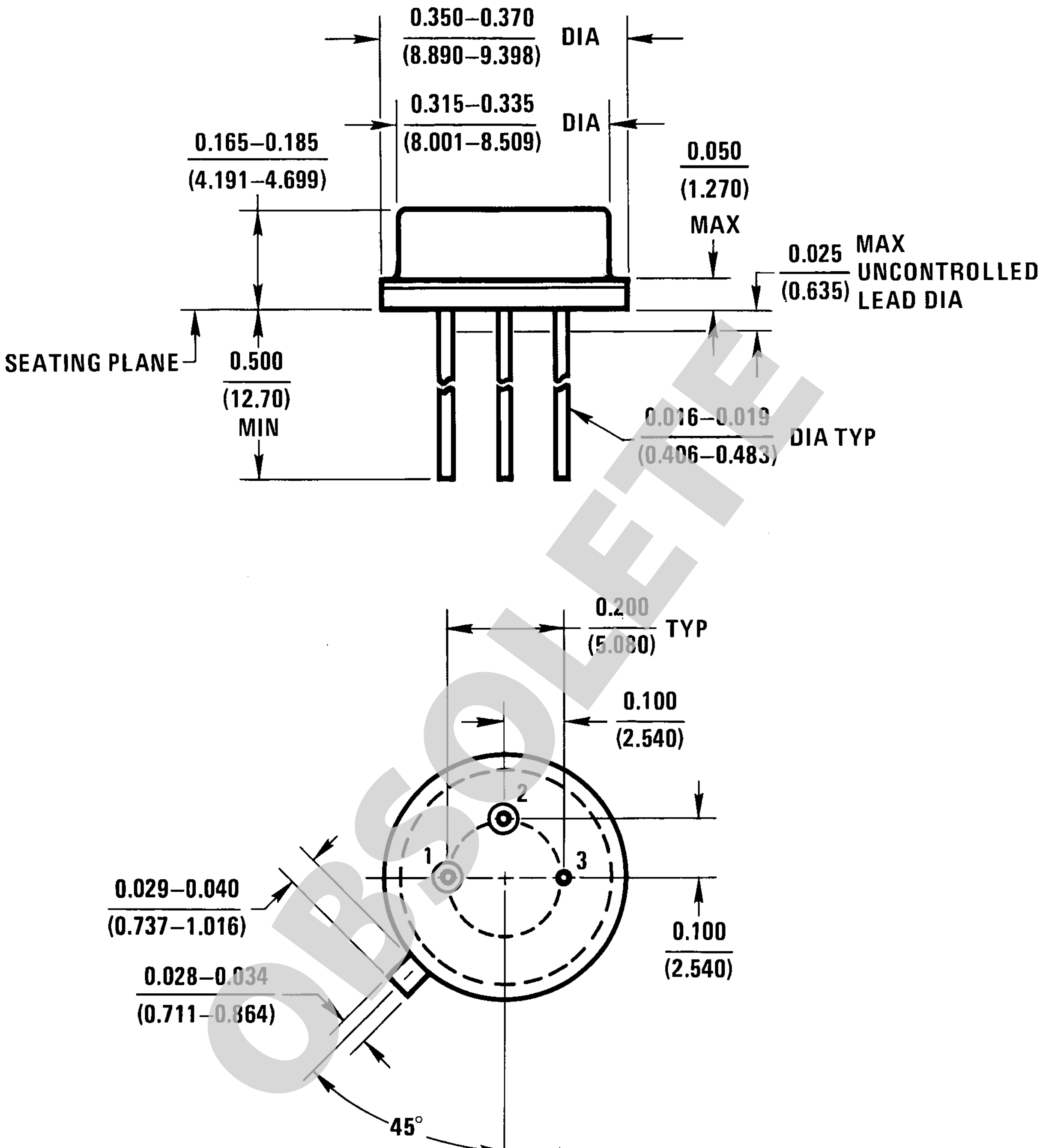
Physical Dimensions inches (millimeters) unless otherwise noted



H03A (REV B)

Metal Can Package (H)
Order Number LM137HVH/883, LM137HVH-QMLV, or LM337HVH
NS Package Number H03A

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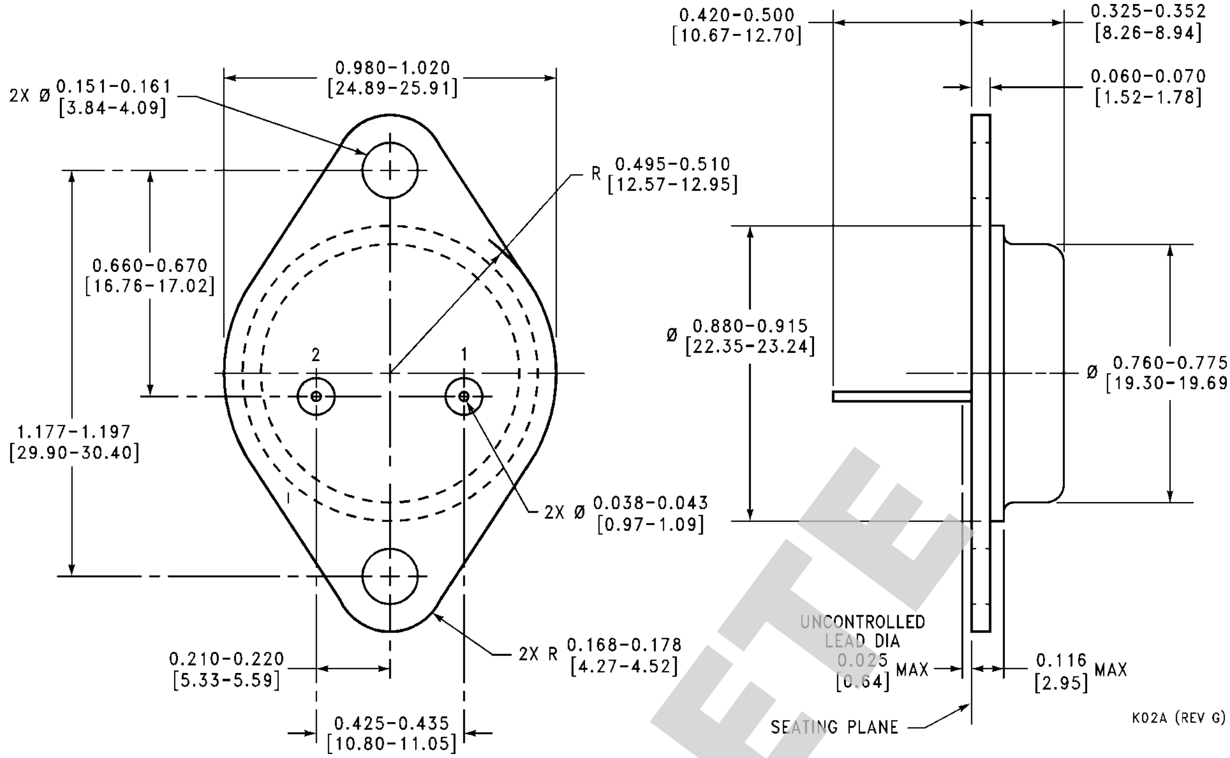
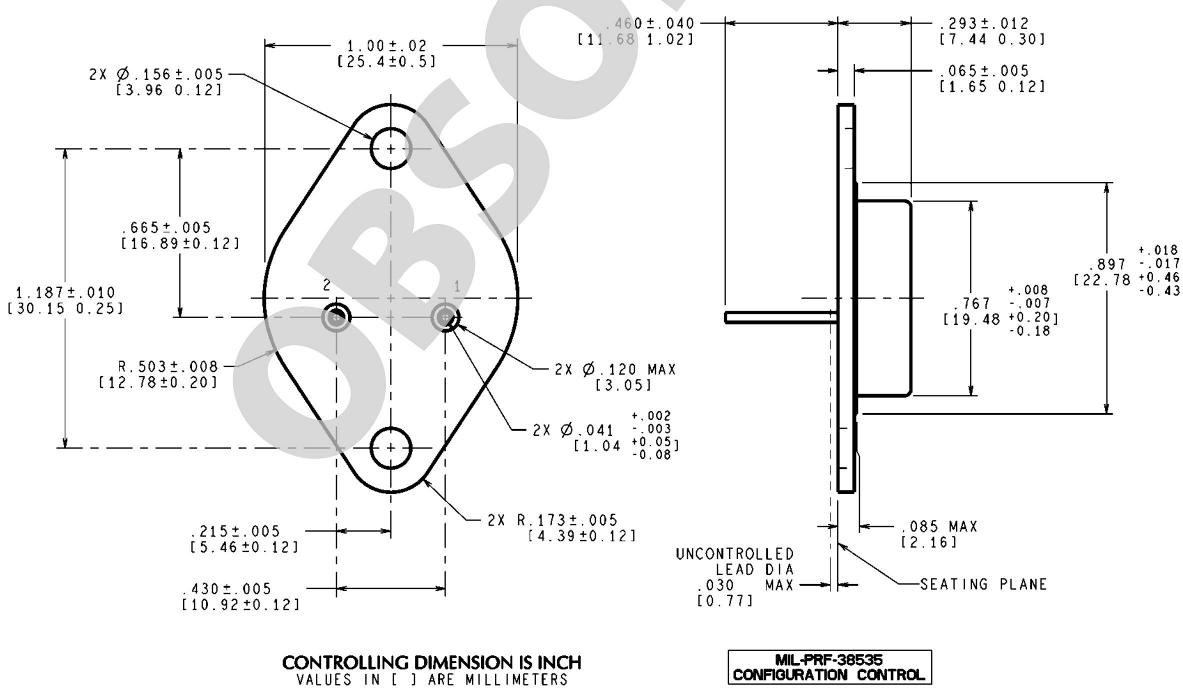


Metal Can Package (K)
Order Number LM337HVK STEEL
NS Package Number K02A



Metal Can Package (K)
Mil-Aero Products
Order Number LM137HVK/883, LM137HVK-QMLV, or SMD #7703404
NS Package Number K02C

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Notes

Notes

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