

LM137HV,LM337HV

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



Literature Number: SNVS777C

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.

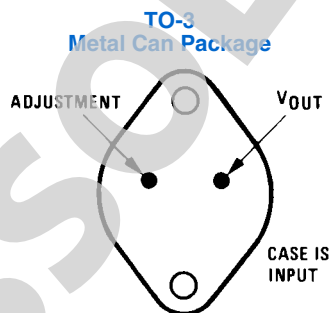
The LM137HV/LM337HV serve a wide variety of applications including local on-card regulation, programmable-output voltage regulation or precision current regulation. The LM137HV/LM337HV are ideal complements to the LM117HV/LM317HV adjustable positive regulators.

Features

- Output voltage adjustable from $-1.2V$ to $-47V$
- 1.5A output current guaranteed, $-55^{\circ}C$ to $+150^{\circ}C$
- 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/ $^{\circ}C$ 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)



906605

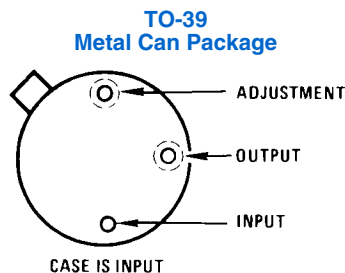
Bottom View

Order Number LM137HVH/883, LM137HVH-QMLV, or SMD #7703404

See NS Package Number K02C

Order Number LM337HVH STEEL

See NS Package Number K02A



906606

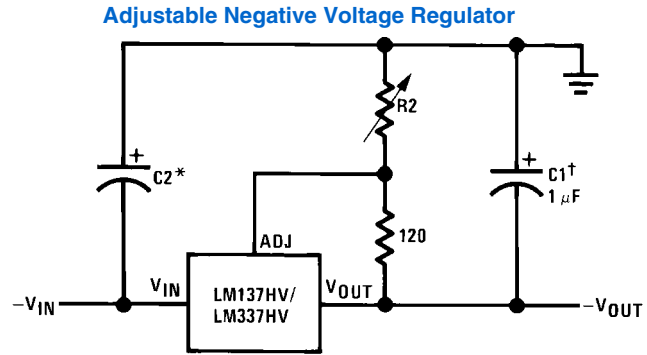
Bottom View

Order Number LM137HVH/883, LM137HVH-QMLV, SMD #7703404

or LML337HVH

See NS Package Number H03A

Typical Applications



906601

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

906625

†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 ft from power-supply filter capacitor.

OBSOLETE

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 300°

(Soldering, 10 sec.)

ESD rating is to be determined.

Electrical Characteristics (Note 2)

Parameter	Conditions	LM137HV			LM337HV			Units
		Min	Typ	Max	Min	Typ	Max	
Line Regulation	$T_J = 25^\circ\text{C}$, $3\text{V} \leq V_{IN} - V_{OUT} \leq 50\text{V}$, (Note 3) $I_L = 10\text{ mA}$		0.01	0.02		0.01	0.04	%/V
Load Regulation	$T_J = 25^\circ\text{C}$, $10\text{ mA} \leq I_{OUT} \leq I_{MAX}$		0.3	0.5		0.3	1.0	%
Thermal Regulation	$T_J = 25^\circ\text{C}$, 10 ms Pulse		0.002	0.02		0.003	0.04	%/W
Adjustment Pin Current			65	100		65	100	μA
Adjustment Pin Current Change	$10\text{ mA} \leq I_L \leq I_{MAX}$		2	5		2	5	μA
	$3.0\text{V} \leq V_{IN} - V_{OUT} \leq 50\text{V}$, $T_J = 25^\circ$		4	6		3	6	μA
Reference Voltage	$T_J = 25^\circ\text{C}$, (Note 4)	-1.225	-1.250	-1.275	-1.213	-1.250	-1.287	V
	$3\text{V} \leq V_{IN} - V_{OUT} \leq 50\text{V}$, (Note 4) $10\text{ mA} \leq I_{OUT} \leq I_{MAX}$, $P \leq P_{MAX}$	-1.200	-1.250	-1.300	-1.200	-1.250	-1.300	V
Line Regulation	$3\text{V} \leq V_{IN} - V_{OUT} \leq 50\text{V}$, (Note 3) $I_L = 10\text{ mA}$		0.02	0.05		0.02	0.07	%/V
Load Regulation	$10\text{ mA} \leq I_{OUT} \leq I_{MAX}$, (Note 3)		0.3	1		0.3	1.5	%
Temperature Stability	$T_{MIN} \leq T_J \leq T_{MAX}$		0.6			0.6		%
Minimum Load Current	$ V_{IN} - V_{OUT} \leq 50\text{V}$		2.5	5		2.5	10	mA
	$ V_{IN} - V_{OUT} \leq 10\text{V}$		1.2	3		1.5	6	mA
Current Limit	$ V_{IN} - V_{OUT} \leq 13\text{V}$							
	K Package	1.5	2.2	3.2	1.5	2.2	3.5	A
	H Package	0.5	0.8	1.6	0.5	0.8	1.8	A
	$ V_{IN} - V_{OUT} = 50\text{V}$							
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		%
	$V_{OUT} = -10\text{V}$, $f = 120\text{ Hz}$ $C_{ADJ} = 10\text{ }\mu\text{F}$	66	77		66	77		dB
Long-Term Stability	$T_A = 125^\circ\text{C}$, 1000 Hours		0.3	1		0.3	1	%
Thermal Resistance, Junction to Case	H Package		12	15		12	15	$^\circ\text{C/W}$
	K Package		2.3	3		2.3	3	$^\circ\text{C/W}$
Thermal Resistance, Junction to Ambient	H Package		140			140		$^\circ\text{C/W}$
	K Package		35			35		$^\circ\text{C/W}$

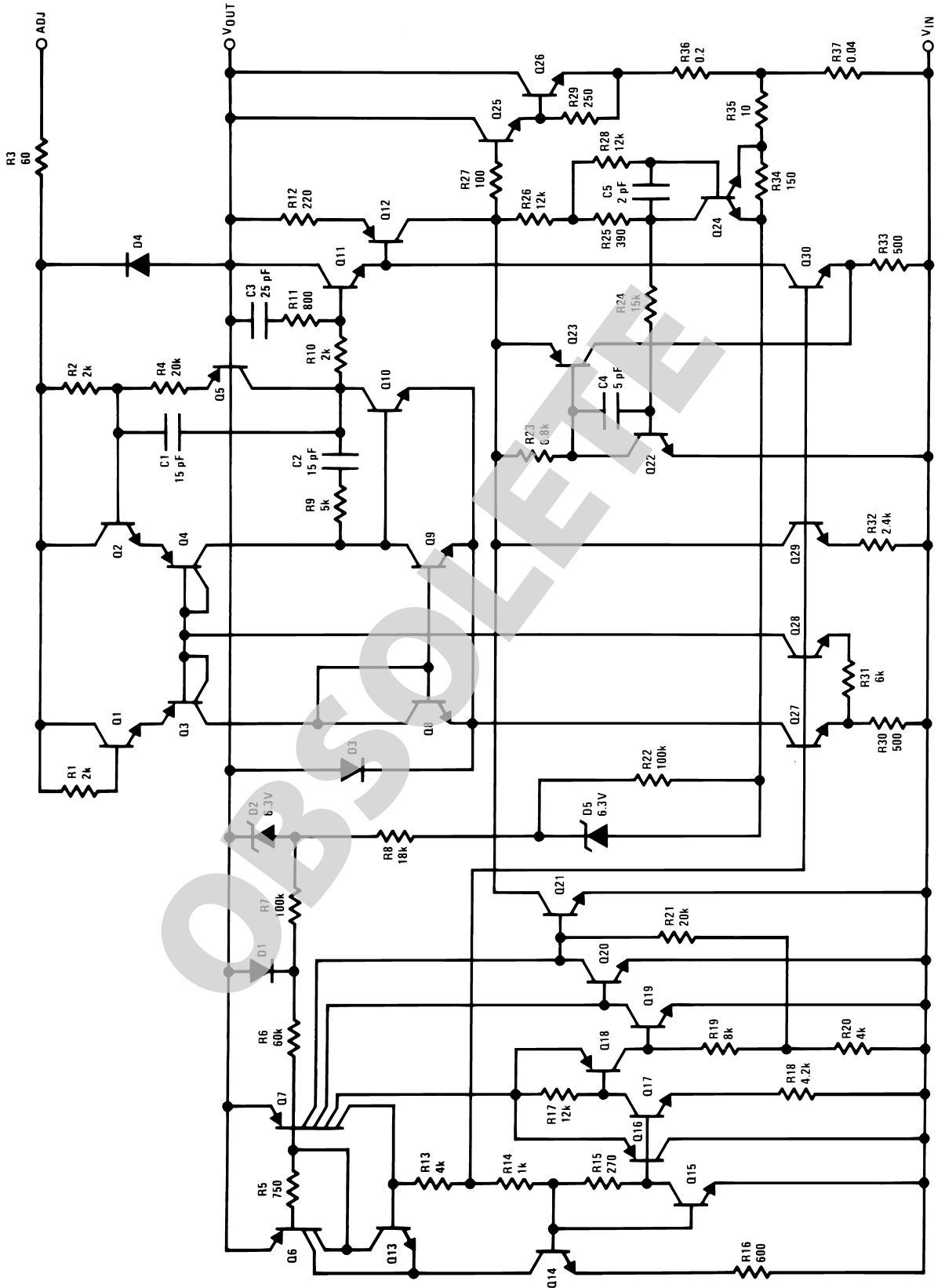
Note 1: "Absolute Maximum Ratings" indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits.

Note 2: Unless otherwise specified, these specifications apply: $-55^\circ\text{C} \leq T_J \leq +150^\circ\text{C}$ for the LM137HV, $0^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$ for the LM337HV; $V_{IN} - V_{OUT} = 5\text{V}$; and $I_{OUT} = 0.1\text{A}$ for the TO-39 package and $I_{OUT} = 0.5\text{A}$ 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.

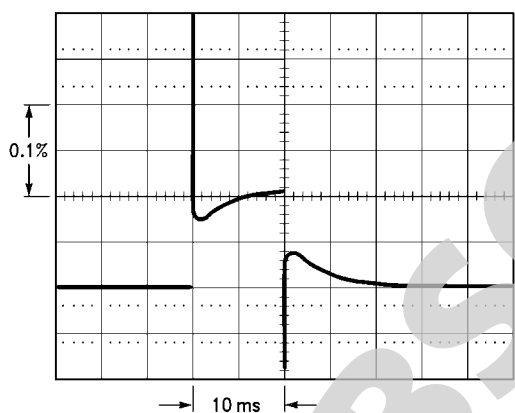
Schematic Diagram



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.

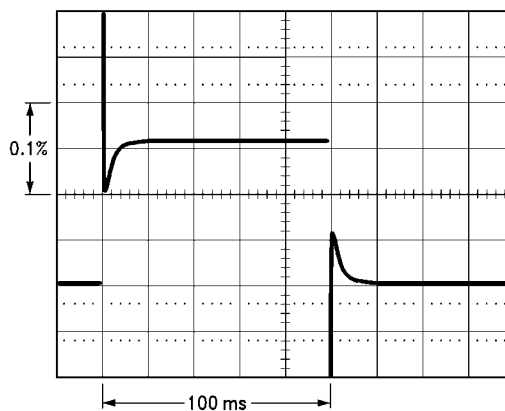
In *Figure 1*, a typical LM137HV's output drifts only 3 mV (or 0.03% of $V_{OUT} = -10V$) when a 10W pulse is applied for 10 ms. This performance is thus well inside the specification limit of $0.02\%/W \times 10W = 0.2\%$ max. When the 10W pulse is ended, the thermal regulation again shows a 3 mV step 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).



906603

LM137HV, $V_{OUT} = -10V$
 $V_{IN} - V_{OUT} = -40V$
 $I_L = 0A \rightarrow 0.25A \rightarrow 0A$
 Vertical sensitivity, 5 mV/div

FIGURE 1.



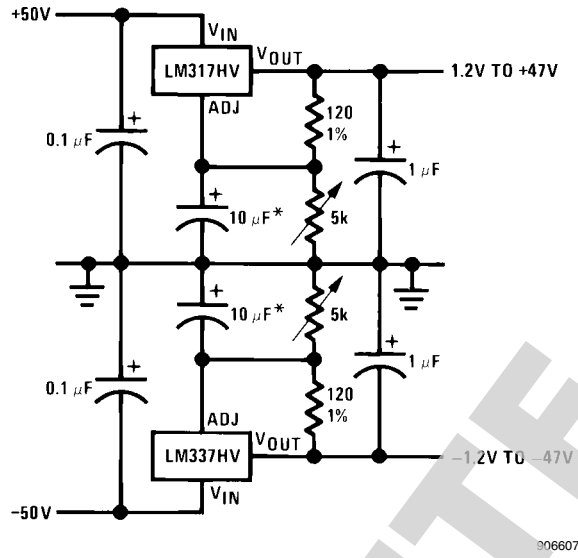
906604

LM137HV, $V_{OUT} = -10V$
 $V_{IN} - V_{OUT} = -40V$
 $I_L = 0A \rightarrow 0.25A \rightarrow 0A$
 Horizontal sensitivity, 20 ms/div

FIGURE 2.

Typical Applications

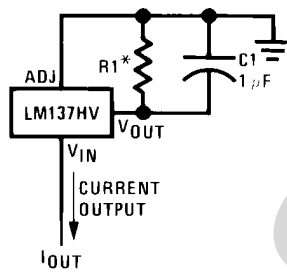
Adjustable High Voltage Regulator



906607

Full output current not available at high input-output voltages
 *The 10 µF capacitors are optional to improve ripple rejection

Current Regulator

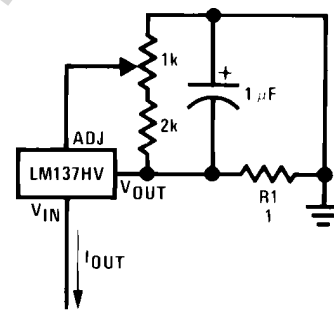


906608

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

* 0.8Ω ≤ R1 ≤ 120Ω

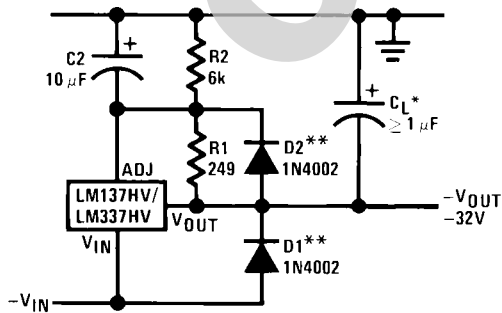
Adjustable Current Regulator



906609

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

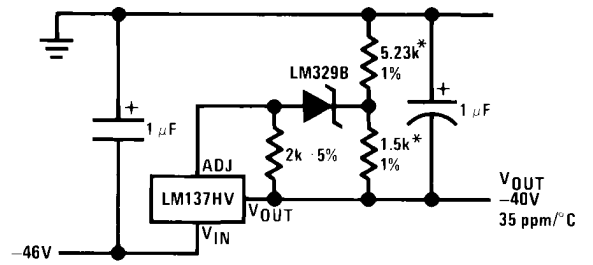
Negative Regulator with Protection Diodes



906610

*When C₂ 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 in case the output is shorted

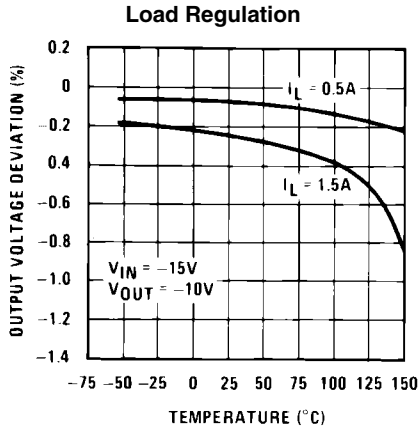
High Stability -40V Regulator



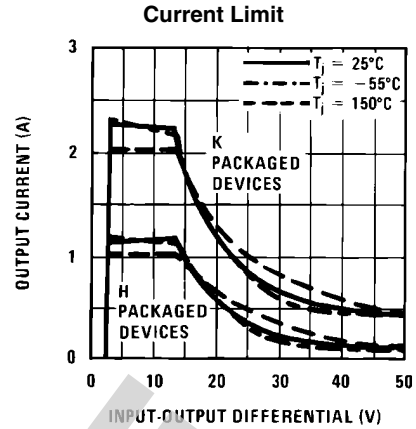
906611

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

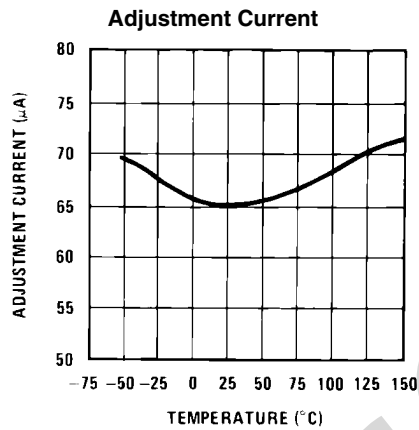
Typical Performance Characteristics (H and K-STEEL Package)



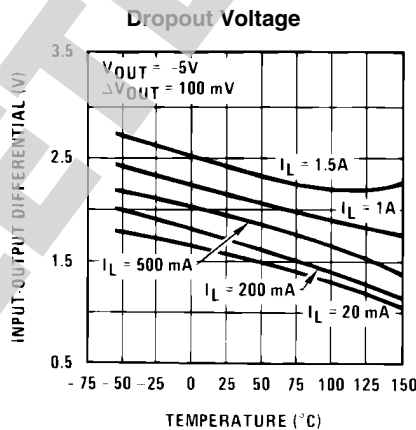
906613



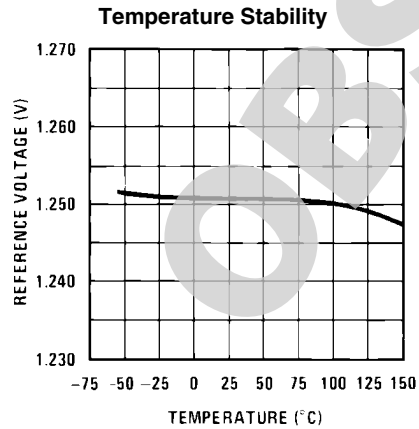
906614



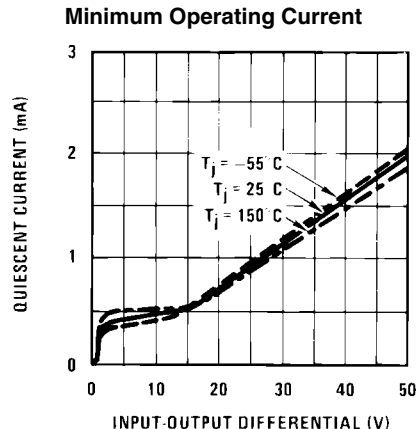
906615



906616

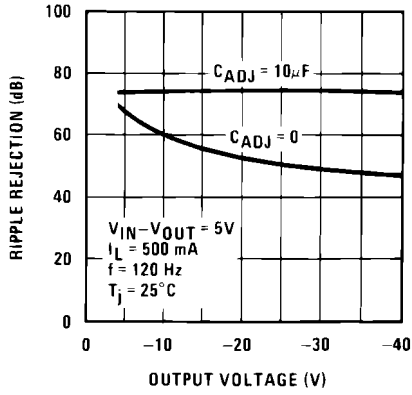


906617



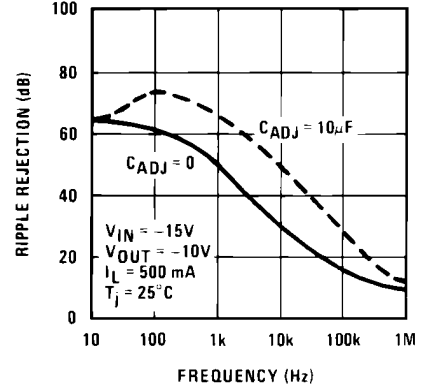
906618

Ripple Rejection



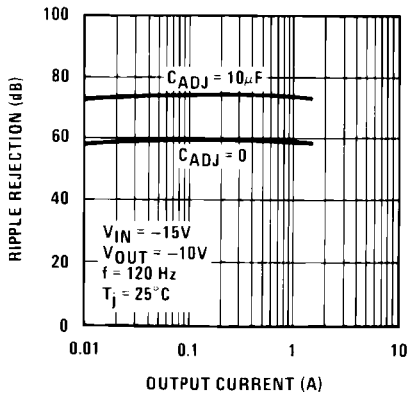
906619

Ripple Rejection



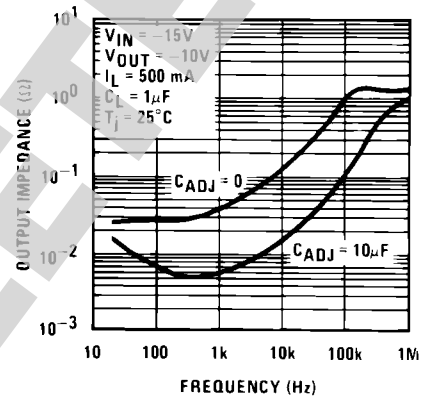
906620

Ripple Rejection



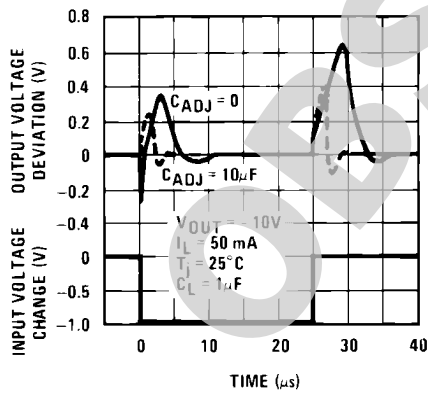
906621

Output Impedance



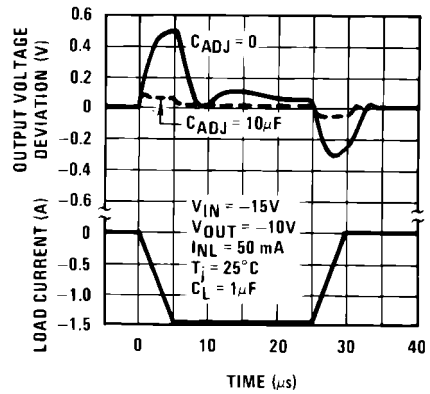
906622

Line Transient Response



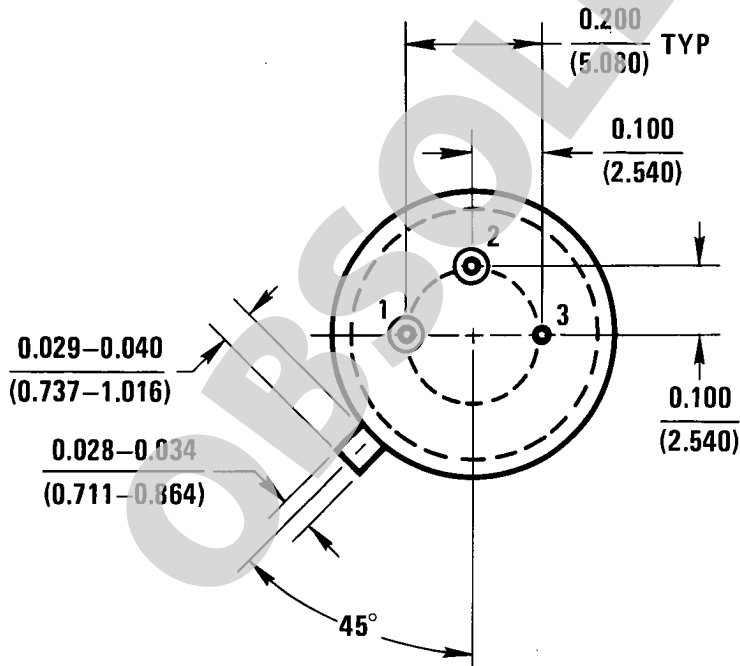
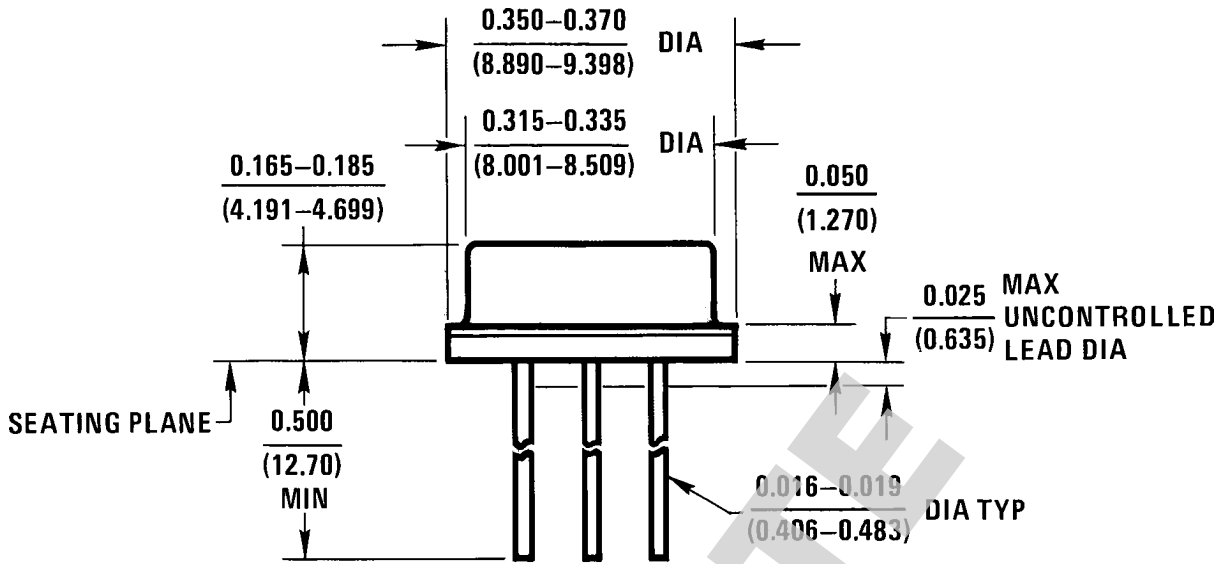
906623

Load Transient Response



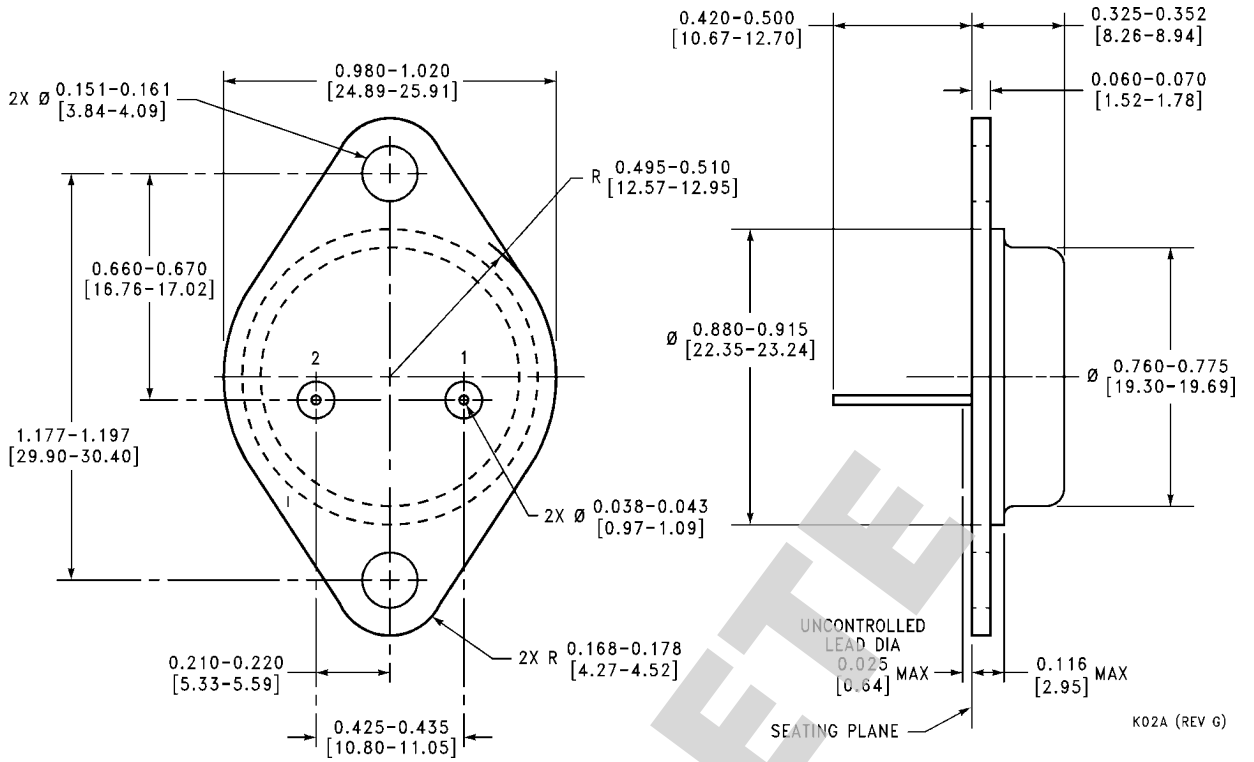
906624

Physical Dimensions inches (millimeters) unless otherwise noted



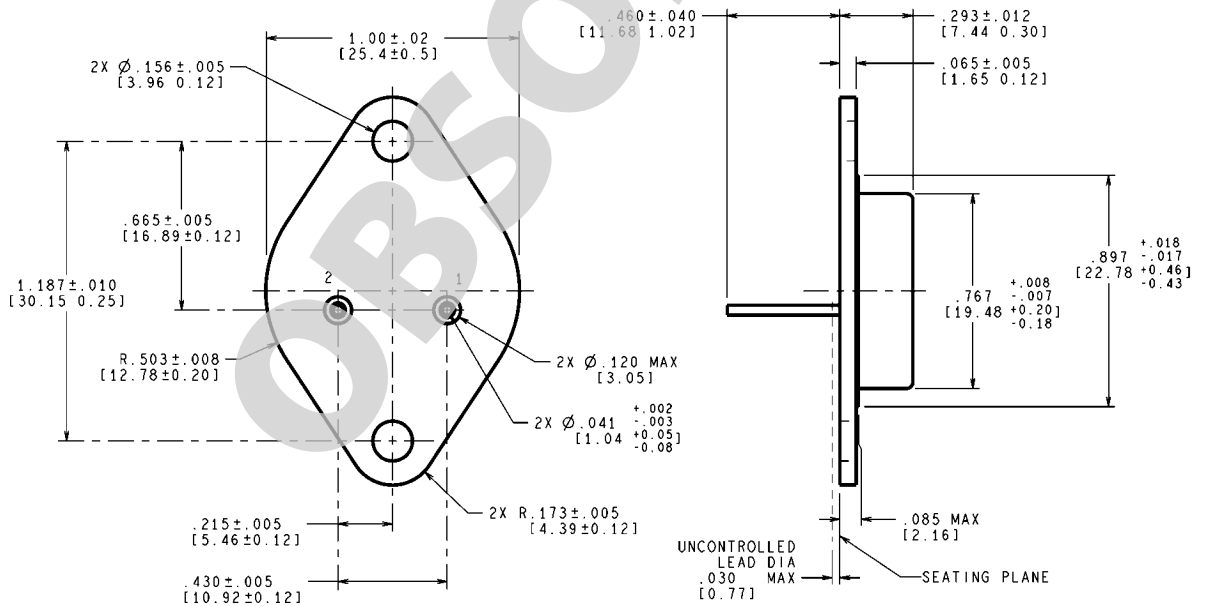
H03A (REV B)

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



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

K02A (REV G)



CONTROLLING DIMENSION IS INCH
 VALUES IN [] ARE MILLIMETERS

MIL-PRF-38535
 CONFIGURATION CONTROL

K02C (Rev E)

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

Notes

LM137HV/LM337HV

OBSOLETE

Notes

For more National Semiconductor product information and proven design tools, visit the following Web sites at:
www.national.com

Products		Design Support	
Amplifiers	www.national.com/amplifiers	WEBENCH® Tools	www.national.com/webench
Audio	www.national.com/audio	App Notes	www.national.com/appnotes
Clock and Timing	www.national.com/timing	Reference Designs	www.national.com/refdesigns
Data Converters	www.national.com/adc	Samples	www.national.com/samples
Interface	www.national.com/interface	Eval Boards	www.national.com/evalboards
LVDS	www.national.com/lvds	Packaging	www.national.com/packaging
Power Management	www.national.com/power	Green Compliance	www.national.com/quality/green
Switching Regulators	www.national.com/switchers	Distributors	www.national.com/contacts
LDOs	www.national.com/ldo	Quality and Reliability	www.national.com/quality
LED Lighting	www.national.com/led	Feedback/Support	www.national.com/feedback
Voltage References	www.national.com/vref	Design Made Easy	www.national.com/easy
PowerWise® Solutions	www.national.com/powerwise	Applications & Markets	www.national.com/solutions
Serial Digital Interface (SDI)	www.national.com/sdi	Mil/Aero	www.national.com/milaero
Temperature Sensors	www.national.com/tempensors	SolarMagic™	www.national.com/solarmagic
PLL/VCO	www.national.com/wireless	PowerWise® Design University	www.national.com/training

THE CONTENTS OF THIS DOCUMENT ARE PROVIDED IN CONNECTION WITH NATIONAL SEMICONDUCTOR CORPORATION ("NATIONAL") PRODUCTS. NATIONAL MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO THE ACCURACY OR COMPLETENESS OF THE CONTENTS OF THIS PUBLICATION AND RESERVES THE RIGHT TO MAKE CHANGES TO SPECIFICATIONS AND PRODUCT DESCRIPTIONS AT ANY TIME WITHOUT NOTICE. NO LICENSE, WHETHER EXPRESS, IMPLIED, ARISING BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT.

TESTING AND OTHER QUALITY CONTROLS ARE USED TO THE EXTENT NATIONAL DEEMS NECESSARY TO SUPPORT NATIONAL'S PRODUCT WARRANTY. EXCEPT WHERE MANDATED BY GOVERNMENT REQUIREMENTS, TESTING OF ALL PARAMETERS OF EACH PRODUCT IS NOT NECESSARILY PERFORMED. NATIONAL ASSUMES NO LIABILITY FOR APPLICATIONS ASSISTANCE OR BUYER PRODUCT DESIGN. BUYERS ARE RESPONSIBLE FOR THEIR PRODUCTS AND APPLICATIONS USING NATIONAL COMPONENTS. PRIOR TO USING OR DISTRIBUTING ANY PRODUCTS THAT INCLUDE NATIONAL COMPONENTS, BUYERS SHOULD PROVIDE ADEQUATE DESIGN, TESTING AND OPERATING SAFEGUARDS.

EXCEPT AS PROVIDED IN NATIONAL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, NATIONAL ASSUMES NO LIABILITY WHATSOEVER, AND NATIONAL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY RELATING TO THE SALE AND/OR USE OF NATIONAL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

LIFE SUPPORT POLICY

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

Life support devices or systems are devices 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. A critical component is any component in 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.

National Semiconductor and the National Semiconductor logo are registered trademarks of National Semiconductor Corporation. All other brand or product names may be trademarks or registered trademarks of their respective holders.

Copyright© 2011 National Semiconductor Corporation

For the most current product information visit us at www.national.com



www.national.com

**National Semiconductor
Americas Technical
Support Center**
Email: support@nsc.com
Tel: 1-800-272-9959

**National Semiconductor Europe
Technical Support Center**
Email: europe.support@nsc.com

**National Semiconductor Asia
Pacific Technical Support Center**
Email: ap.support@nsc.com

**National Semiconductor Japan
Technical Support Center**
Email: jpn.feedback@nsc.com

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

Applications

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

TI E2E Community Home Page

e2e.ti.com

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