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National Semiconductor

LM337L
3-Terminal Adjustable Regulator

General Description

The LM337L is an adjustable 3-terminal negative voltage regulator capable of supplying 100 mA over a 1.2V to 37V output range. It is exceptionally easy to use and requires only two external resistors to set the output voltage. Furthermore, both line and load regulation are better than standard fixed regulators. Also, the LM337L is packaged in a standard TO-92 transistor package which is easy to use.

In addition to higher performance than fixed regulators, the LM337L offers full overload protection. 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, only a single 1 µF solid tantalum output capacitor is needed unless the device is situated more than 6 inches from the input filter capacitors, in which case an input bypass is needed. A larger output capacitor can be added to improve transient response. The adjustment terminal can be bypassed to achieve very high ripple rejection ratios which are difficult to achieve with standard 3-terminal regulators.

Besides replacing fixed regulators, the LM337L 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.

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 LM337L 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.

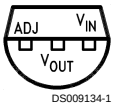
The LM337L is available in a standard TO-92 transistor package and a SO-8 surface mount package. The LM337L is rated for operation over a −25˚C to +125˚C range.

For applications requiring greater output current in excess of 0.5A and 1.5A, see LM137 series data sheets. For the positive complement, see series LM117 and LM317L data sheets.

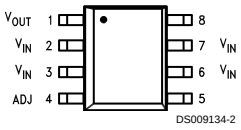
Features

- Adjustable output down to 1.2V
- Guaranteed 100 mA output current
- Line regulation typically 0.01%/V
- Load regulation typically 0.1%
- Current limit constant with temperature
- Eliminates the need to stock many voltages
- Standard 3-lead transistor package
- 80 dB ripple rejection
- Output is short circuit protected

Connection Diagram



Bottom View



Top View

Order Number LM337LM or LM337LZ
See NS Package Number M08A or Z03A

Absolute Maximum Ratings (Note 1)

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

Power Dissipation	Internally Limited
Input–Output Voltage Differential	40V
Operating Junction Temperature Range	−25˚C to +125˚C
Storage Temperature	−55˚C to +150˚C
Lead Temperature (Soldering, 10 sec.)	300˚C
Plastic Package (Soldering 4 sec.)	260˚C

ESD rating to be determined.

Electrical Characteristics (Note 2)

Parameter	Conditions	Min	Typ	Max	Units
Line Regulation	T_A = 25˚C, 3V ≤ $\|V_{IN} - V_{OUT}\|$ ≤ 40V, (Note 3)		0.01	0.04	%/V
Load Regulation	T_A = 25˚C, 5 mA ≤ I_{OUT} ≤ I_{MAX}, (Note 3)		0.1	0.5	%
Thermal Regulation	T_A = 25˚C, 10 ms Pulse		0.04	0.2	%/W
Adjustment Pin Current			50	100	µA
Adjustment Pin Current Change	5 mA ≤ I_L ≤ 100 mA 3V ≤ $\|V_{IN} - V_{OUT}\|$ ≤ 40V		0.2	5	µA
Reference Voltage	3V ≤ $\|V_{IN} - V_{OUT}\|$ ≤ 40V, (Note 4) 10 mA ≤ I_{OUT} ≤ 100 mA, P ≤ 625 mW	1.20	1.25	1.30	V
Line Regulation	3V ≤ $\|V_{IN} - V_{OUT}\|$ ≤ 40V, (Note 3)		0.02	0.07	%/V
Load Regulation	5 mA ≤ I_{OUT} ≤ 100 mA, (Note 3)		0.3	1.5	%
Temperature Stability	T_{MIN} ≤ T_j ≤ T_{MAX}		0.65		%
Minimum Load Current	$\|V_{IN} - V_{OUT}\|$ ≤ 40V 3V ≤ $\|V_{IN} - V_{OUT}\|$ ≤ 15V		3.5 2.2	5 3.5	mA mA
Current Limit	3V ≤ $\|V_{IN} - V_{OUT}\|$ ≤ 13V $\|V_{IN} - V_{OUT}\|$ = 40V	100 25	200 50	320 120	mA mA
Rms Output Noise, % of V_{OUT}	T_A = 25˚C, 10 Hz ≤ f ≤ 10 kHz		0.003		%
Ripple Rejection Ratio	V_{OUT} = −10V, F = 120 Hz, C_{ADJ} = 0 C_{ADJ} = 10 µF	 66	65 80		dB dB
Long-Term Stability	T_A = 125˚C		0.3	1	%

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.

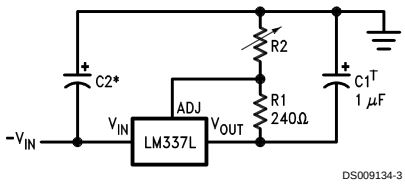
Note 2: Unless otherwise specified, these specifications apply −25˚C ≤ T_j ≤ + 125˚C for the LM337L; $|V_{IN} - V_{OUT}|$ = 5V and I_{OUT} = 40 mA. Although power dissipation is internally limited, these specifications are applicable for power dissipations up to 625 mW. I_{MAX} is 100 mA.

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 regulation.

Note 4: Thermal resistance of the TO-92 package is 180˚C/W junction to ambient with 0.4" leads from a PC board and 160˚C/W junction to ambient with 0.125" lead length to PC board. The M package θ_{JA} is 180˚C/W in still air.

Typical Applications

1.2V-25V Adjustable Regulator



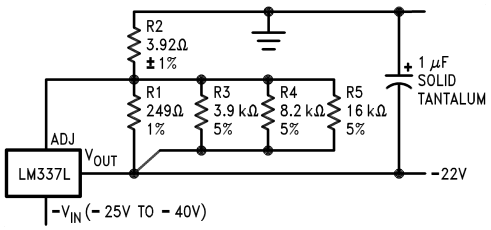
Full output current not available at high input-output voltages

$$-V_{OUT} = -1.25V\left(1 + \frac{R2}{240\Omega}\right)$$

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

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

Regulator with Trimmable Output Voltage



Trim Procedure:

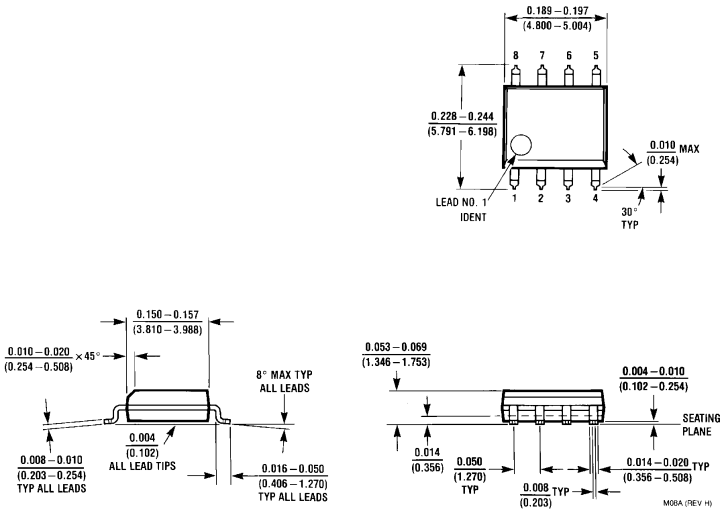
— If V_{OUT} is −23.08V or bigger, cut out R3 (if smaller, don't cut it out).

— Then if V_{OUT} is −22.47V or bigger, cut out R4 (if smaller, don't).

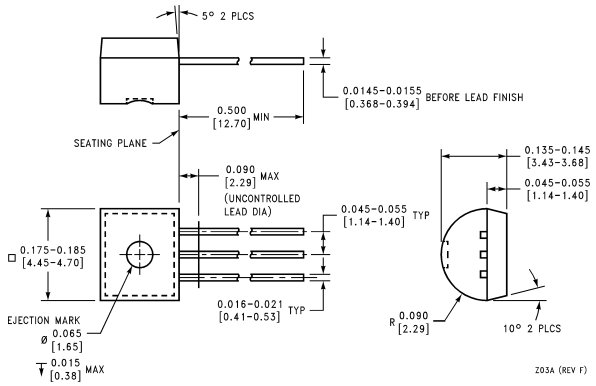
— Then if V_{OUT} is −22.16V or bigger, cut out R5 (if smaller, don't).

This will trim the output to well within 1% of −22.00 V_{DC}, without any of the expense or trouble of a trim pot (see LB-46). Of course, this technique can be used at any output voltage level.

Physical Dimensions inches (millimeters) unless otherwise noted



SO-8 Plastic Package (M)
Order Number LM337LM
NS Package Number M08A



TO-92 Plastic Package (Z)
Order Number LM337LZ
NS Package Number Z03A

Notes

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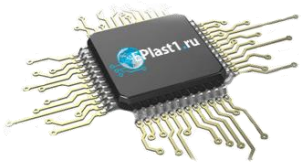

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