

LM137/LM337

3-Terminal Adjustable Negative Regulators

General Description

The LM137/LM337 are adjustable 3-terminal negative voltage regulators capable of supplying in excess of $-1.5A$ over an output voltage range of $-1.2V$ to $-37V$. 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 LM137 series features internal current limiting, thermal shutdown and safe-area compensation, making them virtually blowout-proof against overloads.

The LM137/LM337 serve a wide variety of applications including local on-card regulation, programmable-output voltage regulation or precision current regulation. The LM137/LM337 are ideal complements to the LM117/LM317 adjustable positive regulators.

Features

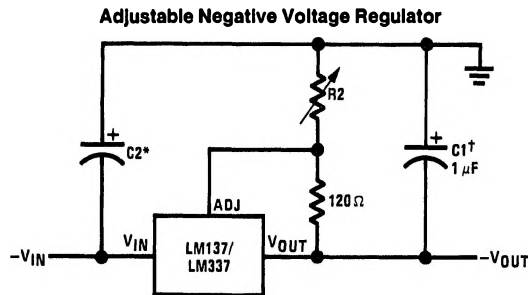
- Output voltage adjustable from $-1.2V$ to $-37V$
- $1.5A$ output current guaranteed, $-55^{\circ}C$ to $+150^{\circ}C$
- Line regulation typically $0.01\%/V$
- Load regulation typically 0.3%
- Excellent thermal regulation, $0.002\%/W$

- 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 is short circuit protected

LM137 Series Packages and Power Capability

Device	Package	Rated Power Dissipation	Design Load Current
LM137/337	TO-3 (K)	20W	1.5A
	TO-39 (H)	2W	0.5A
LM337	TO-220 (T)	15W	1.5A
LM337M	TO-202 (P)	7.5W	0.5A

Typical Applications



TL/H/9087-1

Full output current not available at high input-output voltages

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

†C1 = $1 \mu F$ solid tantalum or $10 \mu F$ aluminum electrolytic required for stability

*C2 = $1 \mu F$ solid tantalum is required only if regulator is more than 4° from power-supply filter capacitor

Output capacitors in the range of $1 \mu F$ to $1000 \mu F$ of aluminum or tantalum electrolytic are commonly used to provide improved output impedance and rejection of transients

Absolute Maximum Ratings

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 40V

Operating Junction Temperature Range

LM137 -55°C to +150°C
LM337 0°C to +125°C

Storage Temperature

-65°C to +150°C

Lead Temperature (Soldering, 10 sec.)

300°C

Plastic Package (Soldering, 4 sec.)

260°C

ESD Rating

2k Volts

Electrical Characteristics (Note 1)

Parameter	Conditions	LM137			LM337			Units
		Min	Typ	Max	Min	Typ	Max	
Line Regulation	$T_j = 25^\circ\text{C}$, $3\text{V} \leq V_{\text{IN}} - V_{\text{OUT}} \leq 40\text{V}$ (Note 2) $I_L = 10\text{ mA}$		0.01	0.02		0.01	0.04	%/V
Load Regulation	$T_j = 25^\circ\text{C}$, $10\text{ mA} \leq I_{\text{OUT}} \leq I_{\text{MAX}}$		0.3	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 Charge	$10\text{ mA} \leq I_L \leq I_{\text{MAX}}$ $3.0\text{V} \leq V_{\text{IN}} - V_{\text{OUT}} \leq 40\text{V}$, $T_A = 25^\circ\text{C}$		2	5		2	5	μA
Reference Voltage	$T_j = 25^\circ\text{C}$ (Note 3) $3\text{V} \leq V_{\text{IN}} - V_{\text{OUT}} \leq 40\text{V}$, (Note 3) $10\text{ mA} \leq I_{\text{OUT}} \leq I_{\text{MAX}}$, $P \leq P_{\text{MAX}}$	-1.225	-1.250	-1.275	-1.213	-1.250	-1.287	V
		-1.200	-1.250	-1.300	-1.200	-1.250	-1.300	V
Line Regulation	$3\text{V} \leq V_{\text{IN}} - V_{\text{OUT}} \leq 40\text{V}$, (Note 2)		0.02	0.05		0.02	0.07	%/V
Load Regulation	$10\text{ mA} \leq I_{\text{OUT}} \leq I_{\text{MAX}}$, (Note 2)		0.3	1		0.3	1.5	%
Temperature Stability	$T_{\text{MIN}} \leq T_j \leq T_{\text{MAX}}$		0.6			0.6		%
Minimum Load Current	$ V_{\text{IN}} - V_{\text{OUT}} \leq 40\text{V}$ $ V_{\text{IN}} - V_{\text{OUT}} \leq 10\text{V}$		2.5	5		2.5	10	mA
			1.2	3		1.5	6	mA
Current Limit	$ V_{\text{IN}} - V_{\text{OUT}} \leq 15\text{V}$ K and T Package H and P Package $ V_{\text{IN}} - V_{\text{OUT}} = 40\text{V}$, $T_j = 25^\circ\text{C}$ K and T Package H and P Package	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
		0.24	0.4		0.15	0.4		A
		0.15	0.17		0.10	0.17		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	$V_{\text{OUT}} = -10\text{V}$, $f = 120\text{ Hz}$ $C_{\text{ADJ}} = 10\text{ }\mu\text{F}$	66	60		66	60		dB
			77			77		dB
Long-Term Stability	$T_j = 125^\circ\text{C}$, 1000 Hours		0.3	1		0.3	1	%
Thermal Resistance, Junction to Case	H Package		12	15		12	15	$^\circ\text{C}/\text{W}$
	K Package		2.3	3		2.3	3	$^\circ\text{C}/\text{W}$
	T Package					4		$^\circ\text{C}/\text{W}$
	P Package					7		$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction to Ambient (No Heat Sink)	H Package		140			140		$^\circ\text{C}/\text{W}$
	K Package		35			35		$^\circ\text{C}/\text{W}$
	T Package					50		$^\circ\text{C}/\text{W}$
	P Package					80		$^\circ\text{C}/\text{W}$

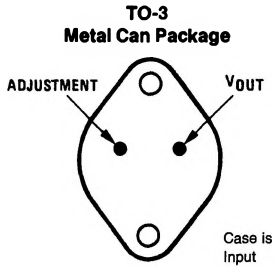
Note 1: Unless otherwise specified, these specifications apply $-55^\circ\text{C} \leq T_j \leq +150^\circ\text{C}$ for the LM137, $0^\circ\text{C} \leq T_j \leq +125^\circ\text{C}$ for the LM337; $V_{\text{IN}} - V_{\text{OUT}} = 5\text{V}$; and $I_{\text{OUT}} = 0.1\text{A}$ for the TO-39 and TO-202 packages 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 TO-202 and 20W for the TO-3 and TO-220. I_{MAX} is 1.5A for the TO-3 and TO-220 packages, and 0.5A for the TO-202 package and 0.2A for the TO-39 package.

Note 2: 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. Load regulation is measured on the output pin at a point $1/8$ " below the base of the TO-3 and TO-39 packages.

Note 3: Selected devices with tightened tolerance reference voltage available.

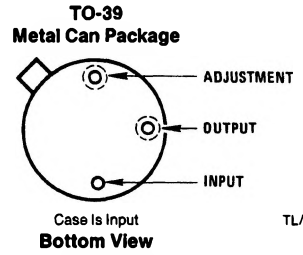
Note 4: Refer to RETS137H drawing for LM137H or RETS137K drawing for LM137K military specifications.

Connection Diagrams



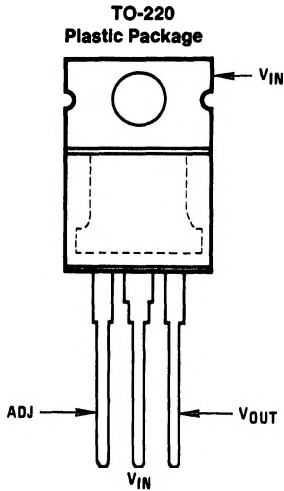
TL/H/9067-5

Bottom View
Order Number LM137K STEEL or LM337K STEEL
See NS Package Number K02A



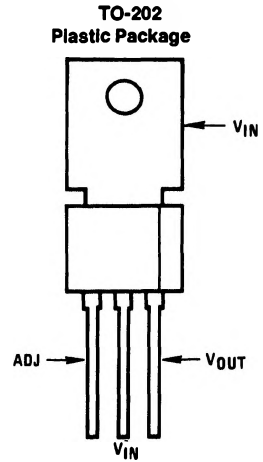
TL/H/9067-6

Bottom View
Order Number LM137H or LM337H
See NS Package Number H03A



TL/H/9067-7

Front View
Order Number LM337T
See NS Package Number T03B

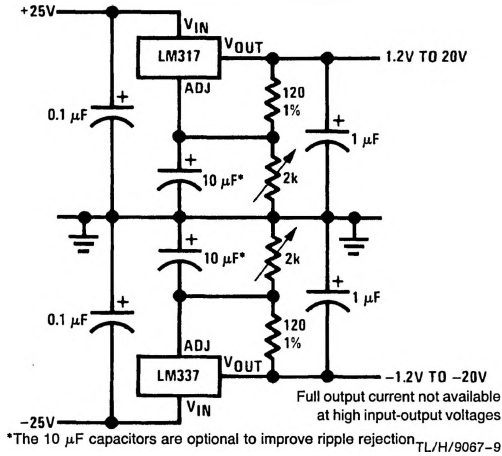


TL/H/9067-8

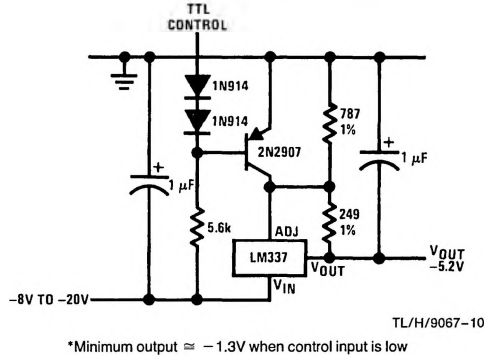
Front View
Order Number LM337MP
See NS Package Number P03A

Typical Applications (Continued)

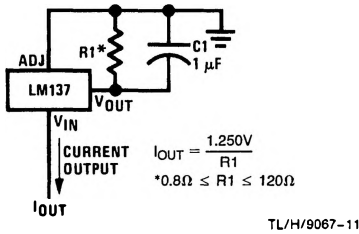
Adjustable Lab Voltage Regulator



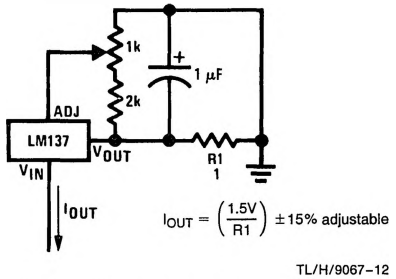
-5.2V Regulator with Electronic Shutdown*



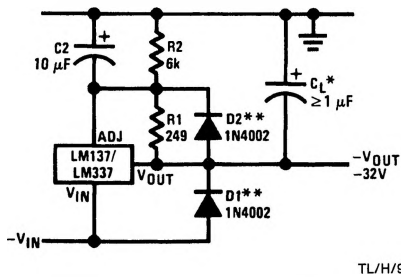
Current Regulator



Adjustable Current Regulator



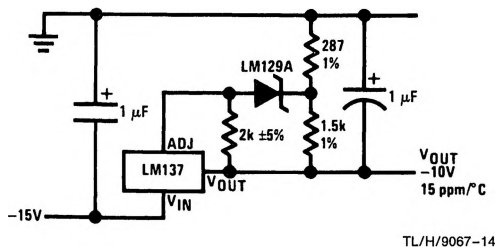
Negative Regulator with Protection Diodes



*When C_L is larger than 20 μF, D1 protects the LM137 in case the input supply is shorted

**When C_2 is larger than 10 μF and $-V_{OUT}$ is larger than -25V, D2 protects the LM137 in case the output is shorted

High Stability -10V Regulator



Typical Performance Characteristics (K Steel and T Packages)

