National Semiconductor

LM2937-2.5, LM2937-3.3
400mA and 500mA Voltage Regulators

General Description

The LM2937-2.5 and LM2937-3.3 are positive voltage regulators capable of supplying up to 500 mA of load current. Both regulators are ideal for converting a common 5V logic supply, or higher input supply voltage, to the lower 2.5V and 3.3V supplies to power VLSI ASIC's and microcontrollers. Special circuitry has been incorporated to minimize the quiescent current to typically only 10 mA with a full 500 mA load current when the input to output voltage differential is greater than 5V.

The LM2937 requires an output bypass capacitor for stability. As with most regulators utilizing a PNP pass transistor, the ESR of this capacitor remains a critical design parameter, but the LM2937-2.5 and LM2937-3.3 include special compensation circuitry that relaxes ESR requirements. The LM2937 is stable for all ESR ratings less than 5Ω. This allows the use of low ESR chip capacitors.

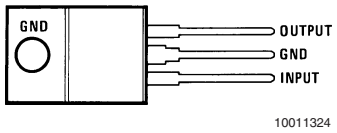
The regulators are also suited for automotive applications, with built in protection from reverse battery connections, two-battery jumps and up to +60V/–50V load dump transients. Familiar regulator features such as short circuit and thermal shutdown protection are also built in.

Features

- Fully specified for operation over –40˚C to +125˚C
- Output current in excess of 500 mA (400mA for SOT-223 package)
- Output trimmed for 5% tolerance under all operating conditions
- Wide output capacitor ESR range, 0.01Ω up to 5Ω
- Internal short circuit and thermal overload protection
- Reverse battery protection
- 60V input transient protection
- Mirror image insertion protection

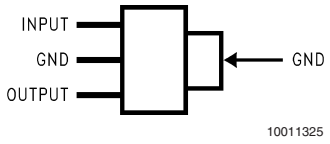
Connection Diagrams and Ordering Information

TO-220 Plastic Package



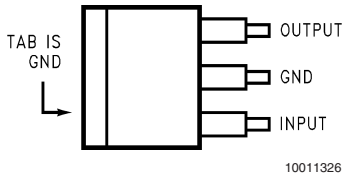
Front View
Order Number LM2937ET-2.5, LM2937ET-3.3,
See NS Package Number T03B

SOT-223 Plastic Package

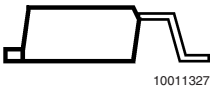


Front View
Order Number LM2937IMP-2.5, LM2937IMP-3.3,
See NS Package Number MA04A

TO-263 Surface-Mount Package



Top View



Side View

Order Number LM2937ES-2.5, LM2937ES-3.3,
See NS Package Number TS3B

Connection Diagrams and Ordering Information (Continued)

Temperature Range	Output Voltage		NSC Package Drawing	Package
	2.5	3.3		
$-40^{\circ}C \le T_A \le 125^{\circ}C$	LM2937ES-2.5 LM2937ET-2.5	LM2937ES-3.3 LM2937ET-3.3	TS3B T03B	TO-263 TO-220
$-40^{\circ}C \le T_A \le 85^{\circ}C$	LM2937IMP-2.5	LM2937IMP-3.3	MA04A	SOT-223
SOT-223 Package Markings	L68B	L69B		

The small physical size of the SOT-223 package does not allow sufficient space to provide the complete device part number. The actual devices will be labeled with the package markings shown.

Absolute Maximum Ratings (Note 1)

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

Input Voltage	
Continuous	26V
Transient (t ≤ 100 ms)	60V
Internal Power Dissipation (Note 2)	Internally Limited
Maximum Junction Temperature	150˚C
Storage Temperature Range	−65˚C to +150˚C
Lead Temperature Soldering	
TO-220 (10 seconds)	260˚C
TO-263 (10 seconds)	230˚C
SOT-223 (Vapor Phase, 60 seconds)	215˚C
SOT-223 (Infrared, 15 seconds)	220˚C
ESD Susceptibility (Note 3)	2 kV

Operating Conditions (Note 1)

Temperature Range (Note 2)	
LM2937ES, LM2937ET	$-40˚C \le T_A \le 125˚C$
LM2937IMP	$-40˚C \le T_A \le 85˚C$
Input Voltage Range	4.75V to 26V

Electrical Characteristics (Note 4)

$V_{IN} = V_{NOM} + 5V$, I_{OUTmax} = 500 mA for the TO-220 and TO-263 packages, I_{OUTmax}=400mA for the SOT-223 package, C_{OUT} = 10 µF unless otherwise indicated. **Boldface limits apply over the entire operating temperature range, of the indicated device**, all other specifications are for $T_A = T_J = 25˚C$.

Output Voltage (V_{OUT})		2.5V		3.3V		Units
Parameter	**Conditions**	**Typ**	**Limit**	**Typ**	**Limit**	
Output Voltage	5 mA ≤ I_{OUT} ≤ I_{OUTmax}		2.42		3.20	V (Min)
		2.5	**2.38**	3.3	**3.14**	V(Min)
			2.56		3.40	V(Max)
			2.62		**3.46**	V(Max)
Line Regulation(Note 5)	4.75V ≤ V_{IN} ≤ 26V, I_{OUT} = 5 mA	7.5	**25**	9.9	**33**	mV(Max)
Load Regulation	5 mA ≤ I_{OUT} ≤ I_{OUTmax}	2.5	**25**	3.3	**33**	mV(Max)
Quiescent Current	7V ≤ V_{IN} ≤ 26V, I_{OUT} = 5 mA	2	**10**	2	**10**	mA(Max)
	V_{IN} = (V_{OUT} + 5V), I_{OUT} = I_{OUTmax}	10	**20**	10	**20**	mA(Max)
	V_{IN} = 5V, I_{OUT} = I_{OUTmax}	66	100**125**	66	100**125**	mA(Max)
Output Noise Voltage	10 Hz–100 kHz, I_{OUT} = 5 mA	75		99		µVrms
Long Term Stability	1000 Hrs.	10		13.2		mV
Short-Circuit Current		1.0	**0.6**	1.0	**0.6**	A(Min)
Peak Line Transient Voltage	t_f < 100 ms, R_L = 100Ω	75	**60**	75	**60**	V(Min)
Maximum Operational Input Voltage			**26**		**26**	V(Min)
Reverse DC Input Voltage	V_{OUT} ≥ −0.6V, R_L = 100Ω	−30	**−15**	−30	**−15**	V(Min)
Reverse Transient Input Voltage	t_r < 1 ms, R_L = 100Ω	−75	**−50**	−75	**−50**	V(Min)

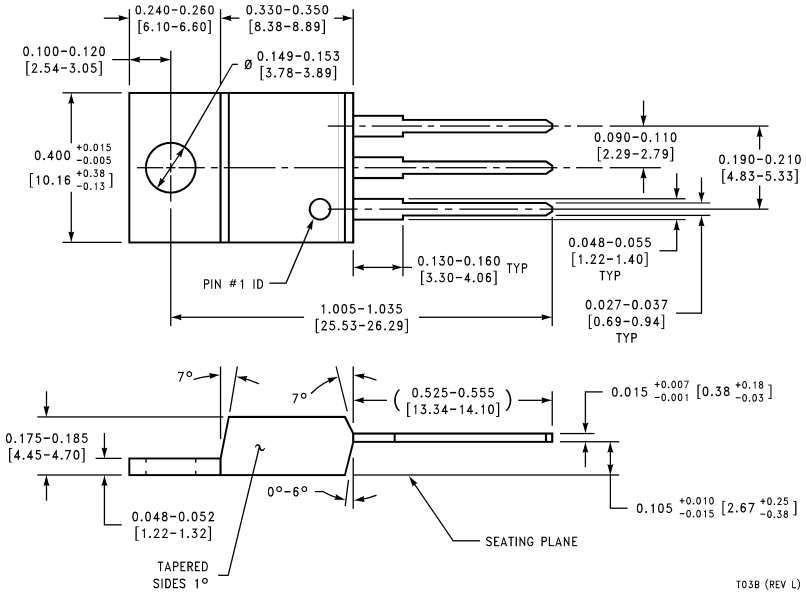
Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Electrical specifications do not apply when operating the device outside of its rated Operating Conditions.

Note 2: The maximum allowable power dissipation at any ambient temperature is $P_{MAX} = (125 - T_A)/\theta_{JA}$, where 125 is the maximum junction temperature for operation, T_A is the ambient temperature, and θ_{JA} is the junction-to-ambient thermal resistance. If this dissipation is exceeded, the die temperature will rise above 125˚C and the electrical specifications do not apply. If the die temperature rises above 150˚C, the regulator will go into thermal shutdown. The junction-to-ambient thermal resistance θ_{JA} is 65˚C/W, for the TO-220 package, 73˚C/W for the TO-263 package, and 174˚C/W for the SOT-223 package. When used with a heatsink, θ_{JA} is the sum of the device junction-to-case thermal resistance θ_{JC} of 3˚C/W and the heatsink case-to-ambient thermal resistance. If the TO-263 or SOT-223 packages are used, the thermal resistance can be reduced by increasing the P.C. board copper area thermally connected to the package (see Application Hints for more information on heatsinking).

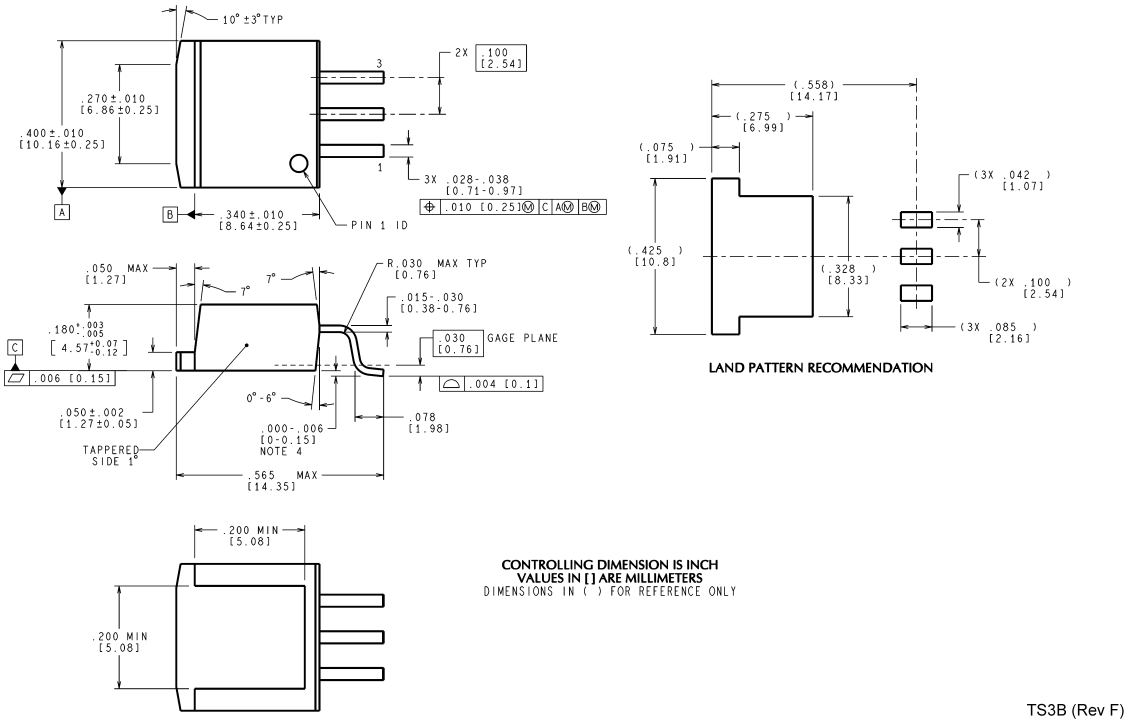
Note 3: ESD rating is based on the human body model, 100 pF discharged through 1.5 kΩ.

Note 4: Typicals are at $T_J = 25˚C$ and represent the most likely parametric norm.

Physical Dimensions inches (millimeters) unless otherwise noted



Plastic Package
Order Number LM2937ET-2.5,
LM2937ET-3.3,
NS Package Number T03B



TS3B (Rev F)

TO-263 3-Lead Plastic Surface Mount Package
Order Number LM2937ES-2.5, LM2937ES-3.3,
NS Package Number TS3B