

LM2937

500 mA Low Dropout Regulator

General Description

The LM2937 is a positive voltage regulator capable of supplying up to 500 mA of load current. The use of a PNP power transistor provides a low dropout voltage characteristic. With a load current of 500 mA the minimum input to output voltage differential required for the output to remain in regulation is typically 0.5V (1V guaranteed maximum over the full operating temperature range). 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 3V.

The LM2937 requires an output bypass capacitor for stability. As with most low dropout regulators, the ESR of this capacitor remains a critical design parameter, but the LM2937 includes special compensation circuitry that relaxes ESR requirements. The LM2937 is stable for all ESR below 3Ω. This allows the use of low ESR chip capacitors.

Ideally suited for automotive applications, the LM2937 will protect itself and any load circuitry from reverse battery

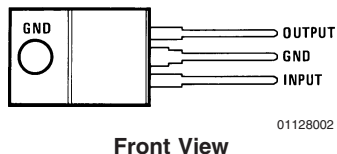
connections, two-battery jumps and up to +60V/-50V load dump transients. Familiar regulator features such as short circuit and thermal shutdown protection are also built in.

Features

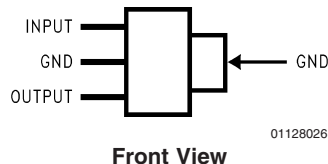
- Fully specified for operation over -40°C to +125°C
- Output current in excess of 500 mA
- Output trimmed for 5% tolerance under all operating conditions
- Typical dropout voltage of 0.5V at full rated load current
- Wide output capacitor ESR range, up to 3Ω
- Internal short circuit and thermal overload protection
- Reverse battery protection
- 60V input transient protection
- Mirror image insertion protection

Connection Diagrams

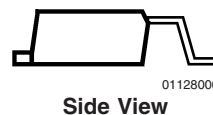
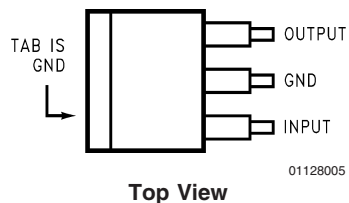
TO-220 Plastic Package



SOT-223 Plastic Package



TO-263 Surface-Mount Package



Ordering Information

Package	Temperature Range	Part Number	Packaging Marking	Transport Media	NSC Drawing
TO-263	$-40^{\circ}\text{C} \leq T_J \leq 125^{\circ}\text{C}$	LM2937ES-5.0	LM2937ES-5.0	Rail	TS3B
		LM2937ESX-5.0		500 Units Tape and Reel	
		LM2937ES-8.0	LM2937ES-8.0	Rail	
		LM2937ESX-8.0		500 Units Tape and Reel	
		LM2937ES-10	LM2937ES-10	Rail	
		LM2937ESX-10		500 Units Tape and Reel	
		LM2937ES-12	LM2937ES-12	Rail	
		LM2937ESX-12		500 Units Tape and Reel	
		LM2937ES-15	LM2937ES-15	Rail	
LM2937ESX-15	500 Units Tape and Reel				
TO-220	$-40^{\circ}\text{C} \leq T_J \leq 125^{\circ}\text{C}$	LM2937ET-5.0	LM2937ET-5.0	Rail	TO3B
		LM2937ET-8.0	LM2937ET-8.0	Rail	
		LM2937ET-10	LM2937ET-10	Rail	
		LM2937ET-12	LM2937ET-12	Rail	
		LM2937ET-15	LM2937ET-15	Rail	
SOT-223	$-40^{\circ}\text{C} \leq T_J \leq 85^{\circ}\text{C}$	LM2937IMP-5.0	L71B	1k Units Tape and Reel	MP04A
		LM2937IMPX-5.0		2k Units Tape and Reel	
		LM2937IMP-8.0	L72B	1k Units Tape and Reel	
		LM2937IMPX-8.0		2k Units Tape and Reel	
		LM2937IMP-10	L73B	1k Units Tape and Reel	
		LM2937IMPX-10		2k Units Tape and Reel	
		LM2937IMP-12	L74B	1k Units Tape and Reel	
		LM2937IMPX-12		2k Units Tape and Reel	
LM2937IMP-15	L75B	1k Units Tape and Reel			
LM2937IMPX-15		2k Units Tape and Reel			

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 ($t \leq 100$ ms)	60V
Internal Power Dissipation (Note 2)	Internally Limited
Maximum Junction Temperature	150°C
Storage Temperature Range	-65°C to +150°C
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)	
LM2937ET, LM2937ES	-40°C \leq T _J \leq 125°C
LM2937IMP	-40°C \leq T _J \leq 85°C
Maximum Input Voltage	26V

Electrical Characteristics

$V_{IN} = V_{NOM} + 5V$, (Note 4) $I_{OUTmax} = 500$ mA for the TO-220 and TO-263 packages, $I_{OUTmax} = 400$ mA for the SOT-223 package, $C_{OUT} = 10$ μ F 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})		5V		8V		10V		Units
Parameter	Conditions	Typ	Limit	Typ	Limit	Typ	Limit	
Output Voltage	$5 \text{ mA} \leq I_{OUT} \leq I_{OUTmax}$		4.85		7.76		9.70	V(Min)
		5.00	4.75	8.00	7.60	10.00	9.50	V(Min)
			5.15		8.24		10.30	V(Max)
			5.25		8.40		10.50	V(Max)
Line Regulation	$(V_{OUT} + 2V) \leq V_{IN} \leq 26V$, $I_{OUT} = 5 \text{ mA}$	15	50	24	80	30	100	mV(Max)
Load Regulation	$5 \text{ mA} \leq I_{OUT} \leq I_{OUTmax}$	5	50	8	80	10	100	mV(Max)
Quiescent Current	$(V_{OUT} + 2V) \leq V_{IN} \leq 26V$, $I_{OUT} = 5 \text{ mA}$	2	10	2	10	2	10	mA(Max)
	$V_{IN} = (V_{OUT} + 5V)$, $I_{OUT} = I_{OUTmax}$	10	20	10	20	10	20	mA(Max)
Output Noise Voltage	10 Hz–100 kHz $I_{OUT} = 5 \text{ mA}$	150		240		300		μ Vrms
Long Term Stability	1000 Hrs.	20		32		40		mV
Dropout Voltage	$I_{OUT} = I_{OUTmax}$	0.5	1.0	0.5	1.0	0.5	1.0	V(Max)
	$I_{OUT} = 50 \text{ mA}$	110	250	110	250	110	250	mV(Max)
Short-Circuit Current		1.0	0.6	1.0	0.6	1.0	0.6	A(Min)
Peak Line Transient Voltage	$t_f < 100 \text{ ms}$, $R_L = 100\Omega$	75	60	75	60	75	60	V(Min)
Maximum Operational Input Voltage			26		26		26	V(Min)
Reverse DC Input Voltage	$V_{OUT} \geq -0.6V$, $R_L = 100\Omega$	-30	-15	-30	-15	-30	-15	V(Min)
Reverse Transient Input Voltage	$t_f < 1 \text{ ms}$, $R_L = 100\Omega$	-75	-50	-75	-50	-75	-50	V(Min)

Electrical Characteristics

$V_{IN} = V_{NOM} + 5V$, (Note 4) $I_{OUTmax} = 500\text{ mA}$ for the TO-220 and TO-263 packages, $I_{OUTmax}=400\text{mA}$ for the SOT-223 package, $C_{OUT} = 10\text{ }\mu\text{F}$ unless otherwise indicated. **Boldface limits apply over the entire operating temperature range of the indicted device.**, all other specifications are for $T_A = T_J = 25^\circ\text{C}$.

Output Voltage (V_{OUT})		12V		15V		Units
Parameter	Conditions	Typ	Limit	Typ	Limit	
Output Voltage	$5\text{ mA} \leq I_{OUT} \leq I_{OUTmax}$		11.64		14.55	V (Min)
		12.00	11.40	15.00	14.25	V(Min)
			12.36		15.45	V(Max)
			12.60		15.75	V(Max)
Line Regulation	$(V_{OUT} + 2V) \leq V_{IN} \leq 26V$, $I_{OUT} = 5\text{ mA}$	36	120	45	150	mV(Max)
Load Regulation	$5\text{ mA} \leq I_{OUT} \leq I_{OUTmax}$	12	120	15	150	mV(Max)
Quiescent Current	$(V_{OUT} + 2V) \leq V_{IN} \leq 26V$, $I_{OUT} = 5\text{ mA}$	2	10	2	10	mA(Max)
		$V_{IN} = (V_{OUT} + 5V)$, $I_{OUT} = I_{OUTmax}$	10	20	10	20
Output Noise Voltage	10 Hz–100 kHz, $I_{OUT} = 5\text{ mA}$	360		450		μVrms
Long Term Stability	1000 Hrs.	44		56		mV
Dropout Voltage	$I_{OUT} = I_{OUTmax}$	0.5	1.0	0.5	1.0	V(Max)
	$I_{OUT} = 50\text{ mA}$	110	250	110	250	mV(Max)
Short-Circuit Current		1.0	0.6	1.0	0.6	A(Min)
Peak Line Transient Voltage	$t_f < 100\text{ ms}$, $R_L = 100\Omega$	75	60	75	60	V(Min)
Maximum Operational Input Voltage			26		26	V(Min)
Reverse DC Input Voltage	$V_{OUT} \geq -0.6V$, $R_L = 100\Omega$	-30	-15	-30	-15	V(Min)
Reverse Transient Input Voltage	$t_r < 1\text{ ms}$, $R_L = 100\Omega$	-75	-50	-75	-50	V(Min)

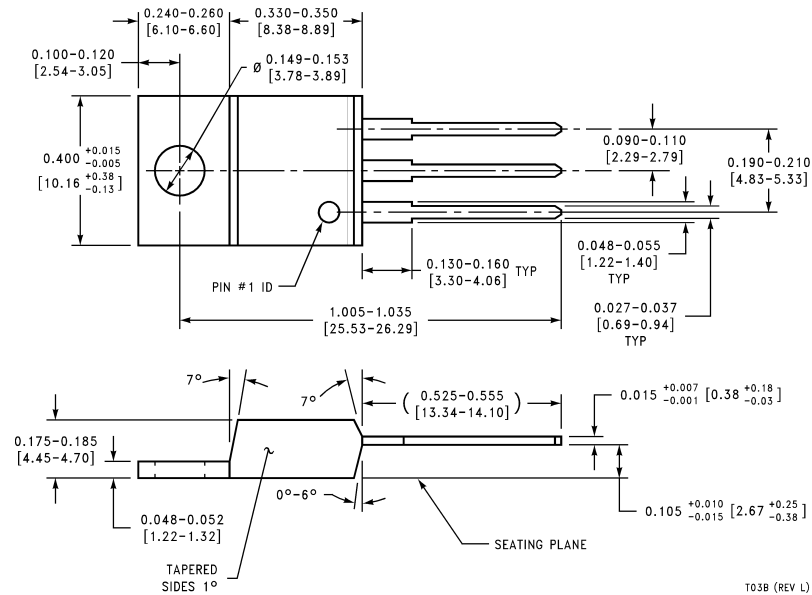
Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Electrical specifications do not apply when operating the device outside of its rated Operating Conditions.

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 LM2937 will go into thermal shutdown. For the LM2937, 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 LM2937 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).

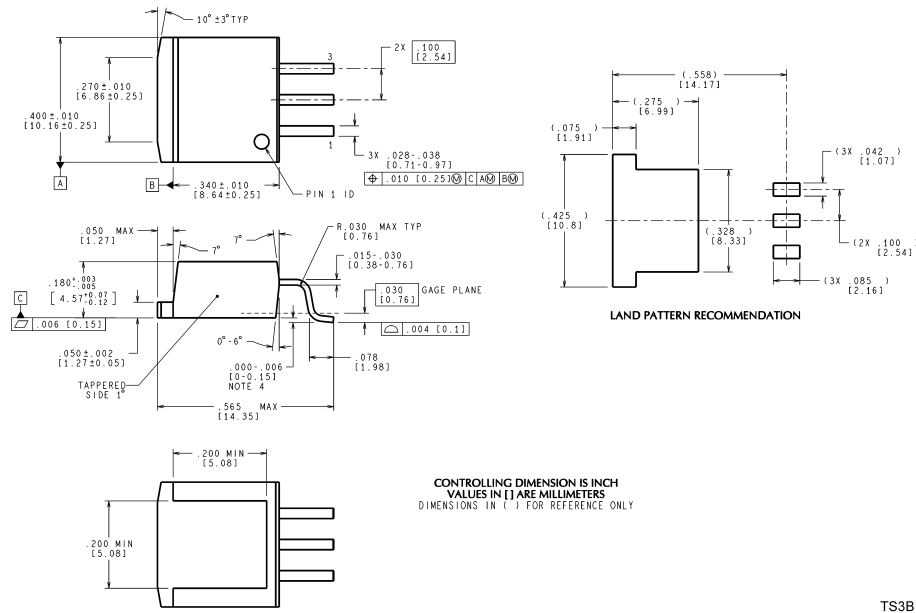
Note 3: ESD rating is based on the human body model, 100 pF discharged through 1.5 k Ω .

Note 4: Typicals are at $T_J = 25^\circ\text{C}$ and represent the most likely parametric norm.

Physical Dimensions inches (millimeters) unless otherwise noted



Plastic Package
Order Number LM2937ET-5.0,
LM2937ET-8.0, LM2937ET-10, LM2937ET-12,
or LM2937ET-15
NS Package Number T03B



TO-263 3-Lead Plastic Surface Mount Package
Order Number LM2937ES-5.0, LM2937ES-8.0, LM2937ES-10, LM2937ES-12 or LM2937ES-15
NS Package Number TS3B