LM2930 3-Terminal Positive Regulator

Check for Samples: LM2930

FEATURES

- Input-Output Differential Less Than 0.6V
- Output Current in Excess of 150 mA
- Reverse Battery Protection
- 40V Load Dump Protection
- Internal Short Circuit Current Limit
- Internal Thermal Overload Protection
- Mirror-Image Insertion Protection
- P^+ Product Enhancement Tested

VOLTAGE RANGE

- LM2930T-5.0: 5V
- LM2930T-8.0: 8V
- LM2930S-5.0: 5V
- LM2930S-8.0: 8V

DESCRIPTION

The LM2930 3-terminal positive regulator features an ability to source 150 mA of output current with an input-output differential of 0.6V or less. Efficient use of low input voltages obtained, for example, from an automotive battery during cold crank conditions, allows 5V circuitry to be properly powered with supply voltages as low as 5.6V. Familiar regulator features such as current limit and thermal overload protection are also provided.

Designed originally for automotive applications, the LM2930 and all regulated circuitry are protected from reverse battery installations or 2 battery jumps. During line transients, such as a load dump (40V) when the input voltage to the regulator can momentarily exceed the specified maximum operating voltage, the regulator will automatically shut down to protect both internal circuits and the load. The LM2930 cannot be harmed by temporary mirror-image insertion.

Fixed outputs of 5V and 8V are available in the plastic TO-220 and SFM power packages.

Connection Diagrams

TO-220 Plastic Package

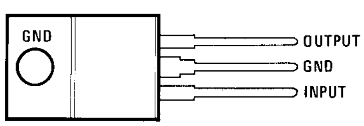


Figure 1. Front View
See Package Number NDE

SFM Plastic Surface-Mount Package

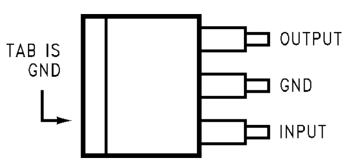


Figure 2. Top View
See Package Number KTT

Figure 3. Side View
See Package Number KTT

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings[1][2]

Input Voltage	Operating Range	26V
	Overvoltage Protection	40V
	Reverse Voltage (100 ms)	−12V
	Reverse Voltage (DC)	−6V
Internal Power Dissipation [3]		Internally Limited
Operating Temperature Range		−40°C to +85°C
Maximum Junction Temperature		125°C
Storage Temperature Range		−65°C to +150°C
Lead Temp. (Soldering, 10 seconds)		230°C

(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 ensure specific performance limits. Electrical Characteristics state DC and AC electrical specifications under particular test conditions which ensure specific performance limits. This assumes that the device is within the Operating Ratings. Specifications are not ensured for parameters where no limit is given, however, the typical value is a good indication of device performance.
(2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.
(3) Thermal resistance without a heat sink for junction to case temperature is 3°C/W and for case to ambient temperature is 50°C/W for the TO-220, 73°C/W for the SFM. If the SFM package is used, the thermal resistance can be reduced by increasing the P.C. board copper area thermally connected to the package. Using 0.5 square inches of copper area, θ_{JA} is 50°C/W; with 1 square inch of copper area, θ_{JA} is 37°C/W; and with 1.6 or more square inches of copper area, θ_{JA} is 32°C/W.

Electrical Characteristics[1]

LM2930-5.0 V_{IN}=14V, I_O=150 mA, T_j=25°C [2], C2=10 µF, unless otherwise specified

Parameter	Conditions	Typ	Tested Limit[3]	Design Limit[4]	Unit
Output Voltage		5	5.3		V_{MAX}
			4.7		V_{MIN}
	6V≤V_{IN}≤26V, 5 mA≤I_O≤150 mA −40°C≤T_J≤125°C			5.5	V_{MAX}
				4.5	V_{MIN}
Line Regulation	9V≤V_{IN}≤16V, I_O=5 mA	7	25		mV_{MAX}
	6V≤V_{IN}≤26V, I_O=5 mA	30	80		mV_{MAX}
Load Regulation	5 mA≤I_O≤150 mA	14	50		mV_{MAX}
Output Impedance	100 mA_{DC} & 10 mA_{rms}, 100 Hz−10 kHz	200			mΩ
Quiescent Current	I_O=10 mA	4	7		mA_{MAX}
	I_O=150 mA	18	40		mA_{MAX}
Output Noise Voltage	10 Hz−100 kHz	140			μV_{rms}
Long Term Stability		20			mV/1000 hr
Ripple Rejection	f_O=120 Hz	56			dB
Current Limit		400	700		mA_{MAX}
			150		mA_{MIN}
Dropout Voltage	I_O=150 mA	0.32	0.6		V_{MAX}
Output Voltage Under	−12V≤V_{IN}≤40V, R_L=100Ω		5.5		V_{MAX}
Transient Conditions			−0.3		V_{MIN}

(1) All characteristics are measured with a capacitor across the input of 0.1 µF and a capacitor across the output of 10 µF. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques (t_W≤10 ms, duty cycle≤5%). Output voltage changes due to changes in internal temperature must be taken into account separately.
(2) To ensure constant junction temperature, low duty cycle pulse testing is used.
(3) Ensured and 100% production tested.
(4) Ensured (but not 100% production tested) over the operating temperature and input current ranges. These limits are not used to calculate outgoing quality levels.

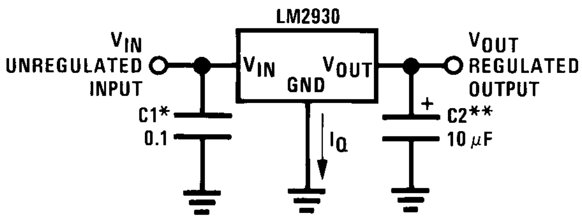
Electrical Characteristics[1]

LM2930-8.0 (V_{IN}=14V, I_O=150 mA, T_j=25°C [2], C2=10 µF, unless otherwise specified)

Parameter	Conditions	Typ	Tested Limit[3]	Design Limit[4]	Unit
Output Voltage		8	8.5		V_{MAX}
			7.5		V_{MIN}
	9.4V≤V_{IN}≤26V, 5 mA≤I_O≤150 mA, −40°C≤T_J≤125°C			8.8	V_{MAX}
				7.2	V_{MIN}
Line Regulation	9.4V≤V_{IN}≤16V, I_O=5 mA	12	50		mV_{MAX}
	9.4V≤V_{IN}≤26V, I_O=5 mA	50	100		mV_{MAX}
Load Regulation	5 mA≤I_O≤150 mA	25	50		mV_{MAX}
Output Impedance	100 mA_{DC} & 10 mA_{rms}, 100 Hz−10 kHz	300			mΩ
Quiescent Current	I_O=10 mA	4	7		mA_{MAX}
	I_O=150 mA	18	40		mA_{MAX}
Output Noise Voltage	10 Hz−100 kHz	170			μV_{rms}
Long Term Stability		30			mV/1000 hr
Ripple Rejection	f_O=120 Hz	52			dB
Current Limit		400	700		mA_{MAX}
			150		mA_{MIN}
Dropout Voltage	I_O=150 mA	0.32	0.6		V_{MAX}
Output Voltage Under	−12V≤V_{IN}≤40V, R_L=100Ω		8.8		V_{MAX}
Transient Conditions			−0.3		V_{MIN}

(1) All characteristics are measured with a capacitor across the input of 0.1 µF and a capacitor across the output of 10 µF. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques (t_W≤10 ms, duty cycle≤5%). Output voltage changes due to changes in internal temperature must be taken into account separately.
(2) To ensure constant junction temperature, low duty cycle pulse testing is used.
(3) Ensured and 100% production tested.
(4) Ensured (but not 100% production tested) over the operating temperature and input current ranges. These limits are not used to calculate outgoing quality levels.

Typical Application



*Required if regulator is located far from power supply filter.
**C_{OUT} must be at least 10 µF to maintain stability. May be increased without bound to maintain regulation during transients. Locate as close as possible to the regulator. This capacitor must be rated over the same operating temperature range as the regulator. The equivalent series resistance (ESR) of this capacitor should be less than 1Ω over the expected operating temperature range.

Typical Performance Characteristics

Output Impedance

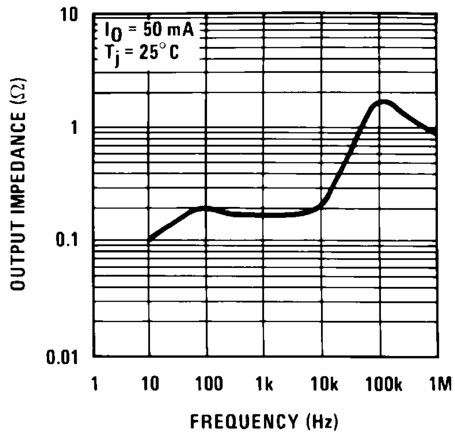


Figure 4.

Overvoltage Supply Current

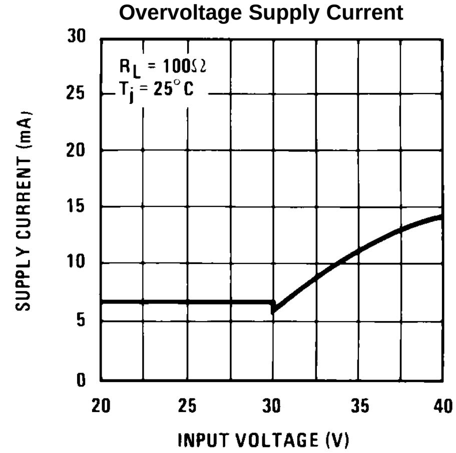


Figure 5.

Reverse Supply Current

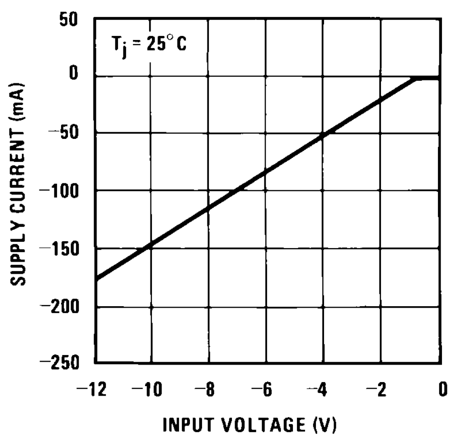


Figure 6.

Output at Reverse Supply

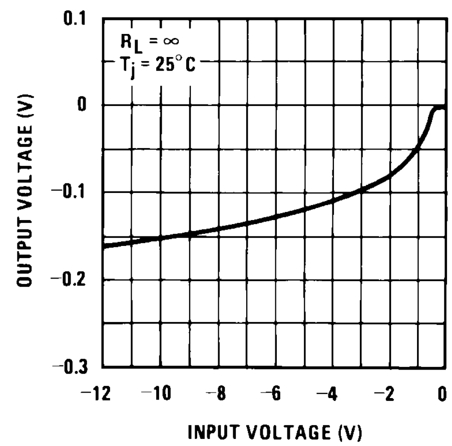


Figure 7.

Output at Overvoltage

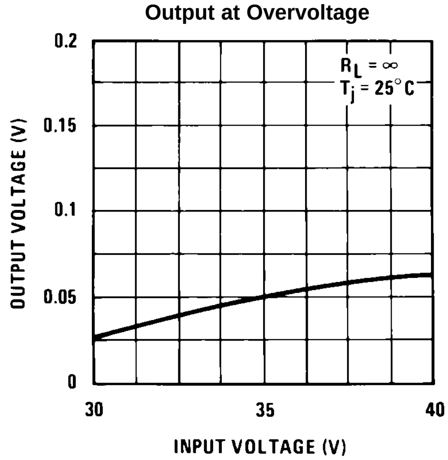


Figure 8.

Output Voltage (Normalized to 1V at T_j=25°C)

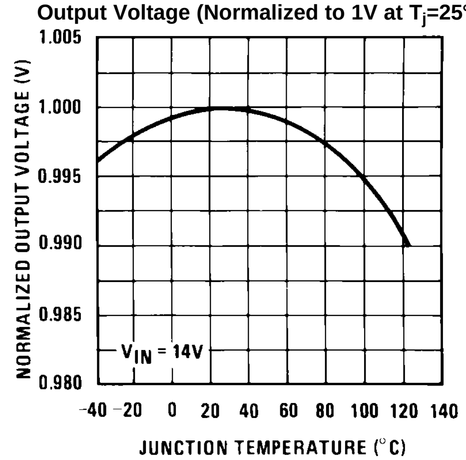


Figure 9.

Typical Performance Characteristics (continued)

Dropout Voltage

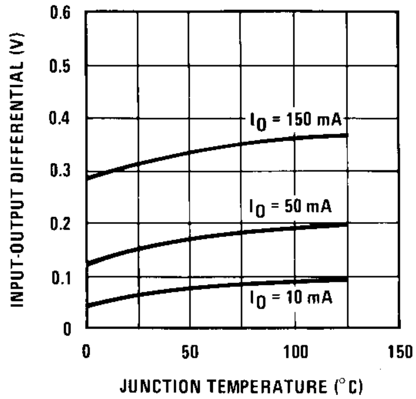


Figure 10.

Dropout Voltage

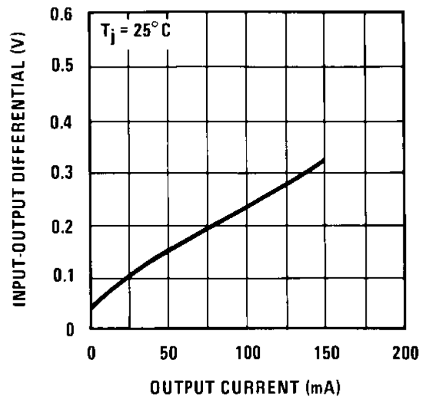


Figure 11.

Low Voltage Behavior

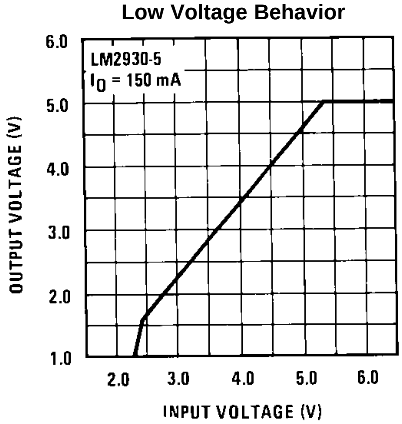


Figure 12.

High Voltage Behavior

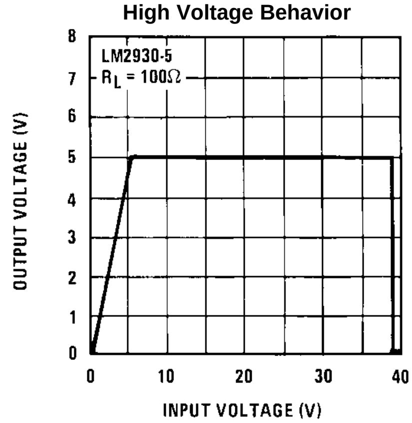


Figure 13.

Line Transient Response

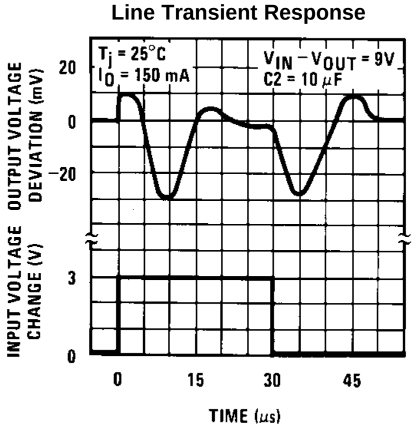


Figure 14.

Load Transient Response

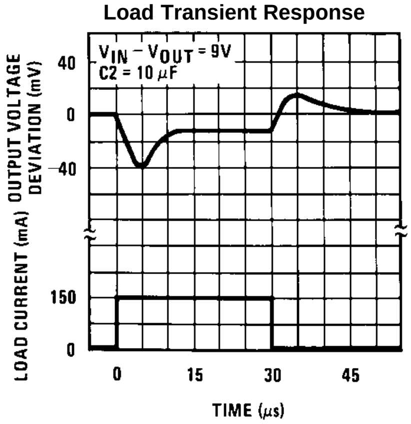


Figure 15.

Typical Performance Characteristics (continued)

Peak Output Current

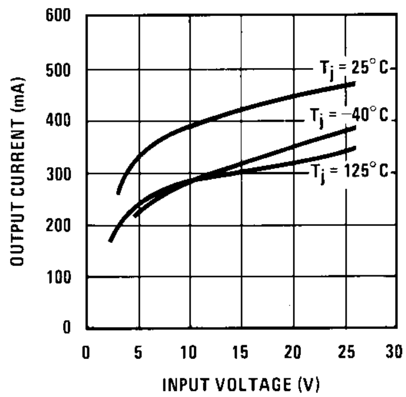


Figure 16.

Quiescent Current

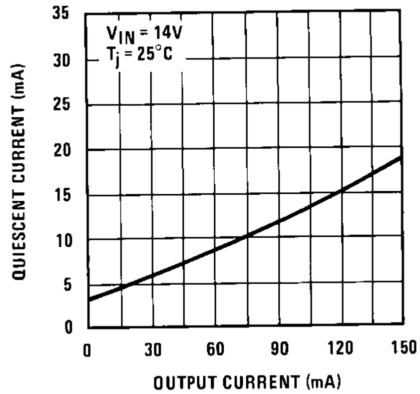


Figure 17.

Quiescent Current

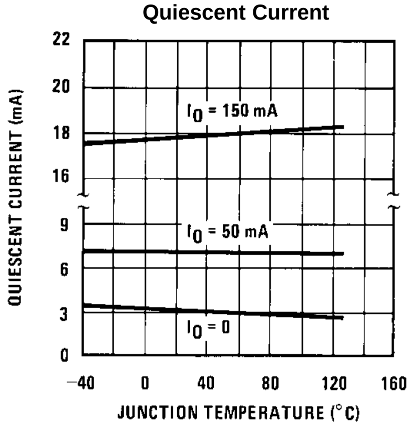


Figure 18.

Quiescent Current

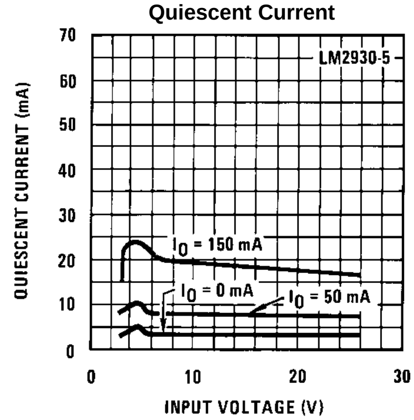


Figure 19.

Ripple Rejection

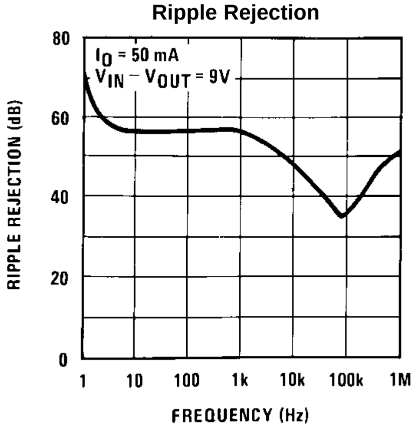


Figure 20.

Ripple Rejection

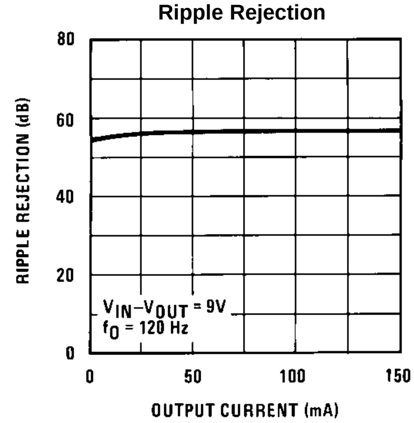


Figure 21.

Definition of Terms

Dropout Voltage: The input-output voltage differential at which the circuit ceases to regulate against further reduction in input voltage. Measured when the output voltage has dropped 100 mV from the nominal value obtained at 14V input, dropout voltage is dependent upon load current and junction temperature.

Input Voltage: The DC voltage applied to the input terminals with respect to ground.

Input-Output Differential: The voltage difference between the unregulated input voltage and the regulated output voltage for which the regulator will operate.

Line Regulation: The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

Load Regulation: The change in output voltage for a change in load current at constant chip temperature.

Long Term Stability: Output voltage stability under accelerated life-test conditions after 1000 hours with maximum rated voltage and junction temperature.

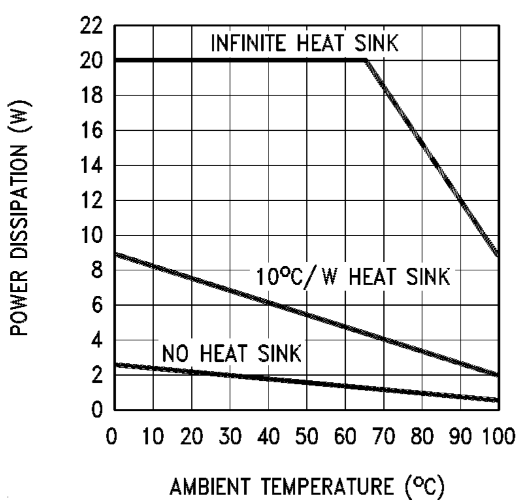
Output Noise Voltage: The rms AC voltage at the output, with constant load and no input ripple, measured over a specified frequency range.

Quiescent Current: That part of the positive input current that does not contribute to the positive load current. The regulator ground lead current.

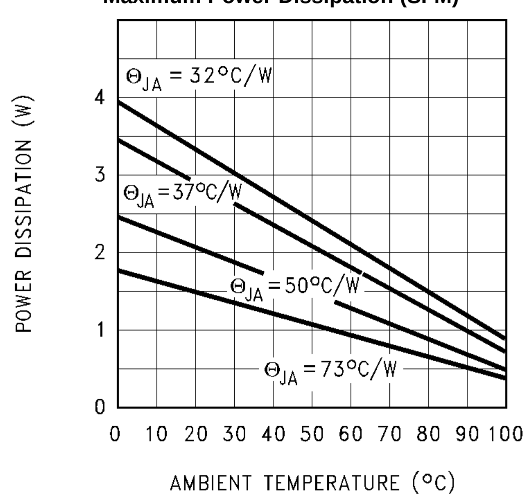
Ripple Rejection: The ratio of the peak-to-peak input ripple voltage to the peak-to-peak output ripple voltage.

Temperature Stability of V_O: The percentage change in output voltage for a thermal variation from room temperature to either temperature extreme.

Maximum Power Dissipation (TO-220)

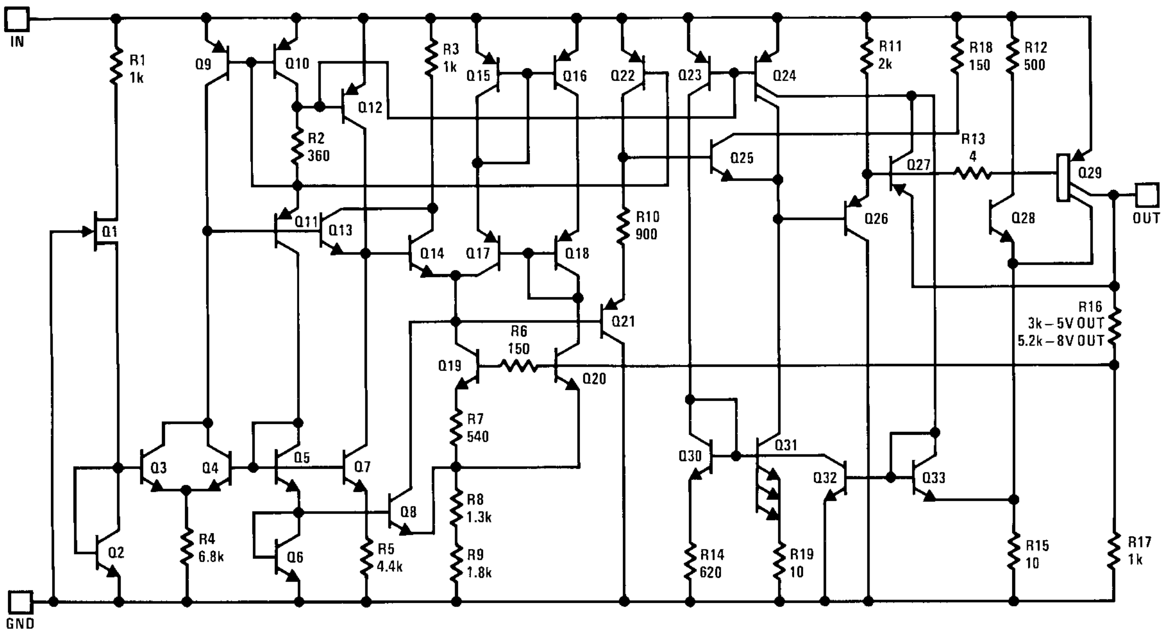


Maximum Power Dissipation (SFM) (1)



(1) Thermal resistance without a heat sink for junction to case temperature is 3°C/W and for case to ambient temperature is 50°C/W for the TO-220, 73°C/W for the SFM. If the SFM package is used, the thermal resistance can be reduced by increasing the P.C. board copper area thermally connected to the package. Using 0.5 square inches of copper area, θ_{JA} is 50°C/W; with 1 square inch of copper area, θ_{JA} is 37°C/W; and with 1.6 or more square inches of copper area, θ_{JA} is 32°C/W.

Schematic Diagram



REVISION HISTORY

Changes from Revision C (April 2013) to Revision D	Page
• Changed layout of National Data Sheet to TI format	8

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM2930T-5.0	OBSOLETE	TO-220	NDE	3		TBD	Call TI	Call TI	-40 to 85	LM2930T -5.0 P+	
LM2930T-5.0/NOPB	ACTIVE	TO-220	NDE	3	45	Green (RoHS & no Sb/Br)	CU SN	Level-1-NA-UNLIM	-40 to 85	LM2930T -5.0 P+	Samples
LM2930T-8.0	OBSOLETE	TO-220	NDE	3		TBD	Call TI	Call TI	-40 to 85	LM2930T 8.0 P+	
LM2930T-8.0/NOPB	OBSOLETE	TO-220	NDE	3		TBD	Call TI	Call TI	-40 to 85	LM2930T 8.0 P+	

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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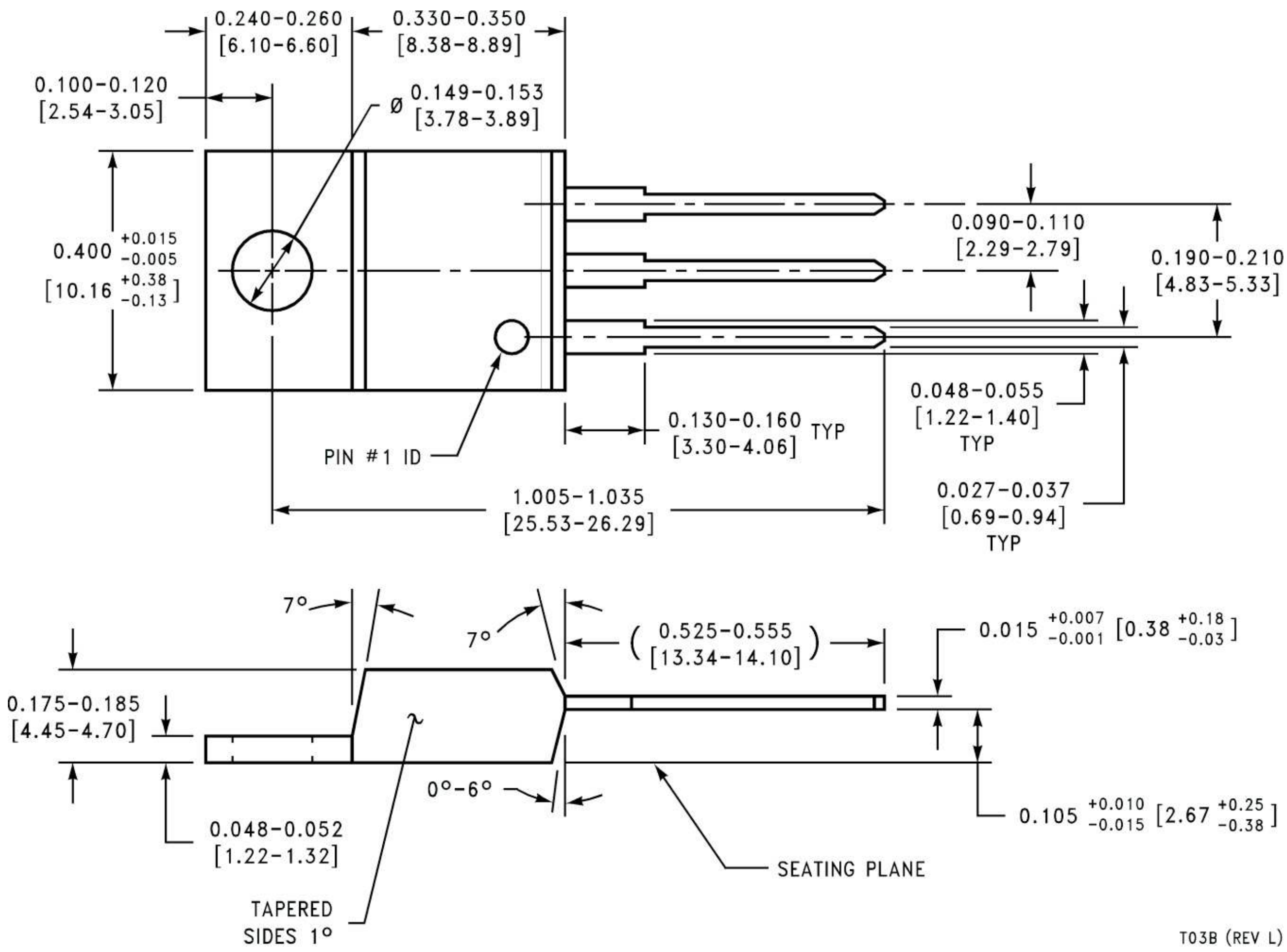
0.240-0.260
[6.10-6.60]
0.330-0.350
[8.38-8.89]
0.100-0.120
[2.54-3.05]
Ø 0.149-0.153
[3.78-3.89]
0.400 +0.015 -0.005
[10.16 +0.38 -0.13]
0.090-0.110
[2.29-2.79]
0.190-0.210
[4.83-5.33]
0.048-0.055
[1.22-1.40]
TYP
0.130-0.160 TYP
[3.30-4.06]
PIN #1 ID
1.005-1.035
[25.53-26.29]
0.027-0.037
[0.69-0.94]
TYP
7°
7°
(0.525-0.555 [13.34-14.10])
0.015 +0.007 -0.001 [0.38 +0.18 -0.03]
0.175-0.185
[4.45-4.70]
0°-6°
0.105 +0.010 -0.015 [2.67 +0.25 -0.38]
0.048-0.052
[1.22-1.32]
SEATING PLANE
TAPERED
SIDES 1°
T03B (REV L)