LM2931, NCV2931 Series

100 mA, Adjustable Output, LDO Voltage Regulator with 60 V Load Dump Protection

The LM2931 series consists of positive fixed and adjustable output voltage regulators that are specifically designed to maintain proper regulation with an extremely low input−to−output voltage differential. These devices are capable of supplying output currents in excess of 100 mA and feature a low bias current of 0.4 mA at 10 mA output.

Designed primarily to survive in the harsh automotive environment, these devices will protect all external load circuitry from input fault conditions caused by reverse battery connection, two battery jump starts, and excessive line transients during load dump. This series also includes internal current limiting, thermal shutdown, and additionally, is able to withstand temporary power−up with mirror−image insertion.

Due to the low dropout voltage and bias current specifications, the LM2931 series is ideally suited for battery powered industrial and consumer equipment where an extension of useful battery life is desirable. The ‘C’ suffix adjustable output regulators feature an output inhibit pin which is extremely useful in microprocessor−based systems.

Features

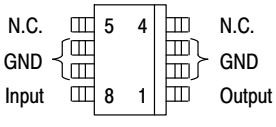
- Input−to−Output Voltage Differential of < 0.6 V @ 100 mA
- Output Current in Excess of 100 mA
- Low Bias Current
- 60 V Load Dump Protection
- −50 V Reverse Transient Protection
- Internal Current Limiting with Thermal Shutdown
- Temporary Mirror−Image Protection
- Ideally Suited for Battery Powered Equipment
- Economical 5−Lead TO−220 Package with Two Optional Leadforms
- Available in Surface Mount SOP−8, D^{2}PAK and DPAK Packages
- High Accuracy (±2.5%) Reference (LM2931AC) Available
- Pb−Free Packages are Available
- NCV Prefix for Automotive and Other Applications Requiring Site and Control Changes

Applications

- Battery Powered Consumer Products
- Hand−held Instruments
- Camcorders and Cameras

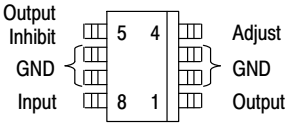
SOIC−8
D SUFFIX
CASE 751

FIXED



(Top View)

ADJUSTABLE

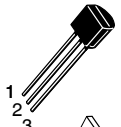


(Top View)

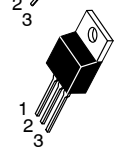
ON Semiconductor®

FIXED OUTPUT VOLTAGE

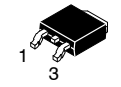
TO−92
Z SUFFIX
CASE 29



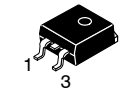
TO−220
T SUFFIX
CASE 221AB



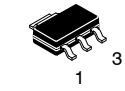
DPAK
DT SUFFIX
CASE 369A



D^{2}PAK
D2T SUFFIX
CASE 936



SOT−223
ST SUFFIX
CASE 318H

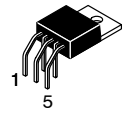


Pin 1. Output
2. Ground
3. Input

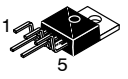
Pin 1. Input
2. Ground
3. Output

ADJUSTABLE OUTPUT VOLTAGE

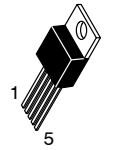
TO−220
TH SUFFIX
CASE 314A



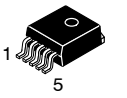
TO−220
TV SUFFIX
CASE 314B



TO−220
T SUFFIX
CASE 314D



D^{2}PAK
D2T SUFFIX
CASE 936A



Pin 1. Adjust
2. Output Inhibit
3. Ground
4. Input
5. Output

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 12 of this data sheet.

DEVICE MARKING INFORMATION

See general marking and heatsink information in the device marking section on page 15 of this data sheet.

Publication Order Number:
LM2931/D

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Input Voltage Continuous	V_I	40	Vdc
Transient Input Voltage ($\tau \leq 100$ ms)	$V_I(\tau)$	60	Vpk
Transient Reverse Polarity Input Voltage 1.0% Duty Cycle, $\tau \leq 100$ ms	$-V_I(\tau)$	−50	Vpk
Electrostatic Discharge Sensitivity (ESD) Human Body Model (HBM) Class 2, JESD22 A114−C Machine Model (MM) Class A, JESD22 A115−A Charged Device Model (CDM), JESD22 C101−C	 − − −	 2000 200 2000	 V V V
Power Dissipation Case 29 (TO−92 Type) T_A = 25°C Thermal Resistance, Junction−to−Ambient Thermal Resistance, Junction−to−Case Case 221A, 314A, 314B and 314D (TO−220 Type) T_A = 25°C Thermal Resistance, Junction−to−Ambient Thermal Resistance, Junction−to−Case Case 318H (SOT−223) T_A = 25°C Thermal Resistance, Junction−to−Ambient Thermal Resistance, Junction−to−Case Case 369A (DPAK) (Note 1) T_A = 25°C Thermal Resistance, Junction−to−Ambient Thermal Resistance, Junction−to−Case Case 751 (SOP−8) (Note 2) T_A = 25°C Thermal Resistance, Junction−to−Ambient Thermal Resistance, Junction−to−Case Case 936 and 936A (D^2PAK) (Note 3) T_A = 25°C Thermal Resistance, Junction−to−Ambient Thermal Resistance, Junction−to−Case	 P_D $R_{\theta JA}$ $R_{\theta JC}$ P_D $R_{\theta JA}$ $R_{\theta JC}$ P_D $R_{\theta JA}$ $R_{\theta JC}$ P_D $R_{\theta JA}$ $R_{\theta JC}$ P_D $R_{\theta JA}$ $R_{\theta JC}$ P_D $R_{\theta JA}$ $R_{\theta JC}$	 Internally Limited 178 83 Internally Limited 65 5.0 Internally Limited 242 21 Internally Limited 92 6.0 Internally Limited 160 25 Internally Limited 70 5.0	 W °C/W °C/W W °C/W °C/W W °C/W °C/W W °C/W °C/W W °C/W °C/W W °C/W °C/W
Operating Ambient Temperature Range	T_A	−40 to +125	°C
Operating Die Junction Temperature	T_J	+150	°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. DPAK Junction−to−Ambient Thermal Resistance is for vertical mounting. Refer to Figure 25 for board mounted Thermal Resistance.
2. SOP−8 Junction−to−Ambient Thermal Resistance is for minimum recommended pad size. Refer to Figure 24 for Thermal Resistance variation versus pad size.
3. D^2PAK Junction−to−Ambient Thermal Resistance is for vertical mounting. Refer to Figure 26 for board mounted Thermal Resistance.
4. NCV rated devices are subjected to and meet the AECQ−100 quality standards.

ELECTRICAL CHARACTERISTICS (V_{in} = 14 V, I_O = 10 mA, C_O = 100 μF, $C_{O(ESR)}$ = 0.3 Ω, T_A = 25°C [Note 5])

Characteristic	Symbol	LM2931−5.0/NCV2931−5.0			LM2931A−5.0/NCV2931A−5.0			Unit
		Min	Typ	Max	Min	Typ	Max	
FIXED OUTPUT								
Output Voltage	V_O							V
V_{in} = 14 V, I_O = 10 mA, T_A = 25°C		4.75	5.0	5.25	4.81	5.0	5.19	
V_{in} = 6.0 V to 26 V, $I_O \le$ 100 mA, T_A = −40° to +125°C		4.50	–	5.50	4.75	–	5.25	
Line Regulation	Reg_{line}							mV
V_{in} = 9.0 V to 16 V		–	2.0	10	–	2.0	10	
V_{in} = 6.0 V to 26 V		–	4.0	30	–	4.0	30	
Load Regulation (I_O = 5.0 mA to 100 mA)	Reg_{load}	–	14	50	–	14	50	mV
Output Impedance	Z_O							mΩ
I_O = 10 mA, ΔI_O = 1.0 mA, f = 100 Hz to 10 kHz		–	200	–	–	200	–	
Bias Current	I_B							mA
V_{in} = 14 V, I_O = 100 mA, T_A = 25°C		–	5.8	30	–	5.8	30	
V_{in} = 6.0 V to 26 V, I_O = 10 mA, T_A = −40° to +125°C		–	0.4	1.0	–	0.4	1.0	
Output Noise Voltage (f = 10 Hz to 100 kHz)	V_n	–	700	–	–	700	–	μVrms
Long Term Stability	S	–	20	–	–	20	–	mV/kHR
Ripple Rejection (f = 120 Hz)	RR	60	90	–	60	90	–	dB
Dropout Voltage	V_I−V_O							V
I_O = 10 mA		–	0.015	0.2	–	0.015	0.2	
I_O = 100 mA		–	0.16	0.6	–	0.16	0.6	
Over−Voltage Shutdown Threshold	$V_{th(OV)}$	26	29.5	40	26	29.5	40	V
Output Voltage with Reverse Polarity Input (V_{in} = −15 V)	$-V_O$	−0.3	0	–	−0.3	0	–	V

5. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient as possible.
6. NCV devices are qualified for automotive use.

ORDERING INFORMATION

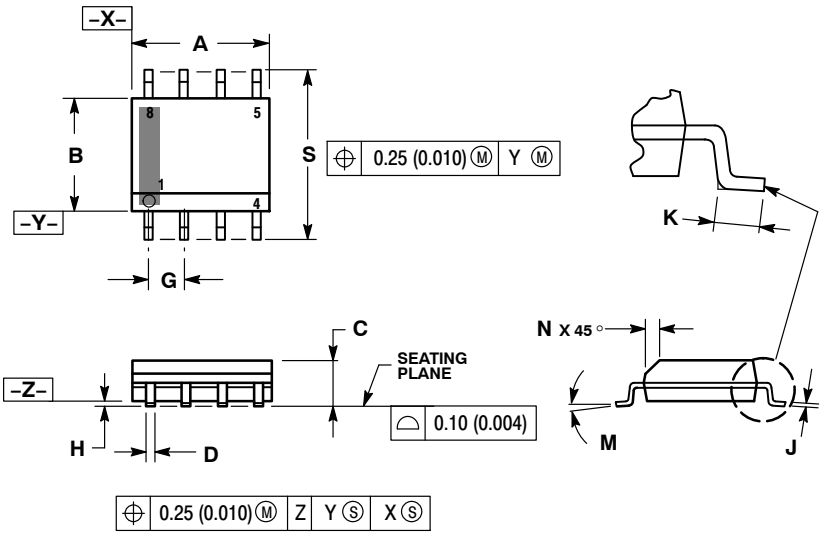
Device	Output		Package	Shipping†
	Voltage	Tolerance		
LM2931AD−5.0	5.0 V	±3.8%	SOIC−8	98 Units / Rail
LM2931AD−5.0G	5.0 V	±3.8%	SOIC−8 (Pb−Free)	98 Units / Rail
LM2931AD−5.0R2	5.0 V	±3.8%	SOIC−8	2500 / Tape & Reel
LM2931AD−5.0R2G	5.0 V	±3.8%	SOIC−8 (Pb−Free)	2500 / Tape & Reel
LM2931ADT−5.0	5.0 V	±3.8%	DPAK	75 Units / Rail
LM2931ADT−5.0G	5.0 V	±3.8%	DPAK (Pb−Free)	75 Units / Rail
LM2931ADT−5.0RK	5.0 V	±3.8%	DPAK	2500 / VacPk Reel
LM2931ADT−5.0RKG	5.0 V	±3.8%	DPAK (Pb−Free)	2500 / VacPk Reel
LM2931AD2T−5.0	5.0 V	±3.8%	D^2PAK	50 Units / Rail
LM2931AD2T−5.0G	5.0 V	±3.8%	D^2PAK (Pb−Free)	50 Units / Rail
LM2931AD2T−5.0R4	5.0 V	±3.8%	D^2PAK	800 / VacPk Reel
LM2931AD2T−5R4G	5.0 V	±3.8%	D^2PAK (Pb−Free)	800 / VacPk Reel
LM2931AT−5.0	5.0 V	±3.8%	TO−220	50 Units / Rail
LM2931AT−5.0G	5.0 V	±3.8%	TO−220 (Pb−Free)	50 Units / Rail
LM2931AZ−5.0	5.0 V	±3.8%	TO−92	2000 / Inner Bag
LM2931AZ−5.0G	5.0 V	±3.8%	TO−92 (Pb−Free)	2000 / Inner Bag
LM2931AZ−5.0RA	5.0 V	±3.8%	TO−92	2000 / Tape & Reel
LM2931AZ−5.0RAG	5.0 V	±3.8%	TO−92 (Pb−Free)	2000 / Tape & Reel
LM2931AZ−5.0RP	5.0 V	±3.8%	TO−92	2000 / Ammo Pack
LM2931AZ−5.0RPG	5.0 V	±3.8%	TO−92 (Pb−Free)	2000 / Ammo Pack
LM2931D−5.0	5.0 V	±5.0%	SOIC−8	98 Units / Rail
LM2931D−5.0G	5.0 V	±5.0%	SOIC−8 (Pb−Free)	98 Units / Rail
LM2931D−5.0R2	5.0 V	±5.0%	SOIC−8	2500 / Tape & Reel
LM2931D−5.0R2G	5.0 V	±5.0%	SOIC−8 (Pb−Free)	2500 / Tape & Reel
LM2931D2T−5.0	5.0 V	±5.0%	D^2PAK	50 Units / Rail
LM2931D2T−5.0G	5.0 V	±5.0%	D^2PAK (Pb−Free)	50 Units / Rail
LM2931D2T−5.0R4	5.0 V	±5.0%	D^2PAK	800 / VacPk Reel
LM2931D2T−5.0R4G	5.0 V	±5.0%	D^2PAK (Pb−Free)	800 / VacPk Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

*NCV2931: T_{low} = −40°C, T_{high} = +125°C. Guaranteed by design. NCV prefix is for automotive and other applications requiring site and change control.

PACKAGE DIMENSIONS

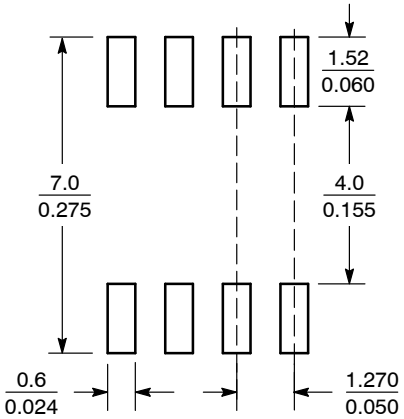
SOIC−8 NB
CASE 751−07
ISSUE AJ



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751−01 THRU 751−06 ARE OBSOLETE. NEW STANDARD IS 751−07.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0 °	8 °	0 °	8 °
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

SOLDERING FOOTPRINT*



SCALE 6:1 (mm / inches)

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.