

LP2950, LP2951, NCV2951

100 mA, Low Power Low Dropout Voltage Regulator

The LP2950 and LP2951 are micropower voltage regulators that are specifically designed to maintain proper regulation with an extremely low input-to-output voltage differential. These devices feature a very low quiescent bias current of 75 μ A and are capable of supplying output currents in excess of 100 mA. Internal current and thermal limiting protection is provided.

The LP2951 has three additional features. The first is the $\overline{\text{Error}}$ Output that can be used to signal external circuitry of an out of regulation condition, or as a microprocessor power-on reset. The second feature allows the output voltage to be preset to 5.0 V, 3.3 V or 3.0 V output (depending on the version) or programmed from 1.25 V to 29 V. It consists of a pinned out resistor divider along with direct access to the Error Amplifier feedback input. The third feature is a Shutdown input that allows a logic level signal to turn-off or turn-on the regulator output.

Due to the low input-to-output voltage differential and bias current specifications, these devices are ideally suited for battery powered computer, consumer, and industrial equipment where an extension of useful battery life is desirable. The LP2950 is available in the three pin case 29 and DPAK packages, and the LP2951 is available in the eight pin dual-in-line, SOIC-8 and Micro8 surface mount packages. The 'A' suffix devices feature an initial output voltage tolerance $\pm 0.5\%$.

Features

- Low Quiescent Bias Current of 75 μ A
- Low Input-to-Output Voltage Differential of 50 mV at 100 μ A and 380 mV at 100 mA
- 5.0 V, 3.3 V or 3.0 V $\pm 0.5\%$ Allows Use as a Regulator or Reference
- Extremely Tight Line and Load Regulation
- Requires Only a 1.0 μ F Output Capacitor for Stability
- Internal Current and Thermal Limiting
- Pb-Free Packages are Available
- NCV Prefix for Automotive and Other Applications Requiring Site and Control Changes

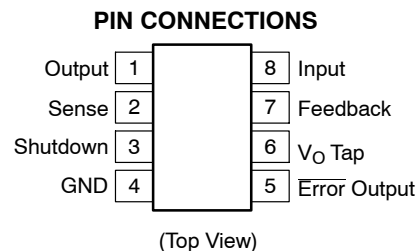
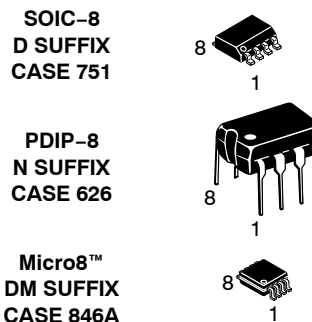
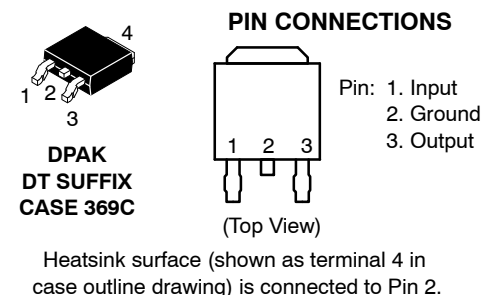
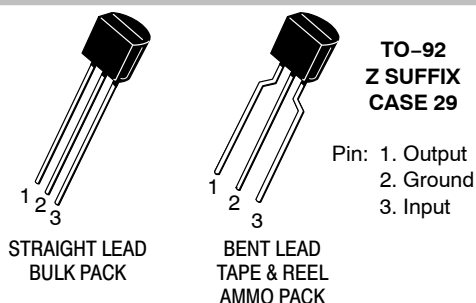
LP2951 Additional Features

- $\overline{\text{Error}}$ Output Signals an Out of Regulation Condition
- Output Programmable from 1.25 V to 29 V
- Logic Level Shutdown Input

(See Following Page for Device Information.)



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ORDERING & MARKING INFORMATION

See detailed ordering and shipping information in the package dimensions section on pages 14 and 16 of this data sheet. See general marking information in the device marking section on page 18 of this data sheet.

LP2950, LP2951, NCV2951

DEVICE INFORMATION

| Package | Output Voltage | | | | Operating Ambient Temperature Range |
|----------------------------|---------------------------------|---------------------------------|---------------------------------|-------------------------|---|
| | 3.0 V | 3.3 V | 5.0 V | Adjustable | |
| TO-92 Suffix Z | LP2950CZ-3.0 LP2950ACZ-3.0 | LP2950CZ-3.3 LP2950ACZ-3.3 | LP2950CZ-5.0 LP2950ACZ-5.0 | Not Available | $T_A = -40^\circ \text{ to } +125^\circ \text{C}$ |
| DPAK Suffix DT | LP2950CDT-3.0 LP2950ACDT-3.0 | LP2950CDT-3.3 LP2950ACDT-3.3 | LP2950CDT-5.0 LP2950ACDT-5.0 | Not Available | $T_A = -40^\circ \text{ to } +125^\circ \text{C}$ |
| SOIC-8 | - | NCV2951ACD-3.3R2 | NCV2951ACDR2 | NCV2951CDR2 | $T_A = -40^\circ \text{ to } +125^\circ \text{C}$ |
| SOIC-8 Suffix D | LP2951CD-3.0 LP2951ACD-3.0 | LP2951CD-3.3 LP2951ACD-3.3 | LP2951CD LP2951ACD | LP2951CD LP2951ACD | $T_A = -40^\circ \text{ to } +125^\circ \text{C}$ |
| Micro8 Suffix DM | LP2951CDM-3.0 LP2951ACDM-3.0 | LP2951CDM-3.3 LP2951ACDM-3.3 | LP2951CDM LP2951ACDM | LP2951CDM LP2951ACDM | $T_A = -40^\circ \text{ to } +125^\circ \text{C}$ |
| DIP-8 Suffix N | LP2951CN-3.0 LP2951ACN-3.0 | LP2951CN-3.3 LP2951ACN-3.3 | LP2951CN LP2951ACN | LP2951CN LP2951ACN | $T_A = -40^\circ \text{ to } +125^\circ \text{C}$ |

LP2950Cx-xx / LP2951Cxx-xx 1% Output Voltage Precision at $T_A = 25^\circ \text{C}$
 LP2950ACx-xx / LP2951ACxx-xx 0.5% Output Voltage Precision at $T_A = 25^\circ \text{C}$

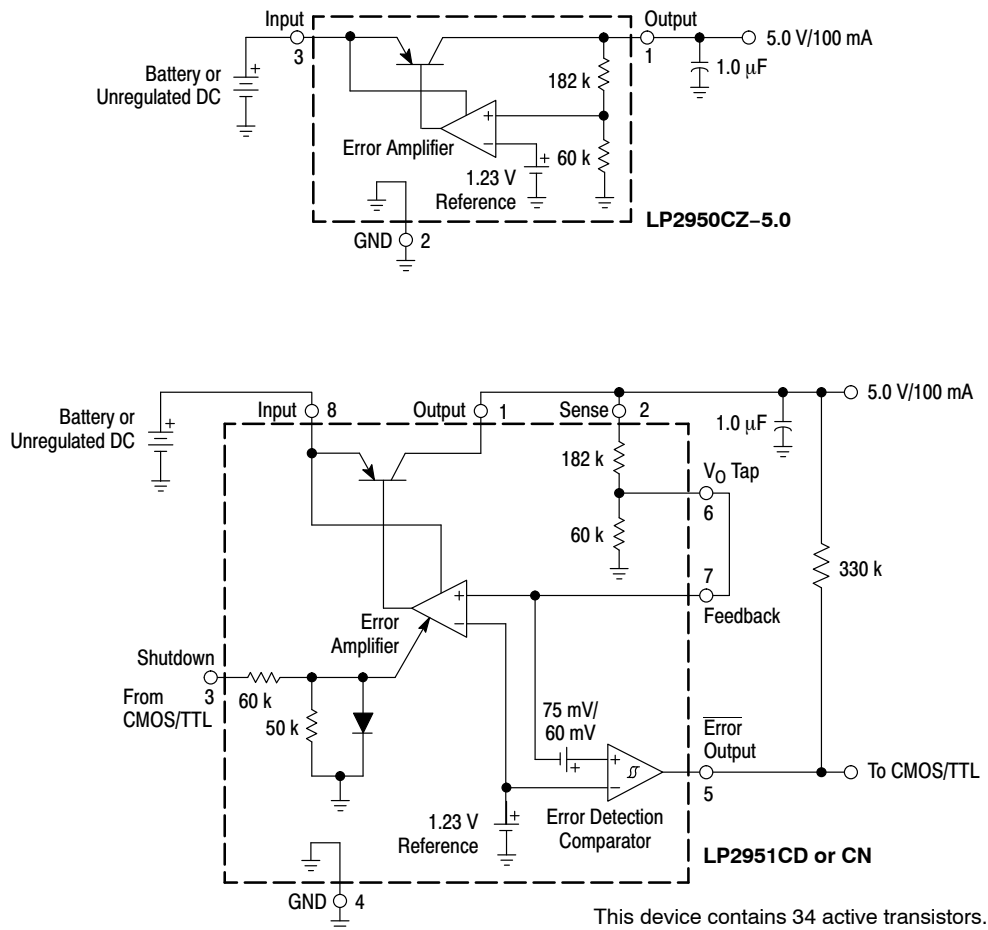


Figure 1. Representative Block Diagrams

LP2950, LP2951, NCV2951

MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$, unless otherwise noted.)

| Rating | Symbol | Value | Unit |
|---|-----------------|--------------------|--------------------|
| Input Voltage | V_{CC} | 30 | Vdc |
| Peak Transient Input Voltage ($t < 20$ ms) | V_{CC} | 32 | Vdc |
| Power Dissipation and Thermal Characteristics | | | |
| Maximum Power Dissipation | P_D | Internally Limited | W |
| Case 751 (SOIC-8) D Suffix | | | |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 180 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Case | $R_{\theta JC}$ | 45 | $^\circ\text{C/W}$ |
| Case 369A (DPAK) DT Suffix (Note 1) | | | |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 92 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Case | $R_{\theta JC}$ | 6.0 | $^\circ\text{C/W}$ |
| Case 29 (TO-226AA/TO-92) Z Suffix | | | |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 160 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Case | $R_{\theta JC}$ | 83 | $^\circ\text{C/W}$ |
| Case 626 N Suffix | | | |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 105 | $^\circ\text{C/W}$ |
| Case 846A (Micro8) DM Suffix | | | |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 240 | $^\circ\text{C/W}$ |
| Feedback Input Voltage | V_{fb} | -1.5 to +30 | Vdc |
| Shutdown Input Voltage | V_{sd} | -0.3 to +30 | Vdc |
| Error Comparator Output Voltage | V_{err} | -0.3 to +30 | Vdc |
| Operating Ambient Temperature Range | T_A | -40 to +125 | $^\circ\text{C}$ |
| Maximum Die Junction Temperature Range | T_J | +150 | $^\circ\text{C}$ |
| Storage Temperature Range | T_{stg} | -65 to +150 | $^\circ\text{C}$ |

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.

LP2950, LP2951, NCV2951

ELECTRICAL CHARACTERISTICS ($V_{in} = V_O + 1.0\text{ V}$, $I_O = 100\ \mu\text{A}$, $C_O = 1.0\ \mu\text{F}$, $T_A = 25^\circ\text{C}$ [Note 3], unless otherwise noted.)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|--|--------|-----|-----|-----|------|
| Output Voltage, 5.0 V Versions $V_{in} = 6.0\text{ V}$, $I_O = 100\ \mu\text{A}$, $T_A = 25^\circ\text{C}$ LP2950C–5.0/LP2951C/NCV2951C* LP2950AC–5.0/LP2951AC/NCV2951AC* $T_A = -40\text{ to }+125^\circ\text{C}$ LP2950C–5.0/LP2951C/NCV2951C* LP2950AC–5.0/LP2951AC/NCV2951AC* $V_{in} = 6.0\text{ to }30\text{ V}$, $I_O = 100\ \mu\text{A to }100\text{ mA}$, $T_A = -40\text{ to }+125^\circ\text{C}$ LP2950C–5.0/LP2951C/NCV2951C* LP2950AC–5.0/LP2951AC/NCV2951AC* | V_O | | | | V |
| Output Voltage, 3.3 V Versions $V_{in} = 4.3\text{ V}$, $I_O = 100\ \mu\text{A}$, $T_A = 25^\circ\text{C}$ LP2950C–3.3/LP2951C–3.3 LP2950AC–3.3/LP2951AC–3.3/NCV2951AC–3.3* $T_A = -40\text{ to }+125^\circ\text{C}$ LP2950C–3.3/LP2951C–3.3 LP2950AC–3.3/LP2951AC–3.3/NCV2951AC–3.3* $V_{in} = 4.3\text{ to }30\text{ V}$, $I_O = 100\ \mu\text{A to }100\text{ mA}$, $T_A = -40\text{ to }+125^\circ\text{C}$ LP2950C–3.3/LP2951C–3.3 LP2950AC–3.3/LP2951AC–3.3/NCV2951AC–3.3* | V_O | | | | V |
| Output Voltage, 3.0 V Versions $V_{in} = 4.0\text{ V}$, $I_O = 100\ \mu\text{A}$, $T_A = 25^\circ\text{C}$ LP2950C–3.0/LP2951C–3.0 LP2950AC–3.0/LP2951AC–3.0 $T_A = -40\text{ to }+125^\circ\text{C}$ LP2950C–3.0/LP2951C–3.0 LP2950AC–3.0/LP2951AC–3.0 $V_{in} = 4.0\text{ to }30\text{ V}$, $I_O = 100\ \mu\text{A to }100\text{ mA}$, $T_A = -40\text{ to }+125^\circ\text{C}$ LP2950C–3.0/LP2951C–3.0 LP2950AC–3.0/LP2951AC–3.0 | V_O | | | | V |

1. The Junction-to-Ambient Thermal Resistance is determined by PCB copper area per Figure 29.
 2. This device series contains ESD protection and exceeds the following tests:
 Human Body Model (HBM), 2000 V, Class 2, JESD22 A114–C
 Machine Model (MM), 200 V, Class B, JESD22 A115–A
 Charged Device Model (CDM), 2000 V, Class IV, JESD22 C101–C
 3. Low duty pulse techniques are used during test to maintain junction temperature as close to ambient as possible.
 4. $V_{O(nom)}$ is the part number voltage option.
 5. Noise tests on the LP2951 are made with a 0.01 μF capacitor connected across Pins 7 and 1.
- *NCV prefix is for automotive and other applications requiring site and change control.

LP2950, LP2951, NCV2951

ELECTRICAL CHARACTERISTICS (continued) ($V_{in} = V_O + 1.0\text{ V}$, $I_O = 100\ \mu\text{A}$, $C_O = 1.0\ \mu\text{F}$, $T_A = 25^\circ\text{C}$ [Note 8], unless otherwise noted.)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|--|-------------------|-----|--------------|--------------|---------------------|
| Line Regulation ($V_{in} = V_{O(nom)} + 1.0\text{ V}$ to 30 V) (Note 9) LP2950C-XX/LP2951C/LP2951C-XX/NCV2951C* LP2950AC-XX/LP2951AC/LP2951AC-XX/NCV2951AC* | Reg_{line} | - | 0.08 0.04 | 0.20 0.10 | % |
| Load Regulation ($I_O = 100\ \mu\text{A}$ to 100 mA) LP2950C-XX/LP2951C/LP2951C-XX/NCV2951C* LP2950AC-XX/LP2951AC/LP2951AC-XX/NCV2951AC* | Reg_{load} | - | 0.13 0.05 | 0.20 0.10 | % |
| Dropout Voltage $I_O = 100\ \mu\text{A}$ $I_O = 100\text{ mA}$ | $V_I - V_O$ | - | 30 350 | 80 450 | mV |
| Supply Bias Current $I_O = 100\ \mu\text{A}$ $I_O = 100\text{ mA}$ | I_{CC} | - | 93 4.0 | 120 12 | μA mA |
| Dropout Supply Bias Current ($V_{in} = V_{O(nom)} - 0.5\text{ V}$, $I_O = 100\ \mu\text{A}$) (Note 9) | $I_{CC(dropout)}$ | - | 110 | 170 | μA |
| Current Limit (V_O Shorted to Ground) | I_{Limit} | - | 220 | 300 | mA |
| Thermal Regulation | $Reg_{thermal}$ | - | 0.05 | 0.20 | %/W |
| Output Noise Voltage (10 Hz to 100 kHz) (Note 10) $C_L = 1.0\ \mu\text{F}$ $C_L = 100\ \mu\text{F}$ | V_n | - | 126 56 | - - | μV_{rms} |

LP2951A/LP2951AC Only

| | | | | | |
|--|-----------|----------------|----------------|----------------|----|
| Reference Voltage ($T_A = 25^\circ\text{C}$) LP2951C/LP2951C-XX/NCV2951C* LP2951AC/LP2951AC-XX/NCV2951AC* | V_{ref} | 1.210 1.220 | 1.235 1.235 | 1.260 1.250 | V |
| Reference Voltage ($T_A = -40$ to $+125^\circ\text{C}$) LP2951C/LP2951C-XX/NCV2951C* LP2951AC/LP2951AC-XX/NCV2951AC* | V_{ref} | 1.200 1.200 | - - | 1.270 1.260 | V |
| Reference Voltage ($T_A = -40$ to $+125^\circ\text{C}$) $I_O = 100\ \mu\text{A}$ to 100 mA , $V_{in} = 23$ to 30 V LP2951C/LP2951C-XX/NCV2951C* LP2951AC/LP2951AC-XX/NCV2951AC* | V_{ref} | 1.185 1.190 | - - | 1.285 1.270 | V |
| Feedback Pin Bias Current | I_{FB} | - | 15 | 40 | nA |

Error Comparator

| | | | | | |
|--|-----------|----|------|-----|---------------|
| Output Leakage Current ($V_{OH} = 30\text{ V}$) | I_{lkg} | - | 0.01 | 1.0 | μA |
| Output Low Voltage ($V_{in} = 4.5\text{ V}$, $I_{OL} = 400\ \mu\text{A}$) | V_{OL} | - | 150 | 250 | mV |
| Upper Threshold Voltage ($V_{in} = 6.0\text{ V}$) | V_{thu} | 40 | 45 | - | mV |
| Lower Threshold Voltage ($V_{in} = 6.0\text{ V}$) | V_{thl} | - | 60 | 95 | mV |
| Hysteresis ($V_{in} = 6.0\text{ V}$) | V_{hy} | - | 15 | - | mV |

Shutdown Input

| | | | | | |
|---|------------|----------|-----------|-----------|---------------|
| Input Logic Voltage Logic "0" (Regulator "On") Logic "1" (Regulator "Off") | V_{shdn} | 0 2.0 | - - | 0.7 30 | V |
| Shutdown Pin Input Current $V_{shdn} = 2.4\text{ V}$ $V_{shdn} = 30\text{ V}$ | I_{shdn} | - - | 35 450 | 50 600 | μA |
| Regulator Output Current in Shutdown Mode ($V_{in} = 30\text{ V}$, $V_{shdn} = 2.0\text{ V}$, $V_O = 0$, Pin 6 Connected to Pin 7) | I_{off} | - | 3.0 | 10 | μA |

6. The Junction-to-Ambient Thermal Resistance is determined by PCB copper area per Figure 29.

7. ESD data available upon request.

8. Low duty pulse techniques are used during test to maintain junction temperature as close to ambient as possible.

9. $V_{O(nom)}$ is the part number voltage option.

10. Noise tests on the LP2951 are made with a $0.01\ \mu\text{F}$ capacitor connected across Pins 7 and 1.

*NCV prefix is for automotive and other applications requiring site and change control.

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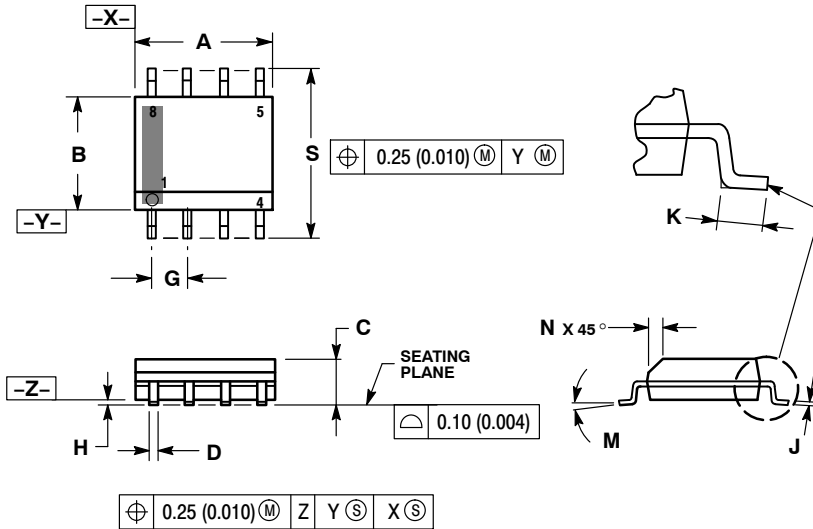
ORDERING INFORMATION (LP2951)

| Part Number | Output Voltage (Volts) | Tolerance (%) | Package | Shipping† |
|------------------|------------------------|---------------|------------------|--------------------------|
| LP2951CD-3.0 | 3.0 | 1.0 | SOIC-8 | 98 Units / Rail |
| LP2951CD-3.0G | 3.0 | 1.0 | SOIC-8 (Pb-Free) | 98 Units / Rail |
| LP2951CD-3.0R2 | 3.0 | 1.0 | SOIC-8 | 2500 Units / Tape & Reel |
| LP2951CD-3.0R2G | 3.0 | 1.0 | SOIC-8 (Pb-Free) | 2500 Units / Tape & Reel |
| LP2951ACD-3.0 | 3.0 | 0.5 | SOIC-8 | 98 Units / Rail |
| LP2951ACD-3.0G | 3.0 | 0.5 | SOIC-8 (Pb-Free) | 98 Units / Rail |
| LP2951ACD-3.0R2 | 3.0 | 0.5 | SOIC-8 | 2500 Units / Tape & Reel |
| LP2951ACD-3.0R2G | 3.0 | 0.5 | SOIC-8 (Pb-Free) | 2500 Units / Tape & Reel |
| LP2951CD-3.3 | 3.3 | 1.0 | SOIC-8 | 98 Units / Rail |
| LP2951CD-3.3G | 3.3 | 1.0 | SOIC-8 (Pb-Free) | 98 Units / Rail |
| LP2951CD-3.3R2 | 3.3 | 1.0 | SOIC-8 | 2500 Units / Tape & Reel |
| LP2951CD-3.3R2G | 3.3 | 1.0 | SOIC-8 (Pb-Free) | 2500 Units / Tape & Reel |
| LP2951ACD-3.3 | 3.3 | 0.5 | SOIC-8 | 98 Units / Rail |
| LP2951ACD-3.3G | 3.3 | 0.5 | SOIC-8 (Pb-Free) | 98 Units / Rail |
| LP2951ACD-3.3R2 | 3.3 | 0.5 | SOIC-8 | 2500 Units / Tape & Reel |
| LP2951ACD-3.3R2G | 3.3 | 0.5 | SOIC-8 (Pb-Free) | 2500 Units / Tape & Reel |
| LP2951CD | 5.0 or Adj. | 1.0 | SOIC-8 | 98 Units / Rail |
| LP2951CDG | 5.0 or Adj. | 1.0 | SOIC-8 (Pb-Free) | 98 Units / Rail |
| LP2951CDR2 | 5.0 or Adj. | 1.0 | SOIC-8 | 2500 Units / Tape & Reel |
| LP2951CDR2G | 5.0 or Adj. | 1.0 | SOIC-8 (Pb-Free) | 2500 Units / Tape & Reel |
| LP2951ACD | 5.0 or Adj. | 0.5 | SOIC-8 | 98 Units / Rail |
| LP2951ACDG | 5.0 or Adj. | 0.5 | SOIC-8 (Pb-Free) | 98 Units / Rail |
| LP2951ACDR2 | 5.0 or Adj. | 0.5 | SOIC-8 | 2500 Units / Tape & Reel |
| LP2951ACDR2G | 5.0 or Adj. | 0.5 | SOIC-8 (Pb-Free) | 2500 Units / Tape & Reel |
| LP2951CDM-3.0R2 | 3.0 | 1.0 | Micro8 | 4000 Units / Tape & Reel |
| LP2951CDM-3.0R2G | 3.0 | 1.0 | Micro8 (Pb-Free) | 4000 Units / Tape & Reel |
| LP2951ACDM-3.0R2 | 3.0 | 0.5 | Micro8 | 4000 Units / Tape & Reel |
| LP2951CDM-3.3R2 | 3.3 | 1.0 | Micro8 | 4000 Units / Tape & Reel |
| LP2951CDM-3.3R2G | 3.3 | 1.0 | Micro8 (Pb-Free) | 4000 Units / Tape & Reel |
| LP2951ACDM-3.3RG | 3.3 | 0.5 | Micro8 (Pb-Free) | 4000 Units / Tape & Reel |
| LP2951ACDM-3.3R2 | 3.3 | 0.5 | Micro8 | 4000 Units / Tape & Reel |
| LP2951CDMR2 | 5.0 or Adj. | 1.0 | Micro8 | 4000 Units / Tape & Reel |
| LP2951CDMR2G | 5.0 or Adj. | 1.0 | Micro8 (Pb-Free) | 4000 Units / Tape & Reel |
| LP2951ACDMR2 | 5.0 or Adj. | 0.5 | Micro8 | 4000 Units / Tape & Reel |
| LP2951ACDMR2G | 5.0 or Adj. | 0.5 | Micro8 (Pb-Free) | 4000 Units / Tape & Reel |

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PACKAGE DIMENSIONS

SOIC-8 D SUFFIX PLASTIC PACKAGE CASE 751-07 ISSUE AJ

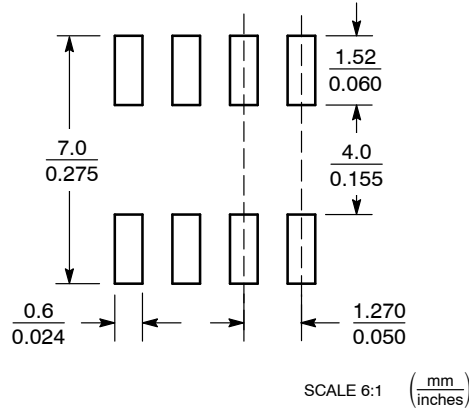


NOTES:

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.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | 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*



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