

DESCRIPTION

The LP2950-XX/LP2951-XX is micropower voltage regulators with very low quiescent current (75uA typ.) and very low dropout voltage (typ. 40 mV at light loads and 380mV at 100mA). Careful design of the LP2950-XX/LP2951-XX has minimized all contributions to the error budget. This includes a tight initial tolerance (0.5% typ.), extremely good load and line regulation (0.05% typ.) and a very low output voltage temperature coefficient, making the part useful as a low-power voltage reference. The LP2950-XX/LP2951XX is ideally suited for use in battery powered systems. Furthermore, the quiescent current of the LP2950-XX/LP2951-XX increases only slightly in dropout, prolonging battery life.

Another feature is an error flag output which warns of a low output voltage, often due to falling batteries on the input. It may be used for a power-on reset. A second feature is the logic-compatible shutdown input which enables the regulator to be switched on and off. Also the part may be pin strapped for a 5V, 3V, or 3.3V output (depending on version), or programmed from 1.24V to 29V with an external pair of resistors. The LP2950-XX is offered in 3-pin TO-92 package compatible with other fixed regulator.

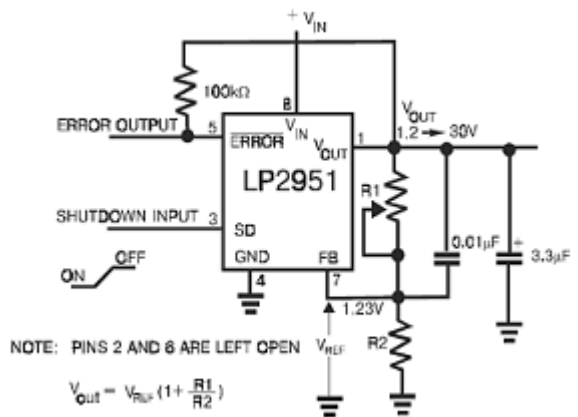
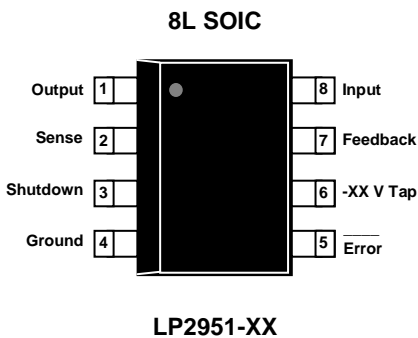
FEATURES

- High accuracy output voltage
- Guaranteed 100mA output current voltage
- Very low quiescent current
- Low dropout voltage
- Extremely tight load and line regulation
- Very low temperature coefficient
- Needs only 1uF for stability
- Error Flag warns of output dropout
- Logic-Controlled electronic shutdown
- Output programmable from 1.24V to 29V

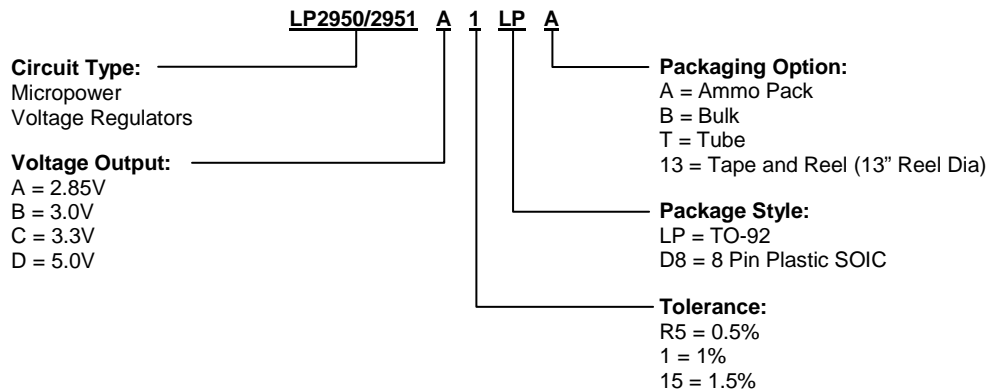
APPLICATIONS

- Battery Powered Systems
- Cordless Telephones
- Radio Control Systems
- Portable/ Palm Top/ Notebook Computers
- Portable Consumer Equipment
- Portable Instrumentation
- Avionics
- Automotive Electronics
- SMPS Post-Regulator
- Voltage Reference

PIN CONFIGURATION – Top View



ORDERING INFORMATION



ABSOLUTE MAXIMUM RATINGS

| | |
|--|--------------------|
| Power Dissipation | Internally Limited |
| Lead Temperature (Soldering, 5 seconds) | 260°C |
| Storage Temperature Range | -65°C to +150°C |
| Operating Junction Temperature Range | -55°C to +125°C |
| Input Supply Voltage | -0.3 to +30V |
| Feedback Input Voltage | -1.5 to +30V |
| Error Comparator Output | -0.3 to +30V |

DEVICE SELECTION GUIDE

| Vout, Volts | Device |
|-------------|--------------------------|
| 2.85* | LP2950-2.85, LP2951-2.85 |
| 3.0 | LP2950-3.0, LP2951-3.0 |
| 3.3 | LP2950-3.3, LP2951-3.3 |
| 5.0 | LP2950-5.0, LP2951-5.0 |

ELECTRICAL CHARACTERISTICS (at Ta = 25°C, Vin = 15V: unless otherwise noted)

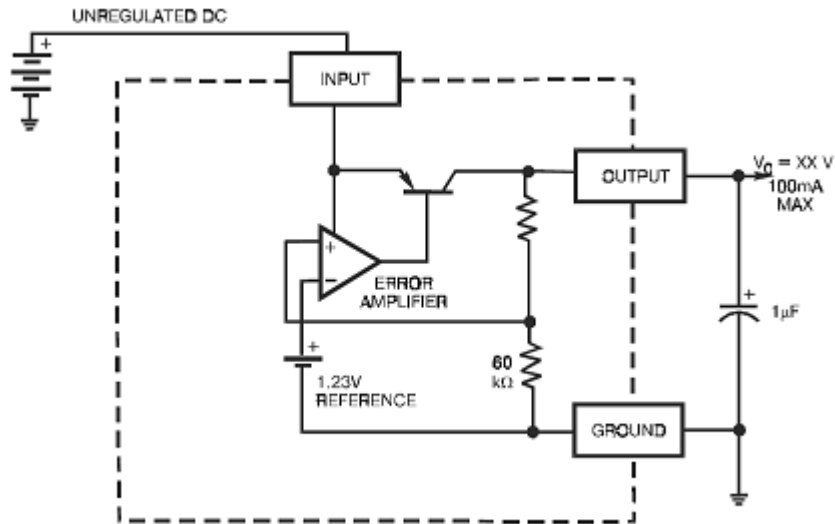
| Parameter | Conditions (Note 2) | Min | Typ | Max | Units | |
|---|---|-------|--------------------|-----------|--------------------|---|
| Output Voltage | at 25°C Full Operating Temperature | 0.5% | 0.995Vo 0.988Vo | Vo | 1.05Vo 1.012Vo | V |
| | at 25°C Full Operating Temperature | 1% | 0.990Vo 0.988Vo | Vo | 1.010Vo 1.012Vo | |
| | at 25°C Full Operating Temperature | 1.5% | 0.985Vo 0.98Vo | Vo | 1.015Vo 1.02Vo | |
| Output Voltage | 100µA ≤ IL ≤ 100mA, TJ ≤ TJMAX | 0.5% | 0.985Vo | Vo | 1.015Vo | |
| | | 1% | 0.985Vo | Vo | 1.015Vo | |
| | | 1.5% | 0.976Vo | Vo | 1.024Vo | |
| Output Voltage Temperature Coefficient | (Note 1) | | 50 | 150 | ppm/°C | |
| Line Regulation (Note3) | Vo + 1V ≤ Vin ≤ 30V (Note 4) | | 0.04 | 0.4 | % | |
| Load Regulation (Note3) | 100µA ≤ IL ≤ 100mA | | 0.1 | 0.3 | % | |
| Dropout Voltage (Note 5) | IL=100uA IL=100mA | | 50 380 | 80 450 | mV | |
| Ground Current | IL=100uA IL=100mA | | 75 8 | 120 12 | uA mA | |
| | | | | | | |
| Dropout Ground Current | Vin=Vo - 0.5V, IL=100 µA | | 110 | 170 | µA | |
| Current Limit | Vout=0 | | 160 | 200 | mA | |
| Thermal Regulation | | | 0.05 | 0.2 | %/W | |
| Output Noise, 10Hz to 100KHz | CL=1µF CL=200µF CL=3.3µF (Bypass=0.01 µF pins 7 to 1 (LP2951-XX)) | | 430 160 100 | | µV rms | |
| 8-pin Versions only | | | | | | |
| Reference Voltage | | 1.21 | 1.235 | 1.26 | V | |
| Reference Voltage | Over Temperature (Note 6) | 1.185 | | 1.285 | | |
| Feedback Pin Bias Current | | | 20 | 40 | nA | |
| Reference Voltage Temperature Coefficient | (Note 7) | | 50 | | ppm/°C | |
| Feedback Pin Bias Current Temperature Coefficient | | | 0.1 | | nA/°C | |

ELECTRICAL CHARACTERISTICS (at Ta = 25°C, Vin = 15V: unless otherwise noted)
(Continued)

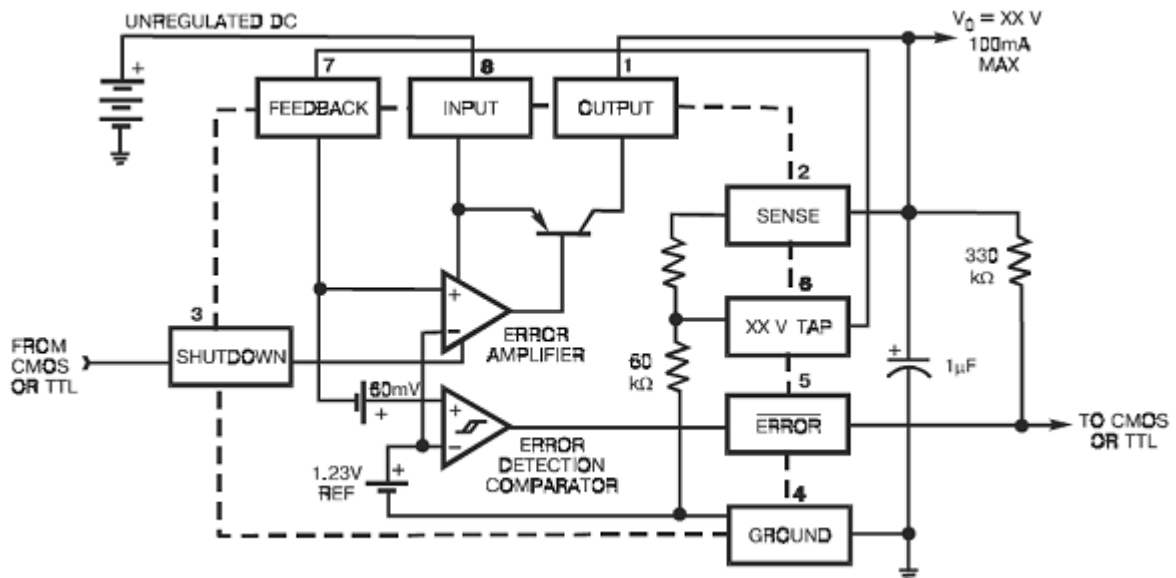
| Error Comparator | | | | | |
|--------------------------------------|--|----|-----------|-----------|----|
| Output Leakage Current | Voh=30V | | 0.01 | 1.0 | μA |
| Output Low Voltage | Vin=4.5V, IOL=400 μA | | 150 | 250 | mV |
| Upper Threshold Voltage | (Note 8) | 40 | 60 | | |
| Lower Threshold Voltage | (Note 8) | | 75 | 95 | |
| Hysterisis | (Note 8) | | 15 | | |
| Shutdown Input | | | | | |
| Input Logic Voltage | Low (Regulator ON) High (Regulator OFF) | 2 | 1.3 | 0.7 | V |
| Shutdown Pin Input Current | Vs=2.4V Vs=30V | | 30 450 | 50 600 | μA |
| Regulator Output Current in Shutdown | (Note 9) | | | | |
| | VOUT = 5.0 V | | 3 | 10 | |
| | 3.3V ≤ VOUT < 5.0 V | | | 20 | |
| | 2.0V ≤ VOUT < 3.3 V | | | 30 | |

- Note 1:** Absolute Maximum Ratings are limits beyond which damage to the device may occur. For guaranteed performance limits and associated test conditions, see the Electrical Characteristics tables.
- Note 2:** Unless otherwise specified all limits guaranteed for Tj=25°C, Vin=Vo + 1V, IL=100uA and CL=1uF for 5V versions and 2.2uF for 3V and 3.3V versions. Additional conditions for the 8-pin versions are FEEDBACK tied to VTAP, OUTPUT tied to SENSE, and VSHUTDOWN < 0.8V.
- Note 3:** Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output voltage due to heating effects are covered under specification for thermal regulation.
- Note 4:** Line regulation for the LP2951-XX is tested at 150°C for IL=mA. For IL=100uA and Tj=125°C, line regulation is guaranteed by design to 0.2%.
- Note 5:** Dropout voltage is defined as the input to output differential at which the output voltage drops 100mV below its nominal value measured at 1V differential. At very low values of programmed output voltage, the minimum supply voltage of 2V (2.3V over temperature) must be taken into account.
- Note 6:** VREF≤VOUT≤(VIN-1V), 2.3V≤VIN≤30V, 100uA≤IL≤100mA, Tj≤TMAX.
- Note 7:** Output or reference voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.
- Note 8:** Comparator thresholds are expressed in terms of a voltage differential at the feedback terminal below the nominal reference voltage measured at Vo + 1V input. To express these thresholds in terms of output voltage change, multiply by the error amplifier gain = Vout/ Vref = (R1+ R2)/R2. For example, at a programmed output voltage of 5V, the error output is guaranteed to go low when the output drops by 95mV 5V/1.235V = 384mV. Thresholds remain constant as a percent of Vout as Vout is varied, with the dropout warning occurring at typically 5% below nominal, 7.5% guaranteed.
- Note 9:** Vshutdown ≥2V, Vin ≤30V, Vout=0, Feed-back pin tied to-XX V tap.

LP2950-XX

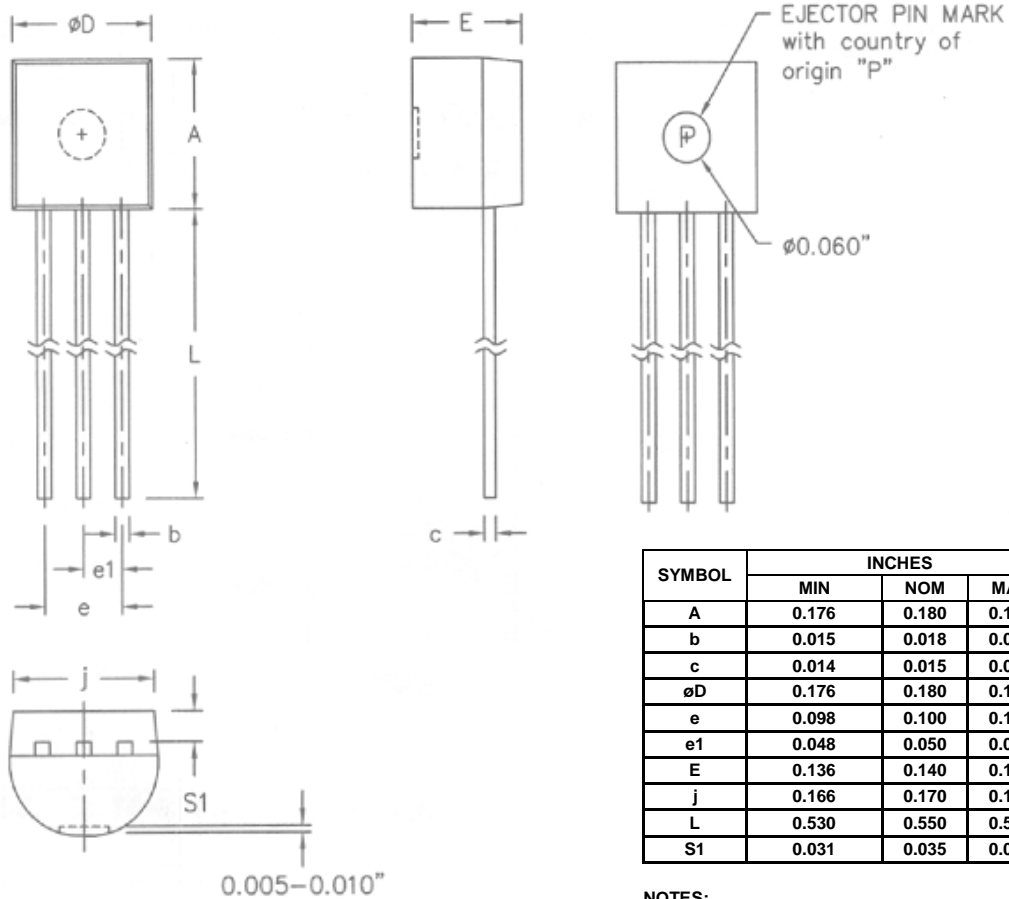


LP2951-XX



TO-92 PACKAGE DIMENSION

3-Lead TO-92 Plastic Package
SLI Package Code: LP

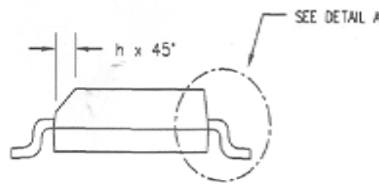
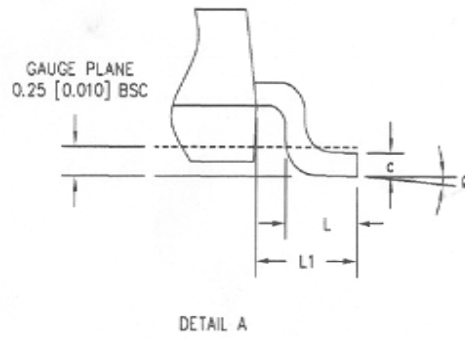
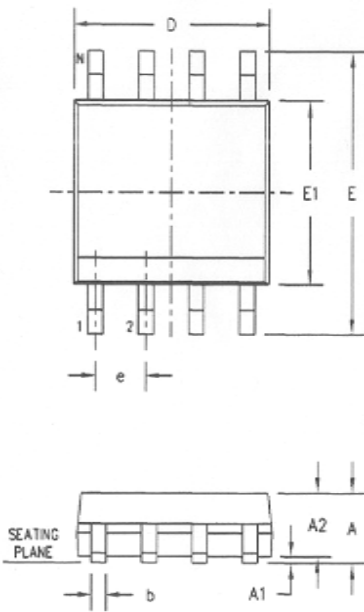


| SYMBOL | INCHES | | |
|----------|--------|-------|-------|
| | MIN | NOM | MAX |
| A | 0.176 | 0.180 | 0.184 |
| b | 0.015 | 0.018 | 0.022 |
| c | 0.014 | 0.015 | 0.020 |
| ϕD | 0.176 | 0.180 | 0.184 |
| e | 0.098 | 0.100 | 0.102 |
| e1 | 0.048 | 0.050 | 0.052 |
| E | 0.136 | 0.140 | 0.144 |
| j | 0.166 | 0.170 | 0.174 |
| L | 0.530 | 0.550 | 0.570 |
| S1 | 0.031 | 0.035 | 0.039 |

- NOTES:
1. ALL DIMENSIONS IN INCHES.
 2. A MECHANICAL TOLERANCE OF ± 0.002 " APPLIES TO ALL DIMENSIONS WHERE NO TOLERANCE IS EXPLICITLY GIVEN.
 3. BASED FROM JEDEC T0-226 VARIATION AA OUTLINE.

8L-SOIC PACKAGE DIMENSION

8-Lead SOIC Plastic
Surface Mounted Package
SLI Package Code: D8



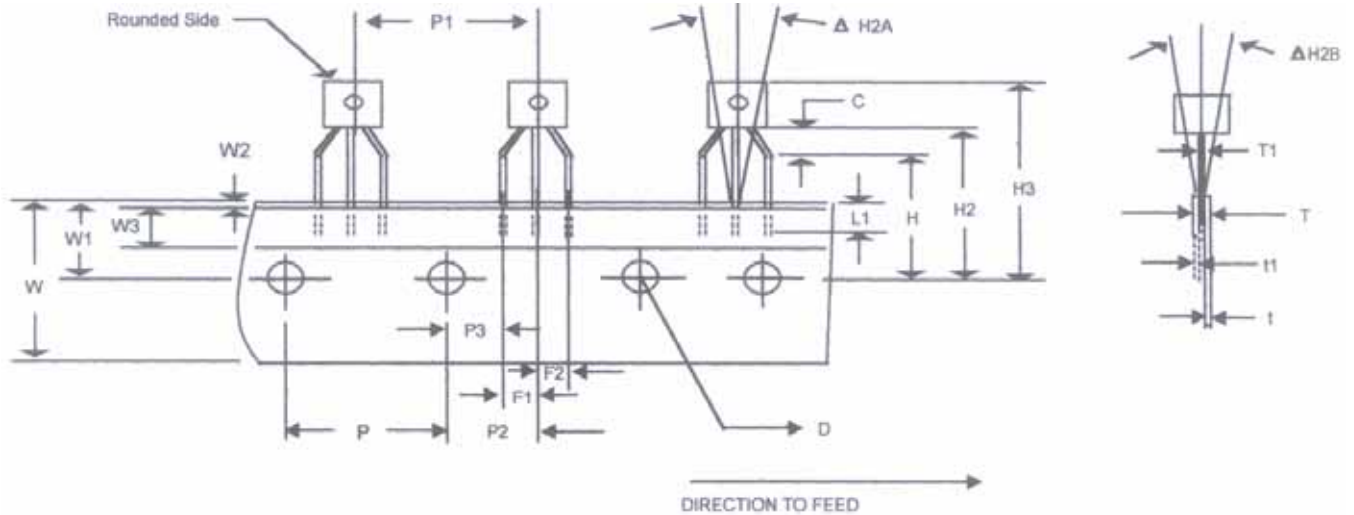
| SYM | DIMENSION IN INCHES | | | DIMENSION IN MM | | |
|-----|---------------------|-------|-------|-----------------|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 0.059 | 0.062 | 0.065 | 1.50 | 1.57 | 1.65 |
| A1 | 0.004 | 0.008 | 0.010 | 0.10 | 0.20 | 0.25 |
| A2 | 0.051 | 0.054 | 0.057 | 1.30 | 1.37 | 1.45 |
| b | 0.013 | 0.016 | 0.020 | 0.33 | 0.41 | 0.51 |
| c | 0.007 | 0.008 | 0.010 | 0.18 | 0.20 | 0.25 |
| D | 0.191 | 0.193 | 0.195 | 4.85 | 4.90 | 4.95 |
| E1 | 0.151 | 0.153 | 0.155 | 3.84 | 3.89 | 3.94 |
| E | 0.228 | 0.234 | 0.240 | 5.79 | 5.94 | 6.10 |
| e | 0.050 | | | 1.27 | | |
| L | 0.020 | 0.024 | 0.032 | 0.51 | 0.61 | 0.81 |
| L1 | 0.039 | 0.041 | 0.043 | 0.99 | 1.04 | 1.09 |
| Ø | 0* | - | B* | 0* | - | B* |
| h | 0.011 | 0.015 | 0.019 | 0.28 | 0.38 | 0.48 |

NOTES:

1. DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS.
2. COPLANARITY APPLIES TO THE TERMINALS. COPLANARITY SHALL NOT EXCEED 0.003" [0.08 mm].
3. BASED FROM JEDEC NS-012 VARIATION AA.



TO-92 AMMO PACK SPECIFICATIONS

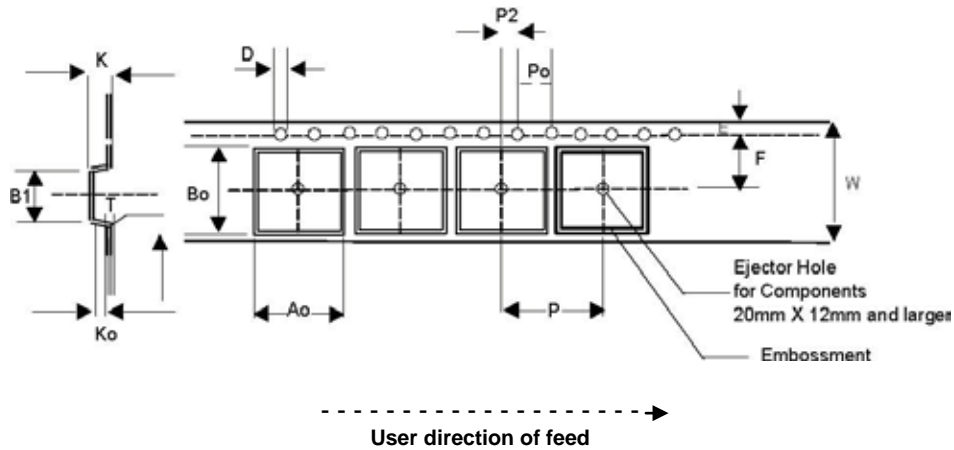


| SYMBOL | DESCRIPTION | NOMINAL VALUE | | TOLERANCES | | | |
|-------------|---|---------------|-------|------------|-------|-------|-------|
| | | | | min | | max | |
| | | mm | inch | mm | inch | mm | inch |
| D | Feed Hole Diameter | 4.0 | 0.157 | 3.8 | 0.150 | 4.2 | 0.165 |
| T1 (POD) | Component Lead Thickness | 0.405 | 0.016 | 0.36 | 0.014 | 0.45 | 0.018 |
| F1/F2 | Lead Pitch (Left / Right) | 2.54 | 0.100 | 2.4 | 0.094 | 2.8 | 0.110 |
| C | Bottom of Component to Seating Plane | 2.50 | 0.098 | 1.50 | 0.059 | 4.00 | 0.157 |
| W1 | Edge to Sprocket Hole Center | 9.0 | 0.354 | 8.50 | 0.335 | 9.50 | 0.374 |
| H2A | Deflection (Left or Right) | 0.50 | 0.020 | 0 | 0 | 0.50 | 0.020 |
| H2B | Deflection (Front or Rear) | 1.0 | 0.039 | 0 | 0 | 1.0 | 0.039 |
| H2 (H + C) | Feed Hole to Bottom of Component | 18.5 | 0.728 | 17.00 | 0.669 | 20.50 | 0.087 |
| H | Height of Seating Plane | 16 | 0.630 | 15.5 | 0.610 | 16.5 | 0.650 |
| H3 | Feed Hole Center to Overall Transistor Height | 27.75 | 1.092 | 23.5 | 0.925 | 32.0 | 1.260 |
| L | Defective Unit Clipped Dimension | - | - | - | - | 11.0 | 0.433 |
| L1 | Leadwire Enclosure | 2.50 | 0.098 | 2.50 | 0.098 | - | - |
| P | Feed Hole Pitch | 12.7 | 0.500 | 12.40 | 0.488 | 13.0 | 0.512 |
| P2 | Center of Feed Hole to Center Lead | 6.35 | 0.250 | 6.0 | 0.234 | 6.75 | 0.266 |
| P3 (P2-F1) | First Lead Spacing Dimension | 3.75 | 0.148 | 3.6 | 0.142 | 3.95 | 0.156 |
| P1 | Center Lead to Center Lead | 12.7 | 0.500 | 12.2 | 0.500 | 13.2 | 0.520 |
| t1 | Adhesive Tape Thickness | 0.18 | 0.007 | 0.16 | 0.006 | 0.20 | 0.008 |
| T (t+t1+T1) | Overall Taped Package Thickness | - | - | - | - | 1.55 | 0.061 |
| T | Carrier Strip Thickness | 0.37 | 0.015 | 0.27 | 0.011 | 0.47 | 0.018 |
| W | Carrier Strip Width (18mm) | 18.00 | 0.709 | 17.5 | 0.689 | 19.0 | 0.748 |
| W3 | Adhesive Tape Width (6mm) | 6.00 | 0.236 | 5.5 | 0.217 | 6.3 | 0.248 |
| W2 | Adhesive Tape Position | 0.25 | 0.010 | 0 | 0 | 0.50 | 0.020 |

| TO-92 Ammo Pack Requirement | | | |
|-----------------------------|----|-------------------|--------------|
| Components | | Tape Width (W) mm | Fan Fold Box |
| TO92 | 3L | 18 | 2000 |

PACKAGE MECHANICAL DRAWING

**Surface Mountable Tape & Reel Specifications in mm (inch)
(SOIC)**

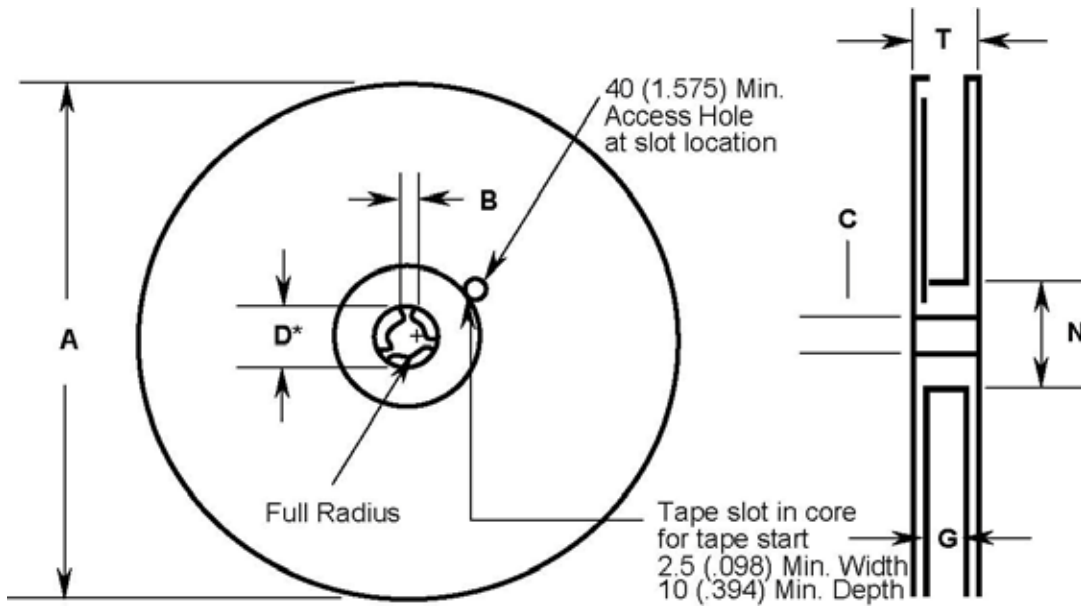


| Tape Size (W) | D | E | P0 | T (Max) | A0, B0, K0 | T1 (Max) | Constant Dimensions |
|-----------------|--------------------------|--------------------------|-------------------------|-----------------|------------|-----------------|---------------------|
| 8, 12, 16, 24mm | 1.55±0.05 (.061±.002) | 1.75±0.10 (.069±.004) | 4.0±0.10 (.157±.004) | 0.400 (.016) | See Note | 0.100 (.004) | |

| Tape Size (W) | B1 Max. | D1 Min. | F | K Max. | P2 | |
|---------------|---------------|---------------|-------------------------|---------------|-----------|---------------------|
| 8 mm | 4.2 (.165) | 1.0 (.039) | 3.5±0.05 (.138±.002) | 2.4 (.094) | 2.0±.05 | |
| 12 mm | 8.2 (.323) | 1.5 (.059) | 5.5±0.05 (.217±.002) | 4.5 (.177) | .079±.002 | Variable Dimensions |

| Per Package Requirement | | | | | |
|-------------------------|-------------------|---------------------|------------------|----------|--|
| Components | Tape Width (W) mm | Cavity Pitch (P) mm | Devices per Reel | | |
| | | | 7" Reel | 13" Reel | |
| SOIC 8L | 12 | 8 | | 2500 | |

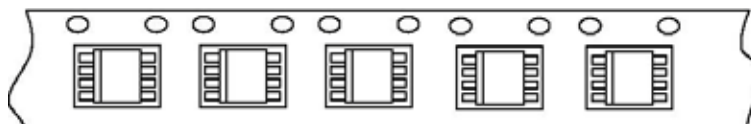
Note: A0 B0 K0 are determined by component size. The clearance between the component and the cavity must be within 0.05 [.002] min. to 0.50 [.020] max. for 8mm tape, 0.05 [.002] min to 0.65 [.026] max for 12mm tape.



| REEL DIMENSIONS | | | | | | | |
|-----------------|-----------------|---------------|--------------------------|----------------|---------------|---------------------------------------|----------------|
| Tape Size | A Max. | B Min. | C | D* Min. | N Min. | G | T Max. |
| 8mm | 330 (12.992) | 1.5 (.059) | 13.0±0.20 (.152±.008) | 20.2 (.795) | 50 (1.973) | 8.4±1.5 0.0 (.331±.059) 0.0 | 14.4 (.567) |
| 12mm | 330 (12.992) | 1.5 (.059) | 13.0±0.20 (.152±.008) | 20.2 (.795) | 50 (1.973) | 12.4±2.0 0.0 (.488±.078) 0.0 | 14.4 (.567) |

MECHANICAL POLARIZATION

SOIC DEVICE



User direction of feed ----->