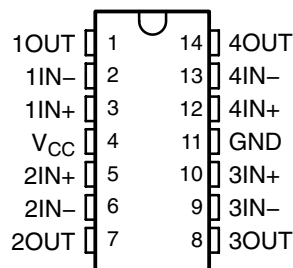


LM124, LM124A, LM224, LM224A, LM324, LM324A, LM2902, LM2902V, LM224K, LM224KA, LM324K, LM324KA, LM2902K, LM2902KV, LM2902KAV QUADRUPLE OPERATIONAL AMPLIFIERS

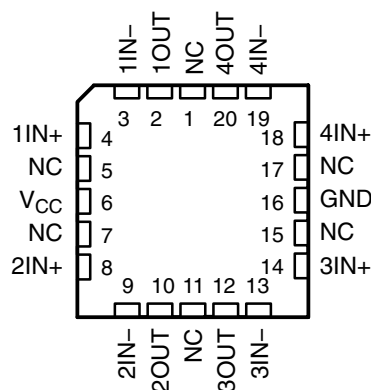
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- **2-kV ESD Protection for:**
 - LM224K, LM224KA
 - LM324K, LM324KA
 - LM2902K, LM2902KV, LM2902KAV
- **Wide Supply Ranges**
 - Single Supply . . . 3 V to 32 V
(26 V for LM2902)
 - Dual Supplies . . . ± 1.5 V to ± 16 V
(± 13 V for LM2902)
- **Low Supply-Current Drain Independent of Supply Voltage . . . 0.8 mA Typ**
- **Common-Mode Input Voltage Range Includes Ground, Allowing Direct Sensing Near Ground**
- **Low Input Bias and Offset Parameters**
 - Input Offset Voltage . . . 3 mV Typ
A Versions . . . 2 mV Typ
 - Input Offset Current . . . 2 nA Typ
 - Input Bias Current . . . 20 nA Typ
A Versions . . . 15 nA Typ
- **Differential Input Voltage Range Equal to Maximum-Rated Supply Voltage . . . 32 V (26 V for LM2902)**
- **Open-Loop Differential Voltage Amplification . . . 100 V/mV Typ**
- **Internal Frequency Compensation**

LM124 . . . D, J, OR W PACKAGE
LM124A . . . J OR W PACKAGE
LM224, LM224A, LM224K, LM224KA . . . D OR N PACKAGE
LM324, LM324K . . . D, N, NS, OR PW PACKAGE
LM324A . . . D, DB, N, NS, OR PW PACKAGE
LM324KA . . . D, N, NS, OR PW PACKAGE
LM2902 . . . D, N, NS, OR PW PACKAGE
LM2902K . . . D, DB, N, NS, OR PW PACKAGE
LM2902KV, LM2902KAV . . . D OR PW PACKAGE
(TOP VIEW)



LM124, LM124A . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

description/ordering information

These devices consist of four independent high-gain frequency-compensated operational amplifiers that are designed specifically to operate from a single supply over a wide range of voltages. Operation from split supplies also is possible if the difference between the two supplies is 3 V to 32 V (3 V to 26 V for the LM2902), and V_{CC} is at least 1.5 V more positive than the input common-mode voltage. The low supply-current drain is independent of the magnitude of the supply voltage.

Applications include transducer amplifiers, dc amplification blocks, and all the conventional operational-amplifier circuits that now can be more easily implemented in single-supply-voltage systems. For example, the LM124 can be operated directly from the standard 5-V supply that is used in digital systems and provides the required interface electronics, without requiring additional ± 15 -V supplies.

LM124, LM124A, LM224, LM224A, LM324, LM324A, LM2902, LM2902V, LM224K, LM224KA, LM324K, LM324KA, LM2902K, LM2902KV, LM2902KAV QUADRUPLE OPERATIONAL AMPLIFIERS

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ORDERING INFORMATION†

| T _A | V _{IOmax} AT 25°C | MAX TESTED V _{CC} | PACKAGE‡ | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|-------------------------------|----------------------------------|--------------|--------------|--------------------------|---------------------|
| 0°C to 70°C | 7 mV | 30 V | PDIP (N) | Tube of 25 | LM324N | LM324N |
| | | | | | LM324KN | LM324KN |
| | | | SOIC (D) | Tube of 50 | LM324D | LM324 |
| | | | | Reel of 2500 | LM324DR | |
| | | | | Reel of 2500 | LM324DRG3 | |
| | | | | Tube of 50 | LM324KD | LM324K |
| | | | | Reel of 2500 | LM324KDR | |
| | | | SOP (NS) | Reel of 2000 | LM324NSR | LM324 |
| | | | | Tube of 50 | LM324KNS | LM324K |
| | | | | Reel of 2000 | LM324KNSR | |
| | TSSOP (PW) | Tube of 90 | LM324PW | L324 | | |
| | | Reel of 2000 | LM324PWR | | | |
| | | Tube of 90 | LM324KPW | L324K | | |
| | | Reel of 2000 | LM324KPWR | | | |
| | 3 mV | 30 V | PDIP (N) | Tube of 25 | LM324AN | LM324AN |
| | | | | Tube of 25 | LM324KAN | LM324KAN |
| | | | SOIC (D) | Tube of 50 | LM324AD | LM324A |
| | | | | Reel of 2500 | LM324ADR | |
| | | | | Tube of 50 | LM324KAD | LM324KA |
| | | | | Reel of 2500 | LM324KADR | |
| SOP (NS) | | | Reel of 2000 | LM324ANSR | LM324A | |
| | | | Tube of 50 | LM324KANS | LM324KA | |
| | | | Reel of 2000 | LM324KANSR | | |
| SSOP (DB) | | | Reel of 2000 | LM324ADBR | LM324A | |
| TSSOP (PW) | | | Tube of 90 | LM324APW | L324A | |
| | | | Reel of 2000 | LM324APWR | | |
| | | | Tube of 90 | LM324KAPW | L324KA | |
| | | | Reel of 2000 | LM324KAPWR | | |
| -25°C to 85°C | 5 mV | 30 V | PDIP (N) | Tube of 25 | LM224N | LM224N |
| | | | | | LM224KN | LM224KN |
| | | | SOIC (D) | Tube of 50 | LM224D | LM224 |
| | | | | Reel of 2500 | LM224DR | |
| | | | | Tube of 50 | LM224KD | LM224K |
| | Reel of 2500 | LM224KDR | | | | |
| | 3 mV | 30 V | PDIP (N) | Tube of 25 | LM224AN | LM224AN |
| | | | | Tube of 25 | LM224KAN | LM224KAN |
| | | | SOIC (D) | Tube of 50 | LM224AD | LM224A |
| | | | | Reel of 2500 | LM224ADR | |
| Tube of 50 | | | | LM224KAD | LM224KA | |
| Reel of 2500 | LM224KADR | | | | | |

† For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.

‡ Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.



LM124, LM124A, LM224, LM224A, LM324, LM324A, LM2902, LM2902V, LM224K, LM224KA, LM324K, LM324KA, LM2902K, LM2902KV, LM2902KAV QUADRUPLE OPERATIONAL AMPLIFIERS

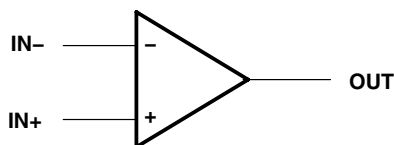
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ORDERING INFORMATION (CONTINUED)

| T_A | V_{IOmax} AT 25°C | MAX TESTED V_{CC} | PACKAGE† | ORDERABLE PART NUMBER | TOP-SIDE MARKING | | |
|----------------|------------------------|---------------------------|--------------|--------------------------|---------------------|----------|----------|
| -40°C to 125°C | 7 mV | 26 V | PDIP (N) | Tube of 25 | LM2902N | LM2902N | |
| | | | | Tube of 25 | LM2902KN | LM2902KN | |
| | | | SOIC (D) | Tube of 50 | LM2902D | LM2902 | |
| | | | | Reel of 2500 | LM2902DR | | |
| | | | | Tube of 50 | LM2902KD | LM2902K | |
| | | | | Reel of 2500 | LM2902KDR | | |
| | | | SOP (NS) | Reel of 2000 | LM2902NSR | LM2902 | |
| | | | | Tube of 50 | LM2902KNS | LM2902K | |
| | | | | Reel of 2000 | LM2902KNSR | | |
| | | | SSOP (DB) | Tube of 80 | LM2902KDB | L2902K | |
| | | | | Reel of 2000 | LM2902KDBR | | |
| | | | TSSOP (PW) | Tube of 90 | LM2902PW | L2902 | |
| | Reel of 2000 | LM2902PWR | | | | | |
| | Tube of 90 | LM2902KPW | | L2902K | | | |
| | Reel of 2000 | LM2902KPWR | | | | | |
| | 2 mV | 32 V | SOIC (D) | Reel of 2500 | LM2902KVQDR | L2902KV | |
| Reel of 2000 | | | | LM2902KVQPWR | L2902KV | | |
| TSSOP (PW) | | | Reel of 2500 | LM2902KAVQDR | L2902KA | | |
| | | | Reel of 2000 | LM2902KAVQPWR | L2902KA | | |
| -55°C to 125°C | 5 mV | 30 V | CDIP (J) | Tube of 25 | LM124J | LM124J | |
| | | | CFP (W) | Tube of 25 | LM124W | LM124W | |
| | | | LCCC (FK) | Tube of 55 | LM124FK | LM124FK | |
| | | | SOIC (D) | Tube of 50 | LM124D | LM124 | |
| | | | | Reel of 2500 | LM124DR | | |
| | 2 mV | 30 V | 30 V | CDIP (J) | Tube of 25 | LM124AJ | LM124AJ |
| | | | | CFP (W) | Tube of 25 | LM124AW | LM124AW |
| | | | | LCCC (FK) | Tube of 55 | LM124AFK | LM124AFK |

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

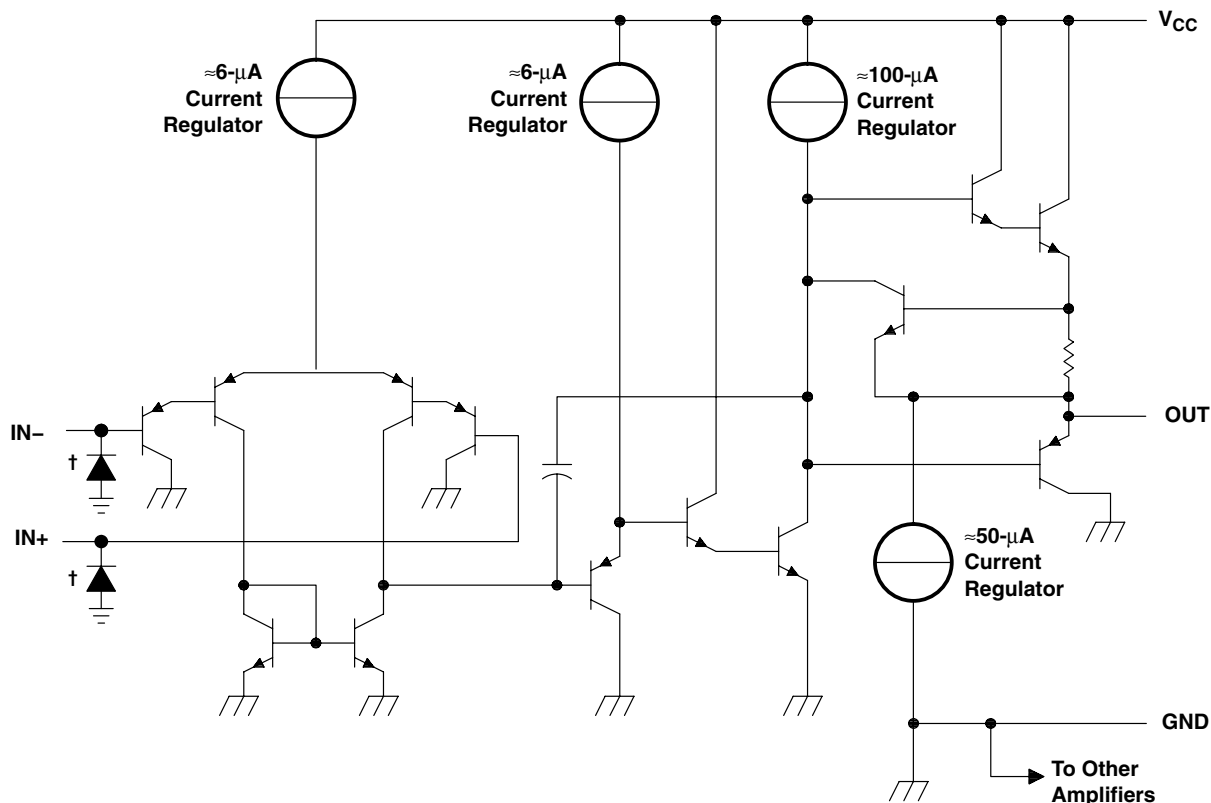
symbol (each amplifier)



LM124, LM124A, LM224, LM224A, LM324, LM324A, LM2902, LM2902V, LM224K, LM224KA, LM324K, LM324KA, LM2902K, LM2902KV, LM2902KAV QUADRUPLE OPERATIONAL AMPLIFIERS

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schematic (each amplifier)



| COMPONENT COUNT (total device) | |
|-----------------------------------|----|
| Epi-FET | 1 |
| Transistors | 95 |
| Diodes | 4 |
| Resistors | 11 |
| Capacitors | 4 |

† ESD protection cells - available on LM324K and LM324KA only

LM124, LM124A, LM224, LM224A, LM324, LM324A, LM2902, LM2902V, LM224K, LM224KA, LM324K, LM324KA, LM2902K, LM2902KV, LM2902KAV QUADRUPLE OPERATIONAL AMPLIFIERS

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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

| | | LM2902 | ALL OTHER DEVICES | UNIT |
|---|----------------|------------|-------------------|------|
| Supply voltage, V_{CC} (see Note 1) | | ±13 or 26 | ±16 or 32 | V |
| Differential input voltage, V_{ID} (see Note 2) | | ±26 | ±32 | V |
| Input voltage, V_I (either input) | | -0.3 to 26 | -0.3 to 32 | V |
| Duration of output short circuit (one amplifier) to ground at (or below) $T_A = 25^\circ\text{C}$, $V_{CC} \leq 15\text{ V}$ (see Note 3) | | Unlimited | Unlimited | |
| Package thermal impedance, θ_{JA} (see Notes 4 and 5) | D package | 86 | 86 | °C/W |
| | DB package | 96 | 96 | |
| | N package | 80 | 80 | |
| | NS package | 76 | 76 | |
| | PW package | 113 | 113 | |
| Package thermal impedance, θ_{JC} (see Notes 6 and 7) | FK package | | 5.61 | °C/W |
| | J package | | 15.05 | |
| | W package | | 14.65 | |
| Operating virtual junction temperature, T_J | | 150 | 150 | °C |
| Case temperature for 60 seconds | FK package | | 260 | °C |
| Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds | J or W package | 300 | 300 | °C |
| Storage temperature range, T_{stg} | | -65 to 150 | -65 to 150 | °C |

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES:
- All voltage values (except differential voltages and V_{CC} specified for the measurement of I_{OS}) are with respect to the network GND.
 - Differential voltages are at $IN+$, with respect to $IN-$.
 - Short circuits from outputs to V_{CC} can cause excessive heating and eventual destruction.
 - Maximum power dissipation is a function of $T_J(\text{max})$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
 - The package thermal impedance is calculated in accordance with JESD 51-7.
 - Maximum power dissipation is a function of $T_J(\text{max})$, θ_{JC} , and T_C . The maximum allowable power dissipation at any allowable case temperature is $P_D = (T_J(\text{max}) - T_C)/\theta_{JC}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
 - The package thermal impedance is calculated in accordance with MIL-STD-883.

ESD protection

| TEST CONDITIONS | | TYP | UNIT |
|------------------|--|-----|------|
| Human-Body Model | LM224K, LM224KA, LM324K, LM324KA, LM2902K, LM2902KV, LM2902KAV | ±2 | kV |



LM124, LM124A, LM224, LM224A, LM324, LM324A, LM2902, LM2902V, LM224K, LM224KA, LM324K, LM324KA, LM2902K, LM2902KV, LM2902KAV QUADRUPLE OPERATIONAL AMPLIFIERS

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electrical characteristics at specified free-air temperature, $V_{CC} = 5\text{ V}$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS† | T_A ‡ | LM124 LM224 | | | LM324 LM324K | | | UNIT | | |
|--|---|------------------------------|----------------|---------------------|----------|---------------------|----------------|----------|---------------|-----|----|
| | | | MIN | TYP§ | MAX | MIN | TYP§ | MAX | | | |
| V_{IO} Input offset voltage | $V_{CC} = 5\text{ V to MAX}$, $V_{IC} = V_{ICRmin}$, $V_O = 1.4\text{ V}$ | 25°C | | 3 | 5 | | 3 | 7 | mV | | |
| | | Full range | | | 7 | | | 9 | | | |
| I_{IO} Input offset current | $V_O = 1.4\text{ V}$ | 25°C | | 2 | 30 | | 2 | 50 | nA | | |
| | | Full range | | | 100 | | | 150 | | | |
| I_{IB} Input bias current | $V_O = 1.4\text{ V}$ | 25°C | | -20 | -150 | | -20 | -250 | nA | | |
| | | Full range | | | -300 | | | -500 | | | |
| V_{ICR} Common-mode input voltage range | $V_{CC} = 5\text{ V to MAX}$ | 25°C | | 0 to $V_{CC} - 1.5$ | | 0 to $V_{CC} - 1.5$ | | | V | | |
| | | Full range | | 0 to $V_{CC} - 2$ | | 0 to $V_{CC} - 2$ | | | | | |
| V_{OH} High-level output voltage | $R_L = 2\text{ k}\Omega$ | 25°C | | $V_{CC} - 1.5$ | | | $V_{CC} - 1.5$ | | | V | |
| | $R_L = 10\text{ k}\Omega$ | 25°C | | | | | | | | | |
| | $V_{CC} = \text{MAX}$ | $R_L = 2\text{ k}\Omega$ | Full range | | 26 | | 26 | | | | |
| | | $R_L \geq 10\text{ k}\Omega$ | Full range | | 27 | 28 | 27 | 28 | | | |
| V_{OL} Low-level output voltage | $R_L \leq 10\text{ k}\Omega$ | Full range | | 5 | 20 | | 5 | 20 | mV | | |
| A_{VD} Large-signal differential voltage amplification | $V_{CC} = 15\text{ V}$, $V_O = 1\text{ V to }11\text{ V}$, $R_L \geq 2\text{ k}\Omega$ | 25°C | | 50 | 100 | | 25 | 100 | V/mV | | |
| | | Full range | | 25 | | | 15 | | | | |
| CMRR Common-mode rejection ratio | $V_{IC} = V_{ICRmin}$ | 25°C | | 70 | 80 | | 65 | 80 | dB | | |
| k_{SVR} Supply-voltage rejection ratio ($\Delta V_{CC}/\Delta V_{IO}$) | | 25°C | | 65 | 100 | | 65 | 100 | dB | | |
| V_{O1}/V_{O2} Crosstalk attenuation | $f = 1\text{ kHz to }20\text{ kHz}$ | 25°C | | 120 | | | 120 | | | dB | |
| I_O Output current | $V_{CC} = 15\text{ V}$, $V_{ID} = 1\text{ V}$, $V_O = 0$ | Source | 25°C | | -20 | -30 | -60 | -20 | -30 | -60 | mA |
| | | | Full range | | -10 | | | -10 | | | |
| | $V_{CC} = 15\text{ V}$, $V_{ID} = -1\text{ V}$, $V_O = 15\text{ V}$ | Sink | 25°C | | 10 | 20 | | 10 | 20 | | |
| | | | Full range | | 5 | | | 5 | | | |
| | $V_{ID} = -1\text{ V}$, $V_O = 200\text{ mV}$ | 25°C | | 12 | 30 | | 12 | 30 | μA | | |
| I_{OS} Short-circuit output current | V_{CC} at 5 V, GND at -5 V | $V_O = 0$, | 25°C | | ± 40 | ± 60 | | ± 40 | ± 60 | mA | |
| I_{CC} Supply current (four amplifiers) | $V_O = 2.5\text{ V}$, No load | Full range | | 0.7 | 1.2 | | 0.7 | 1.2 | mA | | |
| | $V_{CC} = \text{MAX}$, $V_O = 0.5 V_{CC}$, No load | Full range | | 1.4 | 3 | | 1.4 | 3 | | | |

† All characteristics are measured under open-loop conditions, with zero common-mode input voltage, unless otherwise specified. MAX V_{CC} for testing purposes is 26 V for LM2902 and 30 V for the others.

‡ Full range is -55°C to 125°C for LM124, -25°C to 85°C for LM224, and 0°C to 70°C for LM324.

§ All typical values are at $T_A = 25^\circ\text{C}$.



LM124, LM124A, LM224, LM224A, LM324, LM324A, LM2902, LM2902V, LM224K, LM224KA, LM324K, LM324KA, LM2902K, LM2902KV, LM2902KAV QUADRUPLE OPERATIONAL AMPLIFIERS

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electrical characteristics at specified free-air temperature, $V_{CC} = 5\text{ V}$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS† | | T_A ‡ | LM2902 | | | LM2902V | | | UNIT |
|--|---|------------------------------|------------|---------------------|------|---------------------|---------|------|-----|------------------------------|
| | | | | MIN | TYP§ | MAX | MIN | TYP§ | MAX | |
| V_{IO} Input offset voltage | $V_{CC} = 5\text{ V}$ to MAX, $V_{IC} = V_{ICRmin}$, $V_O = 1.4\text{ V}$ | Non-A-suffix devices | 25°C | 3 7 | | 3 7 | | | | mV |
| | | | Full range | | | 10 | | 10 | | |
| | | A-suffix devices | 25°C | | | 1 2 | | | | |
| | | | Full range | | | | | 4 | | |
| $\Delta V_{IO}/\Delta T$ Input offset voltage temperature drift | $R_S = 0\ \Omega$ | | Full range | | | 7 | | | | $\mu\text{V}/^\circ\text{C}$ |
| I_{IO} Input offset current | $V_O = 1.4\text{ V}$ | | 25°C | 2 50 | | 2 50 | | | | nA |
| | | | Full range | | | 300 | | 150 | | |
| $\Delta I_{IO}/\Delta T$ Input offset current temperature drift | | | Full range | | | 10 | | | | $\text{pA}/^\circ\text{C}$ |
| I_{IB} Input bias current | $V_O = 1.4\text{ V}$ | | 25°C | -20 -250 | | -20 -250 | | | | nA |
| | | | Full range | | | -500 | | -500 | | |
| V_{ICR} Common-mode input voltage range | $V_{CC} = 5\text{ V}$ to MAX | | 25°C | 0 to $V_{CC} - 1.5$ | | 0 to $V_{CC} - 1.5$ | | | | V |
| | | | Full range | 0 to $V_{CC} - 2$ | | 0 to $V_{CC} - 2$ | | | | |
| V_{OH} High-level output voltage | $R_L = 2\text{ k}\Omega$ | | 25°C | | | | | | | V |
| | | | 25°C | $V_{CC} - 1.5$ | | $V_{CC} - 1.5$ | | | | |
| | $V_{CC} = \text{MAX}$ | $R_L = 2\text{ k}\Omega$ | Full range | 22 | | 26 | | | | |
| | | $R_L \geq 10\text{ k}\Omega$ | Full range | 23 24 | | 27 | | | | |
| V_{OL} Low-level output voltage | $R_L \leq 10\text{ k}\Omega$ | | Full range | 5 20 | | 5 20 | | | | mV |
| A_{VD} Large-signal differential voltage amplification | $V_{CC} = 15\text{ V}$, $V_O = 1\text{ V}$ to 11 V , $R_L \geq 2\text{ k}\Omega$ | | 25°C | 25 100 | | 25 100 | | | | V/mV |
| | | | Full range | 15 | | 15 | | | | |
| CMRR Common-mode rejection ratio | $V_{IC} = V_{ICRmin}$ | | 25°C | 50 80 | | 60 80 | | | | dB |
| k_{SVR} Supply-voltage rejection ratio ($\Delta V_{CC}/\Delta V_{IO}$) | | | 25°C | 50 100 | | 60 100 | | | | dB |
| V_{O1}/V_{O2} Crosstalk attenuation | $f = 1\text{ kHz}$ to 20 kHz | | 25°C | 120 | | 120 | | | | dB |
| I_O Output current | $V_{CC} = 15\text{ V}$, $V_{ID} = 1\text{ V}$, $V_O = 0$ | Source | 25°C | -20 -30 -60 | | -20 -30 -60 | | | | mA |
| | | | Full range | -10 | | -10 | | | | |
| | $V_{CC} = 15\text{ V}$, $V_{ID} = -1\text{ V}$, $V_O = 15\text{ V}$ | Sink | 25°C | 10 20 | | 10 20 | | | | |
| | | | Full range | 5 | | 5 | | | | |
| | $V_{ID} = -1\text{ V}$, $V_O = 200\text{ mV}$ | | 25°C | 30 | | 12 40 | | | | μA |
| I_{OS} Short-circuit output current | V_{CC} at 5 V , GND at -5 V | $V_O = 0$, | 25°C | ± 40 ± 60 | | ± 40 ± 60 | | | | mA |
| I_{CC} Supply current (four amplifiers) | $V_O = 2.5\text{ V}$, No load | | Full range | 0.7 1.2 | | 0.7 1.2 | | | | mA |
| | $V_{CC} = \text{MAX}$, $V_O = 0.5 V_{CC}$, No load | | Full range | 1.4 3 | | 1.4 3 | | | | |

† All characteristics are measured under open-loop conditions, with zero common-mode input voltage, unless otherwise specified. MAX V_{CC} for testing purposes is 26 V for LM2902 and 32 V for LM2902V.

‡ Full range is -40°C to 125°C for LM2902.

§ All typical values are at $T_A = 25^\circ\text{C}$.



electrical characteristics at specified free-air temperature, $V_{CC} = 5\text{ V}$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS† | | T_A ‡ | LM124A | | | LM224A | | | LM324A, LM324KA | | | UNIT | |
|--|---|------|-------------------|------------------------------|------|-------|---------------------|-------------|-------|---------------------|-------------|---------------|------|----|
| | | | | MIN | TYP§ | MAX | MIN | TYP§ | MAX | MIN | TYP§ | MAX | | |
| V_{IO} Input offset voltage | $V_{CC} = 5\text{ V to }30\text{ V}$, $V_{IC} = V_{ICRmin}$, $V_O = 1.4\text{ V}$ | | 25°C | 2 | | | 2 3 | | | 2 3 | | | mV | |
| | | | Full range | 4 | | | 4 | | | 5 | | | | |
| I_{IO} Input offset current | $V_O = 1.4\text{ V}$ | | 25°C | 10 | | | 2 15 | | | 2 30 | | | nA | |
| | | | Full range | 30 | | | 30 | | | 75 | | | | |
| I_{IB} Input bias current | $V_O = 1.4\text{ V}$ | | 25°C | -50 | | | -15 -80 | | | -15 -100 | | | nA | |
| | | | Full range | -100 | | | -100 | | | -200 | | | | |
| V_{ICR} Common-mode input voltage range | $V_{CC} = 30\text{ V}$ | | 25°C | 0 to $V_{CC} - 1.5$ | | | 0 to $V_{CC} - 1.5$ | | | 0 to $V_{CC} - 1.5$ | | | V | |
| | | | Full range | 0 to $V_{CC} - 2$ | | | 0 to $V_{CC} - 2$ | | | 0 to $V_{CC} - 2$ | | | | |
| V_{OH} High-level output voltage | $R_L = 2\text{ k}\Omega$ $V_{CC} = 30\text{ V}$ | | 25°C | $V_{CC} - 1.5$ | | | $V_{CC} - 1.5$ | | | $V_{CC} - 1.5$ | | | V | |
| | | | Full range | $R_L = 2\text{ k}\Omega$ | 26 | | | 26 | | | 26 | | | |
| | | | | $R_L \geq 10\text{ k}\Omega$ | 27 | | | 27 28 | | | 27 28 | | | |
| V_{OL} Low-level output voltage | $R_L \leq 10\text{ k}\Omega$ | | Full range | 20 | | | 5 20 | | | 5 20 | | | mV | |
| A_{VD} Large-signal differential voltage amplification | $V_{CC} = 15\text{ V}$, $V_O = 1\text{ V to }11\text{ V}$, $R_L \geq 2\text{ k}\Omega$ | | 25°C | 50 | 100 | 50 | 100 | 25 | 100 | | | | V/mV | |
| | | | Full range | 25 | | 25 | | 15 | | | | | | |
| CMRR Common-mode rejection ratio | $V_{IC} = V_{ICRmin}$ | | 25°C | 70 | | 70 | 80 | 65 | 80 | | | | dB | |
| k_{SVR} Supply-voltage rejection ratio ($\Delta V_{CC}/\Delta V_{IO}$) | | | 25°C | 65 | | 65 | 100 | 65 | 100 | | | | dB | |
| V_{O1}/V_{O2} Crosstalk attenuation | $f = 1\text{ kHz to }20\text{ kHz}$ | | 25°C | 120 | | | 120 | | | 120 | | | dB | |
| I_O Output current | $V_{CC} = 15\text{ V}$, $V_{ID} = 1\text{ V}$, $V_O = 0$ | | Source | 25°C | -20 | | | -20 -30 -60 | | | -20 -30 -60 | | | mA |
| | | | Full range | -10 | | | -10 | | | -10 | | | | |
| | $V_{CC} = 15\text{ V}$, $V_{ID} = -1\text{ V}$, $V_O = 15\text{ V}$ | | Sink | 25°C | 10 | | | 10 20 | | | 10 20 | | | |
| | | | Full range | 5 | | | 5 | | | 5 | | | | |
| $V_{ID} = -1\text{ V}$, $V_O = 200\text{ mV}$ | | 25°C | 12 | | | 12 30 | | | 12 30 | | | μA | | |
| I_{OS} Short-circuit output current | V_{CC} at 5 V, $V_O = 0$ | | GND at -5 V, 25°C | ± 40 ± 60 | | | ± 40 ± 60 | | | ± 40 ± 60 | | | mA | |
| I_{CC} Supply current (four amplifiers) | $V_O = 2.5\text{ V}$, No load | | Full range | 0.7 1.2 | | | 0.7 1.2 | | | 0.7 1.2 | | | mA | |
| | $V_{CC} = 30\text{ V}$, No load | | Full range | 1.4 3 | | | 1.4 3 | | | 1.4 3 | | | | |

† All characteristics are measured under open-loop conditions, with zero common-mode input voltage, unless otherwise specified.

‡ Full range is -55°C to 125°C for LM124A, -25°C to 85°C for LM224A, and 0°C to 70°C for LM324A.

§ All typical values are at $T_A = 25^\circ\text{C}$.

**LM124, LM124A, LM224, LM224A, LM324, LM324A, LM2902, LM2902V,
LM224K, LM224KA, LM324K, LM324KA, LM2902K, LM2902KV, LM2902KAV
QUADRUPLE OPERATIONAL AMPLIFIERS**

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operating conditions, $V_{CC} = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$

| PARAMETER | | TEST CONDITIONS | TYP | UNIT |
|-----------|--------------------------------|--|-----|------------------------------|
| SR | Slew rate at unity gain | $R_L = 1\text{ M}\Omega$, $C_L = 30\text{ pF}$, $V_I = \pm 10\text{ V}$ (see Figure 1) | 0.5 | $\text{V}/\mu\text{s}$ |
| B_1 | Unity-gain bandwidth | $R_L = 1\text{ M}\Omega$, $C_L = 20\text{ pF}$ (see Figure 1) | 1.2 | MHz |
| V_n | Equivalent input noise voltage | $R_S = 100\ \Omega$, $V_I = 0\text{ V}$, $f = 1\text{ kHz}$ (see Figure 2) | 35 | $\text{nV}/\sqrt{\text{Hz}}$ |

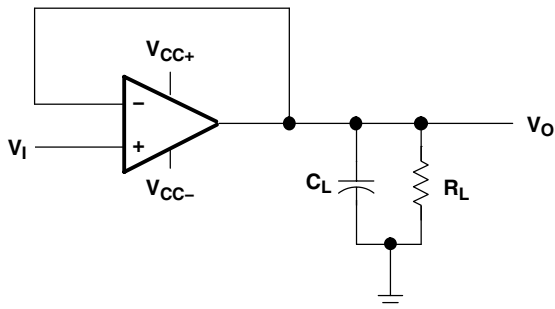


Figure 1. Unity-Gain Amplifier

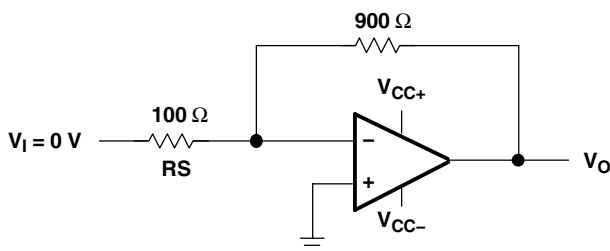


Figure 2. Noise-Test Circuit

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/ Ball Finish | MSL Peak Temp ⁽³⁾ | Samples (Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|----------------------------|----------------------|------------------------------|-----------------------------|
| 5962-7704301VCA | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 | N / A for Pkg Type | |
| 5962-9950403V9B | ACTIVE | XCEPT | KGD | 0 | 100 | TBD | Call TI | N / A for Pkg Type | |
| 5962-9950403VCA | ACTIVE | CDIP | J | 14 | 25 | TBD | A42 | N / A for Pkg Type | |
| 77043012A | ACTIVE | LCCC | FK | 20 | 1 | TBD | Call TI | Call TI | |
| 7704301CA | ACTIVE | CDIP | J | 14 | 1 | TBD | Call TI | Call TI | |
| 7704301DA | ACTIVE | CFP | W | 14 | 1 | TBD | Call TI | Call TI | |
| 77043022A | ACTIVE | LCCC | FK | 20 | 1 | TBD | Call TI | Call TI | |
| 7704302CA | ACTIVE | CDIP | J | 14 | 1 | TBD | Call TI | Call TI | |
| 7704302DA | ACTIVE | CFP | W | 14 | 1 | TBD | Call TI | Call TI | |
| JM38510/11005BCA | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 | N / A for Pkg Type | |
| LM124ADR | OBSOLETE | SOIC | D | 14 | | TBD | Call TI | Call TI | |
| LM124AFKB | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type | |
| LM124AJ | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 | N / A for Pkg Type | |
| LM124AJB | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 | N / A for Pkg Type | |
| LM124AWB | ACTIVE | CFP | W | 14 | 1 | TBD | A42 | N / A for Pkg Type | |
| LM124D | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM124DG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM124DR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM124DRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM124FKB | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type | |
| LM124J | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 | N / A for Pkg Type | |
| LM124JB | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 | N / A for Pkg Type | |
| LM124N | OBSOLETE | PDIP | N | 14 | | TBD | Call TI | Call TI | |
| LM124W | ACTIVE | CFP | W | 14 | 1 | TBD | A42 | N / A for Pkg Type | |
| LM124WB | ACTIVE | CFP | W | 14 | 1 | TBD | A42 | N / A for Pkg Type | |
| LM224AD | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/ Ball Finish | MSL Peak Temp ⁽³⁾ | Samples (Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|----------------------|------------------------------|-----------------------------|
| LM224ADE4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224ADG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224ADR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224ADRE4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224ADRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224AN | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM224ANE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM224D | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224DE4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224DG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224DR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224DRE4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224DRG3 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | |
| LM224DRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224KAD | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224KADE4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224KADG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224KADR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224KADRE4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/ Ball Finish | MSL Peak Temp ⁽³⁾ | Samples (Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|----------------------|------------------------------|-----------------------------|
| LM224KADRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224KAN | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM224KANE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM224KD | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224KDE4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224KDG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224KDR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224KDRE4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224KDRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM224KN | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM224KNE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM224N | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM224NE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM2902D | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902DE4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902DG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902DR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902DRE4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902DRG3 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | |
| LM2902DRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/ Ball Finish | MSL Peak Temp ⁽³⁾ | Samples (Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|----------------------|------------------------------|-----------------------------|
| LM2902KAVQDR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KAVQDRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KAVQPWR | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KAVQPWRG4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KD | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KDB | ACTIVE | SSOP | DB | 14 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KDBE4 | ACTIVE | SSOP | DB | 14 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KDBG4 | ACTIVE | SSOP | DB | 14 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KDE4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KDG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KDR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KDRE4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KDRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KN | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM2902KNE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM2902KNSR | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KNSRE4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KNSRG4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KPW | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/ Ball Finish | MSL Peak Temp ⁽³⁾ | Samples (Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|----------------------|------------------------------|-----------------------------|
| LM2902KPWE4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KPWG4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KPWR | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KPWRE4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KPWRG4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KVQDR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KVQDRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KVQPWR | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902KVQPWRG4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902N | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM2902NE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM2902NSR | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902NSRG4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902PW | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902PWE4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902PWG4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902PWLE | OBSOLETE | TSSOP | PW | 14 | | TBD | Call TI | Call TI | |
| LM2902PWR | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902PWRE4 | ACTIVE | TSSOP | PW | 14 | | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/ Ball Finish | MSL Peak Temp ⁽³⁾ | Samples (Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|----------------------|------------------------------|-----------------------------|
| LM2902PWRG3 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | |
| LM2902PWRG4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM2902QN | OBSOLETE | PDIP | N | 14 | | TBD | Call TI | Call TI | |
| LM324AD | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324ADBLE | OBSOLETE | SSOP | DB | 14 | | TBD | Call TI | Call TI | |
| LM324ADBR | ACTIVE | SSOP | DB | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324ADBRE4 | ACTIVE | SSOP | DB | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324ADBRG4 | ACTIVE | SSOP | DB | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324ADE4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324ADG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324ADR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324ADRE4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324ADRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324AN | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM324ANE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM324ANSR | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324ANSRE4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324ANSRG4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324APW | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/ Ball Finish | MSL Peak Temp ⁽³⁾ | Samples (Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|----------------------|------------------------------|-----------------------------|
| LM324APWE4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324APWG4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324APWLE | OBSOLETE | TSSOP | PW | 14 | | TBD | Call TI | Call TI | |
| LM324APWR | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324APWRE4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324APWRG4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324D | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324DE4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324DG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324DR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324DRE4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324DRG3 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | |
| LM324DRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KAD | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KADE4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KADG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KADR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KADRE4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/ Ball Finish | MSL Peak Temp ⁽³⁾ | Samples (Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|----------------------|------------------------------|-----------------------------|
| LM324KADRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KAN | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM324KANE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM324KANSR | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KANSRE4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KANSRG4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KAPW | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KAPWE4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KAPWG4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KAPWR | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KAPWRE4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KAPWRG4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KD | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KDE4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KDG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KDR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KDRE4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KDRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KN | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/ Ball Finish | MSL Peak Temp ⁽³⁾ | Samples (Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|----------------------------|----------------------|------------------------------|-----------------------------|
| LM324KNE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM324KNSR | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KNSRE4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KNSRG4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KPW | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KPWE4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KPWG4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KPWR | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KPWRE4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324KPWRG4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324N | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM324NE3 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU SN | N / A for Pkg Type | |
| LM324NE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| LM324NSR | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324NSRE4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324NSRG4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324PW | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324PWE4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324PWG4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324PWLE | OBSOLETE | TSSOP | PW | 14 | | TBD | Call TI | Call TI | |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/ Ball Finish | MSL Peak Temp ⁽³⁾ | Samples (Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|----------------------|------------------------------|-----------------------------|
| LM324PWR | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324PWRE4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324PWRG3 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | |
| LM324PWRG4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| LM324Y | OBSOLETE | DIESALE | Y | 0 | | TBD | Call TI | Call TI | |
| M38510/11005BCA | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 | N / A for Pkg Type | |

⁽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.

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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF LM124, LM124-SP, LM124M, LM2902 :

- Catalog: [LM124](#), [LM124](#)
- Automotive: [LM2902-Q1](#)
- Enhanced Product: [LM2902-EP](#)
- Military: [LM124M](#), [LM124M](#)
- Space: [LM124-SP](#), [LM124-SP](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Enhanced Product - Supports Defense, Aerospace and Medical Applications
- Military - QML certified for Military and Defense Applications
- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

TAPE AND REEL INFORMATION
REEL DIMENSIONS

TAPE DIMENSIONS


| | |
|----|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

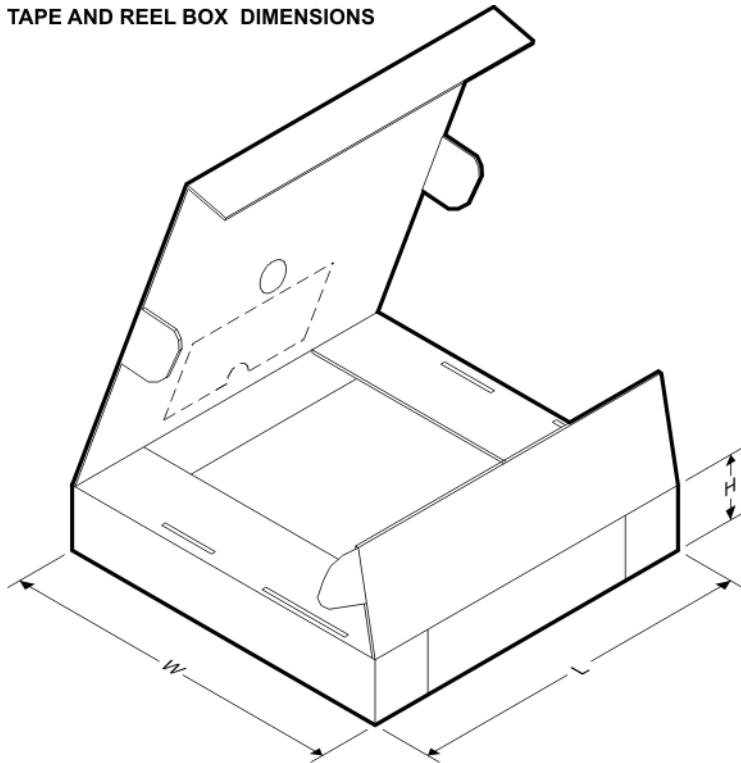
TAPE AND REEL INFORMATION

*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM124DR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| LM224ADR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| LM224DR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| LM224KADR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| LM224KDR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| LM2902DR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| LM2902DR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| LM2902DRG4 | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| LM2902KAVQPWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM2902KDR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| LM2902KNSR | SO | NS | 14 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |
| LM2902KPWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM2902KVQPWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM2902NSR | SO | NS | 14 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |
| LM2902PWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM2902PWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 7.0 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM2902PWRG3 | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 7.0 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM324ADBR | SSOP | DB | 14 | 2000 | 330.0 | 16.4 | 8.2 | 6.6 | 2.5 | 12.0 | 16.0 | Q1 |

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM324ADR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| LM324ANSR | SO | NS | 14 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |
| LM324APWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM324APWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 7.0 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM324DR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| LM324DR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| LM324DRG4 | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| LM324KADR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| LM324KANSR | SO | NS | 14 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |
| LM324KAPWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM324KDR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| LM324KNSR | SO | NS | 14 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |
| LM324KPWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM324NSR | SO | NS | 14 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |
| LM324PWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM324PWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 7.0 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM324PWRG3 | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 7.0 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM124DR | SOIC | D | 14 | 2500 | 346.0 | 346.0 | 33.0 |
| LM224ADR | SOIC | D | 14 | 2500 | 346.0 | 346.0 | 33.0 |
| LM224DR | SOIC | D | 14 | 2500 | 346.0 | 346.0 | 33.0 |
| LM224KADR | SOIC | D | 14 | 2500 | 346.0 | 346.0 | 33.0 |
| LM224KDR | SOIC | D | 14 | 2500 | 346.0 | 346.0 | 33.0 |
| LM2902DR | SOIC | D | 14 | 2500 | 346.0 | 346.0 | 33.0 |
| LM2902DR | SOIC | D | 14 | 2500 | 333.2 | 345.9 | 28.6 |
| LM2902DRG4 | SOIC | D | 14 | 2500 | 346.0 | 346.0 | 33.0 |
| LM2902KAVQPWR | TSSOP | PW | 14 | 2000 | 346.0 | 346.0 | 29.0 |
| LM2902KDR | SOIC | D | 14 | 2500 | 346.0 | 346.0 | 33.0 |
| LM2902KNSR | SO | NS | 14 | 2000 | 346.0 | 346.0 | 33.0 |
| LM2902KPWR | TSSOP | PW | 14 | 2000 | 346.0 | 346.0 | 29.0 |
| LM2902KVQPWR | TSSOP | PW | 14 | 2000 | 346.0 | 346.0 | 29.0 |
| LM2902NSR | SO | NS | 14 | 2000 | 346.0 | 346.0 | 33.0 |
| LM2902PWR | TSSOP | PW | 14 | 2000 | 346.0 | 346.0 | 29.0 |
| LM2902PWR | TSSOP | PW | 14 | 2000 | 364.0 | 364.0 | 27.0 |
| LM2902PWRG3 | TSSOP | PW | 14 | 2000 | 364.0 | 364.0 | 27.0 |
| LM324ADBR | SSOP | DB | 14 | 2000 | 346.0 | 346.0 | 33.0 |
| LM324ADR | SOIC | D | 14 | 2500 | 346.0 | 346.0 | 33.0 |
| LM324ANSR | SO | NS | 14 | 2000 | 346.0 | 346.0 | 33.0 |
| LM324APWR | TSSOP | PW | 14 | 2000 | 346.0 | 346.0 | 29.0 |
| LM324APWR | TSSOP | PW | 14 | 2000 | 364.0 | 364.0 | 27.0 |
| LM324DR | SOIC | D | 14 | 2500 | 346.0 | 346.0 | 33.0 |
| LM324DR | SOIC | D | 14 | 2500 | 333.2 | 345.9 | 28.6 |
| LM324DRG4 | SOIC | D | 14 | 2500 | 346.0 | 346.0 | 33.0 |
| LM324KADR | SOIC | D | 14 | 2500 | 346.0 | 346.0 | 33.0 |
| LM324KANSR | SO | NS | 14 | 2000 | 346.0 | 346.0 | 33.0 |
| LM324KAPWR | TSSOP | PW | 14 | 2000 | 346.0 | 346.0 | 29.0 |
| LM324KDR | SOIC | D | 14 | 2500 | 346.0 | 346.0 | 33.0 |
| LM324KNSR | SO | NS | 14 | 2000 | 346.0 | 346.0 | 33.0 |
| LM324KPWR | TSSOP | PW | 14 | 2000 | 346.0 | 346.0 | 29.0 |
| LM324NSR | SO | NS | 14 | 2000 | 346.0 | 346.0 | 33.0 |
| LM324PWR | TSSOP | PW | 14 | 2000 | 346.0 | 346.0 | 29.0 |
| LM324PWR | TSSOP | PW | 14 | 2000 | 364.0 | 364.0 | 27.0 |
| LM324PWRG3 | TSSOP | PW | 14 | 2000 | 364.0 | 364.0 | 27.0 |

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---------------|------------------------|------------------------|------------------------|------------------------|
| A | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC |
| B MAX | 0.785 (19,94) | .840 (21,34) | 0.960 (24,38) | 1.060 (26,92) |
| B MIN | — | — | — | — |
| C MAX | 0.300 (7,62) | 0.300 (7,62) | 0.310 (7,87) | 0.300 (7,62) |
| C MIN | 0.245 (6,22) | 0.245 (6,22) | 0.220 (5,59) | 0.245 (6,22) |



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package is hermetically sealed with a ceramic lid using glass frit.
 - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

W (R-GDFP-F14)

CERAMIC DUAL FLATPACK



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only.
 - E. Falls within MIL STD 1835 GDFP1-F14 and JEDEC MO-092AB

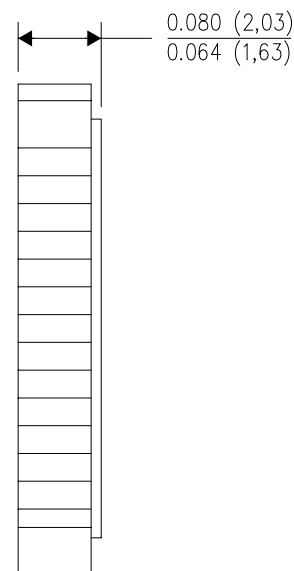
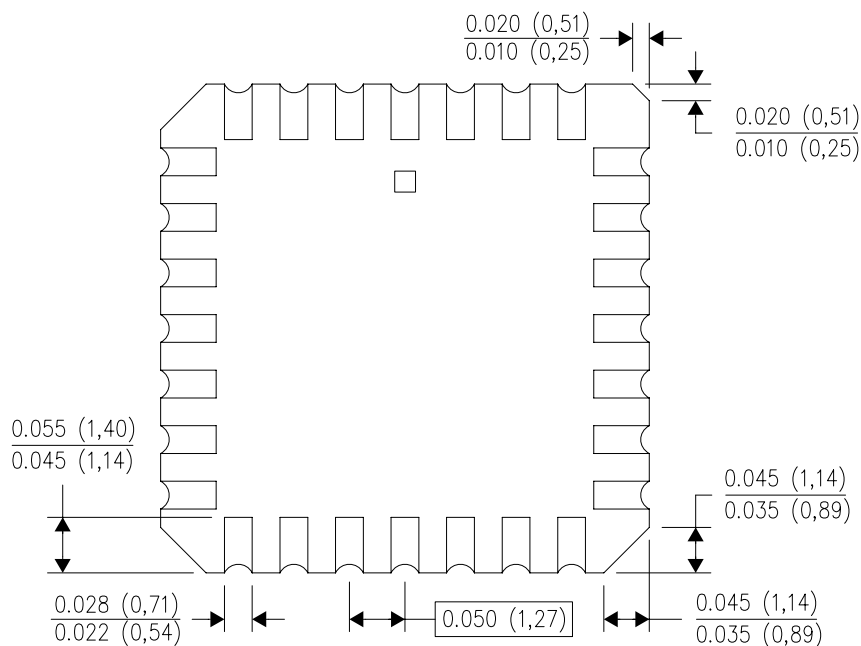
FK (S-CQCC-N**)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



| NO. OF TERMINALS ** | A | | B | |
|---------------------|------------------|------------------|------------------|------------------|
| | MIN | MAX | MIN | MAX |
| 20 | 0.342 (8,69) | 0.358 (9,09) | 0.307 (7,80) | 0.358 (9,09) |
| 28 | 0.442 (11,23) | 0.458 (11,63) | 0.406 (10,31) | 0.458 (11,63) |
| 44 | 0.640 (16,26) | 0.660 (16,76) | 0.495 (12,58) | 0.560 (14,22) |
| 52 | 0.740 (18,78) | 0.761 (19,32) | 0.495 (12,58) | 0.560 (14,22) |
| 68 | 0.938 (23,83) | 0.962 (24,43) | 0.850 (21,6) | 0.858 (21,8) |
| 84 | 1.141 (28,99) | 1.165 (29,59) | 1.047 (26,6) | 1.063 (27,0) |



4040140/D 01/11

- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package can be hermetically sealed with a metal lid.
 - Falls within JEDEC MS-004

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - $\triangle D$ Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

MECHANICAL DATA

PW (R-PDSO-G14)

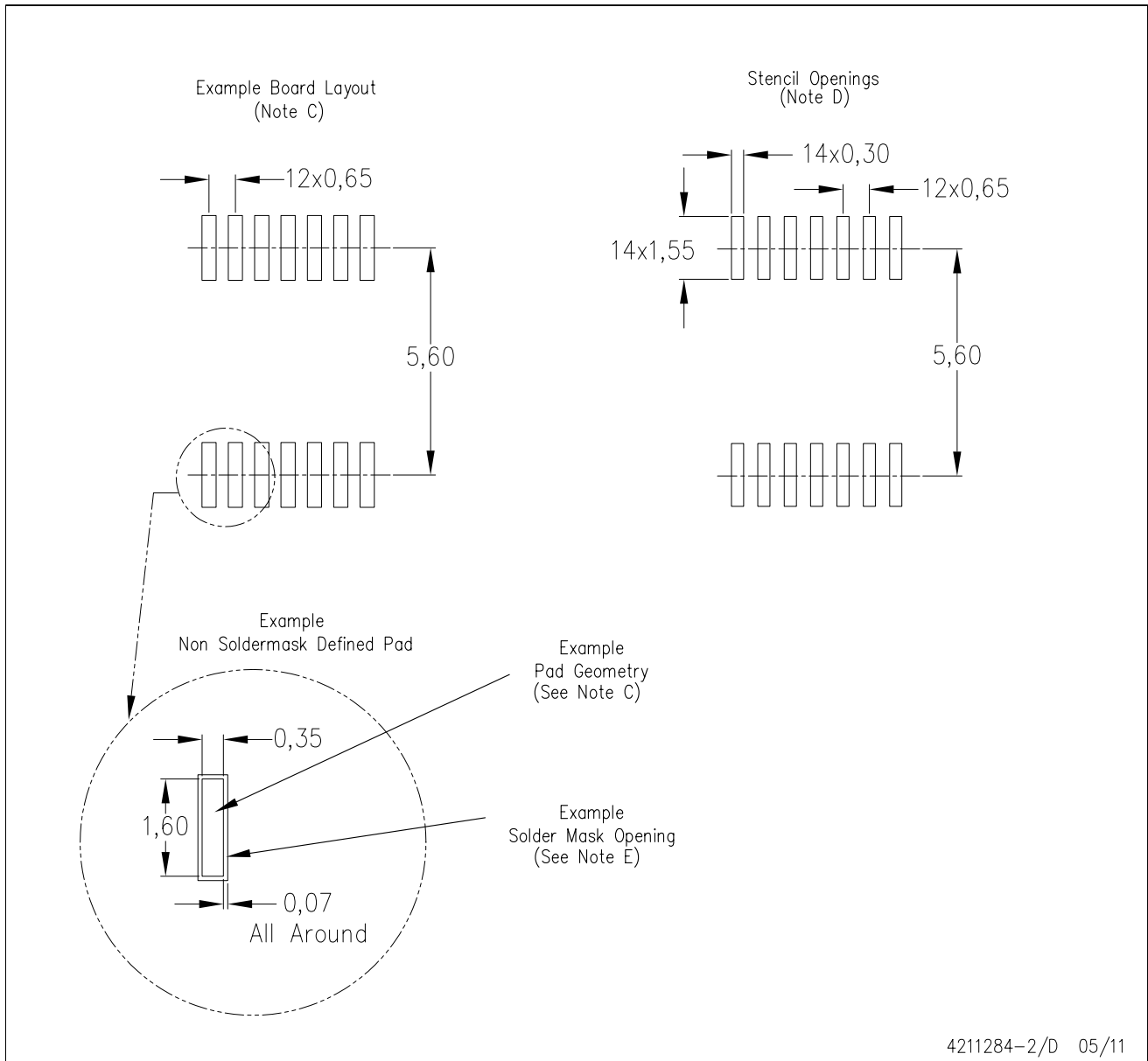
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
 - E. Falls within JEDEC MO-153

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-150

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