

T-45-23-09

CD4029A Types

CMOS Presettable Up/Down Counter

Binary or BCD-Decade

The RCA-CD4029A consists of a four-stage binary or BCD-decade up/down counter with provisions for look-ahead carry in both counting modes. The inputs consist of a single CLOCK, CARRY-IN (CLOCK INHIBIT), BINARY/DECADE, UP/DOWN, PRESET ENABLE, and four individual JAM signals and a CARRY OUT signal are provided as outputs.

A high PRESET ENABLE signal allows information on the JAM INPUTS to preset the counter to any state asynchronously with the clock. A low on each JAM line, when the PRESET-ENABLE signal is high, resets the counter to its zero count. The counter is advanced one count at the positive transition of the clock when the CARRY-IN and PRESET ENABLE signals are low. Advancement is inhibited when the CARRY-IN or PRESET ENABLE signals are high. The CARRY-OUT signal is normally high and goes low when the counter reaches its maximum count in the UP mode or the minimum count in the DOWN mode provided the CARRY-IN signal is low. The CARRY-IN signal in the high state can thus be considered a CLOCK INHIBIT. The CARRY-IN terminal must be connected to V_{SS} when not in use.

Binary counting is accomplished when the BINARY/DECADE input is high; the counter counts in the decade mode when the BINARY/DECADE input is low. The counter counts Up when the UP/DOWN INPUT is high, and Down when the UP/DOWN INPUT

Features:

- Medium speed operation . . . 6 MHz (typ.) @ $C_L=15$ pF and $V_{DD}-V_{SS}=10$ V
- Multi-package parallel clocking for synchronous high speed output response or ripple clocking for slow clock input rise and fall times
- "Preset Enable" and individual "Jam" inputs provided
- Binary or decade up/down counting
- BCD outputs in decade mode
- Quiescent current specified to 15 V
- Maximum input leakage current of $1 \mu A$ at 15 V (full package-temperature range)
- 1-V noise margin (full package-temperature range)

Applications:

- Programmable binary and decade counting/frequency synthesizers-BCD output
- Analog to digital and digital to analog conversion
- Up/Down binary counting
- Magnitude and sign generation
- Up/Down decade counting
- Difference counting

is low. Multiple packages can be connected in either a parallel-clocking or a ripple-clocking arrangement.

Parallel clocking provides synchronous control and hence faster response from all counting outputs. Ripple-clocking allows for longer clock input rise and fall times.

These types are supplied in 16-lead hermetic dual-in-line ceramic packages (D and F suffixes), 16-lead dual-in-line plastic package (E suffix), 16-lead ceramic flat packages (K suffix), and in chip form (H suffix).

RECOMMENDED OPERATING CONDITIONS at $T_A=25^\circ C$, Except as Noted.
For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

| CHARACTERISTIC | V_{DD} (V) | LIMITS | | | | UNITS |
|--|-----------------|---------------------|------|-----------|------|---------|
| | | D, F, K, H Packages | | E Package | | |
| | | Min. | Max. | Min. | Max. | |
| Supply-Voltage Range (For T_A =Full Package-Temperature Range) | | 3 | 12 | 3 | 12 | V |
| Setup Time, t_S^* | 5 | 650 | - | 1300 | - | ns |
| | 10 | 230 | - | 460 | - | |
| Clock Pulse Width, t_W | 5 | 340 | - | 500 | - | ns |
| | 10 | 170 | - | 250 | - | |
| Clock Input Frequency, f_{CL} | 5 | dc | 1.5 | dc | 1 | MHz |
| | 10 | dc | 3 | dc | 2 | |
| Clock Rise or Fall Time, t_{rCL}, t_{fCL}^{**} | 5 | - | 15 | - | 15 | μs |
| | 10 | - | 15 | - | 15 | |
| Preset Enable Pulse Width, t_W | 5 | 330 | - | 660 | - | ns |
| | 10 | 160 | - | 320 | - | |

*From Up/Down, Binary/Decode, Carry In, or Preset Enable Control Inputs to Clock Edge.

**If more than one unit is cascaded in the parallel clocked application, t_{rCL} should be made less than or equal to the sum of the fixed propagation delay at 15 pF and the transition time of the carry output driving stage for the estimated capacitive load.

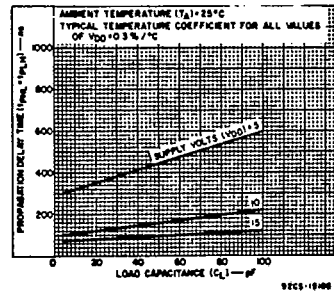
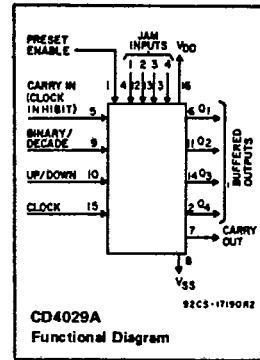


Fig. 1—Typical propagation delay time vs. C_L for Q outputs.

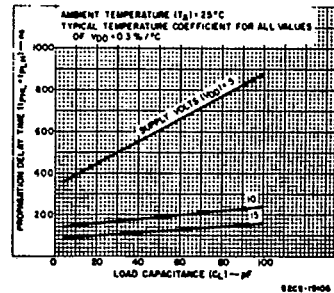


Fig. 2—Typical propagation delay time vs. C_L for carry output.

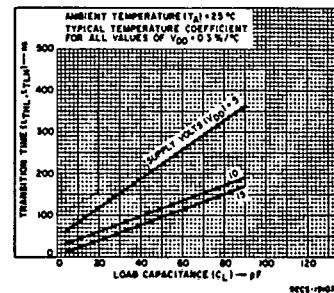


Fig. 3—Typical transition time vs. C_L for Q outputs.

CD4029A Types

MAXIMUM RATINGS, Absolute-Maximum Values:

STORAGE-TEMPERATURE RANGE (T_{stg}) -65 to +150°C

OPERATING-TEMPERATURE RANGE (T_A):

 PACKAGE TYPES D, F, K, H -55 to +125°C

 PACKAGE TYPE E -40 to +85°C

DC SUPPLY-VOLTAGE RANGE, (V_{DD})

(Voltages referenced to V_{SS} Terminal) -0.5 to +15 V

POWER DISSIPATION PER PACKAGE (P_D):

 FOR $T_A = -40$ to +60°C (PACKAGE TYPE E) 500 mW

 FOR $T_A = +60$ to +85°C (PACKAGE TYPE E) Derate Linearly at 12 mW/°C to 200 mW

 FOR $T_A = -55$ to +100°C (PACKAGE TYPES D, F, K) 500 mW

 FOR $T_A = +100$ to +125°C (PACKAGE TYPES D, F, K) Derate Linearly at 12 mW/°C to 200 mW

DEVICE DISSIPATION PER OUTPUT TRANSISTOR:

 FOR $T_A = \text{FULL PACKAGE-TEMPERATURE RANGE (ALL PACKAGE TYPES)}$ 100 mW

INPUT VOLTAGE RANGE, ALL INPUTS 0.5 to $V_{DD} + 0.5$ V

LEAD TEMPERATURE (DURING SOLDERING):

 At distance 1/16 ± 1/32 inch (1.59 ± 0.79 mm) from case for 10 s max. +265°C

DYNAMIC ELECTRICAL CHARACTERISTICS at $T_A = 25^\circ\text{C}$, Input $t_r, t_f = 20$ ns, $C_L = 15$ pF, $R_L = 200$ k Ω

| CHARACTERISTIC | TEST CONDITIONS | LIMITS | | | | | | UNITS |
|---|-----------------|---------------------|------|------|-----------|------|------|---------------|
| | | D, F, K, H Packages | | | E Package | | | |
| | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| Clocked Operation | | | | | | | | |
| Propagation Delay Time: | | | | | | | | |
| t_{PHL}, t_{PLH} Q Outputs | 5 | - | 325 | 650 | - | 325 | 1300 | ns |
| | 10 | - | 115 | 230 | - | 115 | 460 | |
| Carry Output | 5 | - | 425 | 850 | - | 425 | 1700 | ns |
| | 10 | - | 150 | 300 | - | 150 | 600 | |
| Transition Time: | | | | | | | | |
| t_{THL}, t_{TLH} Q Outputs | 5 | - | 100 | 200 | - | 100 | 400 | ns |
| | 10 | - | 50 | 100 | - | 50 | 200 | |
| Carry Output | 5 | - | 200 | 400 | - | 200 | 800 | ns |
| | 10 | - | 100 | 200 | - | 100 | 400 | |
| Minimum Clock Pulse Width, t_W | 5 | - | 200 | 340 | - | 200 | 500 | ns |
| | 10 | - | 100 | 170 | - | 100 | 250 | |
| Clock Rise & Fall Time, $t_r, t_f, t_{rCL}, t_{fCL}^{**}$ | 5 | - | - | 15 | - | - | 15 | μs |
| | 10 | - | - | 15 | - | - | 15 | |
| Minimum Setup Times, t_S^* | 5 | - | 325 | 650 | - | 325 | 1300 | ns |
| | 10 | - | 115 | 230 | - | 115 | 460 | |
| Maximum Clock Input Frequency, f_{CL} | 5 | 1.5 | 2.5 | - | 1 | 2.5 | - | MHz |
| | 10 | 3 | 5 | - | 2 | 5 | - | |
| Input Capacitance, C_i | Any Input | - | 5 | - | - | 5 | - | pF |
| Preset Enable | | | | | | | | |
| Propagation Delay Time: | | | | | | | | |
| t_{PHL}, t_{PLH} Q Outputs | 5 | - | 325 | 650 | - | 325 | 1300 | ns |
| | 10 | - | 115 | 230 | - | 115 | 460 | |
| Carry Output | 5 | - | 425 | 850 | - | 425 | 1700 | ns |
| | 10 | - | 150 | 300 | - | 150 | 600 | |
| Minimum Preset Enable Pulse Width, t_W | 5 | - | 115 | 330 | - | 115 | 660 | ns |
| | 10 | - | 80 | 160 | - | 80 | 320 | |
| Minimum Preset Enable Removal Time | 5 | - | 325 | 650 | - | 325 | 1300 | ns |
| | 10 | - | 115 | 230 | - | 115 | 460 | |
| Carry Input | | | | | | | | |
| Propagation Delay Time: | | | | | | | | |
| t_{PHL}, t_{PLH} Carry Output | 5 | - | 175 | 350 | - | 175 | 700 | ns |
| | 10 | - | 50 | 100 | - | 50 | 200 | |

For footnotes, see Recommended Operating Conditions.

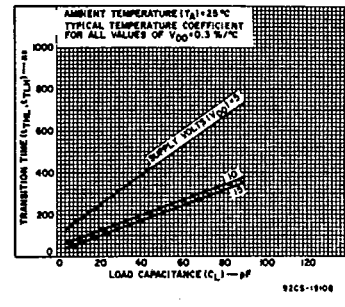


Fig. 4—Typical transition time vs. C_L for carry output.

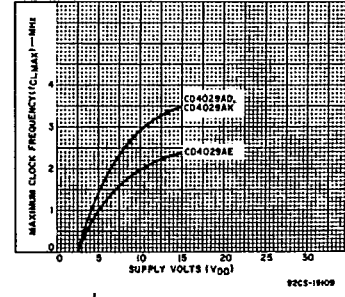


Fig. 5—Maximum clock input frequency vs. V_{DD} .

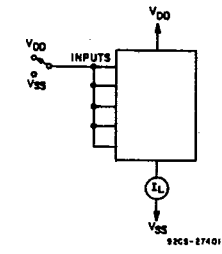


Fig. 6—Quiescent device-current test circuit.

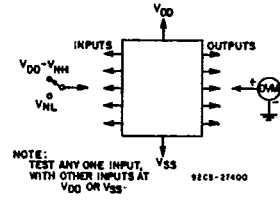


Fig. 7—Noise-immunity test circuit.

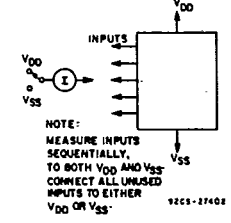


Fig. 8—Input-leakage-current test circuit.

CD4029A Types

STATIC ELECTRICAL CHARACTERISTICS

| Characteristic | Conditions V _O (V) V _{IN} (V) V _{DD} (V) | | | Limits at Indicated Temperatures (°C) | | | | | | | | Units |
|--|--|----|----|---------------------------------------|-------|-------|-------|-----------|-------|-------|-------|-------|
| | | | | D, F, K, H Packages | | | | E Package | | | | |
| | | | | -55 | | +25 | | +125 | | -40 | | |
| Quiescent Device Current, I _L Max. | - | - | 5 | 5 | 0.3 | 5 | 300 | 50 | 0.5 | 50 | 700 | μA |
| | - | - | 10 | 10 | 0.5 | 10 | 600 | 100 | 1 | 100 | 1400 | |
| | - | - | 15 | 50 | 1 | 50 | 2000 | 500 | 5 | 500 | 5000 | |
| Output Voltage: Low-Level, V _{OL} | - | 5 | 5 | 0 Typ.; 0.05 Max. | | | | | | | | V |
| | - | 10 | 10 | 0 Typ.; 0.05 Max. | | | | | | | | |
| | - | 0 | 5 | 4.95 Min.; 5 Typ. | | | | | | | | |
| Output Voltage: High-Level, V _{OH} | - | 0 | 10 | 9.95 Min.; 10 Typ. | | | | | | | | V |
| | - | 0 | 5 | 9.95 Min.; 10 Typ. | | | | | | | | |
| | - | 0 | 10 | 9.95 Min.; 10 Typ. | | | | | | | | |
| Noise Immunity: Inputs Low, V _{NL} | 4.2 | - | 5 | 1.5 Min.; 2.25 Typ. | | | | | | | | V |
| | 9 | - | 10 | 3 Min.; 4.5 Typ. | | | | | | | | |
| | 0.8 | - | 5 | 1.5 Min.; 2.25 Typ. | | | | | | | | |
| Noise Immunity: Inputs High, V _{NH} | 1 | - | 10 | 3 Min.; 4.5 Typ. | | | | | | | | V |
| | 9 | - | 10 | 3 Min.; 4.5 Typ. | | | | | | | | |
| | 1 | - | 10 | 3 Min.; 4.5 Typ. | | | | | | | | |
| Noise Margin: Inputs Low, V _{NML} | 4.5 | - | 5 | 1 Min. | | | | | | | | V |
| | 9 | - | 10 | 1 Min. | | | | | | | | |
| | 0.5 | - | 5 | 1 Min. | | | | | | | | |
| Noise Margin: Inputs High, V _{NMH} | 1 | - | 10 | 1 Min. | | | | | | | | V |
| | 9 | - | 10 | 1 Min. | | | | | | | | |
| | 1 | - | 10 | 1 Min. | | | | | | | | |
| Output Drive Current: N-Channel (Sink), I _{DN} Min. | 0.5 | - | 5 | 0.5 | 0.8 | 0.4 | 0.28 | 0.24 | 0.8 | 0.2 | 0.16 | mA |
| | 0.5 | - | 10 | 0.74 | 1.2 | 0.6 | 0.42 | 0.36 | 1.2 | 0.3 | 0.24 | |
| | 0.5 | - | 10 | 0.1 | 0.16 | 0.08 | 0.06 | 0.05 | 0.16 | 0.04 | 0.03 | |
| Output Drive Current: P-Channel (Source), I _{DP} Min. | 4.5 | - | 5 | -0.18 | -0.24 | -0.12 | -0.08 | -0.07 | -0.24 | -0.06 | -0.05 | mA |
| | 4.5 | - | 10 | -0.3 | -0.4 | -0.2 | -0.14 | -0.14 | -0.4 | -0.1 | -0.08 | |
| | 4.5 | - | 5 | -0.09 | -0.12 | -0.06 | -0.04 | -0.04 | -0.12 | -0.03 | -0.02 | |
| Output Drive Current: P-Channel (Source), I _{DP} Min. | 9.5 | - | 10 | -0.15 | -0.2 | -0.1 | -0.07 | -0.07 | -0.2 | -0.05 | -0.04 | mA |
| | 9.5 | - | 10 | -0.15 | -0.2 | -0.1 | -0.07 | -0.07 | -0.2 | -0.05 | -0.04 | |
| | 9.5 | - | 10 | -0.15 | -0.2 | -0.1 | -0.07 | -0.07 | -0.2 | -0.05 | -0.04 | |
| Input Leakage Current, I _{IL} , I _{IH} | Any Input | | | ±10 ⁻⁵ Typ., ±1 Max. | | | | | | | | μA |
| | - | - | 15 | ±10 ⁻⁵ Typ., ±1 Max. | | | | | | | | |

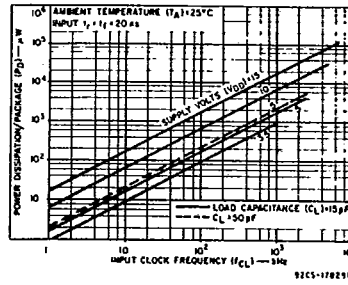


Fig. 9—Typical dissipation characteristics.

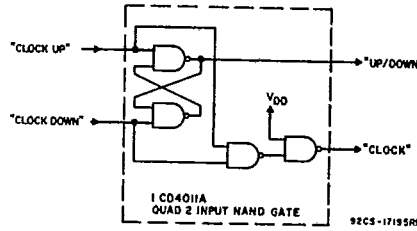


Fig. 10—Conversion of clock up, clock down input signals to clock and up/down input signals.

The CD4029A CLOCK and UP/DOWN inputs are used directly in most applications. In applications where CLOCK UP and CLOCK DOWN inputs are provided, conversion to the CD4029A CLOCK and UP/DOWN inputs can easily be realized by use of the circuit shown below.

CD4029A changes count on positive transitions of CLOCK UP or CLOCK DOWN inputs. For the gate configuration shown below, when counting up the CLOCK DOWN input must be maintained high and conversely when counting down the CLOCK UP input must be maintained high.

| CLOCK | TE | PE | J | Q | Q̄ |
|-------|----|----|---|----|----|
| X | X | 0 | 0 | 0 | 1 |
| L | 1 | 1 | X | Q | Q̄ |
| X | X | 0 | 1 | 1 | 0 |
| L | 0 | 1 | X | Q̄ | Q |
| J | X | 1 | X | Q | Q̄ |

HC—NO CHANGE TE—TOGGLE ENABLE

| CLOCK | TE | PE | J | Q | Q̄ |
|-------|----|----|---|----|----|
| X | X | 0 | 0 | 0 | 1 |
| L | 0 | 1 | X | Q̄ | Q |
| X | X | 0 | 1 | 1 | 0 |
| L | 1 | 1 | X | Q | Q̄ |
| J | X | 1 | X | Q̄ | Q |

X—DON'T CARE

| CONTROL INPUT | LOGIC LEVEL | ACTION |
|-----------------------------|-------------|--|
| BIN/DEC (B/D) | 1 | BINARY COUNT |
| UP/DOWN (U/D) | 1 | UP COUNT |
| UP/DOWN (U/D) | 0 | DOWN COUNT |
| PRESET ENABLE (PE) | 1 | JAM IN |
| PRESET ENABLE (PE) | 0 | NO JAM |
| CARRY IN (CZ) (CLOCK ENHBT) | 1 | NO COUNTER ADVANCE AT POS CLOCK TRANSITION |
| | 0 | ADVANCE COUNTER AT POS CLOCK TRANSITION |

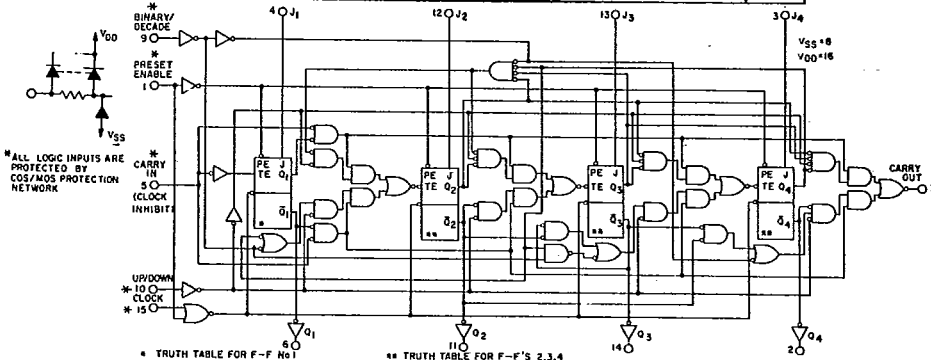
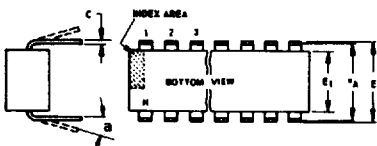
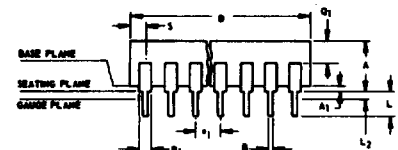


Fig. 11—Logic diagram.

Dimensional Outlines

Dual-In-Line Welded-Seal Ceramic Packages



- NOTES:**
Refer to Rules for Dimensioning (JEDEC Publication No. 95) for Axial Lead Product Outlines.
- When this device is supplied solder-dipped, the maximum lead thickness (narrow portion) will not exceed 0.013" (0.33 mm).
 - Leads within 0.005" (0.12 mm) radius of True Position (TP) at gauge plane with maximum material condition and unit installed.
 - e_A applies in zone L₂ when unit installed.
 - a applies to spread leads prior to installation.
 - N is the maximum quantity of lead positions.
 - N₁ is the quantity of allowable missing leads.

(D) SUFFIX (JEDEC MO-001-AD)
14-Lead Dual-In-Line Welded-Seal Ceramic Package

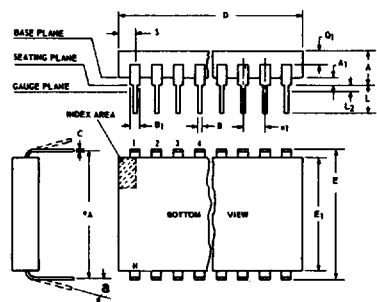
| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|----------------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.120 | 0.160 | | 3.05 | 4.06 |
| A ₁ | 0.020 | 0.065 | | 0.51 | 1.65 |
| B | 0.014 | 0.020 | | 0.356 | 0.508 |
| B ₁ | 0.060 | 0.065 | | 1.27 | 1.65 |
| C | 0.008 | 0.012 | 1 | 0.204 | 0.304 |
| D | 0.745 | 0.770 | | 18.93 | 19.55 |
| E | 0.300 | 0.325 | | 7.62 | 8.25 |
| E ₁ | 0.240 | 0.260 | | 6.10 | 6.60 |
| e ₁ | 0.100 TP | | 2 | 2.54 TP | |
| e _A | 0.300 TP | | 2, 3 | 7.62 TP | |
| L | 0.125 | 0.150 | | 3.18 | 3.81 |
| L ₂ | 0.000 | 0.030 | | 0.000 | 0.76 |
| a | 0° | 15° | 4 | 0° | 15° |
| N | 14 | | 5 | 14 | |
| N ₁ | 0 | | 6 | 0 | |
| Q ₁ | 0.050 | 0.085 | | 1.27 | 2.15 |
| S | 0.065 | 0.090 | | 1.66 | 2.28 |

92SS-4411R2

(D) SUFFIX (JEDEC MO-001-AE)
16-Lead Dual-In-Line Welded-Seal Ceramic Package

| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|----------------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.120 | 0.160 | | 3.05 | 4.06 |
| A ₁ | 0.020 | 0.065 | | 0.51 | 1.65 |
| B | 0.014 | 0.020 | | 0.356 | 0.508 |
| B ₁ | 0.035 | 0.065 | | 0.89 | 1.65 |
| C | 0.008 | 0.012 | 1 | 0.204 | 0.304 |
| D | 0.745 | 0.785 | | 18.93 | 19.93 |
| E | 0.300 | 0.325 | | 7.62 | 8.25 |
| E ₁ | 0.240 | 0.260 | | 6.10 | 6.60 |
| e ₁ | 0.100 TP | | 2 | 2.54 TP | |
| e _A | 0.300 TP | | 2, 3 | 7.62 TP | |
| L | 0.125 | 0.150 | | 3.18 | 3.81 |
| L ₂ | 0.000 | 0.030 | | 0.000 | 0.76 |
| a | 0° | 15° | 4 | 0° | 15° |
| N | 16 | | 5 | 16 | |
| N ₁ | 0 | | 6 | 0 | |
| Q ₁ | 0.050 | 0.085 | | 1.27 | 2.15 |
| S | 0.015 | 0.060 | | 0.39 | 1.52 |

92SS-4266R5



- NOTES:**
Refer to Rules for Dimensioning (JEDEC Publication No. 95) for Axial Lead Product Outlines.
- When this device is supplied solder-dipped, the maximum lead thickness (narrow portion) will not exceed 0.013" (0.33 mm).
 - Leads within 0.005" (0.12 mm) radius of True Position (TP) at gauge plane with maximum material condition and unit installed.
 - e_A applies in zone L₂ when unit installed.
 - a applies to spread leads prior to installation.
 - N is the maximum quantity of lead positions.
 - N₁ is the quantity of allowable missing leads.

(D) SUFFIX (JEDEC MO-015-AG)
24-Lead Dual-In-Line Welded-Seal Ceramic Package

| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|----------------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.090 | 0.200 | | 2.29 | 5.08 |
| A ₁ | 0.020 | 0.070 | | 0.51 | 1.78 |
| B | 0.015 | 0.020 | | 0.381 | 0.508 |
| B ₁ | 0.045 | 0.055 | | 1.143 | 1.397 |
| C | 0.008 | 0.012 | 1 | 0.204 | 0.304 |
| D | 1.15 | 1.22 | | 29.21 | 30.98 |
| E | 0.600 | 0.625 | | 15.24 | 15.87 |
| E ₁ | 0.480 | 0.520 | | 12.20 | 13.20 |
| e ₁ | 0.100 TP | | 2 | 2.54 TP | |
| e _A | 0.600 TP | | 2, 3 | 15.24 TP | |
| L | 0.100 | 0.180 | | 2.54 | 4.57 |
| L ₂ | 0.000 | 0.030 | | 0.00 | 0.76 |
| a | 0° | 15° | 4 | 0° | 15° |
| N | 24 | | 5 | 24 | |
| N ₁ | 0 | | 6 | 0 | |
| Q ₁ | 0.020 | 0.080 | | 0.51 | 2.03 |
| S | 0.020 | 0.060 | | 0.51 | 1.52 |

92CS-19948R4

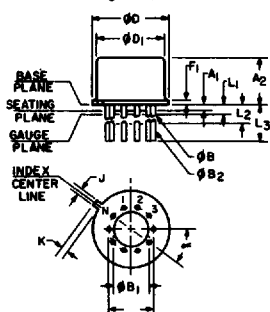
(D) SUFFIX (JEDEC MO-015-AH)
28-Lead Dual-In-Line Welded-Seal Ceramic Package

| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|----------------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.090 | 0.200 | | 2.29 | 5 |
| A ₁ | 0 | 0.070 | 2 | 0 | 1.77 |
| B | 0.015 | 0.020 | | 0.381 | 0.508 |
| B ₁ | 0.015 | 0.065 | | 0.39 | 1.39 |
| C | 0.008 | 0.012 | 1 | 0.204 | 0.304 |
| D | 1.380 | 1.420 | | 35.06 | 36.06 |
| E | 0.600 | 0.625 | | 15.24 | 15.87 |
| E ₁ | 0.485 | 0.515 | | 12.32 | 13.08 |
| e ₁ | 0.100 TP | | 2 | 2.54 TP | |
| e _A | 0.600 TP | | 2, 3 | 15.24 TP | |
| L | 0.100 | 0.200 | | 2.6 | 5 |
| L ₂ | 0 | 0.030 | | 0 | 0.76 |
| a | 0° | 15° | 4 | 0° | 15° |
| N | 28 | | 5 | 28 | |
| N ₁ | 0 | | 6 | 0 | |
| Q ₁ | 0.020 | 0.070 | | 0.51 | 1.77 |
| S | 0.040 | 0.070 | | 1.02 | 1.77 |

92CM-20250R2

TO-5 Style Package

(T) SUFFIX (JEDEC MO-006-AG)
12-Lead Metal Package



92CS-19774

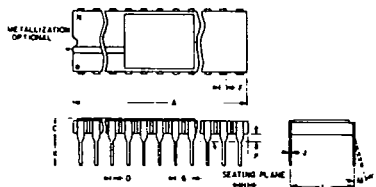
| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|-----------------|--------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| a | 0.230 | | 2 | 5.84 TP | |
| A ₁ | 0 | 0 | | 0 | 0 |
| A ₂ | 0.165 | 0.185 | | 4.19 | 4.70 |
| φB | 0.016 | 0.019 | 3 | 0.407 | 0.482 |
| φB ₁ | 0 | 0 | | 0 | 0 |
| φB ₂ | 0.016 | 0.021 | 3 | 0.407 | 0.533 |
| φD | 0.335 | 0.370 | | 8.51 | 9.39 |
| φD ₁ | 0.305 | 0.335 | | 7.75 | 8.50 |
| F ₁ | 0.020 | 0.040 | | 0.51 | 1.01 |
| j | 0.028 | 0.034 | | 0.712 | 0.863 |
| k | 0.029 | 0.045 | 4 | 0.74 | 1.14 |
| L ₁ | 0.000 | 0.050 | 3 | 0.00 | 1.27 |
| L ₂ | 0.250 | 0.500 | 3 | 6.4 | 12.7 |
| L ₃ | 0.500 | 0.562 | 3 | 12.7 | 14.27 |
| a | 30° TP | | | 30° TP | |
| N | 12 | | 6 | 12 | |
| N ₁ | 1 | | 5 | 1 | |

NOTES:

- Refer to Rules for Dimensioning Axial Lead Product Outlines.
- Leads at gauge plane within 0.007" (0.178 mm) radius of True Position (TP) at maximum material condition.
- φB applies between L₁ and L₂. φB₂ applies between L₂ and 0.500" (12.70 mm) from seating plane. Diameter is uncontrolled in L₁ and beyond 0.500" (12.70 mm).
- Measure from Max. φD.
- N₁ is the quantity of allowable missing leads.
- N is the maximum quantity of lead positions.

Dimensional Outlines (Cont'd)

DUAL-IN-LINE SIDE-BRAZED CERAMIC PACKAGES



(D) SUFFIX
18-Lead Dual-In-Line
Side-Brazed Ceramic Package

| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|--------|--------|-------|------|-------------|--------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.890 | 0.915 | | 22.606 | 23.241 |
| C | — | 0.200 | | — | 5.080 |
| D | 0.015 | 0.021 | | 0.381 | 0.533 |
| F | 0.054 | REF. | 1 | 1.371 | REF. |
| G | 0.100 | BSC | 1 | 2.54 | BSC |
| H | 0.035 | 0.065 | | 0.889 | 1.651 |
| J | 0.008 | 0.012 | 3 | 0.203 | 0.304 |
| K | 0.125 | 0.150 | | 3.175 | 3.810 |
| L | 0.290 | 0.310 | 2 | 7.366 | 7.874 |
| M | 0° | 15° | | 0° | 15° |
| P | 0.025 | 0.045 | | 0.635 | 1.143 |
| N | 18 | | | 18 | |

92CS-27231R1

(D) SUFFIX
22-Lead Dual-In-Line
Side-Brazed Ceramic Package

| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|--------|--------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 1.065 | 1.100 | | 27.05 | 27.94 |
| C | 0.085 | 0.145 | | 2.16 | 3.68 |
| D | 0.017 | 0.023 | | 0.43 | 0.58 |
| F | 0.040 | REF. | 1 | 1.02 | REF. |
| G | 0.100 | BSC | 1 | 2.54 | BSC |
| H | 0.030 | 0.070 | | 0.76 | 1.78 |
| J | 0.008 | 0.012 | 3 | 0.20 | 0.30 |
| K | 0.125 | 0.175 | | 3.18 | 4.45 |
| L | 0.380 | 0.420 | 2 | 9.65 | 10.67 |
| M | — | 7° | | — | 7° |
| P | 0.025 | 0.050 | | 0.64 | 1.27 |
| N | 22 | | | 22 | |

92CS-25186R2

NOTES:

- Leads within 0.005" (0.13 mm)-radius of True Position at maximum material condition.
- Dimension "L" to center of leads when formed parallel.
- When this device is supplied solder-dipped, the maximum lead thickness (narrow portion) will not exceed 0.013" (0.33 mm).

(D) SUFFIX
24-Lead Dual-In-Line
Side-Brazed Ceramic Package

| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|--------|--------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 1.180 | 1.220 | | 29.98 | 30.98 |
| C | 0.085 | 0.145 | | 2.16 | 3.68 |
| D | 0.015 | 0.023 | | 0.39 | 0.58 |
| F | 0.040 | REF. | | 1.02 | REF. |
| G | 0.100 | BSC | 1 | 2.54 | BSC |
| H | 0.030 | 0.070 | | 0.77 | 1.77 |
| J | 0.008 | 0.012 | 3 | 0.21 | 0.30 |
| K | 0.125 | 0.175 | | 3.18 | 4.44 |
| L | 0.580 | 0.620 | 2 | 14.74 | 15.74 |
| M | — | 7° | | — | 7° |
| P | 0.025 | 0.050 | | 0.64 | 1.27 |
| N | 24 | | | 24 | |

92CS-30968R1

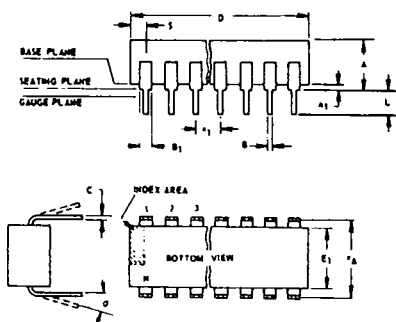
(D) SUFFIX
40-Lead Dual-In-Line
Side-Brazed Ceramic Package

| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|--------|--------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 1.980 | 2.020 | | 50.30 | 51.30 |
| C | 0.095 | 0.155 | | 2.43 | 3.93 |
| D | 0.017 | 0.023 | | 0.43 | 0.58 |
| F | 0.050 | REF. | | 1.27 | REF. |
| G | 0.100 | BSC | 1 | 2.54 | BSC |
| H | 0.030 | 0.070 | | 0.76 | 1.78 |
| J | 0.008 | 0.012 | 3 | 0.20 | 0.30 |
| K | 0.125 | 0.175 | | 3.18 | 4.45 |
| L | 0.580 | 0.620 | 2 | 14.74 | 15.74 |
| M | — | 7° | | — | 7° |
| P | 0.025 | 0.050 | | 0.64 | 1.27 |
| N | 40 | | | 40 | |

92CM-27029R2

Dual-In-Line Plastic and Frit-Seal Ceramic Packages

(E) SUFFIX (JEDEC MO-001-AN)
8-Lead Dual-In-Line Plastic
(Mini-DIP) Package



| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|----------------|--------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.155 | 0.200 | | 3.94 | 5.08 |
| A ₁ | 0.020 | 0.050 | | 0.508 | 1.27 |
| B | 0.014 | 0.020 | | 0.356 | 0.508 |
| B ₁ | 0.035 | 0.065 | | 0.889 | 1.65 |
| C | 0.008 | 0.012 | 1 | 0.203 | 0.304 |
| D | 0.370 | 0.400 | | 9.40 | 10.16 |
| E | 0.300 | 0.325 | | 7.62 | 8.25 |
| E ₁ | 0.240 | 0.260 | | 6.10 | 6.60 |
| e ₁ | 0.100 | TP | 2 | 2.54 | TP |
| e _A | 0.300 | TP | 2, 3 | 7.62 | TP |
| L | 0.125 | 0.150 | | 3.18 | 3.81 |
| L ₂ | 0.000 | 0.030 | | 0.000 | 0.762 |
| a | 0 | 15 | 4 | 0 | 15 |
| N | 8 | | 5 | 8 | |
| N ₁ | 0 | | 6 | 0 | |
| O ₁ | 0.040 | 0.075 | | 1.02 | 1.90 |
| S | 0.015 | 0.060 | | 0.381 | 1.52 |

92CS-24026 R1

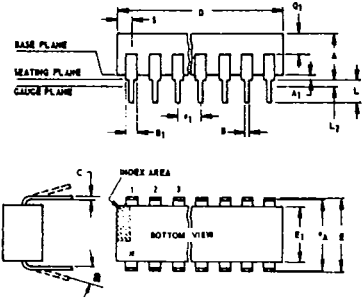
NOTES:

Refer to Rules for Dimensioning (JEDEC Publication No. 95) for Axial Lead Product Outlines.

- When this device is supplied solder-dipped, the maximum lead thickness (narrow portion) will not exceed 0.013".
- Leads within 0.005" (0.12 mm) radius of True Position (TP) at gauge plane with maximum material condition and unit installed.
- e_A applies in zone L₂ when unit installed.
- a applies to spread leads prior to installation.
- N is the maximum quantity of lead positions.
- N₁ is the quantity of allowable missing leads.

Dimensional Outlines (Cont'd)

Dual-In-Line Plastic and Frit-Seal Ceramic Packages (Cont'd)



NOTES:
Refer to Rules for Dimensioning (JEDEC Publication No. 95) for Axial Lead Product Outlines.
1. When this device is supplied solder dipped, the maximum lead thickness (narrow portion) will not exceed 0.013" (0.33 mm).
2. Leads within 0.005" (0.12 mm) radius of True Position (TP) at gauge plane with maximum material condition and unit installed.
3. eA applies in zone L2 when unit installed.
4. a applies to spread leads prior to installation.
5. N is the maximum quantity of lead positions.
6. N1 is the quantity of allowable missing leads.

(E) and (F) SUFFIXES (JEDEC MO-001-AB)
14-Lead Dual-In-Line Plastic or Frit-Seal Ceramic Package

| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|--------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.155 | 0.200 | | 3.94 | 5.08 |
| A1 | 0.020 | 0.050 | | 0.51 | 1.27 |
| B | 0.014 | 0.020 | | 0.356 | 0.508 |
| B1 | 0.050 | 0.065 | | 1.27 | 1.65 |
| C | 0.008 | 0.012 | 1 | 0.204 | 0.304 |
| D | 0.745 | 0.770 | | 18.93 | 19.55 |
| E | 0.300 | 0.325 | | 7.62 | 8.25 |
| E1 | 0.240 | 0.260 | | 6.10 | 6.60 |
| e1 | 0.100 TP | | 2 | 2.54 TP | |
| eA | 0.300 TP | | 2,3 | 7.62 TP | |
| L | 0.125 | 0.150 | | 3.18 | 3.81 |
| L2 | 0.000 | 0.030 | | 0.000 | 0.76 |
| a | 0° | 15° | 4 | 0° | 15° |
| N | 14 | | 5 | 14 | |
| N1 | 0 | | 6 | 0 | |
| Q1 | 0.040 | 0.075 | | 1.02 | 1.90 |
| S | 0.065 | 0.090 | | 1.66 | 2.28 |

92SS-4296R3

(E) and (F) SUFFIXES (JEDEC MO-001-AC)
16-Lead Dual-In-Line Plastic or Frit-Seal Ceramic Package

| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|--------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.155 | 0.200 | | 3.94 | 5.08 |
| A1 | 0.020 | 0.050 | | 0.51 | 1.27 |
| B | 0.014 | 0.020 | | 0.356 | 0.508 |
| B1 | 0.035 | 0.065 | | 0.89 | 1.65 |
| C | 0.008 | 0.012 | 1 | 0.204 | 0.304 |
| D | 0.745 | 0.785 | | 18.93 | 19.93 |
| E | 0.300 | 0.325 | | 7.62 | 8.25 |
| E1 | 0.240 | 0.260 | | 6.10 | 6.60 |
| e1 | 0.100 TP | | 2 | 2.54 TP | |
| eA | 0.300 TP | | 2,3 | 7.62 TP | |
| L | 0.125 | 0.150 | | 3.18 | 3.81 |
| L2 | 0.000 | 0.030 | | 0.000 | 0.76 |
| a | 0° | 15° | 4 | 0° | 15° |
| N | 16 | | 5 | 16 | |
| N1 | 0 | | 6 | 0 | |
| Q1 | 0.040 | 0.075 | | 1.02 | 1.90 |
| S | 0.015 | 0.060 | | 0.39 | 1.52 |

92CM-15967R4

(E) SUFFIX
18-Lead Dual-In-Line Plastic Package

| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|--------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.155 | 0.200 | | 3.94 | 5.08 |
| A1 | 0.020 | 0.050 | | 0.508 | 1.27 |
| B | 0.014 | 0.020 | | 0.356 | 0.508 |
| B1 | 0.035 | 0.065 | | 0.89 | 1.65 |
| C | 0.008 | 0.012 | 1 | 0.204 | 0.304 |
| D | 0.845 | 0.885 | | 21.47 | 22.47 |
| E1 | 0.240 | 0.260 | | 6.10 | 6.60 |
| e1 | 0.100 TP | | 2 | 2.54 TP | |
| eA | 0.300 TP | | 2,3 | 7.62 TP | |
| L | 0.125 | 0.150 | | 3.18 | 3.81 |
| L2 | 0 | 0.030 | | 0 | 0.762 |
| a | 0° | 15° | 4 | 0° | 15° |
| N | 18 | | 5 | 18 | |
| N1 | 0 | | 6 | 0 | |
| S | 0.015 | 0.060 | | 0.39 | 1.52 |

92CS-30630

(E) SUFFIX
22-Lead Dual-In-Line Plastic Package

| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|--------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.155 | 0.200 | | 3.94 | 5.08 |
| A1 | 0.020 | 0.050 | | 0.508 | 1.27 |
| B | 0.015 | 0.020 | | 0.381 | 0.508 |
| B1 | 0.035 | 0.065 | | 0.89 | 1.65 |
| C | 0.008 | 0.012 | 1 | 0.204 | 0.304 |
| D | | 1.120 | | | 28.44 |
| E | 0.390 | 0.420 | | 9.91 | 10.66 |
| E1 | 0.345 | 0.355 | | 8.77 | 9.01 |
| e1 | 0.100 TP | | 2 | 2.54 TP | |
| eA | 0.400 TP | | 2,3 | 10.16 TP | |
| L | 0.125 | 0.150 | | 3.18 | 3.81 |
| L2 | 0 | 0.030 | | 0 | 0.762 |
| a | 2° | 15° | 4 | 2° | 15° |
| N | 22 | | 5 | 22 | |
| N1 | 0 | | 6 | 0 | |
| Q1 | 0.055 | 0.085 | | 1.40 | 2.15 |
| S | 0.015 | 0.060 | | 0.381 | 1.27 |

92CS-30830

(F) SUFFIX (JEDEC MO-001-AG)
16-Lead Dual-In-Line Frit-Seal Ceramic Package

| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|--------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.165 | 0.210 | | 4.20 | 5.33 |
| A1 | 0.015 | 0.045 | | 0.381 | 1.14 |
| B | 0.015 | 0.020 | | 0.381 | 0.508 |
| B1 | 0.045 | 0.070 | | 1.15 | 1.77 |
| C | 0.009 | 0.011 | 1 | 0.229 | 0.279 |
| D | 0.750 | 0.795 | | 19.05 | 20.19 |
| E | 0.295 | 0.325 | | 7.50 | 8.25 |
| E1 | 0.245 | 0.300 | | 6.23 | 7.62 |
| e1 | 0.100 TP | | 2 | 2.54 TP | |
| eA | 0.300 TP | | 2,3 | 7.62 TP | |
| L | 0.120 | 0.160 | | 3.05 | 4.06 |
| L2 | 0.000 | 0.030 | | 0.000 | 0.76 |
| a | 2° | 15° | 4 | 2° | 15° |
| N | 16 | | 5 | 16 | |
| N1 | 0 | | 6 | 0 | |
| Q1 | 0.050 | 0.080 | | 1.27 | 2.03 |
| S | 0.010 | 0.060 | | 0.254 | 1.52 |

92CM-22284R1

(E) and (F) SUFFIXES (JEDEC MO-015-AA)
24-Lead Dual-In-Line Plastic or Frit-Seal Ceramic Package

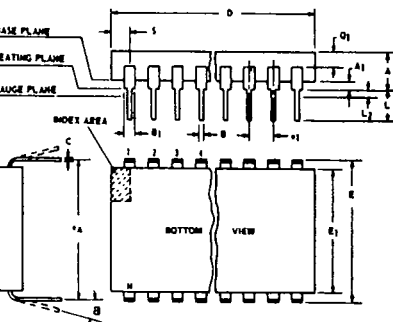
| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|--------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.120 | 0.250 | | 3.10 | 6.30 |
| A1 | 0.020 | 0.070 | | 0.51 | 1.77 |
| B | 0.016 | 0.020 | | 0.407 | 0.508 |
| B1 | 0.028 | 0.070 | | 0.72 | 1.77 |
| C | 0.008 | 0.012 | 1 | 0.204 | 0.304 |
| D | 1.20 | 1.29 | | 30.48 | 32.76 |
| E | 0.600 | 0.625 | | 15.24 | 15.87 |
| E1 | 0.515 | 0.580 | | 13.09 | 14.73 |
| e1 | 0.100 TP | | 2 | 2.54 TP | |
| eA | 0.600 TP | | 2,3 | 15.24 TP | |
| L | 0.100 | 0.200 | | 2.54 | 5.00 |
| L2 | 0.000 | 0.030 | | 0.00 | 0.76 |
| a | 0° | 15° | 4 | 0° | 15° |
| N | 24 | | 5 | 24 | |
| N1 | 0 | | 6 | 0 | |
| Q1 | 0.040 | 0.075 | | 1.02 | 1.90 |
| S | 0.040 | 0.100 | | 1.02 | 2.54 |

92CS26938R2

(E) SUFFIX
40-Lead Dual-In-Line Plastic Package

| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|--------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.120 | 0.250 | | 3.10 | 6.30 |
| A1 | 0.020 | 0.070 | | 0.51 | 1.77 |
| B | 0.016 | 0.020 | | 0.407 | 0.508 |
| B1 | 0.028 | 0.070 | | 0.72 | 1.77 |
| C | 0.008 | 0.012 | 1 | 0.204 | 0.304 |
| D | 2.000 | 2.090 | | 50.80 | 53.09 |
| E1 | 0.515 | 0.580 | | 13.09 | 14.73 |
| e1 | 0.100 TP | | 2 | 2.54 TP | |
| eA | 0.600 TP | | 2,3 | 15.24 TP | |
| L | 0.100 | 0.200 | | 2.54 | 5.00 |
| L2 | 0.000 | 0.030 | | 0.00 | 0.76 |
| a | 0° | 15° | 4 | 0° | 15° |
| N | 40 | | 5 | 40 | |
| N1 | 0 | | 6 | 0 | |
| Q1 | 0.065 | 0.095 | | 1.66 | 2.41 |
| S | 0.040 | 0.100 | | 1.02 | 2.54 |

92CS-30959



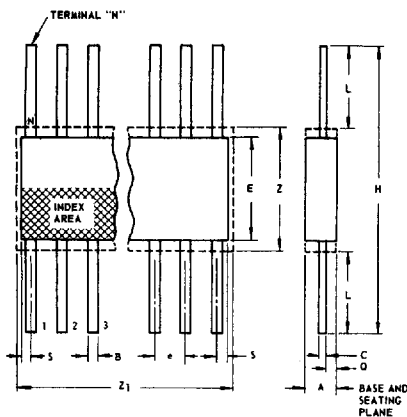
NOTES:
Refer to Rules for Dimensioning (JEDEC Publication No. 95) for Axial Lead Product Outlines.
1. When this device is supplied solder dipped, the maximum lead thickness (narrow portion) will not exceed 0.013".
2. Leads within 0.005" (0.12 mm) radius of True Position (TP) at gauge plane with maximum material condition and unit installed.
3. eA applies in zone L2 when unit installed.
4. a applies to spread leads prior to installation.
5. N is the maximum quantity of lead positions.
6. N1 is the quantity of allowable missing leads.

T-90-20

Dimensional Outlines (Cont'd)

Ceramic Flat Packs

(K) SUFFIX (JEDEC MO-004-AF)
14-Lead



| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|----------------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.008 | 0.100 | | 0.21 | 2.54 |
| B | 0.015 | 0.019 | 1 | 0.381 | 0.482 |
| C | 0.003 | 0.006 | 1 | 0.077 | 0.152 |
| e | 0.050 TP | | 2 | 1.27 TP | |
| E | 0.200 | 0.300 | | 5.1 | 7.6 |
| H | 0.600 | 1.000 | | 15.3 | 25.4 |
| L | 0.150 | 0.350 | | 3.9 | 8.8 |
| N | 14 | | 3 | 14 | |
| Q | 0.005 | 0.050 | | 0.13 | 1.27 |
| S | 0.000 | 0.050 | | 0.00 | 1.27 |
| Z | 0.300 | | 4 | 7.62 | |
| Z ₁ | 0.400 | | 4 | 10.16 | |

9288-4300R3

NOTES:

1. Refer to JEDEC Publication No. 95 for Rules for Dimensioning Peripheral Lead Outlines.
2. Leads within 0.005" (0.12 mm) radius of True Position (TP) at maximum material condition.
3. N is the maximum quantity of lead positions.
4. Z and Z₁ determine a zone within which all body and lead irregularities lie.

(K) SUFFIX (JEDEC MO-004-AG)
16-Lead

| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|----------------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.008 | 0.100 | | 0.21 | 2.54 |
| B | 0.015 | 0.019 | 1 | 0.381 | 0.482 |
| C | 0.003 | 0.006 | 1 | 0.077 | 0.152 |
| e | 0.050 TP | | 2 | 1.27 TP | |
| E | 0.200 | 0.300 | | 5.1 | 7.6 |
| H | 0.600 | 1.000 | | 15.3 | 25.4 |
| L | 0.150 | 0.350 | | 3.9 | 8.8 |
| N | 16 | | 3 | 16 | |
| Q | 0.005 | 0.050 | | 0.13 | 1.27 |
| S | 0.000 | 0.025 | | 0.00 | 0.63 |
| Z | 0.300 | | 4 | 7.62 | |
| Z ₁ | 0.400 | | 4 | 10.16 | |

92CS-17271R3

(K) SUFFIX
24-Lead

| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|----------------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.075 | 0.120 | | 1.91 | 3.04 |
| B | 0.018 | 0.022 | 1 | 0.458 | 0.558 |
| C | 0.004 | 0.007 | 1 | 0.102 | 0.177 |
| e | 0.050 TP | | 2 | 1.27 TP | |
| E | 0.600 | 0.700 | | 15.24 | 17.78 |
| H | 1.150 | 1.350 | | 29.21 | 34.29 |
| L | 0.225 | 0.325 | | 5.72 | 8.25 |
| N | 24 | | 3 | 24 | |
| Q | 0.035 | 0.070 | | 0.89 | 1.77 |
| S | 0.060 | 0.110 | 1 | 1.53 | 2.79 |
| Z | 0.700 | | 4 | 17.78 | |
| Z ₁ | 0.750 | | 4 | 19.05 | |

92CS-19949R2

(K) SUFFIX
28-Lead

| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|----------------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.075 | 0.120 | | 1.91 | 3.04 |
| B | 0.018 | 0.022 | 1 | 0.458 | 0.558 |
| C | 0.004 | 0.007 | 1 | 0.102 | 0.177 |
| e | 0.050 TP | | 2 | 1.27 TP | |
| E | 0.600 | 0.700 | | 15.24 | 17.78 |
| H | 1.150 | 1.350 | | 29.21 | 34.29 |
| L | 0.225 | 0.325 | | 5.72 | 8.25 |
| N | 28 | | 3 | 28 | |
| Q | 0.035 | 0.070 | | 0.89 | 1.77 |
| S | 0 | 0.060 | 1 | 0 | 1.53 |
| Z | 0.700 | | 4 | 17.78 | |
| Z ₁ | 0.750 | | 4 | 19.05 | |

92CS-20972