

T-45-23-17

CD4060A Types

CMOS 14-Stage Ripple-Carry Binary Counter/Divider and Oscillator

The RCA-CD4060A consists of an oscillator section and 14 ripple-carry binary counter stages. The oscillator configuration allows design of either RC or crystal oscillator circuits. A RESET input is provided which resets the counter to the all-0's state and disables the oscillator. A high level on the RESET line accomplishes the reset function. All counter stages are master-slave flip-flops. The state of the counter is advanced one step in binary order on the negative transition of $\phi_1(\phi_0)$. All inputs and outputs are fully buffered.

Features:

- 4-MHz operating frequency (typ.) at $V_{DD} - V_{SS} = 10\text{ V}$
- Common reset
- Fully static operation
- 10 buffered outputs available
- Quiescent current specified to 15 V
- Maximum input leakage current of $1\ \mu\text{A}$ at 15 V (full package-temperature range)
- 1-V noise margin (full package-temperature range)

Oscillator Features:

- All active components on chip
 - RC or crystal oscillator configuration
- Applications:
- Timers
 - Frequency dividers

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).

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}) | -0.5 to +15 V |
| (Voltages referenced to V_{SS} Terminal) | |
| POWER DISSIPATION PER PACKAGE (P_D): | |
| For $T_A = -40$ to $+60^\circ\text{C}$ (PACKAGE TYPE E) | 500 mW |
| For $T_A = +60$ to $+85^\circ\text{C}$ (PACKAGE TYPE E) | Derate Linearly at 12 mW/°C to 200 mW |
| For $T_A = -55$ to $+100^\circ\text{C}$ (PACKAGE TYPES D, F, K) | 500 mW |
| For $T_A = +100$ to $+125^\circ\text{C}$ (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 $V_{DD} + 0.5\text{ V}$ |
| LEAD TEMPERATURE (DURING SOLDERING): | |
| At distance $1/16 \pm 1/32$ Inch ($1.59 \pm 0.79\text{ mm}$) from case for 10 s max. | +265°C |

RECOMMENDED OPERATING CONDITIONS at $T_A = 25^\circ\text{C}$, 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 $T_A = \text{Full Package-Temperature Range}$) | | 3 | 12 | 3 | 12 | V |
| Input-Pulse Width, t_W $f = 100\text{ kHz}$ | 5 10 | 400 110 | — | 500 125 | — | ns |
| Input-Pulse Rise & Fall Time, $t_{r\phi}$, $t_{f\phi}$ | 5 10 | — 15 | 15 7.5 | — 15 | 7.5 | μs |
| Input-Pulse Frequency, f_ϕ | 5 10 | — 1 | — 3 | — 0.9 | 2.75 | MHz |
| Reset Pulse Width, t_W | 5 10 | 1000 500 | — | 1250 600 | — | ns |

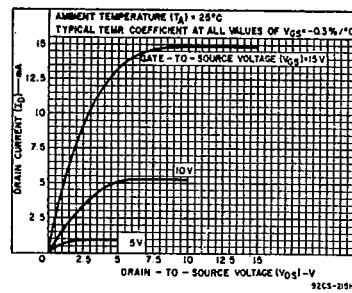
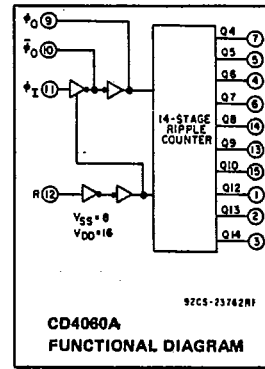


Fig. 1 - Typical n-channel drain characteristics.

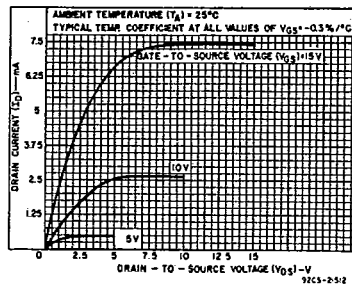


Fig. 2 - Minimum n-channel drain characteristics.

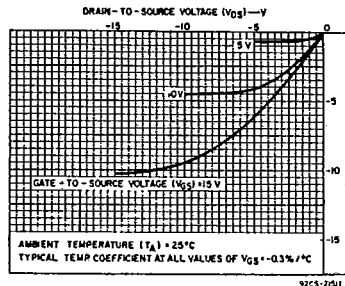


Fig. 3 - Typical p-channel drain characteristics.

CD4060A Types

STATIC ELECTRICAL CHARACTERISTICS

| Characteristic | Conditions | | | Limits at Indicated Temperatures (°C) | | | | | | | Units | | |
|--|-----------------------|------------------------|------------------------|---------------------------------------|-------|--------|-----------|--------|-------|--------|-------|-----|---|
| | V _O (V) | V _{IN} (V) | V _{DD} (V) | D, F, K, H Packages | | | E Package | | | | | | |
| | | | | -55 | +25 | | +125 | -40 | +25 | | | +85 | |
| Quiescent Device Current I _L Max. | - | - | 5 | 15 | 0.5 | 15 | 900 | 50 | 1 | 50 | 700 | μA | |
| | - | - | 10 | 25 | 1 | 25 | 1500 | 100 | 2 | 100 | 1400 | | |
| | - | - | 15 | 50 | 2.5 | 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. | | | | | | | | | |
| High Level V _{OH} | - | 0 | 5 | 4.95 Min.; 5 Typ. | | | | | | | | | V |
| | - | 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. | | | | | | | | | |
| Inputs High V _{NH} | 0.8 | - | 5 | 1.5 Min.; 2.25 Typ. | | | | | | | | | V |
| | 10 | - | 10 | 3 Min.; 4.5 Typ. | | | | | | | | | |
| Noise Margin: Inputs Low, V _{NML} | 4.5 | - | 5 | 1 Min. | | | | | | | | | V |
| | 9 | - | 10 | 1 Min. | | | | | | | | | |
| Inputs High, V _{NMH} | 0.5 | - | 5 | 1 Min. | | | | | | | | | V |
| | 1 | - | 10 | 1 Min. | | | | | | | | | |
| Output Drive Current: * n-Channel (Sink), I _{DN} Min. | 0.5 | - | 5 | 0.22 | 0.36 | 0.18 | 0.125 | 0.21 | 0.36 | 0.18 | 0.15 | mA | |
| | 0.5 | - | 10 | 0.44 | 0.75 | 0.36 | 0.25 | 0.42 | 0.75 | 0.36 | 0.3 | | |
| p-Channel (Source), I _{DP} Min. | 4.5 | - | 5 | -0.15 | -0.25 | -0.125 | -0.085 | -0.145 | -0.25 | -0.125 | -0.1 | mA | |
| | 9.5 | - | 10 | -0.3 | -0.5 | -0.25 | -0.175 | -0.29 | -0.5 | -0.25 | -0.2 | | |
| Input Leakage Current, I _{IL} I _{IH} | Any Input | | | ±10 ⁻⁵ Typ., ±1 Max. | | | | | | | μA | | |

* Data not applicable to Terminal 9 or 10

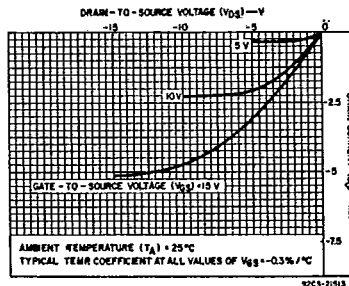


Fig. 4 - Minimum p-channel drain characteristics.

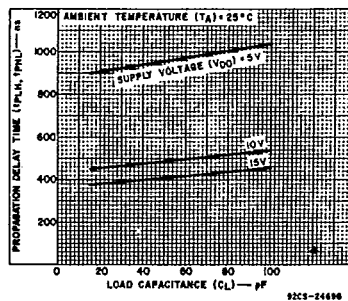


Fig. 5 - Typical propagation delay time vs. load capacitance (Q₄ output).

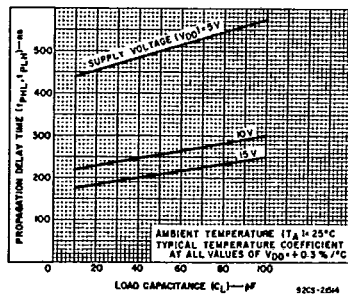


Fig. 6 - Typical propagation delay time vs. load capacitance (Q_n to Q_{n+1}).

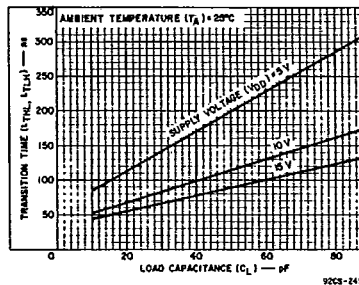


Fig. 8 - Typical output transition time vs. load capacitance.

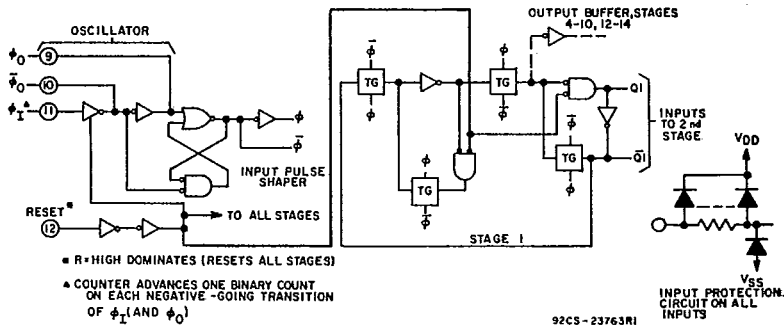


Fig. 7 - Logic diagram of CD4060A oscillator, pulse shaper, and 1 of 14 counter stages.

7-45-23-17

CD4060A Types

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

| CHARACTERISTIC | TEST CONDITIONS | LIMITS | | | | | | UNITS | |
|---|-----------------|---------------------|------|------|-----------|------|------|-------|---------------|
| | | D, F, K, H Packages | | | E Package | | | | |
| | | VDD (V) | Min. | Typ. | Max. | Min. | Typ. | | Max. |
| Input-Pulse Operation | | | | | | | | | |
| Propagation Delay Time, ϕ_1 to Q4 Out; t_{PHL}, t_{PLH} | | 5 | -- | 900 | 1800 | -- | 900 | 1900 | ns |
| | | 10 | -- | 450 | 900 | -- | 450 | 950 | |
| Propagation Delay Time, Q_n to Q_{n+1} ; t_{PHL}, t_{PLH} | | 5 | -- | 450 | 900 | -- | 450 | 950 | ns |
| | | 10 | -- | 225 | 450 | -- | 225 | 475 | |
| Transition Time, t_{THL}, t_{TLH} | | 5 | -- | 150 | 300 | -- | 150 | 350 | ns |
| | | 10 | -- | 75 | 150 | -- | 75 | 175 | |
| Min. Input-Pulse Width t_W | f=100 kHz | 5 | -- | 200 | 400 | -- | 200 | 500 | ns |
| | | 10 | -- | 75 | 110 | -- | 75 | 125 | |
| Input-Pulse Rise & Fall Time, $t_{r\phi}, t_{f\phi}$ | | 5 | -- | -- | 15 | -- | -- | 15 | μs |
| | | 10 | -- | -- | 7.5 | -- | -- | 7.5 | |
| Max. Input-Pulse Frequency, f_ϕ | | 5 | 1 | 1.75 | -- | 0.9 | 1.75 | -- | MHz |
| | | 10 | 3 | 4 | -- | 2.75 | 4 | -- | |
| Input Capacitance, C_i | Any Input | -- | 5 | -- | -- | 5 | -- | pF | |
| Reset Operation | | | | | | | | | |
| Propagation Delay Time, t_{PHL} | | 5 | -- | 500 | 1000 | -- | 500 | 1250 | ns |
| | | 10 | -- | 250 | 500 | -- | 250 | 600 | |
| Minimum Reset Pulse Width, t_W | | 5 | -- | 500 | 1000 | -- | 500 | 1250 | ns |
| | | 10 | -- | 250 | 500 | -- | 250 | 600 | |

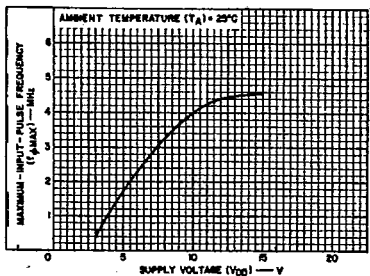


Fig. 9 - Typical maximum-input-pulse frequency vs. supply voltage.

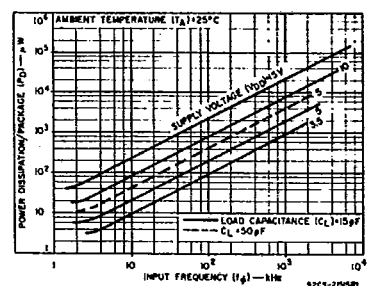


Fig. 10 - Typical dynamic power dissipation characteristics.

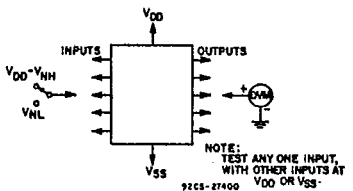


Fig. 12 - Noise-immunity test circuit.

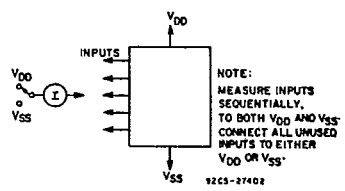


Fig. 13 - Input-leakage-current test circuit.

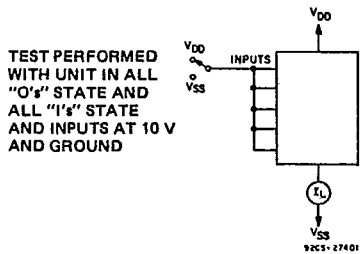
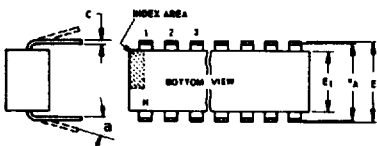
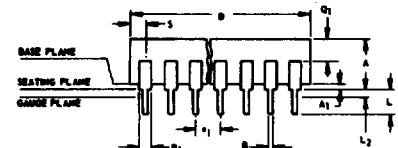


Fig. 11 - Quiescent-device current test circuit.

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

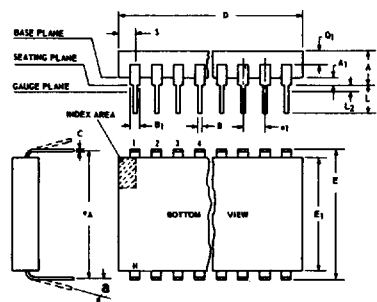
| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|----------------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.120 | 0.160 | | 3.05 | 4.06 |
| A ₁ | 0.020 | 0.065 | | 0.51 | 1.65 |
| B | 0.014 | 0.020 | | 0.356 | 0.508 |
| B ₁ | 0.060 | 0.065 | | 1.27 | 1.65 |
| 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

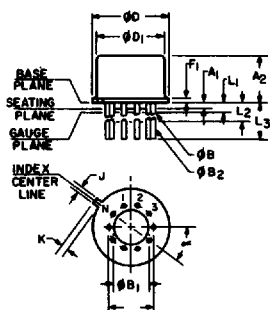
(D) SUFFIX (JEDEC MO-015-AH)
28-Lead Dual-In-Line Welded-Seal Ceramic Package

| 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

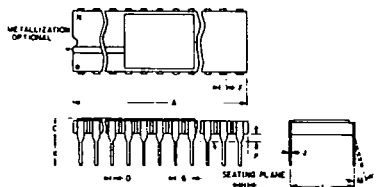
| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|-----------------|--------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| a | 0.230 | | 2 | 5.84 TP | |
| A ₁ | 0 | 0 | | 0 | 0 |
| A ₂ | 0.165 | 0.185 | | 4.19 | 4.70 |
| φB | 0.016 | 0.019 | 3 | 0.407 | 0.482 |
| φB ₁ | 0 | 0 | | 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

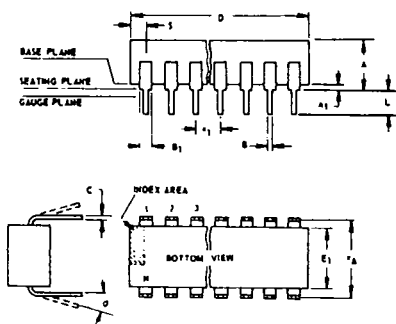
(D) SUFFIX
40-Lead Dual-In-Line
Side-Brazed Ceramic Package

| 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

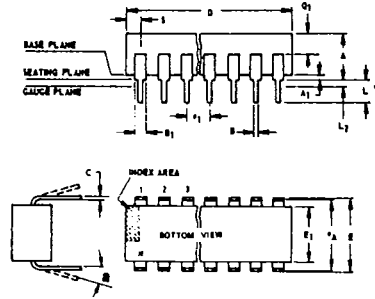
NOTES:

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 |
| A ₁ | 0.020 | 0.050 | | 0.51 | 1.27 |
| B | 0.014 | 0.020 | | 0.356 | 0.508 |
| B ₁ | 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 |
| 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 | 0.040 | 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 |
| A ₁ | 0.020 | 0.050 | | 0.51 | 1.27 |
| 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 | 0.040 | 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 |
| 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 | | 0.89 | 1.65 |
| C | 0.008 | 0.012 | 1 | 0.204 | 0.304 |
| D | 0.845 | 0.885 | | 21.47 | 22.47 |
| 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 | 0.030 | | 0 | 0.762 |
| a | 0° | 15° | 4 | 0° | 15° |
| N | 18 | | 5 | 18 | |
| N ₁ | 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 |
| A ₁ | 0.020 | 0.050 | | 0.508 | 1.27 |
| B | 0.015 | 0.020 | | 0.381 | 0.508 |
| B ₁ | 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 |
| E ₁ | 0.345 | 0.355 | | 8.77 | 9.01 |
| e ₁ | 0.100 TP | | 2 | 2.54 TP | |
| e _A | 0.400 TP | | 2, 3 | 10.16 TP | |
| L | 0.125 | 0.150 | | 3.18 | 3.81 |
| L ₂ | 0 | 0.030 | | 0 | 0.762 |
| a | 2° | 15° | 4 | 2° | 15° |
| N | 22 | | 5 | 22 | |
| N ₁ | 0 | | 6 | 0 | |
| Q ₁ | 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 |
| A ₁ | 0.015 | 0.045 | | 0.381 | 1.14 |
| B | 0.015 | 0.020 | | 0.381 | 0.508 |
| B ₁ | 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 |
| E ₁ | 0.245 | 0.300 | | 6.23 | 7.62 |
| e ₁ | 0.100 TP | | 2 | 2.54 TP | |
| e _A | 0.300 TP | | 2, 3 | 7.62 TP | |
| L | 0.120 | 0.160 | | 3.05 | 4.06 |
| L ₂ | 0.000 | 0.030 | | 0.000 | 0.76 |
| a | 2° | 15° | 4 | 2° | 15° |
| N | 16 | | 5 | 16 | |
| N ₁ | 0 | | 6 | 0 | |
| Q ₁ | 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**

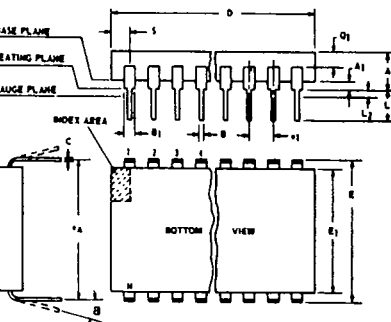
| SYMBOL | INCHES | | NOTE | MILLIMETERS | |
|----------------|----------|-------|------|-------------|-------|
| | MIN. | MAX. | | MIN. | MAX. |
| A | 0.120 | 0.250 | | 3.10 | 6.30 |
| A ₁ | 0.020 | 0.070 | | 0.51 | 1.77 |
| B | 0.016 | 0.020 | | 0.407 | 0.508 |
| B ₁ | 0.028 | 0.070 | | 0.72 | 1.77 |
| 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 |
| E ₁ | 0.515 | 0.580 | | 13.09 | 14.73 |
| e ₁ | 0.100 TP | | 2 | 2.54 TP | |
| e _A | 0.600 TP | | 2, 3 | 15.24 TP | |
| L | 0.100 | 0.200 | | 2.54 | 5.00 |
| 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 | 0.040 | 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 |
| A ₁ | 0.020 | 0.070 | | 0.51 | 1.77 |
| B | 0.016 | 0.020 | | 0.407 | 0.508 |
| B ₁ | 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 |
| E ₁ | 0.515 | 0.580 | | 13.09 | 14.73 |
| e ₁ | 0.100 TP | | 2 | 2.54 TP | |
| e _A | 0.600 TP | | 2, 3 | 15.24 TP | |
| L | 0.100 | 0.200 | | 2.54 | 5.00 |
| L ₂ | 0.000 | 0.030 | | 0.00 | 0.76 |
| a | 0° | 15° | 4 | 0° | 15° |
| N | 40 | | 5 | 40 | |
| N ₁ | 0 | | 6 | 0 | |
| Q ₁ | 0.065 | 0.095 | | 1.66 | 2.41 |
| S | 0.040 | 0.100 | | 1.02 | 2.54 |

92CS-30959



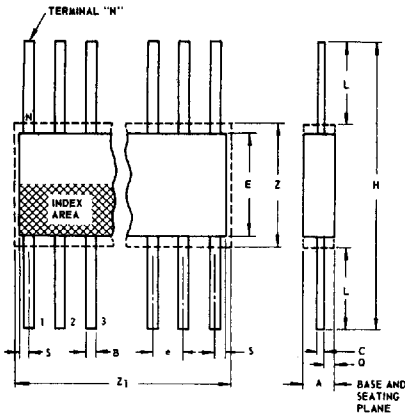
NOTES:
 Refer to Rules for Dimensioning (JEDEC Publication No. 95) for Axial Lead Product Outlines.
 1. When this device is supplied solder dipped, the maximum lead thickness (narrow portion) will not exceed 0.013".
 2. Leads within 0.005" (0.12 mm) radius of True Position (TP) at gauge plane with maximum 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