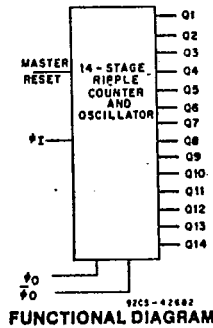


**CD54/74AC7060, CD54/74AC7061
CD54/74ACT7060, CD54/74ACT7061**

Advance Information

T-45-23-17



14-Stage Binary Counter with Oscillator

Type Features:

- On-board oscillator
- Buffered inputs
- Common reset
- Negative-edge clocking
- Typical $f_{MAX} = 200 \text{ MHz @ } V_{CC} = 5 \text{ V, } C_L = 50 \text{ pF}$
- AC/ACT7060 Enabling Reset disables oscillator
- AC/ACT7061 oscillator continues to run when Reset is enabled

The RCA-CD54/74AC7060 and CD54/74AC7061 and the CD54/74ACT7060 CD54/74ACT7061 each 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 Master Reset input is provided which resets the counter to the all-0's state and disables the oscillator in the 7060. In the 7061 the oscillator continues to run when the Master Reset is enabled. A high level on the MR line accomplishes the reset function. All counter stages are master-slave flip-flops. The state of the counter is advanced one step in the binary order on the negative transition of ϕ (and ϕO). All inputs and outputs are buffered. Schmitt trigger action on the input-pulse line permits much slower rise and fall slew rates.

In order to achieve a symmetrical waveform in the oscillator section, the ACT7060 and 7061 input pulse switchpoints are the same as in the AC7060 and 7061 except the MR input in the ACT7060 and 7061 has TTL switching levels.

The CD74AC/ACT7060 and the CD74AC/ACT7061 are supplied in 20-lead dual-in-line plastic packages (E suffix) and in 20-lead dual-in-line small-outline plastic packages (M suffix). Both package types are operable over the following temperature ranges: Commercial (0 to +70°C); Industrial (-40 to +85°C); and Extended Industrial/Military (-55 to +125°C). The CD54AC/ACT7060 and the CD54-AC/ACT7061, available in chip form (H suffix), are operable over the -55 to +125°C temperature range.

Family Features:

- Exceeds 2-kV ESD protection-MIL-STD-883, Method 3015
- SCR-latchup-resistant CMOS process and circuit design
- Balanced propagation delays
- AC types feature 1.5V to 5.5V operation and balanced noise immunity at 30% of the supply
- $\pm 24\text{-mA}$ output drive current (Q1, Q2, and Q3)
 - Fanout to 15 FAST* ICs
 - Drives 50-ohm transmission lines

*FAST is a registered trademark of Fairchild Semiconductor Corp.

TRUTH TABLE

| ϕ | MR | OUTPUT STATE |
|--------|----|-----------------------|
| | L | No Change |
| | L | Advance to Next State |
| X | H | All Outputs are Low |

H = high level (steady state)
L = low level (steady state)
X = don't care



File Number 2062

329

Technical Data

CD54/74AC7060, CD54/74AC7061
CD54/74ACT7060, CD54/74ACT7061

T-45-23-17

MAXIMUM RATINGS, Absolute-Maximum Values:

- DC SUPPLY-VOLTAGE, (V_{CC}) -0.5 to 6 V
- DC INPUT DIODE CURRENT, I_{IK} (for $V_i < -0.5$ V or $V_i > V_{CC} + 0.5$ V) ± 20 mA
- DC OUTPUT DIODE CURRENT, I_{OK} (for $V_o < -0.5$ V or $V_o > V_{CC} + 0.5$ V) ± 50 mA
- DC OUTPUT SOURCE OR SINK CURRENT per Output Pin, I_o (for $V_o > -0.5$ V or $V_o < V_{CC} + 0.5$ V) ± 50 mA
- DC V_{CC} -OR GROUND CURRENT (I_{CC} or I_{GND}) ± 100 mA*
- POWER DISSIPATION PER PACKAGE (P_o):
 - For $T_A = -55$ to $+100^\circ$ C (PACKAGE TYPES E) 500 mW
 - For $T_A = +100$ to $+125^\circ$ C (PACKAGE TYPES E) Derate Linearly at 8 mW/ $^\circ$ C to 300 mW
 - For $T_A = -55$ to $+70^\circ$ C (PACKAGE TYPE M) 400 mW
 - For $T_A = +70$ to $+125^\circ$ C (PACKAGE TYPE M) Derate Linearly at 6 mW/ $^\circ$ C to 70 mW
- OPERATING-TEMPERATURE RANGE (T_A) -55 to $+125^\circ$ C
- STORAGE TEMPERATURE (T_{STG}) -65 to $+150^\circ$ C
- LEAD TEMPERATURE (DURING SOLDERING):
 - At distance $1/16 \pm 1/32$ in. (1.59 ± 0.79 mm) from case for 10 s max. $+265^\circ$ C
 - Unit inserted into PC board (min. thickness $1/16$ in., 1.59 mm) with solder contacting lead tips only $+300^\circ$ C

*(For up to 4 outputs per device; add ± 25 mA for each additional output.)

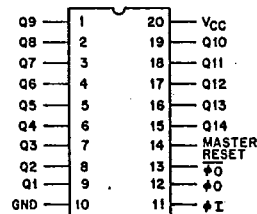
RECOMMENDED OPERATING CONDITIONS:

For maximum reliability, normal operating conditions should be selected so that operation is always within the following ranges:

| CHARACTERISTIC | | LIMITS | | UNITS |
|--|------------|--------|----------|------------|
| | | MIN. | MAX. | |
| Supply-Voltage Range (For $T_A =$ Full Package-Temperature Range) | V_{CC} * | | | |
| AC Types | | 1.5 | 5.5 | V |
| ACT Types | | 4.5 | 5.5 | V |
| DC Input or Output Voltage | V_i, V_o | 0 | V_{CC} | V |
| Operating Temperature | T_A | -55 | +125 | $^\circ$ C |
| Input Rise and Fall Slew Rate | dt/dv † | | | |
| at 1.5 V to 3 V (AC Types) | | 0 | 50 | ns/V |
| at 3.6 V to 5.5 V (AC Types) | | 0 | 20 | |
| at 4.5 V to 5.5 V (ACT Types) | | 0 | 10 | |

†Applicable for MR. Schmitt Input on ϕ 1 line permits slower slew rates.

*Unless otherwise specified, all voltages are referenced to ground.



92CS-43092

TERMINAL ASSIGNMENT

**CD54/74AC7060, CD54/74AC7061
CD54/74ACT7060, CD54/74ACT7061**

STATIC ELECTRICAL CHARACTERISTICS: AC Series

T-45-23-17

| CHARACTERISTIC | TEST CONDITIONS | | V _{CC} (V) | AMBIENT TEMPERATURE (T _A) - °C | | | | | | UNITS | |
|--|--|--|------------------------|--|------|------------|------|-------------|------|-------|----|
| | V _I (V) | I _O (mA) | | +25 | | -40 to +85 | | -55 to +125 | | | |
| | | | | MIN. | MAX. | MIN. | MAX. | MIN. | MAX. | | |
| High-Level Input Voltage | V _{IH} | | 1.5 | 1.2 | — | 1.2 | — | 1.2 | — | V | |
| | | | 3 | 2.1 | — | 2.1 | — | 2.1 | — | | |
| | | | 5.5 | 3.85 | — | 3.85 | — | 3.85 | — | | |
| Low-Level Input Voltage | V _{IL} | | 1.5 | — | 0.3 | — | 0.3 | — | 0.3 | V | |
| | | | 3 | — | 0.9 | — | 0.9 | — | 0.9 | | |
| | | | 5.5 | — | 1.65 | — | 1.65 | — | 1.65 | | |
| Output High Voltage All Outputs | V _{OH} | V _{IH} or V _{IL} | -0.05 | 1.5 | 1.4 | — | 1.4 | — | 1.4 | — | V |
| | | | -0.05 | 3 | 2.9 | — | 2.9 | — | 2.9 | — | |
| | | | -0.05 | 4.5 | 4.4 | — | 4.4 | — | 4.4 | — | |
| φ ₀ , φ ₀ (Pins 12, 13) | V _{IH} or V _{IL} | -2 | 3 | 2.58 | — | 2.48 | — | 2.4 | — | V | |
| | | | 4.5 | 3.94 | — | 3.8 | — | 3.7 | — | | |
| Q1, Q2, Q3 | V _{IH} or V _{IL} | -4 | 3 | 2.58 | — | 2.48 | — | 2.4 | — | V | |
| | | | 4.5 | 3.94 | — | 3.8 | — | 3.7 | — | | |
| | | | 75 | 5.5 | — | 3.85 | — | — | — | | |
| | | | 50 | 5.5 | — | — | — | 3.85 | — | | |
| Q4 thru Q14 | V _{IH} or V _{IL} | -1.3 | 3 | 2.58 | — | 2.48 | — | 2.4 | — | V | |
| | | | 4.5 | 3.94 | — | 3.8 | — | 3.7 | — | | |
| Output Low Voltage All Outputs | V _{OL} | V _{IH} or V _{IL} | -0.05 | 1.5 | — | 0.1 | — | 0.1 | — | 0.1 | V |
| | | | -0.05 | 3 | — | 0.1 | — | 0.1 | — | 0.1 | |
| | | | -0.05 | 4.5 | — | 0.1 | — | 0.1 | — | 0.1 | |
| φ ₀ , φ ₀ (Pins 12, 13) | V _{IH} or V _{IL} | 6 | 3 | — | 0.36 | — | 0.44 | — | 0.50 | V | |
| | | | 4.5 | — | 0.36 | — | 0.44 | — | 0.50 | | |
| Q1, Q2, Q3 | V _{IH} or V _{IL} | 12 | 3 | — | 0.36 | — | 0.44 | — | 0.50 | V | |
| | | | 4.5 | — | 0.36 | — | 0.44 | — | 0.50 | | |
| | | | 75 | 5.5 | — | — | 1.65 | — | — | | |
| | | | 50 | 5.5 | — | — | — | — | 1.65 | | |
| Q4 thru Q14 | V _{IH} or V _{IL} | 4 | 3 | — | 0.36 | — | 0.44 | — | 0.50 | V | |
| | | | 4.5 | — | 0.36 | — | 0.44 | — | 0.50 | | |
| Input Leakage Current | I _I | V _{CC} or Gnd | 5.5 | — | ±0.1 | — | ±1 | — | ±1 | μA | |
| | | | — | — | — | — | — | — | — | | |
| Quiescent Supply Current, MSI | I _{CC} | V _{CC} or Gnd | 0 | 5.5 | — | 8 | — | 80 | — | 160 | μA |
| | | | — | — | — | — | — | — | — | | |

#Test one output at a time for a 1-second maximum duration. Measurement is made by forcing current and measuring voltage to minimize power dissipation.

*Test verifies a minimum 50-Ω transmission-line-drive capability at +85°C; 75 ohms at +125°C.



Technical Data

CD54/74AC7060, CD54/74AC7061
CD54/74ACT7060, CD54/74ACT7061

T-45-23-17

STATIC ELECTRICAL CHARACTERISTICS: ACT Series

| CHARACTERISTIC | TEST CONDITIONS | | V _{CC} (V) | AMBIENT TEMPERATURE (T _A) - °C | | | | | | UNITS | |
|--|--|--|------------------------|--|--------|------------|-----------|-------------|-----------|-------|-----|
| | V _i (V) | I _o (mA) | | +25 | | -40 to +85 | | -55 to +125 | | | |
| | | | | MIN. | MAX. | MIN. | MAX. | MIN. | MAX. | | |
| High-Level Input Voltage MR Only | V _{IH} | | 4.5 to 5.5 | 2 | — | 2 | — | 2 | — | V | |
| Low-Level Input Voltage MR Only | V _{IL} | | 4.5 to 5.5 | — | 0.8 | — | 0.8 | — | 0.8 | | |
| Output High Voltage All Outputs | V _{OH} | V _{IH} or V _{IL} | -0.05 | 4.5 | 4.4 | — | 4.4 | — | 4.4 | | — |
| φ _o , φ _s (Pins 12, 13) Q1, Q2, Q3 | V _{IH} or V _{IL} | -12 | 4.5 | 3.94 | — | 3.8 | — | 3.7 | — | | |
| Q4 thru Q14 | V _{IH} or V _{IL} | -24 | 4.5 | 3.94 | — | 3.8 | — | 3.7 | — | | |
| | | #* { -75 -50 | 5.5 5.5 | — — | — — | 3.85 — | — — | — 3.85 | — — | | |
| Output Low Voltage All Outputs | V _{OL} | V _{IH} or V _{IL} | 0.05 | 4.5 | — | 0.1 | — | 0.1 | — | | 0.1 |
| φ _o , φ _s (Pins 12, 13) Q1, Q2, Q3 | V _{IH} or V _{IL} | 12 | 4.5 | — | 0.36 | — | 0.44 | — | 0.50 | | |
| Q4 thru Q14 | V _{IH} or V _{IL} | 24 | 4.5 | — | 0.36 | — | 0.44 | — | 0.50 | | |
| | | #* { 75 50 | 5.5 5.5 | — — | — — | — — | 1.65 — | — — | — 1.65 | | |
| Input Leakage Current | I _i | V _{CC} or Gnd | 5.5 | — | ±0.1 | — | ±1 | — | ±1 | | μA |
| Quiescent Supply Current, MSI | I _{CC} | V _{CC} or Gnd | 0 | 5.5 | — | 8 | — | 80 | — | | |
| Additional Supply Current per Input Pin, TTL Inputs High Unit Load | ΔI _{CC} | V _{CC} -2.1 | 4.5 to 5.5 | — | 2.4 | — | 2.8 | — | 3 | | mA |

#Test one output at a time for a 1-second maximum duration. Measurement is made by forcing current and measuring voltage to minimize power dissipation.

*Test verifies a minimum 50-Ω transmission-line-drive capability at +85°C, 75 ohms at +125°C.

**CD54/74AC7060, CD54/74AC7061
CD54/74ACT7060, CD54/74ACT7061**

T-45-23-17

PREREQUISITE FOR SWITCHING: AC Series

| CHARACTERISTIC | V _{CC} (V) | AMBIENT TEMPERATURE—°C | | | | UNITS |
|-------------------------------|------------------------|------------------------|------|-------------|------|-------|
| | | -40 to +85 | | -55 to +125 | | |
| | | MIN. | MAX. | MIN. | MAX. | |
| Input Pulse Width | 1.5 | 55 | — | 63 | — | ns |
| | 3.3* | 8.1 | — | 7 | — | |
| | 5† | 4.4 | — | 5 | — | |
| Reset Pulse Width | 1.5 | 44 | — | 50 | — | |
| | 3.3 | 4.9 | — | 5.6 | — | |
| | 5 | 3.5 | — | 4 | — | |
| Reset Removal Time | 1.5 | 44 | — | 50 | — | |
| | 3.3 | 4.9 | — | 5.6 | — | |
| | 5 | 3.5 | — | 4 | — | |
| Minimum Input Pulse Frequency | 1.5 | 9.1 | — | 8 | — | MHz |
| | 3.3 | 81 | — | 71 | — | |
| | 5 | 114 | — | 100 | — | |

*3.3 V: min. ls @ 3 V.
†5 V: min. ls @ 4.5 V.

SWITCHING CHARACTERISTICS: AC Series, t_r, t_f = 3 ns, C_L = 50 pF

| CHARACTERISTIC | V _{CC} (V) | AMBIENT TEMPERATURE—°C | | | | UNITS |
|---|------------------------|------------------------|------|-------------|------|-------|
| | | -40 to +85 | | -55 to +125 | | |
| | | MIN. | MAX. | MIN. | MAX. | |
| Propagation Delays: φ _l to Q1 | 1.5 | — | 230 | — | 254 | ns |
| | 3.3* | 7.2 | 25 | 7 | 28 | |
| | 5† | 5.3 | 18.5 | 5.1 | 20.3 | |
| Q _n to Q _n + 1 | 1.5 | — | 68 | — | 75 | |
| | 3.3 | 2.2 | 7.6 | 2.1 | 8.4 | |
| | 5 | 1.5 | 5.5 | 1.5 | 6 | |
| MR to Q _n | 1.5 | — | 262 | — | 288 | |
| | 3.3 | 8.3 | 29.3 | 8.1 | 32.2 | |
| | 5 | 6 | 21 | 5.8 | 23 | |
| Power Dissipation Capacitance | C _{PD} § | 114 Typ. | | 114 Typ. | | pF |
| Input Capacitance | C _i | — | | 10 | | |

*3.3 V: min. ls @ 3.6 V
max. ls @ 3 V
†5 V: min. ls @ 5.5 V
max. ls @ 4.5 V

§C_{PD} is used to determine the dynamic power consumption, per flip-flop.
P_D = C_{PD}V_{CC}²f_i + Σ (C_LV_{CC}²f_o) where f_i = input frequency
f_o = output frequency
C_L = output load capacitance
V_{CC} = supply voltage.

PREREQUISITE FOR SWITCHING: ACT Series

| CHARACTERISTIC | V _{CC} (V) | AMBIENT TEMPERATURE—°C | | | | UNITS |
|-------------------------------|------------------------|------------------------|------|-------------|------|-------|
| | | -40 to +85 | | -55 to +125 | | |
| | | MIN. | MAX. | MIN. | MAX. | |
| Input Pulse Width | 5* | 4.4 | — | 5 | — | ns |
| Reset Pulse Width | 5 | 3.5 | — | 4 | — | |
| Reset Removal Time | 5 | 4.4 | — | 5 | — | |
| Minimum Input Pulse Frequency | f _{MAX} | 114 | — | 100 | — | MHz |

*Min. ls @ 4.5 V.

Technical Data

CD54/74AC7060, CD54/74ACT7061
CD54/74ACT7060, CD54/74ACT7061

T-45-23-17

SWITCHING CHARACTERISTICS: ACT Series, $t_r, t_f = 3$ ns, $C_L = 50$ pF

| CHARACTERISTIC | V_{CC} (V) | AMBIENT TEMPERATURE—°C | | | | UNITS |
|---------------------------------------|-----------------|------------------------|-----------|-------------|-----------|-------|
| | | -40 to +85 | | -55 to +125 | | |
| | | MIN. | MAX. | MIN. | MAX. | |
| Propagation Delays: ϕI to Q1 | 5* | 5.3 | 18.5 | 5.1 | 20.3 | ns |
| | | t_{PLH} | t_{PHL} | t_{PLH} | t_{PHL} | |
| | | Qn to Qn + 1 | 1.5 | 5.5 | 1.5 | |
| MR to Qn | 5 | 6.3 | 22.1 | 6.1 | 24.3 | |
| Power Dissipation Capacitance | C_{PD}^{\S} | — | 114 Typ. | 114 Typ. | | pF |
| Input Capacitance | C_i | — | 10 | — | 10 | |

*Min. Is @ 5.5 V
 max. Is @ 4.5 V

$\S C_{PD}$ is used to determine the dynamic power consumption, per flip-flop.

$P_D = C_{PD} V_{CC}^2 f_i + \sum (C_L V_{CC}^2 f_o) + V_{CC} \Delta I_{CC}$ where f_i = input frequency
 f_o = output frequency
 C_L = output load capacitance
 V_{CC} = supply voltage.

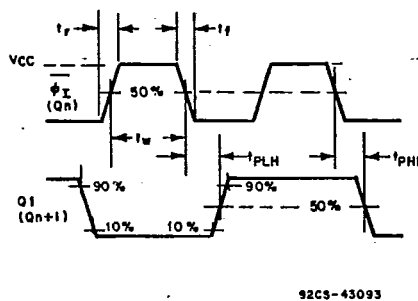
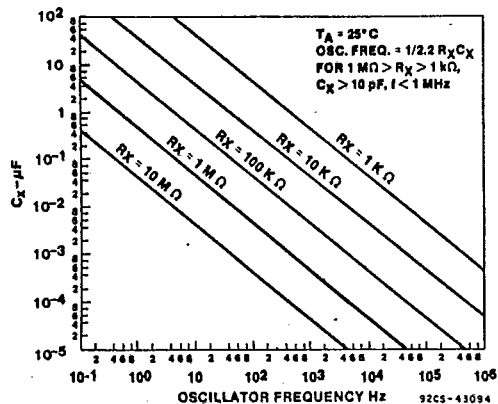


Fig. 1 - Frequency on on-board oscillator as a function of C_x and R_x .

Fig. 2 - Input pulse pre-requisite times and propagation delays for both AC and ACT types.

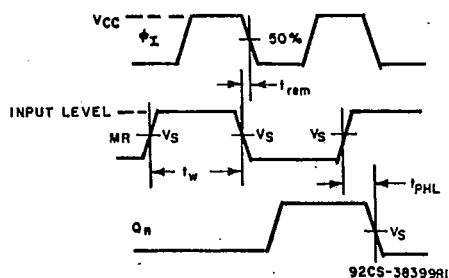
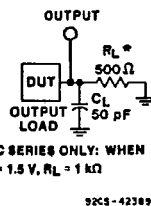


Fig. 3 - Master Reset pre-requisite and propagation delays.

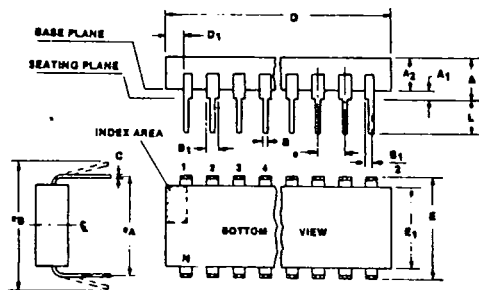


*FOR AC SERIES ONLY: WHEN $V_{CC} = 1.5$ V, $R_L = 1$ K Ω

| | CD54/74AC | CD54/74ACT |
|---------------------------------|--------------|--------------|
| MR Input Level | V_{CC} | 3 V |
| Input Switching Voltage, V_s | $0.5 V_{CC}$ | 1.5 V |
| Output Switching Voltage, V_s | $0.5 V_{CC}$ | $0.5 V_{CC}$ |

Dual-In-Line Plastic Packages

T-90-20



Notes:

1. Refer to JEDEC Publication No. 95 JEDEC Registered and Standard Outlines for Solid State Products, for rules and general information concerning registered and standard outlines, in Section 2.2.
2. Protrusions (flash) on the base plane surface shall not exceed 0.010 in. (0.25 mm).
3. The dimension shown is for full leads. "Half" leads are optional at lead positions $1, N, \frac{N}{2}, \frac{N}{2} + 1$.
4. Dimension D does not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.010 in. (0.25 mm).
5. E is the dimension to the outside of the leads and is measured with the leads perpendicular to the base plane (zero lead spread).
6. Dimension E₁ does not include mold flash or protrusions.
7. Package body and leads shall be symmetrical around center line shown in end view.
8. Lead spacing e shall be non-cumulative and shall be measured at the lead tip. This measurement shall be made before insertion into gauges, boards or sockets.
9. This is a basic installed dimension. Measurement shall be made with the device installed in the seating plane gauge (JEDEC Outline No. GS-3, seating plane gauge). Leads shall be in true position within 0.010 in. (0.25 mm) diameter for dimension e_A.
10. e_B is the dimension to the outside of the leads and is measured at the lead tips before the device is installed. Negative lead spread is not permitted.
11. N is the maximum number of lead positions.
12. Dimension D₁ at the left end of the package must equal dimension D₁ at the right end of the package within 0.030 in. (0.76 mm).
13. For automatic insertion, any raised irregularity on the top surface (step, mesa, etc.) shall be symmetrical about the lateral and longitudinal package centerlines.

(E) Suffix (JEDEC MS-001-AC)
14-Lead Dual-In-Line Plastic Package

| SYMBOL | INCHES | | MILLIMETERS | | NOTES |
|----------------|-----------|-------|-------------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. | |
| A | — | 0.210 | — | 5.33 | 9 |
| A ₁ | 0.015 | — | 0.39 | — | 9 |
| A ₂ | 0.115 | 0.195 | 2.93 | 4.95 | |
| B | 0.014 | 0.022 | 0.356 | 0.558 | |
| B ₁ | 0.045 | 0.070 | 1.15 | 1.77 | 3 |
| C | 0.008 | 0.015 | 0.204 | 0.381 | |
| D | 0.725 | 0.795 | 18.42 | 20.19 | 4 |
| D ₁ | 0.005 | — | 0.13 | — | 12 |
| E | 0.300 | 0.325 | 7.62 | 8.25 | 5 |
| E ₁ | 0.240 | 0.280 | 6.10 | 7.11 | 6, 7 |
| e | 0.100 BSC | | 2.54 BSC | | 8 |
| e _A | 0.300 BSC | | 7.62 BSC | | 9 |
| e _B | — | 0.430 | — | 10.92 | 10 |
| L | 0.115 | 0.160 | 2.93 | 4.06 | 9 |
| N | 14 | | 14 | | 11 |

92CS-39901

(E) Suffix (JEDEC MS-001-AA)
16-Lead Dual-In-Line Plastic Package

| SYMBOL | INCHES | | MILLIMETERS | | NOTES |
|----------------|-----------|-------|-------------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. | |
| A | — | 0.210 | — | 5.33 | 9 |
| A ₁ | 0.015 | — | 0.39 | — | 9 |
| A ₂ | 0.115 | 0.195 | 2.93 | 4.95 | |
| B | 0.014 | 0.022 | 0.356 | 0.558 | |
| B ₁ | 0.045 | 0.070 | 1.15 | 1.77 | 3 |
| C | 0.008 | 0.015 | 0.204 | 0.381 | |
| D | 0.745 | 0.840 | 18.93 | 21.33 | 4 |
| D ₁ | 0.005 | — | 0.13 | — | 12 |
| E | 0.300 | 0.325 | 7.62 | 8.25 | 5 |
| E ₁ | 0.240 | 0.280 | 6.10 | 7.11 | 6, 7 |
| e | 0.100 BSC | | 2.54 BSC | | 8 |
| e _A | 0.300 BSC | | 7.62 BSC | | 9 |
| e _B | — | 0.430 | — | 10.92 | 10 |
| L | 0.115 | 0.160 | 2.93 | 4.06 | 9 |
| N | 16 | | 16 | | 11 |

92CS-39900

(E) Suffix (JEDEC MS-001-AE)
20-Lead Dual-In-Line Plastic Package

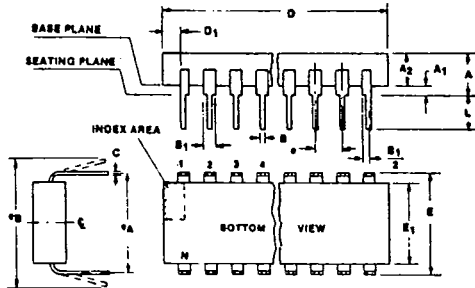
| SYMBOL | INCHES | | MILLIMETERS | | NOTES |
|----------------|-----------|-------|-------------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. | |
| A | — | 0.210 | — | 5.33 | 9 |
| A ₁ | 0.015 | — | 0.39 | — | 9 |
| A ₂ | 0.115 | 0.195 | 2.93 | 4.95 | |
| B | 0.014 | 0.022 | 0.356 | 0.558 | |
| B ₁ | 0.045 | 0.070 | 1.15 | 1.77 | 3 |
| C | 0.008 | 0.015 | 0.204 | 0.381 | |
| D | 0.925 | 1.060 | 23.5 | 26.9 | 4 |
| D ₁ | 0.005 | — | 0.13 | — | 12 |
| E | 0.300 | 0.325 | 7.62 | 8.25 | 5 |
| E ₁ | 0.240 | 0.280 | 6.10 | 7.11 | 6, 7 |
| e | 0.100 BSC | | 2.54 BSC | | 8 |
| e _A | 0.300 BSC | | 7.62 BSC | | 9 |
| e _B | — | 0.430 | — | 10.92 | 10 |
| L | 0.115 | 0.160 | 2.93 | 4.06 | 9 |
| N | 20 | | 20 | | 11 |

92CS-39997

Dual-In-Line Plastic Packages

T-90-20

(E) Suffix (JEDEC MS-001-AF)
24-Lead Dual-In-Line Plastic Package



| SYMBOL | INCHES | | MILLIMETERS | | NOTES |
|----------------|-----------|-------|-------------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. | |
| A | — | 0.210 | — | 5.33 | 9 |
| A ₁ | 0.015 | — | 0.39 | — | 9 |
| A ₂ | 0.115 | 0.195 | 2.93 | 4.95 | |
| B | 0.014 | 0.022 | 0.356 | 0.558 | |
| B ₁ | 0.045 | 0.070 | 1.15 | 1.77 | 3 |
| C | 0.008 | 0.015 | 0.204 | 0.381 | |
| D | 1.125 | 1.275 | 28.6 | 32.3 | 4 |
| D ₁ | 0.005 | — | 0.13 | — | 12 |
| E | 0.300 | 0.325 | 7.62 | 8.25 | 5 |
| E ₁ | 0.240 | 0.280 | 6.10 | 7.11 | 6, 7 |
| e | 0.100 BSC | | 2.54 BSC | | 8 |
| e _A | 0.300 BSC | | 7.62 BSC | | 9 |
| e _B | — | 0.430 | — | 10.92 | 10 |
| L | 0.115 | 0.160 | 2.93 | 4.06 | 9 |
| N | 24 | | 24 | | 11 |

92CS-39943

Notes:

1. Refer to JEDEC Publication No. 95 JEDEC Registered and Standard Outlines for Solid State Products, for rules and general information concerning registered and standard outlines, in Section 2.2.
2. Protrusions (flash) on the base plane surface shall not exceed 0.010 in. (0.25 mm).
3. The dimension shown is for full leads. "Half" leads are optional at lead positions

$$1, N, \frac{N}{2}, \frac{N}{2} + 1.$$
4. Dimension D does not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.010 in. (0.25 mm).
5. E is the dimension to the outside of the leads and is measured with the leads perpendicular to the base plane (zero lead spread).
6. Dimension E₁ does not include mold flash or protrusions.
7. Package body and leads shall be symmetrical around

center line shown in end view.

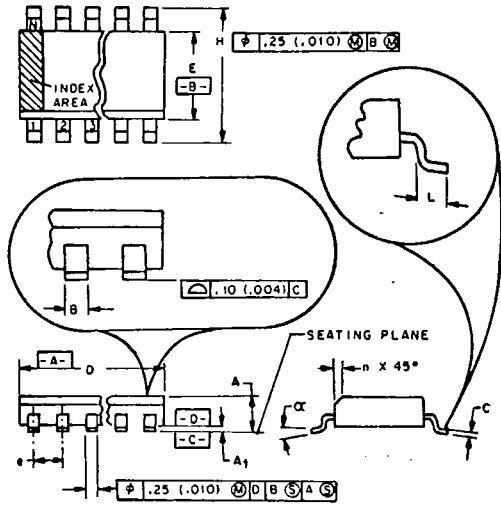
8. Lead spacing e shall be non-cumulative and shall be measured at the lead tip. This measurement shall be made before insertion into gauges, boards or sockets.
9. This is a basic installed dimension. Measurement shall be made with the device installed in the seating plane gauge (JEDEC Outline No. GS-3, seating plane gauge). Leads shall be in true position within 0.010 in. (0.25 mm) diameter for dimension e_A.
10. e_B is the dimension to the outside of the leads and is measured at the lead tips before the device is installed. Negative lead spread is not permitted.
11. N is the maximum number of lead positions.
12. Dimension D₁ at the left end of the package must equal dimension D₁ at the right end of the package within 0.030 in. (0.76 mm).
13. For automatic insertion, any raised irregularity on the top surface (step, mesa, etc.) shall be symmetrical about the lateral and longitudinal package centerlines.



Dimensional Outlines

Dual-In-Line Small-Outline Plastic Packages

T-90-20



NOTES:

1. Refer to applicable symbol list.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. "D" is a reference datum.
4. "A" and "B" are reference datums and do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15 mm (0.006 in.).
5. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the cross-hatched area.
6. "L" is the length of terminal for soldering to a substrate.
7. "N" is the number of terminal positions.
8. Terminal numbers are shown for reference only.
9. Controlling dimensions: MILLIMETERS.

M Suffix (JEDEC MS-012AB)
14-Lead Dual-In-Line Small-Outline (SO) Package

| SYMBOL | INCHES | | MILLIMETERS | | NOTES |
|----------------|-----------|--------|-------------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. | |
| A | 0.0532 | 0.0688 | 1.35 | 1.75 | |
| A ₁ | 0.0040 | 0.0098 | 0.10 | 0.25 | |
| B | 0.0138 | 0.020 | 0.35 | 0.508 | |
| C | 0.0075 | 0.0098 | 0.19 | 0.25 | |
| D | 0.3367 | 0.3444 | 8.55 | 8.75 | 4 |
| E | 0.1497 | 0.1574 | 3.80 | 4.00 | 4 |
| e | 0.050 BSC | | 1.27 BSC | | |
| H | 0.2284 | 0.2440 | 5.80 | 6.20 | |
| h | 0.0099 | 0.0196 | 0.25 | 0.50 | 5 |
| L | 0.016 | 0.050 | 0.40 | 1.27 | 6 |
| N | 14 | | 14 | | 7 |
| α | 0° 8° | | 0° 8° | | |

Notes: 1, 2, 3, 8, 9

92CS-38924R2

M Suffix (JEDEC MS-012AC)
16-Lead Dual-In-Line Small-Outline (SO) Package

| SYMBOL | INCHES | | MILLIMETERS | | NOTES |
|----------------|-----------|--------|-------------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. | |
| A | 0.0532 | 0.0688 | 1.35 | 1.75 | |
| A ₁ | 0.0040 | 0.0098 | 0.10 | 0.25 | |
| B | 0.0138 | 0.020 | 0.35 | 0.508 | |
| C | 0.0075 | 0.0098 | 0.19 | 0.25 | |
| D | 0.3859 | 0.3937 | 9.80 | 10.00 | 4 |
| E | 0.1497 | 0.1574 | 3.80 | 4.00 | 4 |
| e | 0.050 BSC | | 1.27 BSC | | |
| H | 0.2284 | 0.2440 | 5.80 | 6.20 | |
| h | 0.0099 | 0.0196 | 0.25 | 0.50 | 5 |
| L | 0.016 | 0.050 | 0.40 | 1.27 | 6 |
| N | 16 | | 16 | | 7 |
| α | 0° 8° | | 0° 8° | | |

Notes: 1, 2, 3, 8, 9

92CS-38925R2

M Suffix (JEDEC MS-013AC)
20-Lead Dual-In-Line Small-Outline (SO) Package

| SYMBOL | INCHES | | MILLIMETERS | | NOTES |
|----------------|-----------|--------|-------------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. | |
| A | 0.0926 | 0.1043 | 2.35 | 2.65 | |
| A ₁ | 0.0040 | 0.0118 | 0.10 | 0.30 | |
| B | 0.0138 | 0.020 | 0.35 | 0.508 | |
| C | 0.0091 | 0.0125 | 0.23 | 0.32 | |
| D | 0.4861 | 0.5118 | 12.60 | 13.00 | 4 |
| E | 0.2914 | 0.2992 | 7.40 | 7.60 | 4 |
| e | 0.050 BSC | | 1.27 BSC | | |
| H | 0.394 | 0.419 | 10.00 | 10.65 | |
| h | 0.010 | 0.029 | 0.25 | 0.75 | 5 |
| L | 0.016 | 0.050 | 0.40 | 1.27 | 6 |
| N | 20 | | 20 | | 7 |
| α | 0° 8° | | 0° 8° | | |

Notes: 1, 2, 3, 8, 9

92CS-38926R2

M Suffix (JEDEC MS-013AD)
24-Lead Dual-In-Line Small-Outline (SO) Package

| SYMBOL | INCHES | | MILLIMETERS | | NOTES |
|----------------|-----------|--------|-------------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. | |
| A | 0.0926 | 0.1043 | 2.35 | 2.65 | |
| A ₁ | 0.0040 | 0.0118 | 0.10 | 0.30 | |
| B | 0.0138 | 0.020 | 0.35 | 0.508 | |
| C | 0.0091 | 0.0125 | 0.23 | 0.32 | |
| D | 0.5985 | 0.6141 | 15.20 | 15.60 | 4 |
| E | 0.2914 | 0.2992 | 7.40 | 7.60 | 4 |
| e | 0.050 BSC | | 1.27 BSC | | |
| H | 0.394 | 0.419 | 10.00 | 10.65 | |
| h | 0.010 | 0.029 | 0.25 | 0.75 | 5 |
| L | 0.016 | 0.050 | 0.40 | 1.27 | 6 |
| N | 24 | | 24 | | 7 |
| α | 0° 8° | | 0° 8° | | |

Notes: 1, 2, 3, 8, 9

92CS-39037R2