

Dual D-Type Flip-Flop with Set and Clear With 5V-Tolerant Inputs

The MC74LVX74 is an advanced high speed CMOS D-type flip-flop. The inputs tolerate voltages up to 7V, allowing the interface of 5V systems to 3V systems.

The signal level applied to the D input is transferred to O output during the positive going transition of the Clock pulse.

Clear (CD) and Set (SD) are independent of the Clock (CP) and are accomplished by setting the appropriate input Low.

- High Speed: $f_{max} = 145\text{MHz}$ (Typ) at $V_{CC} = 3.3\text{V}$
- Low Power Dissipation: $I_{CC} = 2\mu\text{A}$ (Max) at $T_A = 25^\circ\text{C}$
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Low Noise: $V_{OLP} = 0.5\text{V}$ (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300mA
- ESD Performance: HBM > 2000V; Machine Model > 200V

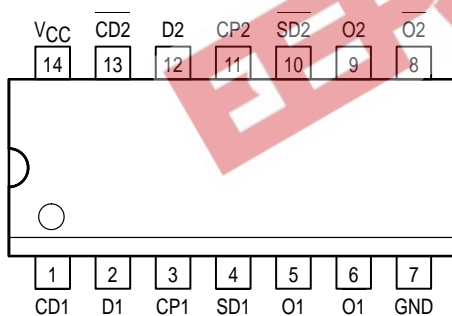



Figure 1. 14-Lead Pinout (Top View)


MC74LVX74

LVX

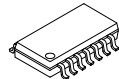
LOW-VOLTAGE CMOS



D SUFFIX
14-LEAD SOIC PACKAGE
CASE 751A-03



DT SUFFIX
14-LEAD TSSOP PACKAGE
CASE 948G-01



M SUFFIX
14-LEAD SOIC EIAJ PACKAGE
CASE 965-01

PIN NAMES

| Pins | Function |
|----------|---------------------|
| CP1, CP2 | Clock Pulse Inputs |
| D1, D2 | Data Inputs |
| CD1, CD2 | Direct Clear Inputs |
| SD1, SD2 | Direct Set Inputs |
| O1, O2 | Outputs |



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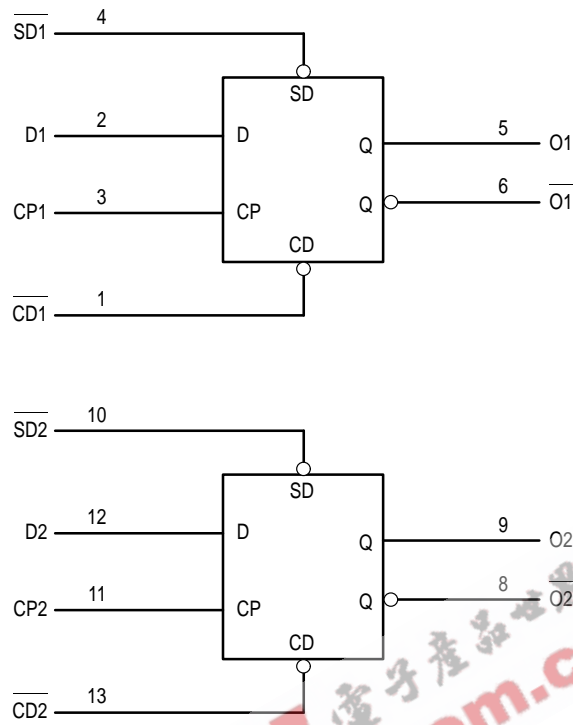


Figure 2. Logic Diagram

| INPUTS | | | | OUTPUTS | | OPERATING MODE |
|--------|-----|-----|----|---------|----|------------------------|
| SDn | CDn | CPn | Dn | On | On | |
| L | H | X | X | H | L | Asynchronous Set |
| H | L | X | X | L | H | Asynchronous Clear |
| L | L | X | X | H | H | Undetermined |
| H | H | ↑ | h | H | L | Load and Read Register |
| H | H | ↑ | l | L | H | |
| H | H | ↕ | X | NC | NC | Hold |

H = High Voltage Level; h = High Voltage Level One Setup Time Prior to the Low-to-High Clock Transition; L = Low Voltage Level; l = Low Voltage Level One Setup Time Prior to the Low-to-High Clock Transition; NC = No Change; X = High or Low Voltage Level or Transitions are Acceptable; ↑ = Low-to-High Transition; ↕ = Not a Low-to-High Transition; For I_{CC} Reasons DO NOT FLOAT Inputs

MAXIMUM RATINGS*

| Symbol | Parameter | Value | Unit |
|------------------|---|------------------------------|------|
| V _{CC} | DC Supply Voltage | -0.5 to +7.0 | V |
| V _{in} | DC Input Voltage | -0.5 to +7.0 | V |
| V _{out} | DC Output Voltage | -0.5 to V _{CC} +0.5 | V |
| I _{IJK} | Input Diode Current | -20 | mA |
| I _{OK} | Output Diode Current | ±20 | mA |
| I _{out} | DC Output Current, per Pin | ±25 | mA |
| I _{CC} | DC Supply Current, V _{CC} and GND Pins | ±50 | mA |
| P _D | Power Dissipation | 180 | mW |
| T _{stg} | Storage Temperature | -65 to +150 | °C |

* Absolute maximum continuous ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute-maximum-rated conditions is not implied.

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit |
|------------------|--|-----|-----------------|------|
| V _{CC} | DC Supply Voltage | 2.0 | 3.6 | V |
| V _{in} | DC Input Voltage | 0 | 5.5 | V |
| V _{out} | DC Output Voltage | 0 | V _{CC} | V |
| T _A | Operating Temperature, All Package Types | -40 | +85 | °C |
| Δt/ΔV | Input Rise and Fall Time | 0 | 100 | ns/V |

DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Test Conditions | V _{CC} V | T _A = 25°C | | | T _A = -40 to 85°C | | Unit |
|-----------------|--|--|----------------------|-----------------------|-----|------|------------------------------|------|------|
| | | | | Min | Typ | Max | Min | Max | |
| V _{IH} | High-Level Input Voltage | | 2.0 | 1.5 | | | 1.5 | | V |
| | | | 3.0 | 2.0 | | | 2.0 | | |
| | | | 3.6 | 2.4 | | | 2.4 | | |
| V _{IL} | Low-Level Input Voltage | | 2.0 | | | 0.5 | | 0.5 | V |
| | | | 3.0 | | | 0.8 | | 0.8 | |
| | | | 3.6 | | | 0.8 | | 0.8 | |
| V _{OH} | High-Level Output Voltage (V _{in} = V _{IH} or V _{IL}) | I _{OH} = -50μA I _{OH} = -50μA I _{OH} = -4mA | 2.0 | 1.9 | 2.0 | | 1.9 | | V |
| | | | 3.0 | 2.9 | 3.0 | | 2.9 | | |
| | | | 3.0 | 2.58 | | | 2.48 | | |
| V _{OL} | Low-Level Output Voltage (V _{in} = V _{IH} or V _{IL}) | I _{OL} = 50μA I _{OL} = 50μA I _{OL} = 4mA | 2.0 | | 0.0 | 0.1 | | 0.1 | V |
| | | | 3.0 | | 0.0 | 0.1 | | 0.1 | |
| | | | 3.0 | | | 0.36 | | 0.44 | |
| I _{in} | Input Leakage Current | V _{in} = 5.5V or GND | 3.6 | | | ±0.1 | | ±1.0 | μA |
| I _{CC} | Quiescent Supply Current | V _{in} = V _{CC} or GND | 3.6 | | | 2.0 | | 20.0 | μA |

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AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0\text{ns}$)

| Symbol | Parameter | Test Conditions | $T_A = 25^\circ\text{C}$ | | | $T_A = -40 \text{ to } 85^\circ\text{C}$ | | Unit |
|--------------------------|---|--|--------------------------|------|------------|--|------------|------|
| | | | Min | Typ | Max | Min | Max | |
| t_{PLH} , t_{PHL} | Propagation Delay CP to O or O | $V_{CC} = 2.7\text{V}$ $C_L = 15\text{pF}$ | | 7.3 | 15.0 | 1.0 | 18.5 | ns |
| | | $C_L = 50\text{pF}$ | | 9.8 | 18.5 | 1.0 | 22.0 | |
| | | $V_{CC} = 3.3 \pm 0.3\text{V}$ $C_L = 15\text{pF}$ | | 5.7 | 9.7 | 1.0 | 11.5 | |
| | | $C_L = 50\text{pF}$ | | 8.2 | 13.2 | 1.0 | 15.0 | |
| t_{PLH} , t_{PHL} | Propagation Delay SD or CD to O or O | $V_{CC} = 2.7\text{V}$ $C_L = 15\text{pF}$ | | 8.4 | 15.6 | 1.0 | 18.5 | ns |
| | | $C_L = 50\text{pF}$ | | 10.9 | 19.1 | 1.0 | 22.0 | |
| | | $V_{CC} = 3.3 \pm 0.3\text{V}$ $C_L = 15\text{pF}$ | | 6.6 | 10.1 | 1.0 | 12.0 | |
| | | $C_L = 50\text{pF}$ | | 9.1 | 13.6 | 1.0 | 15.5 | |
| f_{max} | Maximum Clock Frequency (50% Duty Cycle) | $V_{CC} = 2.7\text{V}$ $C_L = 15\text{pF}$ | 55 | 135 | | 50 | | MHz |
| | | $C_L = 50\text{pF}$ | 45 | 60 | | 40 | | |
| | | $V_{CC} = 3.3 \pm 0.3\text{V}$ $C_L = 15\text{pF}$ | 95 | 145 | | 80 | | |
| | | $C_L = 50\text{pF}$ | 60 | 85 | | 50 | | |
| t_{OSHL} t_{OSLH} | Output-to-Output Skew (Note 1.) | $V_{CC} = 2.7\text{V}$ $C_L = 50\text{pF}$ $V_{CC} = 3.3 \pm 0.3\text{V}$ $C_L = 50\text{pF}$ | | | 1.5 1.5 | | 1.5 1.5 | ns |

1. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t_{OSHL}) or LOW-to-HIGH (t_{OSLH}); parameter guaranteed by design.

TIMING REQUIREMENTS (Input $t_r = t_f = 3.0\text{ns}$)

| Symbol | Parameter | V_{CC} V | Guaranteed Limit | | Unit |
|-----------|---------------------------------------|-----------------------|--------------------------|--|------|
| | | | $T_A = 25^\circ\text{C}$ | $T_A = -40 \text{ to } 85^\circ\text{C}$ | |
| t_w | Minimum Pulse Width, CP | 2.7V | 8.5 | 10.0 | ns |
| | | $3.3\text{V} \pm 0.3$ | 6.0 | 7.0 | |
| t_w | Minimum Pulse Width, CD or SD | 2.7V | 8.5 | 10.0 | ns |
| | | $3.3\text{V} \pm 0.3$ | 6.0 | 7.0 | |
| t_{su} | Minimum Setup Time, D to CP | 2.7V | 8.0 | 9.5 | ns |
| | | $3.3\text{V} \pm 0.3$ | 5.5 | 6.5 | |
| t_h | Minimum Hold Time, D to CP | 2.7V | 0.5 | 0.5 | ns |
| | | $3.3\text{V} \pm 0.3$ | 0.5 | 0.5 | |
| t_{rec} | Minimum Recovery Time, SD or CD to CP | 2.7V | 6.5 | 7.5 | ns |
| | | $3.3\text{V} \pm 0.3$ | 5.0 | 5.0 | |

CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | $T_A = 25^\circ\text{C}$ | | | $T_A = -40 \text{ to } 85^\circ\text{C}$ | | Unit |
|----------|---|--------------------------|-----|-----|--|-----|------|
| | | Min | Typ | Max | Min | Max | |
| C_{in} | Input Capacitance | | 4 | 10 | | 10 | pF |
| C_{PD} | Power Dissipation Capacitance (Note 2.) | | 25 | | | | pF |

2. C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: $I_{CC(OPR)} = C_{PD} \cdot V_{CC} \cdot f_{in} + I_{CC}/2$ (per flip-flop). C_{PD} is used to determine the no-load dynamic power consumption; $P_D = C_{PD} \cdot V_{CC}^2 \cdot f_{in} + I_{CC} \cdot V_{CC}$.

NOISE CHARACTERISTICS (Input $t_r = t_f = 3.0\text{ns}$, $C_L = 50\text{pF}$, $V_{CC} = 3.3\text{V}$, Measured in SOIC Package)

| Symbol | Characteristic | $T_A = 25^\circ\text{C}$ | | Unit |
|-----------|--|--------------------------|------|------|
| | | Typ | Max | |
| V_{OLP} | Quiet Output Maximum Dynamic V_{OL} | 0.3 | 0.5 | V |
| V_{OLV} | Quiet Output Minimum Dynamic V_{OL} | -0.3 | -0.5 | V |
| V_{IHD} | Minimum High Level Dynamic Input Voltage | | 2.0 | V |
| V_{ILD} | Maximum Low Level Dynamic Input Voltage | | 0.8 | V |

SWITCHING WAVEFORMS

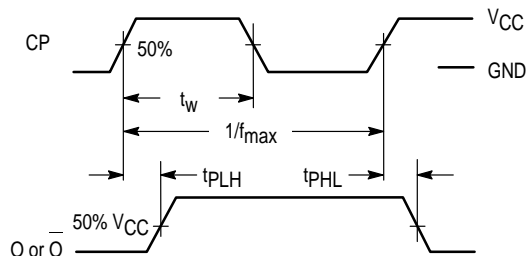


Figure 3.

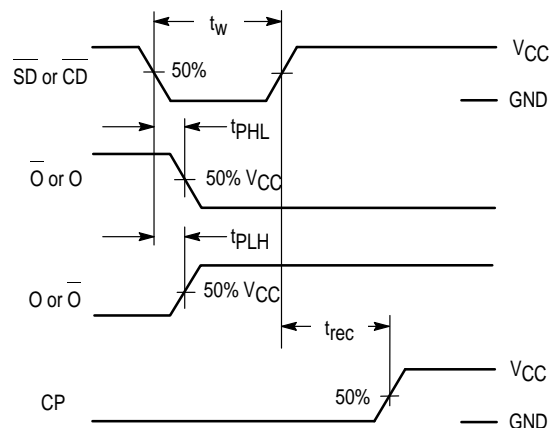


Figure 4.

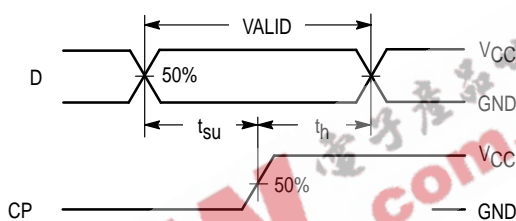
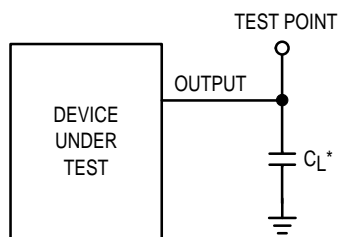


Figure 5.

TEST CIRCUIT

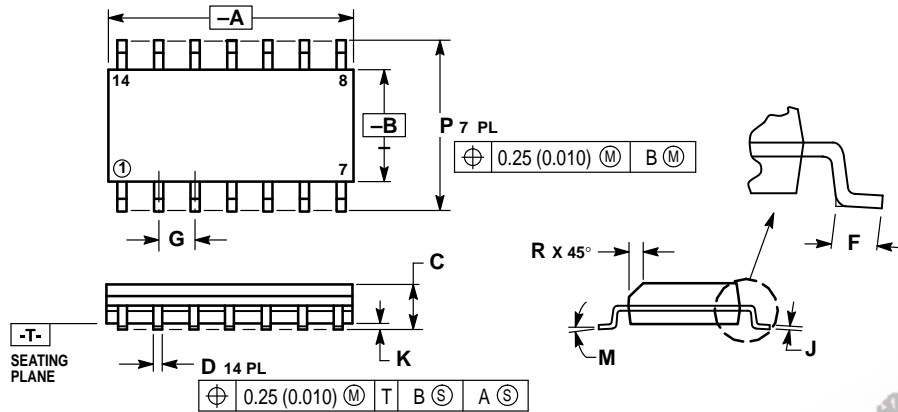


* Includes all probe and jig capacitance

Figure 6.

OUTLINE DIMENSIONS

D SUFFIX
 PLASTIC SOIC PACKAGE
 CASE 751A-03
 ISSUE F

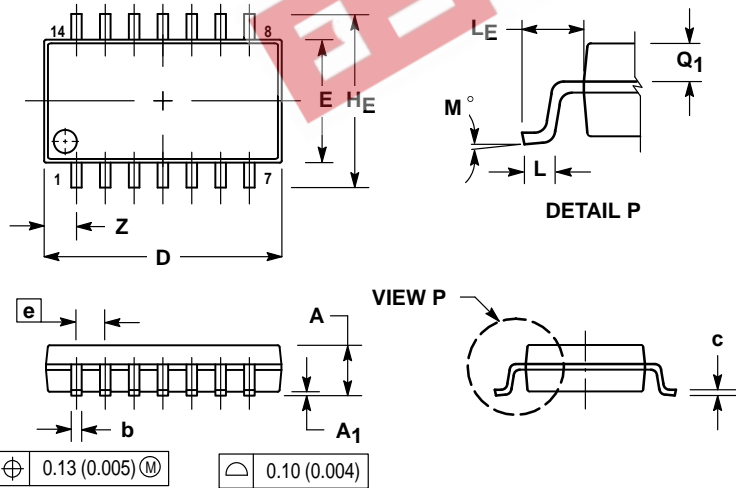


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 8.55 | 8.75 | 0.337 | 0.344 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.054 | 0.068 |
| D | 0.35 | 0.49 | 0.014 | 0.019 |
| F | 0.40 | 1.25 | 0.016 | 0.049 |
| G | 1.27 BSC | | 0.050 BSC | |
| J | 0.19 | 0.25 | 0.008 | 0.009 |
| K | 0.10 | 0.25 | 0.004 | 0.009 |
| M | 0° | 7° | 0° | 7° |
| P | 5.80 | 6.20 | 0.228 | 0.244 |
| R | 0.25 | 0.50 | 0.010 | 0.019 |

M SUFFIX
 PLASTIC SOIC EIAJ PACKAGE
 CASE 965-01
 ISSUE O



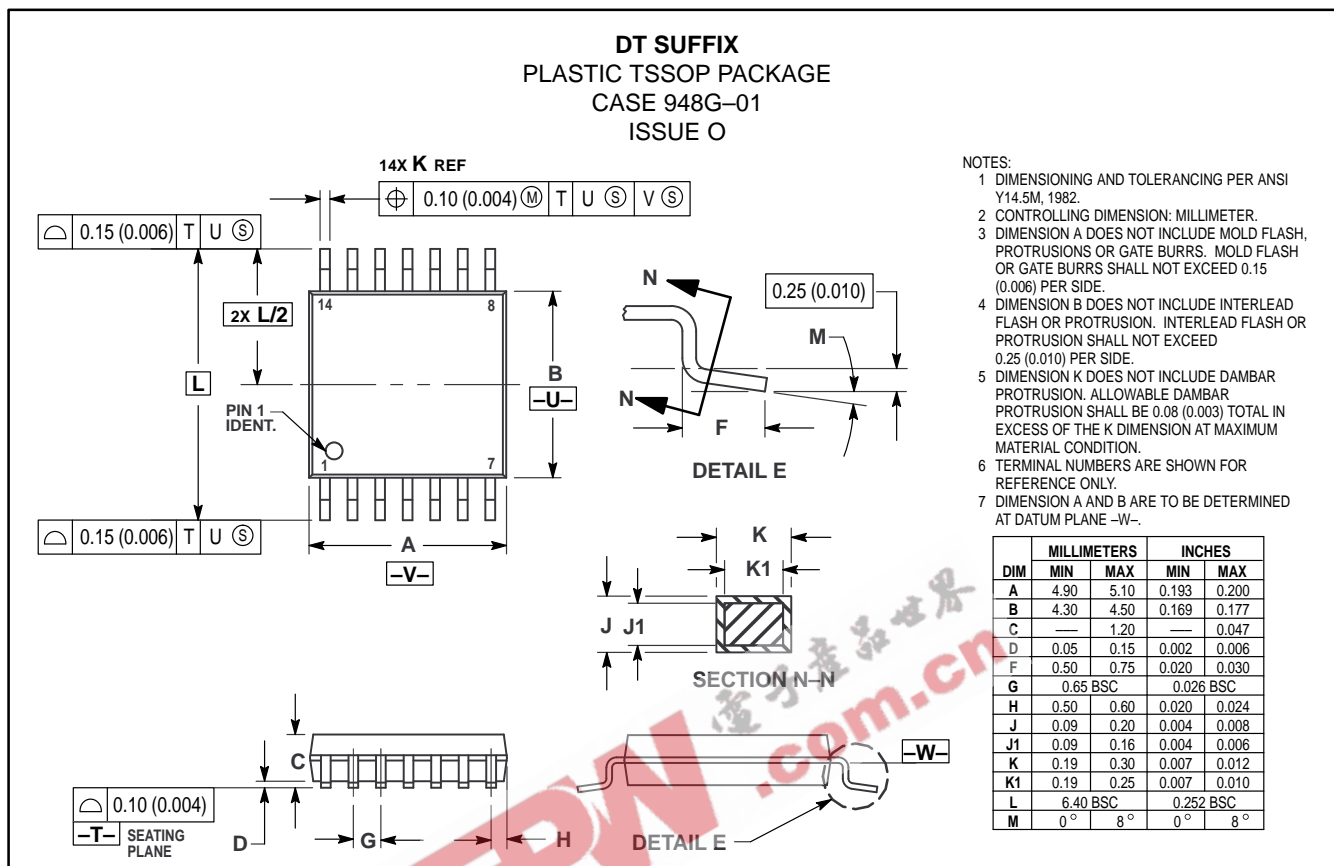
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

| DIM | MILLIMETERS | | INCHES | |
|----------------|-------------|-------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | --- | 2.05 | --- | 0.081 |
| A ₁ | 0.05 | 0.20 | 0.002 | 0.008 |
| b | 0.35 | 0.50 | 0.014 | 0.020 |
| c | 0.18 | 0.27 | 0.007 | 0.011 |
| D | 9.90 | 10.50 | 0.390 | 0.413 |
| E | 5.10 | 5.45 | 0.201 | 0.215 |
| e | 1.27 BSC | | 0.050 BSC | |
| H _E | 7.40 | 8.20 | 0.291 | 0.323 |
| L | 0.50 | 0.85 | 0.020 | 0.033 |
| LE | 1.10 | 1.50 | 0.043 | 0.059 |
| M | 0° | 10° | 0° | 10° |
| Q ₁ | 0.70 | 0.90 | 0.028 | 0.035 |
| Z | --- | 1.42 | --- | 0.056 |

OUTLINE DIMENSIONS

DT SUFFIX
 PLASTIC TSSOP PACKAGE
 CASE 948G-01
 ISSUE O



- NOTES:
- 1 DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 - 2 CONTROLLING DIMENSION: MILLIMETER.
 - 3 DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
 - 4 DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
 - 5 DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
 - 6 TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
 - 7 DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

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 Nishi-Gotanda, Shinagawa-ku, Tokyo 141, Japan. 81-3-5487-8488

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