

MC74LVX374

Octal D-Type Flip-Flop with 3-State Outputs

With 5V-Tolerant Inputs

The MC74LVX374 is an advanced high speed CMOS octal D-type flip-flop with 3-state outputs. The inputs tolerate voltages up to 7.0 V, allowing the interface of 5.0 V systems to 3.0 V systems.

This 8-bit D-type flip-flop is controlled by a clock input and an output enable input. When the output enable input is high, the eight outputs are in a high impedance state.

Features

- High Speed: $f_{max} = 160$ MHz (Typ) at $V_{CC} = 3.3$ V
- Low Power Dissipation: $I_{CC} = 4$ μ A (Max) at $T_A = 25^\circ$ C
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Low Noise: $V_{OLP} = 0.8$ V (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300 mA
- ESD Performance:
 - Human Body Model > 2000 V;
 - Machine Model > 200 V
- These Devices are Pb-Free and are RoHS Compliant

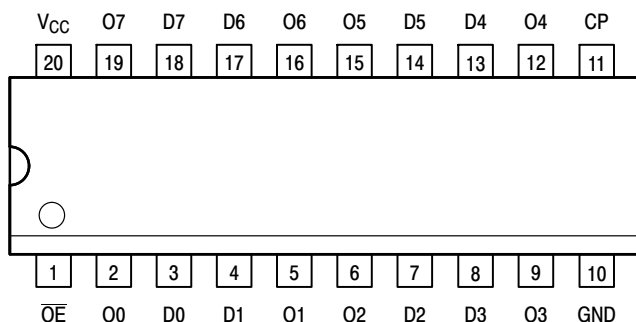


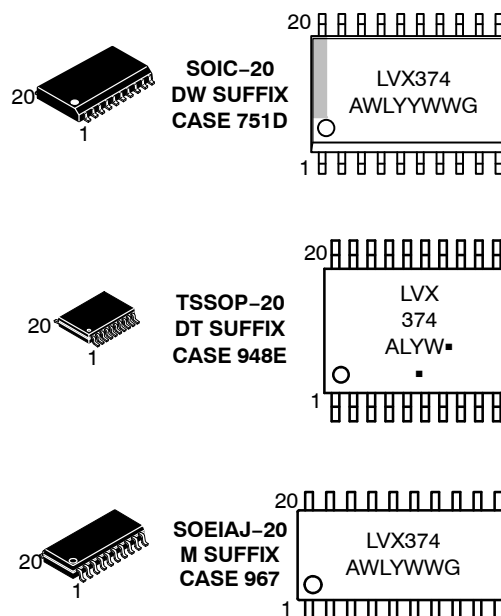
Figure 1. 20-Lead Pinout (Top View)



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MARKING DIAGRAMS



LVX374 = Specific Device Code
 A = Assembly Location
 WL, L = Wafer Lot
 Y = Year
 WW, W = Work Week
 G or ■ = Pb-Free Package
 (Note: Microdot may be in either location)

PIN NAMES

| Pins | Function |
|-----------------|---------------------|
| \overline{OE} | Output Enable Input |
| CP | Clock Pulse Input |
| D0-D7 | Data Inputs |
| O0-O7 | 3-State Outputs |

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

MC74LVX374

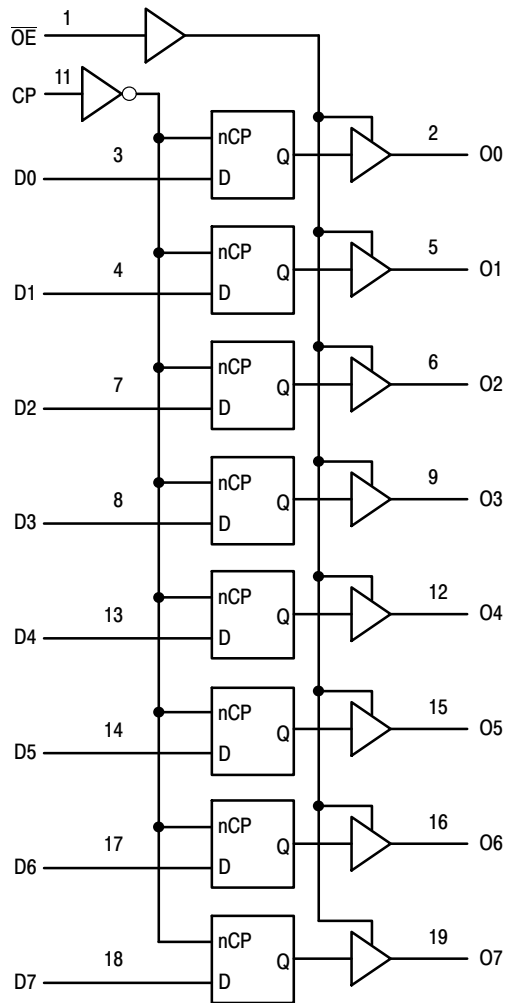


Figure 2. Logic Diagram

| INPUTS | | | OUTPUTS | OPERATING MODE |
|--------|----|----|---------|--|
| OE | CP | Dn | On | |
| L | ↑ | l | L | Load and Read Register |
| L | ↑ | h | H | |
| L | ↕ | X | NC | Hold and Read Register |
| H | ↕ | X | Z | Hold and Disable Outputs |
| H | ↑ | l | Z | Load Internal Register and Disable Outputs |
| H | ↑ | h | Z | |

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, State Prior to Low-to-High Clock Transition; X = High or Low Voltage Level and Transitions are Acceptable; Z = High Impedance State; ↑ = Low-to-High Transition; ↕ = Not a Low-to-High Transition; For I_{CC} Reasons DO NOT FLOAT Inputs

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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 _{IK} | 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 | ±75 | mA |
| P _D | Power Dissipation | 180 | mW |
| T _{stg} | Storage Temperature | -65 to +150 | °C |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

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 _{OZ} | Maximum 3-State Leakage Current | V _{in} = V _{IL} or V _{IH} V _{out} = V _{CC} or GND | 3.6 | | | ±0.2 5 | | ±2.5 | μA |
| I _{CC} | Quiescent Supply Current | V _{in} = V _{CC} or GND | 3.6 | | | 4.0 | | 40.0 | 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 | |
| f_{max} | Maximum Clock Frequency (50% Duty Cycle) | $V_{\text{CC}} = 2.7\text{V}$ $C_L = 15\text{pF}$ $C_L = 50\text{pF}$ | 60 45 | 115 60 | | 50 40 | | MHz |
| | | $V_{\text{CC}} = 3.3 \pm 0.3\text{V}$ $C_L = 15\text{pF}$ $C_L = 50\text{pF}$ | 100 60 | 160 95 | | 85 55 | | |
| t_{PLH} , t_{PHL} | Propagation Delay CP to O | $V_{\text{CC}} = 2.7\text{V}$ $C_L = 15\text{pF}$ $C_L = 50\text{pF}$ | | 8.5 11.0 | 16.3 19.8 | 1.0 1.0 | 19.5 23.0 | ns |
| | | $V_{\text{CC}} = 3.3 \pm 0.3\text{V}$ $C_L = 15\text{pF}$ $C_L = 50\text{pF}$ | | 6.7 9.2 | 10.6 14.1 | 1.0 1.0 | 12.5 16.0 | |
| t_{PZL} , t_{PZH} | Output Enable Time OE to O | $V_{\text{CC}} = 2.7\text{V}$ $R_L = 1\text{k}\Omega$ $C_L = 15\text{pF}$ $C_L = 50\text{pF}$ | | 7.6 10.1 | 14.5 18.0 | 1.0 1.0 | 17.5 21.0 | ns |
| | | $V_{\text{CC}} = 3.3 \pm 0.3\text{V}$ $R_L = 1\text{k}\Omega$ $C_L = 15\text{pF}$ $C_L = 50\text{pF}$ | | 5.9 8.4 | 9.3 12.8 | 1.0 1.0 | 11.0 14.5 | |
| t_{PLZ} , t_{PHZ} | Output Disable Time OE to O | $V_{\text{CC}} = 2.7\text{V}$ $R_L = 1\text{k}\Omega$ $C_L = 50\text{pF}$ | | 11.5 | 18.5 | 1.0 | 22.0 | ns |
| | | $V_{\text{CC}} = 3.3 \pm 0.3\text{V}$ $R_L = 1\text{k}\Omega$ $C_L = 50\text{pF}$ | | 9.6 | 13.2 | 1.0 | 15.0 | |
| t_{OSHL} , t_{OSLH} | Output-to-Output Skew (Note 1) | $V_{\text{CC}} = 2.7\text{V}$ $C_L = 50\text{pF}$ | | | 1.5 | | 1.5 | ns |
| | | $V_{\text{CC}} = 3.3 \pm 0.3\text{V}$ $C_L = 50\text{pF}$ | | | 1.5 | | 1.5 | |

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.

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_{out} | Maximum Three-State Output Capacitance | | 6 | | | | pF |
| C_{PD} | Power Dissipation Capacitance (Note 2) | | 32 | | | | 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: $I_{\text{CC(OPR)}} = C_{\text{PD}} \cdot V_{\text{CC}} \cdot f_{\text{in}} + I_{\text{CC}}/8$ (per flip-flop). C_{PD} is used to determine the no-load dynamic power consumption; $P_{\text{D}} = C_{\text{PD}} \cdot V_{\text{CC}}^2 \cdot f_{\text{in}} + I_{\text{CC}} \cdot V_{\text{CC}}$.

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

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

TIMING REQUIREMENTS (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 |
|-----------------|-----------------------------|--|--------------------------|------------|--|------|
| | | | Typ | Limit | Limit | |
| t_{w} | Minimum Pulse Width, CP | $V_{\text{CC}} = 2.7\text{V}$ $V_{\text{CC}} = 3.3 \pm 0.3\text{V}$ | | 7.5 5.0 | 8.0 5.5 | ns |
| t_{su} | Minimum Setup Time, D to CP | $V_{\text{CC}} = 2.7\text{V}$ $V_{\text{CC}} = 3.3 \pm 0.3\text{V}$ | | 6.5 4.5 | 6.5 4.5 | ns |
| t_{h} | Minimum Hold Time, D to CP | $V_{\text{CC}} = 2.7\text{V}$ $V_{\text{CC}} = 3.3 \pm 0.3\text{V}$ | | 2.0 2.0 | 2.0 2.0 | ns |

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ORDERING INFORMATION

| Device | Package | Shipping† |
|-----------------|------------------------|------------------|
| MC74LVX374DWR2G | SOIC-20 (Pb-Free) | 1000 Tape & Reel |
| MC74LVX374DTR2G | TSSOP-20* | 2500 Tape & Reel |
| MC74LVX374MG | SOEIAJ-20 (Pb-Free) | 50 Units / Rail |
| MC74LVX374MELG | SOEIAJ-20 (Pb-Free) | 2000 Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

*This package is inherently Pb-Free.

SWITCHING WAVEFORMS

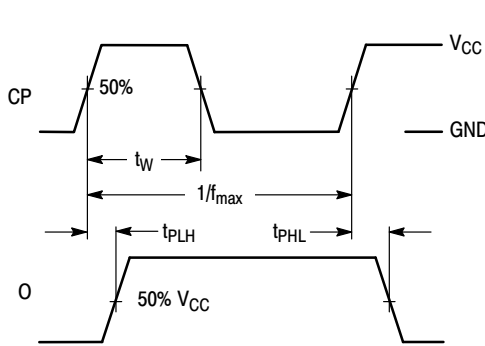


Figure 3.

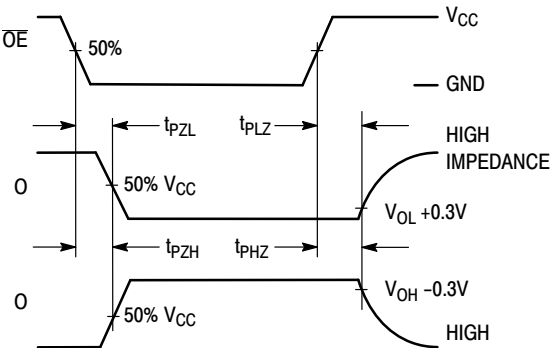


Figure 4.

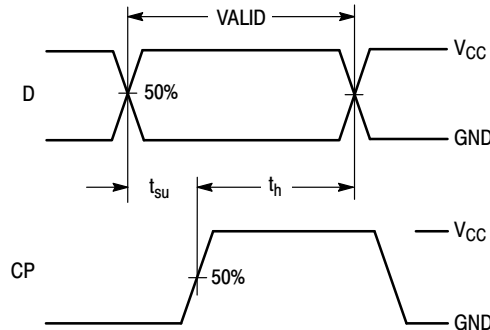
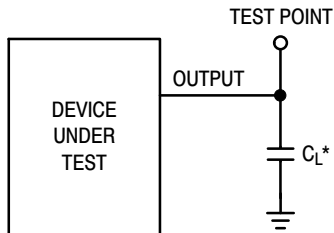


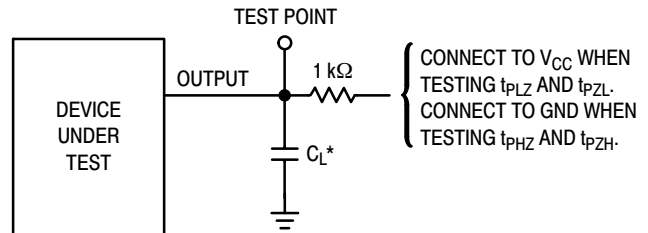
Figure 5.

TEST CIRCUITS



*Includes all probe and jig capacitance

Figure 6. Propagation Delay Test Circuit



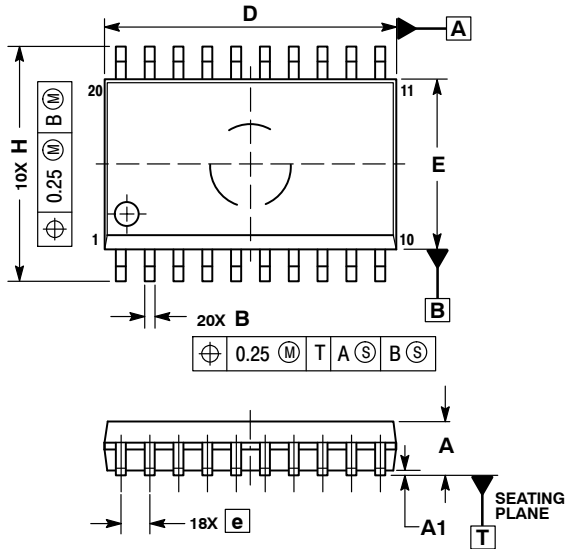
*Includes all probe and jig capacitance

Figure 7. Three-State Test Circuit

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PACKAGE DIMENSIONS

SOIC-20
CASE 751D-05
ISSUE G

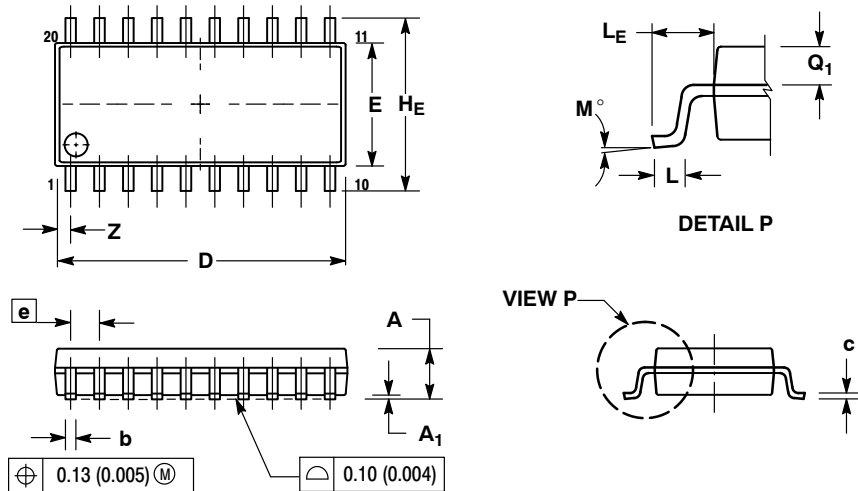


NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS | |
|-------|-------------|-------|
| | MIN | MAX |
| A | 2.35 | 2.65 |
| A1 | 0.10 | 0.25 |
| B | 0.35 | 0.49 |
| C | 0.23 | 0.32 |
| D | 12.65 | 12.95 |
| E | 7.40 | 7.60 |
| e | 1.27 BSC | |
| H | 10.05 | 10.55 |
| h | 0.25 | 0.75 |
| L | 0.50 | 0.90 |
| theta | 0° | 7° |

SOEIAJ-20
CASE 967-01
ISSUE A



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 |
| A1 | 0.05 | 0.20 | 0.002 | 0.008 |
| b | 0.35 | 0.50 | 0.014 | 0.020 |
| c | 0.15 | 0.25 | 0.006 | 0.010 |
| D | 12.35 | 12.80 | 0.486 | 0.504 |
| 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 |
| L_E | 1.10 | 1.50 | 0.043 | 0.059 |
| M | 0° | 10° | 0° | 10° |
| Q1 | 0.70 | 0.90 | 0.028 | 0.035 |
| Z | --- | 0.81 | --- | 0.032 |

MC74LVX374

PACKAGE DIMENSIONS

TSSOP-20
CASE 948E-02
ISSUE C

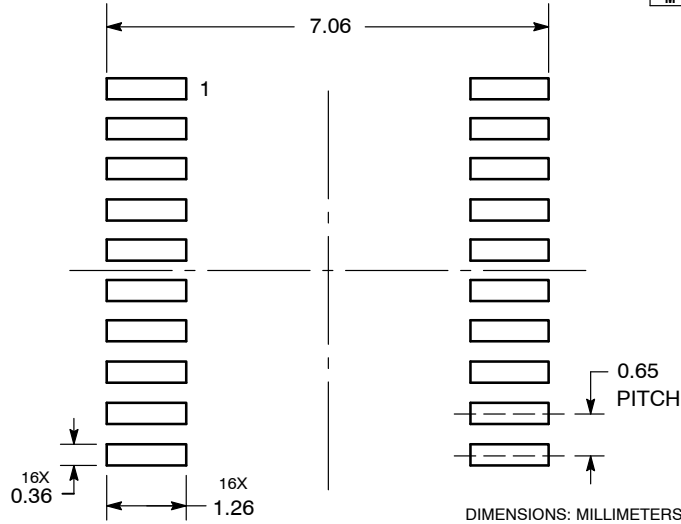


NOTES:

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-.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 6.40 | 6.60 | 0.252 | 0.260 |
| B | 4.30 | 4.50 | 0.169 | 0.177 |
| C | --- | 1.20 | --- | 0.047 |
| D | 0.05 | 0.15 | 0.002 | 0.006 |
| F | 0.50 | 0.75 | 0.020 | 0.030 |
| G | 0.65 BSC | | 0.026 BSC | |
| H | 0.27 | 0.37 | 0.011 | 0.015 |
| J | 0.09 | 0.20 | 0.004 | 0.008 |
| J1 | 0.09 | 0.16 | 0.004 | 0.006 |
| K | 0.19 | 0.30 | 0.007 | 0.012 |
| K1 | 0.19 | 0.25 | 0.007 | 0.010 |
| L | 6.40 BSC | | 0.252 BSC | |
| M | 0° | 8° | 0° | 8° |

SOLDERING FOOTPRINT



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