

## 74LCX574

### Low Voltage Octal D-Type Flip-Flop with 5V Tolerant Inputs and Outputs

#### General Description

The LCX574 is a high-speed, low power octal flip-flop with a buffered common Clock (CP) and a buffered common Output Enable ( $\overline{OE}$ ). The information presented to the D inputs is stored in the flip-flops on the LOW-to-HIGH Clock (CP) transition.

The LCX574 is functionally identical to the LCX374 except for the pinouts.

The LCX574 is designed for low voltage (2.5V or 3.3V)  $V_{CC}$  applications with capability of interfacing to a 5V signal environment. The LCX574 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

#### Features

- 5V tolerant inputs and outputs
- 2.3V–3.6V  $V_{CC}$  specifications provided
- 7.5 ns  $t_{PD}$  max ( $V_{CC} = 3.3V$ ), 10  $\mu A$   $I_{CC}$  max
- Power down high impedance inputs and outputs
- Supports live insertion/withdrawal (Note 1)
- $\pm 24$  mA output drive ( $V_{CC} = 3.0V$ )
- Implements patented noise/EMI reduction circuitry
- Latch-up performance exceeds JEDEC 78 conditions
- ESD performance:
  - Human body model > 2000V
  - Machine model > 200V
- Leadless Pb-Free DQFN package

**Note 1:** To Ensure the high-impedance state during power up or down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pull-up resistor: the minimum value or the resistor is determined by the current-sourcing capability of the driver.

#### Ordering Code:

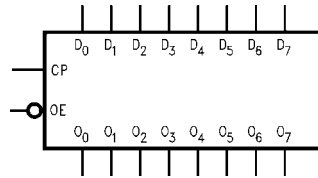
| Order Number                             | Package Number | Package Description   |
|--|----------------|---|
| 74LCX574WM                               | M20B           | 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide                          |
| 74LCX574WM_NL<br>(Note 3)                | M20B           | Pb-Free 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide                  |
| 74LCX574SJ                               | M20D           | Pb-Free 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide                               |
| 74LCX574BQX<br>(Preliminary)<br>(Note 2) | MLP020B        | Pb-Free 20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm |
| 74LCX574MSA                              | MSA20          | 20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide                               |
| 74LCX574MTC                              | MTC20          | 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide                         |
| 74LCX574MTC_NL<br>(Note 3)               | MTC20          | Pb-Free 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide                 |

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.  
Pb-Free package per JEDEC J-STD-020B.

**Note 2:** DQFN package available in Tape and Reel only

**Note 3:** "\_NL" indicates Pb-Free package (per JEDEC J-STD-020B). Device available in Tape and Reel only.

**Logic Symbol**

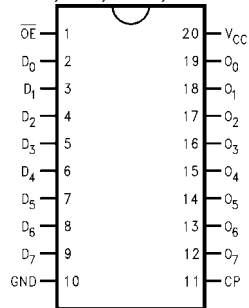


**Pin Descriptions**

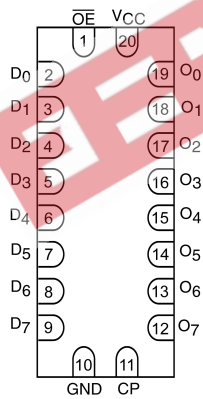
| Pin Names                      | Description                 |
|--------------------------------|-----------------------------|
| D <sub>0</sub> -D <sub>7</sub> | Data Inputs                 |
| CP                             | Clock Pulse Input           |
| $\overline{OE}$                | 3-STATE Output Enable Input |
| O <sub>0</sub> -O <sub>7</sub> | 3-STATE Outputs             |

**Connection Diagrams**

**Pin Assignments for SOIC, SOP, SSOP, TSSOP**



**Pad Assignments for DQFN**



(Top View)

**Truth Table**

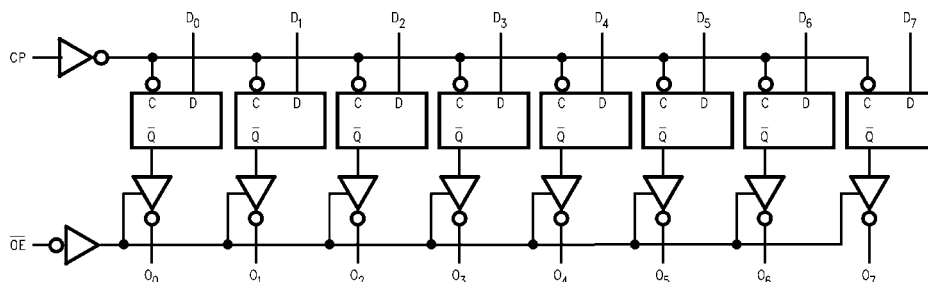
| Inputs               | Internal | Outputs        | Function          |
|----------------------|----------|----------------|-------------------|
| $\overline{OE}$ CP D | Q        | O <sub>n</sub> |                   |
| H H L                | NC       | Z              | Hold              |
| H H H                | NC       | Z              | Hold              |
| H $\swarrow$ L       | L        | Z              | Load              |
| H $\swarrow$ H       | H        | Z              | Load              |
| L $\swarrow$ L       | L        | L              | Data Available    |
| L $\swarrow$ H       | H        | H              | Data Available    |
| L H L                | NC       | NC             | No Change in Data |
| L H H                | NC       | NC             | No Change in Data |

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Immaterial  
 Z = High Impedance  
 $\swarrow$  = LOW-to-HIGH Transition  
 NC = No Change

**Functional Description**

The LCX574 consists of eight edge-triggered flip-flops with individual D-type inputs and 3-STATE true outputs. The buffered clock and buffered Output Enable are common to all flip-flops. The eight flip-flops will store the state of their individual D inputs that meet the setup and hold time requirements on the LOW-to-HIGH Clock (CP) transition. With the Output Enable ( $\overline{OE}$ ) LOW, the contents of the eight flip-flops are available at the outputs. When  $\overline{OE}$  is HIGH, the outputs go to the high impedance state. Operation of the  $\overline{OE}$  input does not affect the state of the flip-flops.

**Logic Diagram**



Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

| Absolute Maximum Ratings (Note 4) |                                  |   |   |       |
|-----------------------------------|----------------------------------|---|---|-------|
| Symbol                            | Parameter                        | Value   | Conditions  | Units |
| V <sub>CC</sub>                   | Supply Voltage                   | -0.5 to +7.0                                  |   | V     |
| V <sub>I</sub>                    | DC Input Voltage                 | -0.5 to +7.0                                  |   | V     |
| V <sub>O</sub>                    | DC Output Voltage                | -0.5 to +7.0<br>-0.5 to V <sub>CC</sub> + 0.5 | Output in 3-STATE<br>Output in HIGH or LOW State (Note 5) | V     |
| I <sub>IK</sub>                   | DC Input Diode Current           | -50   | V <sub>I</sub> < GND                                      | mA    |
| I <sub>OK</sub>                   | DC Output Diode Current          | -50<br>+50                                    | V <sub>O</sub> < GND<br>V <sub>O</sub> > V <sub>CC</sub>  | mA    |
| I <sub>O</sub>                    | DC Output Source/Sink Current    | ±50   |   | mA    |
| I <sub>CC</sub>                   | DC Supply Current per Supply Pin | ±100  |   | mA    |
| I <sub>GND</sub>                  | DC Ground Current per Ground Pin | ±100  |   | mA    |
| T <sub>STG</sub>                  | Storage Temperature              | -65 to +150                                   |   | °C    |

| Recommended Operating Conditions (Note 6) |  |                               |     |                 |    |
|---|--|-------------------------------|-----|-----------------|----|
| Symbol                                    | Parameter  | Min                           | Max | Units           |    |
| V <sub>CC</sub>                           | Supply Voltage   | Operating                     | 2.0 | 3.6             | V  |
|   |  | Data Retention                | 1.5 | 3.6             |    |
| V <sub>I</sub>                            | Input Voltage  | 0                             | 5.5 | V               |    |
| V <sub>O</sub>                            | Output Voltage   | HIGH or LOW State             | 0   | V <sub>CC</sub> | V  |
|   |  | 3-STATE                       | 0   | 5.5             |    |
| I <sub>OH</sub> /I <sub>OL</sub>          | Output Current   | V <sub>CC</sub> = 3.0V - 3.6V |     | ±24             | mA |
|   |  | V <sub>CC</sub> = 2.7V - 3.0V |     | ±12             |    |
|   |  | V <sub>CC</sub> = 2.3V - 2.7V |     | ±8              |    |
| T <sub>A</sub>                            | Free-Air Operating Temperature                                       | -40                           | 85  | °C              |    |
| Δt/ΔV                                     | Input Edge Rate, V <sub>IN</sub> = 0.8V-2.0V, V <sub>CC</sub> = 3.0V | 0                             | 10  | ns/V            |    |

**Note 4:** The Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the Absolute Maximum Ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

**Note 5:** I<sub>O</sub> Absolute Maximum Rating must be observed.

**Note 6:** Unused inputs must be held HIGH or LOW. They may not float.

## DC Electrical Characteristics

| Symbol           | Parameter                 | Conditions   | V <sub>CC</sub><br>(V) | T <sub>A</sub> = -40°C to +85°C |      | Units |
|------------------|---------------------------|--|------------------------|---------------------------------|------|-------|
|                  |                           |  |                        | Min                             | Max  |       |
| V <sub>IH</sub>  | HIGH Level Input Voltage  |  | 2.3 - 2.7              | 1.7                             |      | V     |
|                  |                           |  | 2.7 - 3.6              | 2.0                             |      |       |
| V <sub>IL</sub>  | LOW Level Input Voltage   |  | 2.3 - 2.7              |                                 | 0.7  | V     |
|                  |                           |  | 2.7 - 3.6              |                                 | 0.8  |       |
| V <sub>OH</sub>  | HIGH Level Output Voltage | I <sub>OH</sub> = -100 μA  | 2.3 - 3.6              | V <sub>CC</sub> - 0.2           |      | V     |
|                  |                           | I <sub>OH</sub> = -8 mA  | 2.3                    | 1.8                             |      |       |
|                  |                           | I <sub>OH</sub> = -12 mA   | 2.7                    | 2.2                             |      |       |
|                  |                           | I <sub>OH</sub> = -18 mA   | 3.0                    | 2.4                             |      |       |
|                  |                           | I <sub>OH</sub> = -24 mA   | 3.0                    | 2.2                             |      |       |
| V <sub>OL</sub>  | LOW Level Output Voltage  | I <sub>OL</sub> = 100 μA   | 2.3 - 3.6              |                                 | 0.2  | V     |
|                  |                           | I <sub>OL</sub> = 8 mA   | 2.3                    |                                 | 0.6  |       |
|                  |                           | I <sub>OL</sub> = 12 mA  | 2.7                    |                                 | 0.4  |       |
|                  |                           | I <sub>OL</sub> = 16 mA  | 3.0                    |                                 | 0.4  |       |
|                  |                           | I <sub>OL</sub> = 24 mA  | 3.0                    |                                 | 0.55 |       |
| I <sub>I</sub>   | Input Leakage Current     | 0 ≤ V <sub>I</sub> ≤ 5.5V  | 2.3 - 3.6              |                                 | ±5.0 | μA    |
| I <sub>OZ</sub>  | 3-STATE Output Leakage    | 0 ≤ V <sub>O</sub> ≤ 5.5V<br>V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> | 2.3 - 3.6              |                                 | ±5.0 | μA    |
| I <sub>OFF</sub> | Power-Off Leakage Current | V <sub>I</sub> or V <sub>O</sub> = 5.5V  | 0                      |                                 | 10   | μA    |

**DC Electrical Characteristics** (Continued)

| Symbol           | Parameter                             | Conditions   | V <sub>CC</sub><br>(V) | T <sub>A</sub> = -40°C to +85°C |     | Units |
|------------------|---------------------------------------|--|------------------------|---------------------------------|-----|-------|
|                  |                                       |  |                        | Min                             | Max |       |
| I <sub>CC</sub>  | Quiescent Supply Current              | V <sub>I</sub> = V <sub>CC</sub> or GND                | 2.3 – 3.6              |                                 | 10  | μA    |
|                  |                                       | 3.6V ≤ V <sub>I</sub> , V <sub>O</sub> ≤ 5.5V (Note 7) | 2.3 – 3.6              |                                 | ±10 |       |
| ΔI <sub>CC</sub> | Increase in I <sub>CC</sub> per Input | V <sub>IH</sub> = V <sub>CC</sub> - 0.6V               | 2.3 – 3.6              |                                 | 500 | μA    |

Note 7: Outputs disabled or 3-STATE only.

**AC Electrical Characteristics**

| Symbol            | Parameter                      | T <sub>A</sub> = -40°C to +85°C, R <sub>L</sub> = 500 Ω |     |                        |     |                              |      | Units |
|-------------------|--------------------------------|---|-----|------------------------|-----|------------------------------|------|-------|
|                   |                                | V <sub>CC</sub> = 3.3V ± 0.3V                           |     | V <sub>CC</sub> = 2.7V |     | V <sub>CC</sub> = 2.5 ± 0.2V |      |       |
|                   |                                | C <sub>L</sub> = 50 pF                                  |     | C <sub>L</sub> = 50 pF |     | C <sub>L</sub> = 30 pF       |      |       |
|                   |                                | Min   | Max | Min                    | Max | Min                          | Max  |       |
| f <sub>MAX</sub>  | Maximum Clock Frequency        | 150   |     |                        |     |                              |      | MHz   |
| t <sub>PHL</sub>  | Propagation Delay              | 1.5   | 8.5 | 1.5                    | 9.5 | 1.5                          | 10.5 | ns    |
| t <sub>PLH</sub>  | CP to O <sub>n</sub>           | 1.5   | 8.5 | 1.5                    | 9.5 | 1.5                          | 10.5 | ns    |
| t <sub>PZL</sub>  | Output Enable Time             | 1.5   | 8.5 | 1.5                    | 9.5 | 1.5                          | 10.5 | ns    |
| t <sub>PZH</sub>  |                                | 1.5   | 8.5 | 1.5                    | 9.5 | 1.5                          | 10.5 | ns    |
| t <sub>PLZ</sub>  | Output Disable Time            | 1.5   | 6.5 | 1.5                    | 7.0 | 1.5                          | 7.8  | ns    |
| t <sub>PHZ</sub>  |                                | 1.5   | 6.5 | 1.5                    | 7.0 | 1.5                          | 7.8  | ns    |
| t <sub>S</sub>    | Setup Time                     | 2.5   |     | 2.5                    |     | 4.0                          |      | ns    |
| t <sub>H</sub>    | Hold Time                      | 1.5   |     | 1.5                    |     | 2.0                          |      | ns    |
| t <sub>W</sub>    | Pulse Width                    | 3.3   |     | 3.3                    |     | 4.0                          |      | ns    |
| t <sub>OSSL</sub> | Output to Output Skew (Note 8) |   | 1.0 |                        |     |                              |      | ns    |
| t <sub>OSLH</sub> |                                |   | 1.0 |                        |     |                              |      | ns    |

Note 8: 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<sub>OSSL</sub>) or LOW-to-HIGH (t<sub>OSLH</sub>).

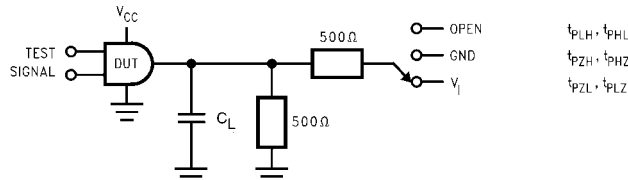
**Dynamic Switching Characteristics**

| Symbol           | Parameter                                   | Conditions   | V <sub>CC</sub><br>(V) | T <sub>A</sub> = 25°C | Units |
|------------------|---|--|------------------------|-----------------------|-------|
|                  |   |  |                        | Typical               |       |
| V <sub>OLP</sub> | Quiet Output Dynamic Peak V <sub>OL</sub>   | C <sub>L</sub> = 50 pF, V <sub>IH</sub> = 3.3V, V <sub>IL</sub> = 0V | 3.3                    | 0.8                   | V     |
|                  |   | C <sub>L</sub> = 30 pF, V <sub>IH</sub> = 2.5V, V <sub>IL</sub> = 0V | 2.5                    | 0.6                   |       |
| V <sub>OLV</sub> | Quiet Output Dynamic Valley V <sub>OL</sub> | C <sub>L</sub> = 50 pF, V <sub>IH</sub> = 3.3V, V <sub>IL</sub> = 0V | 3.3                    | -0.8                  | V     |
|                  |   | C <sub>L</sub> = 30 pF, V <sub>IH</sub> = 2.5V, V <sub>IL</sub> = 0V | 2.5                    | -0.6                  |       |

**Capacitance**

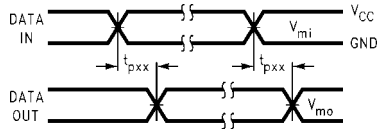
| Symbol           | Parameter                     | Conditions  | Typical | Units |
|------------------|-------------------------------|---|---------|-------|
| C <sub>IN</sub>  | Input Capacitance             | V <sub>CC</sub> = Open, V <sub>I</sub> = 0V or V <sub>CC</sub>              | 7       | pF    |
| C <sub>OUT</sub> | Output Capacitance            | V <sub>CC</sub> = 3.3V, V <sub>I</sub> = 0V or V <sub>CC</sub>              | 8       | pF    |
| C <sub>PD</sub>  | Power Dissipation Capacitance | V <sub>CC</sub> = 3.3V, V <sub>I</sub> = 0V or V <sub>CC</sub> , f = 10 MHz | 25      | pF    |

**AC LOADING and WAVEFORMS** Generic for LCX Family

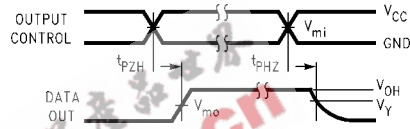


**FIGURE 1. AC Test Circuit ( $C_L$  includes probe and jig capacitance)**

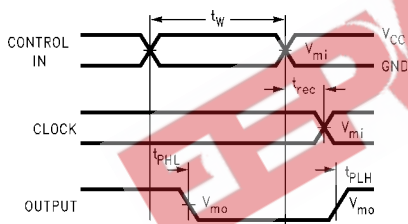
| Test               | Switch  |
|--------------------|---|
| $t_{PLH}, t_{PHL}$ | Open  |
| $t_{PZL}, t_{PLZ}$ | 6V at $V_{CC} = 3.3 \pm 0.3V$<br>$V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$ |
| $t_{PZH}, t_{PHZ}$ | GND   |



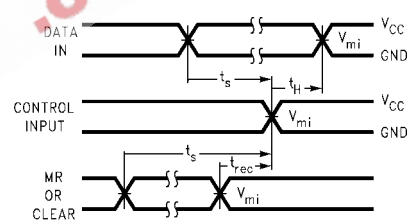
**Waveform for Inverting and Non-Inverting Functions**



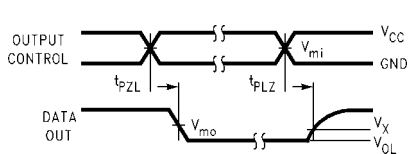
**3-STATE Output High Enable and Disable Times for Logic**



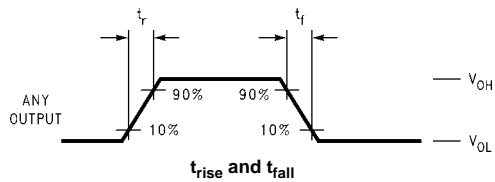
**Propagation Delay, Pulse Width and  $t_{rec}$  Waveforms**



**Setup Time, Hold Time and Recovery Time for Logic**



**3-STATE Output Low Enable and Disable Times for Logic**



**FIGURE 2. Waveforms (Input Characteristics;  $f = 1MHz$ ,  $t_r = t_f = 3ns$ )**

| Symbol   | $V_{CC}$        |                 |                  |
|----------|-----------------|-----------------|------------------|
|          | $3.3V \pm 0.3V$ | $2.7V$          | $2.5V \pm 0.2V$  |
| $V_{mi}$ | 1.5V            | 1.5V            | $V_{CC}/2$       |
| $V_{mo}$ | 1.5V            | 1.5V            | $V_{CC}/2$       |
| $V_x$    | $V_{OL} + 0.3V$ | $V_{OL} + 0.3V$ | $V_{OL} + 0.15V$ |
| $V_y$    | $V_{OH} - 0.3V$ | $V_{OH} - 0.3V$ | $V_{OH} - 0.15V$ |

**Schematic Diagram** Generic for LCX Family



### Tape and Reel Specification

Tape Format for DQFN

| Package Designator | Tape Section       | Number Cavities | Cavity Status | Cover Tape Status |
|--------------------|--------------------|-----------------|---------------|-------------------|
| BQX                | Leader (Start End) | 125 (typ)       | Empty         | Sealed            |
|                    | Carrier            | 3000            | Filled        | Sealed            |
|                    | Trailer (Hub End)  | 75 (typ)        | Empty         | Sealed            |

**TAPE DIMENSIONS** inches (millimeters)

| PKG. SIZE | DIM.Ao    | DIM.Bo    | DIM.Ko    |
|-----------|-----------|-----------|-----------|
| 3.5 X 4.5 | 3.8 ± 0.1 | 4.8 ± 0.1 | 0.9 ± 0.1 |
| 3.0 X 3.0 | 3.3 ± 0.1 | 3.3 ± 0.1 | 0.9 ± 0.1 |
| 2.5 X 4.5 | 2.8 ± 0.1 | 4.8 ± 0.1 | 0.9 ± 0.1 |
| 2.5 X 3.5 | 2.8 ± 0.1 | 3.8 ± 0.1 | 0.9 ± 0.1 |
| 2.5 X 3.0 | 2.8 ± 0.1 | 3.3 ± 0.1 | 0.9 ± 0.1 |
| 2.5 X 2.5 | 2.8 ± 0.1 | 2.8 ± 0.1 | 0.9 ± 0.1 |

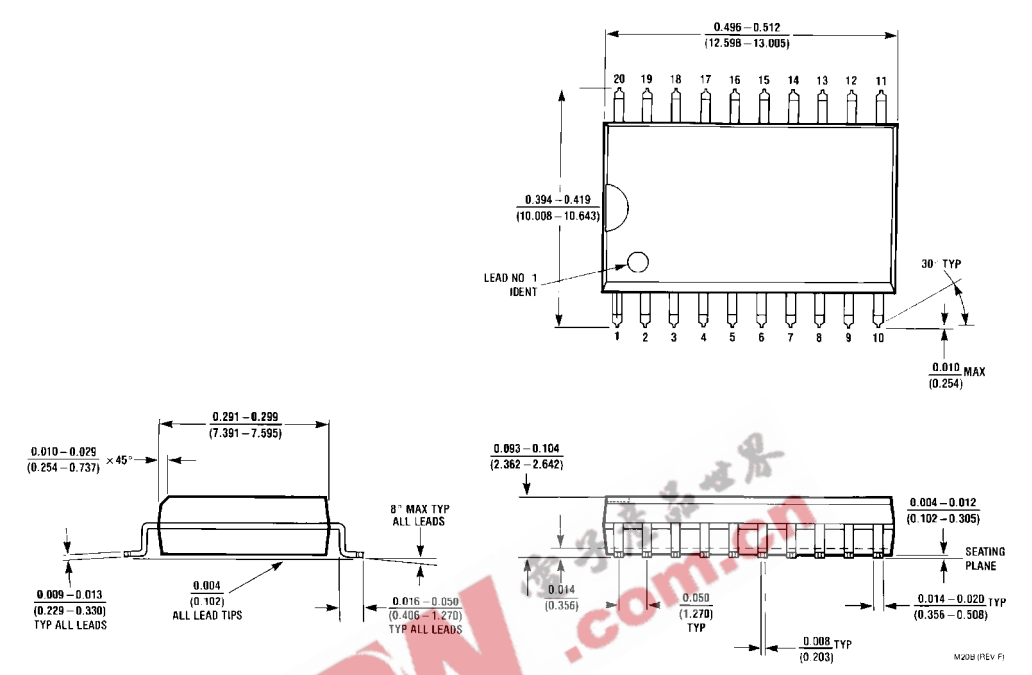
DIMENSIONS ARE IN MILLIMETERS

- NOTES: unless otherwise specified
- Cumulative pitch for feeding holes and cavities (chip pockets) not to exceed 0.008[0.20] over 10 pitch span.
  - Smallest allowable bending radius.
  - Thru hole inside cavity is centered within cavity.
  - Tolerance is ±0.002[0.05] for these dimensions on all 12mm tapes.
  - Ao and Bo measured on a plane 0.120[0.30] above the bottom of the pocket.
  - Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
  - Pocket position relative to sprocket hole measured as true position of pocket. Not pocket hole.
  - Controlling dimension is millimeter. Dimension in inches rounded.

**REEL DIMENSIONS** inches (millimeters)

| Tape Size | A               | B               | C                | D                | N                | W1              | W2              |
|-----------|-----------------|-----------------|------------------|------------------|------------------|-----------------|-----------------|
| 12 mm     | 13.0<br>(330.0) | 0.059<br>(1.50) | 0.512<br>(13.00) | 0.795<br>(20.20) | 2.165<br>(55.00) | 0.488<br>(12.4) | 0.724<br>(18.4) |

**Physical Dimensions** inches (millimeters) unless otherwise noted



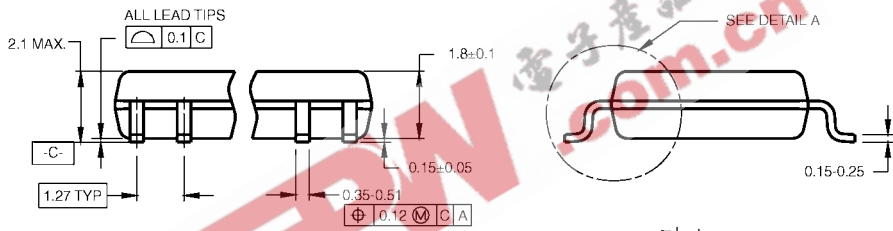
**20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide  
Package Number M20B**



**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



**LAND PATTERN RECOMMENDATION**



DIMENSIONS ARE IN MILLIMETERS

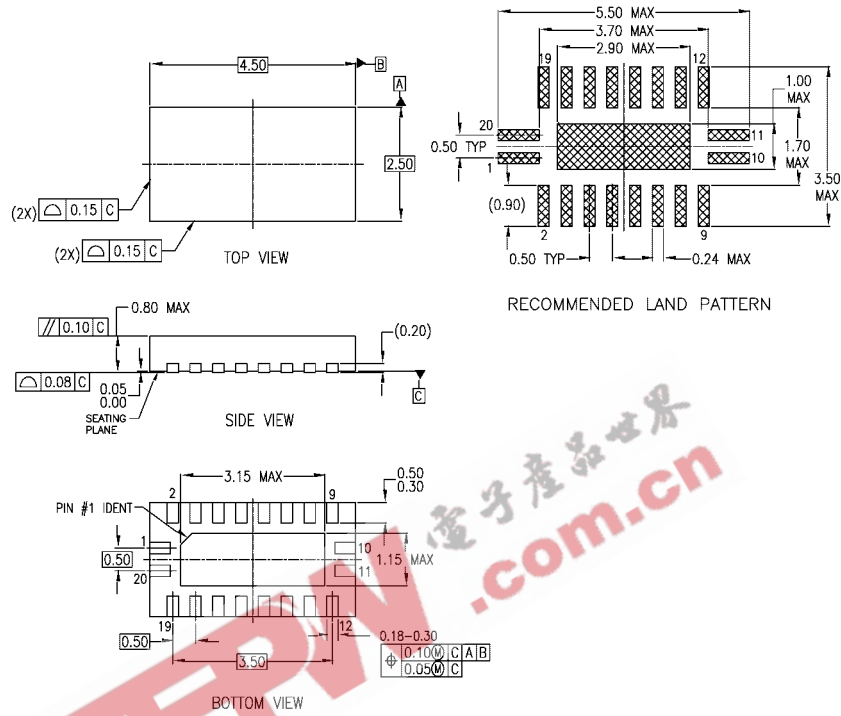
- NOTES:
- A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.
  - B. DIMENSIONS ARE IN MILLIMETERS.
  - C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M20DRevB1

**DETAIL A**

**Pb-Free 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide  
Package Number M20D**

**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



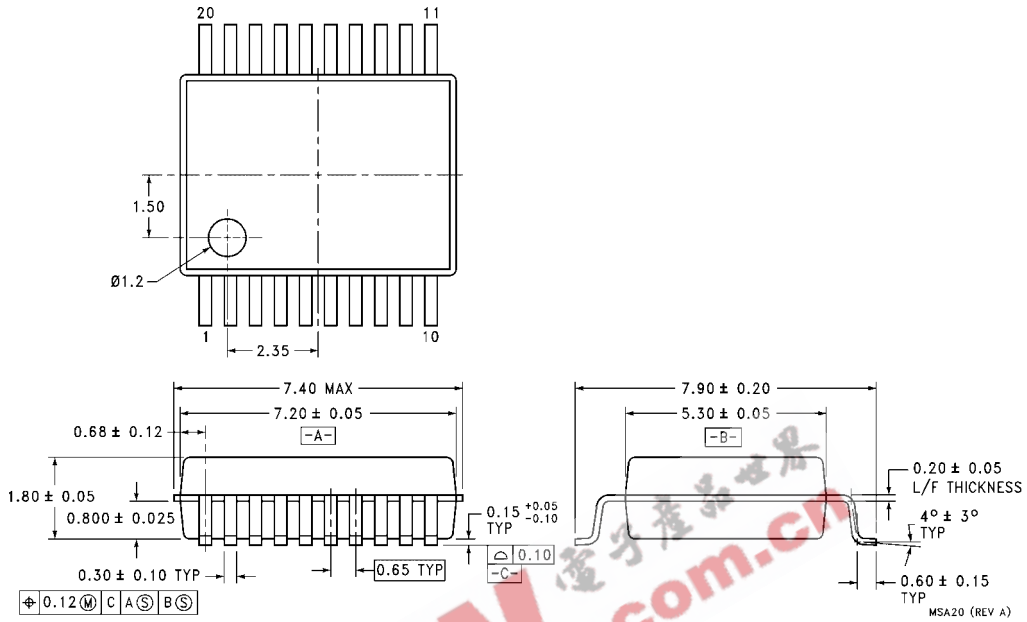
NOTES:

- A. CONFORMS TO JEDEC REGISTRATION MO-241, VARIATION AC
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

MLP020BrevA

**Pb-Free 20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm  
Package Number MLP020B**

**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



**20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide  
 Package Number MSA20**

### Physical Dimensions inches (millimeters) unless otherwise noted (Continued)

DIMENSIONS ARE IN MILLIMETERS

NOTES:

- A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AC, REF NOTE 6, DATE 7/93.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLDS FLASH, AND TIE BAR EXTRUSIONS.
- D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.

MTC20REV D1

**20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  
Package Number MTC20**

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**LIFE SUPPORT POLICY**

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1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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