

74LCX574

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

Features

- 5V tolerant inputs and outputs
- 2.3V–3.6V V_{CC} specifications provided
- 7.5ns t_{PD} max ($V_{CC} = 3.3V$), 10 μ A I_{CC} max
- Power down high impedance inputs and outputs
- Supports live insertion/withdrawal¹
- $\pm 24mA$ 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

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 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.

Ordering Information

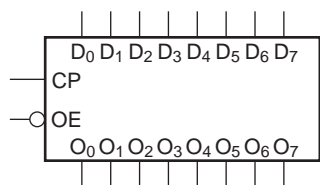
| Order Number | Package Number | Package Description |
|-----------------------------|----------------|---|
| 74LCX574WM | M20B | 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide |
| 74LCX574WM_NL ³ | M20B | Pb-Free 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide |
| 74LCX574SJ | M20D | 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide |
| 74LCX574BQX 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 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.

Notes:

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 of the resistor is determined by the current-sourcing capability of the driver.
2. DQFN package available in Tape and Reel only
3. "_NL" indicates Pb-Free package (per JEDEC J-STD-020B). Device available in Tape and Reel only.

Logic Symbol

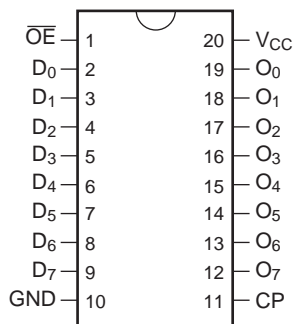


Pin Descriptions

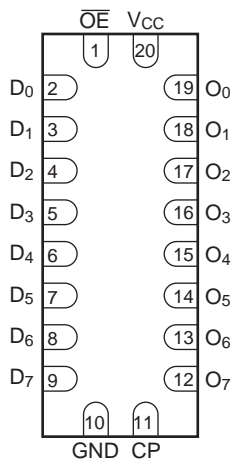
| Pin Names | Description |
|--------------------------------|-----------------------------|
| D ₀ -D ₇ | Data Inputs |
| CP | Clock Pulse Input |
| \overline{OE} | 3-STATE Output Enable Input |
| O ₀ -O ₇ | 3-STATE Outputs |

Connection Diagrams

Pin Assignments for SOIC, SOP, SSOP, TSSOP



Pad Assignments for DQFN



(Top View)

Truth Table

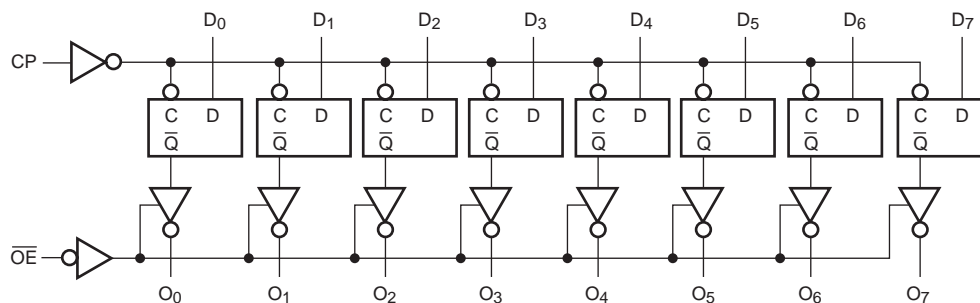
| Inputs | | | Internal | Outputs | Function |
|-----------------|----|---|----------------|----------------|-------------------|
| \overline{OE} | CP | D | \overline{Q} | O _n | |
| H | H | L | NC | Z | Hold |
| H | H | H | NC | Z | Hold |
| H | | L | H | Z | Load |
| H | | H | L | Z | Load |
| L | | L | H | L | Data Available |
| L | | H | L | 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
 = 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 loading 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

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.

| Symbol | Parameter | Conditions | Value | Units |
|-----------|----------------------------------|--|------------------------|--------------------|
| V_{CC} | Supply Voltage | | -0.5 to +7.0 | V |
| V_I | DC Input Voltage | | -0.5 to +7.0 | V |
| V_O | DC Output Voltage | Output in 3-STATE | -0.5 to +7.0 | V |
| | | Output in HIGH or LOW State ⁴ | -0.5 to $V_{CC} + 0.5$ | |
| I_{IK} | DC Input Diode Current | $V_I < \text{GND}$ | -50 | mA |
| I_{OK} | DC Output Diode Current | $V_O < \text{GND}$ | -50 | mA |
| | | $V_O > V_{CC}$ | +50 | |
| I_O | DC Output Source/Sink Current | | ± 50 | mA |
| I_{CC} | DC Supply Current per Supply Pin | | ± 100 | mA |
| I_{GND} | DC Ground Current per Ground Pin | | ± 100 | mA |
| T_{STG} | Storage Temperature | | -65 to +150 | $^{\circ}\text{C}$ |

Recommended Operating Conditions⁵

| Symbol | Parameter | Conditions | Min. | Max. | Units |
|---------------------|--------------------------------|--|------|----------|--------------------|
| V_{CC} | Supply Voltage | Operating | 2.0 | 3.6 | V |
| | | Data Retention | 1.5 | 3.6 | |
| V_I | Input Voltage | | 0 | 5.5 | V |
| V_O | Output Voltage | HIGH or LOW State | 0 | V_{CC} | V |
| | | 3-STATE | 0 | 5.5 | |
| I_{OH}/I_{OL} | Output Current | $V_{CC} = 3.0\text{V} - 3.6\text{V}$ | | ± 24 | mA |
| | | $V_{CC} = 2.7\text{V} - 3.0\text{V}$ | | ± 12 | |
| | | $V_{CC} = 2.3\text{V} - 2.7\text{V}$ | | ± 8 | |
| T_A | Free-Air Operating Temperature | | -40 | 85 | $^{\circ}\text{C}$ |
| $\Delta t/\Delta V$ | Input Edge Rate | $V_{IN} = 0.8\text{V} - 2.0\text{V}, V_{CC} = 3.0\text{V}$ | 0 | 10 | ns/V |

Notes:

- I_O Absolute Maximum Rating must be observed.
- Unused inputs must be held HIGH or LOW. They may not float.

DC Electrical Characteristics

| Symbol | Parameter | Conditions | V _{CC} (V) | T _A = -40°C to +85°C | | Units |
|------------------|---------------------------------------|---|---------------------|---------------------------------|------|-------|
| | | | | Min. | Max. | |
| V _{IH} | HIGH Level Input Voltage | | 2.3 – 2.7 | 1.7 | | V |
| | | | 2.7 – 3.6 | 2.0 | | |
| V _{IL} | LOW Level Input Voltage | | 2.3 – 2.7 | | 0.7 | V |
| | | | 2.7 – 3.6 | | 0.8 | |
| V _{OH} | HIGH Level Output Voltage | I _{OH} = -100μA | 2.3 – 3.6 | V _{CC} - 0.2 | | V |
| | | I _{OH} = -8mA | 2.3 | 1.8 | | |
| | | I _{OH} = -12mA | 2.7 | 2.2 | | |
| | | I _{OH} = -18mA | 3.0 | 2.4 | | |
| | | I _{OH} = -24mA | 3.0 | 2.2 | | |
| V _{OL} | LOW Level Output Voltage | I _{OL} = 100μA | 2.3 – 3.6 | | 0.2 | V |
| | | I _{OL} = 8mA | 2.3 | | 0.6 | |
| | | I _{OL} = 12mA | 2.7 | | 0.4 | |
| | | I _{OL} = 16mA | 3.0 | | 0.4 | |
| | | I _{OL} = 24mA | 3.0 | | 0.55 | |
| I _I | Input Leakage Current | 0 ≤ V _I ≤ 5.5V | 2.3 – 3.6 | | ±5.0 | μA |
| I _{OZ} | 3-STATE Output Leakage | 0 ≤ V _O ≤ 5.5V, V _I = V _{IH} or V _{IL} | 2.3 – 3.6 | | ±5.0 | μA |
| I _{OFF} | Power-Off Leakage Current | V _I or V _O = 5.5V | 0 | | 10 | μA |
| I _{CC} | Quiescent Supply Current | V _I = V _{CC} or GND | 2.3 – 3.6 | | 10 | μA |
| | | 3.6V ≤ V _I , V _O ≤ 5.5V ⁶ | 2.3 – 3.6 | | ±10 | |
| ΔI _{CC} | Increase in I _{CC} per Input | V _{IH} = V _{CC} - 0.6V | 2.3 – 3.6 | | 500 | μA |

AC Electrical Characteristics

| Symbol | Parameter | T _A = -40°C to +85°C, R _L = 500 Ω | | | | | | Units |
|--|--|---|------|------------------------|------|------------------------------|------|-------|
| | | V _{CC} = 3.3V ± 0.3V | | V _{CC} = 2.7V | | V _{CC} = 2.5 ± 0.2V | | |
| | | C _L = 50 pF | | C _L = 50 pF | | C _L = 30 pF | | |
| | | Min. | Max. | Min. | Max. | Min. | Max. | |
| f _{MAX} | Maximum Clock Frequency | 150 | | | | | | MHz |
| t _{PHL} , t _{PLH} | Propagation Delay, CP to O _n | 1.5 | 8.5 | 1.5 | 9.5 | 1.5 | 10.5 | ns |
| t _{PZL} , t _{PZH} | Output Enable Time | 1.5 | 8.5 | 1.5 | 9.5 | 1.5 | 10.5 | ns |
| t _{PLZ} , t _{PHZ} | Output Disable Time | 1.5 | 6.5 | 1.5 | 7.0 | 1.5 | 7.8 | ns |
| t _S | Setup Time | 2.5 | | 2.5 | | 4.0 | | ns |
| t _H | Hold Time | 1.5 | | 1.5 | | 2.0 | | ns |
| t _W | Pulse Width | 3.3 | | 3.3 | | 4.0 | | ns |
| t _{OSHL} , t _{OSLH} | Output to Output Skew ⁷ | | 1.0 | | | | | ns |

Notes:

6. Outputs disabled or 3-STATE only.

7. 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}).

Dynamic Switching Characteristics

| Symbol | Parameter | Conditions | V _{CC} (V) | T _A = 25°C | |
|------------------|---|---|---------------------|-----------------------|-------|
| | | | | Typical | Units |
| V _{OLP} | Quiet Output Dynamic Peak V _{OL} | C _L = 50pF, V _{IH} = 3.3V, V _{IL} = 0V | 3.3 | 0.8 | V |
| | | C _L = 30pF, V _{IH} = 2.5V, V _{IL} = 0V | 2.5 | 0.6 | |
| V _{OLV} | Quiet Output Dynamic Valley V _{OL} | C _L = 50pF, V _{IH} = 3.3V, V _{IL} = 0V | 3.3 | -0.8 | V |
| | | C _L = 30pF, V _{IH} = 2.5V, V _{IL} = 0V | 2.5 | -0.6 | |

Capacitance

| Symbol | Parameter | Conditions | Typical | Units |
|------------------|-------------------------------|---|---------|-------|
| C _{IN} | Input Capacitance | V _{CC} = Open, V _I = 0V or V _{CC} | 7 | pF |
| C _{OUT} | Output Capacitance | V _{CC} = 3.3V, V _I = 0V or V _{CC} | 8 | pF |
| C _{PD} | Power Dissipation Capacitance | V _{CC} = 3.3V, V _I = 0V or V _{CC} , f = 10 MHz | 25 | pF |

AC Loading and Waveforms (Generic for LCX Family)

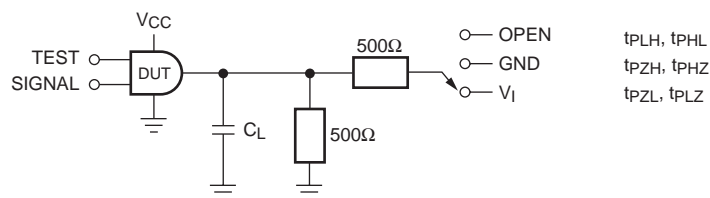
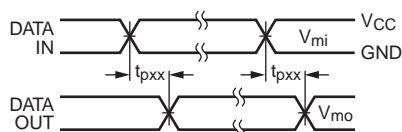
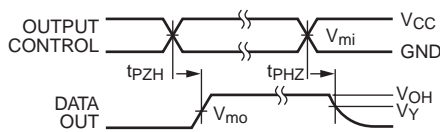


Figure 1. AC Test Circuit (C_L includes probe and jig capacitance)

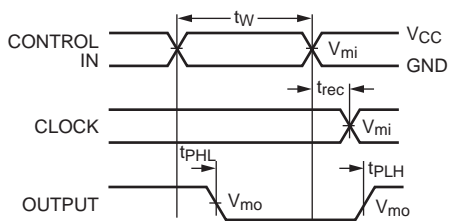
| Test | Switch |
|-----------------------|---|
| t_{PLH} , t_{PHL} | Open |
| t_{PZL} , t_{PLZ} | 6V at $V_{CC} = 3.3 \pm 0.3V$ $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$ |
| t_{PZH} , t_{PHZ} | GND |



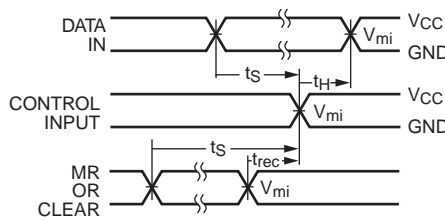
Waveform for Inverting and Non-Inverting Functions



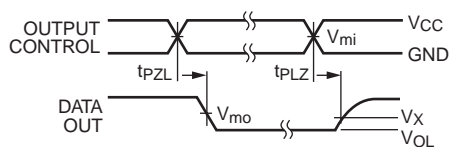
3-STATE Output High Enable and Disable Times for Logic



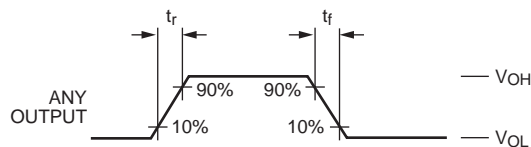
Propagation Delay, Pulse Width and t_{rec} Waveforms



Setup Time, Hold Time and Recovery Time for Logic



3-STATE Output Low Enable and Disable Times for Logic

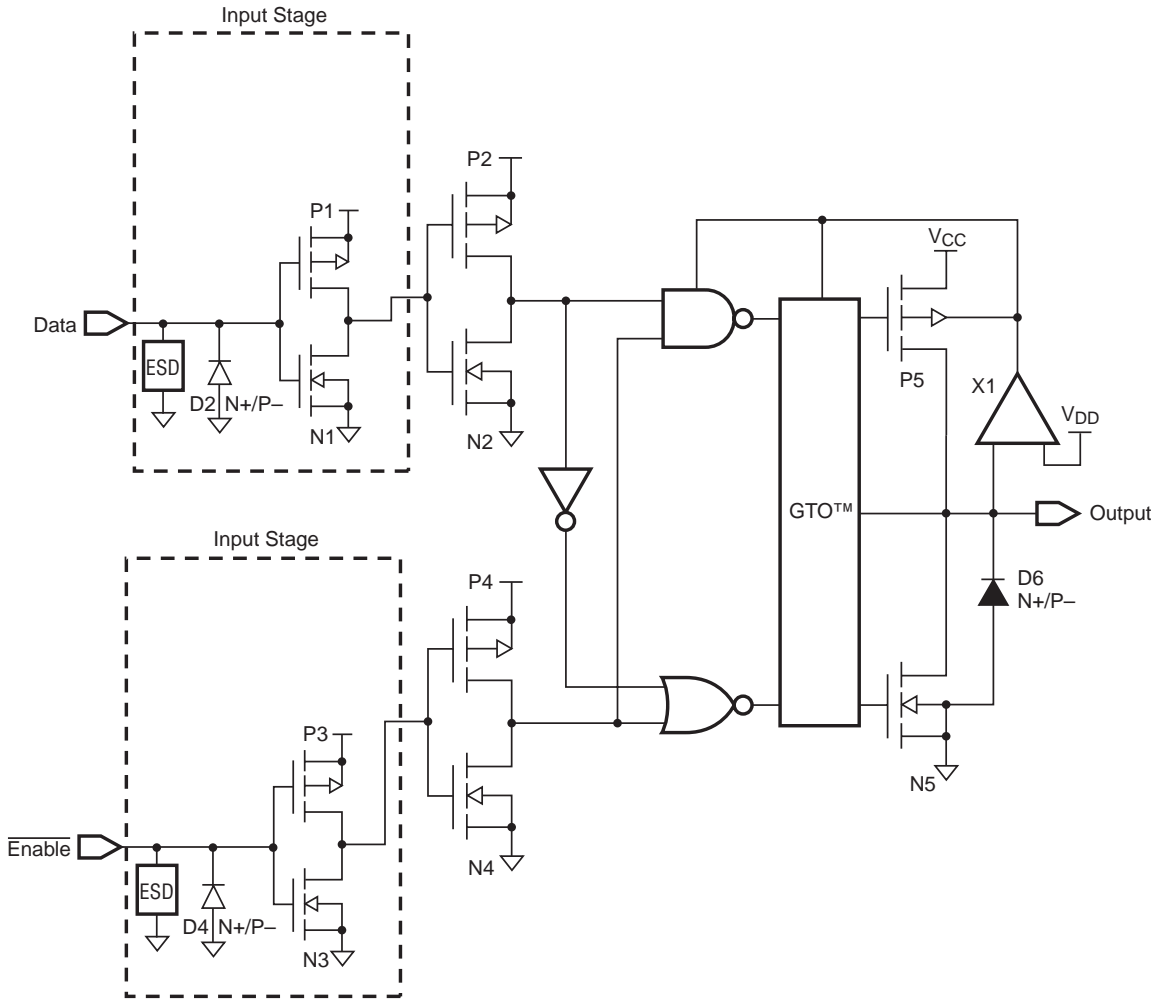


t_{rise} and t_{fall}

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)

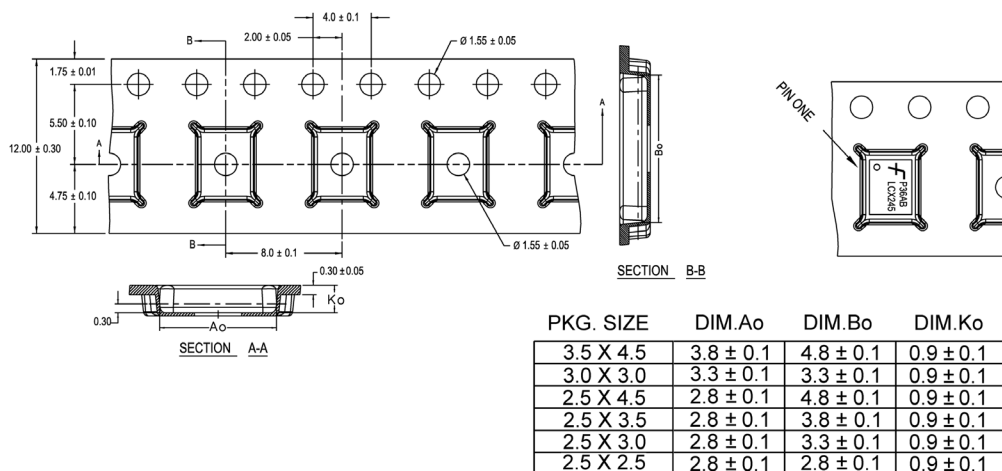


Tape and Reel Specification

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)

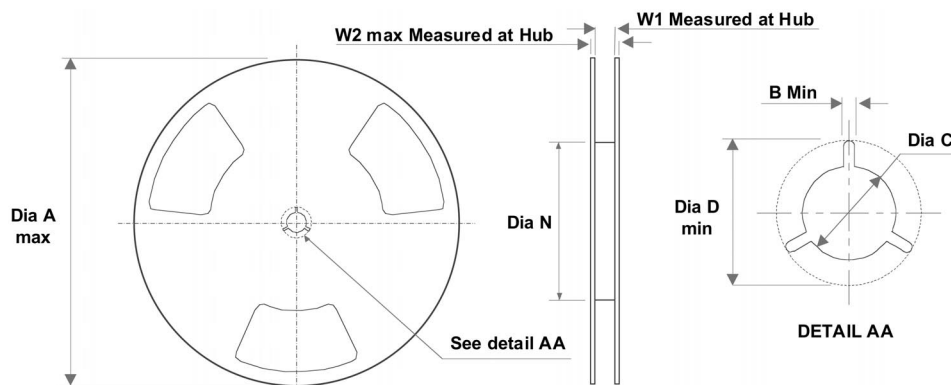


DIMENSIONS ARE IN MILLIMETERS

NOTES: unless otherwise specified

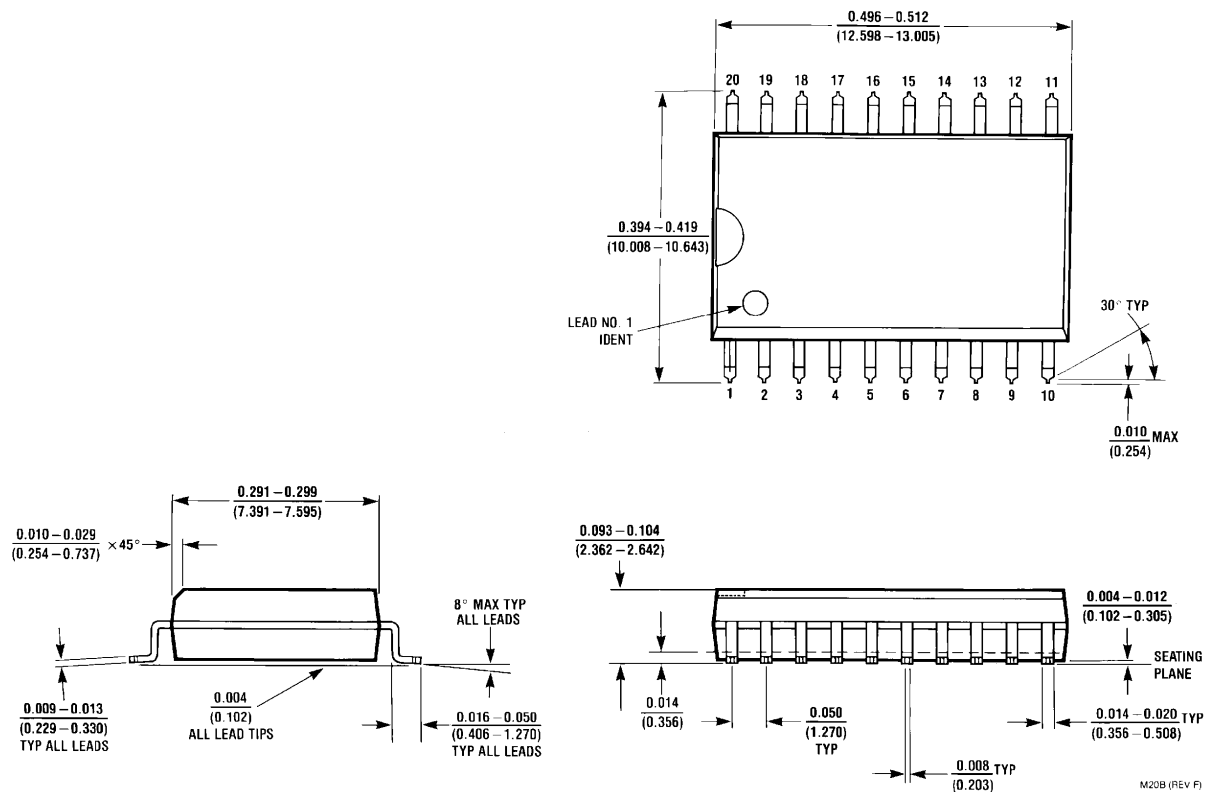
1. Cumulative pitch for feeding holes and cavities (chip pockets) not to exceed 0.008[0.20] over 10 pitch span.
2. Smallest allowable bending radius.
3. Thru hole inside cavity is centered within cavity.
4. Tolerance is $\pm 0.002[0.05]$ for these dimensions on all 12mm tapes.
5. A₀ and B₀ measured on a plane 0.120[0.30] above the bottom of the pocket.
6. K₀ measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
7. Pocket position relative to sprocket hole measured as true position of pocket. Not pocket hole.
8. Controlling dimension is millimeter. Dimension in inches rounded.

Reel Dimensions inches (millimeters)



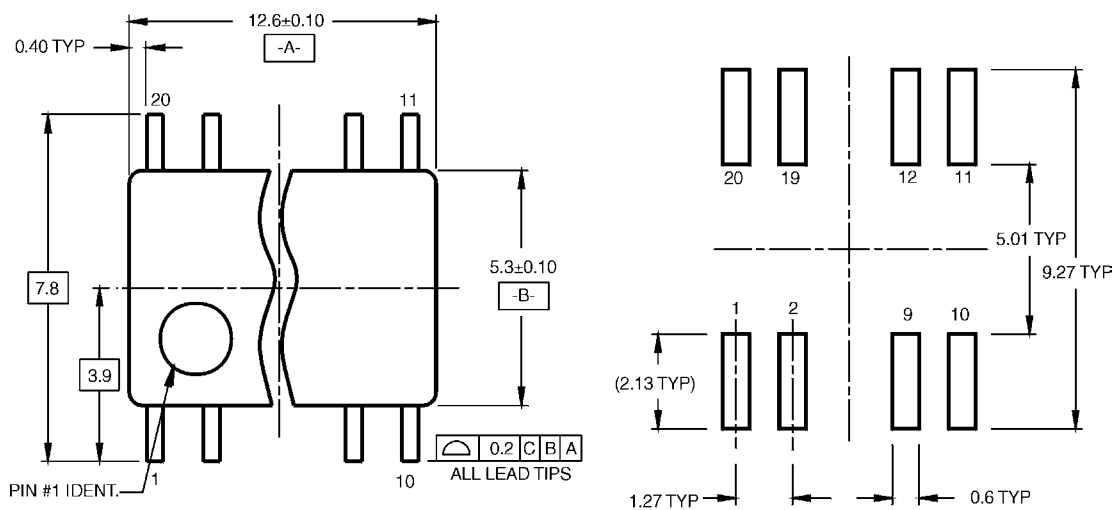
| Tape Size | A | B | C | D | N | W1 | W2 |
|-----------|-----------------|-----------------|------------------|------------------|------------------|-----------------|-----------------|
| 12 mm | 13.0 (330.0) | 0.059 (1.50) | 0.512 (13.00) | 0.795 (20.20) | 2.165 (55.00) | 0.488 (12.4) | 0.724 (18.4)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

Physical Dimensions inches (millimeters) unless otherwise noted

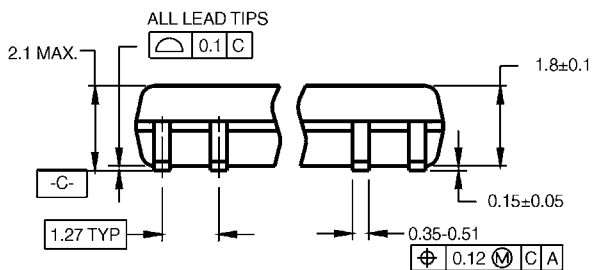
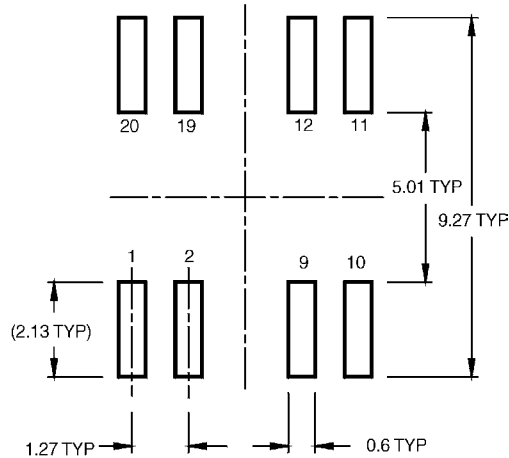


**20-Lead Small Outline Integrated Circuit (SOIC),
JEDEC MS-013, 0.300" Wide Package Number M20B**

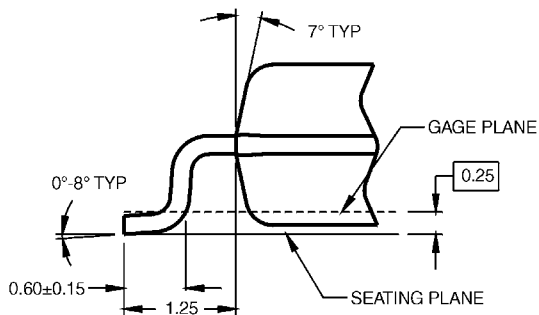
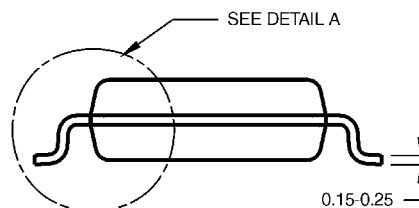
Physical Dimensions (Continued) inches (millimeters) unless otherwise noted



LAND PATTERN RECOMMENDATION



DIMENSIONS ARE IN MILLIMETERS



DETAIL A

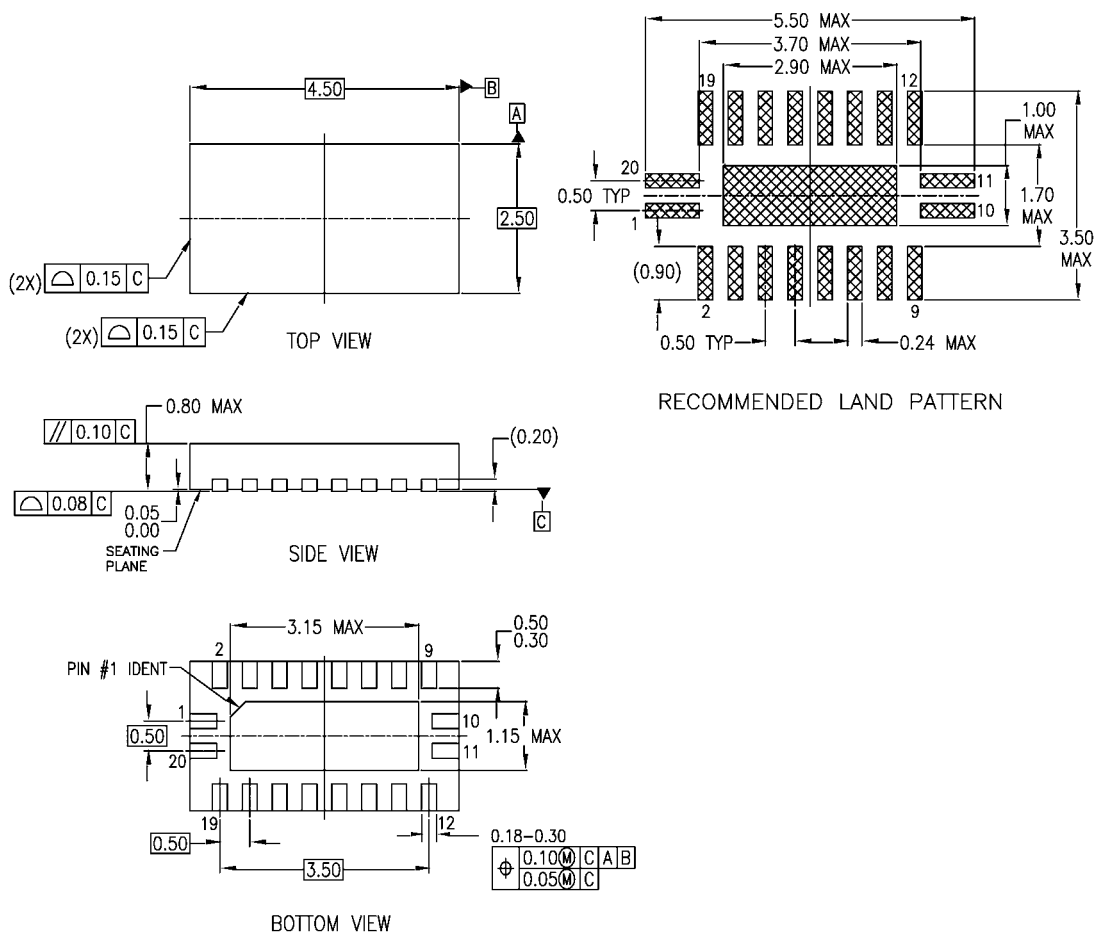
NOTES:

- 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

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

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

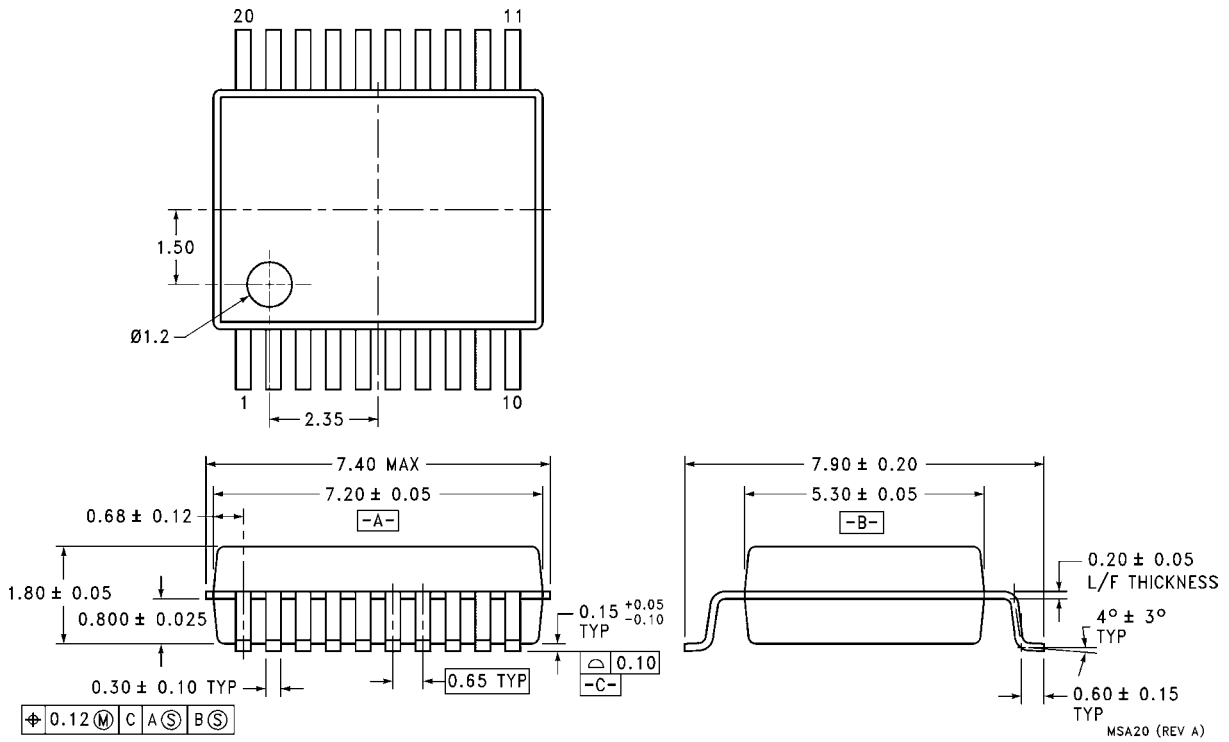


- NOTES:
- A. CONFORMS TO JEDEC REGISTRATION MO-241, VARIATION AC
 - B. DIMENSIONS ARE IN MILLIMETERS.
 - C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

MLP020BrevA

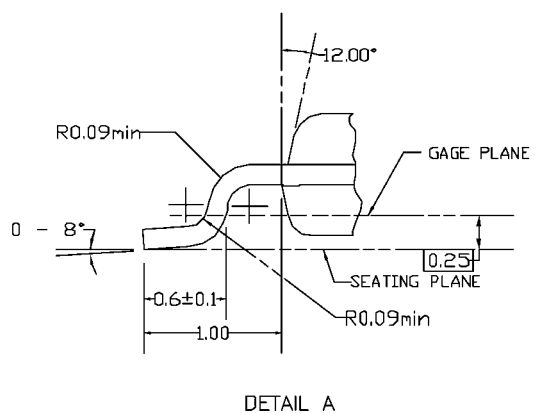
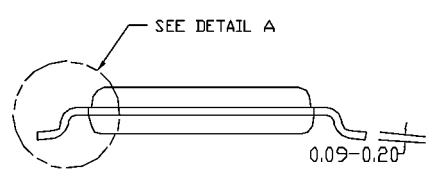
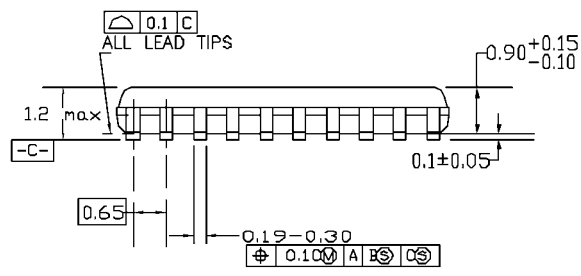
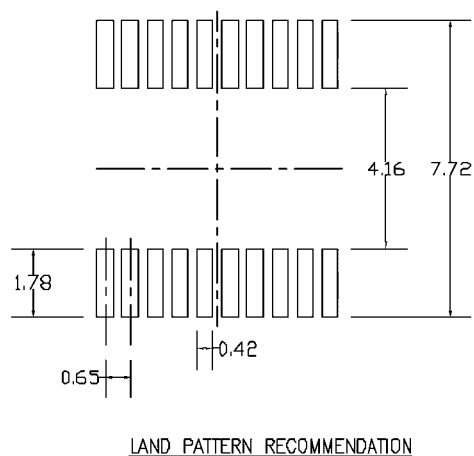
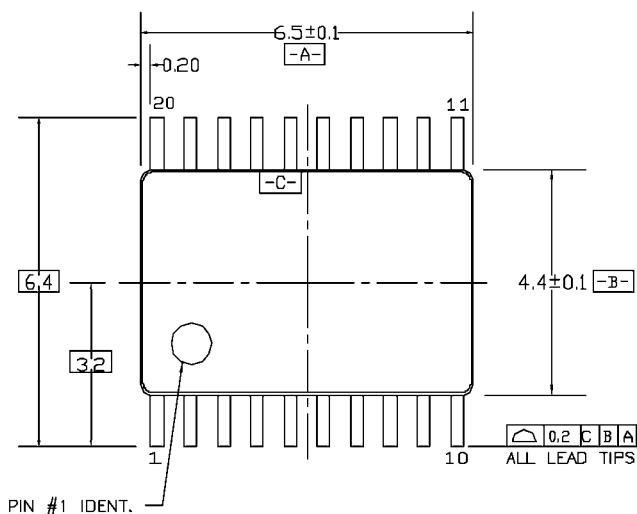
Pb-Free 20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm Package Number MLP020B

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)



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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| ActiveArray [™] | FAST _r [™] | LittleFET [™] | PowerTrench [®] | SuperSOT [™] -8 |
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| CoolFET [™] | GlobalOptoisolator [™] | MicroPak [™] | QT Optoelectronics [™] | TinyLogic [®] |
| CROSSVOLT [™] | GTO [™] | MICROWIRE [™] | Quiet Series [™] | TINYOPTO [™] |
| DOME [™] | HiSeC [™] | MSX [™] | RapidConfigure [™] | TruTranslation [™] |
| EcoSPARK [™] | I ² C [™] | MSXPro [™] | RapidConnect [™] | UHC [™] |
| E ² CMOS [™] | <i>i-Lo</i> [™] | OCX [™] | μSerDes [™] | UltraFET [®] |
| EnSigna [™] | ImpliedDisconnect [™] | OCXPro [™] | ScalarPump [™] | UniFET [™] |
| FACT [™] | IntelliMAX [™] | OPTOLOGIC [®] | SILENT SWITCHER [®] | VCX [™] |
| FACT Quiet Series [™] | | OPTOPLANAR [™] | SMART START [™] | Wire [™] |
| Across the board. Around the world. [™] | | PACMAN [™] | SPM [™] | |
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| Programmable Active Droop [™] | | Power247 [™] | SuperFET [™] | |
| | | PowerEdge [™] | SuperSOT [™] -3 | |

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