

## 74LCX244

### Low Voltage Buffer/Line Driver with 5V Tolerant Inputs and Outputs

#### General Description

The LCX244 contains eight non-inverting buffers with 3-STATE outputs. The device may be employed as a memory address driver, clock driver and bus-oriented transmitter/receiver. The LCX244 is designed for low voltage (2.5V or 3.3V)  $V_{CC}$  applications with capability of interfacing to a 5V signal environment.

The LCX244 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 to 3.6V  $V_{CC}$  specifications provided
- 6.5 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 500 mA
- ESD performance:
  - Human body model > 2000V
  - Machine model > 200V
- Leadless DQFN Pb-Free 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   |
|-----------------------------|----------------|---|
| 74LCX244WM<br>(Note 2)      | M20B           | 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide                          |
| 74LCX244WMX_NL<br>(Note 4)  | M20B           | Pb-Free 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide                  |
| 74LCX244SJ<br>(Note 2)      | M20D           | Pb-Free 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide                               |
| 74LCX244BQX<br>(Note 3)     | MLP020B        | Pb-Free 20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm |
| 74LCX244MSA<br>(Note 2)     | MSA20          | 20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide                               |
| 74LCX244MTC<br>(Note 2)     | MTC20          | 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide                         |
| 74LCX244MTC_NL<br>(Note 4)  | MTC20          | Pb-Free 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide                 |
| 74LCX244MTCX_NL<br>(Note 4) | MTC20          | Pb-Free 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide                 |

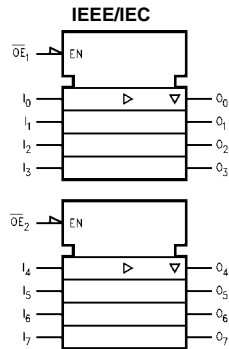
Pb-Free package per JEDEC J-STD-020B.

**Note 2:** Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

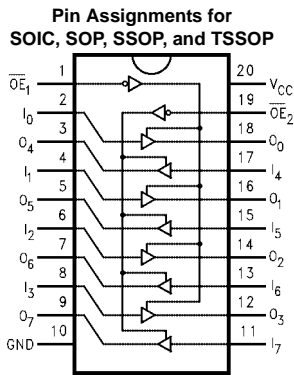
**Note 3:** DQFN package available in Tape and Reel only.

**Note 4:** "\_NL" indicates Pb-Free package (per JEDEC J-STD-020B). Please use order number as indicated.

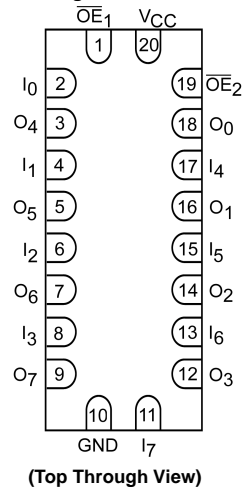
**Logic Symbol**



**Connection Diagrams**



**Pad Assignments for DQFN**



**Pin Descriptions**

| Pin Names                          | Description                  |
|------------------------------------|------------------------------|
| $\overline{OE}_1, \overline{OE}_2$ | 3-STATE Output Enable Inputs |
| $I_0 - I_7$                        | Inputs                       |
| $O_0 - O_7$                        | Outputs                      |

**Truth Tables**

| Inputs            |       | Outputs<br>(Pins 12, 14, 16, 18) |
|-------------------|-------|----------------------------------|
| $\overline{OE}_1$ | $I_n$ |                                  |
| L                 | L     | L                                |
| L                 | H     | H                                |
| H                 | X     | Z                                |

| Inputs            |       | Outputs<br>(Pins 3, 5, 7, 9) |
|-------------------|-------|------------------------------|
| $\overline{OE}_2$ | $I_n$ |                              |
| L                 | L     | L                            |
| L                 | H     | H                            |
| H                 | X     | Z                            |

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Immaterial  
 Z = High Impedance

| Absolute Maximum Ratings (Note 5)  |   |  |   |                                 |       |       |
|--|---|--|---|---------------------------------|-------|-------|
| 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 6) |                                 | 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 7)  |   |  |   |                                 |       |       |
| 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 to 3.6V   |   | ±24                             | mA    |       |
|  |   | V <sub>CC</sub> = 2.7V to 3.0V   |   | ±12                             |       |       |
|  |   | V <sub>CC</sub> = 2.3V to 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 to 2.0V, V <sub>CC</sub> = 3.0V | 0  | 10  | ns/V                            |       |       |
| <p><b>Note 5:</b> 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.</p> <p><b>Note 6:</b> I<sub>O</sub> Absolute Maximum Rating must be observed.</p> <p><b>Note 7:</b> Unused inputs or I/Os must be held HIGH or LOW. They may not float.</p> |   |  |   |                                 |       |       |
| 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 to 2.7  | 1.7                             |       | V     |
|  |   |  | 2.7 to 3.6  | 2.0                             |       |       |
| V <sub>IL</sub>  | LOW Level Input Voltage   |  | 2.3 to 2.7  |                                 | 0.7   | V     |
|  |   |  | 2.7 to 3.6  |                                 | 0.8   |       |
| V <sub>OH</sub>  | HIGH Level Output Voltage   | I <sub>OH</sub> = -100 μA  | 2.3 to 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 to 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>O</sub> ≤ 5.5V  | 2.3 to 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 to 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    |

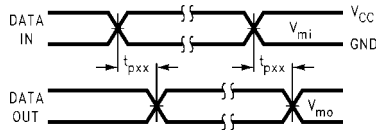
| DC Electrical Characteristics (Continued)   |   |   |                        |                                 |       |                              |      |       |
|---|---|---|------------------------|---------------------------------|-------|------------------------------|------|-------|
| Symbol  | 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 8)                      | 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                           |      |       |
| <b>Note 8:</b> Outputs disabled or 3-STATE only.  |   |   |                        |                                 |       |                              |      |       |
| AC Electrical Characteristics   |   |   |                        |                                 |       |                              |      |       |
| Symbol  | Parameter                                   | T <sub>A</sub> = -40°C to +85°C, R <sub>L</sub> = 500Ω                      |                        |                                 |       |                              |      | Units |
|   |   | V <sub>CC</sub> = 3.3V ± 0.3V   |                        | V <sub>CC</sub> = 2.7V          |       | V <sub>CC</sub> = 2.5V ± 0.2 |      |       |
|   |   | C <sub>L</sub> = 50 pF  |                        | C <sub>L</sub> = 50 pF          |       | C <sub>L</sub> = 30 pF       |      |       |
|   |   | Min   | Max                    | Min                             | Max   | Min                          | Max  |       |
| t <sub>PHL</sub>  | Propagation Delay                           | 1.5   | 6.5                    | 1.5                             | 7.5   | 1.5                          | 7.8  | ns    |
| t <sub>PLH</sub>  | Data to Output                              | 1.5   | 6.5                    | 1.5                             | 7.5   | 1.5                          | 7.8  |       |
| t <sub>PZL</sub>  | Output Enable Time                          | 1.5   | 8.0                    | 1.5                             | 9.0   | 1.5                          | 10.0 | ns    |
| t <sub>PZH</sub>  |   | 1.5   | 8.0                    | 1.5                             | 9.0   | 1.5                          | 10.0 |       |
| t <sub>PLZ</sub>  | Output Disable Time                         | 1.5   | 7.0                    | 1.5                             | 8.0   | 1.5                          | 8.4  | ns    |
| t <sub>PHZ</sub>  |   | 1.5   | 7.0                    | 1.5                             | 8.0   | 1.5                          | 8.4  |       |
| t <sub>OSSL</sub>   | Output to Output Skew<br>(Note 9)           |   | 1.0                    |                                 |       |                              |      | ns    |
| t <sub>OSLH</sub>   |   |   | 1.0                    |                                 |       |                              |      |       |
| <b>Note 9:</b> 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>              | 7.0                    | pF                              |       |                              |      |       |
| C <sub>OUT</sub>  | Output Capacitance                          | V <sub>CC</sub> = 3.3V, V <sub>I</sub> = 0V or V <sub>CC</sub>              | 8.0                    | 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 | 25.0                   | pF                              |       |                              |      |       |

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

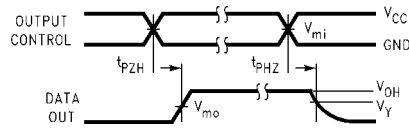


**FIGURE 1. AC Test Circuit ( $C_L$  includes probe and jig capacitance)**

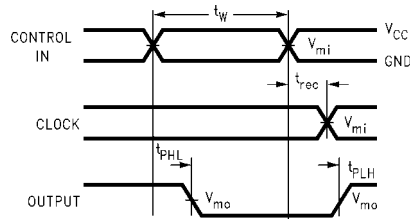
| Test                  | Switch  |
|-----------------------|---|
| $t_{PLH}$ , $t_{PHL}$ | Open  |
| $t_{PZL}$ , $t_{PLZ}$ | 6V at $V_{CC} = 3.3V \pm 0.3V$<br>$V_{CC} \times 2$ at $V_{CC} = 2.5V \pm 0.2V$ |
| $t_{PZH}$ , $t_{PHZ}$ | GND   |



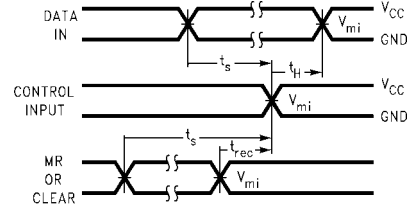
**Waveform for Inverting and Non-Inverting Functions**



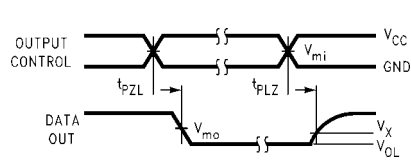
**3-STATE Output High Enable and Disable Times for Logic**



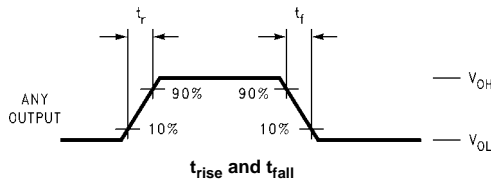
**Propagation Delay, Pulse Width and  $t_{rec}$  Waveforms**



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



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



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

| 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



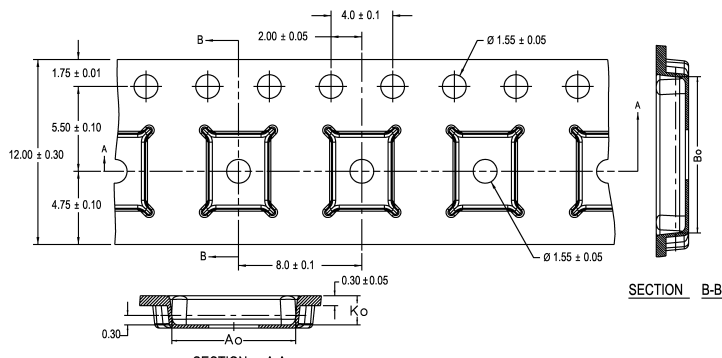
FIGURE 3.

### Tape and Reel Specification

Tape Format for DQFN

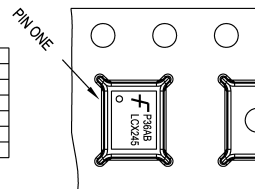
| Package Designator | Tape Section       | Number Cavities | Cavity Status | Cover Tape Status |
|--------------------|--------------------|-----------------|---------------|-------------------|
| BQX                | Leader (Start End) | 125 (typ)       | Empty         | Sealed            |
|     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

TAPE DIMENSIONS inches (millimeters)



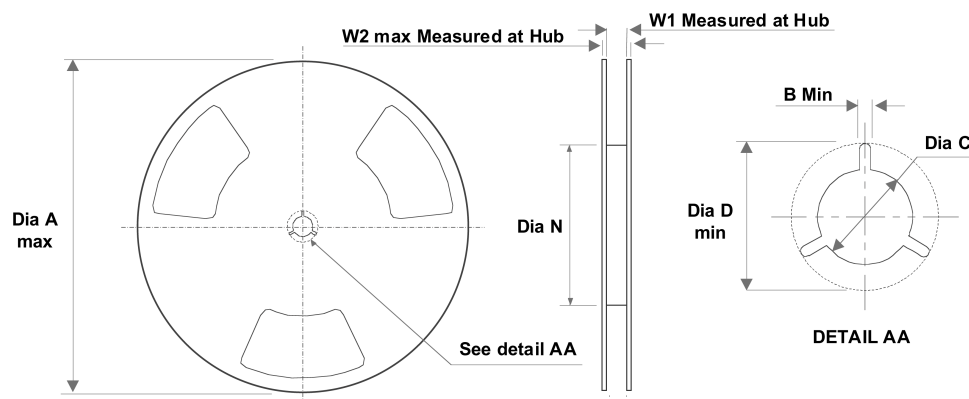
| PKG. SIZE | DIM. A <sub>o</sub> | DIM. B <sub>o</sub> | DIM. K <sub>o</sub> |
|-----------|---------------------|---------------------|---------------------|
| 3.0 X 3.0 | 3.3±0.1             | 3.3±0.1             | 0.9±0.1             |
| 3.5 X 4.5 | 3.8±0.1             | 4.8±0.1             | 0.9±0.1             |
| 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             |

DIMENSIONS ARE IN MILLIMETERS



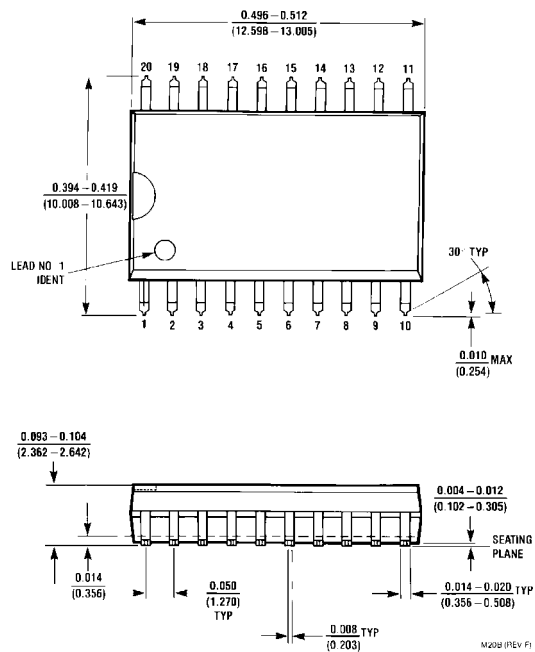
### FSC MLP/DQFN CARRIER TAPE SPECIFICATIONS

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**



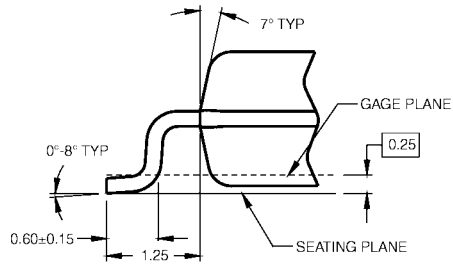
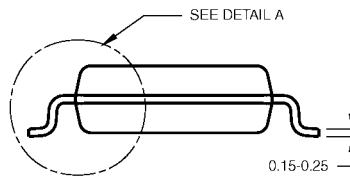
**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



LAND PATTERN RECOMMENDATION



DIMENSIONS ARE IN MILLIMETERS



DETAIL A

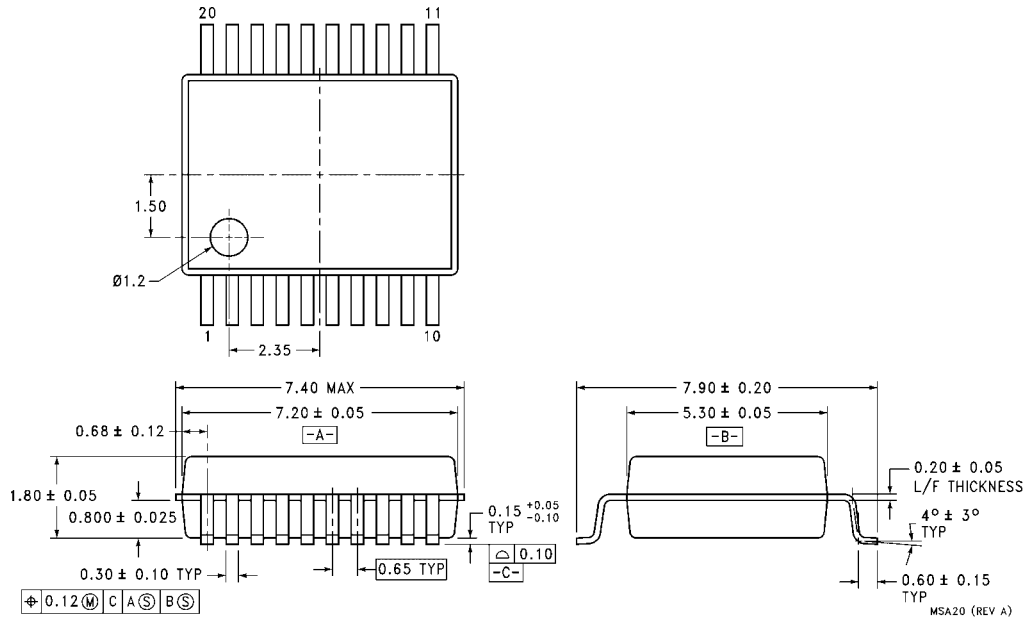
- NOTES:
- A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.
  - B. DIMENSIONS ARE IN MILLIMETERS.
  - C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M20DRevB1

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

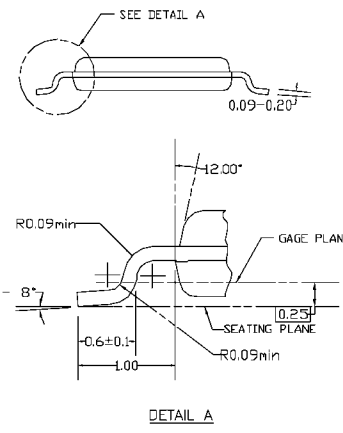
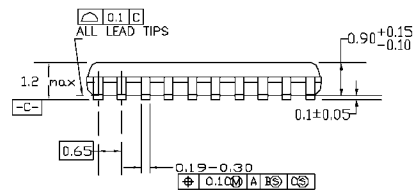
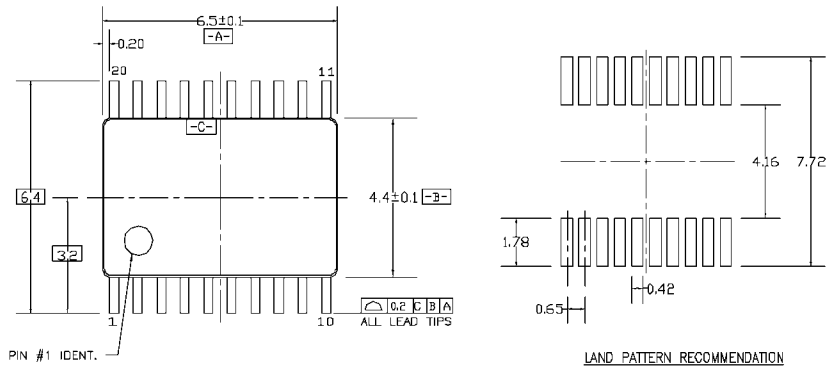


**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



**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**

Fairchild does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and Fairchild reserves the right at any time without notice to change said circuitry and specifications.

**LIFE SUPPORT POLICY**

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF FAIRCHILD SEMICONDUCTOR CORPORATION. As used herein:

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.

[www.fairchildsemi.com](http://www.fairchildsemi.com)