

## 74LCX240

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

#### General Description

The LCX240 is an inverting octal buffer and line driver designed to be employed as a memory address driver, clock driver and bus oriented transmitter or receiver. The device is designed for low voltage (2.5V or 3.3V)  $V_{CC}$  applications with capability of interfacing to a 5V signal environment.

The LCX240 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
- 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

**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:

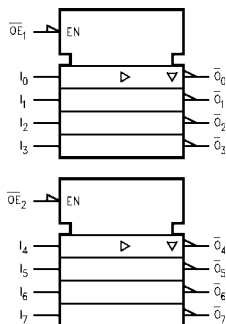
| Order Number             | Package Number | Package Description                                                                 |
|--------------------------|----------------|-------------------------------------------------------------------------------------|
| 74LCX240WM               | M20B           | 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide          |
| 74LCX240SJ               | M20D           | Pb-Free 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide               |
| 74LCX240MSA              | MSA20          | 20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide               |
| 74LCX240MTC              | MTC20          | 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide         |
| 74LCX240MTCX_NL (Note 2) | 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.

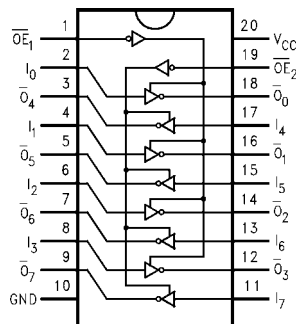
Pb-Free package per JEDEC J-STD-020B.

**Note 2:** "\_NL" indicates Pb-Free package (per JEDEC J-STD-020B). Device available in Tape and Reel only.

#### Logic Diagram



#### Connection Diagram



## Pin Descriptions

| Pin Names                          | Description                  |
|------------------------------------|------------------------------|
| $\overline{OE}_1, \overline{OE}_2$ | 3-STATE Output Enable Inputs |
| $I_0-I_7$                          | Inputs                       |
| $\overline{O}_0-\overline{O}_7$    | Outputs                      |

## Truth Tables

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

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

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

| Absolute Maximum Ratings <sup>(Note 3)</sup> |                                  |                               |                                      |       |
|----------------------------------------------|----------------------------------|-------------------------------|--------------------------------------|-------|
| 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                  | Output in 3-STATE                    | V     |
|                                              |                                  | −0.5 to V <sub>CC</sub> + 0.5 | Output in HIGH or LOW State (Note 4) | 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                           | V <sub>O</sub> < GND                 | mA    |
|                                              |                                  | +50                           | V <sub>O</sub> > V <sub>CC</sub>     |       |
| 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 <sup>(Note 5)</sup>

| 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<br>V <sub>CC</sub> = 2.7V – 3.0V<br>V <sub>CC</sub> = 2.3V – 2.7V |     | ±24<br>±12<br>±8 | mA |
| 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 3:** 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 4:** I<sub>O</sub> Absolute Maximum Rating must be observed.

**Note 5:** 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> = −100μA                               | 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> = 100μA                                | 2.3 – 3.6              |                                 | 0.2  | V     |
|                  |                                       | I <sub>OL</sub> = 8mA                                  | 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>OFF</sub> | Power-Off Leakage Current             | V <sub>I</sub> or V <sub>O</sub> = 5.5V                |                        |                                 | 10   | μA    |
| 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 6) | 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    |

**DC Electrical Characteristics** (Continued)

Note 6: 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 ± 0.2V |      |       |
|                   |                                | C <sub>L</sub> = 50 pF                                 |     | C <sub>L</sub> = 50 pF |     | C <sub>L</sub> = 30 pF        |      |       |
|                   |                                | Min                                                    | Max | Min                    | Max | Min                           | Max  |       |
| t <sub>PHL</sub>  | Propagation Delay              | 1.5                                                    | 6.5 | 1.5                    | 7.5 | 1.5                           | 7.8  | ns    |
| t <sub>PLH</sub>  |                                | 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>OSHL</sub> | Output to Output Skew (Note 7) |                                                        | 1.0 |                        |     |                               |      | ns    |
| t <sub>OSLH</sub> |                                |                                                        | 1.0 |                        |     |                               |      |       |

Note 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**

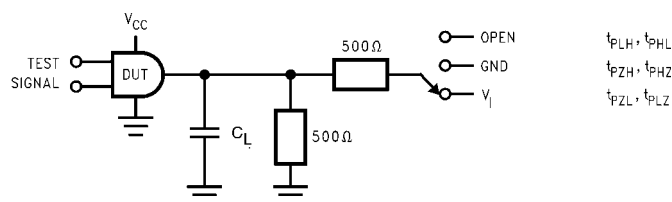
| Symbol    | Parameter                            | Conditions                                                                                           | $V_{CC}$<br>(V) | $T_A = 25^{\circ}\text{C}$ | Units |
|-----------|--------------------------------------|------------------------------------------------------------------------------------------------------|-----------------|----------------------------|-------|
|           |                                      |                                                                                                      |                 | Typical                    |       |
| $V_{OLP}$ | Quiet Output Dynamic Peak $V_{OL}$   | $C_L = 50\text{ pF}, V_{IH} = 3.3V, V_{IL} = 0V$<br>$C_L = 30\text{ pF}, V_{IH} = 2.5V, V_{IL} = 0V$ | 3.3<br>2.5      | 0.8<br>0.6                 | V     |
| $V_{OLV}$ | Quiet Output Dynamic Valley $V_{OL}$ | $C_L = 50\text{ pF}, V_{IH} = 3.3V, V_{IL} = 0V$<br>$C_L = 30\text{ pF}, V_{IH} = 2.5V, V_{IL} = 0V$ | 3.3<br>2.5      | -0.8<br>-0.6               | V     |

**Capacitance**

| Symbol    | Parameter                     | Conditions                                                      | Typical | Units |
|-----------|-------------------------------|-----------------------------------------------------------------|---------|-------|
| $C_{IN}$  | Input Capacitance             | $V_{CC} = \text{Open}, V_I = 0V \text{ or } V_{CC}$             | 7       | pF    |
| $C_{OUT}$ | Output Capacitance            | $V_{CC} = 3.3V, V_I = 0V \text{ or } V_{CC}$                    | 8       | pF    |
| $C_{PD}$  | Power Dissipation Capacitance | $V_{CC} = 3.3V, V_I = 0V \text{ or } V_{CC}, f = 10\text{ MHz}$ | 25      | pF    |

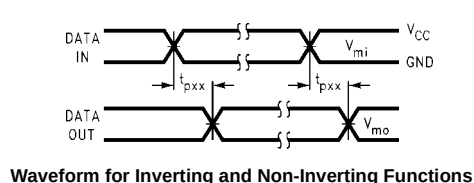
# AC Loading and Waveforms

Generic for LCX Family

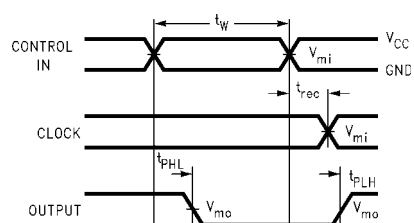


**FIGURE 1. AC Test Circuit**  
( $C_L$  includes probe and jig capacitance)

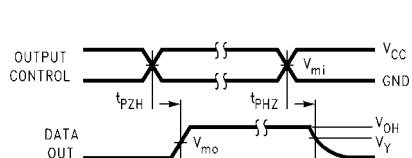
| Test                  | Switch                                                                        |
|-----------------------|-------------------------------------------------------------------------------|
| $t_{PLH}$ , $t_{PHL}$ | Open                                                                          |
| $t_{PZL}$ , $t_{PLZ}$ | 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                                                                           |



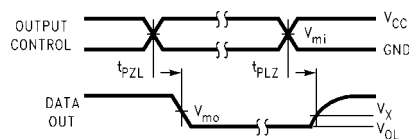
**Waveform for Inverting and Non-Inverting Functions**



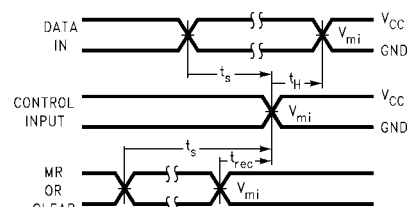
**Propagation Delay, Pulse Width and  $t_{rec}$  Waveforms**



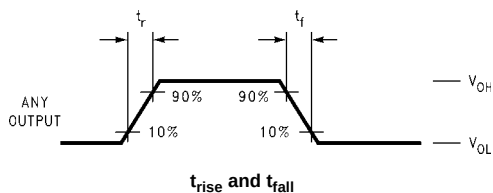
**3-STATE Output High Enable and Disable Times for Logic**



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



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

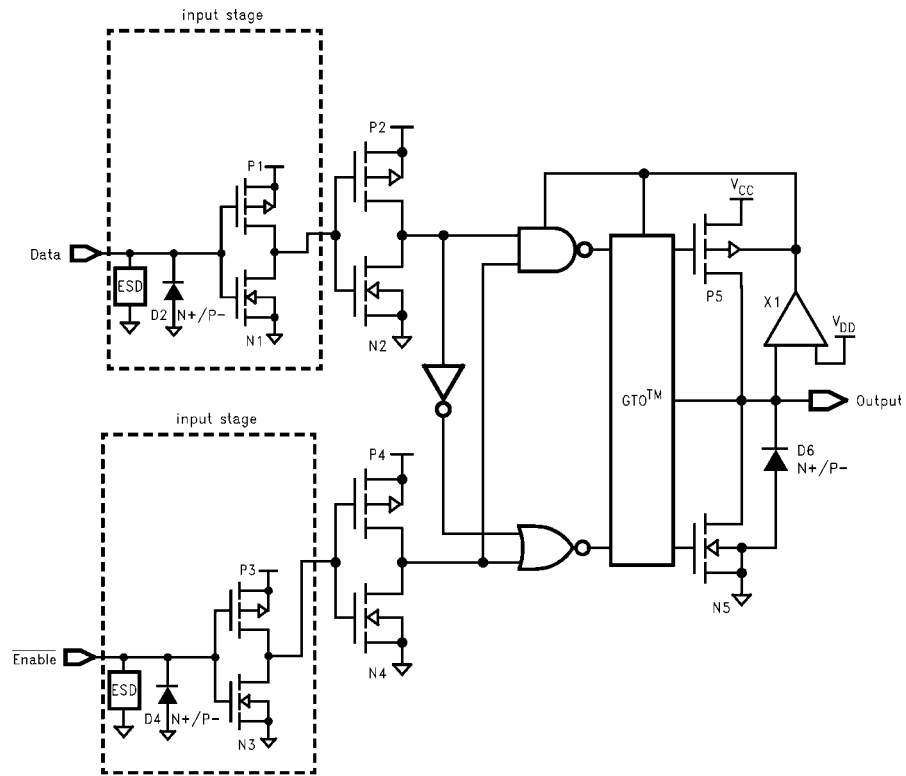


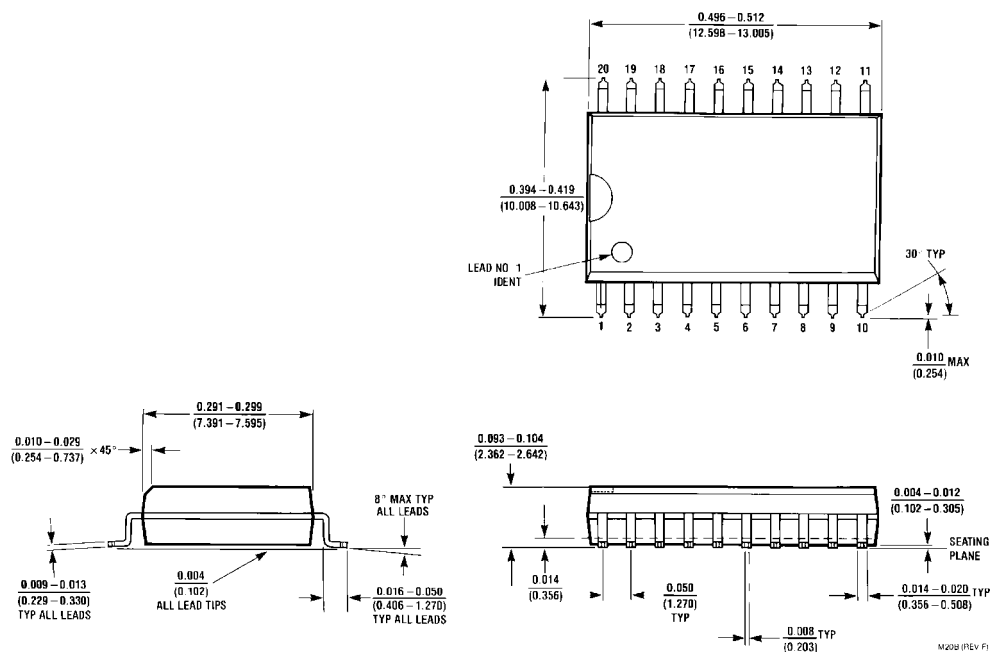
**FIGURE 2. Waveforms**

(Input Pulse Characteristics;  $f = 1\text{MHz}$ ,  $t_r = t_f = 3\text{ns}$ )

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

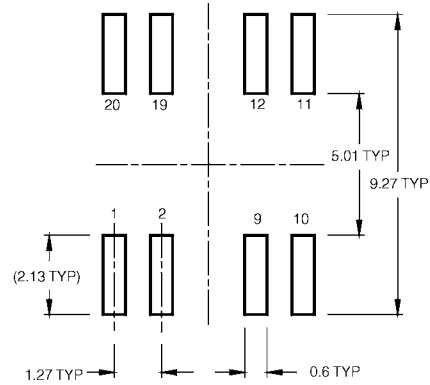
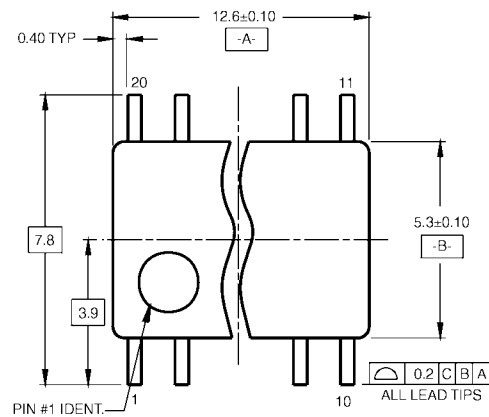
# Schematic Diagram Generic for LCX Family



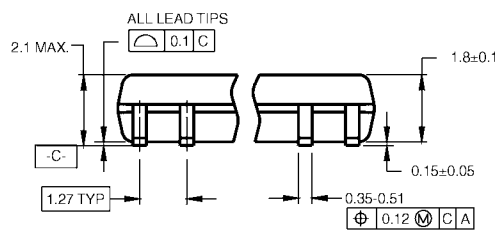
**Physical Dimensions** inches (millimeters) unless otherwise noted


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

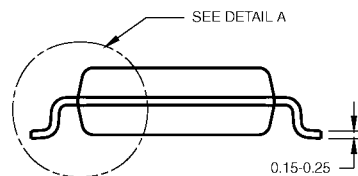
# Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



LAND PATTERN RECOMMENDATION



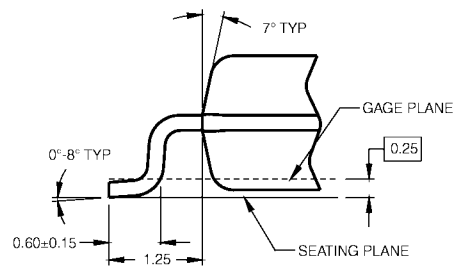
DIMENSIONS ARE IN MILLIMETERS



## 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

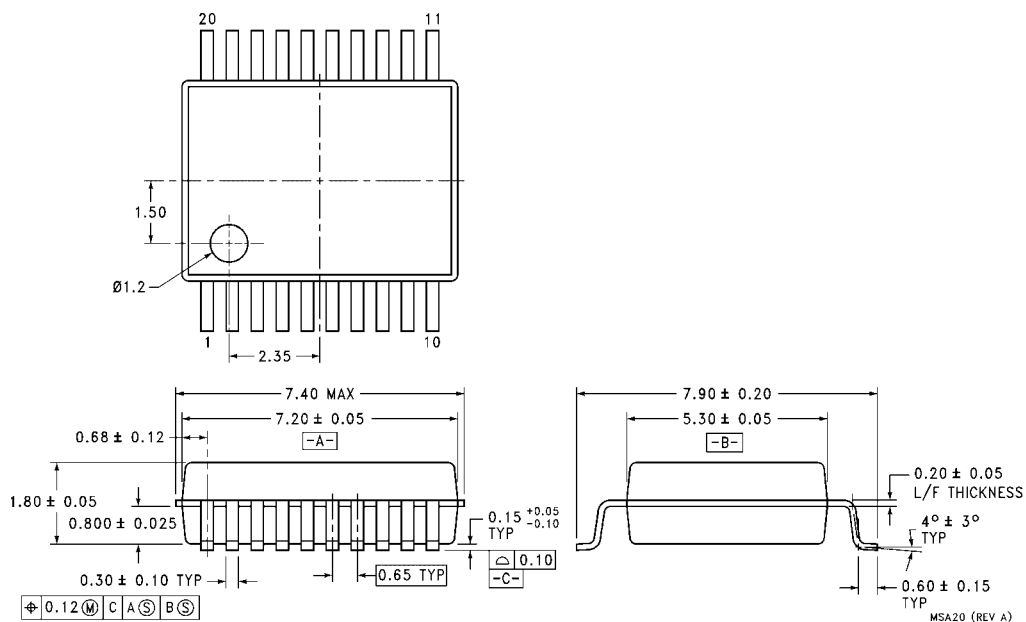


DETAIL A

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

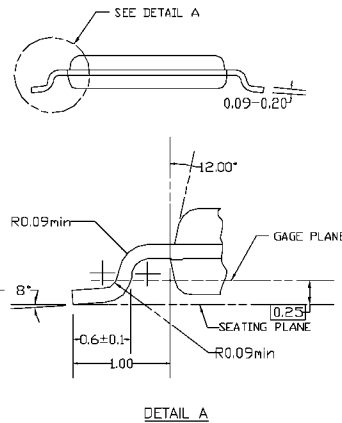
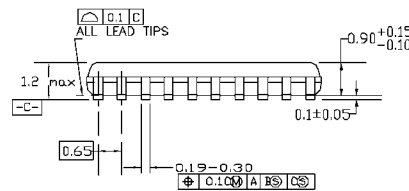
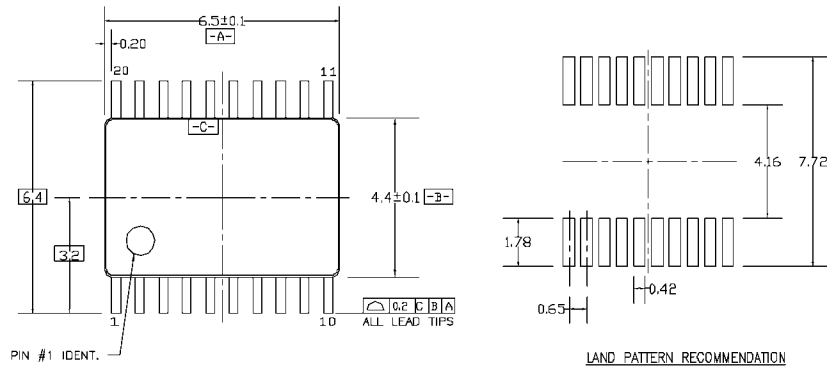


**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



**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:

- CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AG, REF NOTE 6, DATE 7/93.
- DIMENSIONS ARE IN MILLIMETERS.
- DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLDS FLASH, AND TIE BAR EXTRUSIONS.
- 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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