

## 74LCX257

### Low Voltage Quad 2-Input Multiplexer with 5V Tolerant Inputs and Outputs

#### General Description

The LCX257 is a quad 2-input multiplexer with 3-STATE outputs. Four bits of data from two sources can be selected using a Common Data Select input. The four outputs present the selected data in true (non inverted) form. The outputs may be switched to a high impedance state by placing a logic HIGH on the common Output Enable ( $\overline{OE}$ ) input, allowing the outputs to interface directly with bus-oriented systems.

The 74LCX257 is fabricated with 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
- 6.0 ns  $t_{PD}$  max ( $V_{CC} = 3.3V$ ,  $I_n \rightarrow Z_n$ ), 10  $\mu A$   $I_{CC}$  max
- Power down high impedance inputs and outputs
- Supports live insertion/withdrawal (Note 1)
- Implements patented noise/EMI reduction circuitry
- Latch-up performance exceeds 500 mA
- ESD performance:

Human body model > 2000V

Machine model > 200V

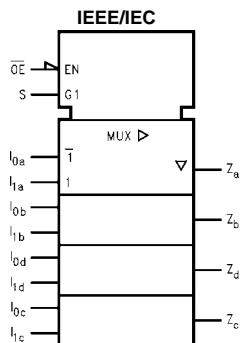
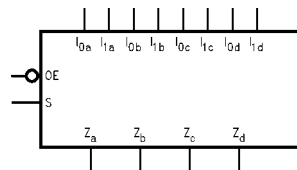
**Note 1:** To ensure the high-impedance state during power up or down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pull-up resistor: the minimum value or the resistor is determined by the current-sourcing capability of the driver.

#### Ordering Code:

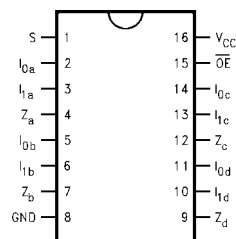
| Order Number | Package Number | Package Description   |
|--------------|----------------|---|
| 74LCX257M    | M16A           | 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow |
| 74LCX257SJ   | M16D           | 16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide               |
| 74LCX257MTC  | MTC16          | 16-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.

#### Logic Symbols



#### Connection Diagram



#### Pin Descriptions

| Pin Names       | Description                 |
|-----------------|-----------------------------|
| S               | Common Data Select Input    |
| $\overline{OE}$ | 3-STATE Output Enable Input |
| $I_{0a}-I_{0d}$ | Data Inputs from Source 0   |
| $I_{1a}-I_{1d}$ | Data Inputs from Source 1   |
| $Z_a-Z_d$       | 3-STATE Multiplexer Outputs |

## Functional Description

The LCX257 is a quad 2-input multiplexer with 3-STATE outputs. It selects four bits of data from two sources under control of a Common Data Select input. When the Select input is LOW, the  $I_{0x}$  inputs are selected and when Select is HIGH, the  $I_{1x}$  inputs are selected. The data on the selected inputs appears at the outputs in true (non inverted) form. The device is the logic implementation of a 4-pole, 2-position switch where the position of the switch is determined by the logic levels supplied to the Select input. The logic equations for the outputs are shown below:

$$Z_a = \overline{OE} \cdot (1_{1a} \cdot S + I_{0a} \cdot \overline{S})$$

$$Z_b = \overline{OE} \cdot (1_{1b} \cdot S + I_{0b} \cdot \overline{S})$$

$$Z_c = \overline{OE} \cdot (1_{1c} \cdot S + I_{0c} \cdot \overline{S})$$

$$Z_d = \overline{OE} \cdot (1_{1d} \cdot S + I_{0d} \cdot \overline{S})$$

When the Output Enable ( $\overline{OE}$ ) is HIGH, the outputs are forced to a high impedance state. If the outputs are tied together, all but one device must be in the high impedance state to avoid high currents that would exceed the maximum ratings. Designers should ensure the Output Enable signals to 3-STATE devices whose outputs are tied together are designed so there is no overlap.

## Truth Table

| Output Enable   | Select Input | Data Inputs |       | Outputs |
|-----------------|--------------|-------------|-------|---------|
| $\overline{OE}$ | S            | $I_0$       | $I_1$ | Z       |
| H               | X            | X           | X     | Z       |
| L               | H            | X           | L     | L       |
| L               | H            | X           | H     | H       |
| L               | L            | L           | X     | L       |
| L               | L            | H           | X     | H       |

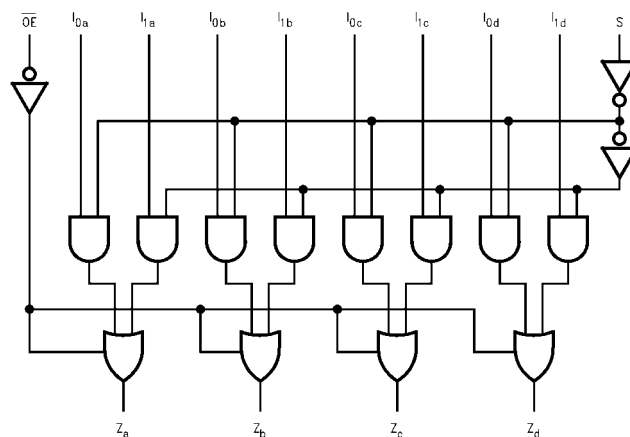
H = HIGH Voltage Level

L = LOW Voltage Level

X = Immaterial

Z = High Impedance

## 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 <sup>(Note 1)</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<br>−0.5 to V <sub>CC</sub> + 0.5 | Output in 3-STATE<br>Output in HIGH or LOW State (Note 2) | 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 <sup>(Note 4)</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 2:** 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 3:** I<sub>O</sub> Absolute Maximum rating must be observed.

**Note 4:** 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 5) | 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 5: 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> = 2.5V ± 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   | 7.0 | 1.5                    | 8.5 | 1.5                           | 9.1 | ns    |
| t <sub>PLH</sub>  | S→Z <sub>n</sub>               | 1.5   | 7.0 | 1.5                    | 8.5 | 1.5                           | 9.1 |       |
| t <sub>PHL</sub>  | Propagation Delay              | 1.5   | 6.0 | 1.5                    | 6.5 | 1.5                           | 7.2 | ns    |
| t <sub>PLH</sub>  | I <sub>n</sub> →Z <sub>n</sub> | 1.5   | 6.0 | 1.5                    | 6.5 | 1.5                           | 7.2 |       |
| t <sub>PZL</sub>  | Output Enable Time             | 1.5   | 7.0 | 1.5                    | 8.5 | 1.5                           | 9.1 | ns    |
| t <sub>PZH</sub>  | OE→Z <sub>n</sub>              | 1.5   | 7.0 | 1.5                    | 8.5 | 1.5                           | 9.1 |       |
| t <sub>PLZ</sub>  | Output Disable Time            | 1.5   | 5.5 | 1.5                    | 6.0 | 1.5                           | 6.6 | ns    |
| t <sub>PHZ</sub>  | OE→Z <sub>n</sub>              | 1.5   | 5.5 | 1.5                    | 6.0 | 1.5                           | 6.6 |       |
| t <sub>OSHL</sub> | Output to Output Skew (Note 6) |   | 1.0 |                        |     |                               |     | ns    |
| t <sub>OSLH</sub> |                                |   | 1.0 |                        |     |                               |     |       |

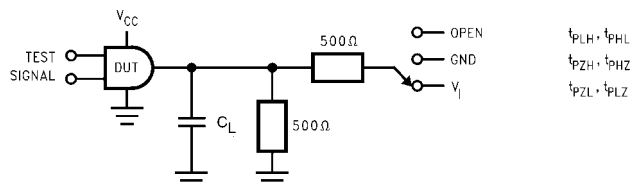
Note 6: Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t<sub>OSHL</sub>) or LOW-to-HIGH (t<sub>OSLH</sub>).

## Dynamic Switching Characteristics

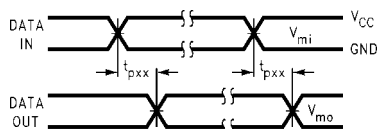
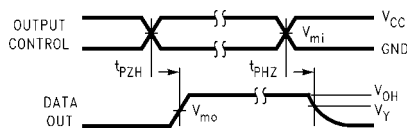
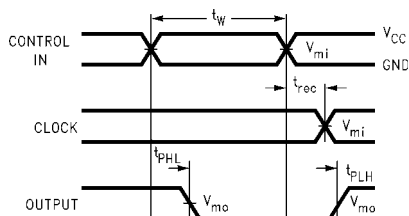
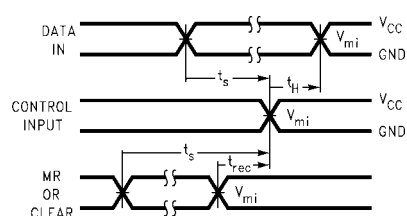
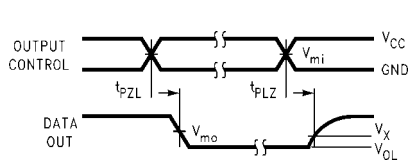
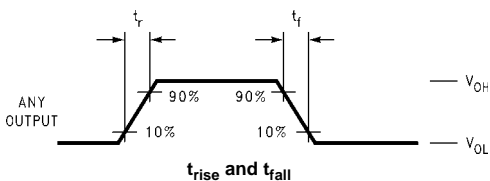
| Symbol           | Parameter                                   | Conditions   | V <sub>CC</sub><br>(V) | T <sub>A</sub> = 25°C | Units |
|------------------|---|--|------------------------|-----------------------|-------|
|                  |   |  |                        | Typical               |       |
| 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    |

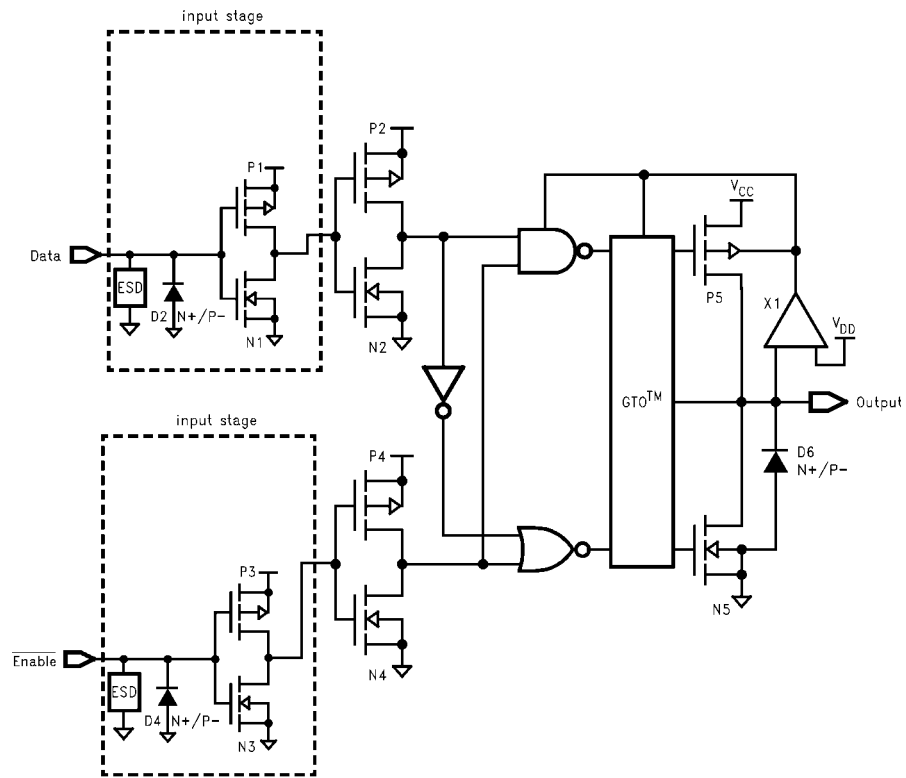
**AC LOADING and WAVEFORMS** Generic for LCX Family**FIGURE 1. AC Test Circuit ( $C_L$  includes probe and jig capacitance)**

| 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   |

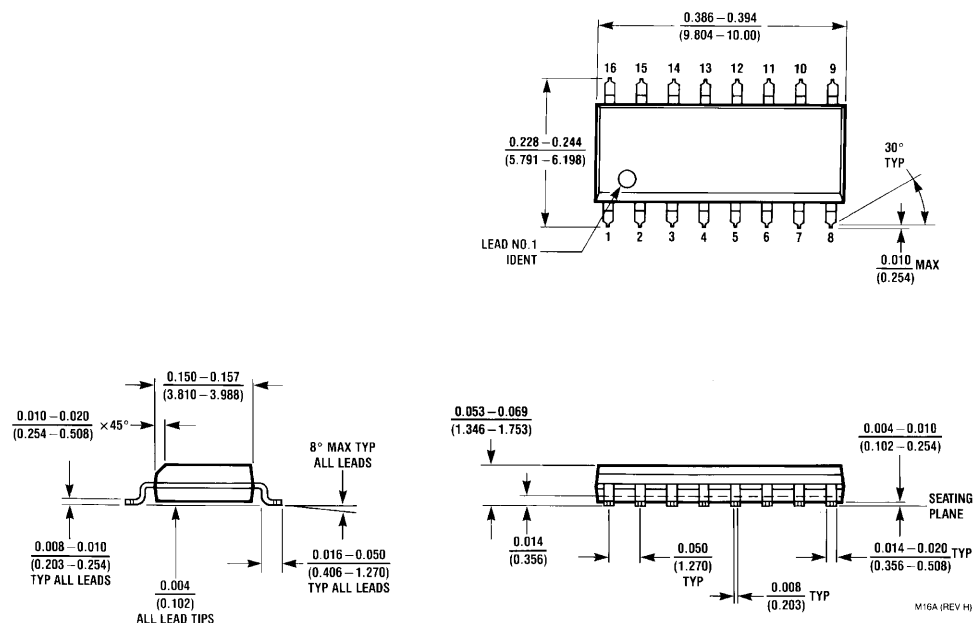
**Waveform for Inverting and Non-Inverting Functions****3-STATE Output High Enable and Disable Times for Logic****Propagation Delay, Pulse Width and  $t_{rec}$  Waveforms****Setup Time, Hold Time and Recovery Time for Logic****3-STATE Output Low Enable and Disable Times for Logic****FIGURE 2. Waveforms**  
(Input Characteristics;  $f = 1\text{MHz}$ ,  $t_R = t_F = 3\text{ns}$ )

| 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

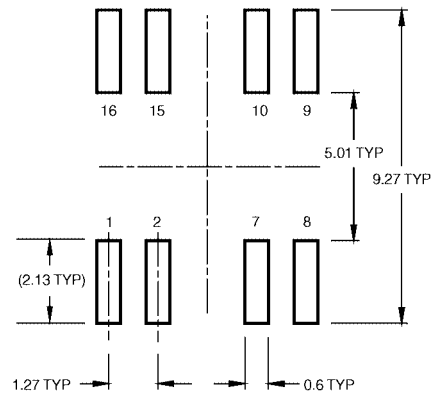
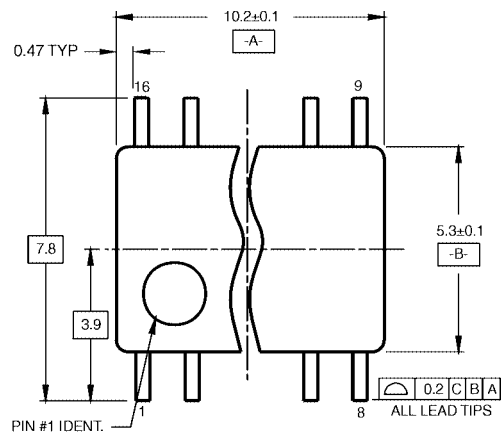


**Physical Dimensions** inches (millimeters) unless otherwise noted

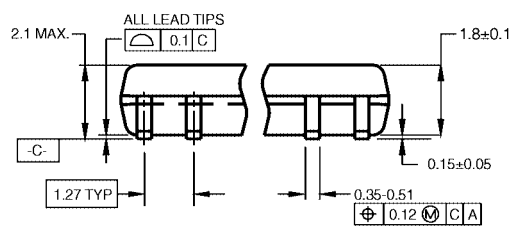


**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow  
Package Number M16A**

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



LAND PATTERN RECOMMENDATION

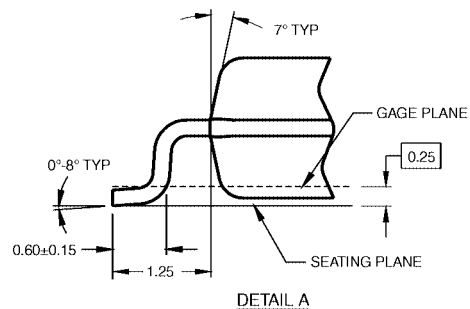
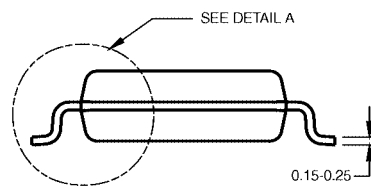


DIMENSIONS ARE IN MILLIMETERS

## 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.

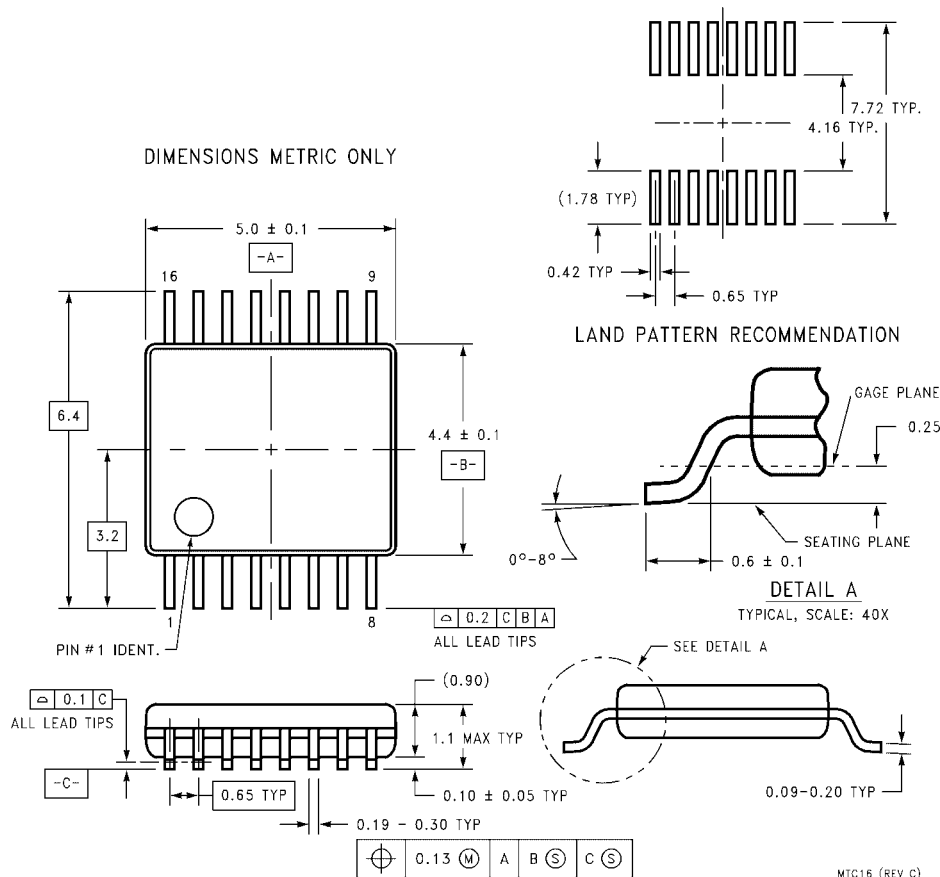
M16DRevB1



16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide  
Package Number M16D



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



**16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  
Package Number MTC16**

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