

# 74LCX02

## Low Voltage Quad 2-Input NOR Gate with 5V Tolerant Inputs

### Features

- 5V tolerant inputs
- 2.3V–3.6V  $V_{CC}$  specifications provided
- 5.2ns  $t_{PD}$  max. ( $V_{CC} = 3.3V$ ), 10 $\mu$ A  $I_{CC}$  max.
- Power down high impedance inputs and outputs
- $\pm 24mA$  output drive ( $V_{CC} = 3.0V$ )
- Implements proprietary noise/EMI reduction circuitry
- Latch-up performance exceeds 500mA
- ESD performance:
  - Human body model > 2000V
  - Machine model > 200V

### General Description

The LCX02 contains four 2-input NOR gates. The inputs tolerate voltages up to 7V allowing the interface of 5V systems to 3V systems.

The 74LCX02 is fabricated with advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

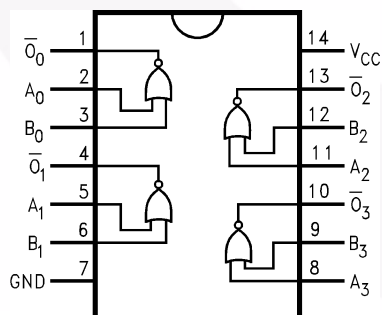
### Ordering Information

| Order Number | Package Number | Package Description                                                          |
|--------------|----------------|------------------------------------------------------------------------------|
| 74LCX02M     | M14A           | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow |
| 74LCX02SJ    | M14D           | 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide                |
| 74LCX02MTC   | MTC14          | 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  |

Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering number.

 All packages are lead free per JEDEC: J-STD-020B standard.

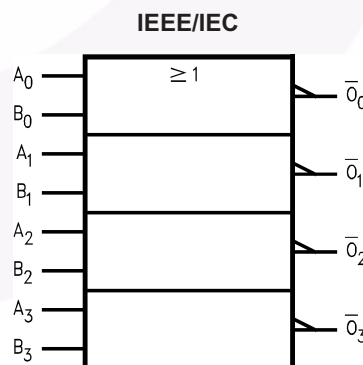
### Connection Diagram



### Pin Description

| Pin Names   | Description |
|-------------|-------------|
| $A_n, B_n$  | Inputs      |
| $\bar{O}_n$ | Outputs     |

### Logic Symbol



## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

| Symbol    | Parameter                                                     | Rating                   |
|-----------|---------------------------------------------------------------|--------------------------|
| $V_{CC}$  | Supply Voltage                                                | −0.5V to +7.0V           |
| $V_I$     | DC Input Voltage                                              | −0.5V to +7.0V           |
| $V_O$     | DC Output Voltage, Output in HIGH or LOW State <sup>(1)</sup> | −0.5V to $V_{CC} + 0.5V$ |
| $I_{IK}$  | DC Input Diode Current, $V_I < GND$                           | −50mA                    |
| $I_{OK}$  | DC Output Diode Current<br>$V_O < GND$                        | −50mA                    |
|           | $V_O > V_{CC}$                                                | +50mA                    |
| $I_O$     | DC Output Source/Sink Current                                 | ±50mA                    |
| $I_{CC}$  | DC Supply Current per Supply Pin                              | ±100mA                   |
| $I_{GND}$ | DC Ground Current per Ground Pin                              | ±100mA                   |
| $T_{STG}$ | Storage Temperature                                           | −65°C to +150°C          |

**Note:**

1.  $I_O$  Absolute Maximum Rating must be observed.

## Recommended Operating Conditions<sup>(2)</sup>

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

| Symbol                | Parameter                                               | Min. | Max.     | Units |
|-----------------------|---------------------------------------------------------|------|----------|-------|
| $V_{CC}$              | Supply Voltage<br>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     |
| $I_{OH} / I_{OL}$     | Output Current<br>$V_{CC} = 3.0V-3.6V$                  |      | ±24      | mA    |
|                       | $V_{CC} = 2.7V-3.0V$                                    |      | ±12      |       |
|                       | $V_{CC} = 2.3V-2.7V$                                    |      | ±8       |       |
| $T_A$                 | Free-Air Operating Temperature                          | −40  | 85       | °C    |
| $\Delta t / \Delta V$ | Input Edge Rate, $V_{IN} = 0.8V-2.0V$ , $V_{CC} = 3.0V$ | 0    | 10       | ns/V  |

**Note:**

2. Unused inputs must be held HIGH or LOW. They may not float.

## DC Electrical Characteristics

| Symbol           | Parameter                             | V <sub>CC</sub> (V) | Conditions                               | 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             | 2.3–3.6             | I <sub>OH</sub> = -100μA                 | V <sub>CC</sub> - 0.2           |      | V     |
|                  |                                       | 2.3                 | I <sub>OH</sub> = -8mA                   | 1.8                             |      |       |
|                  |                                       | 2.7                 | I <sub>OH</sub> = -12mA                  | 2.2                             |      |       |
|                  |                                       | 3.0                 | I <sub>OH</sub> = -18mA                  | 2.4                             |      |       |
|                  |                                       |                     | I <sub>OH</sub> = -24mA                  | 2.2                             |      |       |
| V <sub>OL</sub>  | LOW Level Output Voltage              | 2.3–3.6             | I <sub>OL</sub> = 100μA                  |                                 | 0.2  | V     |
|                  |                                       | 2.3                 | I <sub>OL</sub> = 8mA                    |                                 | 0.6  |       |
|                  |                                       | 2.7                 | I <sub>OL</sub> = 12mA                   |                                 | 0.4  |       |
|                  |                                       | 3.0                 | I <sub>OL</sub> = 16mA                   |                                 | 0.4  |       |
|                  |                                       |                     | I <sub>OL</sub> = 24mA                   |                                 | 0.55 |       |
| I <sub>I</sub>   | Input Leakage Current                 | 2.3–3.6             | 0 ≤ V <sub>I</sub> ≤ 5.5V                |                                 | ±5.0 | μA    |
| I <sub>OFF</sub> | Power-Off Leakage Current             | 0                   | V <sub>I</sub> or V <sub>O</sub> = 5.5V  |                                 | 10   | μA    |
| I <sub>CC</sub>  | Quiescent Supply Current              | 2.3–3.6             | V <sub>I</sub> = V <sub>CC</sub> or GND  |                                 | 10   | μA    |
|                  |                                       |                     | 3.6V ≤ V <sub>I</sub> ≤ 5.5V             |                                 | ±10  |       |
| ΔI <sub>CC</sub> | Increase in I <sub>CC</sub> per Input | 2.3–3.6             | V <sub>IH</sub> = V <sub>CC</sub> - 0.6V |                                 | 500  | μA    |

## 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,<br>C <sub>L</sub> = 50pF |      | V <sub>CC</sub> = 2.7V,<br>C <sub>L</sub> = 50pF |      | V <sub>CC</sub> = 2.5V ± 0.2V,<br>C <sub>L</sub> = 30pF |      |       |
|                                       |                                      | Min.                                                    | Max. | Min.                                             | Max. | Min.                                                    | Max. |       |
| t <sub>PHL</sub> , t <sub>PLH</sub>   | Propagation Delay                    | 1.5                                                     | 5.2  | 1.5                                              | 6.0  | 1.5                                                     | 6.2  | ns    |
| t <sub>OSHL</sub> , t <sub>OSLH</sub> | Output to Output Skew <sup>(3)</sup> |                                                         | 1.0  |                                                  |      |                                                         |      | ns    |

## Note:

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

**Capacitance**

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

# AC Loading and Waveforms (Generic for LCX Family)

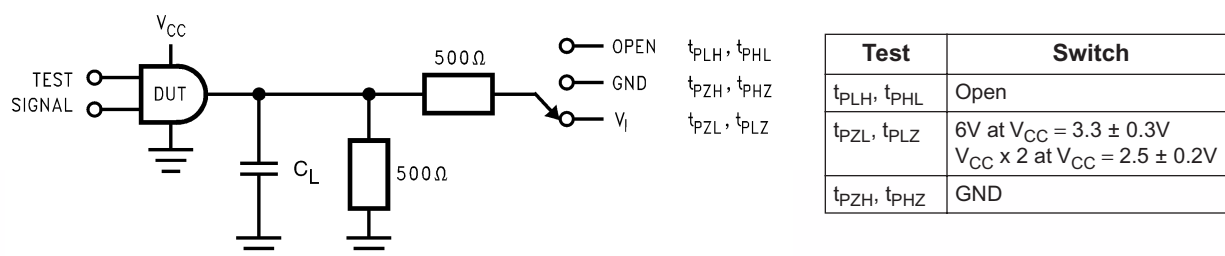
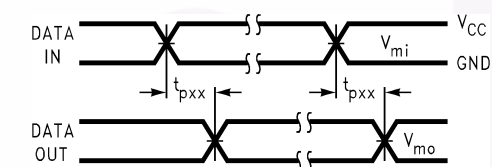
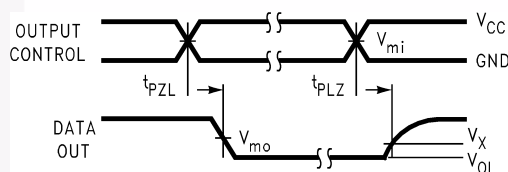


Figure 1. AC Test Circuit ( $C_L$  includes probe and jig capacitance)

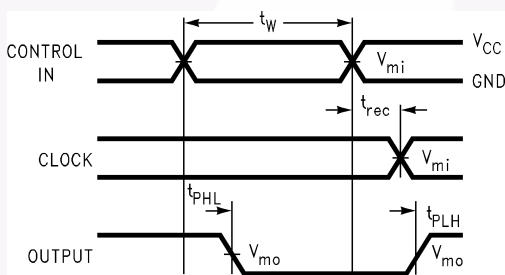
## Waveform for Inverting and Non-Inverting Functions



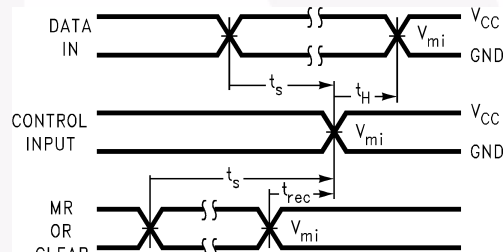
## 3-STATE Output High Enable and Disable Times for Logic



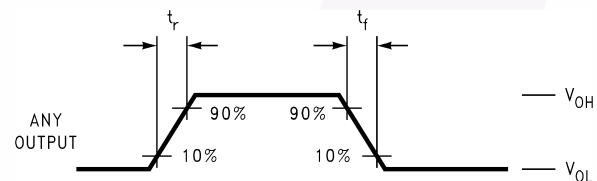
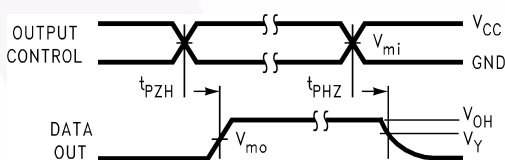
## Propagation Delay, Pulse Width and $t_{rec}$ Waveforms



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



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

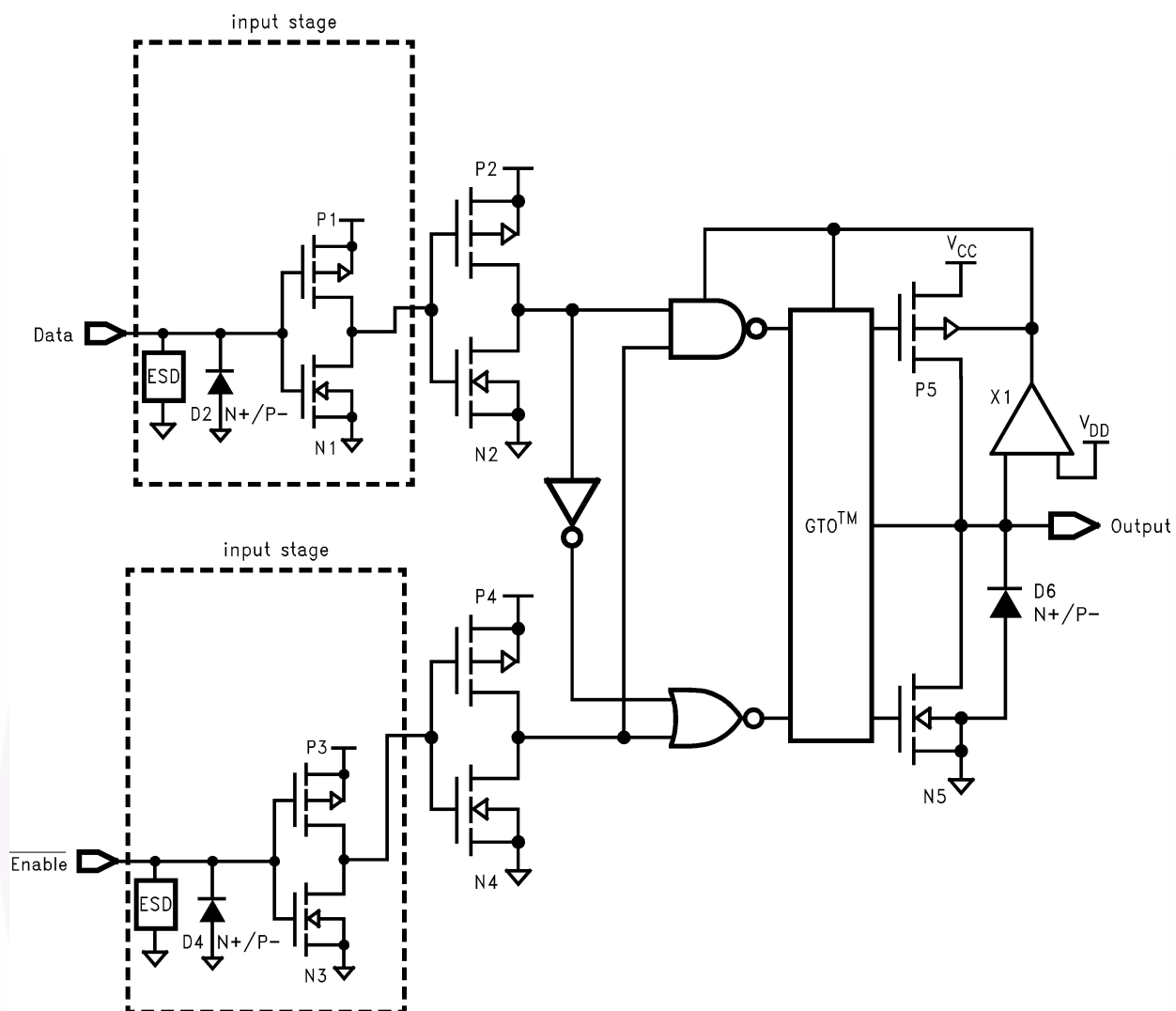


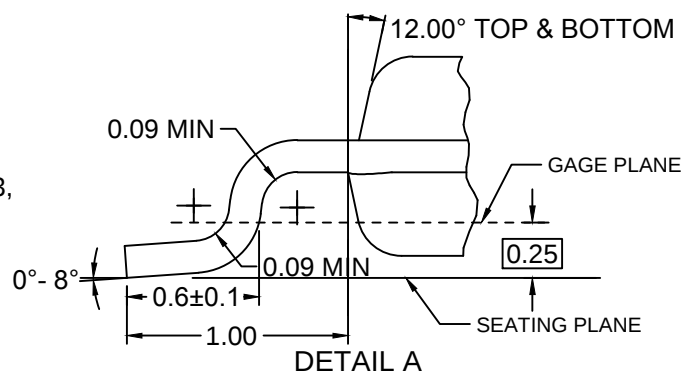
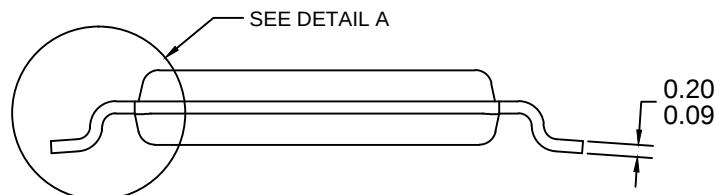
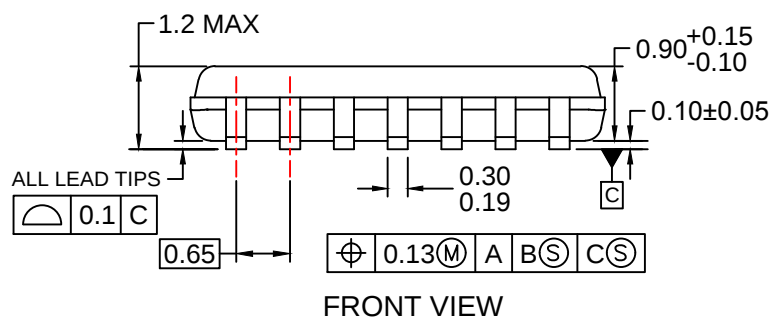
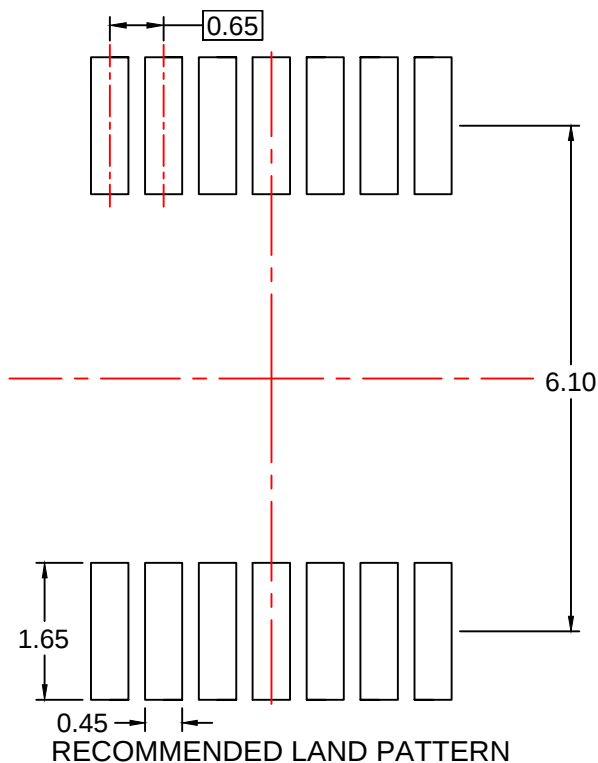
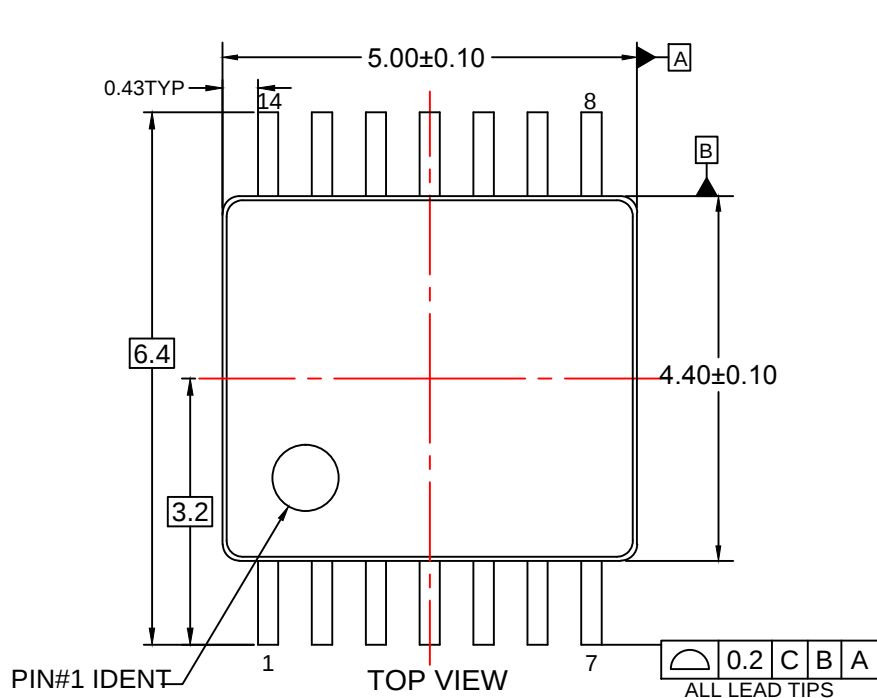
$t_{rise}$  and  $t_{fall}$

| Symbol   | $V_{CC}$        |                 |                  |
|----------|-----------------|-----------------|------------------|
|          | $3.3V \pm 0.3V$ | $2.7V$          | $2.5V \pm 0.2V$  |
| $V_{mi}$ | 1.5V            | 1.5V            | $V_{CC}/2$       |
| $V_{m0}$ | 1.5V            | 1.5V            | $V_{CC}/2$       |
| $V_x$    | $V_{OL} + 0.3V$ | $V_{OL} + 0.3V$ | $V_{OL} + 0.15V$ |
| $V_y$    | $V_{OH} - 0.3V$ | $V_{OH} - 0.3V$ | $V_{OH} - 0.15V$ |

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

**Schematic Diagram** (Generic for LCX Family)

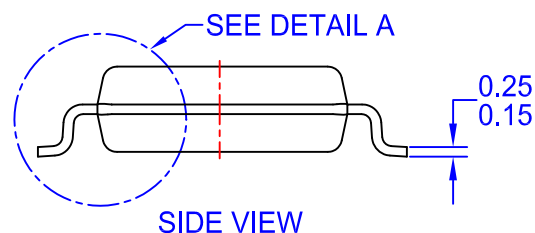
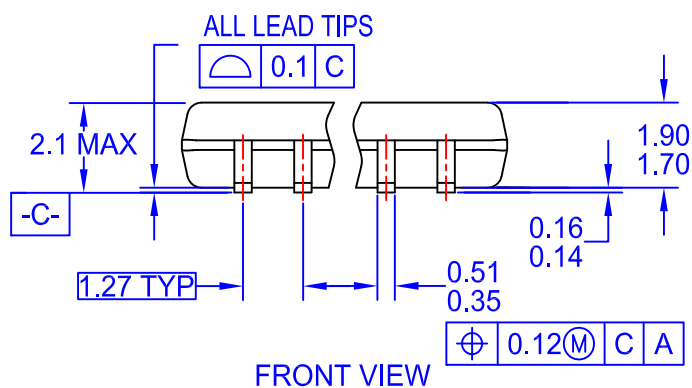
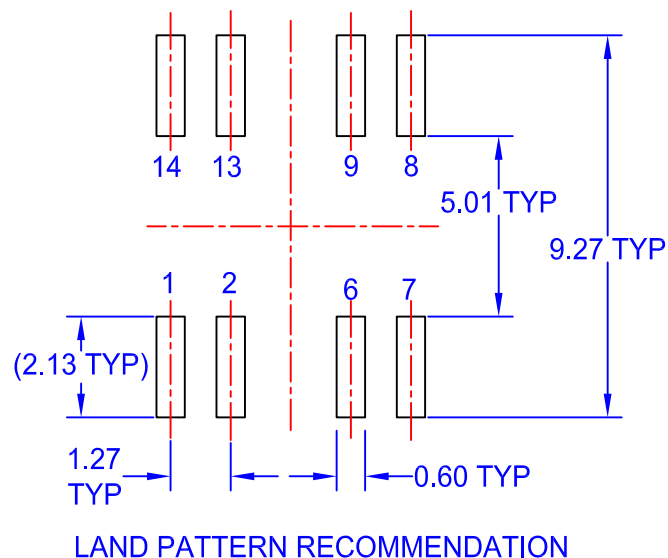
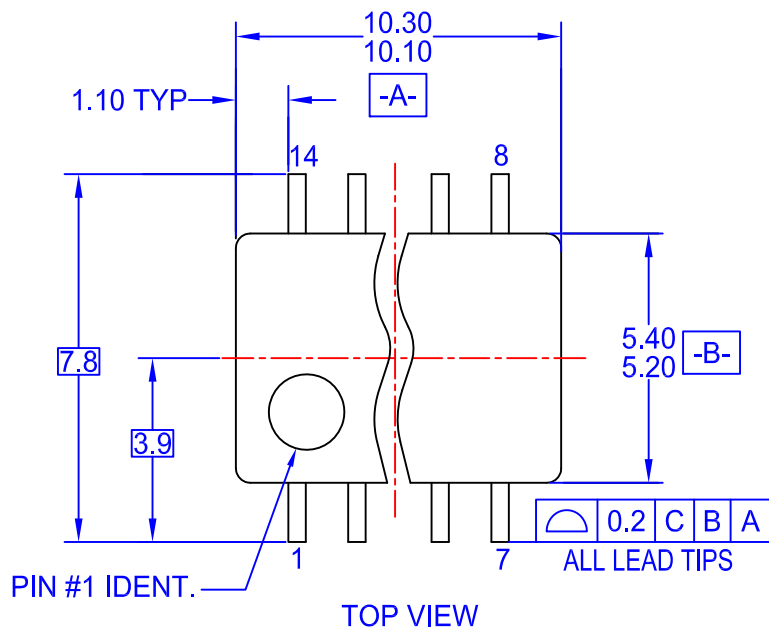




#### NOTES:

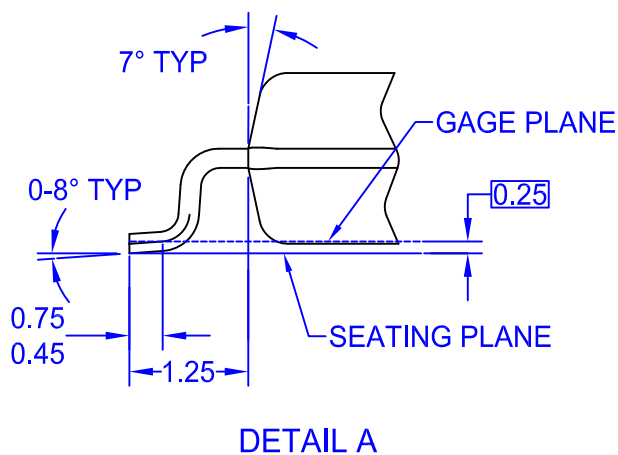
- CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB, REF NOTE 6
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- DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS
- DIMENSIONING AND TOLERANCES PER ANSI Y14.5M, 2009.
- LANDPATTERN STANDARD: SOP65P640X110-14M.
- DRAWING FILE NAME: MKT-MTC14rev7.

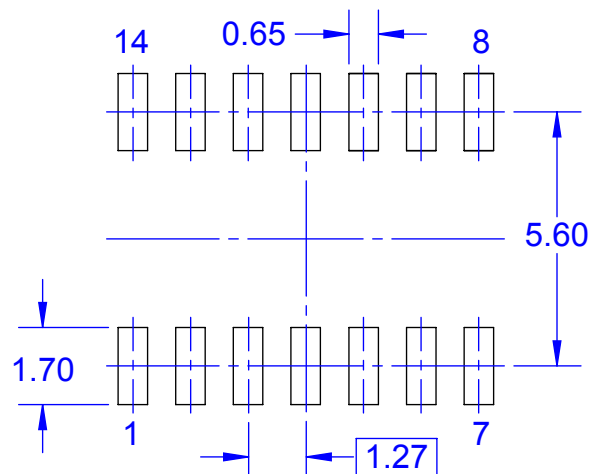
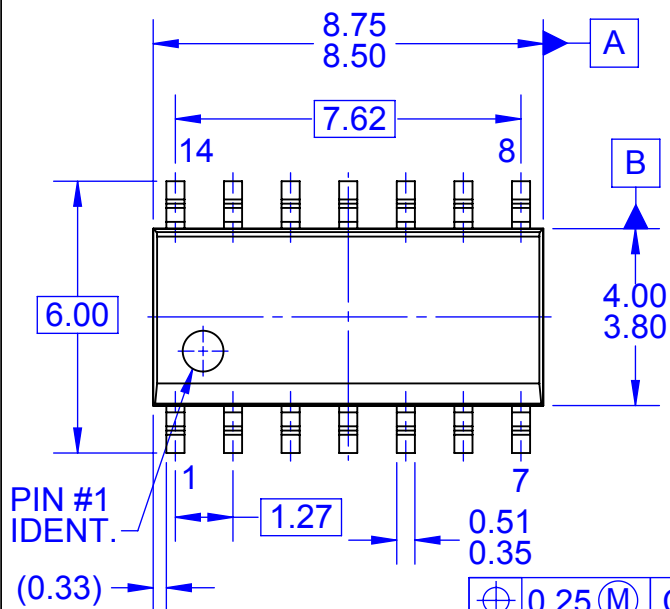




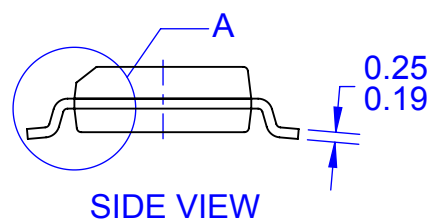
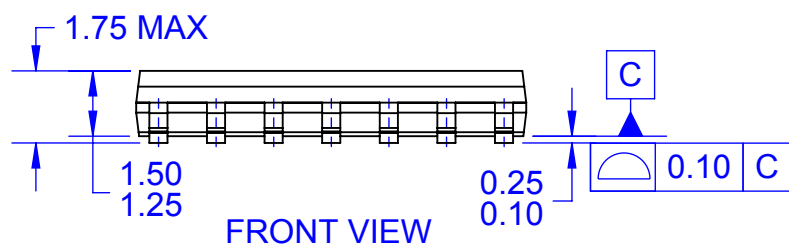
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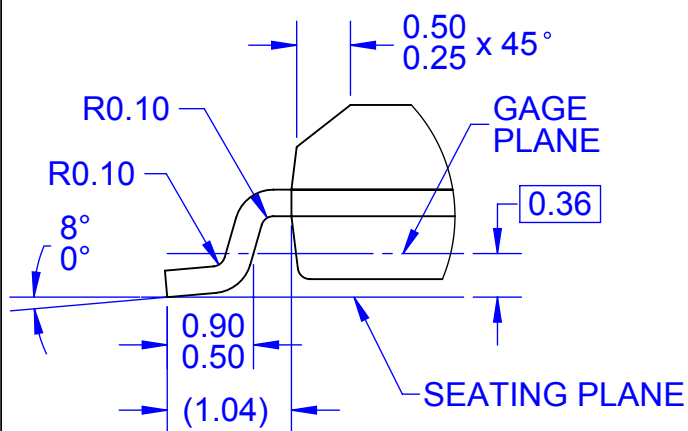
LAND PATTERN RECOMMENDATION



SIDE VIEW

#### NOTES:

- CONFORMS TO JEDEC MS-012, VARIATION AB, ISSUE C
- ALL DIMENSIONS ARE IN MILLIMETERS
- DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS
- LAND PATTERN STANDARD: SOIC127P600X145-14M
- CONFORMS TO ASME Y14.5M, 2009
- DRAWING FILENAME: MKT-M14Arev14



DETAIL A  
SCALE 16 : 1



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