

## 74LCX541

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

#### General Description

The LCX541 is an octal buffer/line driver designed to be employed as memory and address drivers, clock drivers and bus oriented transmitter/receivers. The LCX541 is a non inverting option of the LCX540.

This device is similar in function to the LCX244 while providing flow-through architecture (inputs on opposite side from outputs). This pinout arrangement makes this device especially useful as an output port for microprocessors, allowing ease of layout and greater PC board density.

The LCX541 is designed for low voltage (2.5V or 3.3V)  $V_{CC}$  applications with capability of interfacing to a 5V signal environment. The LCX541 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

#### Features

- 5V tolerant input 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

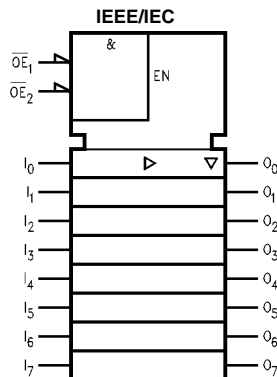
**Note 1:** To ensure the high-impedance state during power up or down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pull-up resistor; the minimum value or the resistor is determined by the current-sourcing capability of the driver.

#### Ordering Code:

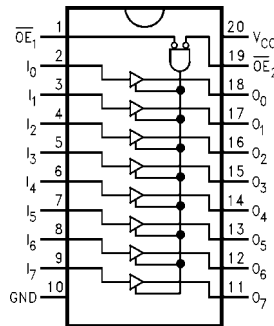
| Order Number | Package Number | Package Description   |
|--------------|----------------|---|
| 74LCX541WWM  | M20B           | 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide  |
| 74LCX541SJ   | M20D           | 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide               |
| 74LCX541MSA  | MSA20          | 20-Lead Shrink Small Outline Package (SSOP), EIAJ TYPE II, 5.3mm Wide       |
| 74LCX541MTC  | MTC20          | 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.

#### Logic Symbol



#### Connection Diagram



## 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 Table

| Inputs            |                   |   | Outputs |
|-------------------|-------------------|---|---------|
| $\overline{OE}_1$ | $\overline{OE}_2$ | I | $O_n$   |
| L                 | L                 | H | H       |
| H                 | X                 | X | Z       |
| X                 | H                 | X | Z       |
| L                 | L                 | L | L       |

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

| Absolute Maximum Ratings <sup>(Note 2)</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 3) | 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 4) |  |                               |     |                 |    |
|---|--|-------------------------------|-----|-----------------|----|
| 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 |     | ±24             | mA |
|   |  | V <sub>CC</sub> = 2.7V – 3.0V |     | ±12             |    |
|   |  | V <sub>CC</sub> = 2.3V – 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–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 or I/O's 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                | 0                      |                                 | 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 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    |

**DC Electrical Characteristics** (Continued)

Note 5: Outputs disabled or 3-STATE only.

**AC Electrical Characteristics**

| Symbol     | Parameter                      | $T_A = -40^\circ\text{C to } +85^\circ\text{C}, R_L = 500\Omega$ |     |                      |     |                          |      | Units |
|------------|--------------------------------|--|-----|----------------------|-----|--------------------------|------|-------|
|            |                                | $V_{CC} = 3.3V \pm 0.3V$   |     | $V_{CC} = 2.7V$      |     | $V_{CC} = 2.5V \pm 0.2V$ |      |       |
|            |                                | $C_L = 50\text{ pF}$   |     | $C_L = 50\text{ pF}$ |     | $C_L = 30\text{ pF}$     |      |       |
|            |                                | Min  | Max | Min                  | Max | Min                      | Max  |       |
| $t_{PHL}$  | Propagation Delay              | 1.5  | 6.5 | 1.5                  | 7.5 | 1.5                      | 7.8  | ns    |
| $t_{PLH}$  |                                | 1.5  | 6.5 | 1.5                  | 7.5 | 1.5                      | 7.8  |       |
| $t_{PZL}$  | Output Enable Time             | 1.5  | 8.5 | 1.5                  | 9.5 | 1.5                      | 10.5 | ns    |
| $t_{PZH}$  |                                | 1.5  | 8.5 | 1.5                  | 9.5 | 1.5                      | 10.5 |       |
| $t_{PLZ}$  | Output Disable Time            | 1.5  | 7.5 | 1.5                  | 8.5 | 1.5                      | 9.0  | ns    |
| $t_{PHZ}$  |                                | 1.5  | 7.5 | 1.5                  | 8.5 | 1.5                      | 9.0  |       |
| $t_{OSHL}$ | Output to Output Skew (Note 6) |  | 1.0 |                      |     |                          |      | ns    |
| $t_{OSLH}$ |                                |  | 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 ( $t_{OSHL}$ ) or LOW-to-HIGH ( $t_{OSLH}$ ).

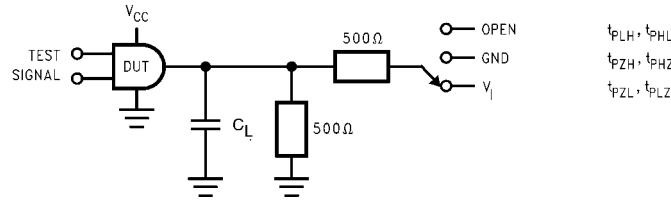
**Dynamic Switching Characteristics**

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

**Capacitance**

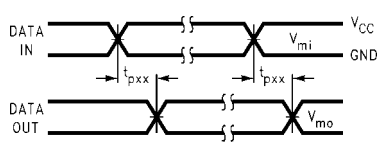
| Symbol    | Parameter                     | Conditions  | Typical | Units |
|-----------|-------------------------------|---|---------|-------|
| $C_{IN}$  | Input Capacitance             | $V_{CC} = \text{Open}, V_I = 0V \text{ or } V_{CC}$             | 7       | pF    |
| $C_{OUT}$ | Output Capacitance            | $V_{CC} = 3.3V, V_I = 0V \text{ or } V_{CC}$                    | 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

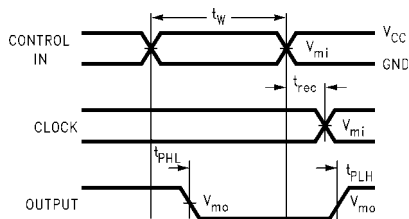


**FIGURE 1. AC Test Circuit**  
 ( $C_L$  includes probe and jig capacitance)

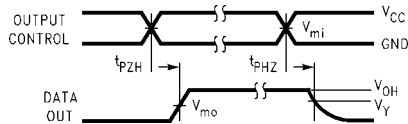
| Test               | Switch  |
|--------------------|---|
| $t_{PLH}, t_{PHL}$ | Open  |
| $t_{PZL}, t_{PLZ}$ | 6V at $V_{CC} = 3.3 \pm 0.3V$<br>$V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$ |
| $t_{PZH}, t_{PHZ}$ | GND   |



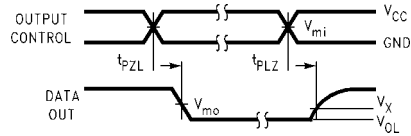
**Waveform for Inverting and Non-Inverting Functions**



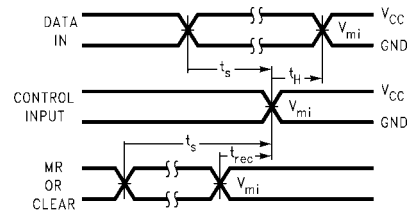
**Propagation Delay, Pulse Width and  $t_{rec}$  Waveforms**



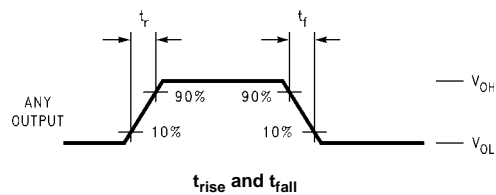
**3-STATE Output High Enable and Disable Times for Logic**



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



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



**FIGURE 2. Waveforms**

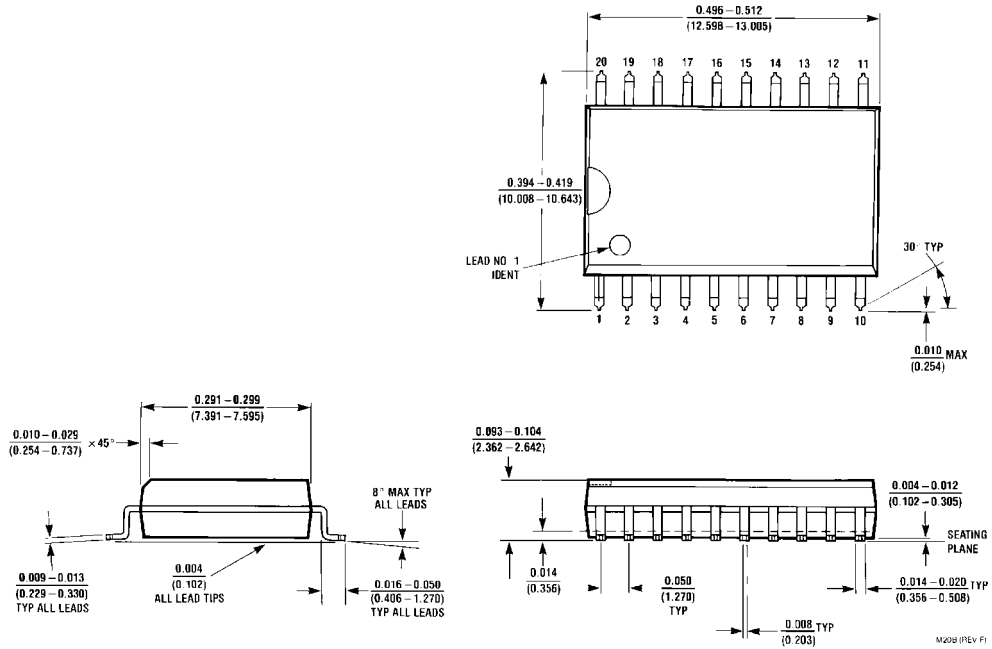
(Input Pulse Characteristics;  $f = 1MHz, t_r = t_f = 3ns$ )

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

**Schematic Diagram** Generic for LCX Family



**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

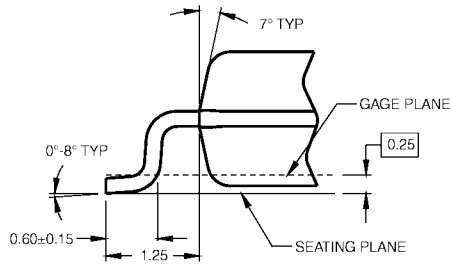


DIMENSIONS ARE IN MILLIMETERS



- NOTES:  
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B. DIMENSIONS ARE IN MILLIMETERS.  
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M20DRevB1

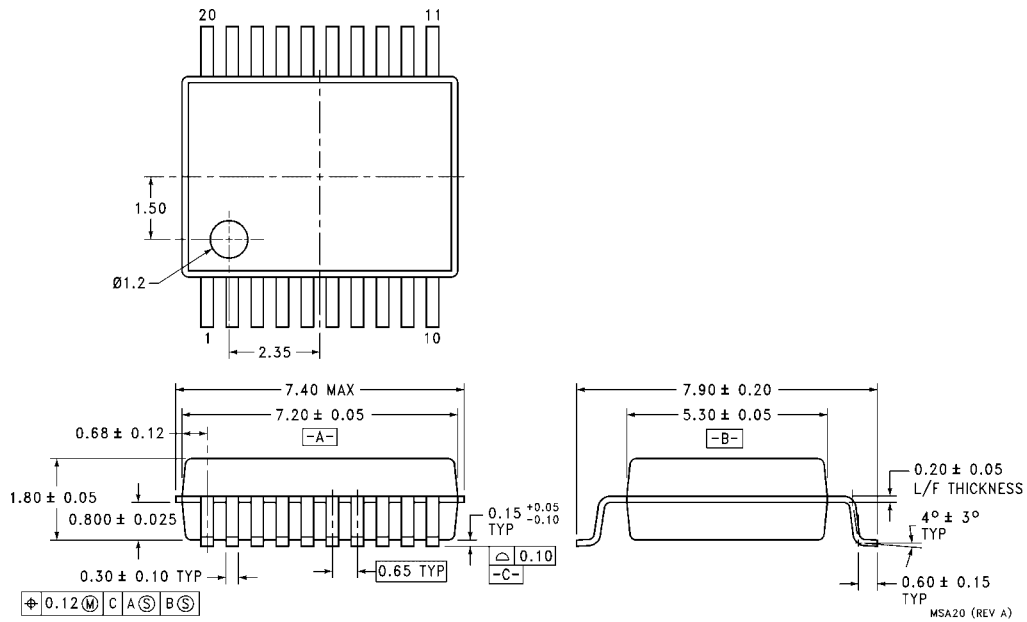


DETAIL A

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



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



### 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.  
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 D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.

MTC20RevD1

**20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  
 Package Number MTC20**

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