

# 74LCX540

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

### Features

- 5V tolerant input and outputs
- 2.3V–3.6V  $V_{CC}$  specifications provided
- 6.5ns  $t_{PD}$  max ( $V_{CC} = 3.3V$ ), 10 $\mu$ A  $I_{CC}$  max
- Power down high impedance inputs and outputs
- Supports live insertion/withdrawal<sup>(1)</sup>
- Implements patented noise/EMI reduction circuitry
- Latch-up performance exceeds JEDEC 78 conditions
- ESD performance
  - Human body model > 2000V
  - Machine model > 200V
- Leadless Pb-Free DQFN package

### General Description

The LCX540 is an octal buffer/line driver designed to be employed as a memory and address driver, clock driver and bus oriented transmitter/receiver.

This device is similar in function to the LCX240 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 LCX540 is designed for low voltage (2.5V or 3.3V)  $V_{CC}$  applications with capability of interfacing to a 5V signal environment. The LCX540 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

### Ordering Information

| Order Number                  | Package Number | Package Description   |
|-------------------------------|----------------|---|
| 74LCX540WM                    | M20B           | 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide                          |
| 74LCX540SJ                    | M20D           | 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide                                       |
| 74LCX540BQX <sup>(2)</sup>    | MLP020B        | Pb-Free 20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm |
| 74LCX540MSA                   | MSA20          | 20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide                               |
| 74LCX540MTC                   | MTC20          | 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide                         |
| 74LCX540MTC_NL <sup>(3)</sup> | MTC20          | Pb-Free 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide                 |

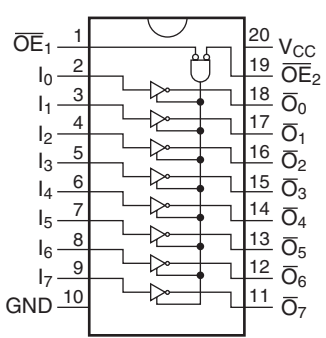
Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code. Pb-Free package per JEDEC J-STD-020B.

#### Notes:

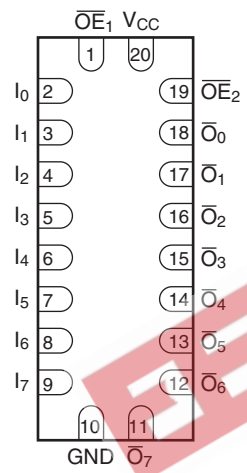
1. To ensure the high impedance state during power up or down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pull-up resistor: the minimum value of the resistor is determined by the current-sourcing capability of the driver.
2. DQFN package available in Tape and Reel only.
3. "\_NL" indicates Pb-Free package (per JEDEC J-STD-020B). Device available in Tape and Reel only.

### Connection Diagrams

**Pin Assignments for SOIC, SOP, SSOP, TSSOP**

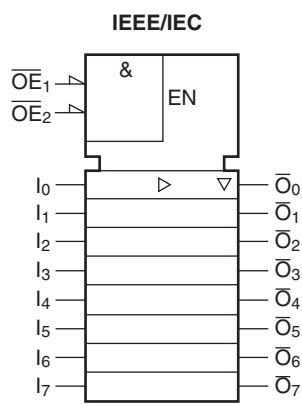


**Pad Assignment for DQFN**



**(Top View)**

### Logic Symbol



### Truth Table

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

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

### 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                      |

## 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                        | Conditions                                 | Value                  | Units |
|-----------|----------------------------------|--|------------------------|-------|
| $V_{CC}$  | Supply Voltage                   |  | -0.5 to +7.0           | V     |
| $V_I$     | DC Input Voltage                 |  | -0.5 to +7.0           | V     |
| $V_O$     | DC Output Voltage                | Output in 3-STATE                          | -0.5 to +7.0           | V     |
|           |                                  | Output in HIGH or LOW State <sup>(4)</sup> | -0.5 to $V_{CC} + 0.5$ |       |
| $I_{IK}$  | DC Input Diode Current           | $V_I < GND$                                | -50                    | mA    |
| $I_{OK}$  | DC Output Diode Current          | $V_O < GND$                                | -50                    | mA    |
|           |                                  | $V_O > V_{CC}$                             | +50                    |       |
| $I_O$     | DC Output Source/Sink Current    |  | $\pm 50$               | mA    |
| $I_{CC}$  | DC Supply Current per Supply Pin |  | $\pm 100$              | mA    |
| $I_{GND}$ | DC Ground Current per Ground Pin |  | $\pm 100$              | mA    |
| $T_{STG}$ | Storage Temperature              |  | -65 to +150            | °C    |

## Recommended Operating Conditions<sup>(5)</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                      | Conditions                            | Min. | Max.     | Units |
|---------------------|--------------------------------|---------------------------------------|------|----------|-------|
| $V_{CC}$            | Supply Voltage                 | 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     |
|                     |                                | 3-STATE                               | 0    | 5.5      |       |
| $I_{OH}/I_{OL}$     | Output Current                 | $V_{CC} = 3.0V - 3.6V$                |      | $\pm 24$ | mA    |
|                     |                                | $V_{CC} = 2.7V - 3.0V$                |      | $\pm 12$ |       |
|                     |                                | $V_{CC} = 2.3V - 2.7V$                |      | $\pm 8$  |       |
| $T_A$               | 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  |

### Notes:

- $I_O$  Absolute Maximum Rating must be observed.
- 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> (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> = -8mA  | 2.3                 | 1.8                             |      |       |
|                  |                                       | I <sub>OH</sub> = -12mA   | 2.7                 | 2.2                             |      |       |
|                  |                                       | I <sub>OH</sub> = -18mA   | 3.0                 | 2.4                             |      |       |
|                  |                                       | I <sub>OH</sub> = -24mA   | 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> = 12mA  | 2.7                 |                                 | 0.4  |       |
|                  |                                       | I <sub>OL</sub> = 16mA  | 3.0                 |                                 | 0.4  |       |
|                  |                                       | I <sub>OL</sub> = 24mA  | 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 Voltage                | 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    |
| 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 <sup>(6)</sup>                      | 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    |

### 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> = 50pF                                  |      | C <sub>L</sub> = 50pF  |      | C <sub>L</sub> = 30pF         |      |       |
|                                       |                                      | Min.   | Max. | Min.                   | Max. | Min.                          | Max. |       |
| t <sub>PHL</sub> , t <sub>PLH</sub>   | Propagation Delay                    | 1.5  | 6.5  | 1.5                    | 7.5  | 1.5                           | 7.8  | ns    |
| t <sub>PZL</sub> , t <sub>PZH</sub>   | Output Enable Time                   | 1.5  | 8.5  | 1.5                    | 9.5  | 1.5                           | 10.5 | ns    |
| t <sub>PLZ</sub> , t <sub>PHZ</sub>   | Output Disable Time                  | 1.5  | 7.5  | 1.5                    | 8.5  | 1.5                           | 9.0  | ns    |
| t <sub>OSSL</sub> , t <sub>OSLH</sub> | Output to Output Skew <sup>(7)</sup> |  | 1.0  |                        |      |                               |      | ns    |

#### Notes:

- Outputs disabled or 3-STATE only.
- 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 |       |
|------------------|---|---|------------------------|-----------------------|-------|
|                  |   |   |                        | Typical               | Units |
| V <sub>OLP</sub> | Quiet Output Dynamic Peak V <sub>OL</sub>   | C <sub>L</sub> = 50pF, V <sub>IH</sub> = 3.3V, V <sub>IL</sub> = 0V | 3.3                    | 0.8                   | V     |
|                  |   | C <sub>L</sub> = 30pF, 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> = 50pF, V <sub>IH</sub> = 3.3V, V <sub>IL</sub> = 0V | 3.3                    | -0.8                  | V     |
|                  |   | C <sub>L</sub> = 30pF, 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    |

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### AC Loading and Waveforms (Generic for LCX Family)

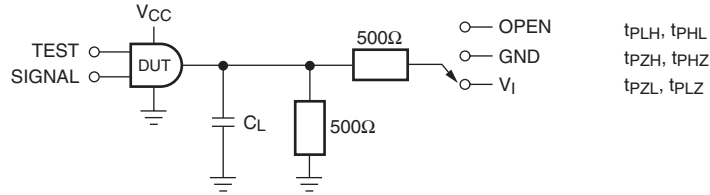
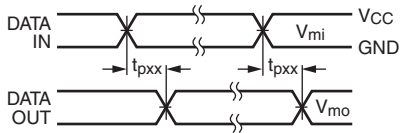
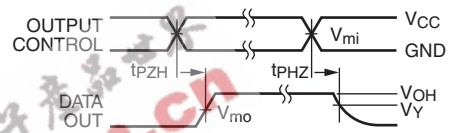


Figure 1. AC Test Circuit ( $C_L$  includes probe and jig capacitance)

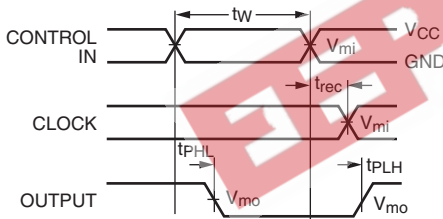
| Test                  | Switch  |
|-----------------------|---|
| $t_{PLH}$ , $t_{PHL}$ | Open  |
| $t_{PZL}$ , $t_{PLZ}$ | 6V at $V_{CC} = 3.3 \pm 0.3V$<br>$V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$ |
| $t_{PZH}$ , $t_{PHZ}$ | GND   |



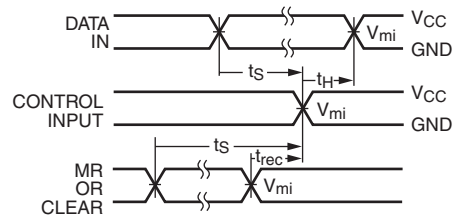
Waveform for Inverting and Non-Inverting Functions



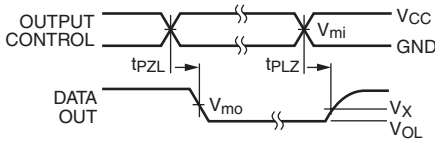
3-STATE Output High Enable and Disable Times for Logic



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

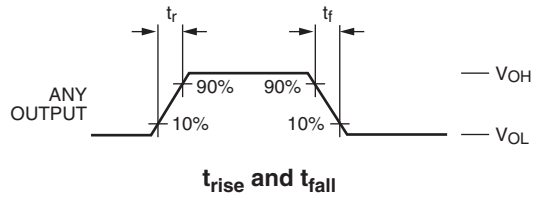
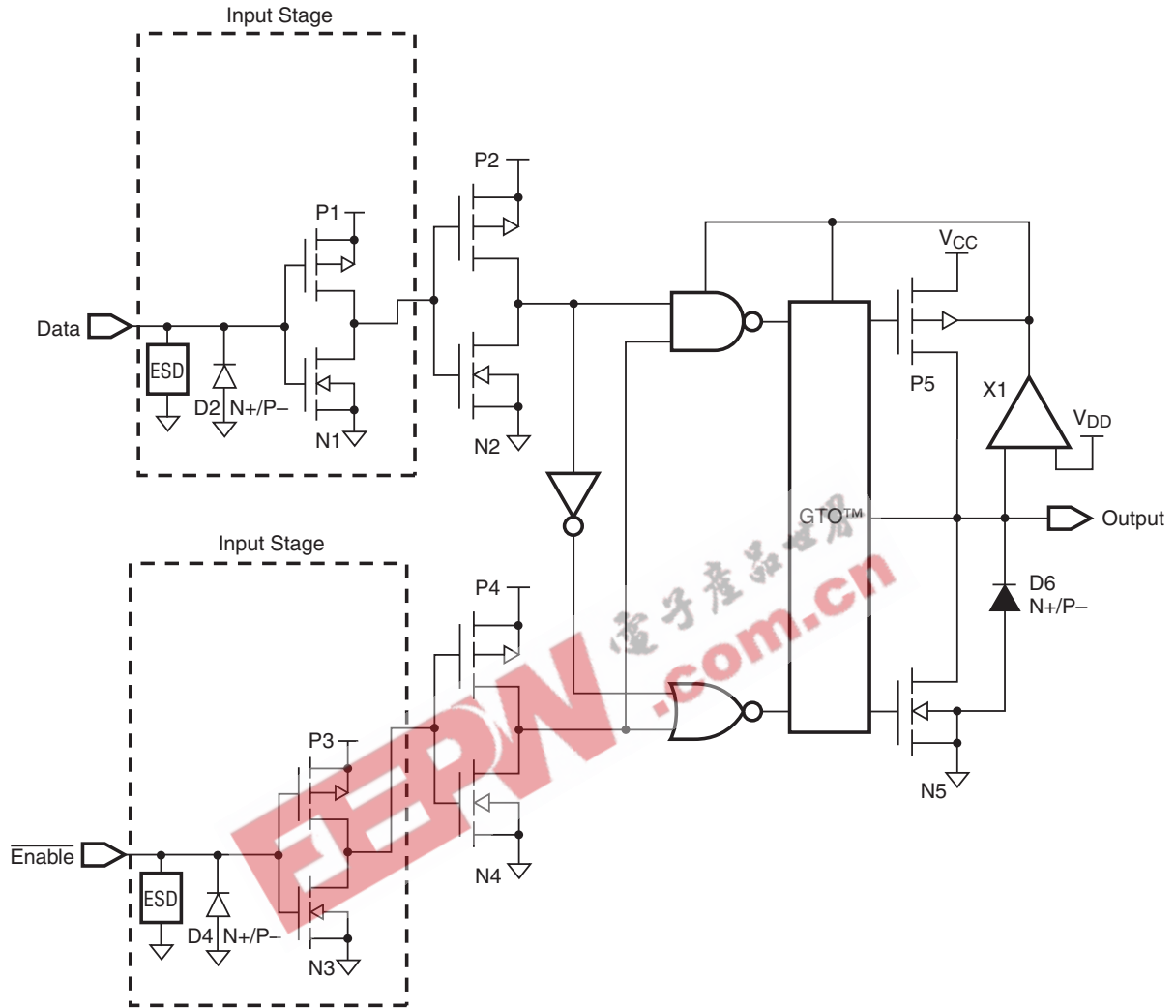


Figure 2. Waveforms (Input Characteristics;  $f = 1MHz$ ,  $t_r = t_f = 3ns$ )

| 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)

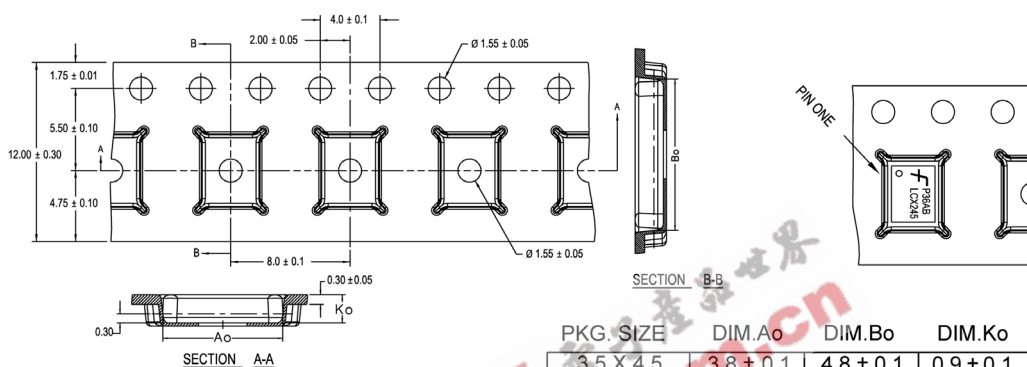


## Tape and Reel Specification

### 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)



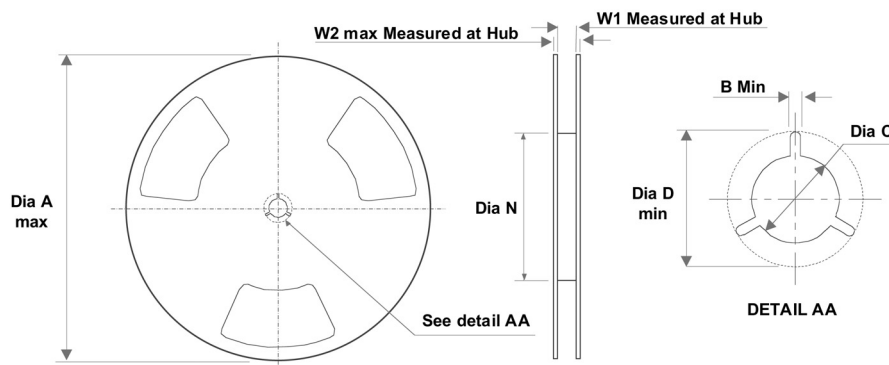
| PKG. SIZE | DIM.Ao    | DIM.Bo    | DIM.Ko    |
|-----------|-----------|-----------|-----------|
| 3.5 X 4.5 | 3.8 ± 0.1 | 4.8 ± 0.1 | 0.9 ± 0.1 |
| 3.0 X 3.0 | 3.3 ± 0.1 | 3.3 ± 0.1 | 0.9 ± 0.1 |
| 2.5 X 4.5 | 2.8 ± 0.1 | 4.8 ± 0.1 | 0.9 ± 0.1 |
| 2.5 X 3.5 | 2.8 ± 0.1 | 3.8 ± 0.1 | 0.9 ± 0.1 |
| 2.5 X 3.0 | 2.8 ± 0.1 | 3.3 ± 0.1 | 0.9 ± 0.1 |
| 2.5 X 2.5 | 2.8 ± 0.1 | 2.8 ± 0.1 | 0.9 ± 0.1 |

DIMENSIONS ARE IN MILLIMETERS

NOTES: unless otherwise specified

1. Cumulative pitch for feeding holes and cavities (chip pockets) not to exceed 0.008[0.20] over 10 pitch span.
2. Smallest allowable bending radius.
3. Thru hole inside cavity is centered within cavity.
4. Tolerance is  $\pm 0.002$  [0.05] for these dimensions on all 12mm tapes.
5. Ao and Bo measured on a plane 0.120[0.30] above the bottom of the pocket.
6. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
7. Pocket position relative to sprocket hole measured as true position of pocket. Not pocket hole.
8. Controlling dimension is millimeter. Dimension in inches rounded.

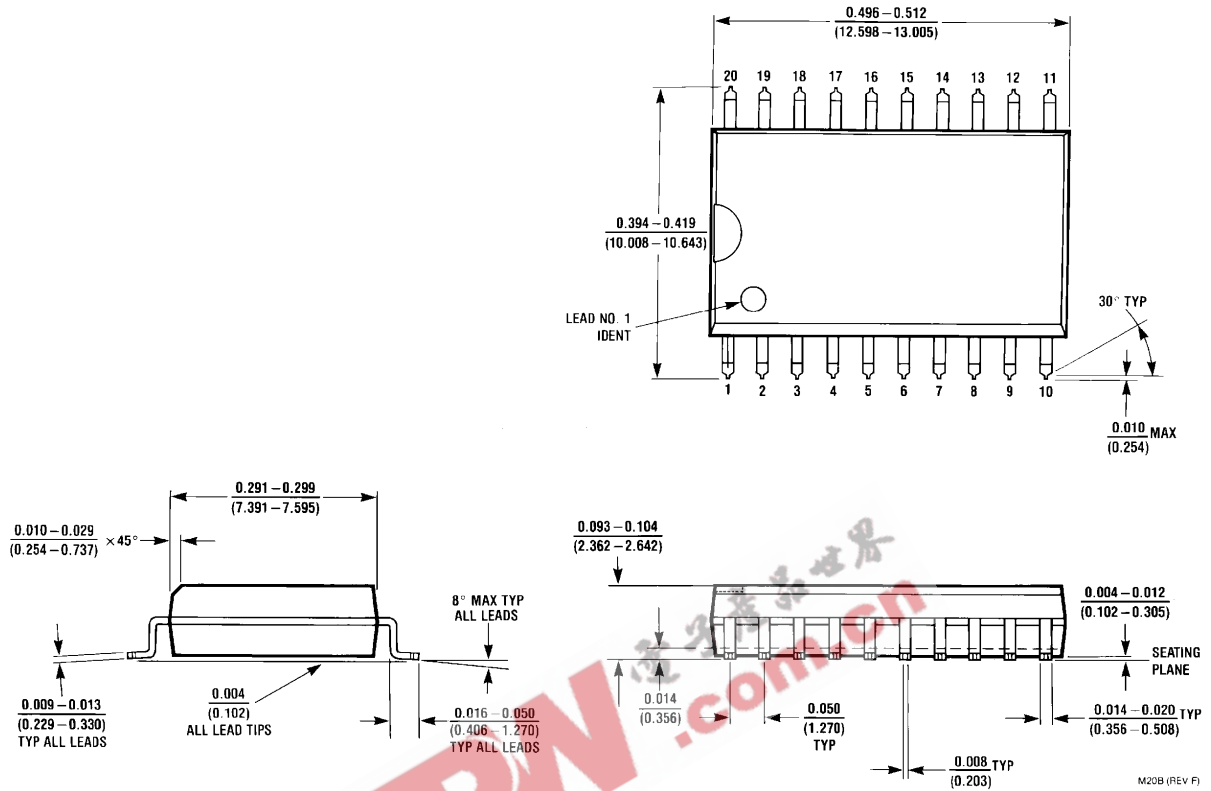
### Reel Dimensions inches (millimeters)



| Tape Size | A               | B               | C                | D                | N                | W1              | W2              |
|-----------|-----------------|-----------------|------------------|------------------|------------------|-----------------|-----------------|
| 12mm      | 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) |

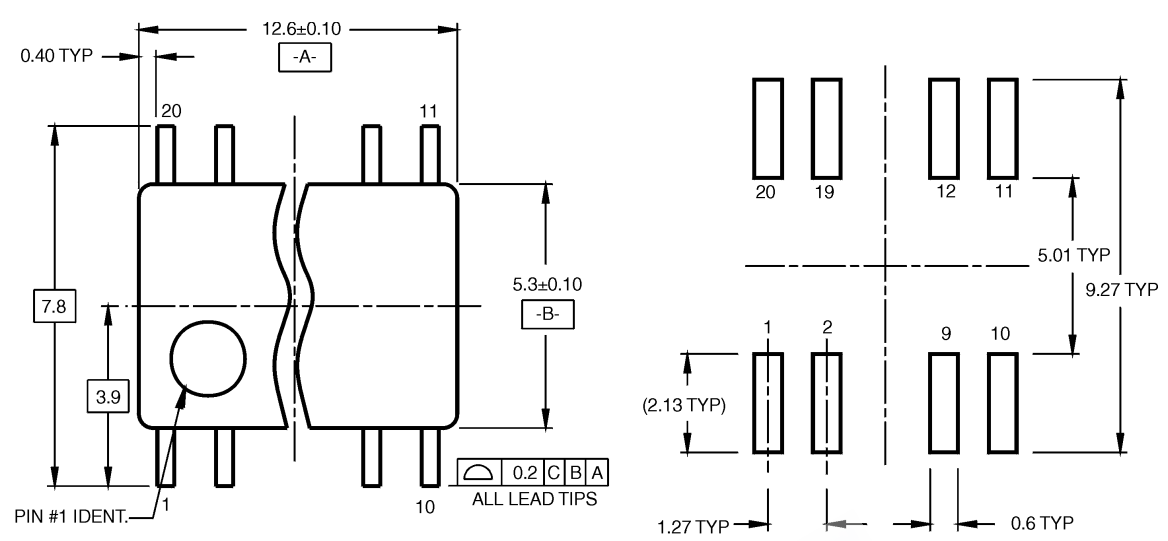


**Physical Dimensions** inches (millimeters) unless otherwise noted

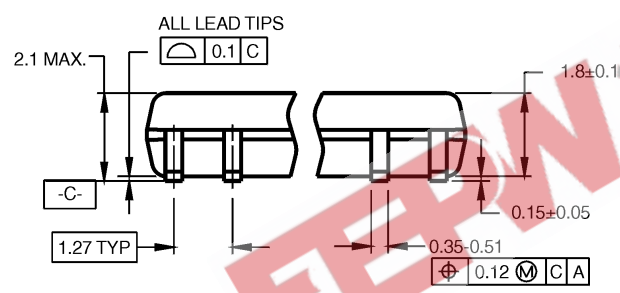


**Figure 3. 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide Package Number M20B**

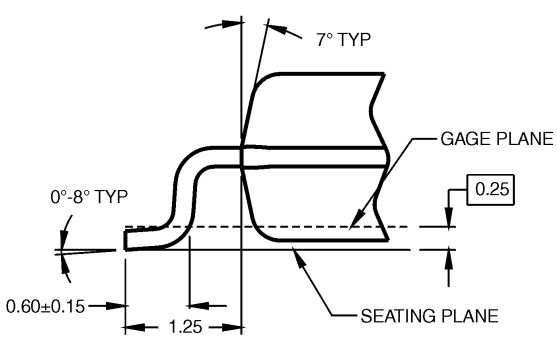
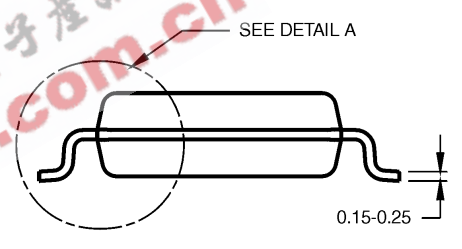
**Physical Dimensions** (Continued) millimeters unless otherwise noted



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DIMENSIONS ARE IN MILLIMETERS



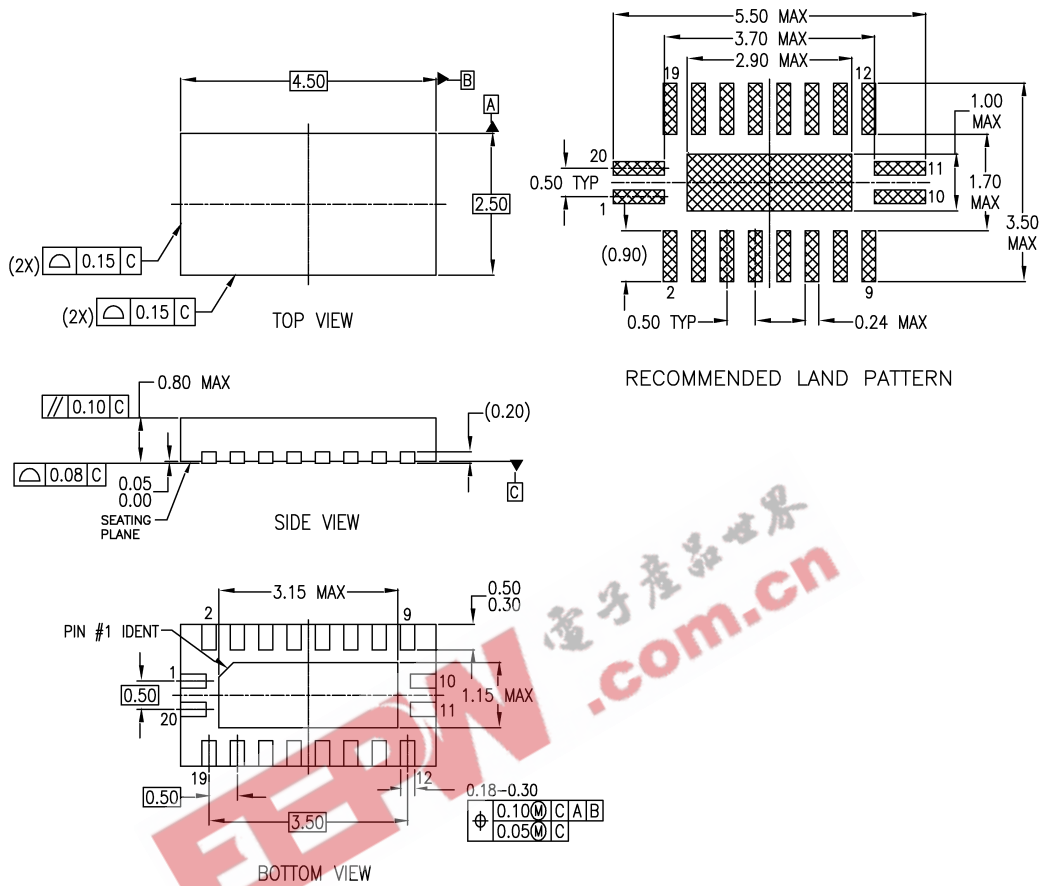
DETAIL A

- 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

**Figure 4. 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide Package Number M20D**

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



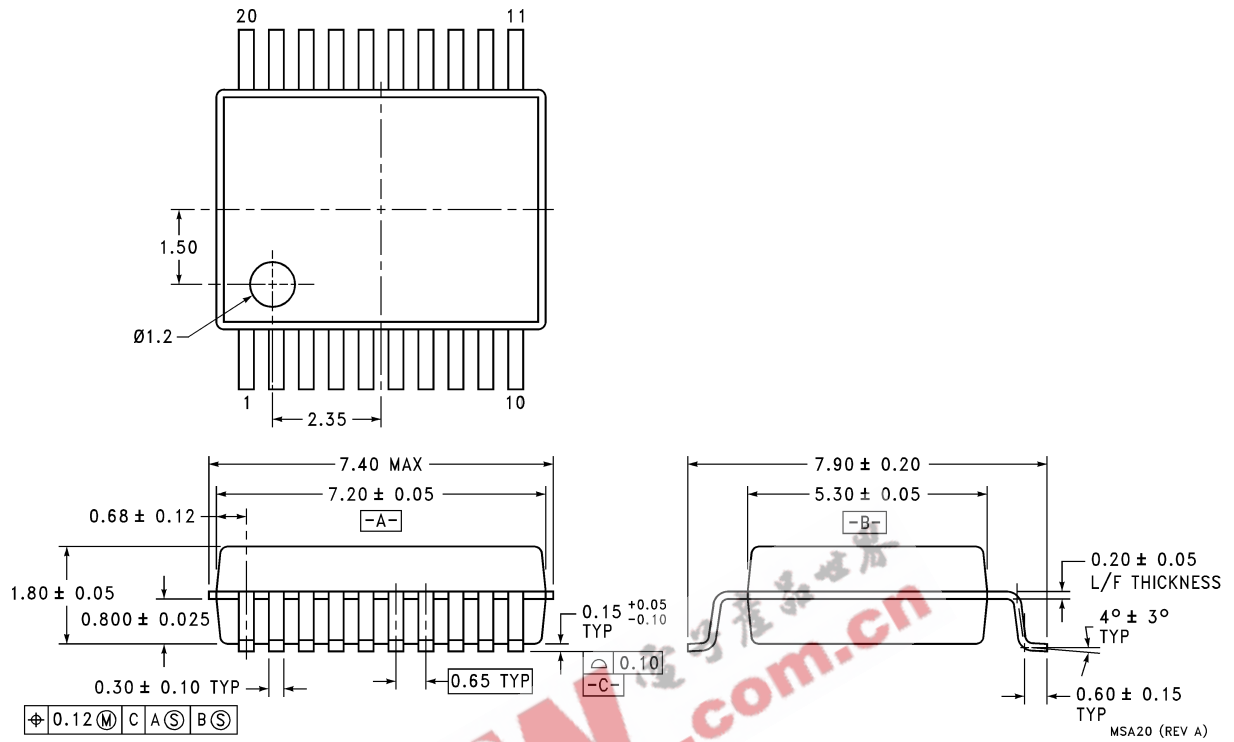
NOTES:

- A. CONFORMS TO JEDEC REGISTRATION MO-241, VARIATION AC
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

MLP020BrevA

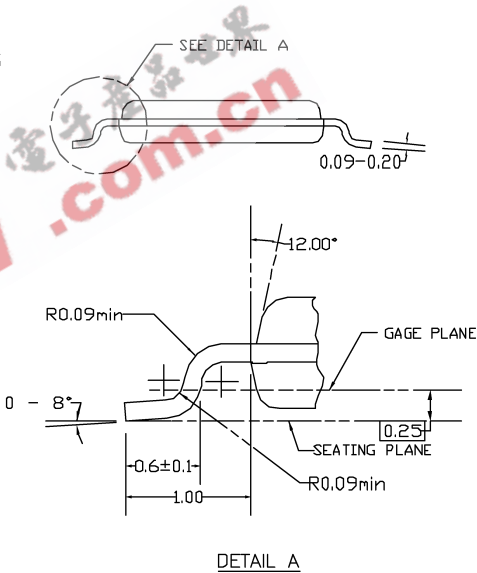
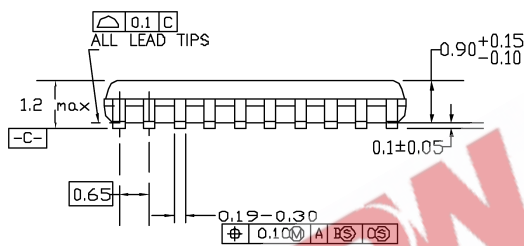
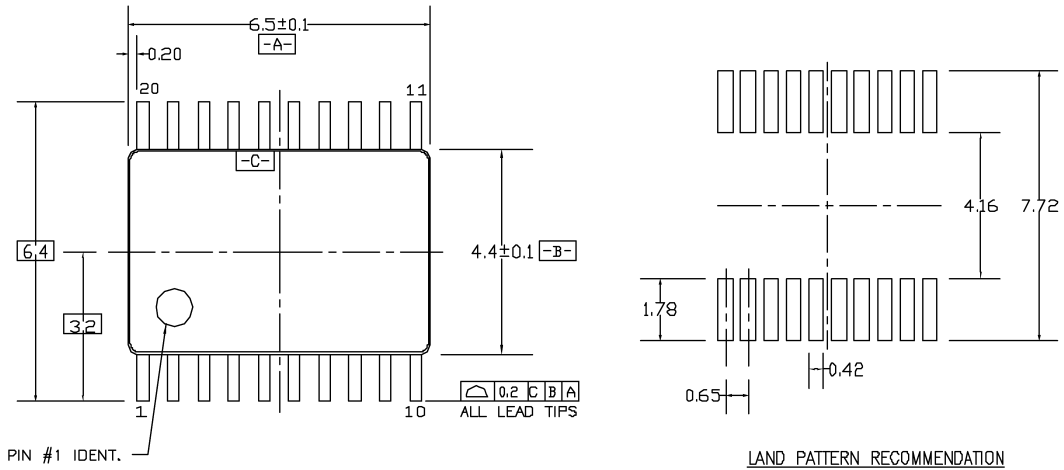
**Figure 5. Pb-Free 20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm Package Number MLP020B**

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



**Figure 6. 20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide Package Number MSA20**

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



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

**Figure 7. 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide Package Number MTC20**



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|                         |                      |                            |   |
|-------------------------|----------------------|----------------------------|---|
| ACEx®                   | Green FPS™ e-Series™ | Power-SPM™                 | SyncFET™  |
| Build it Now™           | GTO™                 | PowerTrench®               | The Power Franchise®  |
| CorePLUS™               | <i>i-Lo</i> ™        | Programmable Active Droop™ |  ™ |
| CROSSVOLT™              | IntelliMAX™          | QFET®                      | TinyBoost™  |
| CTL™                    | ISOPLANAR™           | QS™                        | TinyBuck™   |
| Current Transfer Logic™ | MegaBuck™            | QT Optoelectronics™        | TinyLogic®  |
| EcoSPARK®               | MICROCOUPLER™        | Quiet Series™              | TINYOPTO™   |
| FACT Quiet Series™      | MicroPak™            | RapidConfigure™            | TinyPower™  |
| FACT®                   | Motion-SPM™          | SMART START™               | TinyPWM™  |
| FAST®                   | OPTOLOGIC®           | SPM®                       | TinyWire™   |
| FastvCore™              | OPTOPLANAR®          | STEALTH™                   | μSerDes™  |
| FPS™                    | PDP-SPM™             | SuperFET™                  | UHC®  |
| FRFET®                  | Power220®            | SuperSOT™-3                | UniFET™   |
| Global Power ResourceSM | Power247®            | SuperSOT™-6                | VCX™  |
| Green FPS™              | POWEREDGE®           | SuperSOT™-8                |   |

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- A critical component is 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.

## PRODUCT STATUS DEFINITIONS

### Definition of Terms

| Datasheet Identification | Product Status         | Definition   |
|--------------------------|------------------------|--|
| Advance Information      | Formative or In Design | This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.   |
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