

# 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

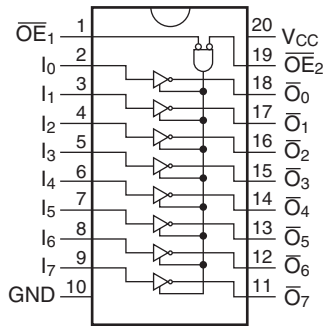
Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code. Pb-Free package per JEDEC J-STD-020B.

#### Notes:

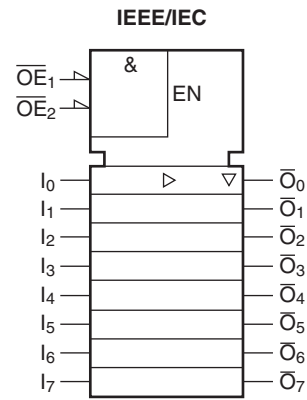
1. To ensure the high impedance state during power up or down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pull-up resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.
2. DQFN package available in Tape and Reel only.
3. "\_NL" indicates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

### Connection Diagrams

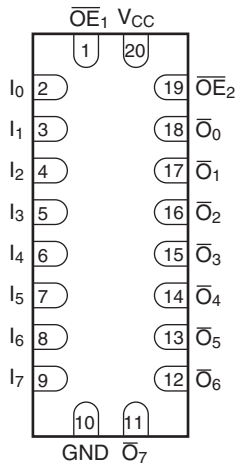
**Pin Assignments for SOIC, SOP, SSOP, TSSOP**



### Logic Symbol



**Pad Assignment for DQFN**



**(Top View)**

### 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	$^{\circ}C$

## 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	$^{\circ}C$
$\Delta t/\Delta V$	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, 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>).

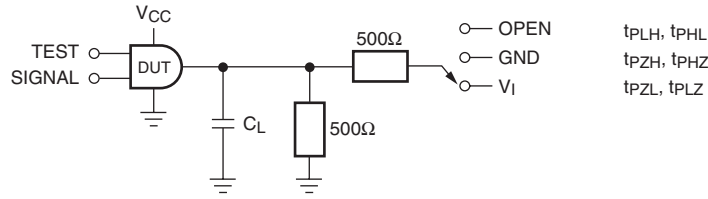
### Dynamic Switching Characteristics

Symbol	Parameter	Conditions	V <sub>CC</sub> (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> = 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

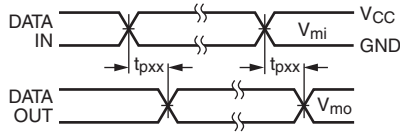
Symbol	Parameter	Conditions	Typical	Units
C <sub>IN</sub>	Input Capacitance	V <sub>CC</sub> = Open, V <sub>I</sub> = 0V or V <sub>CC</sub>	7	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>CC</sub> = 3.3V, V <sub>I</sub> = 0V or V <sub>CC</sub>	8	pF
C <sub>PD</sub>	Power Dissipation Capacitance	V <sub>CC</sub> = 3.3V, V <sub>I</sub> = 0V or V <sub>CC</sub> , f = 10 MHz	25	pF

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

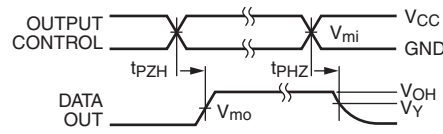


**Figure 1. AC Test Circuit** ( $C_L$  includes probe and jig capacitance)

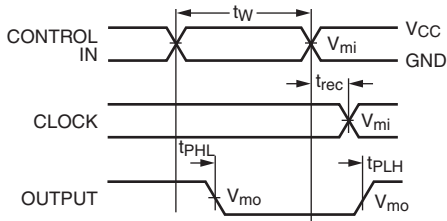
Test	Switch
$t_{PLH}$ , $t_{PHL}$	Open
$t_{PZL}$ , $t_{PLZ}$	6V at $V_{CC} = 3.3 \pm 0.3V$ $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$
$t_{PZH}$ , $t_{PHZ}$	GND



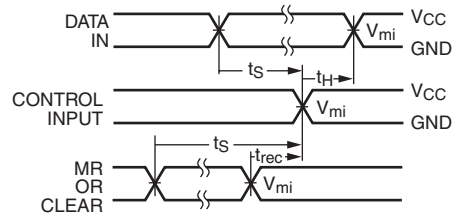
**Waveform for Inverting and Non-Inverting Functions**



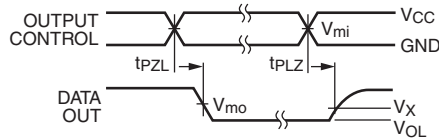
**3-STATE Output High Enable and Disable Times for Logic**



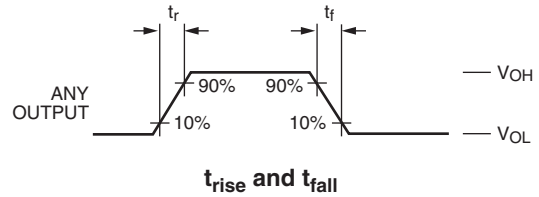
**Propagation Delay, Pulse Width and  $t_{rec}$  Waveforms**



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



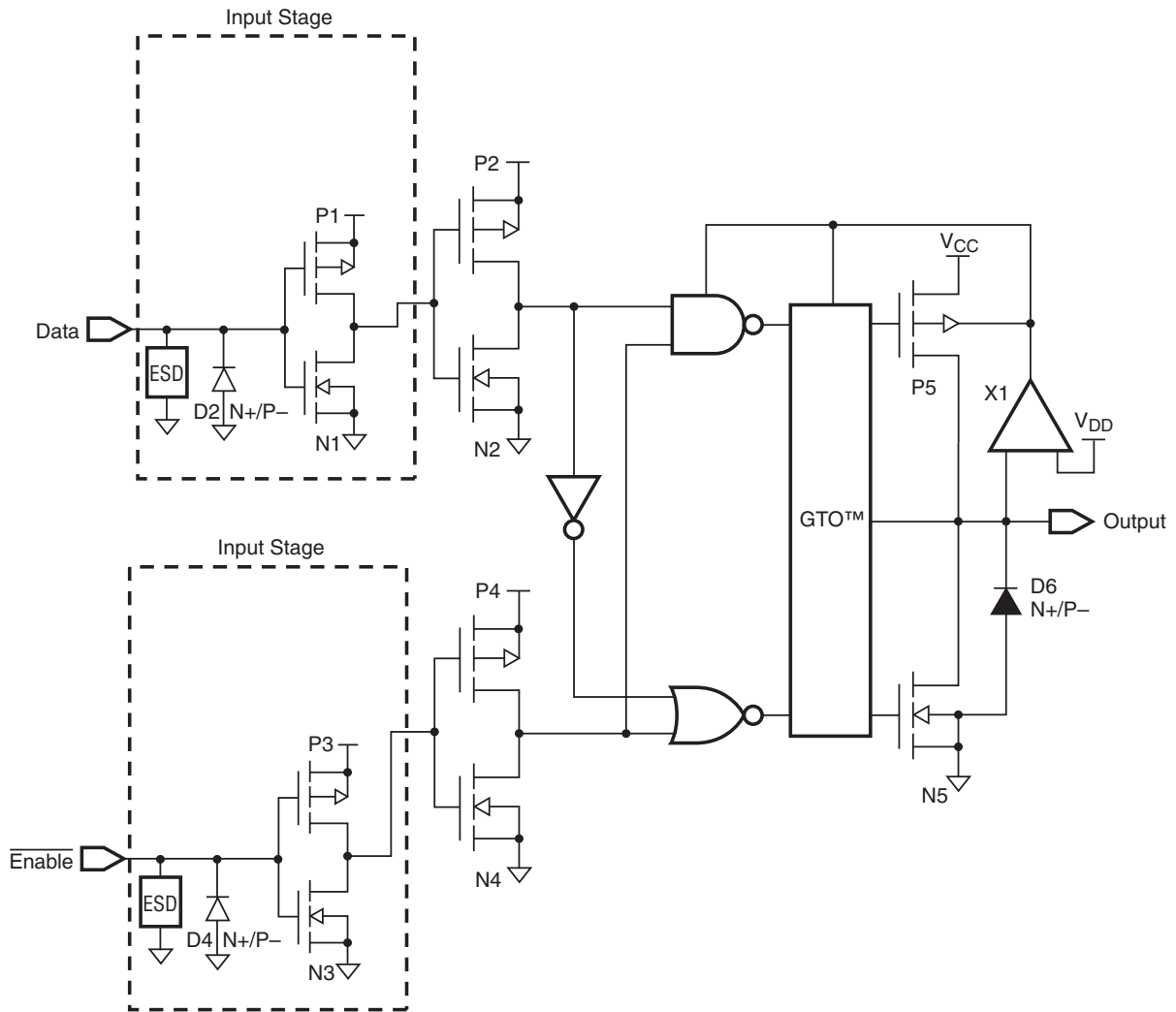
**3-STATE Output Low Enable and Disable Times for Logic**



**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)

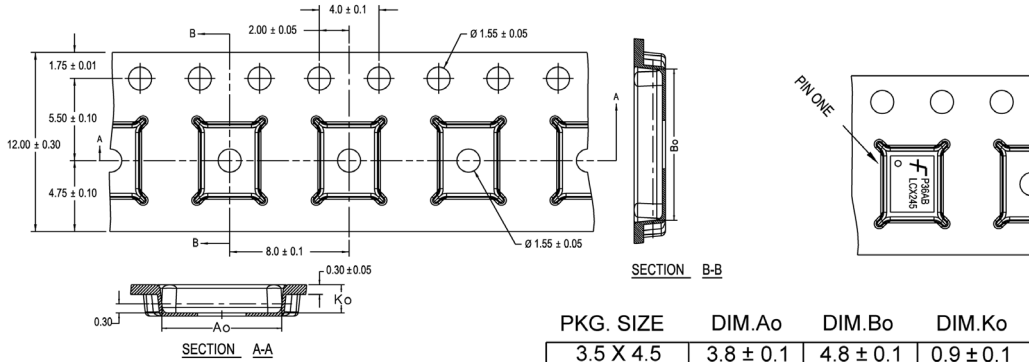


## Tape and Reel Specification

### 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)



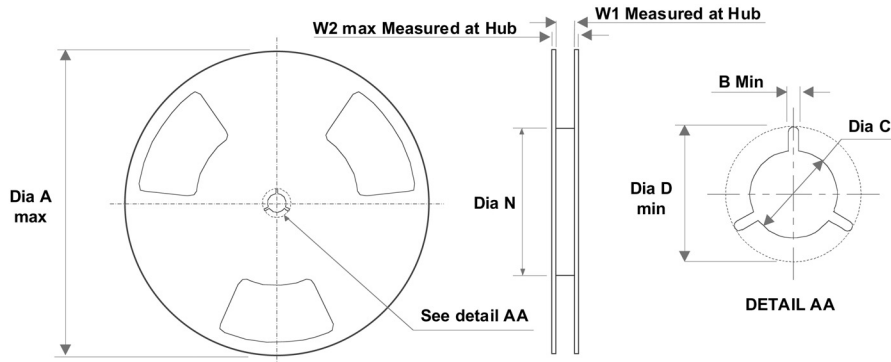
PKG. SIZE	DIM.Ao	DIM.Bo	DIM.Ko
3.5 X 4.5	3.8 ± 0.1	4.8 ± 0.1	0.9 ± 0.1
3.0 X 3.0	3.3 ± 0.1	3.3 ± 0.1	0.9 ± 0.1
2.5 X 4.5	2.8 ± 0.1	4.8 ± 0.1	0.9 ± 0.1
2.5 X 3.5	2.8 ± 0.1	3.8 ± 0.1	0.9 ± 0.1
2.5 X 3.0	2.8 ± 0.1	3.3 ± 0.1	0.9 ± 0.1
2.5 X 2.5	2.8 ± 0.1	2.8 ± 0.1	0.9 ± 0.1

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.

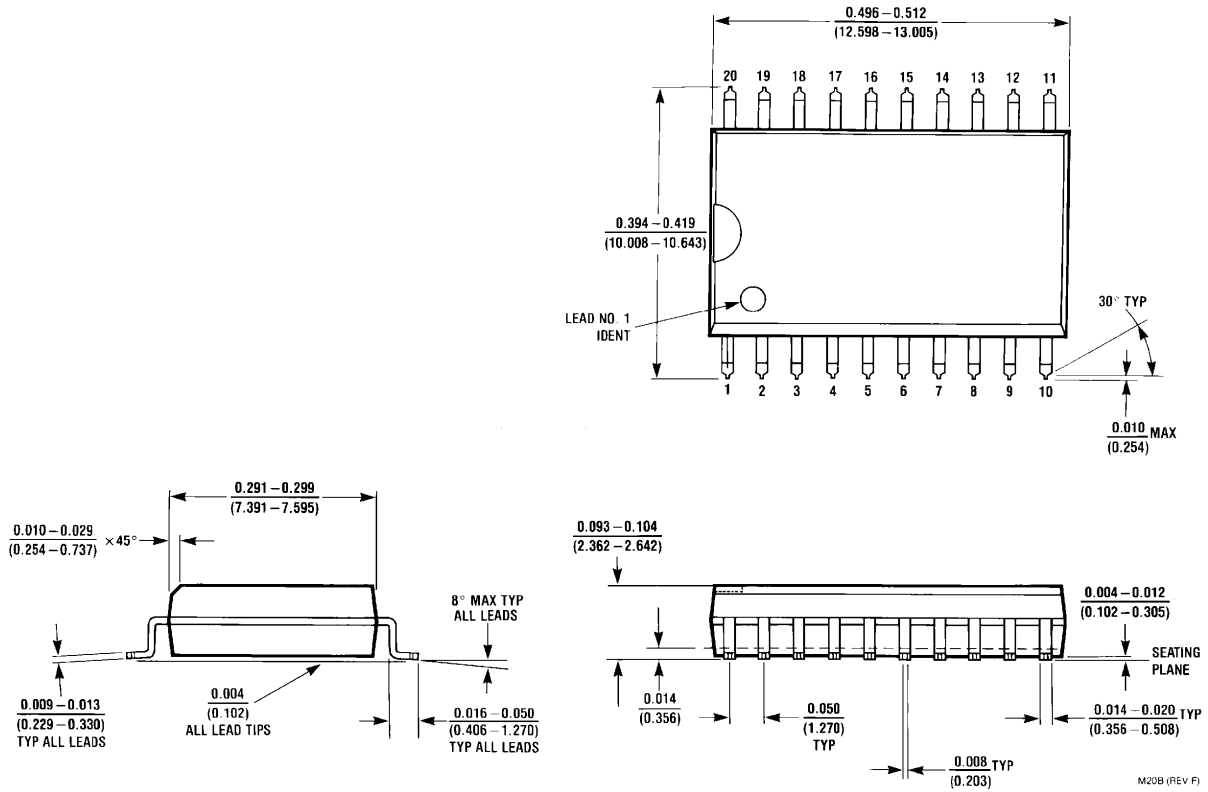
### Reel Dimensions inches (millimeters)



Tape Size	A	B	C	D	N	W1	W2
12mm	13.0 (330.0)	0.059 (1.50)	0.512 (13.00)	0.795 (20.20)	2.165 (55.00)	0.488 (12.4)	0.724 (18.4)

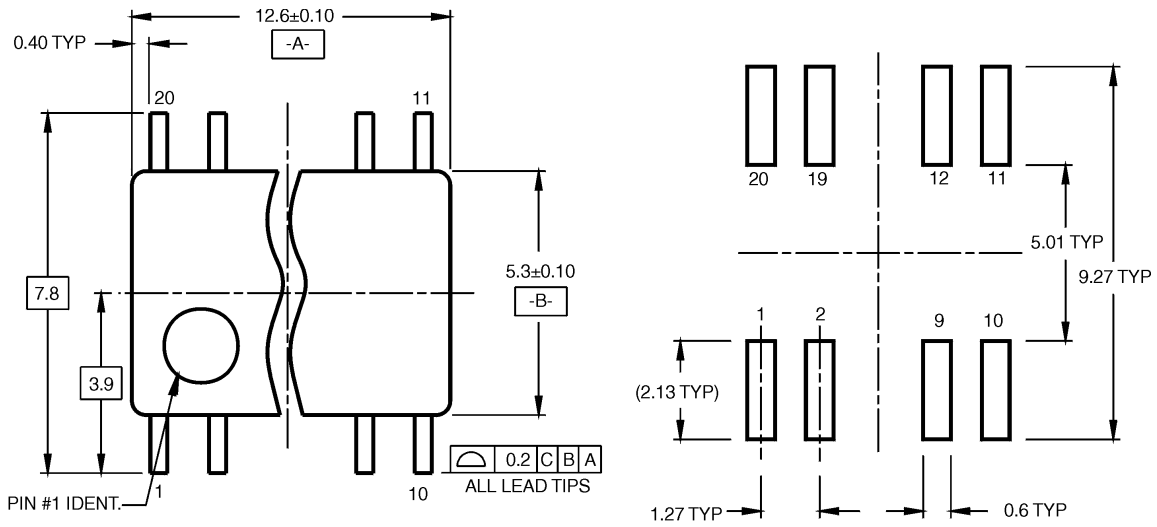


**Physical Dimensions** inches (millimeters) unless otherwise noted

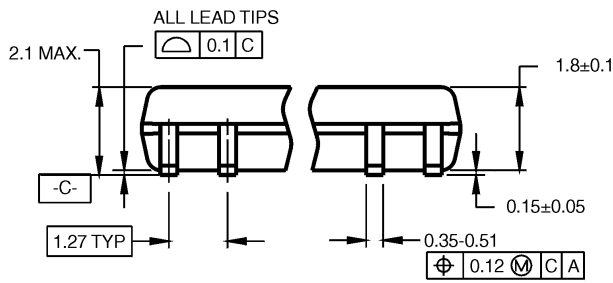


**Figure 3. 20-Lead Small Outline Integrated Circuit (SOIC),  
JEDEC MS-013, 0.300" Wide Package Number M20B**

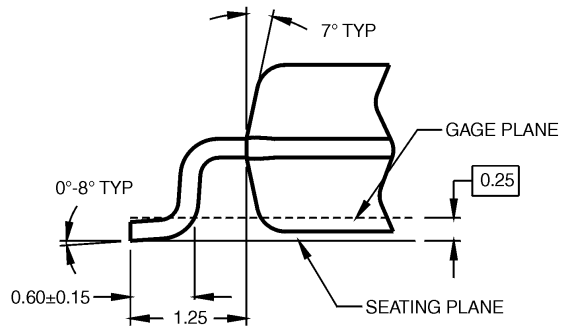
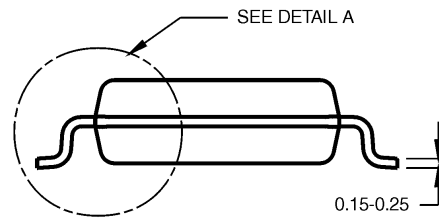
**Physical Dimensions** (Continued) millimeters unless otherwise noted



LAND PATTERN RECOMMENDATION



DIMENSIONS ARE IN MILLIMETERS



DETAIL A

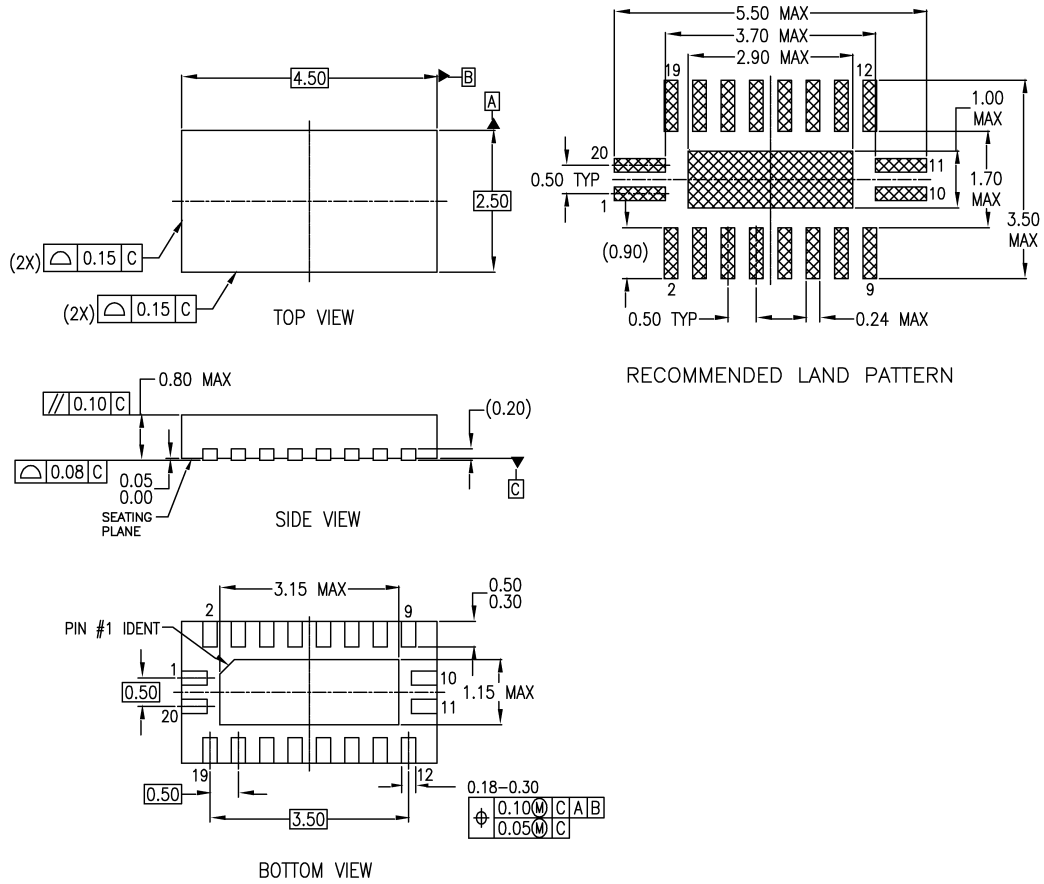
NOTES:

- 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



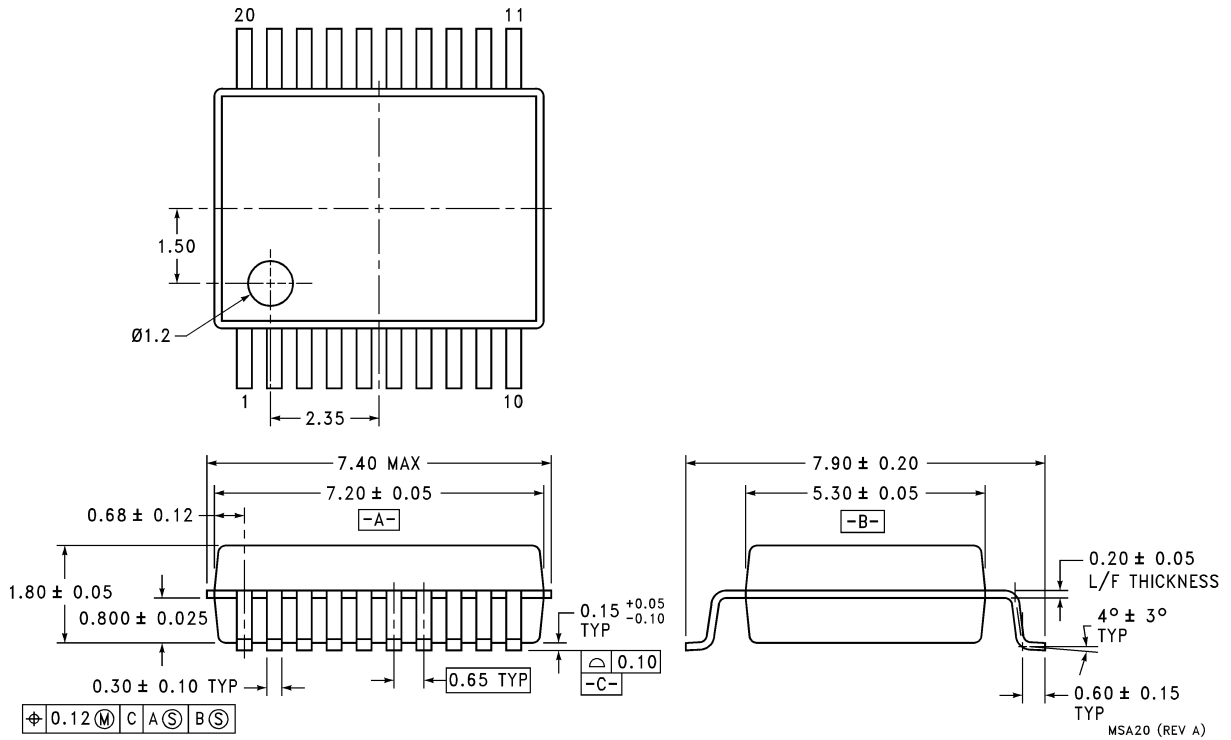
**NOTES:**

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

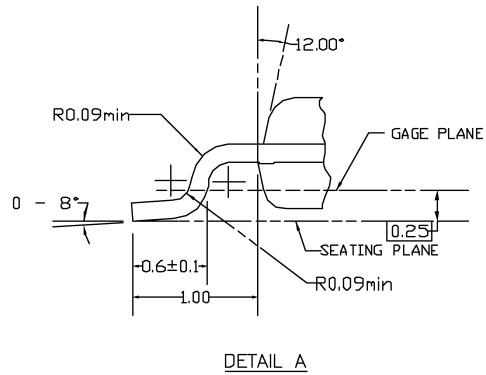
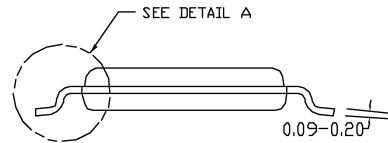
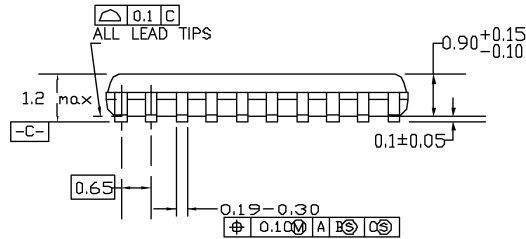
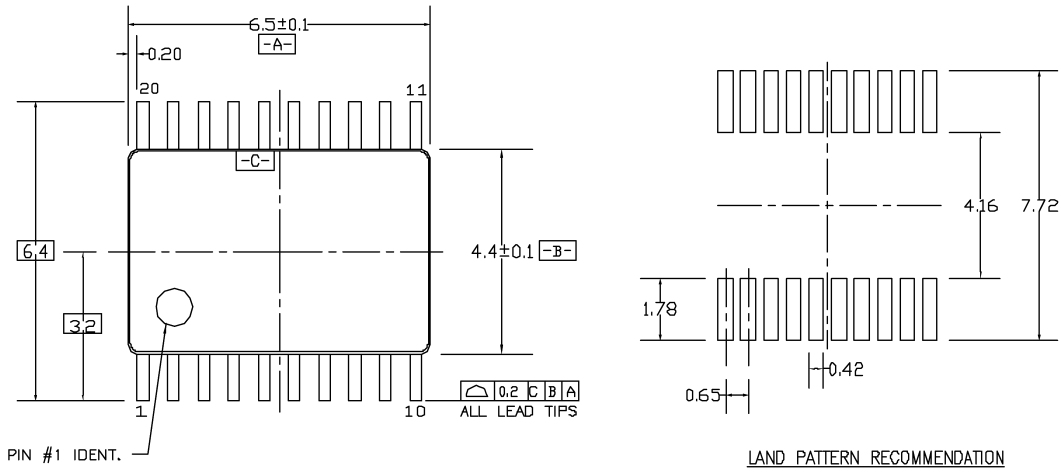
MLP020BrevA

**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



**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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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 Resource™	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.
Preliminary	First Production	This datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only.

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