

# 74LCX373

## Low Voltage Octal Transparent Latch with 5V Tolerant Inputs and Outputs

### Features

- 5V tolerant inputs and outputs
- 2.3V–3.6V  $V_{CC}$  specifications provided
- 8.0ns  $t_{PD}$  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>
- $\pm 24mA$  output drive ( $V_{CC} = 3.0V$ )
- 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 LCX373 consists of eight latches with 3-STATE outputs for bus organized system applications. The device is designed for low voltage applications with capability of interfacing to a 5V signal environment.

The LCX373 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

### Ordering Information

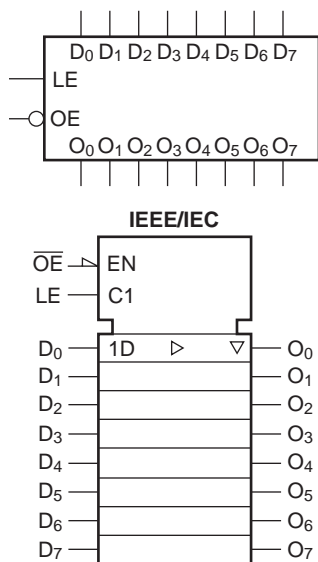
Order Number	Package Number	Package Description
74LCX373WM	M20B	20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
74LCX373SJ	M20D	Pb-Free 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74LCX373BQX <sup>2</sup>	MLP020B	Pb-Free 20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm
74LCX373MSA	MSA20	20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide
74LCX373MTC	MTC20	20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
74LCX373MTCX_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.

## Logic Symbols



## Pin Descriptions

Pin Names	Description
D <sub>0</sub> -D <sub>7</sub>	Data Inputs
LE	Latch Enable Input
$\overline{OE}$	3-STATE Output Enable Input
O <sub>0</sub> -O <sub>7</sub>	3-STATE Latch Outputs

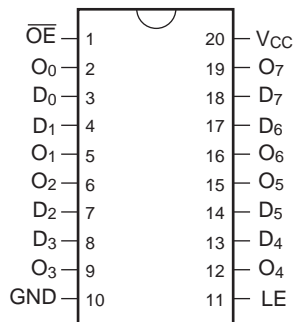
## Truth Table

Inputs			Outputs
LE	$\overline{OE}$	D <sub>n</sub>	O <sub>n</sub>
X	H	X	Z
H	L	L	L
H	L	H	H
L	L	X	O <sub>0</sub>

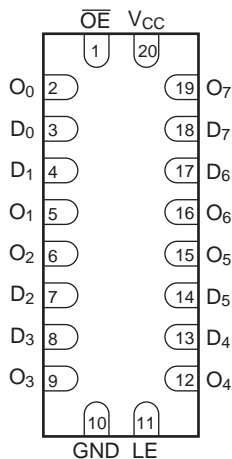
H = HIGH Voltage  
 L = LOW Voltage  
 Z = High Impedance  
 X = Immaterial  
 O<sub>0</sub> = Previous O<sub>0</sub> before HIGH-to-LOW transition of Latch Enable

## Connection Diagrams

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



### Pad Assignments for DQFN

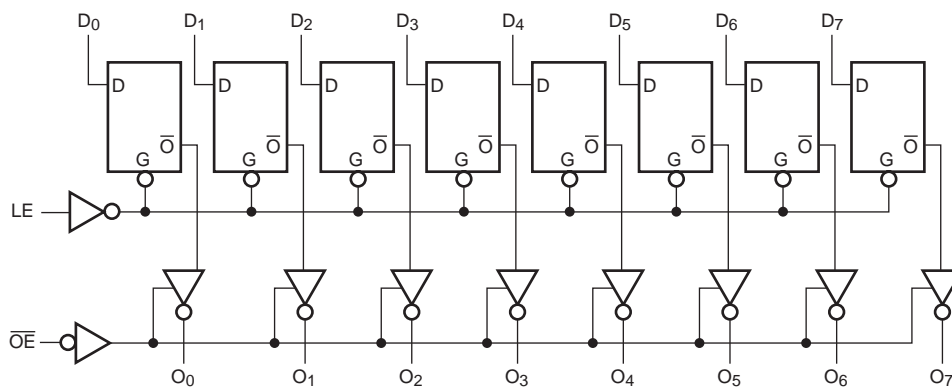


(Top View)

## Functional Description

The LCX373 contains eight D-type latches with 3-STATE standard outputs. When the Latch Enable (LE) input is HIGH, data on the D<sub>n</sub> inputs enters the latches. In this condition the latches are transparent, i.e. a latch output will change state each time its D input changes. When LE is LOW, the latches store the information that was present on the D inputs a setup time preceding the HIGH-to-LOW transition of LE. The 3-STATE standard outputs are controlled by the Output Enable ( $\overline{OE}$ ) input. When  $\overline{OE}$  is LOW, the standard outputs are in the 2-state mode. When  $\overline{OE}$  is HIGH, the standard outputs are in the high impedance mode but this does not interfere with entering new data into the latches.

**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

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.

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>

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:

4.  $I_O$  Absolute Maximum Rating must be observed.
5. Unused inputs 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> = -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, 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> = 500 Ω						Units
		V <sub>CC</sub> = 3.3V ± 0.3V		V <sub>CC</sub> = 2.7V		V <sub>CC</sub> = 2.5 ± 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, D <sub>n</sub> to O <sub>n</sub>	1.5	8.0	1.5	9.0	1.5	9.6	ns
t <sub>PHL</sub> , t <sub>PLH</sub>	Propagation Delay, LE to O <sub>n</sub>	1.5	8.5	1.5	9.5	1.5	10.5	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>S</sub>	Setup Time, D <sub>n</sub> to LE	2.5		2.5		4.0		ns
t <sub>H</sub>	Hold Time, D <sub>n</sub> to LE	1.5		1.5		2.0		ns
t <sub>W</sub>	LE Pulse Width	3.3		3.3		4.0		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>I</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>I</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 = 10MHz	25	pF

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

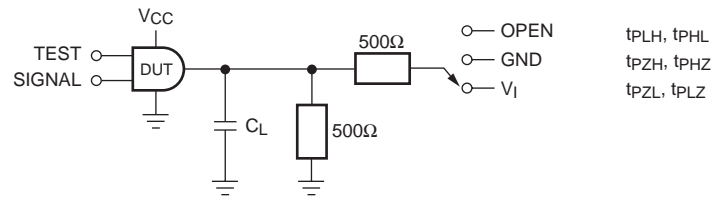
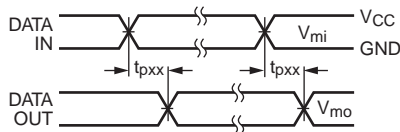
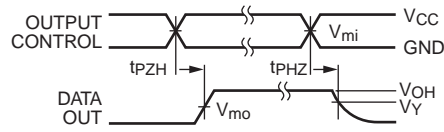


Figure 1. AC Test Circuit ( $C_L$  includes probe and jig capacitance)

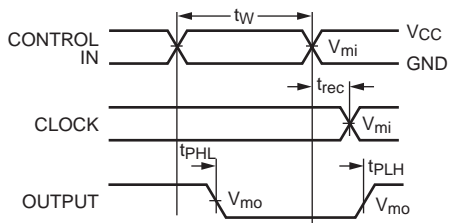
Test	Switch
$t_{PLH}$ , $t_{PHL}$	Open
$t_{PZL}$ , $t_{PLZ}$	6V at $V_{CC} = 3.3 \pm 0.3V$ $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$
$t_{PZH}$ , $t_{PHZ}$	GND



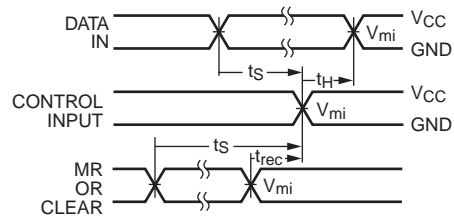
Waveform for Inverting and Non-Inverting Functions



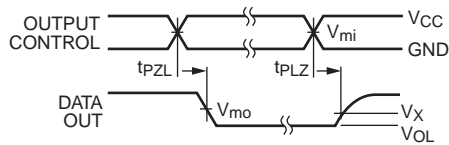
3-STATE Output High Enable and Disable Times for Logic



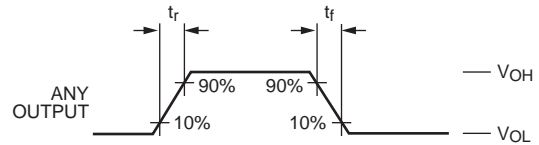
Propagation Delay, Pulse Width and  $t_{rec}$  Waveforms



Setup Time, Hold Time and Recovery Time for Logic



3-STATE Output Low Enable and Disable Times for Logic

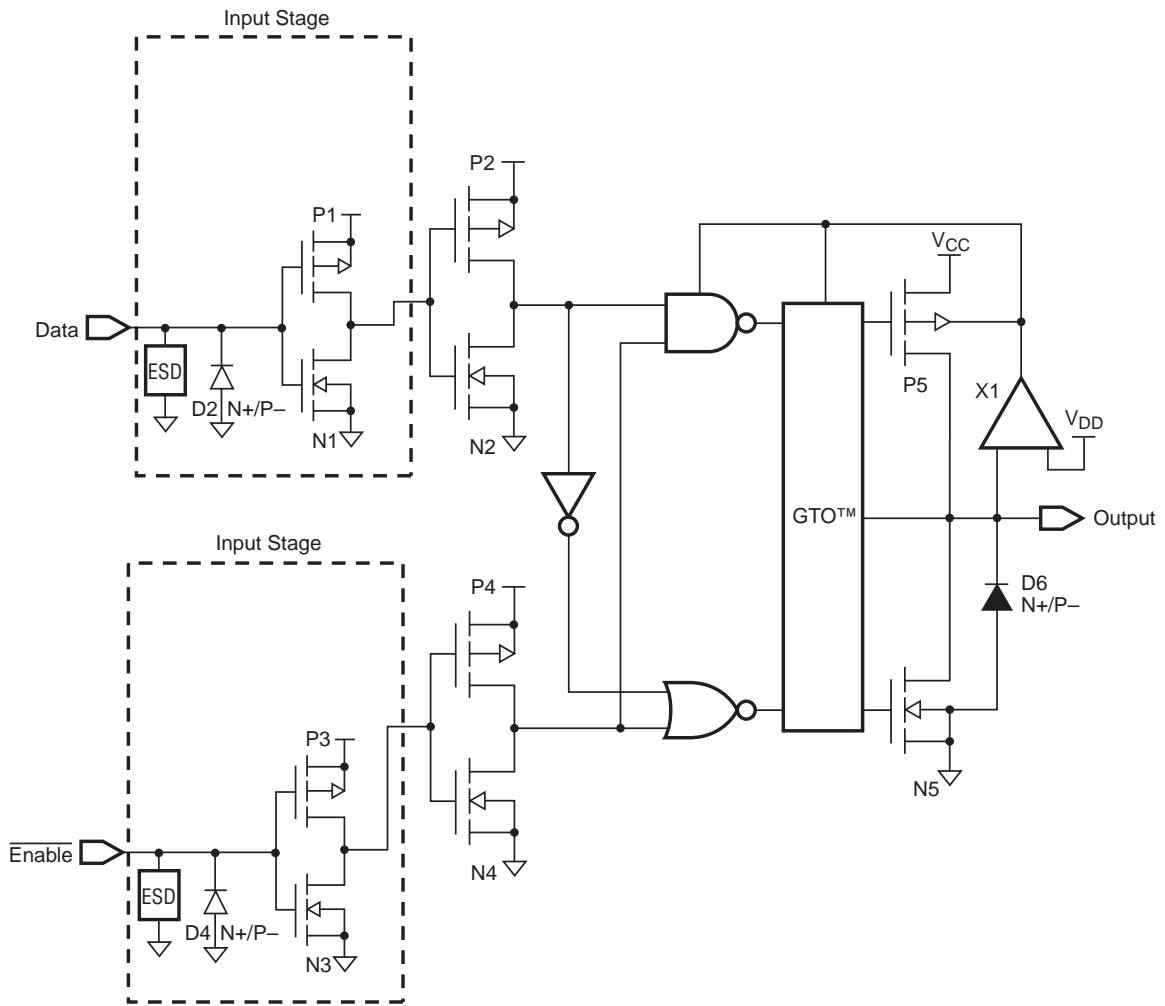


$t_{rise}$  and  $t_{fall}$

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)



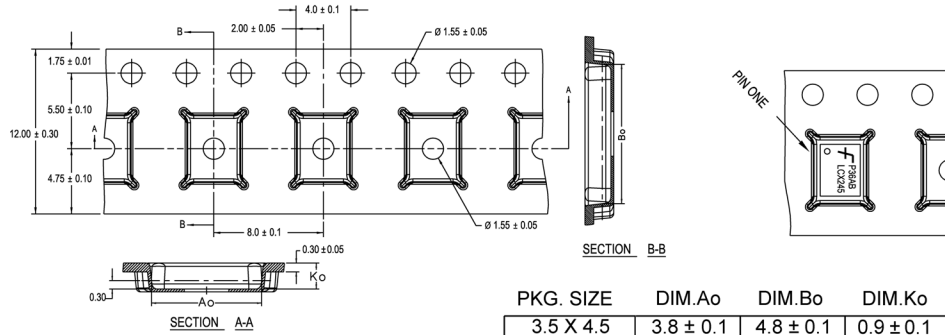


## Tape and Reel Specification

### 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)



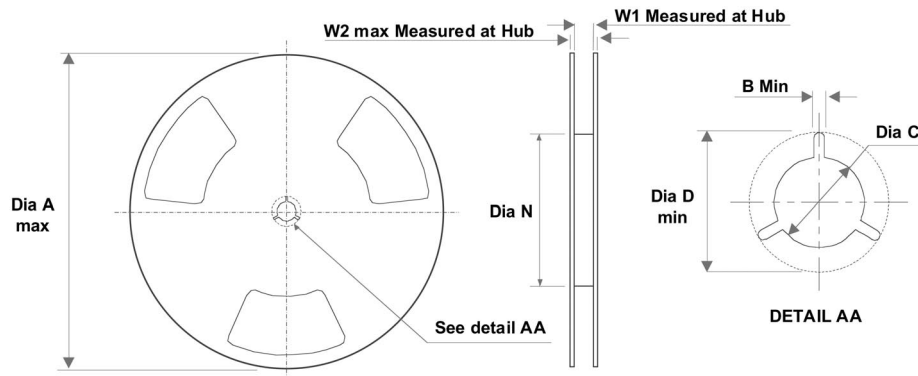
PKG. SIZE	DIM.Ao	DIM.Bo	DIM.Ko
3.5 X 4.5	3.8 ± 0.1	4.8 ± 0.1	0.9 ± 0.1
3.0 X 3.0	3.3 ± 0.1	3.3 ± 0.1	0.9 ± 0.1
2.5 X 4.5	2.8 ± 0.1	4.8 ± 0.1	0.9 ± 0.1
2.5 X 3.5	2.8 ± 0.1	3.8 ± 0.1	0.9 ± 0.1
2.5 X 3.0	2.8 ± 0.1	3.3 ± 0.1	0.9 ± 0.1
2.5 X 2.5	2.8 ± 0.1	2.8 ± 0.1	0.9 ± 0.1

DIMENSIONS ARE IN MILLIMETERS

NOTES: unless otherwise specified

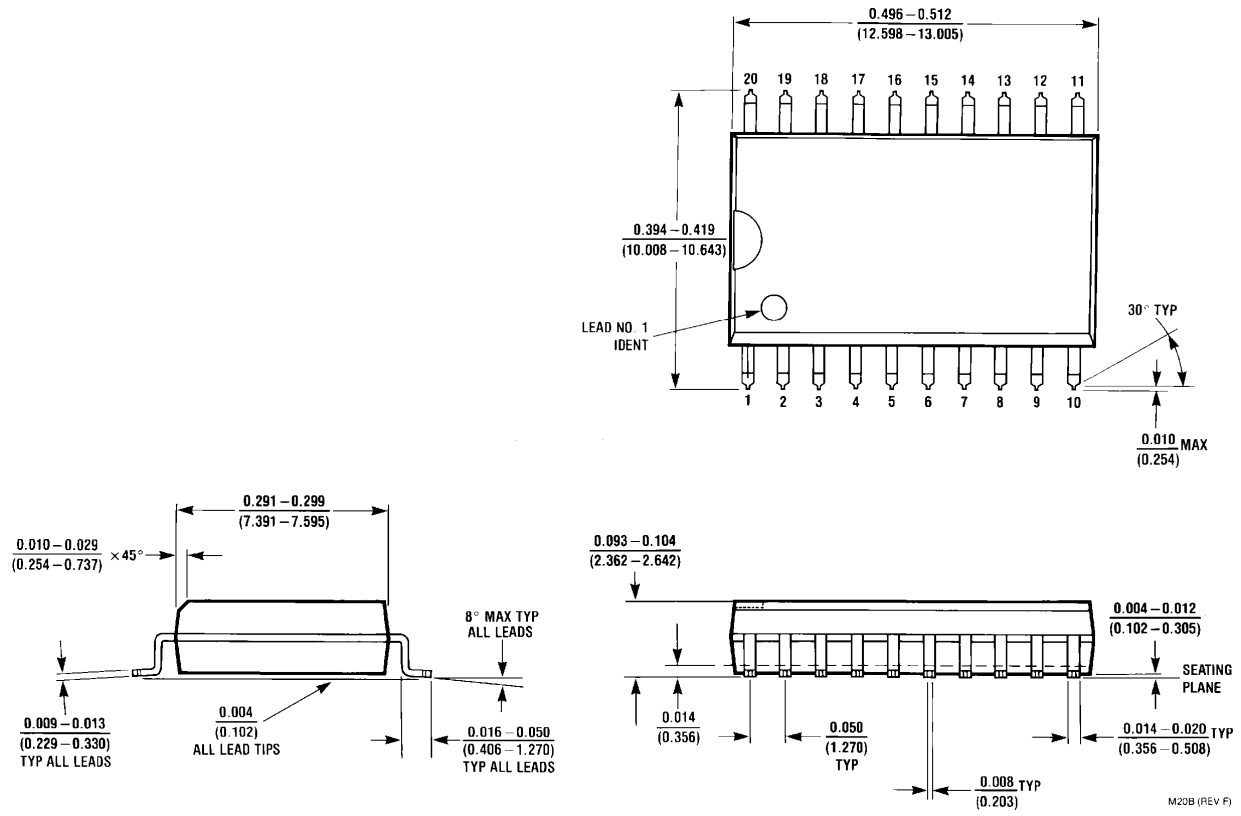
1. Cumulative pitch for feeding holes and cavities (chip pockets) not to exceed 0.008[0.20] over 10 pitch span.
2. Smallest allowable bending radius.
3. Thru hole inside cavity is centered within cavity.
4. Tolerance is  $\pm 0.002$ [0.05] for these dimensions on all 12mm tapes.
5. Ao and Bo measured 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
12 mm	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)

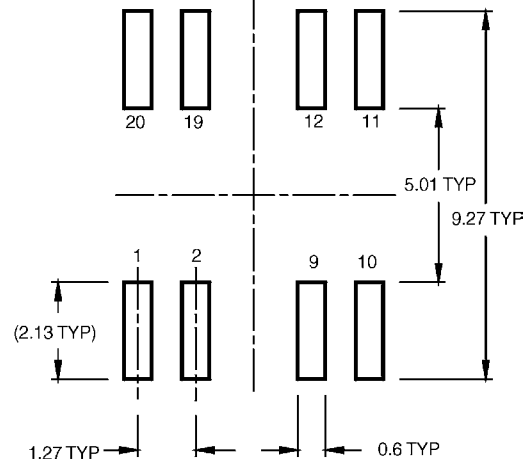
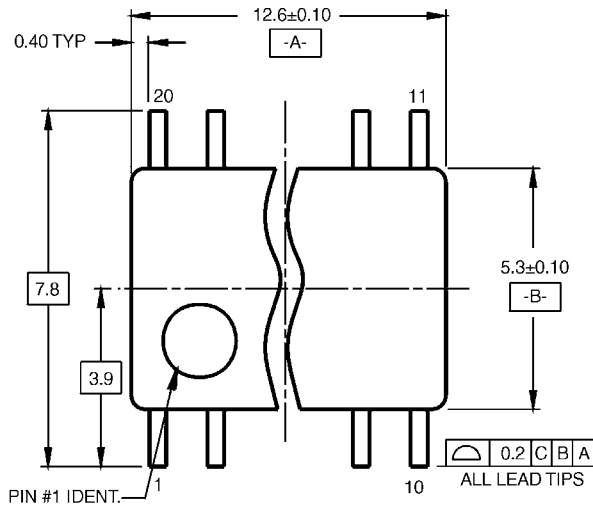
**Physical Dimensions** inches (millimeters) unless otherwise noted



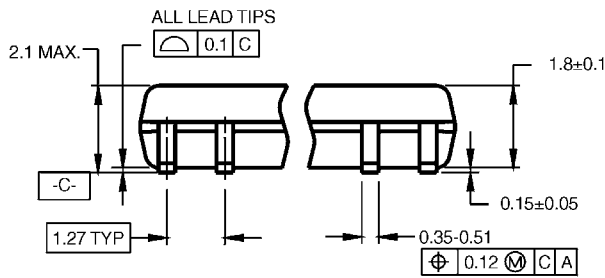
**20-Lead Small Outline Integrated Circuit (SOIC),  
JEDEC MS-013, 0.300" Wide Package Number M20B**

M20B (REV F)

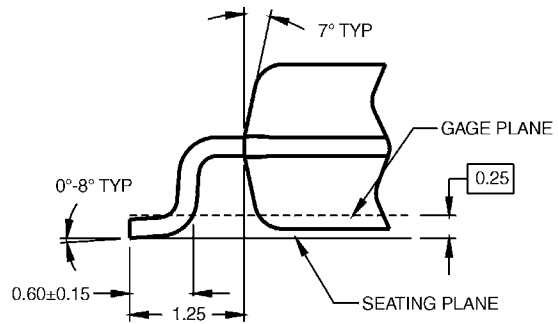
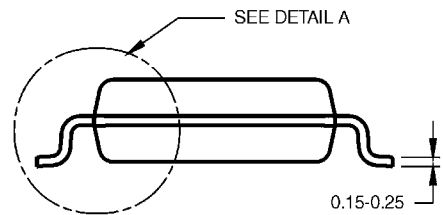
**Physical Dimensions** (Continued) inches (millimeters) unless otherwise noted



LAND PATTERN RECOMMENDATION



DIMENSIONS ARE IN MILLIMETERS



DETAIL A

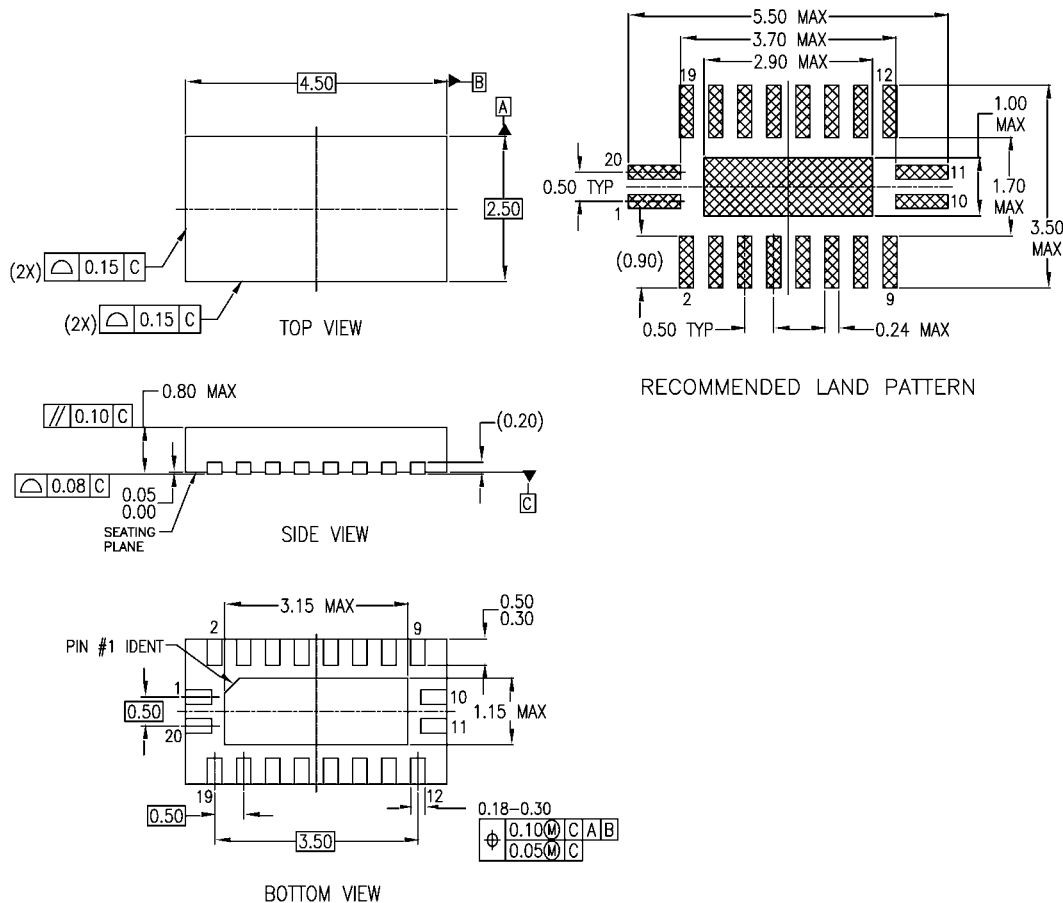
NOTES:

- 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.

M20DRRevB1

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

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



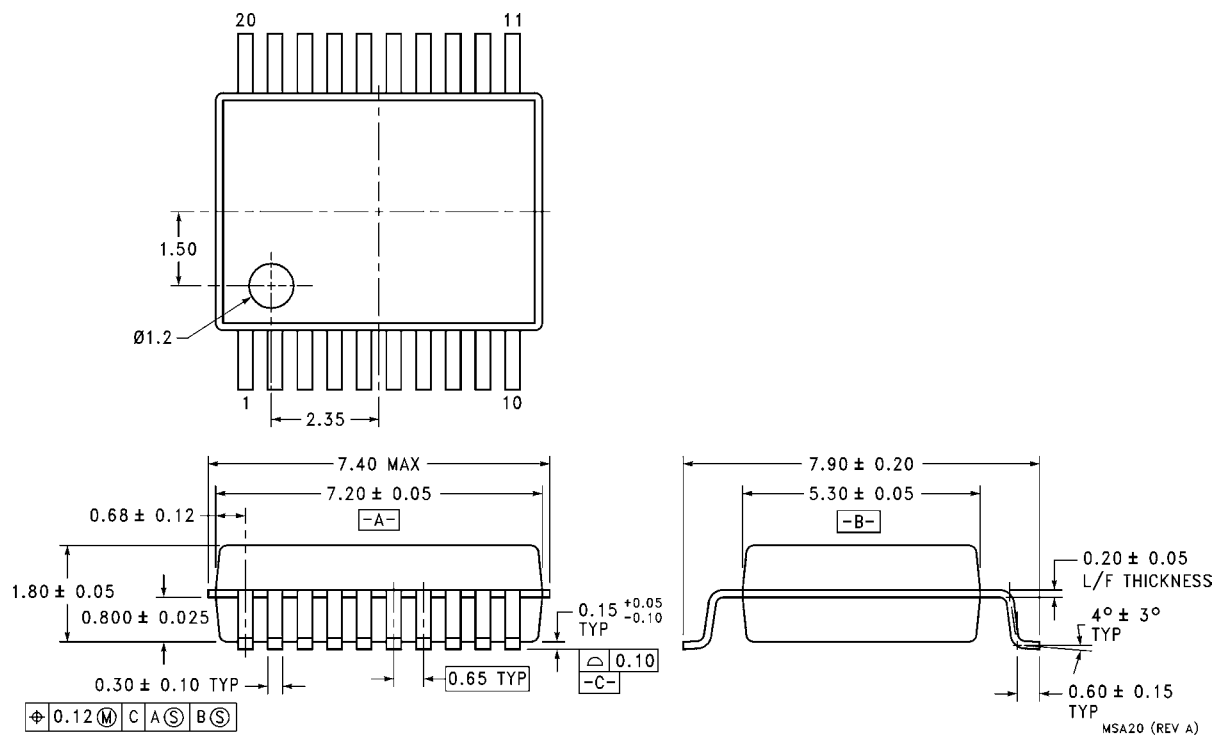
**NOTES:**

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

MLP020BrevA

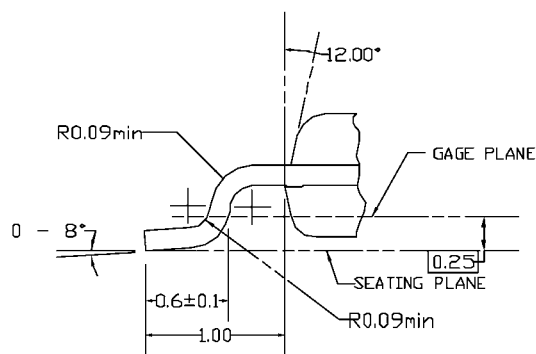
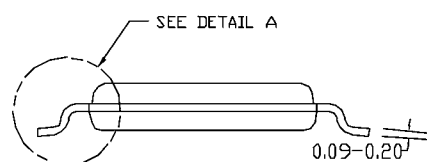
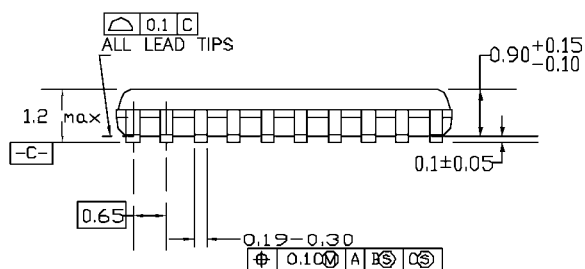
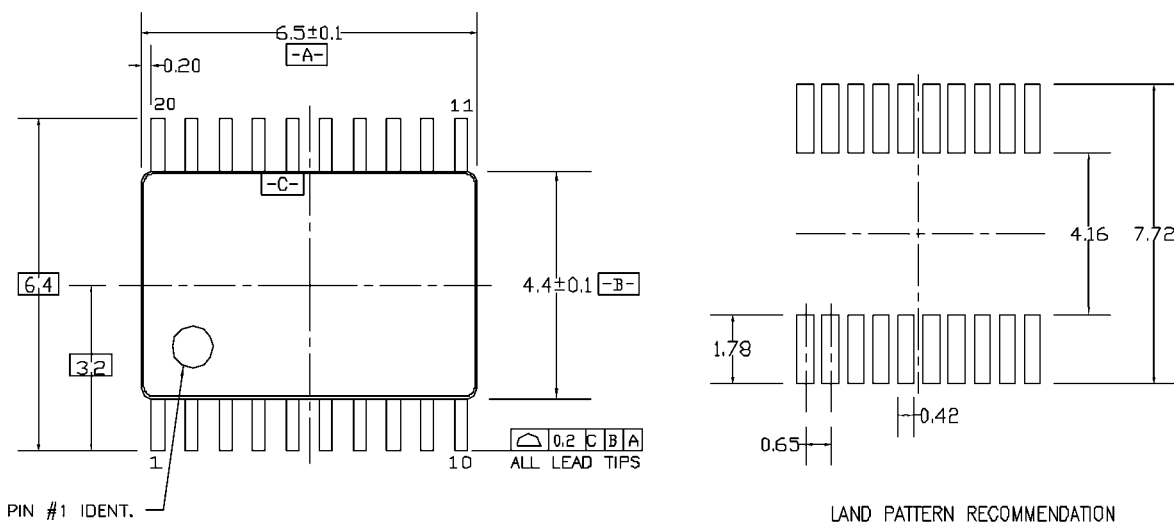
**Pb-Free 20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN),  
JEDEC MO-241, 2.5 x 4.5mm Package Number MLP020B**

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



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

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



DETAIL A

**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

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

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ActiveArray <sup>TM</sup>	FAST <sup>r</sup> <sup>TM</sup>	LittleFET <sup>TM</sup>	PowerTrench <sup>®</sup>	SuperSOT <sup>TM</sup> -8
Bottomless <sup>TM</sup>	FPS <sup>TM</sup>	MICROCOUPLER <sup>TM</sup>	QFET <sup>®</sup>	SyncFET <sup>TM</sup>
Build it Now <sup>TM</sup>	FRFET <sup>TM</sup>	MicroFET <sup>TM</sup>	QS <sup>TM</sup>	TCM <sup>TM</sup>
CoolFET <sup>TM</sup>	GlobalOptoisolator <sup>TM</sup>	MicroPak <sup>TM</sup>	QT Optoelectronics <sup>TM</sup>	TinyLogic <sup>®</sup>
CROSSVOLT <sup>TM</sup>	GTO <sup>TM</sup>	MICROWIRE <sup>TM</sup>	Quiet Series <sup>TM</sup>	TINYOPTO <sup>TM</sup>
DOME <sup>TM</sup>	HiSeC <sup>TM</sup>	MSX <sup>TM</sup>	RapidConfigure <sup>TM</sup>	TruTranslation <sup>TM</sup>
EcoSPARK <sup>TM</sup>	I <sup>2</sup> C <sup>TM</sup>	MSXPro <sup>TM</sup>	RapidConnect <sup>TM</sup>	UHC <sup>TM</sup>
E <sup>2</sup> CMOS <sup>TM</sup>	i-Lo <sup>TM</sup>	OCX <sup>TM</sup>	μSerDes <sup>TM</sup>	UltraFET <sup>®</sup>
EnSigna <sup>TM</sup>	ImpliedDisconnect <sup>TM</sup>	OCXPro <sup>TM</sup>	ScalarPump <sup>TM</sup>	UniFET <sup>TM</sup>
FACT <sup>TM</sup>	IntelliMAX <sup>TM</sup>	OPTOLOGIC <sup>®</sup>	SILENT SWITCHER <sup>®</sup>	VCX <sup>TM</sup>
FACT Quiet Series <sup>TM</sup>		OPTOPLANAR <sup>TM</sup>	SMART START <sup>TM</sup>	Wire <sup>TM</sup>
Across the board. Around the world. <sup>TM</sup>		PACMAN <sup>TM</sup>	SPM <sup>TM</sup>	
The Power Franchise <sup>®</sup>		POP <sup>TM</sup>	Stealth <sup>TM</sup>	
Programmable Active Droop <sup>TM</sup>		Power247 <sup>TM</sup>	SuperFET <sup>TM</sup>	
		PowerEdge <sup>TM</sup>	SuperSOT <sup>TM</sup> -3	

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