

## 74LCXH245

### Low Voltage Bidirectional Transceiver with Bushold

#### General Description

The LCXH245 contains eight non-inverting bidirectional buffers with 3-STATE outputs and is intended for bus oriented applications. The device is designed for low voltage (2.5V and 3.3V)  $V_{CC}$  applications. The  $T/\bar{R}$  input determines the direction of data flow through the device. The  $\overline{OE}$  input disables both the A and B ports by placing them in a high impedance state.

The LCXH245 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation. The LCXH16244 data inputs include active bushold circuitry, eliminating the need for external pull-up resistors to hold unused or floating data inputs at a valid logic level.

#### Features

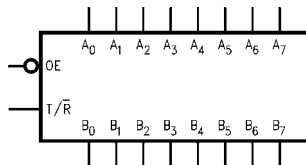
- 5V tolerant control inputs
- 2.3V–3.6V  $V_{CC}$  specifications provided
- 7.0 ns  $t_{PD}$  max ( $V_{CC} = 3.3V$ ), 10  $\mu A$   $I_{CC}$  max
- Power down high impedance outputs
- $\pm 24$  mA output drive ( $V_{CC} = 3.0V$ )
- Implements patented noise/EMI reduction circuitry
- Latch-up performance exceeds 500 mA
- Bushold on inputs eliminates the need for external pull-up/pull-down resistors
- ESD performance:
  - Human body model > 2000V
  - Machine model > 200V

#### Ordering Code:

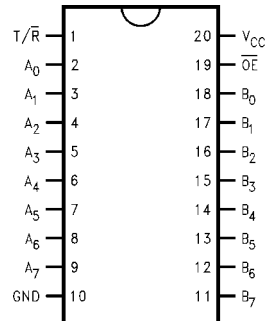
Order Number	Package Number	Package Description
74LCXH245WM	M20B	20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
74LCXH245SJ	M20D	20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74LCXH245MSA	MSA20	20-Lead Shrink Small Outline Package (SSOP), EIAJ TYPE II, 5.3mm Wide
74LCXH245MTC	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
$\overline{OE}$	Output Enable Input
$T/\bar{R}$	Transmit/Receive Input
$A_0$ – $A_7$	Side A Inputs or 3-STATE Outputs (Bushold)
$B_0$ – $B_7$	Side B Inputs or 3-STATE Outputs (Bushold)

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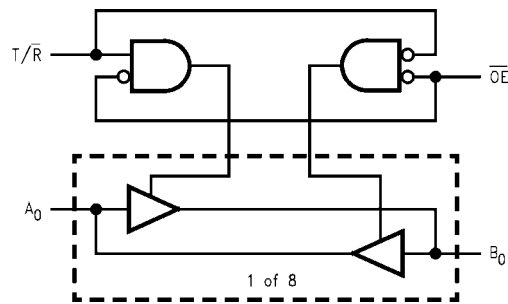
**Truth Table**

Inputs		Outputs
$\overline{OE}$	$\overline{T/R}$	
L	L	Bus B <sub>0</sub> – B <sub>7</sub> Data to Bus A <sub>0</sub> – A <sub>7</sub>
L	H	Bus A <sub>0</sub> – A <sub>7</sub> Data to Bus B <sub>0</sub> – B <sub>7</sub>
H	X	HIGH Z State on A <sub>0</sub> – A <sub>7</sub> , B <sub>0</sub> – B <sub>7</sub> (Note 1)

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

**Note 1:** Unused bus terminals during HIGH Z State must be held HIGH or LOW.

**Logic Diagram**



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>	T/ $\bar{R}$ , OE I/O Ports	0.5 to +7.0 -0.5 to V <sub>CC</sub> + 0.5		V
V <sub>O</sub>	DC Output Voltage	-0.5 to +7.0 -0.5 to V <sub>CC</sub> + 0.5	Output in 3-STATE 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 +50	V <sub>O</sub> < GND 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 <sup>(Note 4)</sup>					
Symbol	Parameter	Min	Max	Units	
V <sub>CC</sub>	Supply Voltage				
		Operating	2.0	3.6	V
		Data Retention	1.5	3.6	V
V <sub>I</sub>	Input Voltage	0	V <sub>CC</sub>	V	
V <sub>O</sub>	Output Voltage				
		HIGH or LOW State	0	V <sub>CC</sub>	V
		3-STATE	0	5.5	V
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	mA
		V <sub>CC</sub> = 2.3V - 2.7V		±8	mA
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:** Floating or unused control inputs must be HIGH or LOW.

### 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> = 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	V <sub>I</sub> = V <sub>CC</sub> or GND	2.3 - 3.6		±5.0	μA

## DC Electrical Characteristics (Continued)

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = -40°C to +85°C		Units
				Min	Max	
I <sub>I(HOLD)</sub>	Bushold Input Minimum Drive Hold Current	V <sub>IN</sub> = 0.7V	2.3	45		μA
		V <sub>IN</sub> = 1.7V		-45		
		V <sub>IN</sub> = 0.8V	3.0	75		
		V <sub>IN</sub> = 2.0V		-75		
I <sub>I(OD)</sub>	Bushold Input Over-Drive Current to Change State	(Note 6)	2.7	300		μA
		(Note 7)		-300		
		(Note 6)	3.6	450		
		(Note 7)		-450		
I <sub>OZ</sub>	3-STATE I/O Leakage	V <sub>O</sub> = V <sub>CC</sub> or GND	2.3 - 3.6		±5.0	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

**Note 5:** Outputs disabled or 3-STATE only.

**Note 6:** An external driver must source at least the specified current to switch from LOW-to-HIGH.

**Note 7:** An external driver must sink at least the specified current to switch from HIGH-to-LOW.

## 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> = 50 pF		C <sub>L</sub> = 50 pF		C <sub>L</sub> = 30 pF		
		Min	Max	Min	Max	Min	Max	
t <sub>PHL</sub>	Propagation Delay	1.5	7.0	1.5	8.0	1.5	8.4	ns
t <sub>PLH</sub>	A <sub>n</sub> to B <sub>n</sub> or B <sub>n</sub> to A <sub>n</sub>	1.5	7.0	1.5	8.0	1.5	8.4	
t <sub>PZL</sub>	Output Enable Time	1.5	8.5	1.5	9.5	1.5	10.5	ns
t <sub>PZH</sub>	Output Enable Time	1.5	8.5	1.5	9.5	1.5	10.5	
t <sub>PLZ</sub>	Output Disable Time	1.5	7.5	1.5	8.5	1.5	9.0	ns
t <sub>PHZ</sub>	Output Disable Time	1.5	7.5	1.5	8.5	1.5	9.0	
t <sub>OSSL</sub>	Output to Output Skew (Note 8)		1.0					ns
t <sub>OSLH</sub>			1.0					

**Note 8:** 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>).

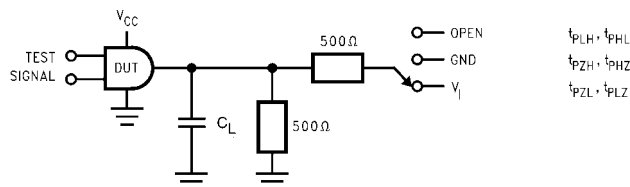
## Dynamic Switching Characteristics

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> = 50 pF, V <sub>IH</sub> = 3.3V, V <sub>IL</sub> = 0V C <sub>L</sub> = 30 pF, V <sub>IH</sub> = 2.5V, V <sub>IL</sub> = 0V	3.3 2.5	0.8 0.6	V
V <sub>OLV</sub>	Quiet Output Dynamic Valley V <sub>OL</sub>	C <sub>L</sub> = 50 pF, V <sub>IH</sub> = 3.3V, V <sub>IL</sub> = 0V C <sub>L</sub> = 30 pF, V <sub>IH</sub> = 2.5V, V <sub>IL</sub> = 0V	3.3 2.5	-0.8 -0.6	

## Capacitance

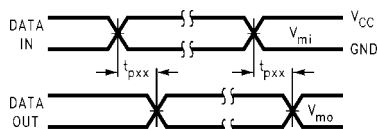
Symbol	Parameter	Conditions	Typical	Units
C <sub>IN</sub>	Input Capacitance	V <sub>CC</sub> = Open, V <sub>I</sub> = 0V or V <sub>CC</sub>	7	pF
C <sub>I/O</sub>	Input/Output Capacitance	V <sub>CC</sub> = 3.3V, V <sub>I</sub> = 0V or V <sub>CC</sub>	8	pF
C <sub>PD</sub>	Power Dissipation Capacitance	V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

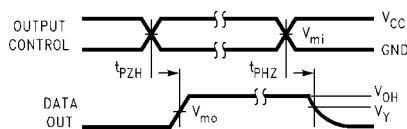


**FIGURE 1. AC Test Circuit** ( $C_L$  includes probe and jig capacitance)

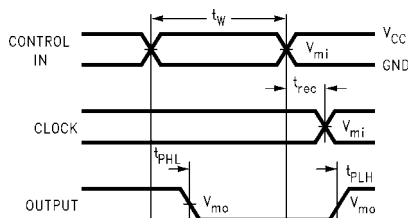
Test	Switch
$t_{PLH}$ , $t_{PHL}$	Open
$t_{PZL}$ , $t_{PLZ}$	6V at $V_{CC} = 3.3 \pm 0.3V$ ; and 2.7V $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$
$t_{PZH}$ , $t_{PHZ}$	GND



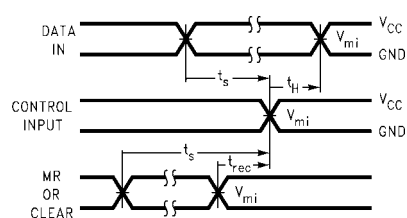
**Waveform for Inverting and Non-Inverting Functions**



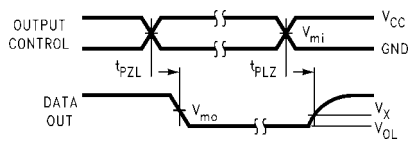
**3-STATE Output High Enable and Disable Times for Logic**



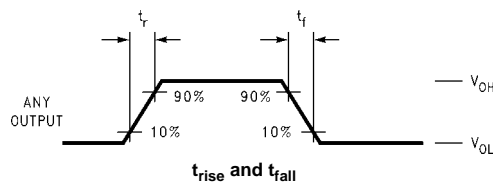
**Propagation Delay, Pulse Width and  $t_{rec}$  Waveforms**



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



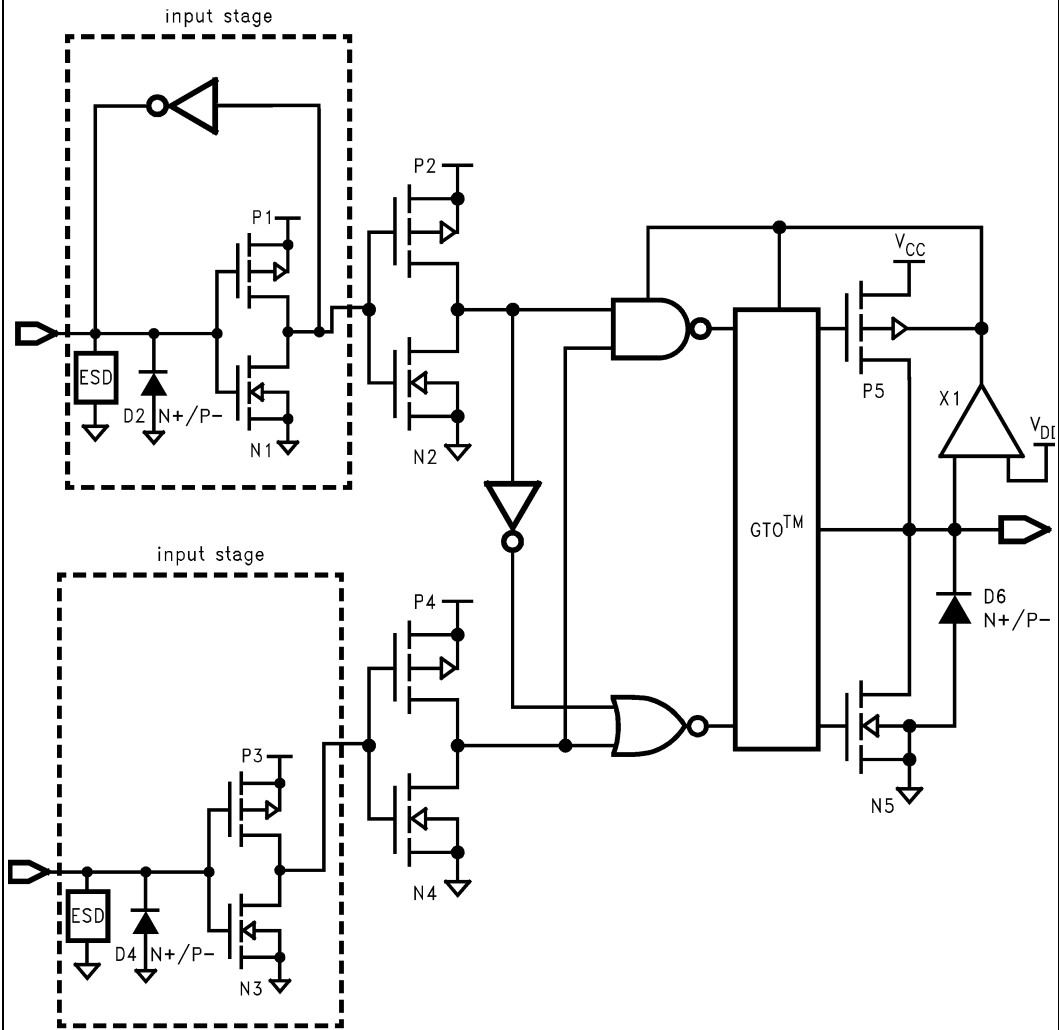
**3-STATE Output Low Enable and Disable Times for Logic**



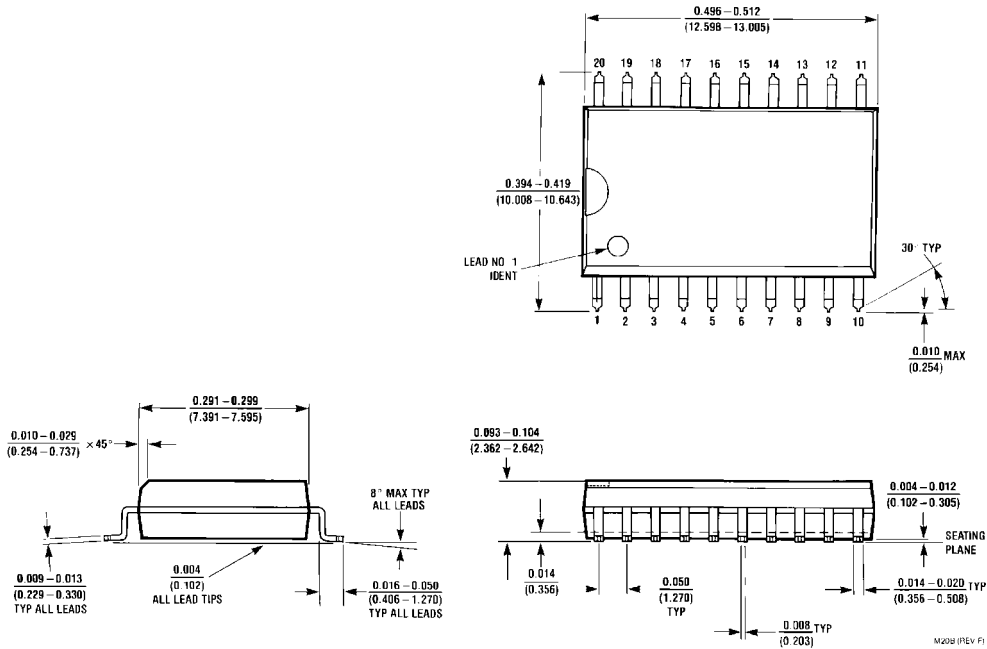
**FIGURE 2. Waveforms**  
(Input Characteristics;  $f = 1MHz$ ,  $t_r = t_f = 3ns$ )

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 LCXH Family (with Bushold)

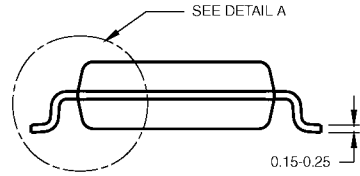
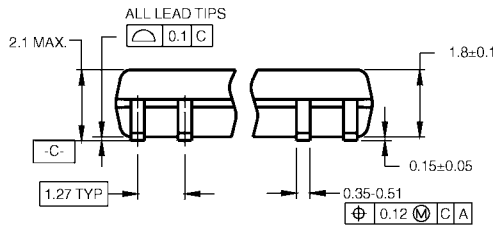
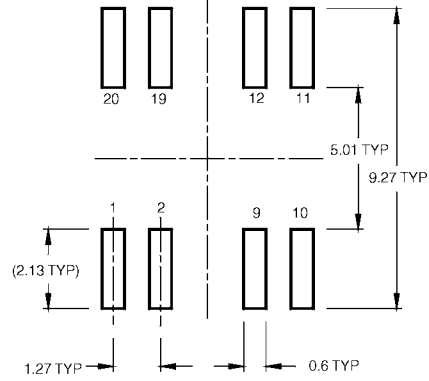
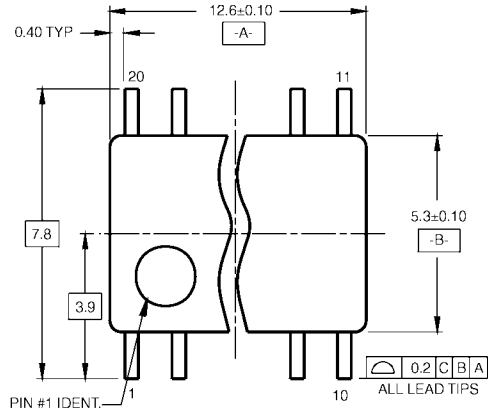


**Physical Dimensions** inches (millimeters) unless otherwise noted



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

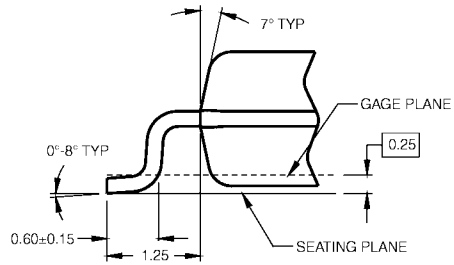
**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



DIMENSIONS ARE IN MILLIMETERS

- 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

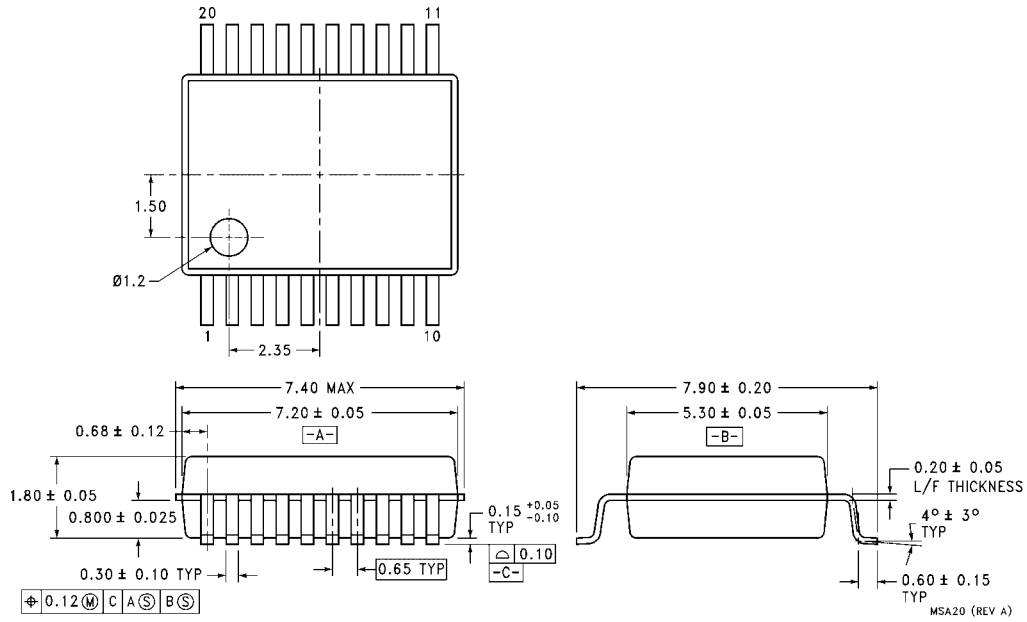


DETAIL A

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

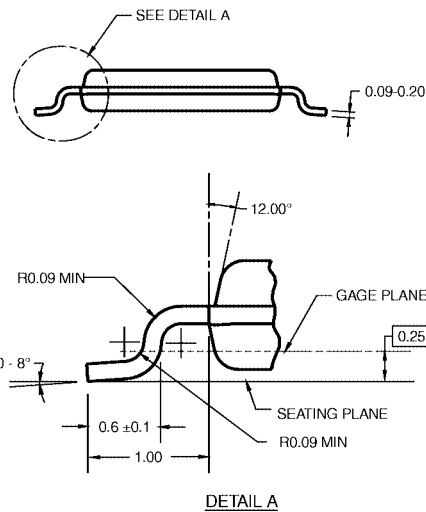
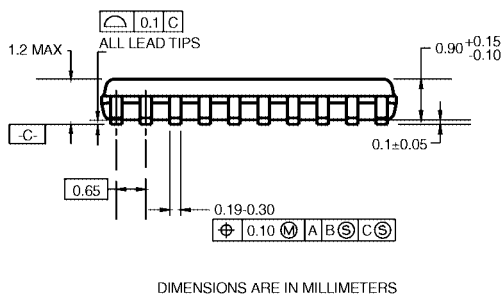
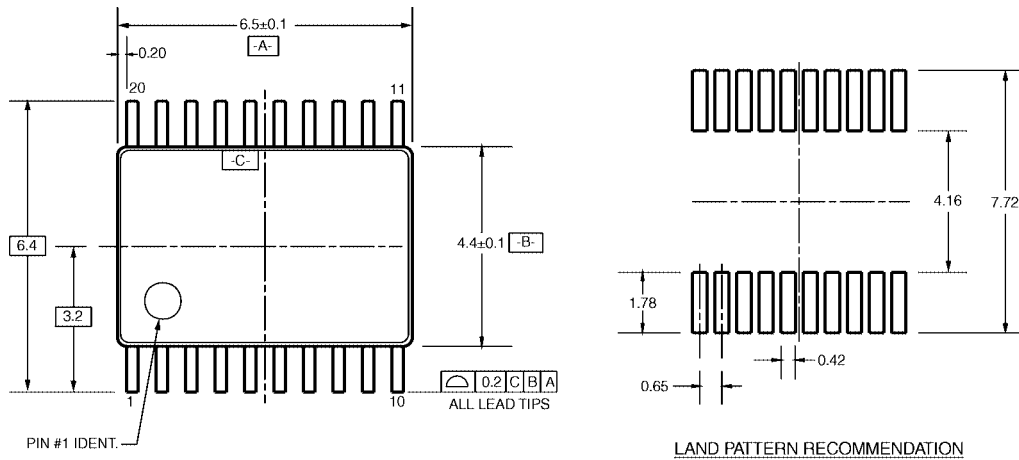


**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



**20-Lead Shrink Small Outline Package (SSOP), EIAJ TYPE II, 5.3mm Wide Package Number MSA20**

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



- 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, MOLD FLASH, AND TIE BAR EXTRUSIONS.
  - 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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