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December 2013

# 74LCX245 Low Voltage Bidirectional Transceiver with 5V Tolerant Inputs and Outputs

#### **Features**

- 5V tolerant inputs and outputs
- 2.3V to 3.6V V<sub>CC</sub> specifications provided
- 7.0ns  $t_{PD}$  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>
- $\pm 24$ mA output drive ( $V_{CC} = 3.0$ V)
- Implements proprietary noise/EMI reduction circuitry
- Latch-up performance exceeds 500mA
- ESD performance:
  - Human body model > 2000V
  - Machine model > 200V
- Leadless DQFN package

#### Note:

 To ensure the high-impedance state during power up or down, OE should be tied to V<sub>CC</sub> through a pull-up resistor: the minimum value or the resistor is determined by the current-sourcing capability of the driver.

# **General Description**

The LCX245 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 with capability of interfacing to a 5V signal environment. The  $T/\overline{R}$  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 LCX245 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
74LCX245WM	M20B	20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
74LCX245SJ	M20D	20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74LCX245BQX <sup>(2)</sup>	MLP20B	20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm
74LCX245MSA	MSA20	20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide
74LCX245MTC	MTC20	20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

#### Note:

2. DQFN package available in Tape and Reel only.

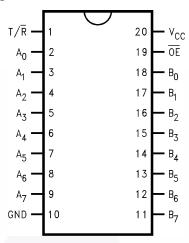
Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering number.



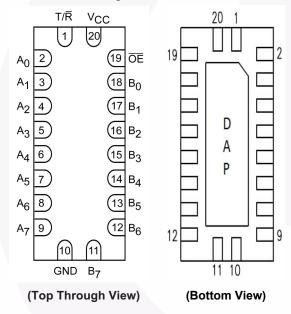
All packages are lead free per JEDEC: J-STD-020B standard.

# **Connection Diagrams**

Pin Assignments for SOIC, SOP, SSOP, and TSSOP



Pin Assignment for DQFN

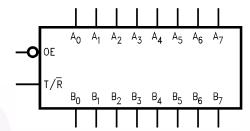


# **Pin Description**

Pin Names	Description		
ŌĒ	Output Enable Input		
T/R	Transmit/Receive Input		
A <sub>0</sub> -A <sub>7</sub>	Side A Inputs or 3-STATE Outputs		
B <sub>0</sub> –B <sub>7</sub>	Side B Inputs or 3-STATE Outputs		
DAP	No Connect		

Note: DAP (Die Attach Pad)

# **Logic Symbol**



#### **Truth Table**

Inputs			
OE	T/R	Outputs	
L	L	Bus B <sub>0</sub> – B <sub>7</sub> Data to Bus A <sub>0</sub> – A <sub>7</sub>	
L	Н	Bus $A_0 - A_7$ Data to Bus $B_0 - B_7$	
Н	Х	HIGH Z State on A <sub>0</sub> – A <sub>7</sub> , B <sub>0</sub> – B <sub>7</sub> <sup>(3)</sup>	

H = HIGH Voltage Level

L = LOW Voltage Level

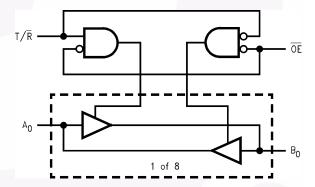
X = Immaterial

Z = High Impedance

#### Note:

3. Unused bus terminals during HIGH Z State must be held HIGH or LOW.

# **Logic Diagram**



## **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	Rating
V <sub>CC</sub>	Supply Voltage	-0.5V to +7.0V
V <sub>I</sub>	DC Input Voltage	-0.5V to +7.0V
Vo	DC Output Voltage	
	Output in 3-STATE	-0.5V to +7.0V
	Output in HIGH or LOW State <sup>(4)</sup>	-0.5V to V <sub>CC</sub> + 0.5V
I <sub>IK</sub>	DC Input Diode Current, V <sub>I</sub> < GND	_50mA
I <sub>OK</sub>	DC Output Diode Current	
	V <sub>O</sub> < GND	_50mA
	$V_O > V_{CC}$	+50mA
Io	DC Output Source/Sink Current	±50mA
I <sub>CC</sub>	DC Supply Current per Supply Pin	±100mA
I <sub>GND</sub>	DC Ground Current per Ground Pin	±100mA
T <sub>STG</sub>	Storage Temperature	−65°C to +150°C

#### Note:

4. IO Absolute Maximum Rating must be observed.

# 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	Min.	Max.	Units
V <sub>CC</sub>	Supply Voltage			
	Operating	2.0	3.6	V
	Data Retention	1.5	3.6	
VI	Input Voltage	0	5.5	V
Vo	Output Voltage			
	3-STATE		5.5	V
	HIGH or LOW State	0	V <sub>CC</sub>	
I <sub>OH</sub> / I <sub>OL</sub>	Output Current			
	$V_{CC} = 3.0V - 3.6V$		±24	mA
	$V_{CC} = 2.7V - 3.0V$		±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

5. Unused inputs must be held HIGH or LOW. They may not float.

#### **DC Electrical Characteristics**

				$T_A = -40$ °C	to +85°C	
Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	Min.	Max.	Units
V <sub>IH</sub>	HIGH Level Input Voltage	2.3–2.7		1.7		V
		2.7–3.6	1	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	2.3–3.6	$I_{OH} = -100 \mu A$	V <sub>CC</sub> - 0.2		V
		2.3	$I_{OH} = -8mA$	1.8		
		2.7	$I_{OH} = -12mA$	2.2		
		3.0	$I_{OH} = -18mA$	2.4		
			$I_{OH} = -24mA$	2.2		
V <sub>OL</sub>	LOW Level Output Voltage	2.3–3.6	$I_{OL} = 100 \mu A$		0.2	V
		2.3	$I_{OL} = 8mA$		0.6	
		2.7	I <sub>OL</sub> = 12mA		0.4	
		3.0	I <sub>OL</sub> = 16mA		0.4	
			I <sub>OL</sub> = 24mA		0.55	
I <sub>I</sub>	Input Leakage Current	2.3–3.6	$0 \le V_I \le 5.5V$		±5.0	μA
I <sub>OZ</sub>	3-STATE Output Leakage	2.3–3.6	$0 \le V_O \le 5.5V$ , $V_I = V_{IH} \text{ or } V_{IL}$		±5.0	μΑ
I <sub>OFF</sub>	Power-Off Leakage Current	0	$V_I$ or $V_O = 5.5V$		10	μA
I <sub>CC</sub>	Quiescent Supply Current	2.3–3.6	$V_I = V_{CC}$ or GND		10	μA
			$3.6V \le V_I, V_O \le 5.5V^{(6)}$		±10	
$\Delta I_{CC}$	Increase in I <sub>CC</sub> per Input	2.3-3.6	$V_{IH} = V_{CC} - 0.6V$		500	μΑ

#### Note:

6. Outputs disabled or 3-STATE only.

#### **AC Electrical Characteristics**

		$T_A = -40$ °C to +85°C, $R_L = 500\Omega$						
		$\label{eq:VCC} \begin{array}{c} V_{CC} = 3.3 \text{V} \pm 0.3 \text{V}, \\ C_L = 50 \text{pF} \end{array}$		$V_{CC} = 2.7V,$ $C_L = 50pF$		$\begin{aligned} \text{V}_{\text{CC}} = 2.5 \text{V} \pm 0.2 \text{V}, \\ \text{C}_{\text{L}} = 30 \text{pF} \end{aligned}$		
Symbol	Parameter	Min.	Max.	Min.	Max.	Min.	Max.	Units
t <sub>PHL</sub> , t <sub>PLH</sub>	Propagation Delay, 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	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
toshl, toslh	Output to Output Skew <sup>(7)</sup>		1.0					ns

### Note:

7. 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>OSHL</sub>) or LOW-to-HIGH (t<sub>OSLH</sub>).

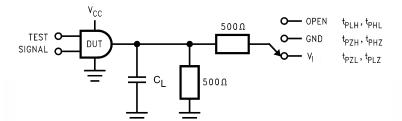
# **Dynamic Switching Characteristics**

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

# Capacitance

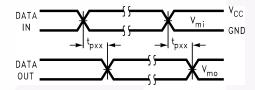
Symbol	Parameter	Conditions	Typical	Units
C <sub>IN</sub>	Input Capacitance	$V_{CC}$ = Open, $V_I$ = 0V or $V_{CC}$	7.0	pF
C <sub>OUT</sub>	Output Capacitance	$V_{CC} = 3.3V$ , $V_I = 0V$ or $V_{CC}$	8.0	pF
C <sub>PD</sub>	Power Dissipation Capacitance	$V_{CC} = 3.3V, V_{I} = 0V \text{ or } V_{CC}, f = 10MHz$	25.0	pF

# AC Loading and Waveforms (Generic for LCX Family)

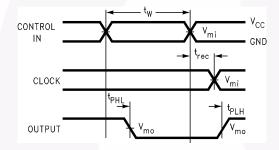


Test	Switch
t <sub>PLH</sub> , t <sub>PHL</sub>	Open
$t_{PZL}, t_{PLZ}$	6V at $V_{CC} = 3.3 \pm 0.3V$ $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$
$t_{PZH},t_{PHZ}$	GND

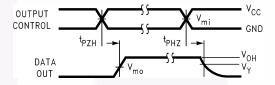
Figure 1. AC Test Circuit (C<sub>L</sub> includes probe and jig capacitance)



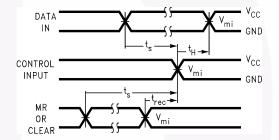
#### **Waveform for Inverting and Non-Inverting Functions**



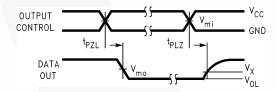
Propagation Delay. Pulse Width and  $t_{rec}$  Waveforms



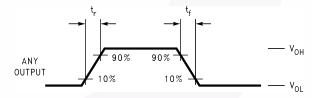
3-STATE Output High Enable and Disable Times for Logic



Setup Time, Hold Time and Recovery Time for Logic



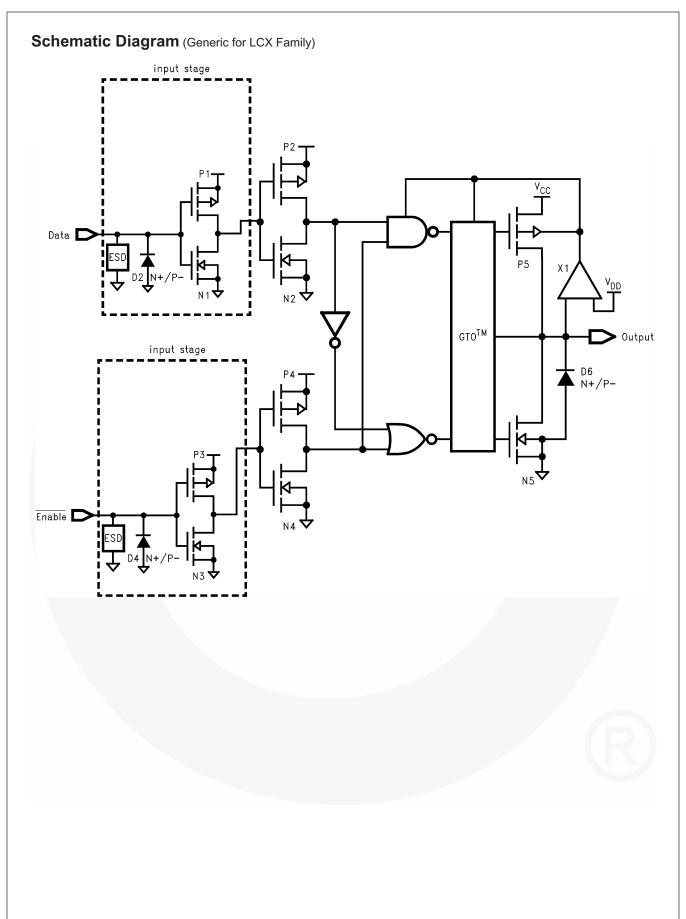
3-STATE Output Low Enable and Disable Times for Logic



t<sub>rise</sub> and t<sub>fall</sub>

	V <sub>CC</sub>				
Symbol	3.3V ± 0.3V	2.7V	2.5V ± 0.2V		
V <sub>mi</sub>	1.5V	1.5V	V <sub>CC</sub> /2		
V <sub>mo</sub>	1.5V	1.5V	V <sub>CC</sub> /2		
V <sub>x</sub>	V <sub>OL</sub> + 0.3V	V <sub>OL</sub> + 0.3V	V <sub>OL</sub> + 0.15V		
V <sub>y</sub>	V <sub>OH</sub> – 0.3V	V <sub>OH</sub> – 0.3V	V <sub>OH</sub> – 0.15V		

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

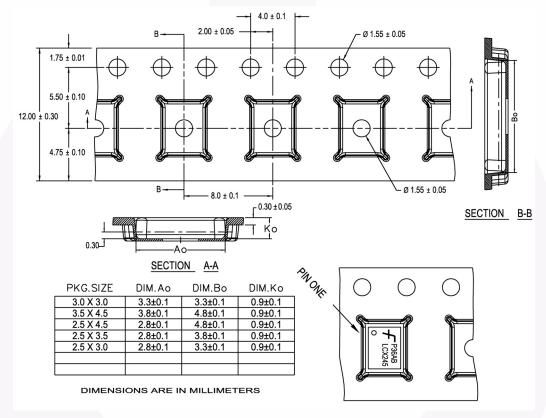


# **Tape and Reel Specification**

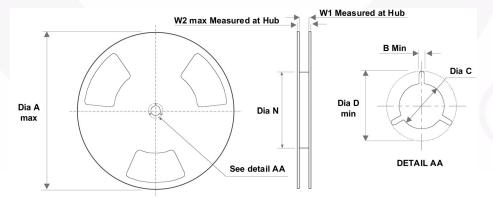
#### **Tape Format for DQFN**

Package Designator	Tape Section	Number of 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 Dimension inches (millimeters)



#### Reel Dimensions inches (millimeters)

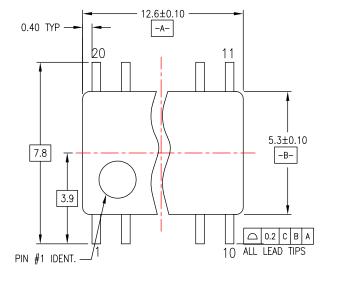


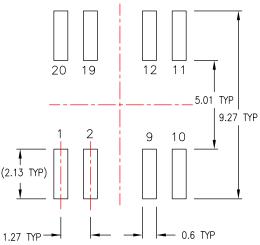
Tape Size	Α	В	С	D	N	W1	W2
12mm	13.0 (330.0)	0.059 (1.50)	0.512 (13.00)	0.795 (20.20)	2.165 (55.00)	0.488 (12.4)	0.724 (18.4)

## **Physical Dimensions** 13.00 12.60 11.43 В 9.50 10.65 7.60 10.00 7.40 PIN ONE 0.35 INDICATOR **⊕** 0.25 **M** C B A LAND PATTERN RECOMMENDATION 2.65 MAX SEE DETAIL A 0.33 0.20 △ 0.10 C 0.30 0.10 0.75 SEATING PLANE NOTES: UNLESS OTHERWISE SPECIFIED (R0.10) A) THIS PACKAGE CONFORMS TO JEDEC GAGE PLANE MS-013, VARIATION AC, ISSUE E (R0.10) B) ALL DIMENSIONS ARE IN MILLIMETERS. 0.25 C) DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS. D) CONFORMS TO ASME Y14.5M-1994 0.40 SEATING PLANE E) LANDPATTERN STANDARD: SOIC127P1030X265-20L (1.40)DETAIL A F) DRAWING FILENAME: MKT-M20BREV3

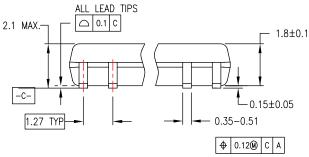
Figure 3. 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide

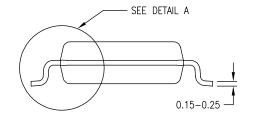
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LAND PATTERN RECOMMENDATION



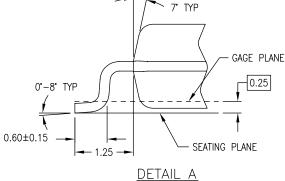


DIMENSIONS ARE IN MILLIMETERS

## 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.



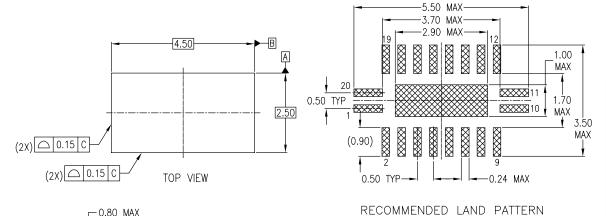
M20DREVC

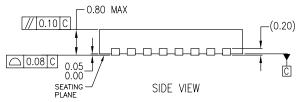
Figure 4. 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide

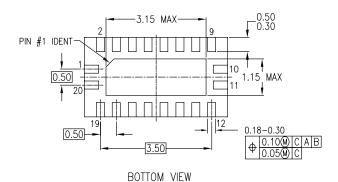
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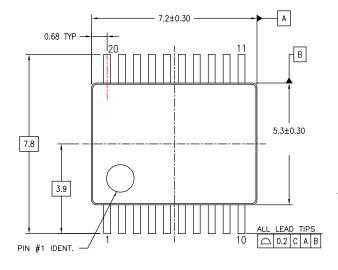
#### NOTES:

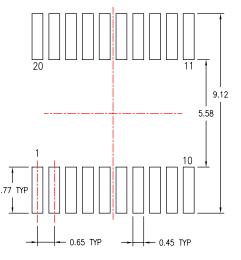
- A. CONFORMS TO JEDEC REGISTRATION MO-241, VARIATION AC
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

MLP20BrevA

#### Figure 5. 20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm

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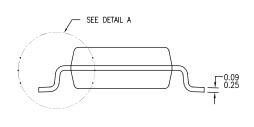


LAND PATTERN RECOMMENDATIONS

2.0 MAX. 1.75±0.04

0.65 TYP 0.22-0.38

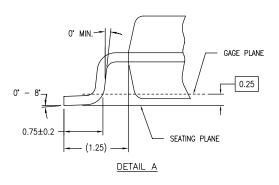
0.13±0.08



#### DIMENSIONS ARE IN MILLIMETERS

#### NOTES:

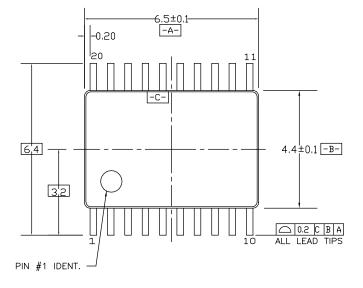
- A. CONFORMS TO JEDEC REGISTRATION MO-150, VARIATION AE, DATE 1/94.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- D. DIMENSIONS AND TOLERANCES PER ASME Y14.5M 1994.

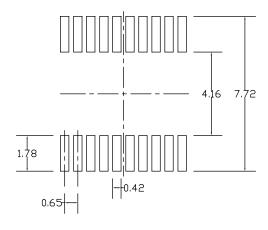


# MSA20REVB

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

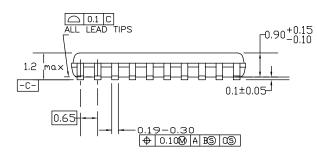
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LAND PATTERN RECOMMENDATION

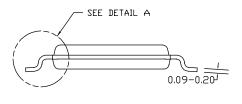
-12.00°

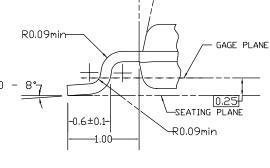




#### NOTES:

- A. CONFORMS TO JEDEC REGISTRATION MD-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.





DETAIL A

MTC20REVD1

## Figure 8. 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

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