



March 1995

Revised March 2005

74LCX540

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

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.

Features

- 5V tolerant inputs and outputs
- 2.3V–3.6V V_{CC} specifications provided
- 6.5 ns t_{PD} max ($V_{CC} = 3.3V$), 10 μA I_{CC} max
- Power down high impedance inputs and outputs
- Supports live insertion/withdrawal (Note 1)
- 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

Note 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 or the resistor is determined by the current-sourcing capability of the driver.

Ordering Code:

Order Number	Package Number	Package Description
74LCX540WM	M20B	20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
74LCX540SJ	M20D	Pb-Free 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74LCX540BQX (Preliminary) (Note 2)	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 (Note 3)	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.

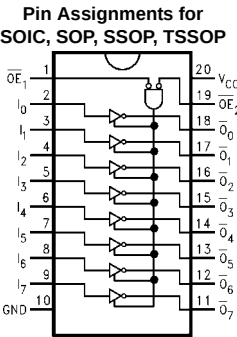
Note 2: DQFN package available in Tape and Reel only.

Note 3: "_NL" indicates Pb-Free package (per JEDEC J-STD-020B). Device available in Tape and Reel only.

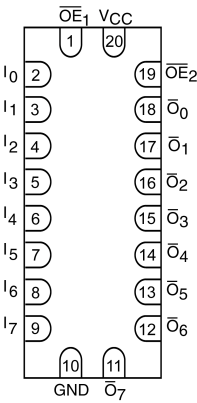
74LCX540 Low Voltage Octal Buffer/Line Driver with 5V Tolerant Inputs and Outputs



Connection Diagrams

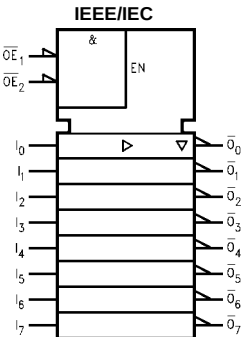


Pad Assignments for DQFN



(Top View)

Logic Symbol



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

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

Absolute Maximum Ratings(Note 4)

Symbol	Parameter	Value	Conditions	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	-0.5 to +7.0 -0.5 to $V_{CC} + 0.5$	Output in 3-STATE Output in HIGH or LOW State (Note 5)	V
I_{IK}	DC Input Diode Current	-50	$V_I < GND$	mA
I_{OK}	DC Output Diode Current	-50 +50	$V_O < GND$ $V_O > V_{CC}$	mA
I_O	DC Output Source/Sink Current	±50		mA
I_{CC}	DC Supply Current per Supply Pin	±100		mA
I_{GND}	DC Ground Current per Ground Pin	±100		mA
T_{STG}	Storage Temperature	-65 to +150		°C

Recommended Operating Conditions (Note 6)

Symbol	Parameter	Min	Max	Units
V_{CC}	Supply Voltage			
	Operating	2.0	3.6	V
	Data Retention	1.5	3.6	V
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	V
I_{OH}/I_{OL}	Output Current			
	$V_{CC} = 3.0V - 3.6V$		±24	mA
	$V_{CC} = 2.7V - 3.0V$		±12	mA
	$V_{CC} = 2.3V - 2.7V$		±8	mA
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

Note 4: 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 5: I_O Absolute Maximum Rating must be observed.

Note 6: Unused (inputs or I/O's) must be held HIGH or LOW. They may not float.

DC Electrical Characteristics

Symbol	Parameter	Conditions	V_{CC} (V)	$T_A = -40^\circ C$ to $-85^\circ C$		Units
				Min	Max	
V_{IH}	HIGH Level Input Voltage		2.3 - 2.7 2.7 - 3.6	1.7 2.0		V
V_{IL}	LOW Level Input Voltage		2.3 - 2.7 2.7 - 3.6		0.7 0.8	V
V_{OH}	HIGH Level Output Voltage	$I_{OH} = -100 \mu A$ $I_{OH} = -8 \text{ mA}$ $I_{OH} = -12 \text{ mA}$ $I_{OH} = -18 \text{ mA}$ $I_{OH} = -24 \text{ mA}$	2.3 - 3.6 2.3 2.7 3.0 3.0	$V_{CC} - 0.2$ 1.8 2.2 2.4 2.2		V
V_{OL}	LOW Level Output Voltage	$I_{OL} = 100 \mu A$ $I_{OL} = 8 \text{ mA}$ $I_{OL} = 12 \text{ mA}$ $I_{OL} = 16 \text{ mA}$ $I_{OL} = 24 \text{ mA}$	2.3 - 3.6 2.3 2.7 3.0 3.0		0.2 0.6 0.4 0.4 0.55	V
I_I	Input Leakage Current	$0 \leq V_I \leq 5.5V$	2.3 - 3.6		±5.0	μA
I_{OZ}	3-STATE Output Leakage	$0 \leq V_O \leq 5.5V$ $V_I = V_{IH}$ or V_{IL}	2.3 - 3.6		±5.0	μA
I_{OFF}	Power-Off Leakage Current	V_I or $V_O = 5.5V$	0		10	μA

DC Electrical Characteristics (Continued)

Symbol	Parameter	Conditions	V _{CC} (V)	T _A = -40°C to +85°C		Units
				Min	Max	
I _{CC}	Quiescent Supply Current	V _I = V _{CC} or GND	2.3 – 3.6		10	μA
		3.6V ≤ V _I , V _O ≤ 5.5V (Note 7)	2.3 – 3.6		±10	
ΔI _{CC}	Increase in I _{CC} per Input	V _{IH} = V _{CC} – 0.6V	2.3 – 3.6		500	μA

Note 7: Outputs disabled or 3-STATE only.

AC Electrical Characteristics

Symbol	Parameter	T _A = -40°C to +85°C, R _L = 500Ω						Units
		V _{CC} = 3.3V ± 0.3V		V _{CC} = 2.7V		V _{CC} = 2.5V ± 0.2V		
		C _L = 50pF		C _L = 50pF		C _L = 30 pF		
		Min	Max	Min	Max	Min	Max	
t _{PHL}	Propagation Delay	1.5	6.5	1.5	7.5	1.5	7.8	ns
t _{PLH}		1.5	6.5	1.5	7.5	1.5	7.8	
t _{PZL}	Output Enable Time	1.5	8.5	1.5	9.5	1.5	10.5	ns
t _{PZH}		1.5	8.5	1.5	9.5	1.5	10.5	
t _{PLZ}	Output Disable Time	1.5	7.5	1.5	8.5	1.5	9.0	ns
t _{PHZ}		1.5	7.5	1.5	8.5	1.5	9.0	
t _{OSHL}	Output to Output Skew (Note 8)		1.0					ns
t _{OSLH}			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_{OSHL}) or LOW-to-HIGH (t_{OSLH}).

Dynamic Switching Characteristics

Symbol	Parameter	Conditions	V _{CC} (V)	T _A = 25°C	Units
				Typical	
V _{OLP}	Quiet Output Dynamic Peak V _{OL}	C _L = 50 pF, V _{IH} = 3.3V, V _{IL} = 0V	3.3	0.8	V
		C _L = 30 pF, V _{IH} = 2.5V, V _{IL} = 0V	2.5	0.6	
V _{OLV}	Quiet Output Dynamic Valley V _{OL}	C _L = 50 pF, V _{IH} = 3.3V, V _{IL} = 0V	3.3	-0.8	V
		C _L = 30 pF, V _{IH} = 2.5V, V _{IL} = 0V	2.5	-0.6	

Capacitance

Symbol	Parameter	Conditions	Typical	Units
C _{IN}	Input Capacitance	V _{CC} = Open, V _I = 0V or V _{CC}	7	pF
C _{OUT}	Output Capacitance	V _{CC} = 3.3V, V _I = 0V or V _{CC}	8	pF
C _{PD}	Power Dissipation Capacitance	V _{CC} = 3.3V, V _I = 0V or V _{CC} , f = 10 MHz	25	pF

AC LOADING and WAVEFORMS Generic for LCX Family

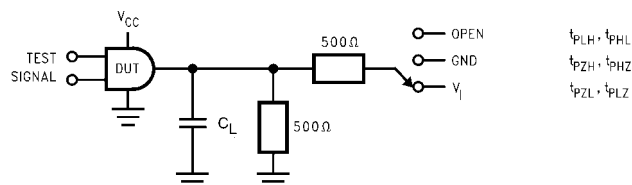
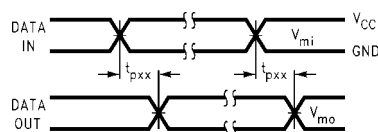
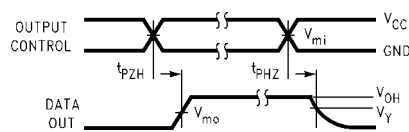


FIGURE 1. AC Test Circuit (C_L includes probe and jig capacitance)

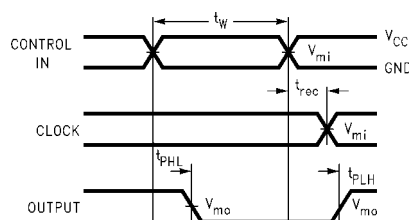
Test	Switch
t_{PLH} , t_{PHL}	Open
t_{PZL} , t_{PLZ}	6V at $V_{CC} = 3.3 \pm 0.3V$ $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$
t_{PZH} , t_{PHZ}	GND



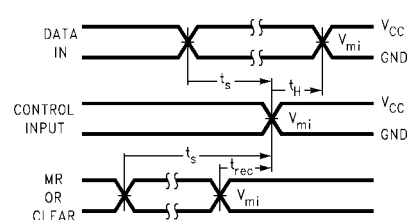
Waveform for Inverting and Non-Inverting Functions



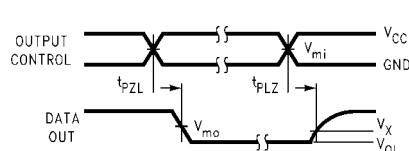
3-STATE Output High Enable and Disable Times for Logic



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

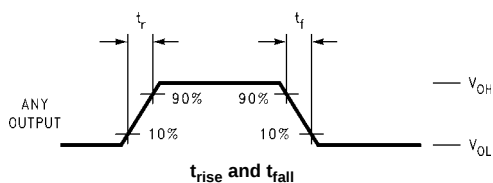
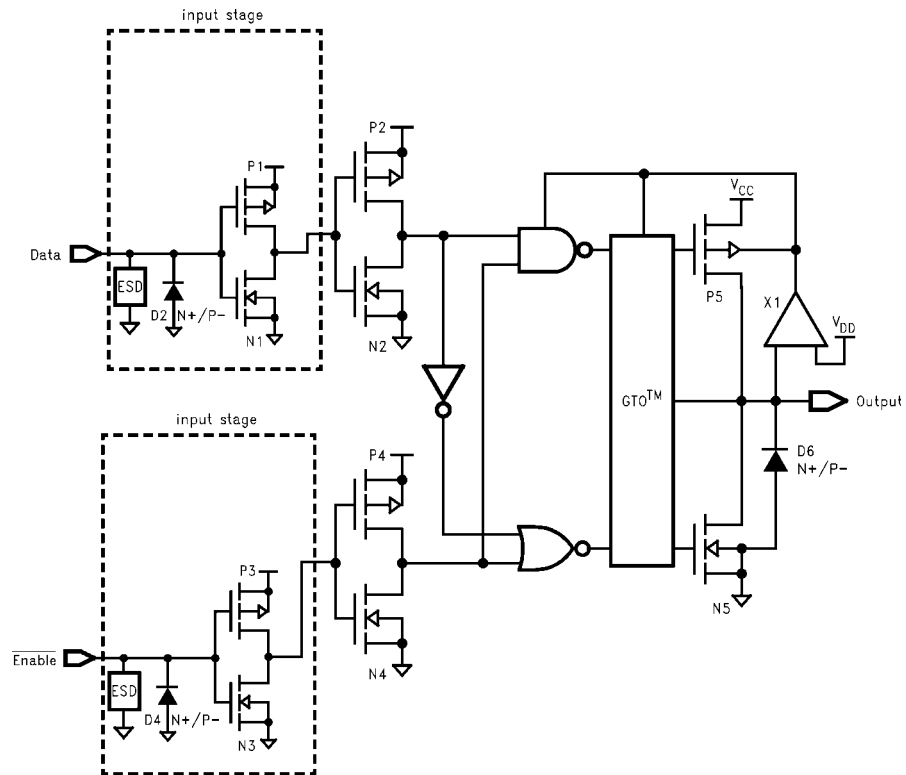


FIGURE 2. Waveforms
(Input Characteristics; $f = 1MHz$, $t_R = t_F = 3ns$)

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

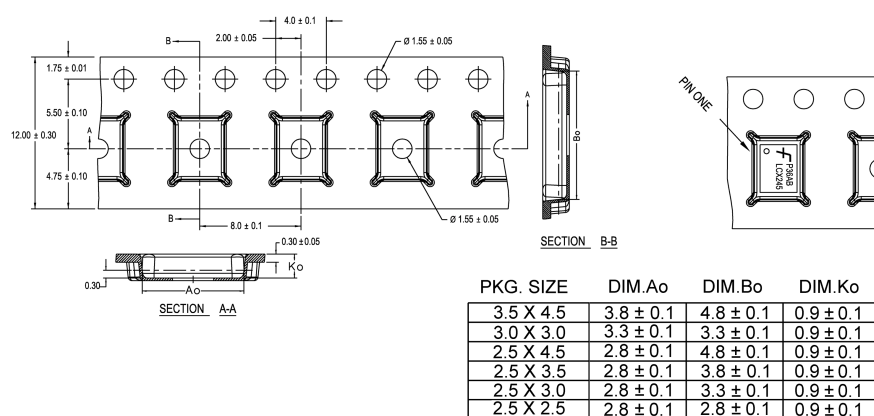


Tape and Reel Specification

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)

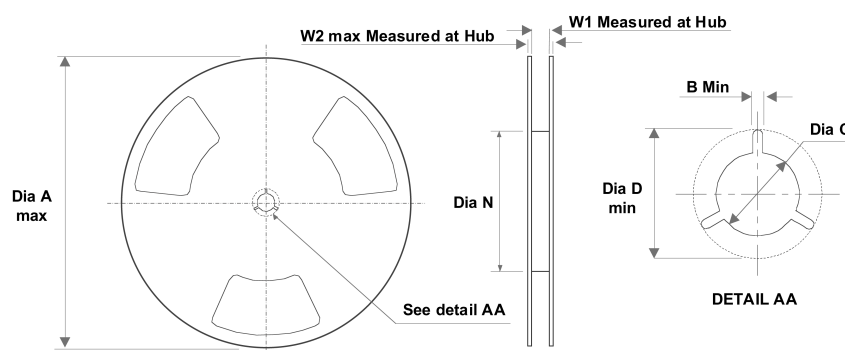


DIMENSIONS ARE IN MILLIMETERS

NOTES: unless otherwise specified

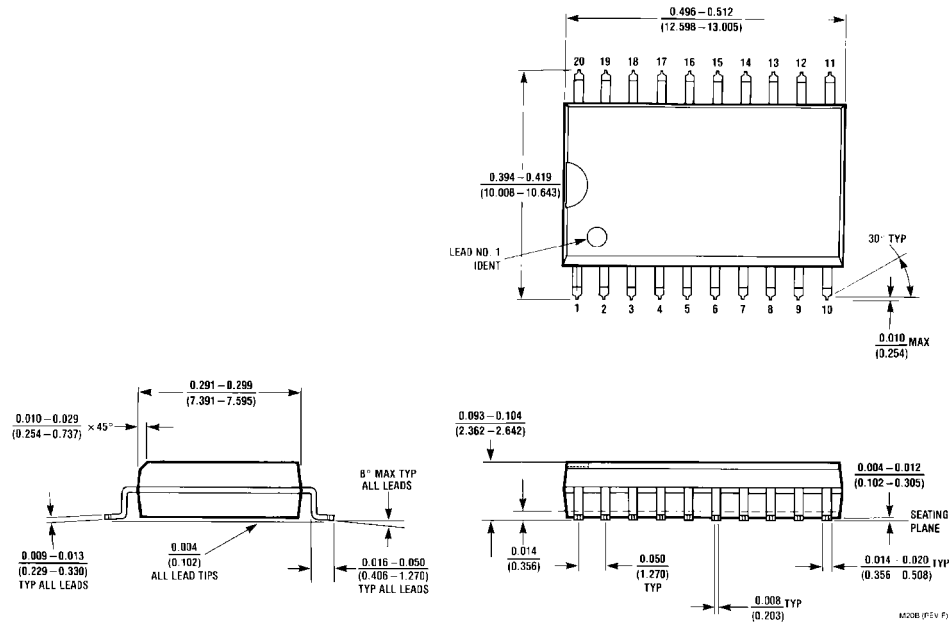
1. Cumulative pitch for feeding holes and cavities (chip pockets) not to exceed 0.008[0.20] over 10 pitch span.
2. Smallest allowable bending radius.
3. Thru hole inside cavity is centered within cavity.
4. Tolerance is $\pm 0.002[0.05]$ for these dimensions on all 12mm tapes.
5. Ao and Bo measured on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

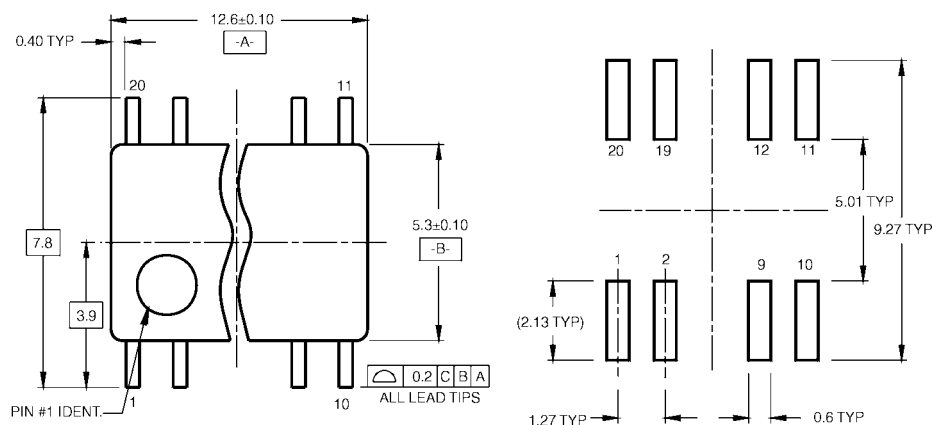


Tape Size	A	B	C	D	N	W1	W2
12 mm	13.0 (330.0)	0.059 (1.50)	0.512 (13.00)	0.795 (20.20)	2.165 (55.00)	0.488 (12.4)	0.724 (18.4)

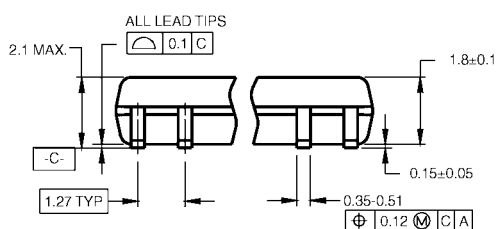
Physical Dimensions inches (millimeters) unless otherwise noted



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

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


LAND PATTERN RECOMMENDATION

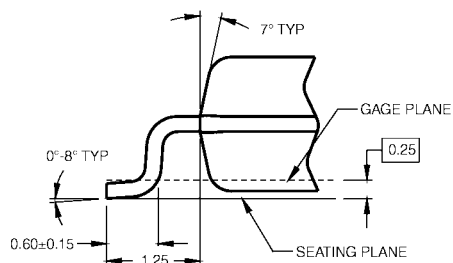


DIMENSIONS ARE IN MILLIMETERS

NOTES:

- CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.
- DIMENSIONS ARE IN MILLIMETERS.
- DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

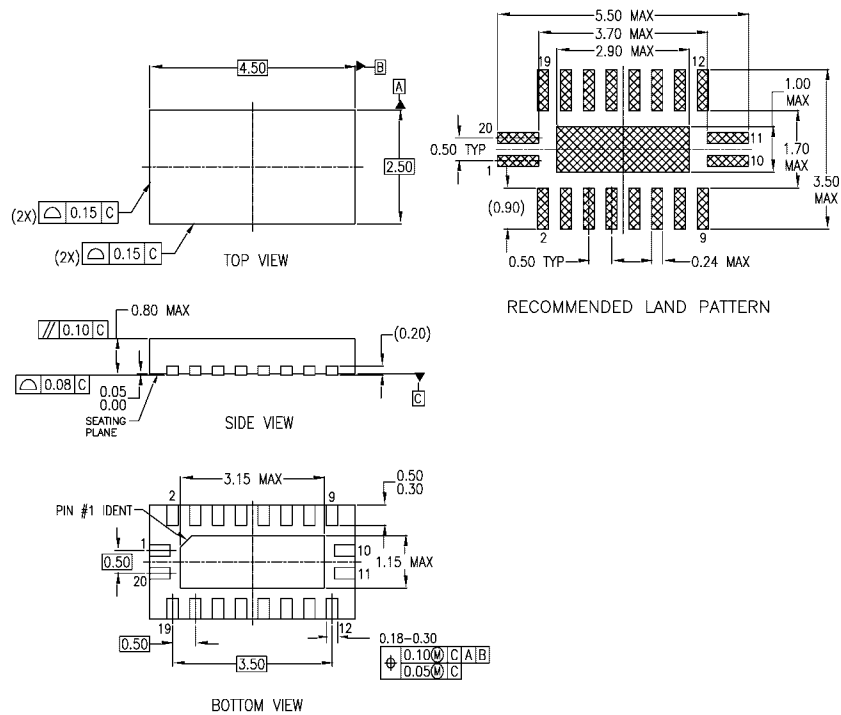
M20DRevB1



DETAIL A

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

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



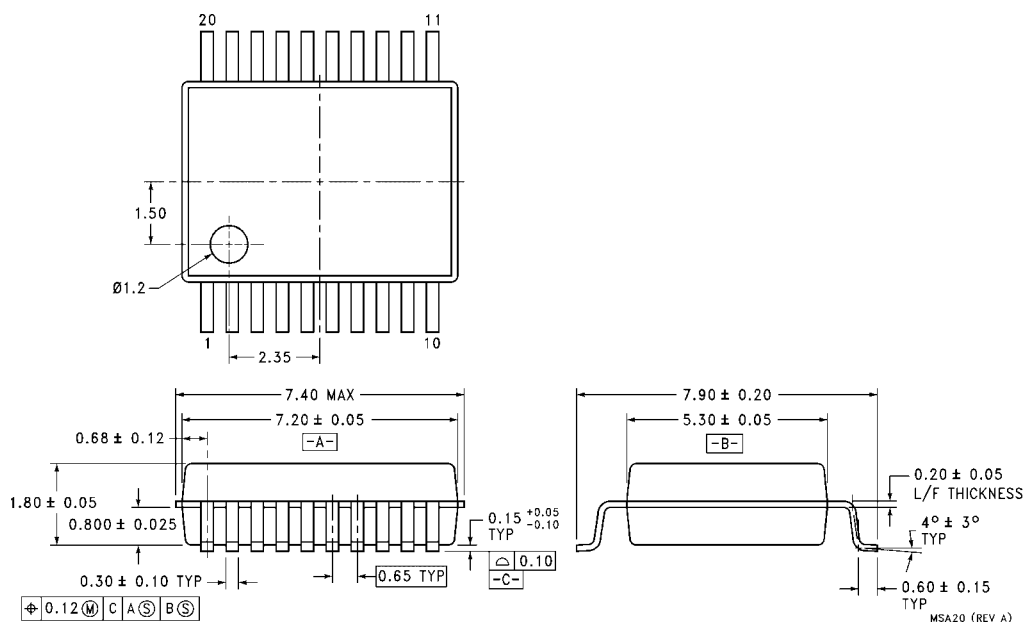
NOTES:

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

MLP020BrevA

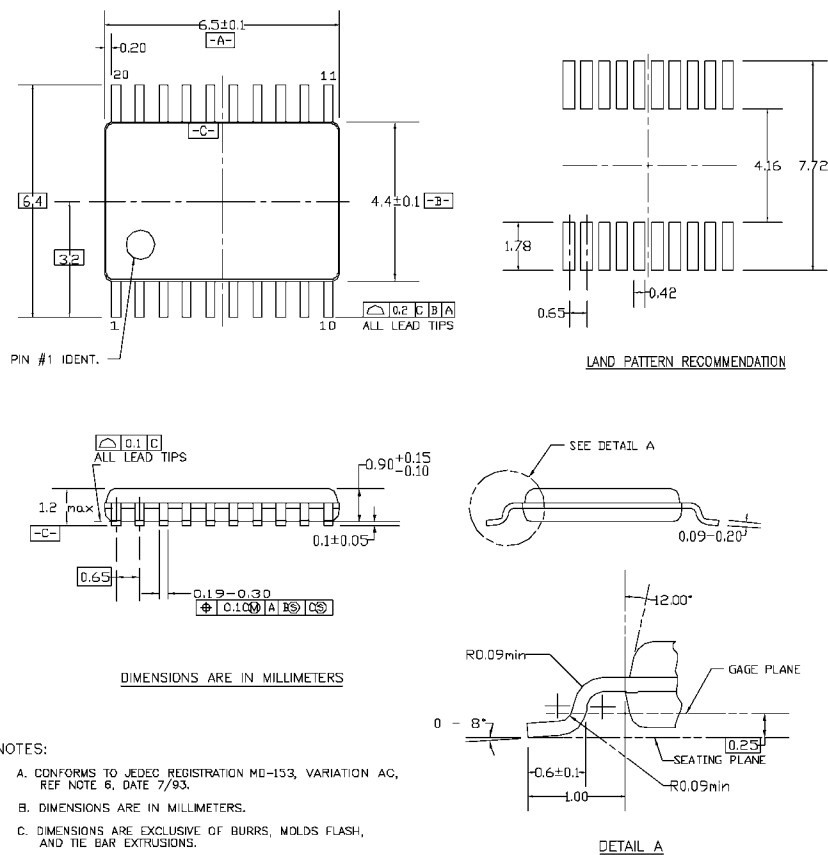
**Pb-Free 20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm
Package Number MLP020B**

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



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

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



MTC20REV.D1

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

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