FAIRCHILD SEMICONDUCTOR™

October 1995
Revised May 2003

74LCX2244

Low Voltage Buffer/Line Driver with 5V Tolerant Inputs and Outputs with 26Ω Series Resistors in the Outputs

General Description

The LCX2244 contains eight non-inverting buffers with 3-STATE outputs. The device may be employed as a memory address driver, clock driver and bus-oriented transmitter/receiver. The LCX2244 is designed for low voltage (2.5V or 3.3V) V_{CC} applications with capability of interfacing to a 5V signal environment. The 26Ω series resistors help reduce output overshoot and undershoot.

The LCX2244 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 to 3.6V V_{CC} specifications provided
- 7.5 ns t_{PD} max (V_{CC} = 3.3V) 10 μA I_{CC} max
- Power down high impedance inputs and outputs
- 26Ω-series resistors in the outputs
- Supports live insertion/withdrawal (Note 1)
- ±12 mA output drive (V_{CC} = 3.0V)
- Implements patented noise/EMI reduction circuitry
- Latch-up performance exceeds 500 mA
- ESD performance:
  - Human body model > 2000V
  - Machine model > 200V
- Leadless DQFN package

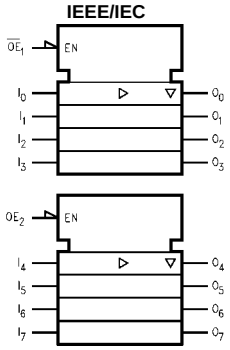
Note 1: To ensure the high-impedance state during power up or down, $\overline{OE}$ should be tied to V_{CC} through a pull-up resistor: the minimum value or the resistor is determined by the current-sourcing capability of the driver.

Ordering Code:

Order Number	Package Number	Package Description
74LCX2244WM	M20B	20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
74LCX2244SJ	M20D	20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74LCX2244BQ (Preliminary)	MLP020B (Preliminary)	20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm
74LCX2244MSA	MSA20	20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide
74LCX2244MTC	MTC20	20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

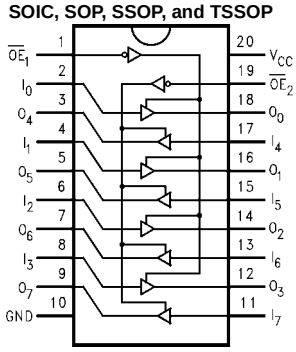
Devices also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

Logic Symbol

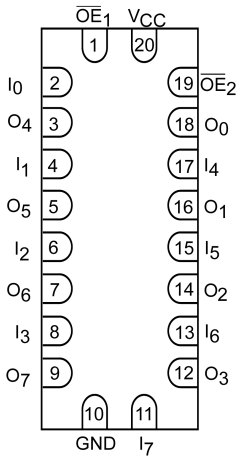


Connection Diagrams

Pin Assignments for SOIC, SOP, SSOP, and TSSOP



Pad Assignment for DQFN



(Top Through View)

Pin Descriptions

Pin Names	Description
$\overline{OE}_1$, $\overline{OE}_2$	3-STATE Output Enable Inputs
I_0–I_7	Inputs
O_0–O_7	Outputs

Truth Tables

Inputs		Outputs
$\overline{OE}_1$	I_n	(Pins 12, 14, 16, 18)
L	L	L
L	H	H
H	X	Z

Inputs		Outputs
$\overline{OE}_2$	I_n	(Pins 3, 5, 7, 9)
L	H	L
L	H	H
H	X	Z

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

Absolute Maximum Ratings(Note 2)

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 3)	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 4)

Symbol	Parameter		Min	Max	Units
V_{CC}	Supply Voltage	Operating	2.0	3.6	V
		Data Retention	1.5	3.6	
V_I	Input Voltage		0.0	5.5	V
V_O	Output Voltage	HIGH or LOW State	0.0	V_{CC}	V
		3-STATE	0.0	5.5	
I_{OH}/I_{OL}	Output Current	V_{CC} = 3.0V − 3.6V		±12.0	mA
		V_{CC} = 2.7V − 3.0V		±8.0	
		V_{CC} = 2.3V − 2.7V		±4.0	
T_A	Free-Air Operating Temperature		−40.0	85.0	°C
$\Delta t/\Delta V$	Input Edge Rate, V_{IN} = 0.8V − 2.0V, V_{CC} = 3.0V		0.0	10.0	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_O Absolute Maximum Rating must be observed.

Note 4: Unused inputs must be held HIGH or LOW. They may not float.

DC Electrical Characteristics

Symbol	Parameter	Conditions	V_{CC} (V)	T_A = −40°C to +85°C		Units
				Min	Max	
V_{IH}	HIGH Level Input Voltage		2.3 − 2.7	1.7		V
			2.7 − 3.6	2.0		
V_{IL}	LOW Level Input Voltage		2.3 − 2.7		0.7	V
			2.7 − 3.6		0.8	
V_{OH}	HIGH Level Output Voltage	I_{OH} = −100 µA	2.3 − 3.6	V_{CC} − 0.2		V
		I_{OH} = −4 mA	2.3	1.8		
		I_{OH} = −4 mA	2.7	2.2		
		I_{OH} = −6 mA	3.0	2.4		
		I_{OH} = − 8mA	2.7	2.0		
		I_{OH} = −12 mA	3.0	2.0		
V_{OL}	LOW Level Output Voltage	I_{OL} = 100 µA	2.3 − 3.6		0.2	V
		I_{OL} = 4 mA	2.3		0.6	
		I_{OL} = 4 mA	2.7		0.4	
		I_{OL} = 6 mA	3.0		0.55	
		I_{OL} = 8 mA	2.7		0.6	
		I_{OL} = 12 mA	3.0		0.8	
I_I	Input Leakage Current	0 ≤ V_I ≤ 5.5V	2.3 − 3.6		±5.0	µA
I_{OZ}	3-STATE Output Leakage	0 ≤ V_O ≤ 5.5V V_I = V_{IH} or V_{IL}	2.3 − 3.6		±5.0	µA

DC Electrical Characteristics (Continued)

Symbol	Parameter	Conditions	V_{CC} (V)	$T_A = -40°C$ to $+85°C$		Units
				Min	Max	
I_{OFF}	Power-Off Leakage Current	V_I or V_O = 5.5V	0.0		10.0	µA
I_{CC}	Quiescent Supply Current	$V_I = V_{CC}$ or GND	2.3 – 3.6		10.0	µA
		3.6V ≤ V_I, V_O ≤ 5.5V (Note 5)	2.3 – 3.6		±10.0	
ΔI_{CC}	Increase in I_{CC} per Input	$V_{IH} = V_{CC} - 0.6V$	2.3 – 3.6		500	µA

Note 5: Outputs disabled or 3-STATE only.

AC Electrical Characteristics

Symbol	Parameter	$T_A = -40°C$ to $+85°C$, $R_L = 500\Omega$						Units
		$V_{CC} = 3.3V \pm 0.3V$		$V_{CC} = 2.7V$		$V_{CC} = 2.5 \pm 0.2V$		
		$C_L = 50pF$		$C_L = 50pF$		$C_L = 30pF$		
		Min	Max	Min	Max	Min	Max	
t_{PHL}	Propagation Delay	1.5	7.5	1.5	8.5	1.5	9.0	ns
t_{PLH}	Data to Output	1.5	7.5	1.5	8.5	1.5	9.0	
t_{PZL}	Output Enable Time	1.5	9.0	1.5	10.0	1.5	10.5	ns
t_{PZH}		1.5	9.0	1.5	10.0	1.5	10.5	
t_{PLZ}	Output Disable Time	1.5	7.0	1.5	8.0	1.5	8.4	ns
t_{PHZ}		1.5	7.0	1.5	8.0	1.5	8.4	
t_{OSHL}	Output to Output Skew (Note 6)		1.0					ns
t_{OSLH}			1.0					

Note 6: 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)	$T_A = 25°C$ Typical	Units
V_{OLP}	Quiet Output Dynamic Peak V_{OL}	C_L = 50 pF, V_{IH} = 3.3V, V_{IL} = 0V	3.3	0.35	V
		C_L = 30 pF, V_{IH} = 2.5V, V_{IL} = 0V	2.5	0.25	
V_{OLV}	Quiet Output Dynamic Valley V_{OL}	C_L = 50 pF, V_{IH} = 3.3V, V_{IL} = 0V	3.3	–0.35	V
		C_L = 30 pF, V_{IH} = 2.5V, V_{IL} = 0V	2.5	–0.25	

Capacitance

Symbol	Parameter	Conditions	Typical	Units
C_{IN}	Input Capacitance	V_{CC} = Open, V_I = 0V or V_{CC}	7.0	pF
C_{OUT}	Output Capacitance	V_{CC} = 3.3V, V_I = 0V or V_{CC}	8.0	pF
C_{PD}	Power Dissipation Capacitance	V_{CC} = 3.3V, V_I = 0V or V_{CC}, f = 10 MHz	25.0	pF

AC LOADING and WAVEFORMS Generic for LCX Family

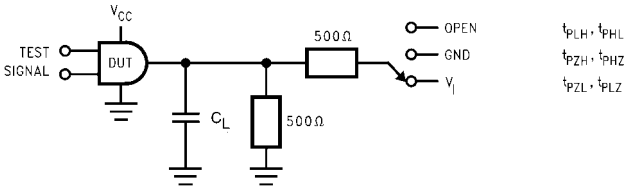
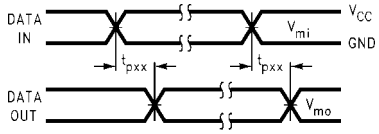
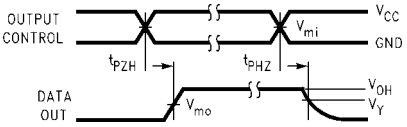


FIGURE 1. AC Test Circuit (C_L includes probe and jig capacitance)

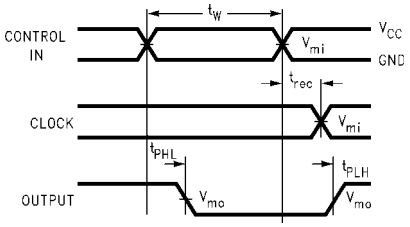
Test	Switch
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6V at V_{CC} = 3.3 ± 0.3V V_{CC} x 2 at V_{CC} = 2.5 ± 0.2V
t_{PZH},t_{PHZ}	GND



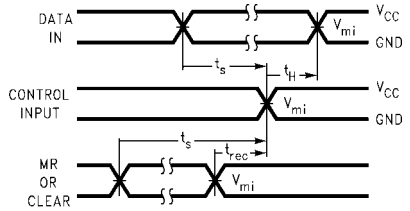
Waveform for Inverting and Non-Inverting Functions



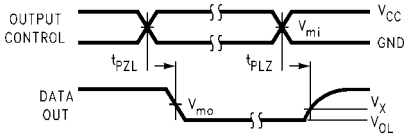
3-STATE Output High Enable and Disable Times for Logic



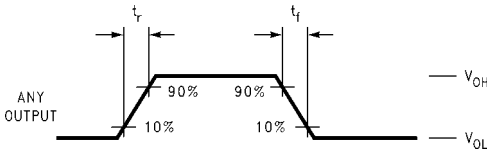
Propagation Delay. Pulse Width and t_{rec} Waveforms



Setup Time, Hold Time and Recovery Time for Logic



3-STATE Output Low Enable and Disable Times for Logic

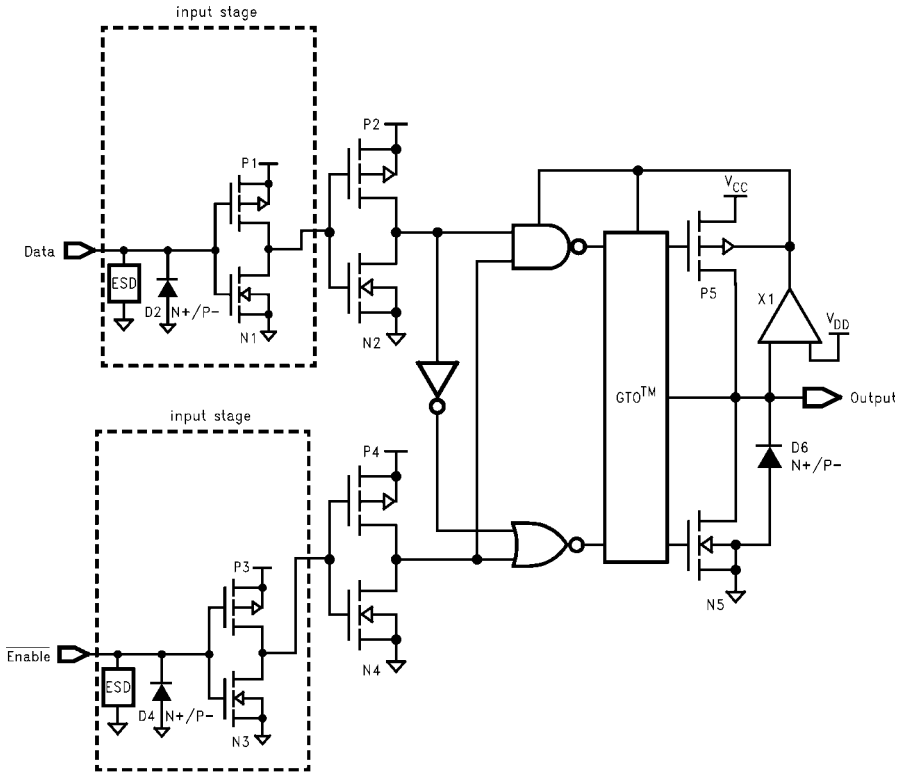


t_{rise} and t_{fall}

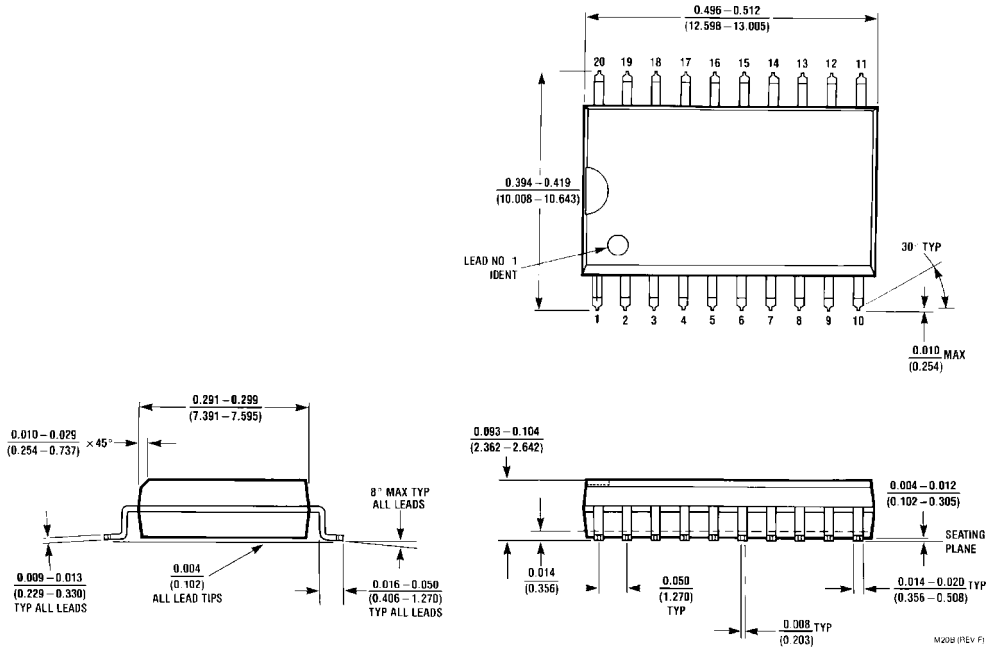
FIGURE 2. Waveforms
(Input Characteristics; f =1MHz, t_r = t_f = 3ns)

Symbol	V_{CC}		
	3.3V ± 0.3V	**2.7V**	**2.5V ± 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

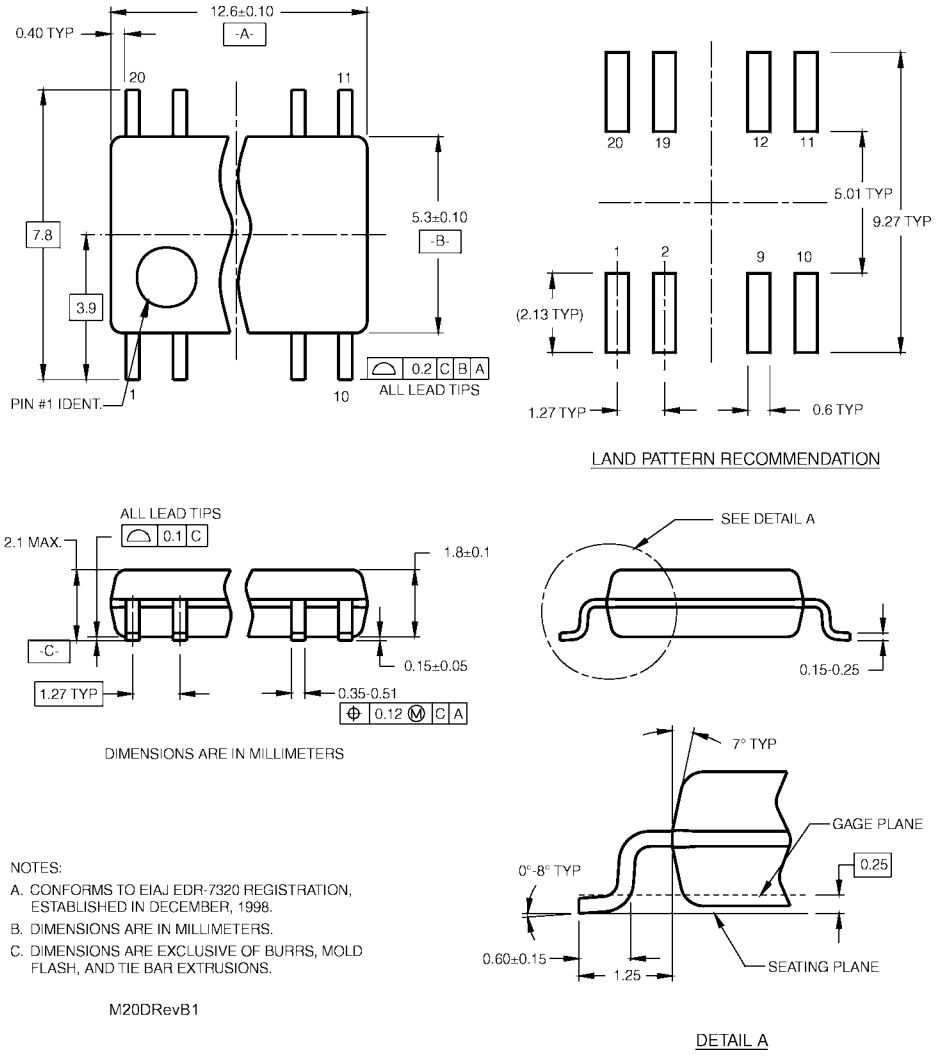


Physical Dimensions inches (millimeters) unless otherwise noted



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

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



NOTES:

A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.

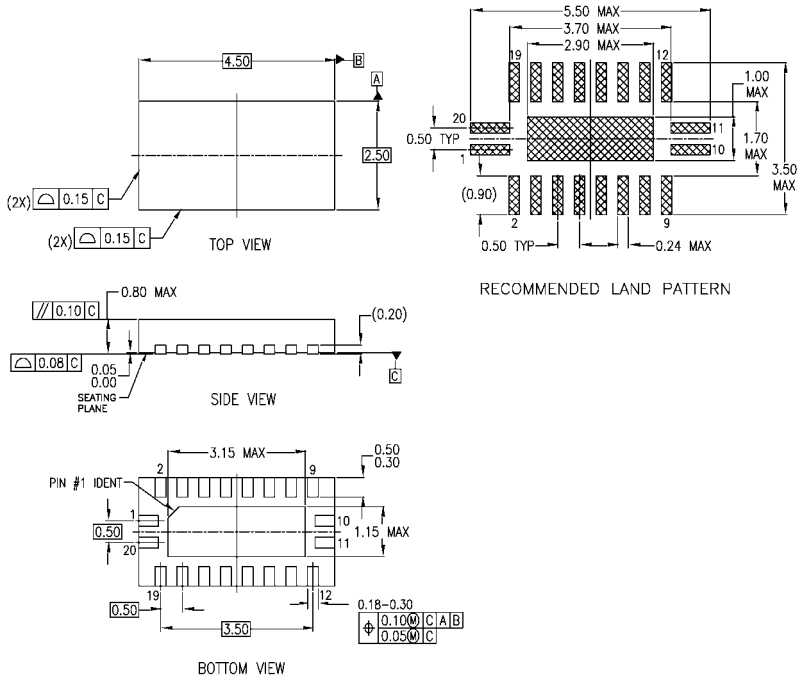
B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M20DRevB1

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

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



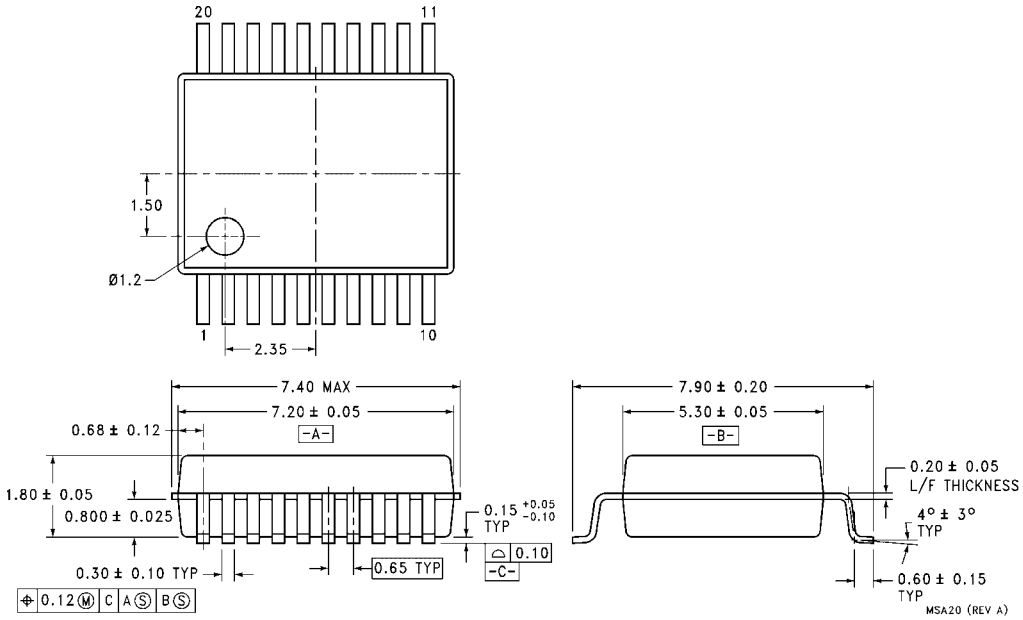
NOTES:

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

MLP020BrevA

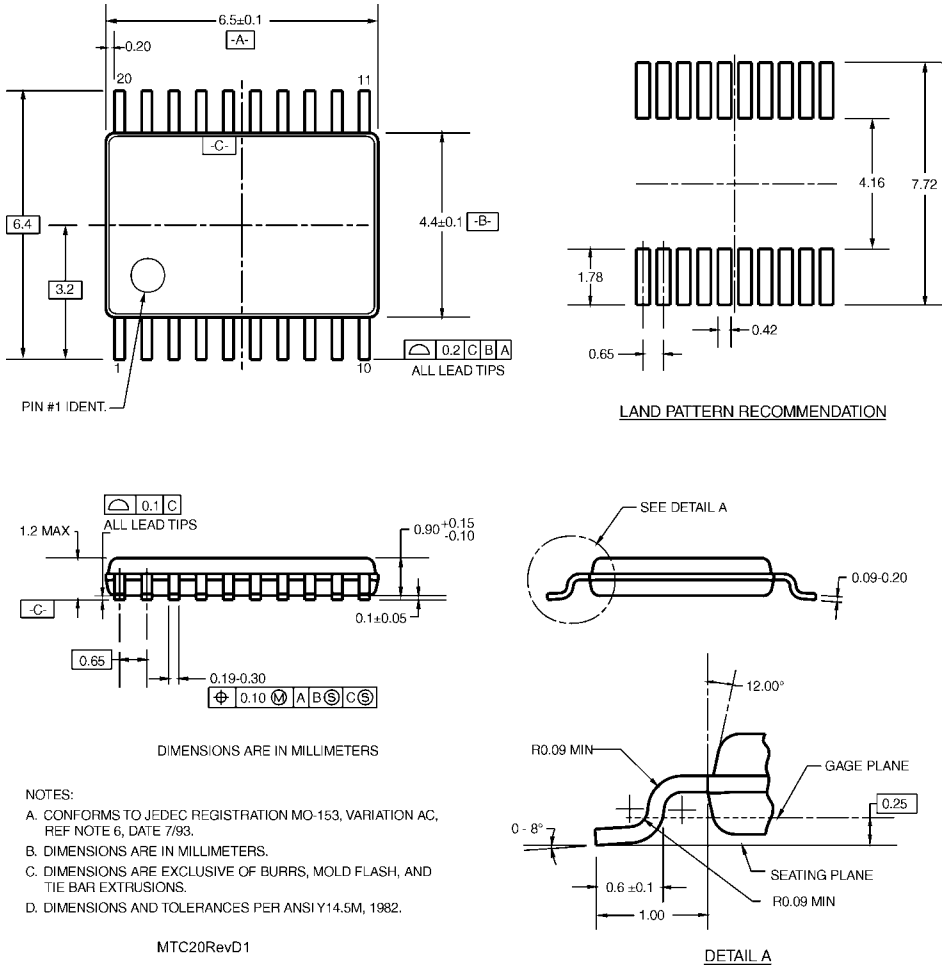
20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm
Package Number MLP020B
(Preliminary)

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)



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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2. A critical component in 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.

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