FAIRCHILD SEMICONDUCTOR®

June 1999
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74VCXH2245
Low Voltage Bidirectional Transceiver with Bushold and 26Ω Series Resistors in B Outputs

General Description

The VCXH2245 contains eight non-inverting bidirectional buffers with 3-STATE outputs and is intended for bus oriented applications. The T/$\overline{R}$ input determines the direction of data flow. The $\overline{OE}$ input disables both the A and B Ports by placing them in a high impedance state. The VCXH2245 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.

The 74VCXH2245 is designed for low voltage (1.4V to 3.6V) V_{CC} applications. The VCXH2245 is also designed with 26Ω series resistance in the B Port outputs. This design reduces line noise in applications such as memory address drivers, clock drivers, and bus transceivers transmitters

The 74VCXH2245 is fabricated with an advanced CMOS technology to achieve high-speed operation while maintaining low CMOS power dissipation.

Features

- 1.4V-3.6V V_{CC} supply operation
- 3.6V tolerant control inputs
- Bushold on data inputs eliminates the need for external pull-up/pull-down resistors
- 26Ω series resistors in B Port outputs
- t_{PD} (A to B)

  4.4 ns max for 3.0V to 3.6V V_{CC}
- Static Drive (I_{OH}/I_{OL} B outputs):

  ±12 mA @ 3.0V V_{CC}
- Uses patented Quiet Series™ noise/EMI reduction circuitry
- Latchup performance exceeds 300 mA
- ESD performance:

  Human body model > 2000V

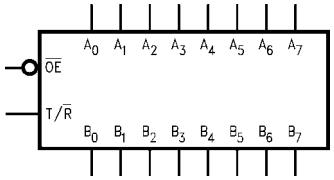
  Machine model > 200V

Ordering Code:

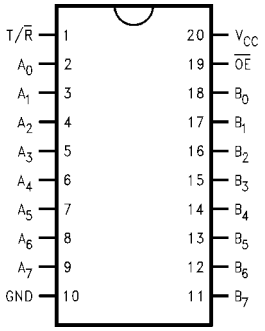
Order Number	Package Number	Package Description
74VCXH2245WM	M20B	20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
74VCXH2245MTC	MTC20	20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

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

Logic Symbol



Connection Diagram



Quiet Series™ is a trademark of Fairchild Semiconductor Corporation.

Pin Descriptions

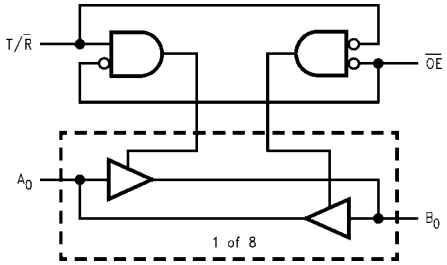
Pin Names	Description
$\overline{OE}$	Output Enable Input (Active LOW)
T/$\overline{R}$	Transmit/Receive Input
A_0–A_7	Side A Bushold Inputs or 3-STATE Outputs
B_0–B_7	Side B Bushold Inputs or 3-STATE Outputs

Truth Table

Inputs		Outputs
$\overline{OE}$	T/$\overline{R}$	
L	L	Bus B_0–B_7 Data to Bus A_0–A_7
L	H	Bus A_0–A_7 Data to Bus B_0–B_7
H	X	HIGH Z State on A_0–A_7, B_0–B_7

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

Logic Diagram



Absolute Maximum Ratings (Note 1)

Supply Voltage (V_{CC})	−0.5V to +4.6V
DC Input Voltage (V_I)	
$T/\overline{R}$, $\overline{OE}$	−0.5V to 4.6 V
I/O Ports	−0.5V to V_{CC} + 0.5V
DC Output Voltage (V_O)(Note 2)	−0.5V to V_{CC} + 0.5V
DC Input Diode Current (I_{IK}) V_I < 0V	−50 mA
DC Output Diode Current (I_{OK})	
V_O < 0V	−50 mA
V_O > V_{CC}	+50 mA
DC Output Source/Sink Current (I_{OH}/I_{OL})	±50 mA
DC V_{CC} or Ground Current	±100 mA
Storage Temperature (T_{STG})	−65°C to +150°C

Recommended Operating Conditions (Note 3)

Power Supply Voltage (V_{CC})	
Operating	1.4V to 3.6V
Input Voltage	−0.3V to V_{CC}
Output Voltage (V_O)	0V to V_{CC}
Output Current in I_{OH}/I_{OL} - A Outputs	
V_{CC} = 3.0V to 3.6V	± 24 mA
V_{CC} = 2.3V to 2.7V	± 18 mA
V_{CC} = 1.65V to 2.3V	± 6 mA
V_{CC} = 1.4V to 1.65V	± 2 mA
Output Current in I_{OH}/I_{OL} - B Outputs	
V_{CC} = 3.0V to 3.6V	± 12 mA
V_{CC} = 2.3V to 2.7V	± 8 mA
V_{CC} = 1.65V to 2.3V	± 3 mA
V_{CC} = 1.4V to 1.65V	± 1 mA
Free Air Operating Temperature (T_A)	−40°C to +85°C
Minimum Input Edge Rate ($\Delta t/\Delta V$)	
V_{IN} = 0.8V to 2.0V, V_{CC} = 3.0V	10 ns/V

Note 1: 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 2: I_O Absolute Maximum Rating must be observed.

Note 3: Floating or unused control inputs must be held HIGH or LOW.

DC Electrical Characteristics

Symbol	Parameter	Conditions	V_{CC} (V)	Min	Max	Units
V_{IH}	HIGH Level Input Voltage		2.7 - 3.6	2.0		V
			2.3 - 2.7	1.6		
			1.65 - 2.3	0.65 x V_{CC}		
			1.4 - 1.6	0.65 x V_{CC}		
V_{IL}	LOW Level Input Voltage		2.7 - 3.6		0.8	V
			2.3 - 2.7		0.7	
			1.65 - 2.3		0.35 x V_{CC}	
			1.4 - 1.6		0.35 x V_{CC}	
V_{OH}	HIGH Level Output Voltage	I_{OH} = −100 μA	2.7 - 3.6	V_{CC} - 0.2		V
	A Outputs	I_{OH} = −12 mA	2.7	2.2		
		I_{OH} = −18 mA	3.0	2.4		
		I_{OH} = −24 mA	3.0	2.2		
		I_{OH} = −100 μA	2.3 - 2.7	V_{CC} - 0.2		
		I_{OH} = −6 mA	2.3	2.0		
		I_{OH} = −12 mA	2.3	1.8		
		I_{OH} = −18 mA	2.3	1.7		
		I_{OH} = −100 μA	1.65 - 2.3	V_{CC} - 0.2		
		I_{OH} = −6 mA	1.65	1.25		
		I_{OH} = −100 μA	1.4 - 1.6	V_{CC} - 0.2		
		I_{OH} = −2 mA	1.4	1.05		

DC Electrical Characteristics (Continued)

Symbol	Parameter	Conditions	V_{CC} (V)	Min	Max	Units
V_{OH}	HIGH Level Output Voltage	I_{OH} = −100 μA	2.7 - 3.6	V_{CC} - 0.2		V
	B Outputs	I_{OH} = −6 mA	2.7	2.2		
		I_{OH} = −8 mA	3.0	2.4		
		I_{OH} = −12 mA	3.0	2.2		
		I_{OH} = −100 μA	2.3 - 2.7	V_{CC} - 0.2		
		I_{OH} = −4 mA	2.3	2.0		
		I_{OH} = −6 mA	2.3	1.8		
		I_{OH} = −8 mA	2.3	1.7		
		I_{OH} = −100 μA	1.65 - 2.3	V_{CC} - 0.2		
		I_{OH} = −3 mA	1.65	1.25		
		I_{OH} = −100 μA	1.4 - 1.6	V_{CC} - 0.2		
		I_{OH} = −1 mA	1.4	1.05		
V_{OL}	LOW Level Output Voltage	I_{OL} = 100 μA	2.7 - 3.6		0.2	V
	A Outputs	I_{OL} = 12 mA	2.7		0.4	
		I_{OL} = 18 mA	3.0		0.4	
		I_{OL} = 24 mA	3.0		0.55	
		I_{OL} = 100 μA	2.3 - 2.7		0.2	
		I_{OL} = 12 mA	2.3		0.4	
		I_{OL} = 18 mA	2.3		0.6	
		I_{OL} = 100 μA	1.65 - 2.3		0.2	
		I_{OL} = 6 mA	1.65		0.3	
		I_{OL} = 100 μA	1.4 - 1.6		0.2	
		I_{OL} = 2 mA	1.4		0.35	
V_{OL}	LOW Level Output Voltage	I_{OL} = 100 μA	2.7 - 3.6		0.2	V
	B Outputs	I_{OL} = 6 mA	2.7		0.4	
		I_{OL} = 8 mA	3.0		0.55	
		I_{OL} = 12 mA	3.0		0.8	
		I_{OL} = 100 μA	2.3 - 2.7		0.2	
		I_{OL} = 6 mA	2.3		0.4	
		I_{OL} = 8 mA	2.3		0.6	
		I_{OL} = 100 μA	1.65 - 2.3		0.2	
		I_{OL} = 3 mA	1.65		0.3	
		I_{OL} = 100 μA	1.4 - 1.6		0.2	
		I_{OL} = 1 mA	1.4		0.35	
I_I	Input Leakage Current	V_{IN} = V_{CC} or GND	1.4 - 3.6		±5.0	μA
$I_{I(HOLD)}$	Bushold Input Minimum	V_{IN} = 0.8V	3.0	75.0		μA
	Drive Hold Current	V_{IN} = 2.0V	3.0	−75.0		
		V_{IN} = 0.7V	2.3	45.0		
		V_{IN} = 1.6V	2.3	−45.0		
		V_{IN} = 0.57V	1.65	25.0		
		V_{IN} = 1.07V	1.65	−25.0		
$I_{I(OD)}$	Bushold Input Over-Drive	(Note 4)	3.6	450		μA
	Current to Change State	(Note 5)	3.6	−450		
		(Note 4)	2.7	300		
		(Note 5)	2.7	−300		
		(Note 4)	1.95	200		
		(Note 5)	1.95	−200		
I_{OZ}	3-STATE Output Leakage	V_O = V_{CC} or GND V_I = V_{IH} or V_{IL}	1.4 - 3.6		±10.0	μA
I_{CC}	Quiescent Supply Current	V_I = V_{CC} or GND	1.4 - 3.6		20.0	μA
ΔI_{CC}	Increase in I_{CC} per Input	V_{IH} = V_{CC} − 0.6V	2.7 - 3.6		750	μA

Note 4: An external driver must source at least the specified current to switch from LOW-to-HIGH.

Note 5: An external driver must sink at least the specified current to switch from HIGH-to-LOW.

AC Electrical Characteristics (Note 6)

Symbol	Parameter	Conditions	V_{CC} (V)	$T_A = -40°C$ to $+85°C$		Units	Figure Number
				Min	Max		
t_{PHL} t_{PLH}	Propagation Delay B_n to A_n	$C_L = 30$ pF, $R_L = 500\Omega$	3.3 ± 0.3	0.6	3.5	ns	Figures 1, 2
			2.5 ± 0.2	0.8	4.2		
			1.8 ± 0.15	1.5	8.4		
		$C_L = 15$ pF, $R_L = 2k\Omega$	1.5 ± 0.1	1.0	16.8		Figures 5, 6
t_{PZL} t_{PZH}	Output Enable Time B_n to A_n	$C_L = 30$ pF, $R_L = 500\Omega$	3.3 ± 0.3	0.6	4.5	ns	Figures 1, 3, 4
			2.5 ± 0.2	0.8	5.6		
			1.8 ± 0.15	1.5	9.8		
		$C_L = 15$ pF, $R_L = 2k\Omega$	1.5 ± 0.1	1.0	19.6		Figures 5, 7, 8
t_{PLZ} t_{PHZ}	Output Disable Time B_n to A_n	$C_L = 30$ pF, $R_L = 500\Omega$	3.3 ± 0.3	0.6	3.6	ns	Figures 1, 3, 4
			2.5 ± 0.2	0.8	4.0		
			1.8 ± 0.15	1.5	7.2		
		$C_L = 15$ pF, $R_L = 2k\Omega$	1.5 ± 0.1	1.0	14.4		Figures 5, 7, 8
t_{PHL} t_{PLH}	Propagation Delay A_n to B_n	$C_L = 30$ pF, $R_L = 500\Omega$	3.3 ± 0.3	0.6	4.4	ns	Figures 1, 2
			2.5 ± 0.2	0.8	5.6		
			1.8 ± 0.15	1.5	9.8		
		$C_L = 15$ pF, $R_L = 2k\Omega$	1.5 ± 0.1	1.0	19.6		Figures 5, 6
t_{PZL} t_{PZH}	Output Enable Time A_n to B_n	$C_L = 30$ pF, $R_L = 500\Omega$	3.3 ± 0.3	0.6	5.0	ns	Figures 1, 3, 4
			2.5 ± 0.2	0.8	6.6		
			1.8 ± 0.15	1.5	9.8		
		$C_L = 15$ pF, $R_L = 2k\Omega$	1.5 ± 0.1	1.0	19.6		Figures 5, 7, 8
t_{PLZ} t_{PHZ}	Output Disable Time A_n to B_n	$C_L = 30$ pF, $R_L = 500\Omega$	3.3 ± 0.3	0.6	4.2	ns	Figures 1, 3, 4
			2.5 ± 0.2	0.8	4.7		
			1.8 ± 0.15	1.5	8.5		
		$C_L = 15$ pF, $R_L = 2k\Omega$	1.5 ± 0.1	1.0	16.9		Figures 5, 7, 8
t_{OSHL} t_{OSLH}	Output to Output Skew (Note 7)	$C_L = 30$ pF, $R_L = 500\Omega$	3.3 ± 0.3		0.5	ns	
			2.5 ± 0.2		0.5		
			1.8 ± 0.15		0.75		
		$C_L = 15$ pF, $R_L = 2k\Omega$	1.5 ± 0.1		1.5		

Note 6: For $C_L = 50$ pF, add approximately 300 ps to the AC maximum specification.

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_{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}, B to A	C_L = 30 pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	1.8	0.3	V
			2.5	0.7	
			3.3	1.0	
	Quiet Output Dynamic Peak V_{OL}, A to B	C_L = 30 pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	1.8	0.2	V
			2.5	0.45	
			3.3	0.65	
V_{OLV}	Quiet Output Dynamic Valley V_{OL}, B to A	C_L = 30 pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	1.8	−0.3	V
			2.5	−0.7	
			3.3	−1.0	
	Quiet Output Dynamic Valley, V_{OL}, A to B	C_L = 30 pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	1.8	−0.2	V
			2.5	−0.45	
			3.3	−0.65	
V_{OHV}	Quiet Output Dynamic Valley V_{OH}, B to A	C_L = 30 pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	1.8	1.3	V
			2.5	1.7	
			3.3	2.0	
	Quiet Output Dynamic Valley V_{OH}, A to B	C_L = 30 pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	1.8	1.5	V
			2.5	2.0	
			3.3	2.5	

Capacitance

Symbol	Parameter	Conditions	$T_A = +25°C$ Typical	Units
C_{IN}	Input Capacitance	V_I = 0V or V_{CC}, V_{CC} = 1.8V, 2.5V or 3.3V	6	pF
$C_{I/O}$	Input/Output Capacitance	V_I = 0V or V_{CC}, V_{CC} = 1.8V, 2.5V or 3.3V	7	pF
C_{PD}	Power Dissipation Capacitance	V_I = 0V or V_{CC}, f = 10 MHz, V_{CC} = 1.8V, 2.5V or 3.3V	20	pF

AC Loading and Waveforms (V_{CC} 3.3V ± 0.3V to 1.8V ± 0.5V)

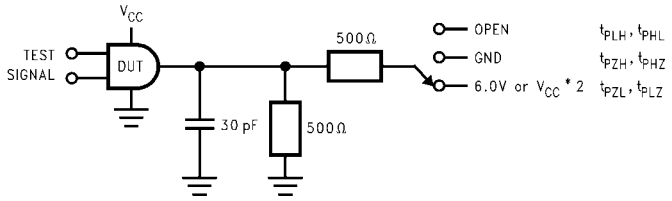


FIGURE 1. AC Test Circuit

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} = 2.5V ± 0.2V; 1.8V ± 0.15V
t_{PZH}, t_{PHZ}	GND

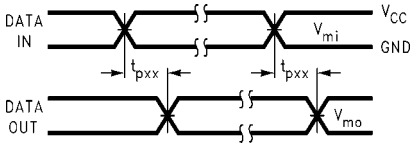


FIGURE 2. Waveform for Inverting and Non-inverting Functions

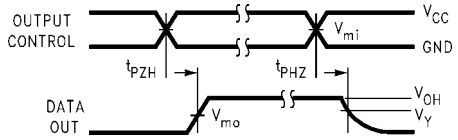


FIGURE 3. 3-STATE Output High Enable and Disable Times for Low Voltage Logic

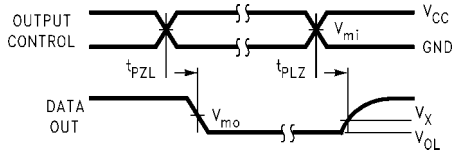


FIGURE 4. 3-STATE Output Low Enable and Disable Times for Low Voltage Logic

Symbol	V_{CC}		
	3.3V ± 0.3V	**2.5V ± 0.2V**	**1.8V ± 0.15V**
V_{mi}	1.5V	$V_{CC}/2$	$V_{CC}/2$
V_{mo}	1.5V	$V_{CC}/2$	$V_{CC}/2$
V_x	V_{OL} + 0.3V	V_{OL} + 0.15V	V_{OL} + 0.15V
V_y	V_{OH} − 0.3V	V_{OH} − 0.15V	V_{OH} − 0.15V

AC Loading and Waveforms (V_{CC} 1.5V ± 0.1V)

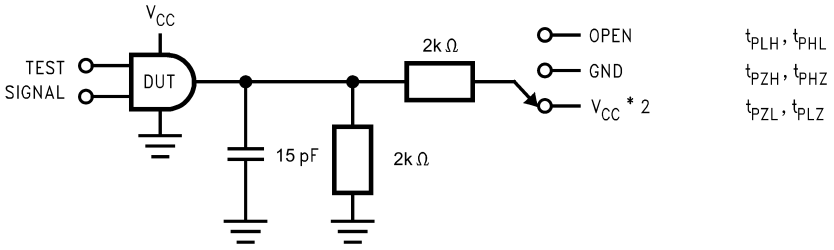


FIGURE 5. AC Test Circuit

TEST	SWITCH
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	V_{CC} x 2 at V_{CC} = 1.5V ± 0.1V
t_{PZH}, t_{PHZ}	GND

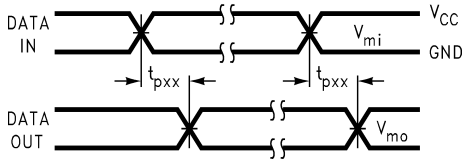


FIGURE 6. Waveform for Inverting and Non-inverting Functions

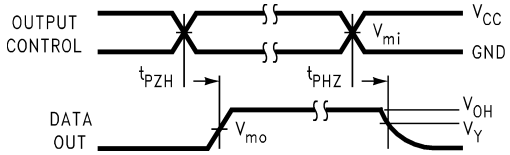


FIGURE 7. 3-STATE Output High Enable and Disable Times for Low Voltage Logic

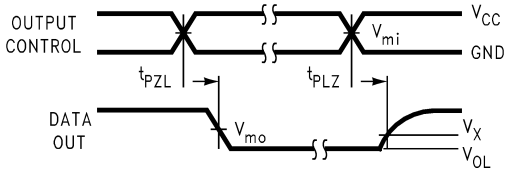
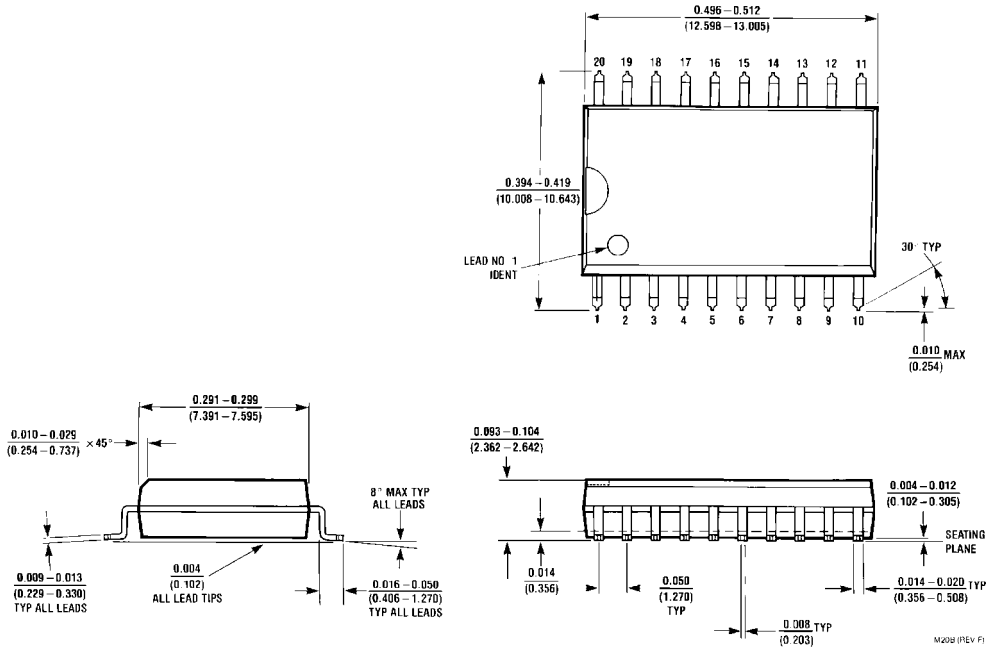


FIGURE 8. 3-STATE Output Low Enable and Disable Times for Low Voltage Logic

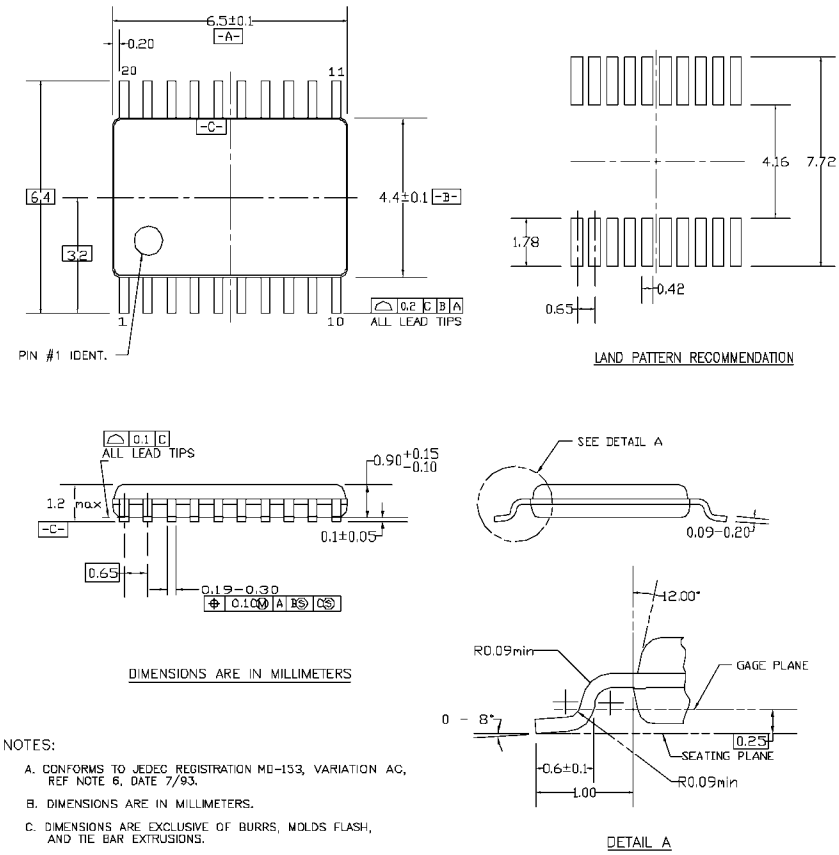
Symbol	V_{CC}
	1.5V ± 0.1V
V_{mi}	$V_{CC}/2$
V_{mo}	$V_{CC}/2$
V_x	V_{OL} + 0.1V
V_y	V_{OH} − 0.1V

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 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.

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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