

74ACQ245, 74ACTQ245

Quiet Series™ Octal Bidirectional Transceiver with 3-STATE Inputs/Outputs

Features

- I_{CC} and I_{OZ} reduced by 50%
- Guaranteed simultaneous switching noise level and dynamic threshold performance
- Guaranteed pin-to-pin skew AC performance
- Improved latch-up immunity
- 3-STATE outputs drive bus lines or buffer memory address registers
- Outputs source/sink 24mA
- Faster prop delays than the standard ACT245

General Description


The ACQ/ACTQ245 contains eight non-inverting bidirectional buffers with 3-STATE outputs and is intended for bus-oriented applications. Current sinking capability is 24mA at both the A and B ports. The Transmit/Receive (T/\bar{R}) input determines the direction of data flow through the bidirectional transceiver. Transmit (active-HIGH) enables data from A Ports to B Ports; Receive (active-LOW) enables data from B Ports to A Ports. The Output Enable input, when HIGH, disables both A and B ports by placing them in a HIGH Z condition.

The ACQ/ACTQ utilizes Fairchild Quiet Series™ technology to guarantee quiet output switching and improve dynamic threshold performance. FACT Quiet Series™ features GTO™ output control and undershoot corrector in addition to a split ground bus for superior performance.

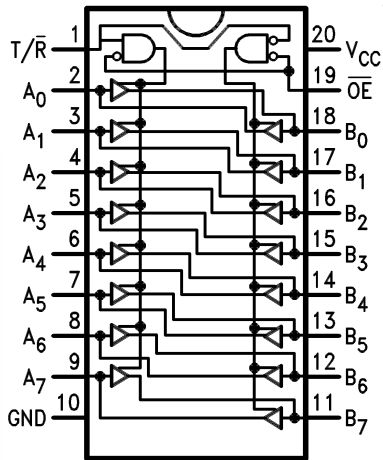
Ordering Information

Order Number	Package Number	Package Description
74ACQ245SC	M20B	20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
74ACQ245SJ	M20D	20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74ACTQ245SC	M20B	20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
74ACTQ245SJ	M20D	20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74ACTQ245QSC	MQA20	20-Lead Quarter Size Outline Package (QSOP), JEDEC MO-137, 0.150" Wide
74ACTQ245MSA	MSA20	20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide
74ACTQ245MTC	MTC20	20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

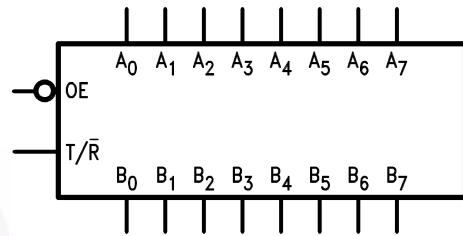
Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering number.

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

Connection Diagram

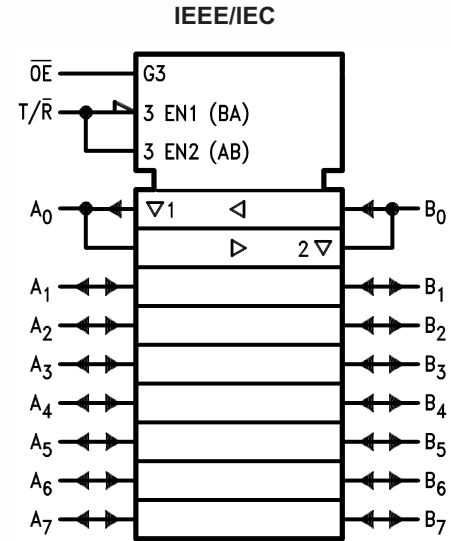


Logic Symbol



Pin Description

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



Truth Table

Inputs		Outputs
OE	T/\overline{R}	
L	L	Bus B Data to Bus A
L	H	Bus A Data to Bus B
H	X	HIGH-Z State

H = HIGH Voltage Level

L = LOW Voltage Level

X = Immaterial

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_{CC}	Supply Voltage	-0.5V to +7.0V
I_{IK}	DC Input Diode Current	
	$V_I = -0.5V$ $V_I = V_{CC} + 0.5V$	-20mA +20mA
V_I	DC Input Voltage	-0.5V to $V_{CC} + 0.5V$
I_{OK}	DC Output Diode Current	
	$V_O = -0.5V$ $V_O = V_{CC} + 0.5V$	-20mA +20mA
V_O	DC Output Voltage	-0.5V to $V_{CC} + 0.5V$
I_O	DC Output Source or Sink Current	$\pm 50mA$
I_{CC} or I_{GND}	DC V_{CC} or Ground Current per Output Pin	$\pm 50mA$
T_{STG}	Storage Temperature	-65°C to +150°C
	DC Latch-Up Source or Sink Current	$\pm 300mA$
T_J	Junction Temperature	140°C

Recommended Operating Conditions

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	Rating
V_{CC}	Supply Voltage	
	ACQ ACTQ	2.0V to 6.0V 4.5V to 5.5V
V_I	Input Voltage	0V to V_{CC}
V_O	Output Voltage	0V to V_{CC}
T_A	Operating Temperature	-40°C to +85°C
$\Delta V / \Delta t$	Minimum Input Edge Rate, ACQ Devices: V_{IN} from 30% to 70% of V_{CC} , V_{CC} @ 3.0V, 4.5V, 5.5V	125mV/ns
$\Delta V / \Delta t$	Minimum Input Edge Rate, ACTQ Devices: V_{IN} from 0.8V to 2.0V, V_{CC} @ 4.5V, 5.5V	125mV/ns

DC Electrical Characteristics for ACQ

Symbol	Parameter	V _{CC} (V)	Conditions	T _A = +25°C		T _A = -40°C to +85°C		Units	
				Typ.	Guaranteed Limits				
V _{IH}	Minimum HIGH Level Input Voltage	3.0	V _{OUT} = 0.1V or V _{CC} - 0.1V	1.5	2.1	2.1		V	
		4.5		2.25	3.15	3.15			
		5.5		2.75	3.85	3.85			
V _{IL}	Maximum LOW Level Input Voltage	3.0	V _{OUT} = 0.1V or V _{CC} - 0.1V	1.5	0.9	0.9		V	
		4.5		2.25	1.35	1.35			
		5.5		2.75	1.65	1.65			
V _{OH}	Minimum HIGH Level Output Voltage	3.0	I _{OUT} = -50μA	2.99	2.9	2.9		V	
		4.5		4.49	4.4	4.4			
		5.5		5.49	5.4	5.4			
		3.0	V _{IN} = V _{IL} or V _{IH} , I _{OH} = -12mA		2.56	2.46			
		4.5		V _{IN} = V _{IL} or V _{IH} , I _{OH} = -24mA		3.86	3.76		
		5.5			V _{IN} = V _{IL} or V _{IH} , I _{OH} = -24mA ⁽¹⁾		4.86		4.76
V _{OL}	Maximum LOW Level Output Voltage	3.0	I _{OUT} = 50μA	0.002		0.1	0.1		V
		4.5		0.001	0.1	0.1			
		5.5		0.001	0.1	0.1			
		3.0	V _{IN} = V _{IL} or V _{IH} , I _{OL} = 12mA		0.36	0.44			
		4.5		V _{IN} = V _{IL} or V _{IH} , I _{OL} = 24mA		0.36	0.44		
		5.5			V _{IN} = V _{IL} or V _{IH} , I _{OL} = 24mA ⁽¹⁾		0.36	0.44	
I _{IN} ⁽³⁾	Maximum Input Leakage Current	5.5	V _I = V _{CC} , GND			±0.1	±1.0		μA
I _{OLD}	Minimum Dynamic Output Current ⁽²⁾	5.5	V _{OLD} = 1.65V Max.			75		mA	
I _{OHD}		5.5	V _{OHD} = 3.85V Min.			-75		mA	
I _{CC} ⁽³⁾	Maximum Quiescent Supply Current	5.5	V _{IN} = V _{CC} or GND		4.0	40.0		μA	
I _{OZT}	Maximum I/O Leakage Current	5.5	V _I (OE) = V _{IL} , V _{IH} ; V _I = V _{CC} , GND; V _O = V _{CC} , GND		±0.3	±3.0		μA	
V _{OLP}	Quiet Output Maximum Dynamic V _{OL}	5.0	Figures 1 & 2 ⁽⁴⁾	1.1	1.5			V	
V _{OLV}	Quiet Output Minimum Dynamic V _{OL}	5.0	Figures 1 & 2 ⁽⁴⁾	-0.6	-1.2			V	
V _{IHD}	Minimum HIGH Level Dynamic Input Voltage	5.0	⁽⁵⁾	3.1	3.5			V	
V _{ILD}	Maximum LOW Level Dynamic Input Voltage	5.0	⁽⁵⁾	1.9	1.5			V	

Notes:

- All outputs loaded; thresholds on input associated with output under test.
- Maximum test duration 2.0ms, one output loaded at a time.
- I_{IN} and I_{CC} @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V_{CC}.
- Max number of outputs defined as (n). Data Inputs are driven 0V to 5V; one output @ GND.
- Max number of Data Inputs (n) switching. (n-1) Inputs switching 0V to 5V (ACQ). Input-under-test switching: 5V to threshold (V_{ILD}), 0V to threshold (V_{IHD}), f = 1 MHz.

DC Electrical Characteristics for ACTQ

Symbol	Parameter	V _{CC} (V)	Conditions	T _A = +25°C		T _A = -40°C to +85°C		Units
				Typ.	Guaranteed Limits			
V _{IH}	Minimum HIGH Level Input Voltage	4.5	V _{OUT} = 0.1V or V _{CC} - 0.1V	1.5	2.0	2.0		V
		5.5		1.5	2.0	2.0		
V _{IL}	Maximum LOW Level Input Voltage	4.5	V _{OUT} = 0.1V or V _{CC} - 0.1V	1.5	0.8	0.8		V
		5.5		1.5	0.8	0.8		
V _{OH}	Minimum HIGH Level Output Voltage	4.5	I _{OUT} = -50μA	4.49	4.4	4.4		V
		5.5		5.49	5.4	5.4		
		4.5	V _{IN} = V _{IL} or V _{IH} , I _{OH} = -24mA		3.86	3.76		
		5.5		V _{IN} = V _{IL} or V _{IH} , I _{OH} = -24mA ⁽⁶⁾		4.86	4.76	
V _{OL}	Maximum LOW Level Output Voltage	4.5	I _{OUT} = 50μA	0.001	0.1	0.1		V
		5.5		0.001	0.1	0.1		
		4.5	V _{IN} = V _{IL} or V _{IH} , I _{OL} = 24mA		0.36	0.44		
		5.5		V _{IN} = V _{IL} or V _{IH} , I _{OL} = 24mA ⁽⁶⁾		0.36	0.44	
I _{IN}	Maximum Input Leakage Current	5.5	V _I = V _{CC} , GND		±0.1	±1.0		μA
I _{OZT}	Maximum 3-STATE Leakage Current	5.5	V _I = V _{IL} , V _{IH} , V _O = V _{CC} , GND		±0.3	±3.0		μA
I _{CCCT}	Maximum I _{CC} /Input	5.5	V _I = V _{CC} - 2.1V	0.6		1.5		mA
I _{OLD}	Minimum Dynamic	5.5	V _{OLD} = 1.65V Max.			75		mA
I _{OHD}	Output Current ⁽⁷⁾	5.5	V _{OHD} = 3.85V Min.			-75		mA
I _{CC}	Maximum Quiescent Supply Current	5.5	V _{IN} = V _{CC} or GND		4.0	40.0		μA
V _{OLP}	Quiet Output Maximum Dynamic V _{OL}	5.0	Figures 1 & 2 ⁽⁸⁾	1.1	1.5			V
V _{OLV}	Quiet Output Minimum Dynamic V _{OL}	5.0	Figures 1 & 2 ⁽⁸⁾	-0.6	-1.2			V
V _{IHD}	Minimum HIGH Level Dynamic Input Voltage	5.0	⁽⁹⁾	1.9	2.2			V
V _{ILD}	Maximum LOW Level Dynamic Input Voltage	5.0	⁽⁹⁾	1.2	0.8			V

Notes:

- All outputs loaded; thresholds on input associated with output under test.
- Maximum test duration 2.0ms, one output loaded at a time.
- Max number of outputs defined as (n). n-1 Data Inputs are driven 0V to 3V; one output @ GND.
- Max number of Data Inputs (n) switching. (n-1) Inputs switching 0V to 3V (ACTQ). Input-under-test switching: 3V to threshold (V_{ILD}), 0V to threshold (V_{IHD}) f = 1 MHz.

AC Electrical Characteristics for ACQ

Symbol	Parameter	V_{CC} (V) ⁽¹⁰⁾	$T_A = +25^\circ\text{C}$, $C_L = 5\text{ pF}$			$T_A = -40^\circ\text{C to } +85^\circ\text{C}$, $C_L = 50\text{ pF}$		Units
			Min.	Typ.	Max.	Min.	Max.	
t_{PHL} , t_{PLH}	Propagation Delay, Data to Output	3.3	2.0	7.5	10.0	2.0	10.5	ns
		5.0	1.5	5.0	6.5	1.5	7.0	
t_{PZL} , t_{PZH}	Output Enable Time	3.3	3.0	8.5	13.0	3.0	13.5	ns
		5.0	2.0	6.0	8.5	2.0	9.0	
t_{PHZ} , t_{PLZ}	Output Disable Time	3.3	1.0	8.5	14.5	1.0	15.0	ns
		5.0	1.0	7.5	9.5	1.0	10.0	
t_{OSHL} , t_{OSLH}	Output to Output Skew, Data to Output ⁽¹¹⁾	3.3		1.0	1.5		1.5	ns
		5.0		0.5	1.0		1.0	

Notes:

10. Voltage range 5.0 is $5.0\text{V} \pm 0.5\text{V}$. Voltage range 3.3 is $3.3\text{V} \pm 0.3\text{V}$.

11. 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}). Parameter guaranteed by design.

AC Electrical Characteristics for ACTQ

Symbol	Parameter	V_{CC} (V) ⁽¹²⁾	$T_A = +25^\circ\text{C}$, $C_L = 50\text{ pF}$			$T_A = -40^\circ\text{C to } +85^\circ\text{C}$, $C_L = 50\text{ pF}$		Units
			Min.	Typ.	Max.	Min.	Max.	
t_{PHL} , t_{PLH}	Propagation Delay, Data to Output	5.0	1.5	5.5	7.0	1.5	7.5	ns
t_{PZL} , t_{PZH}	Output Enable Time	5.0	2.0	7.0	9.0	2.0	9.5	ns
t_{PHZ} , t_{PLZ}	Output Disable Time	5.0	1.0	8.0	10.0	1.0	10.5	ns
t_{OSHL} , t_{OSLH}	Output to Output Skew, Data to Output ⁽¹³⁾	5.0		0.5	1.0		1.0	ns

Notes:

12. Voltage range 5.0 is $5.0\text{V} \pm 0.5\text{V}$

13. 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}). Parameter guaranteed by design.

Capacitance

Symbol	Parameter	Conditions	Typ.	Units
C_{IN}	Input Capacitance	$V_{CC} = \text{OPEN}$	4.5	pF
$C_{I/O}$	Input/Output Capacitance	$V_{CC} = 5.0\text{V}$	15	pF
C_{PD}	Power Dissipation Capacitance	$V_{CC} = 5.0\text{V}$	80.0	pF

FACT Noise Characteristics

The setup of a noise characteristics measurement is critical to the accuracy and repeatability of the tests. The following is a brief description of the setup used to measure the noise characteristics of FACT.

Equipment:

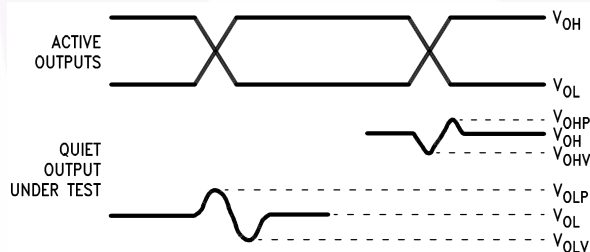
Hewlett Packard Model 8180A Word Generator

PC-163A Test Fixture

Tektronics Model 7854 Oscilloscope

Procedure:

1. Verify Test Fixture Loading: Standard Load 50pF, 500Ω.
2. Deskew the HFS generator so that no two channels have greater than 150 ps skew between them. This requires that the oscilloscope be deskewed first. It is important to deskew the HFS generator channels before testing. This will ensure that the outputs switch simultaneously.
3. Terminate all inputs and outputs to ensure proper loading of the outputs and that the input levels are at the correct voltage.
4. Set the HFS generator to toggle all but one output at a frequency of 1 MHz. Greater frequencies will increase DUT heating and effect the results of the measurement.
5. Set the HFS generator input levels at 0V LOW and 3V HIGH for ACT devices and 0V LOW and 5V HIGH for AC devices. Verify levels with an oscilloscope.



Notes:

14. V_{OHV} and V_{OLP} are measured with respect to ground reference.
15. Input pulses have the following characteristics:
 $f = 1\text{MHz}$, $t_r = 3\text{ns}$, $t_f = 3\text{ns}$, skew < 150ps.

Figure 1. Quiet Output Noise Voltage Waveforms

V_{OLP}/V_{OLV} and V_{OHP}/V_{OHV} :

- Determine the quiet output pin that demonstrates the greatest noise levels. The worst case pin will usually be the furthest from the ground pin. Monitor the output voltages using a 50Ω coaxial cable plugged into a standard SMB type connector on the test fixture. Do not use an active FET probe.
- Measure V_{OLP} and V_{OLV} on the quiet output during the worst case transition for active and enable. Measure V_{OHP} and V_{OHV} on the quiet output during the worst case active and enable transition.
- Verify that the GND reference recorded on the oscilloscope has not drifted to ensure the accuracy and repeatability of the measurements.

V_{ILD} and V_{IHD} :

- Monitor one of the switching outputs using a 50Ω coaxial cable plugged into a standard SMB type connector on the test fixture. Do not use an active FET probe.
- First increase the input LOW voltage level, V_{IL} , until the output begins to oscillate or steps out a min of 2ns. Oscillation is defined as noise on the output LOW level that exceeds V_{IL} limits, or on output HIGH levels that exceed V_{IH} limits. The input LOW voltage level at which oscillation occurs is defined as V_{ILD} .
- Next decrease the input HIGH voltage level, V_{IH} , until the output begins to oscillate or steps out a min of 2ns. Oscillation is defined as noise on the output LOW level that exceeds V_{IL} limits, or on output HIGH levels that exceed V_{IH} limits. The input HIGH voltage level at which oscillation occurs is defined as V_{IHD} .
- Verify that the GND reference recorded on the oscilloscope has not drifted to ensure the accuracy and repeatability of the measurements.

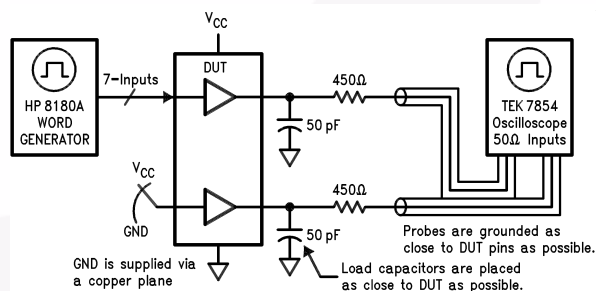


Figure 2. Simultaneous Switching Test Circuit

Physical Dimensions

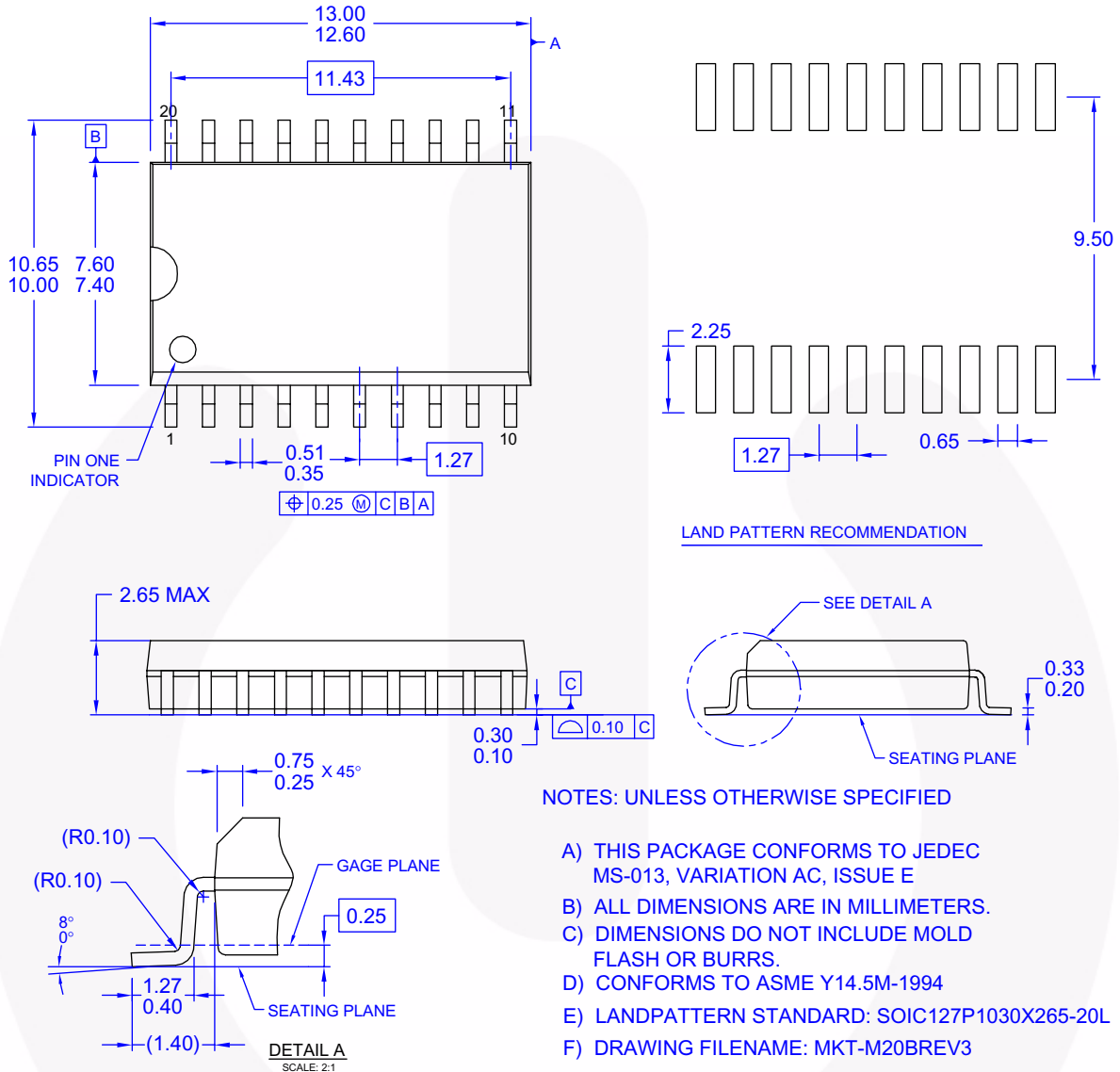


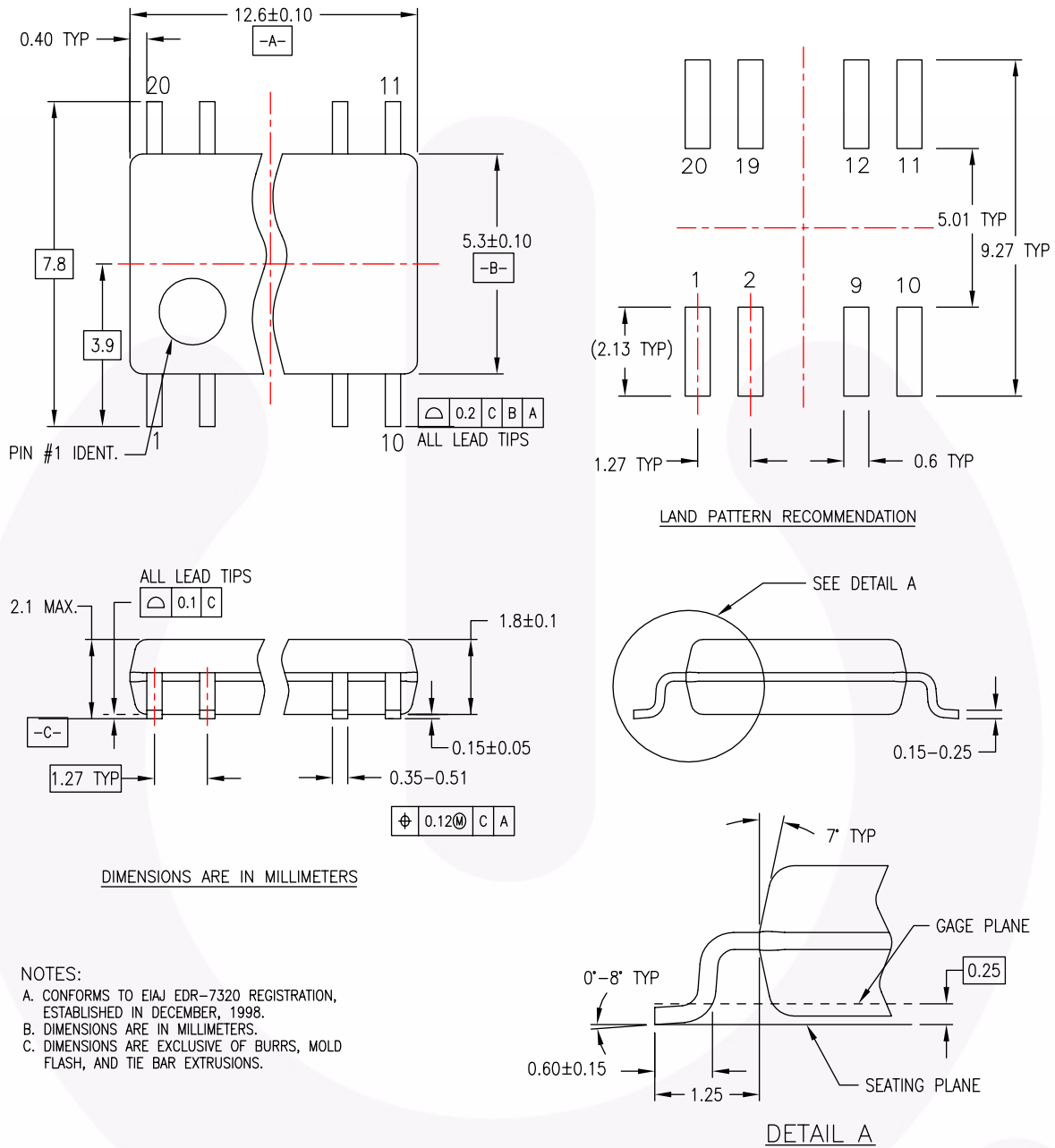
Figure 3. 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

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<http://www.fairchildsemi.com/packaging/>

Physical Dimensions (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.

M20DREVC

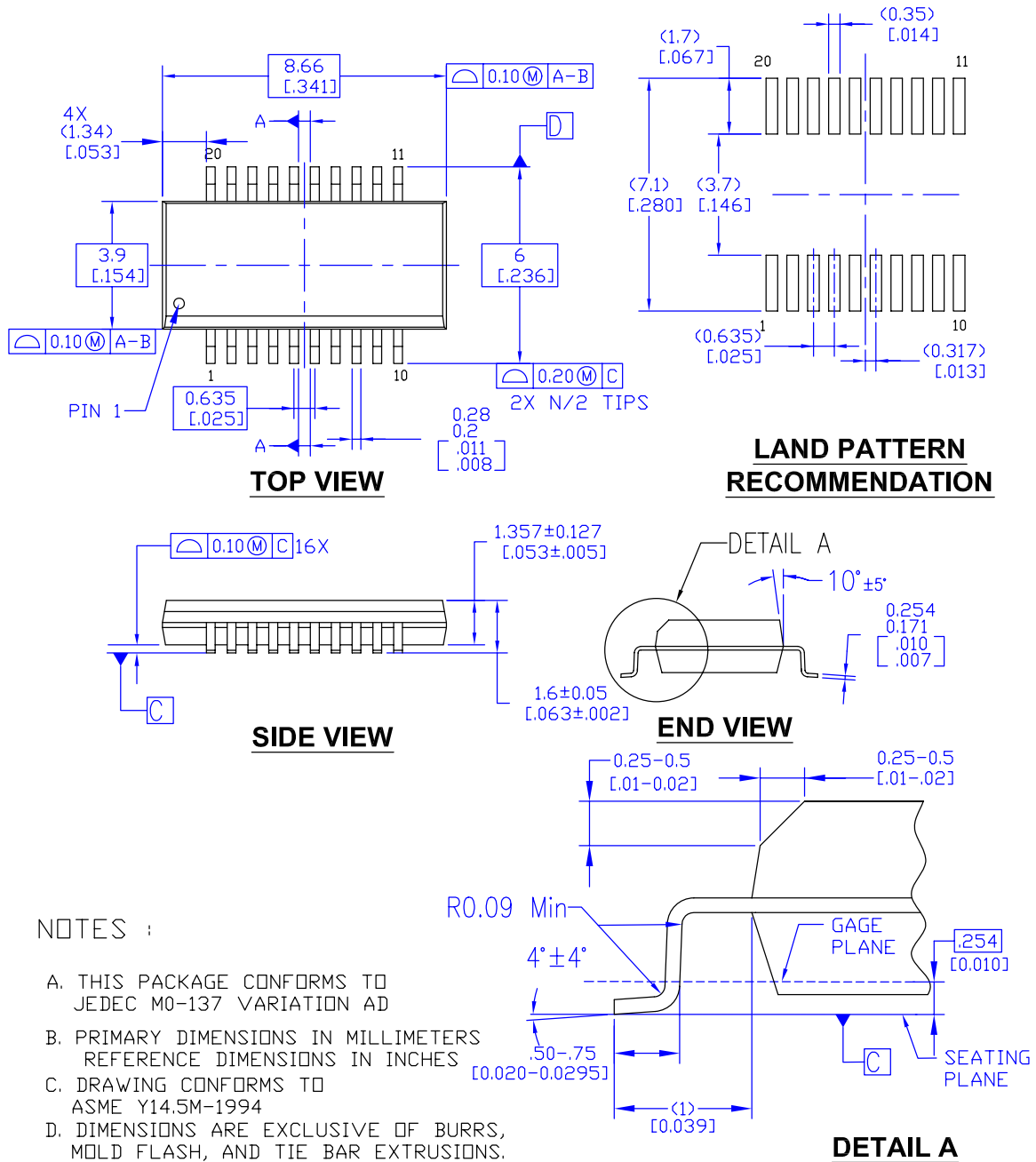
Figure 4. 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide

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Physical Dimensions (Continued)



MQA20REVA

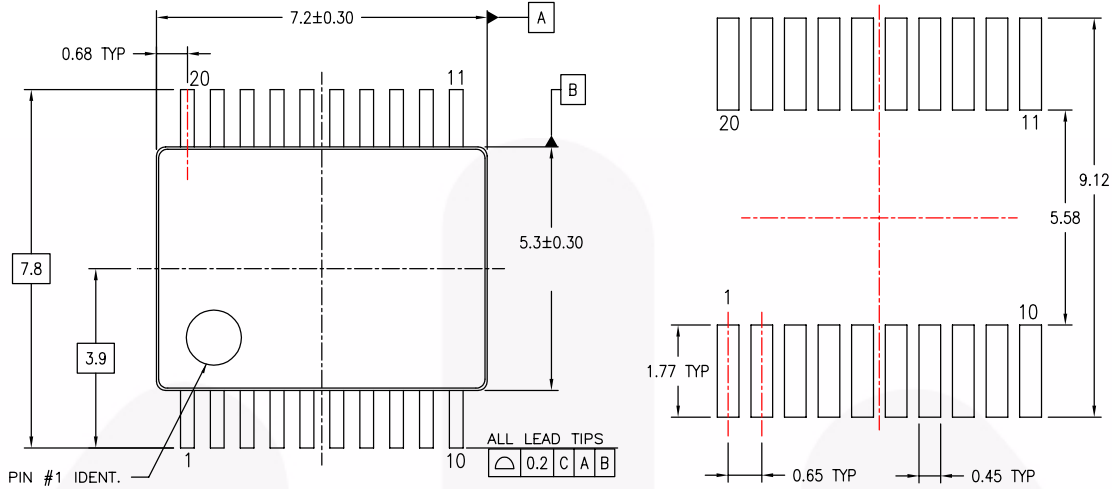
Figure 5. 20-Lead Quarter Size Outline Package (QSOP), JEDEC MO-137, 0.150" Wide

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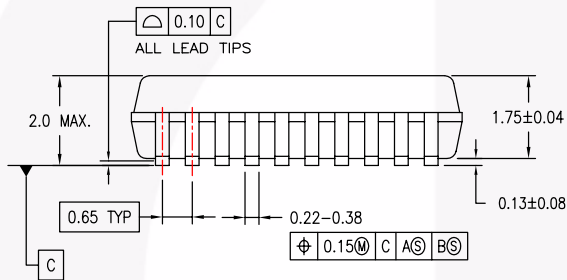
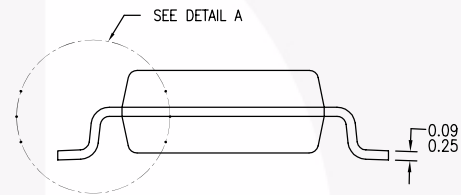
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Physical Dimensions (Continued)



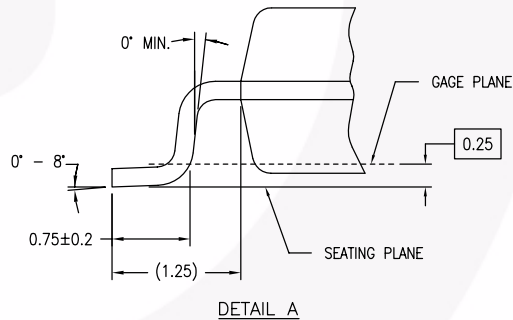
LAND PATTERN RECOMMENDATIONS



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

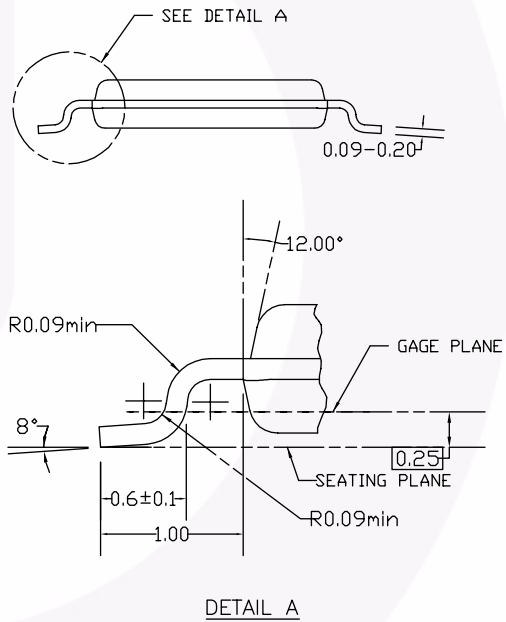
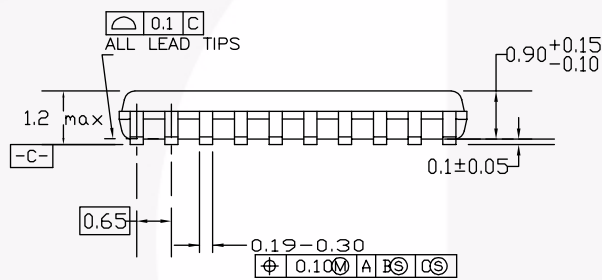
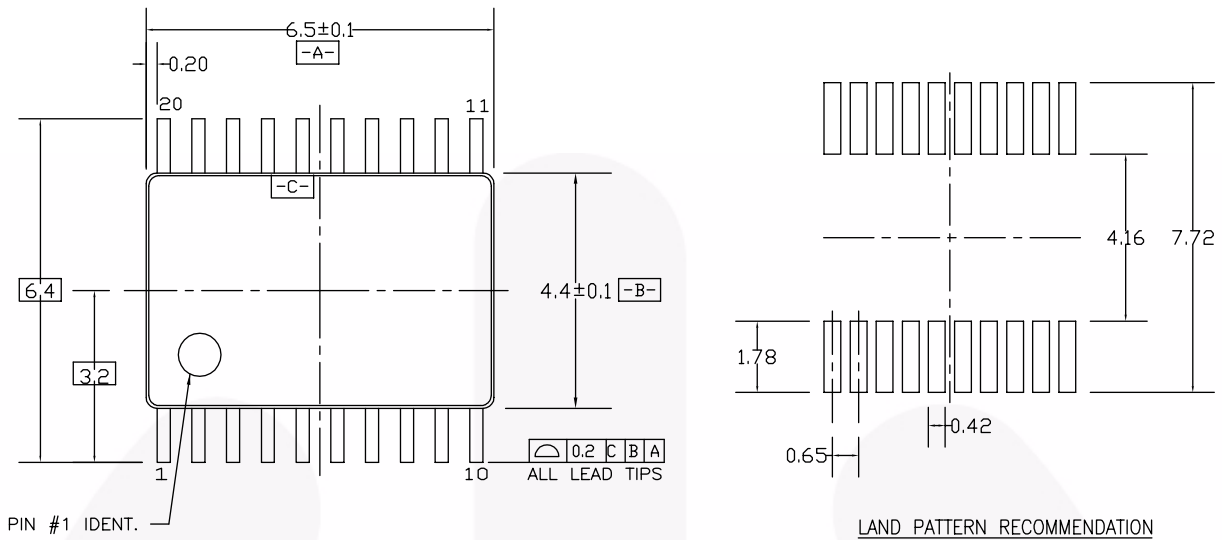
Figure 6. 20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide

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Physical Dimensions (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.

MTC20REV D1

Figure 7. 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

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


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