



July 1989
Revised November 1999

74ACQ245 • 74ACTQ245

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

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 24 mA at both the A and B ports. The Transmit/Receive (T/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.

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 24 mA
- Faster prop delays than the standard ACT245

Ordering Code:

Order Number	Package Number	Package Description
74ACQ245SC	M20B	20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide Body
74ACQ245SJ	M20D	20-Lead Small Outline Package (SOP) EIAJ TYPE II, 5.3mm Wide
74ACQ245PC	N20A	20-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
74ACTQ245SC	M20B	20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide Body
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), EIAJ TYPE II, 5.3mm Wide
74ACTQ245MTC	MTC20	20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
74ACTQ245PC	N20A	20-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

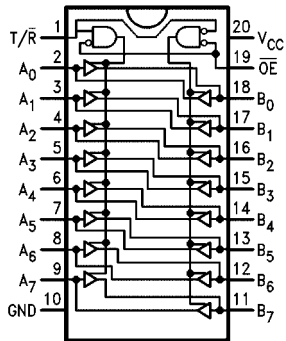
Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

FACT™, Quiet Series™, FACT Quiet Series™, and GTO™ are trademarks of Fairchild Semiconductor Corporation.

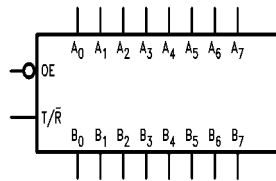
74ACQ245 • 74ACTQ245 Quiet Series™ Octal Bidirectional Transceiver with 3-STATE Inputs/Outputs

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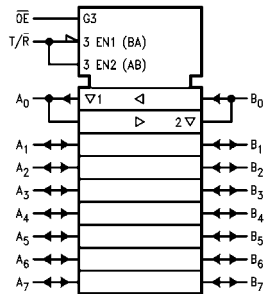
Connection Diagram



Logic Symbols



IEEE/IEC



Pin Descriptions

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
\overline{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 (Note 1)		Recommended Operating Conditions	
Supply Voltage (V_{CC})	-0.5V to +7.0V	Supply Voltage (V_{CC})	2.0V to 6.0V
DC Input Diode Current (I_{IK})		ACQ	4.5V to 5.5V
$V_I = -0.5V$	-20 mA	ACTQ	0V to V_{CC}
$V_I = V_{CC} + 0.5V$	+20 mA	Output Voltage (V_O)	0V to V_{CC}
DC Input Voltage (V_I)	-0.5V to $V_{CC} + 0.5V$	Operating Temperature (T_A)	-40°C to +85°C
DC Output Diode Current (I_{OK})		Minimum Input Edge Rate $\Delta V/\Delta t$	
$V_O = -0.5V$	-20 mA	ACQ Devices	
$V_O = V_{CC} + 0.5V$	+20 mA	V_{IN} from 30% to 70% of V_{CC}	
DC Output Voltage (V_O)	-0.5V to $V_{CC} + 0.5V$	V_{CC} @ 3.0V, 4.5V, 5.5V	125 mV/ns
DC Output Source or Sink Current (I_O)	± 50 mA	Minimum Input Edge Rate $\Delta V/\Delta t$	
DC V_{CC} or Ground Current per Output Pin (I_{CC} or I_{GND})	± 50 mA	ACTQ Devices	
Storage Temperature (T_{STG})	-65°C to +150°C	V_{IN} from 0.8V to 2.0V	
DC Latch-Up Source or Sink Current	± 300 mA	V_{CC} @ 4.5V, 5.5V	125 mV/ns
Junction Temperature (T_J)		Note 1: Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. Fairchild does not recommend operation of FACT™ circuits outside databook specifications.	
PDIP	140°C		

DC Electrical Characteristics for ACQ								
Symbol	Parameter	V_{CC} (V)	$T_A = +25^\circ\text{C}$		$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		Units	Conditions
			Typ	Guaranteed Limits	Guaranteed Limits	Guaranteed Limits		
V_{IH}	Minimum HIGH Level Input Voltage	3.0	1.5	2.1	2.1	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$	
		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	1.5	0.9	0.9	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$	
		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	2.99	2.9	2.9	V	$I_{OUT} = -50 \mu A$	
		4.5	4.49	4.4	4.4			
		5.5	5.49	5.4	5.4			
		3.0		2.56	2.46	V	$V_{IN} = V_{IL}$ or V_{IH} $I_{OH} = -12$ mA $I_{OH} = -24$ mA $I_{OH} = -24$ mA (Note 2)	
		4.5		3.86	3.76			
		5.5		4.86	4.76			
V_{OL}	Maximum LOW Level Output Voltage	3.0	0.002	0.1	0.1	V	$I_{OUT} = 50 \mu A$	
		4.5	0.001	0.1	0.1			
		5.5	0.001	0.1	0.1			
		3.0		0.36	0.44	V	$V_{IN} = V_{IL}$ or V_{IH} $I_{OL} = 12$ mA $I_{OL} = 24$ mA $I_{OL} = 24$ mA (Note 2)	
		4.5		0.36	0.44			
		5.5		0.36	0.44			
I_{IN} (Note 4)	Maximum Input Leakage Current	5.5		± 0.1	± 1.0	μA	$V_I = V_{CC}, GND$	
I_{OLD}	Minimum Dynamic Output Current (Note 3)	5.5			75	mA	$V_{OLD} = 1.65V$ Max	
I_{OHD}	Output Current (Note 3)	5.5			-75	mA	$V_{OHD} = 3.85V$ Min	
I_{CC} (Note 4)	Maximum Quiescent Supply Current	5.5		4.0	40.0	μA	$V_{IN} = V_{CC}$ or GND	
I_{OZT}	Maximum I/O Leakage Current	5.5		± 0.3	± 3.0	μA	V_I (OE) = V_{IL}, V_{IH} $V_I = V_{CC}, GND$ $V_O = V_{CC}, GND$	

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DC Electrical Characteristics for ACQ (Continued)								
Symbol	Parameter	V _{CC} (V)	T _A = +25°C		T _A = -40°C to +85°C	Units	Conditions	
			Typ	Guaranteed Limits				
V _{OLP}	Quiet Output Maximum Dynamic V _{OL}	5.0	1.1	1.5		V	Figure 1, Figure 2 (Note 5)(Note 6)	
V _{OLV}	Quiet Output Minimum Dynamic V _{OL}	5.0	-0.6	-1.2		V	Figure 1, Figure 2 (Note 5)(Note 6)	
V _{IHD}	Minimum HIGH Level Dynamic Input Voltage	5.0	3.1	3.5		V	(Note 5)(Note 7)	
V _{ILD}	Maximum LOW Level Dynamic Input Voltage	5.0	1.9	1.5		V	(Note 5)(Note 7)	
<p>Note 2: All outputs loaded; thresholds on input associated with output under test.</p> <p>Note 3: Maximum test duration 2.0 ms, one output loaded at a time.</p> <p>Note 4: I_{IN} and I_{CC} @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V_{CC}.</p> <p>Note 5: DIP package.</p> <p>Note 6: Max number of outputs defined as (n). Data Inputs are driven 0V to 5V; one output @ GND.</p> <p>Note 7: 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.</p>								
DC Electrical Characteristics for ACTQ								
Symbol	Parameter	V _{CC} (V)	T _A = +25°C		T _A = -40°C to +85°C	Units	Conditions	
			Typ	Guaranteed Limits				
V _{IH}	Minimum HIGH Level Input Voltage	4.5	1.5	2.0	2.0	V	V _{OUT} = 0.1V or V _{CC} - 0.1V	
		5.5	1.5	2.0	2.0			
V _{IL}	Maximum LOW Level Input Voltage	4.5	1.5	0.8	0.8	V	V _{OUT} = 0.1V or V _{CC} - 0.1V	
		5.5	1.5	0.8	0.8			
V _{OH}	Minimum HIGH Level Output Voltage	4.5	4.49	4.4	4.4	V	I _{OUT} = -50 μA	
		5.5	5.49	5.4	5.4			
			4.5		3.86	3.76	V	V _{IN} = V _{IL} or V _{IH} I _{OH} = -24 mA I _{OH} = -24 mA (Note 8)
			5.5		4.86	4.76		
V _{OL}	Maximum LOW Level Output Voltage	4.5	0.001	0.1	0.1	V	I _{OUT} = 50 μA	
		5.5	0.001	0.1	0.1			
			4.5		0.36	0.44	V	V _{IN} = V _{IL} or V _{IH} I _{OL} = 24 mA I _{OL} = 24 mA (Note 8)
			5.5		0.36	0.44		
I _{IN}	Maximum Input Leakage Current	5.5		±0.1	±1.0	μA	V _I = V _{CC} , GND	
I _{OZT}	Maximum 3-STATE Leakage Current	5.5		±0.3	±3.0	μA	V _I = V _{IL} , V _{IH} V _O = V _{CC} , GND	
I _{CCT}	Maximum I _{CC} /Input	5.5	0.6		1.5	mA	V _I = V _{CC} - 2.1V	
I _{OLD}	Minimum Dynamic	5.5			75	mA	V _{OLD} = 1.65V Max	
I _{OH}	Output Current (Note 9)	5.5			-75	mA	V _{OH} = 3.85V Min	
I _{CC}	Maximum Quiescent Supply Current	5.5		4.0	40.0	μA	V _{IN} = V _{CC} or GND	
V _{OLP}	Quiet Output Maximum Dynamic V _{OL}	5.0	1.1	1.5		V	Figure 1, Figure 2 (Note 10)(Note 11)	
V _{OLV}	Quiet Output Minimum Dynamic V _{OL}	5.0	-0.6	-1.2		V	Figure 1, Figure 2 (Note 10)(Note 11)	
V _{IHD}	Minimum HIGH Level Dynamic Input Voltage	5.0	1.9	2.2		V	(Note 10)(Note 12)	
V _{ILD}	Maximum LOW Level Dynamic Input Voltage	5.0	1.2	0.8		V	(Note 10)(Note 12)	
<p>Note 8: All outputs loaded; thresholds on input associated with output under test.</p> <p>Note 9: Maximum test duration 2.0 ms, one output loaded at a time.</p> <p>Note 10: DIP package.</p> <p>Note 11: Max number of outputs defined as (n). n-1 Data Inputs are driven 0V to 3V; one output @ GND.</p> <p>Note 12: 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.</p>								

AC Electrical Characteristics for ACQ								
Symbol	Parameter	V _{CC} (V) (Note 13)	T _A = +25°C C _L = 50 pF			T _A = -40°C to +85°C C _L = 50 pF		Units
			Min	Typ	Max	Min	Max	
t _{PHL}	Propagation Delay	3.3	2.0	7.5	10.0	2.0	10.5	ns
t _{PLH}	Data to Output	5.0	1.5	5.0	6.5	1.5	7.0	
t _{PZL}	Output Enable Time	3.3	3.0	8.5	13.0	3.0	13.5	ns
t _{PZH}		5.0	2.0	6.0	8.5	2.0	9.0	
t _{PHZ}	Output Disable Time	3.3	1.0	8.5	14.5	1.0	15.0	ns
t _{PLZ}		5.0	1.0	7.5	9.5	1.0	10.0	
t _{OSSL}	Output to Output Skew (Note 14)	3.3		1.0	1.5		1.5	ns
t _{OSLH}	Data to Output	5.0		0.5	1.0		1.0	

Note 13: Voltage Range 5.0 is 5.0V ± 0.5V
Voltage Range 3.3 is 3.3V ± 0.3V

Note 14: 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_{OSSL}) or LOW-to-HIGH (t_{OSLH}). Parameter guaranteed by design.

AC Electrical Characteristics for ACTQ								
Symbol	Parameter	V _{CC} (V) (Note 15)	T _A = +25°C C _L = 50 pF			T _A = -40°C to +85°C C _L = 50 pF		Units
			Min	Typ	Max	Min	Max	
t _{PHL}	Propagation Delay	5.0	1.5	5.5	7.0	1.5	7.5	ns
t _{PLH}	Data to Output							
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 _{OSSL}	Output to Output Skew (Note 16)	5.0		0.5	1.0		1.0	ns
t _{OSLH}	Data to Output							

Note 15: Voltage Range 5.0 is 5.0V ± 0.5V

Note 16: 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_{OSSL}) or LOW-to-HIGH (t_{OSLH}). Parameter guaranteed by design.

Capacitance

Symbol	Parameter	Typ	Units	Conditions
C _{IN}	Input Capacitance	4.5	pF	V _{CC} = OPEN
C _{I/O}	Input/Output Capacitance	15	pF	V _{CC} = 5.0V
C _{PD}	Power Dissipation Capacitance	80.0	pF	V _{CC} = 5.0V

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 50 pF, 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.

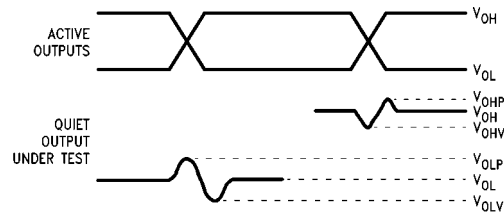


FIGURE 1. Quiet Output Noise Voltage Waveforms

Note 17: V_{OHV} and V_{OLP} are measured with respect to ground reference.

Note 18: Input pulses have the following characteristics: $f = 1$ MHz, $t_r = 3$ ns, $t_f = 3$ ns, skew < 150 ps.

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 2 ns. 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 2 ns. 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.

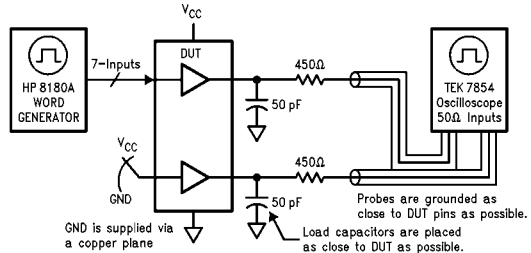
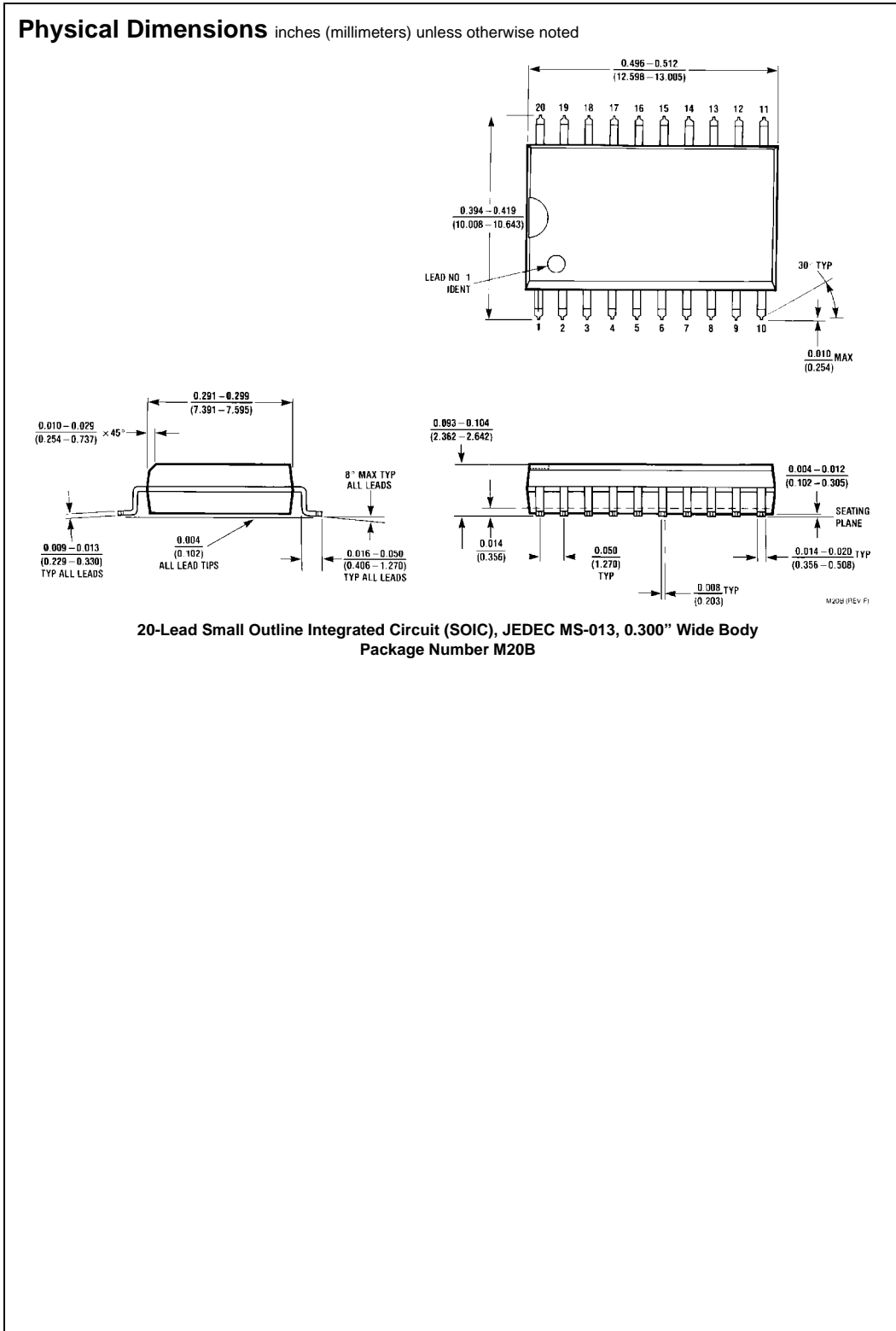
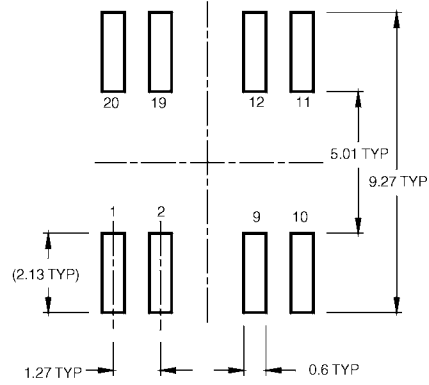
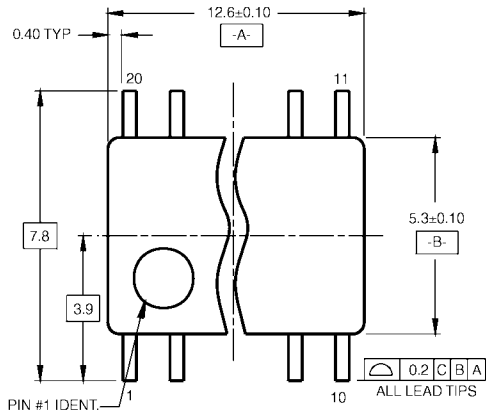


FIGURE 2. Simultaneous Switching Test Circuit



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



DIMENSIONS ARE IN MILLIMETERS



DETAIL A

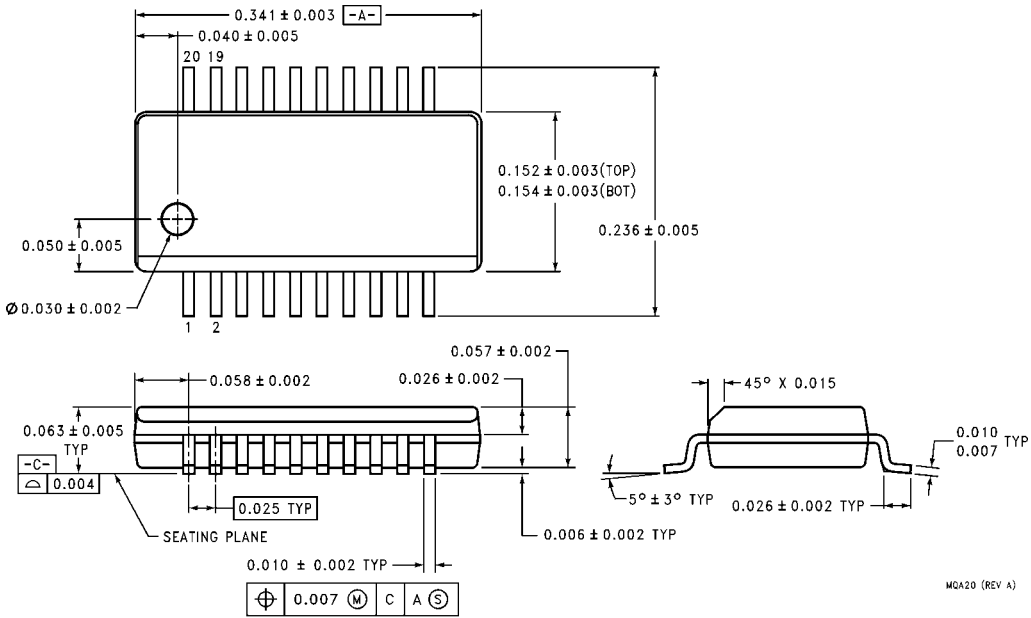
NOTES:

- 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.

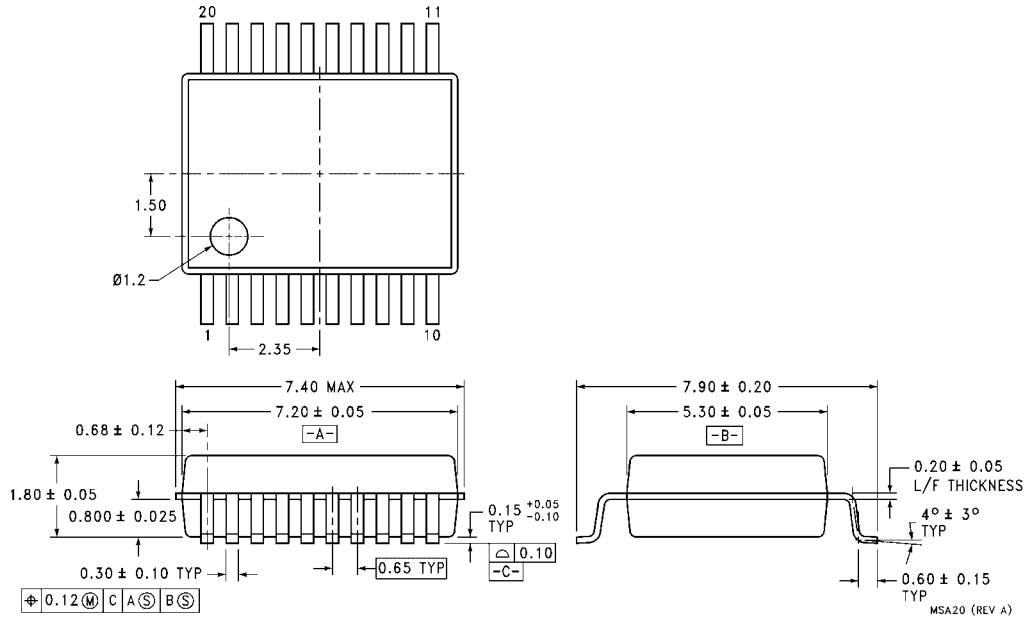
M20DRevB1

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

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



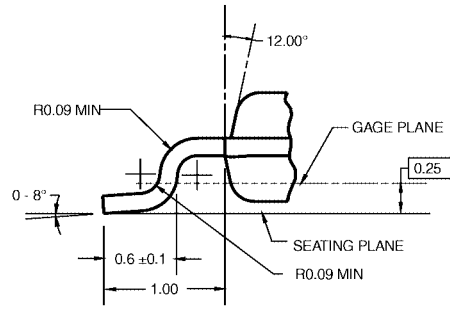
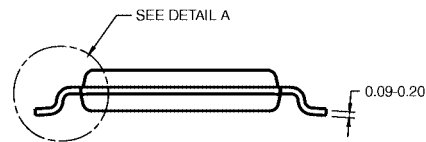
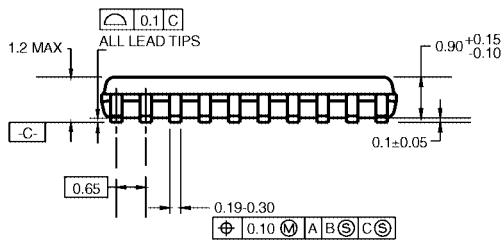
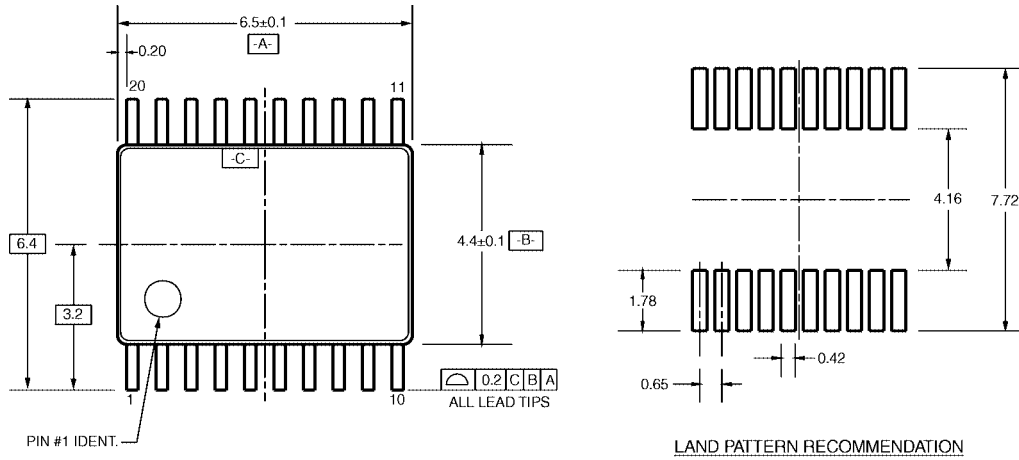
**20-Lead Quarter Size Outline Package (QSOP), JEDEC MO-137, 0.150" Wide
Package Number MQA20**



**20-Lead Shrink Small Outline Package (SSOP), EIAJ TYPE II, 5.3mm Wide
Package Number MSA20**

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



DIMENSIONS ARE IN MILLIMETERS

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

DETAIL A

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

