

## 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

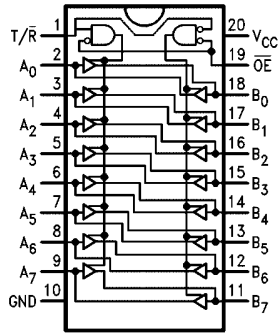
#### Ordering Code:

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

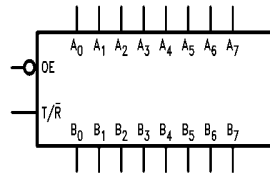
Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

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

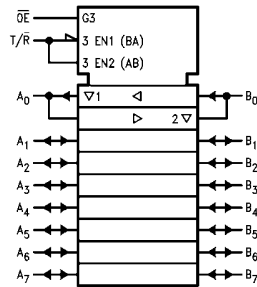
### Connection Diagram



### 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)

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

**Recommended Operating Conditions**

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

**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.

**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				
$V_{IH}$	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 $V_{IH}$ $I_{OH} = -12 \text{ mA}$ $I_{OH} = -24 \text{ mA}$ $I_{OH} = -24 \text{ mA}$ (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 $V_{IH}$ $I_{OL} = 12 \text{ mA}$ $I_{OL} = 24 \text{ mA}$ $I_{OL} = 24 \text{ mA}$ (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	$V_I = V_{CC}, \text{ GND}$	
$I_{OLD}$	Minimum Dynamic	5.5			75	mA	$V_{OLD} = 1.65V \text{ Max}$	
$I_{OHD}$	Output Current (Note 3)	5.5			-75	mA	$V_{OHD} = 3.85V \text{ Min}$	
$I_{CC}$ (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	$V_I (\text{OE}) = V_{IL}, V_{IH}$ $V_I = V_{CC}, \text{ GND}$ $V_O = V_{CC}, \text{ GND}$	

**DC Electrical Characteristics for ACQ** (Continued)

Symbol	Parameter	V <sub>CC</sub> (V)	T <sub>A</sub> = +25°C		T <sub>A</sub> = -40°C to +85°C	Units	Conditions
			Typ	Guaranteed Limits			
V <sub>OLP</sub>	Quiet Output Maximum Dynamic V <sub>OL</sub>	5.0	1.1	1.5		V	Figure 1, Figure 2 (Note 5)(Note 6)
V <sub>OLV</sub>	Quiet Output Minimum Dynamic V <sub>OL</sub>	5.0	-0.6	-1.2		V	Figure 1, Figure 2 (Note 5)(Note 6)
V <sub>IHD</sub>	Minimum HIGH Level Dynamic Input Voltage	5.0	3.1	3.5		V	(Note 5)(Note 7)
V <sub>ILD</sub>	Maximum LOW Level Dynamic Input Voltage	5.0	1.9	1.5		V	(Note 5)(Note 7)

**Note 2:** All outputs loaded; thresholds on input associated with output under test.

**Note 3:** Maximum test duration 2.0 ms, one output loaded at a time.

**Note 4:** I<sub>IN</sub> and I<sub>CC</sub> @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V<sub>CC</sub>.

**Note 5:** DIP package.

**Note 6:** Max number of outputs defined as (n). Data Inputs are driven 0V to 5V; one output @ GND.

**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<sub>ILD</sub>), 0V to threshold (V<sub>IHD</sub>), f = 1 MHz.

**DC Electrical Characteristics for ACTQ**

Symbol	Parameter	V <sub>CC</sub> (V)	T <sub>A</sub> = +25°C		T <sub>A</sub> = -40°C to +85°C	Units	Conditions	
			Typ	Guaranteed Limits				
V <sub>IH</sub>	Minimum HIGH Level Input Voltage	4.5	1.5	2.0	2.0	V	V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> - 0.1V	
		5.5	1.5	2.0	2.0			
V <sub>IL</sub>	Maximum LOW Level Input Voltage	4.5	1.5	0.8	0.8	V	V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> - 0.1V	
		5.5	1.5	0.8	0.8			
V <sub>OH</sub>	Minimum HIGH Level Output Voltage	4.5	4.49	4.4	4.4	V	I <sub>OUT</sub> = -50 μA	
		5.5	5.49	5.4	5.4			
			4.5		3.86	3.76	V	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OH</sub> = -24 mA I <sub>OH</sub> = -24 mA (Note 8)
			5.5		4.86	4.76		
V <sub>OL</sub>	Maximum LOW Level Output Voltage	4.5	0.001	0.1	0.1	V	I <sub>OUT</sub> = 50 μA	
		5.5	0.001	0.1	0.1			
			4.5		0.36	0.44	V	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OL</sub> = 24 mA I <sub>OL</sub> = 24 mA (Note 8)
			5.5		0.36	0.44		
I <sub>IN</sub>	Maximum Input Leakage Current	5.5		±0.1	±1.0	μA	V <sub>I</sub> = V <sub>CC</sub> , GND	
I <sub>OZT</sub>	Maximum 3-STATE Leakage Current	5.5		±0.3	±3.0	μA	V <sub>I</sub> = V <sub>IL</sub> , V <sub>IH</sub> V <sub>O</sub> = V <sub>CC</sub> , GND	
I <sub>CCT</sub>	Maximum I <sub>CC</sub> /Input	5.5	0.6		1.5	mA	V <sub>I</sub> = V <sub>CC</sub> - 2.1V	
I <sub>OLD</sub>	Minimum Dynamic	5.5			75	mA	V <sub>OLD</sub> = 1.65V Max	
I <sub>OHD</sub>	Output Current (Note 9)	5.5			-75	mA	V <sub>OHD</sub> = 3.85V Min	
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5		4.0	40.0	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND	
V <sub>OLP</sub>	Quiet Output	5.0	1.1	1.5		V	Figure 1, Figure 2 (Note 10)(Note 11)	
	Maximum Dynamic V <sub>OL</sub>							
V <sub>OLV</sub>	Quiet Output	5.0	-0.6	-1.2		V	Figure 1, Figure 2 (Note 10)(Note 11)	
	Minimum Dynamic V <sub>OL</sub>							
V <sub>IHD</sub>	Minimum HIGH Level Dynamic Input Voltage	5.0	1.9	2.2		V	(Note 10)(Note 12)	
V <sub>ILD</sub>	Maximum LOW Level Dynamic Input Voltage	5.0	1.2	0.8		V	(Note 10)(Note 12)	

**Note 8:** All outputs loaded; thresholds on input associated with output under test.

**Note 9:** Maximum test duration 2.0 ms, one output loaded at a time.

**Note 10:** DIP package.

**Note 11:** Max number of outputs defined as (n). n-1 Data Inputs are driven 0V to 3V; one output @ GND.

**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<sub>ILD</sub>), 0V to threshold (V<sub>IHD</sub>), f = 1 MHz.

AC Electrical Characteristics for ACQ								
Symbol	Parameter	V <sub>CC</sub> (V) (Note 13)	T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		Units
			Min	Typ	Max	Min	Max	
t <sub>PHL</sub>	Propagation Delay	3.3	2.0	7.5	10.0	2.0	10.5	ns
t <sub>PLH</sub>	Data to Output	5.0	1.5	5.0	6.5	1.5	7.0	
t <sub>PZL</sub>	Output Enable Time	3.3	3.0	8.5	13.0	3.0	13.5	ns
t <sub>PZH</sub>		5.0	2.0	6.0	8.5	2.0	9.0	
t <sub>PHZ</sub>	Output Disable Time	3.3	1.0	8.5	14.5	1.0	15.0	ns
t <sub>PLZ</sub>		5.0	1.0	7.5	9.5	1.0	10.0	
t <sub>OSHL</sub>	Output to Output Skew (Note 14)	3.3		1.0	1.5		1.5	ns
t <sub>OSLH</sub>	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<sub>OSHL</sub>) or LOW-to-HIGH (t<sub>OSLH</sub>). Parameter guaranteed by design.

AC Electrical Characteristics for ACTQ								
Symbol	Parameter	V <sub>CC</sub> (V) (Note 15)	T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		Units
			Min	Typ	Max	Min	Max	
t <sub>PHL</sub>	Propagation Delay	5.0	1.5	5.5	7.0	1.5	7.5	ns
t <sub>PLH</sub>	Data to Output							
t <sub>PZL</sub> , t <sub>PZH</sub>	Output Enable Time	5.0	2.0	7.0	9.0	2.0	9.5	ns
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Output Disable Time	5.0	1.0	8.0	10.0	1.0	10.5	ns
t <sub>OSHL</sub>	Output to Output Skew (Note 16)	5.0		0.5	1.0		1.0	ns
t <sub>OSLH</sub>	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<sub>OSHL</sub>) or LOW-to-HIGH (t<sub>OSLH</sub>). Parameter guaranteed by design.

### Capacitance

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

## FACT Noise Characteristics

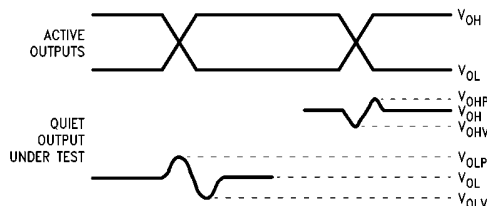
The setup of a noise characteristics measurement is critical to the accuracy and repeatability of the tests. The following is a brief description of the setup used to measure the noise characteristics of FACT.

### 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.

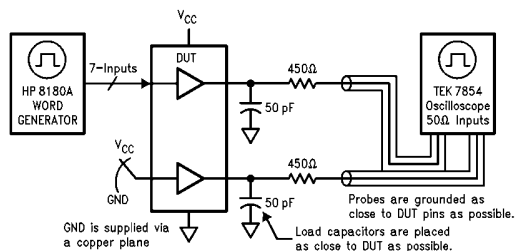
**Note 18:** Input pulses have the following characteristics:  $f = 1$  MHz,  $t_r = 3$  ns,  $t_f = 3$  ns, skew  $< 150$  ps.

$V_{OLP}/V_{OLV}$  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.

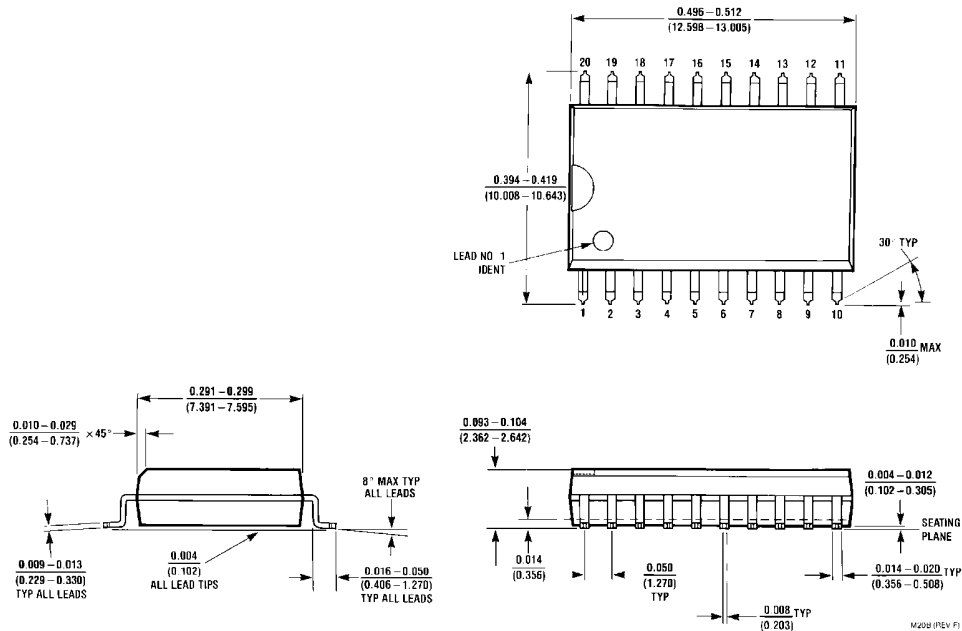
$V_{ILD}$  and  $V_{IHD}$ :

- 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.



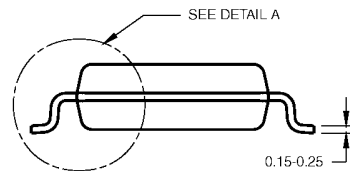
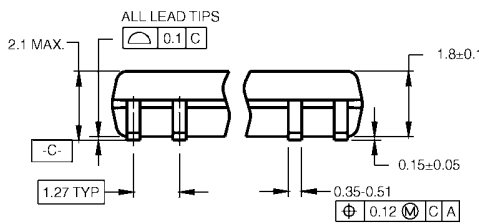
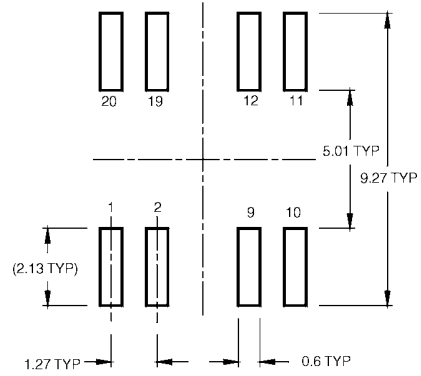
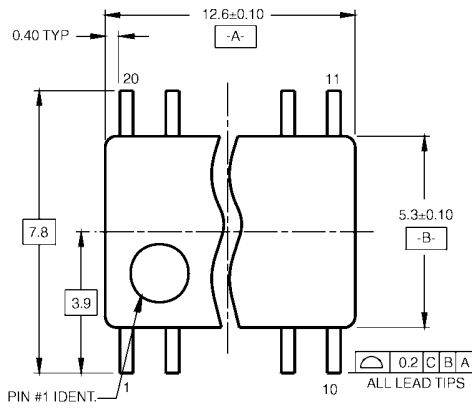
**FIGURE 2. Simultaneous Switching Test Circuit**

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



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

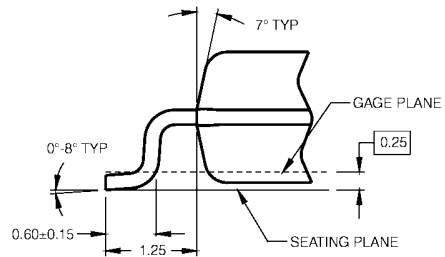
**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



DIMENSIONS ARE IN MILLIMETERS

- 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.

M20DRRevB1

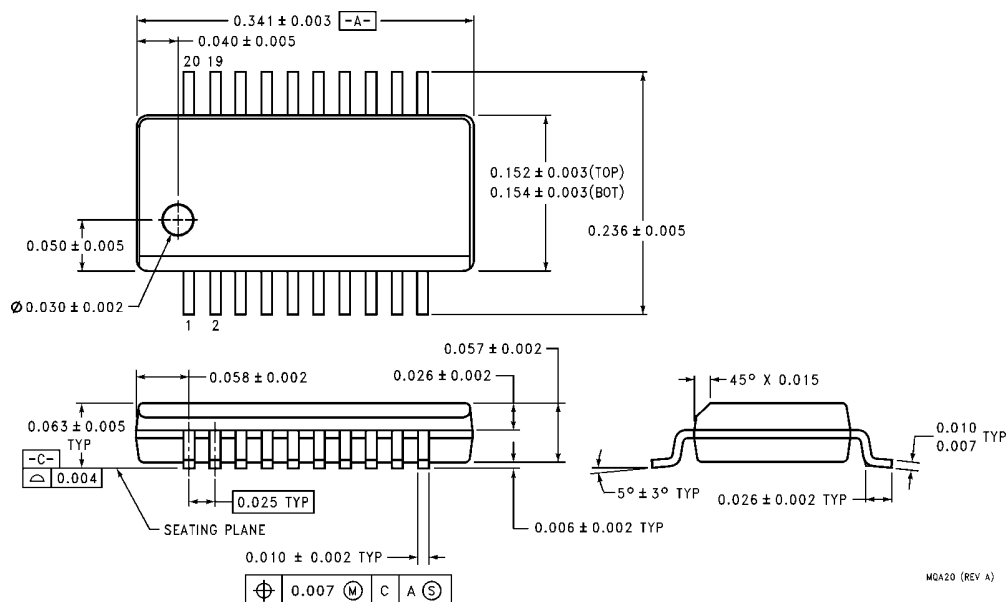


DETAIL A

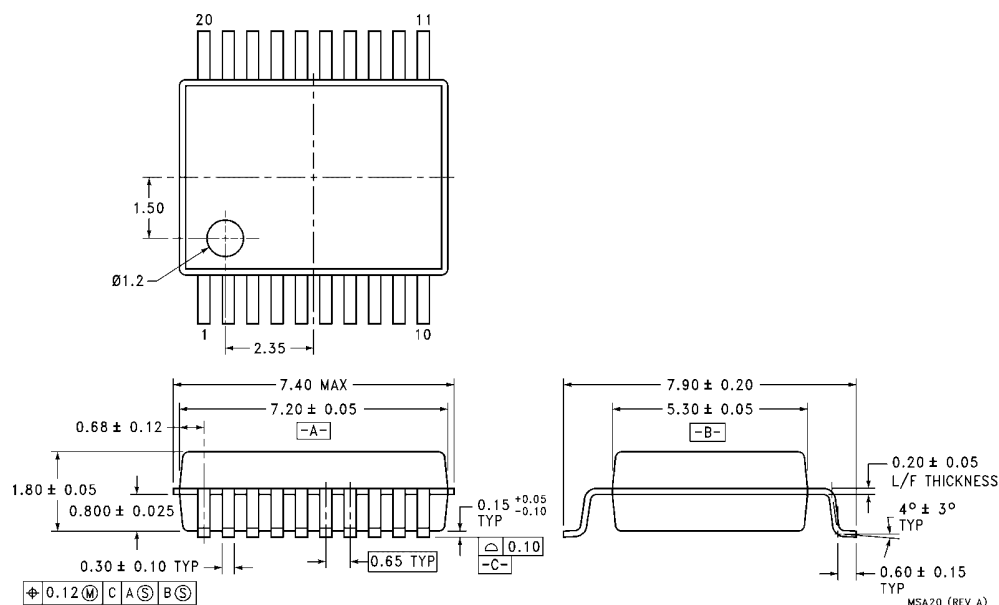
**20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide  
 Package Number M20D**



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

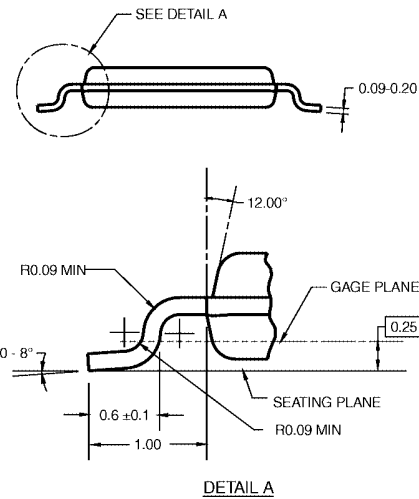
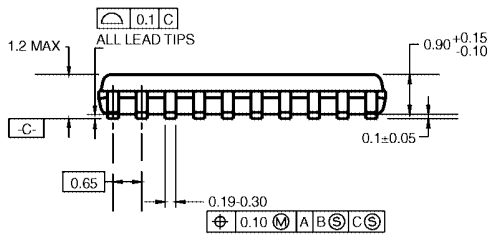
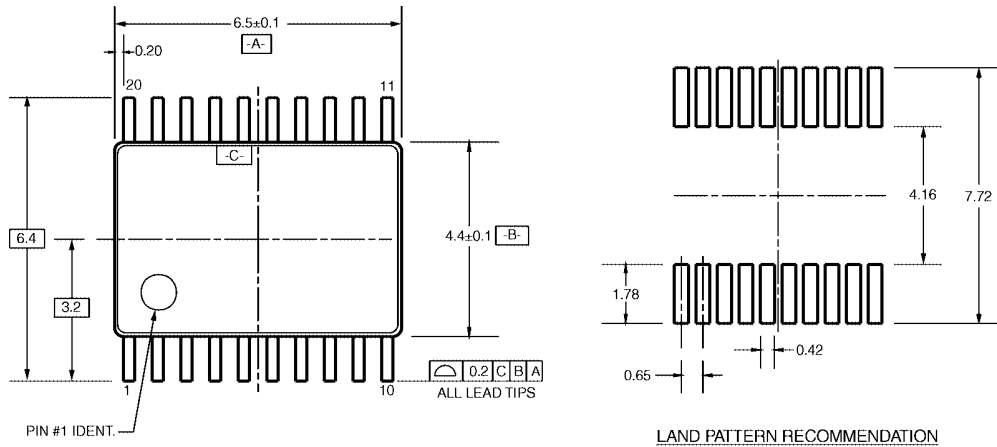


**20-Lead Quarter Size Outline Package (QSOP), JEDEC MO-137, 0.150" Wide  
Package Number MQA20**



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

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

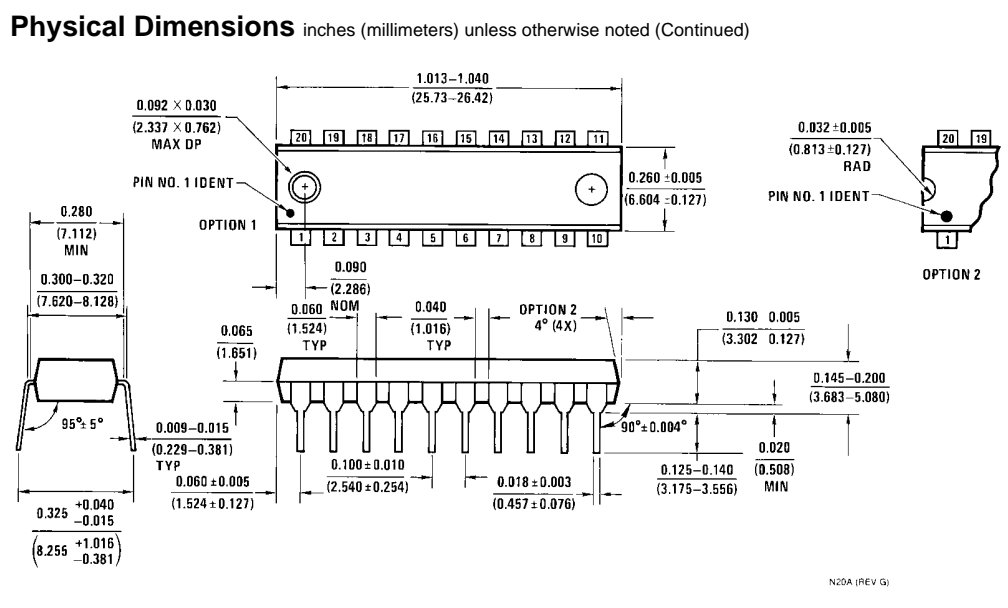


DIMENSIONS ARE IN MILLIMETERS

- 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

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



**20-Lead Plastic Dual-In-Line (PDIP), JEDEC MS-001, 0.300" Wide  
Package Number N20A**

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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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