



## 54ACQ/74ACQ245 • 54ACTQ/74ACTQ245 Quiet Series Octal Bidirectional Transceiver with TRI-STATE® Inputs/Outputs

### General Description

The 'ACQ/'ACTQ245 contains eight non-inverting bidirectional buffers with TRI-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.

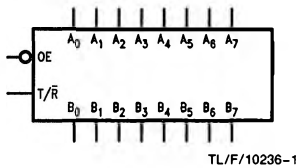
The 'ACQ/'ACTQ utilizes NSC Quiet Series technology to guarantee quiet output switching and improve dynamic threshold performance. FACT Quiet Series™ features GTO™ output control and undershoot corrector in addition to a split ground bus for superior performance.

### Features

- Guaranteed simultaneous switching noise level and dynamic threshold performance
- Guaranteed pin-to-pin skew AC performance
- Improved latch-up immunity
- TRI-STATE outputs drive bus lines or buffer memory address registers
- Outputs source/sink 24 mA
- Faster prop delays than the standard 'ACT245
- 4 kV minimum ESD immunity ('ACQ)

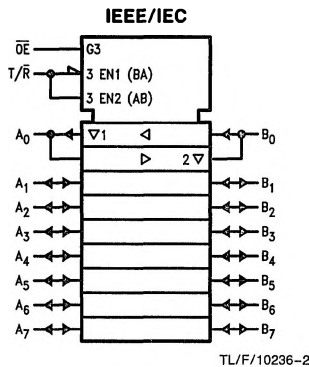
**Ordering Code:** See Section 8

### Logic Symbols



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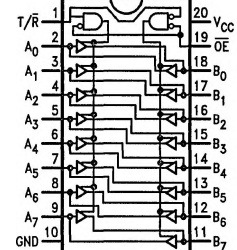
Pin Names	Description
OE	Output Enable Input
T/R	Transmit/Receive Input
A <sub>0</sub> -A <sub>7</sub>	Side A TRI-STATE Inputs or TRI-STATE Outputs
B <sub>0</sub> -B <sub>7</sub>	Side B TRI-STATE Inputs or TRI-STATE Outputs



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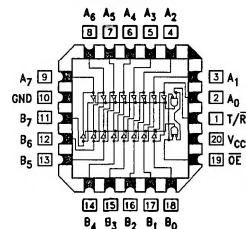
### Connection Diagrams

#### Pin Assignment for DIP, Flatpak and SOIC



TL/F/10236-3

#### Pin Assignment for LCC and PCC



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### Truth Table

Inputs		Outputs
OE	T/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)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

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 Input 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 to $V_{CC} + 0.5V$
DC Output Source or Sink Current ( $I_O$ )	$\pm 50$ mA
DC $V_{CC}$ or Ground Current per Output Pin ( $I_{CC}$ or $I_{GND}$ )	$\pm 50$ mA
Storage Temperature ( $T_{STG}$ )	-65°C to +150°C
DC Latch-Up Source or Sink Current	$\pm 300$ mA
Junction Temperature ( $T_J$ )	
CDIP	175°C
PDIP	140°C

**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. National does not recommend operation of FACT circuits outside databook specifications.

**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 ( $T_A$ )	
74ACQ/ACTQ	-40°C to +85°C
54ACQ/ACTQ	-55°C to +125°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

**DC Characteristics for 'ACQ Family Devices**

Symbol	Parameter	$V_{CC}$ (V)	74ACQ		54ACQ	74ACQ	Units	Conditions
			$T_A = +25^\circ\text{C}$		$T_A =$ -55°C to +125°C	$T_A =$ -40°C to +85°C		
			Typ		Guaranteed Limits			
$V_{IH}$	Minimum High Level Input Voltage	3.0	1.5	2.1	2.1	2.1	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		4.5	2.25	3.15	3.15	3.15		
		5.5	2.75	3.85	3.85	3.85		
$V_{IL}$	Maximum Low Level Input Voltage	3.0	1.5	0.9	0.9	0.9	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		4.5	2.25	1.35	1.35	1.35		
		5.5	2.75	1.65	1.65	1.65		
$V_{OH}$	Minimum High Level Output Voltage	3.0	2.99	2.9	2.9	2.9	V	$I_{OUT} = -50 \mu\text{A}$
		4.5	4.49	4.4	4.4	4.4		
		5.5	5.49	5.4	5.4	5.4		
$V_{OL}$	Maximum Low Level Output Voltage	3.0		2.56	2.4	2.46	V	* $V_{IN} = V_{IL}$ or $V_{IH}$ -12 mA $I_{OH}$ -24 mA -24 mA
		4.5		3.86	3.7	3.76		
		5.5		4.86	4.7	4.76		
$V_{OL}$	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1	0.1	V	$I_{OUT} = 50 \mu\text{A}$
		4.5	0.001	0.1	0.1	0.1		
		5.5	0.001	0.1	0.1	0.1		
$V_{OL}$	Maximum Low Level Output Voltage	3.0		0.36	0.50	0.44	V	* $V_{IN} = V_{IL}$ or $V_{IH}$ 12 mA $I_{OL}$ 24 mA 24 mA
		4.5		0.36	0.50	0.44		
		5.5		0.36	0.50	0.44		
$I_{IN}$	Maximum Input Leakage Current	5.5		$\pm 0.1$	$\pm 1.0$	$\pm 1.0$	$\mu\text{A}$	$V_I = V_{CC}, \text{GND}$ (Note 1)

\*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

## DC Characteristics for 'ACQ Family Devices (Continued)

Symbol	Parameter	V <sub>CC</sub> (V)	74ACQ		54ACQ	74ACQ	Units	Conditions
			T <sub>A</sub> = +25°C		T <sub>A</sub> = -55°C to +125°C	T <sub>A</sub> = -40°C to +85°C		
			Typ	Guaranteed Limits				
I <sub>OLD</sub>	†Minimum Dynamic Output Current	5.5			50	75	mA	V <sub>OLD</sub> = 1.65V Max
I <sub>OHD</sub>		5.5			-50	-75	mA	V <sub>OHD</sub> = 3.85V Min
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5		8.0	160.0	80.0	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND (Note 1)
I <sub>OZT</sub>	Maximum I/O Leakage Current	5.5		±0.6	±11.0	±6.0	μA	V <sub>I</sub> (OE) = V <sub>IL</sub> , V <sub>IH</sub> V <sub>I</sub> = V <sub>CC</sub> , GND V <sub>O</sub> = V <sub>CC</sub> , GND
V <sub>OLP</sub>	Quiet Output Maximum Dynamic V <sub>OL</sub>	5.0	1.1	1.5			V	Figures 1, 2 (Notes 2, 3)
V <sub>OLV</sub>	Quiet Output Minimum Dynamic V <sub>OL</sub>	5.0	-0.6	-1.2			V	Figures 1, 2 (Notes 2,3)
V <sub>IHD</sub>	Maximum High Level Dynamic Input Voltage	5.0	3.1	3.5			V	(Notes 2, 4)
V <sub>ILD</sub>	Maximum Low Level Dynamic Input Voltage	5.0	1.9	1.5			V	(Notes 2, 4)

\*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

Note 1: 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>. I<sub>CC</sub> for 54ACQ @ 25°C is identical to 74ACQ @ 25°C.

Note 2: Worst case package.

Note 3: Max number of outputs defined as (n). Data Inputs are driven 0V to 5V; one output @ GND.

Note 4: 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 Characteristics for 'ACTQ Family Devices

Symbol	Parameter	V <sub>CC</sub> (V)	74ACTQ		54ACTQ	74ACTQ	Units	Conditions	
			T <sub>A</sub> = +25°C		T <sub>A</sub> = -55°C to +125°C	T <sub>A</sub> = -40°C to +85°C			
			Typ	Guaranteed Limits					
V <sub>IH</sub>	Minimum High Level Input Voltage	4.5	1.5	2.0	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	2.0			
V <sub>IL</sub>	Maximum Low Level Input Voltage	4.5	1.5	0.8	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	0.8			
V <sub>OH</sub>	Minimum High Level Output Voltage	4.5	4.49	4.4	4.4	4.4	V	I <sub>OUT</sub> = -50 μA	
		5.5	5.49	5.4	5.4	5.4			
			4.5		3.86	3.70	3.76	V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> -24 mA
			5.5		4.86	4.70	4.76		
V <sub>OL</sub>	Maximum Low Level Output Voltage	4.5	0.001	0.1	0.1	0.1	V	I <sub>OUT</sub> = 50 μA	
		5.5	0.001	0.1	0.1	0.1			
			4.5		0.36	0.50	0.44	V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> 24 mA
			5.5		0.36	0.50	0.44		
I <sub>IN</sub>	Maximum Input Leakage Current	5.5		±0.1	±1.0	±1.0	μA	V <sub>I</sub> = V <sub>CC</sub> , GND	

\*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

## DC Characteristics for 'ACTQ Family Devices (Continued)

Symbol	Parameter	V <sub>CC</sub> (V)	74ACTQ		54ACTQ		74ACTQ		Units	Conditions
			T <sub>A</sub> = +25°C		T <sub>A</sub> = -55°C to +125°C		T <sub>A</sub> = -40°C to +85°C			
			Typ	Guaranteed Limits						
I <sub>OZ</sub>	Maximum TRI-STATE Leakage Current	5.5		±0.5	±10.0	±5.0			μA	V <sub>I</sub> = V <sub>IL</sub> , V <sub>IH</sub> V <sub>O</sub> = V <sub>CC</sub> , GND
I <sub>CC</sub> T	Maximum I <sub>CC</sub> /Input	5.5	0.6		1.6	1.5			mA	V <sub>I</sub> = V <sub>CC</sub> - 2.1V
I <sub>OLD</sub>	†Minimum Dynamic Output Current	5.5			50	75			mA	V <sub>OLD</sub> = 1.65V Max
I <sub>OHD</sub>	Output Current	5.5			-50	-75			mA	V <sub>OHD</sub> = 3.85V Min
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5		8.0	160.0	80.0			μA	V <sub>IN</sub> = V <sub>CC</sub> or GND (Note 1)
V <sub>OLP</sub>	Quiet Output Maximum Dynamic V <sub>OL</sub>	5.0	1.1	1.5					V	Figures 1, 2 (Notes 2, 3)
V <sub>OLV</sub>	Quiet Output Minimum Dynamic V <sub>OL</sub>	5.0	-0.6	-1.2					V	Figures 1, 2 (Notes 2, 3)
V <sub>IHD</sub>	Maximum High Level Dynamic Input Voltage	5.0	1.9	2.2					V	(Notes 2, 4)
V <sub>ILD</sub>	Maximum Low Level Dynamic Input Voltage	5.0	1.2	0.8					V	(Notes 2, 4)

\*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

Note 1: I<sub>CC</sub> for 54ACTQ @ 25°C is identical to 74ACTQ @ 25°C.

Note 2: Worst case package.

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

Note 4: 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: See Section 2 for Waveforms

Symbol	Parameter	V <sub>CC</sub> * (V)	74ACQ			54ACQ		74ACQ		Units	Fig. No.
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = -55°C to +125°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF			
			Min	Typ	Max	Min	Max	Min	Max		
t <sub>PHL</sub> , t <sub>PLH</sub>	Propagation Delay Data to Output	3.3 5.0	2.0 1.5	7.5 5.0	10.0 6.5			2.0 1.5	10.5 7.0	ns	2-3, 4
t <sub>PZL</sub> , t <sub>PZH</sub>	Output Enable Time	3.3 5.0	3.0 2.0	8.5 6.0	13.0 8.5			3.0 2.0	13.5 9.0	ns	2-5, 6
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Output Disable Time	3.3 5.0	1.0 1.0	8.5 7.5	14.5 9.5			1.0 1.0	15.0 10.0	ns	2-5, 6
t <sub>OSHL</sub> , t <sub>OSLH</sub>	Output to Output Skew** Data to Output	3.3 5.0		1.0 0.5	1.5 1.0				1.5 1.0	ns	

\*Voltage Range 5.0 is 5.0V ±0.5V  
Voltage Range 3.3 is 3.3V ±0.3V

\*\*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:** See Section 2 for Waveforms

Symbol	Parameter	V <sub>CC</sub> * (V)	74ACTQ			54ACTQ		74ACTQ		Units	Fig. No.
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = -55°C to +125°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF			
			Min	Typ	Max	Min	Max	Min	Max		
t <sub>PHL</sub> , t <sub>PLH</sub>	Propagation Delay Data to Output	5.0	1.5	5.5	7.0	1.5	9.0	1.5	7.5	ns	2-3, 4
t <sub>PZL</sub> , t <sub>PZH</sub>	Output Enable Time	5.0	2.0	7.0	9.0	1.5	12.0	2.0	9.5	ns	2-5, 6
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Output Disable Time	5.0	1.0	8.0	10.0	1.0	11.5	1.0	10.5	ns	2-5, 6
t <sub>OSHL</sub> , t <sub>OSLH</sub>	Output to Output Skew** Data to Output	5.0		0.5	1.0				1.0	ns	

\*Voltage Range 5.0 is 5.0V ±0.5V

\*\*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> = 5.0V
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