National Semiconductor

54AC/74AC899 • 54ACT/74ACT899
9-Bit Latchable Transceiver with Parity Generator/Checker

General Description

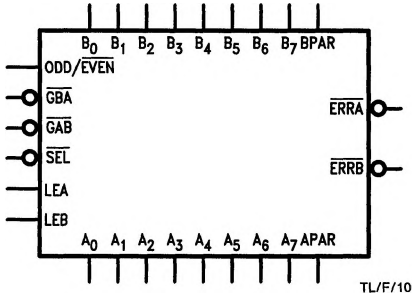
The 'AC/'ACT899 is a 9-bit to 9-bit parity transceiver with transparent latches. The device can operate as a feed-through transceiver or it can generate/check parity from the 8-bit data busses in either direction. The 'AC/'ACT899 features independent latch enables for the A-to-B direction and the B-to-A direction, a select pin for ODD/$\overline{\text{EVEN}}$ parity, and separate error signal output pins for checking parity.

Features

- Latchable transceiver with output sink of 24 mA
- Option to select generate parity and check or "feed-through" data/parity in directions A-to-B or B-to-A
- Independent latch enable for A-to-B and B-to-A directions
- Select pin for ODD/$\overline{\text{EVEN}}$ parity
- $\overline{\text{ERRA}}$ and $\overline{\text{ERRB}}$ output pins for parity checking
- Ability to simultaneously generate and check parity
- May be used in system applications in place of the '534 and '280
- May be used in system applications in place of the '657 and '373 (no need to change T/$\overline{\text{R}}$ to check parity)
- 4 kV minimum ESD immunity

Ordering Code: See Section 8

Logic Symbol



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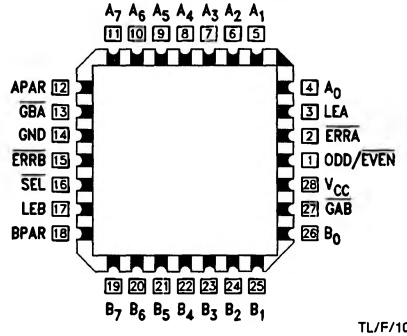
Connection Diagram

Pin Assignment for PCC



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Pin Names	Description
A_0–A_7	A Bus Data Inputs/Data Outputs
B_0–B_7	B Bus Data Inputs/Data Outputs
APAR, BPAR	A and B Bus Parity Inputs
ODD/$\overline{\text{EVEN}}$	ODD/$\overline{\text{EVEN}}$ Parity Select, Active LOW for EVEN Parity
$\overline{\text{GBA}}$, $\overline{\text{GAB}}$	Output Enables for A or B Bus, Active LOW
$\overline{\text{SEL}}$	Select Pin for Feed-Through or Generate Mode, LOW for Generate Mode
LEA, LEB	Latch Enables for A and B Latches, HIGH for Transparent Mode
$\overline{\text{ERRA}}$, $\overline{\text{ERRB}}$	Error Signals for Checking Generated Parity with Parity In, LOW if Error Occurs

Functional Description

The 'AC/'ACT899 has three principal modes of operation which are outlined below. These modes apply to both the A-to-B and B-to-A directions.

— Bus A (B) communicates to Bus B (A), parity is generated and passed on to the B (A) Bus as BPAR (APAR). If LEB (LEA) is HIGH and the Mode Select ($\overline{\text{SEL}}$) is LOW, the parity generated from B[0:7] (A[0:7]) can be checked and monitored by $\overline{\text{ERRB}}$ ($\overline{\text{ERRA}}$).

— Bus A (B) communicates to Bus B (A) in a feed-through mode if $\overline{\text{SEL}}$ is HIGH. Parity is still generated and checked as $\overline{\text{ERRA}}$ and $\overline{\text{ERRB}}$ in the feed-through mode (can be used as an interrupt to signal a data/parity bit error to the CPU).

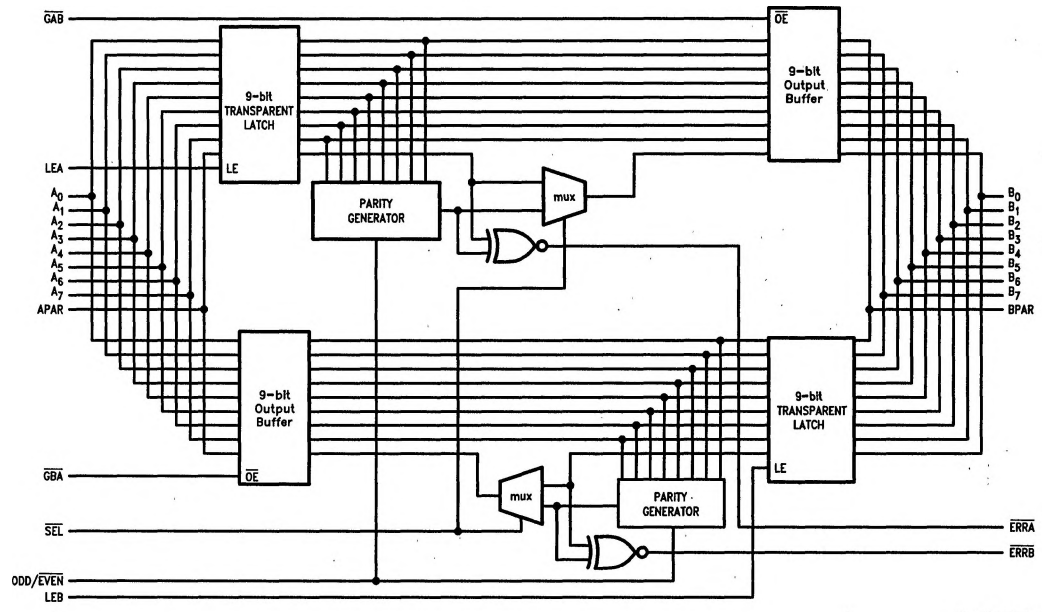
— Independent Latch Enables (LEA and LEB) allow other permutations of generating/checking (see Function Table below).

Function Table

Inputs					Operation
$\overline{\text{GAB}}$	$\overline{\text{GBA}}$	$\overline{\text{SEL}}$	LEA	LEB	
H	H	X	X	X	Busses A and B are TRI-STATE®.
H	L	L	L	H	Generates parity from B[0:7] based on O/$\overline{\text{E}}$ (Note 1). Generated parity → APAR. Generated parity checked against BPAR and output as $\overline{\text{ERRB}}$.
H	L	L	H	H	Generates parity from B[0:7] based on O/$\overline{\text{E}}$. Generated parity → APAR. Generated parity checked against BPAR and output as $\overline{\text{ERRB}}$. Generated parity also fed back through the A latch for generate/check as $\overline{\text{ERRA}}$.
H	L	L	X	L	Generates parity from B latch data based on O/$\overline{\text{E}}$. Generated parity → APAR. Generated parity checked against latched BPAR and output as $\overline{\text{ERRB}}$.
H	L	H	X	H	BPAR/B[0:7] → APAR/A0:7] Feed-through mode. Generated parity checked against BPAR and output as $\overline{\text{ERRB}}$.
H	L	H	H	H	BPAR/B[0:7] → APAR/A[0:7] Feed-through mode. Generated parity checked against BPAR and output as $\overline{\text{ERRB}}$. Generated parity also fed back through the A latch for generate/check as $\overline{\text{ERRA}}$.
L	H	L	H	L	Generates parity for A[0:7] based on O/$\overline{\text{E}}$. Generated parity → BPAR. Generated parity checked against APAR and output as $\overline{\text{ERRA}}$.
L	H	L	H	H	Generates parity from A[0:7] based on O/$\overline{\text{E}}$. Generated parity → BPAR. Generated parity checked against APAR and output as $\overline{\text{ERRA}}$. Generated parity also fed back through the B latch for generate/check as $\overline{\text{ERRB}}$.
L	H	L	L	X	Generates parity from A latch data based on O/$\overline{\text{E}}$. Generated parity → BPAR. Generated parity checked against latched APAR and output as $\overline{\text{ERRA}}$.
L	H	H	H	L	APAR/A[0:7] → BPAR/B[0:7] Feed-through mode. Generated parity checked against APAR and output as $\overline{\text{ERRA}}$.
L	H	H	H	H	APAR/A[0:7] → BPAR/B[0:7] Feed-through mode. Generated parity checked against APAR and output as $\overline{\text{ERRA}}$. Generated parity also fed back through the B latch for generate/check as $\overline{\text{ERRB}}$.

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
Note 1: O/$\overline{\text{E}}$ = ODD/$\overline{\text{EVEN}}$

Functional Block Diagram



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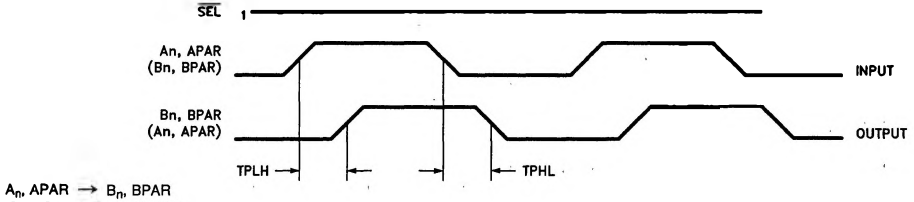
AC Path



A_n, APAR → B_n, BPAR
(B_n, BPAR → A_n, APAR)

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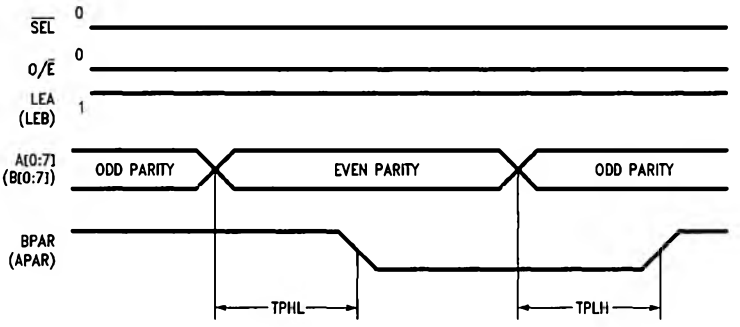
FIGURE 1

AC Path (Continued)



$A_n \rightarrow$ BPAR
($B_n \rightarrow$ APAR)

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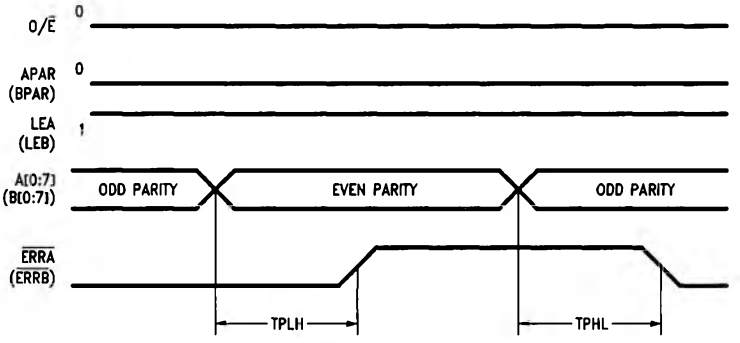
FIGURE 2



$A_n \rightarrow \overline{ERRA}$
($B_n \rightarrow \overline{ERRB}$)

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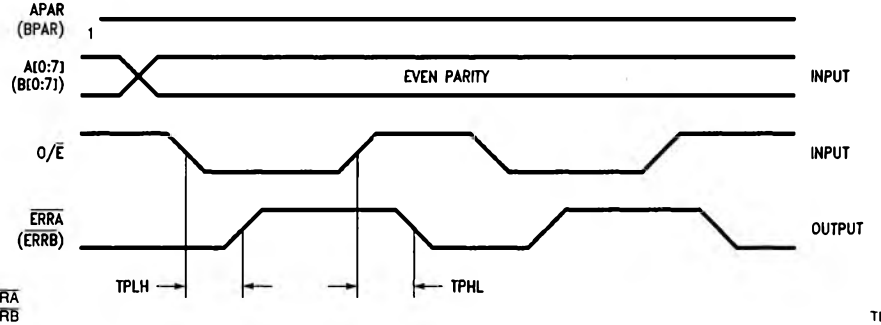
FIGURE 3



$O/\overline{E} \rightarrow \overline{ERRA}$
$O/\overline{E} \rightarrow \overline{ERRB}$

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FIGURE 4

AC Path (Continued)

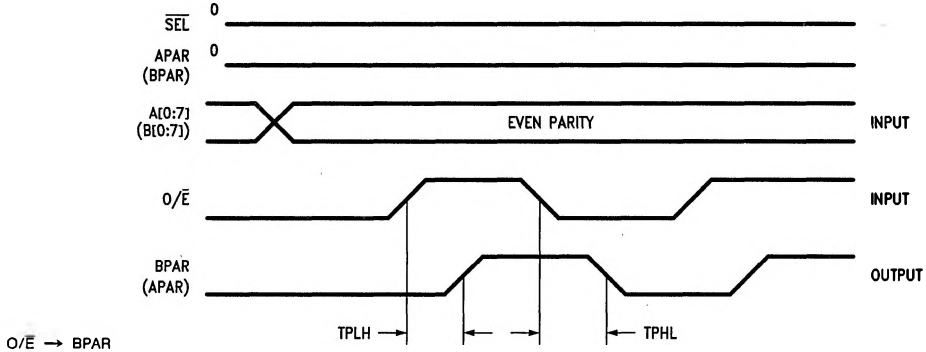

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FIGURE 5

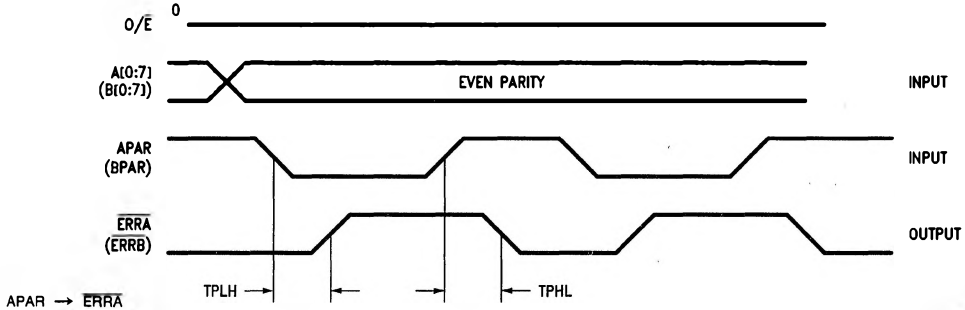

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FIGURE 6

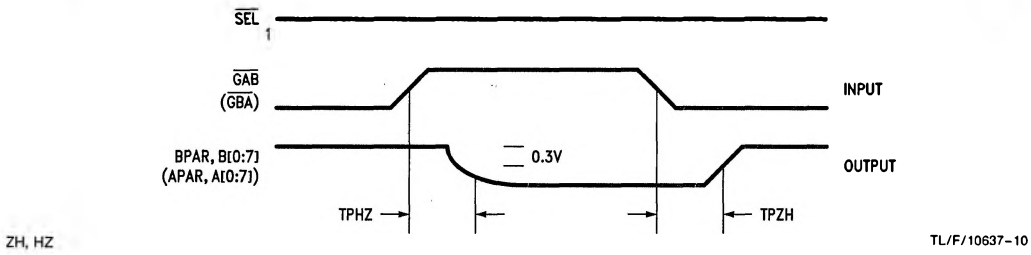

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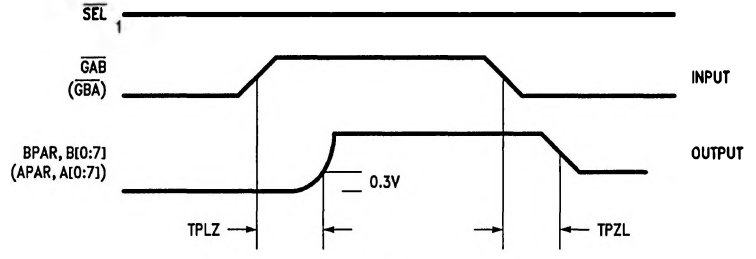
FIGURE 7

AC Path (Continued)



ZL, LZ

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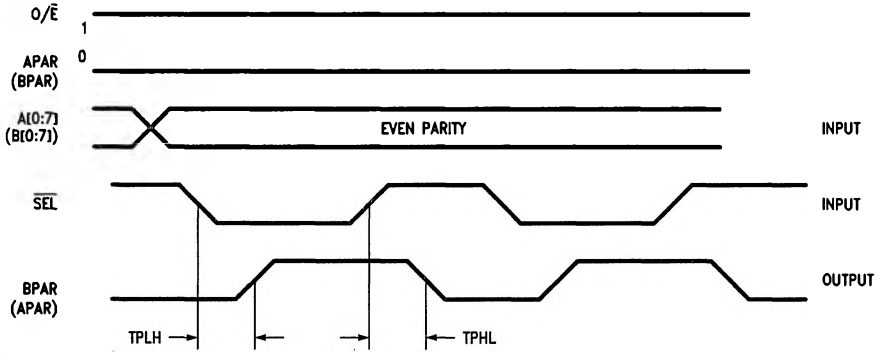
FIGURE 8



SEL → BPAR
(SEL → APAR)

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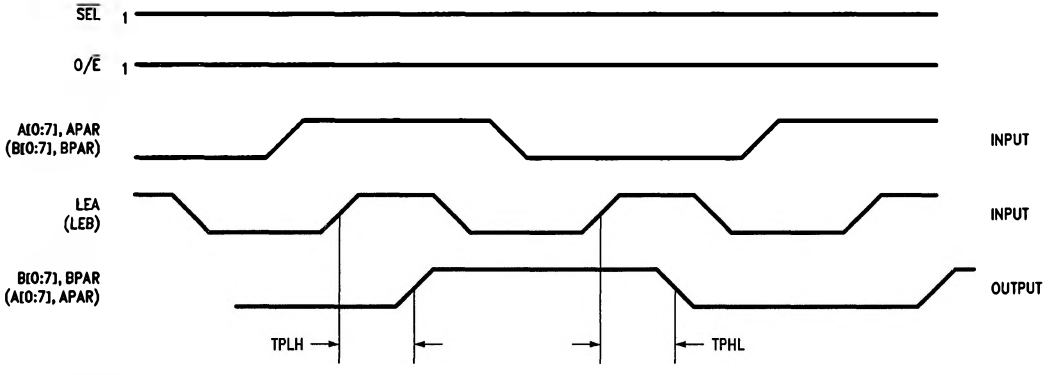
FIGURE 9



LEA → BPAR, B[0:7]
(LEB → APAR, A[0:7])

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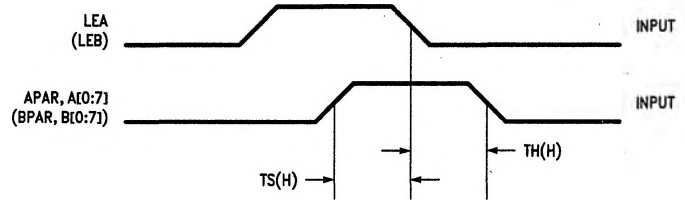
FIGURE 10

AC Path (Continued)



TS(H), TH(H)
LEA → APAR, A[0:7]
(LEB → BPAR, B[0:7])

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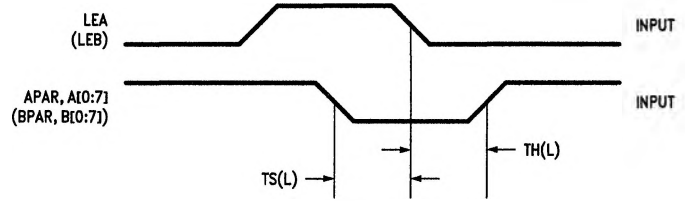
FIGURE 11



TS(L), TH(L)
LEA → APAR, A[0:7]
(LEB → BPAR, B[0:7])

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FIGURE 12

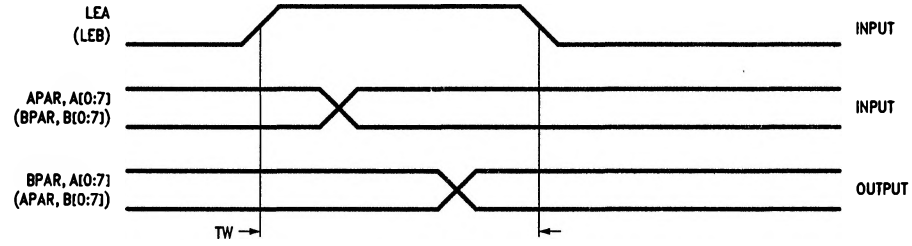

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FIGURE 13

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 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)	
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})	
'AC	2.0V to 6.0V
'ACT	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)	
74AC/ACT	−40°C to +85°C
54AC/ACT	−55°C to +125°C
Minimum Input Edge Rate ΔV/Δt 'AC 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 ΔV/Δt 'ACT Devices V_{IN} from 0.8V to 2.0V V_{CC} @ 4.5V, 5.5V	125 mV/ns

DC Electrical Characteristics for 'AC Family Devices

Symbol	Parameter	V_{CC} (V)	74AC T_A = +25°C		54AC T_A = −55°C to +125°C	74AC T_A = −40°C to +85°C	Units	Conditions
			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 μA
		4.5	4.49	4.4	4.4	4.4		
		5.5	5.49	5.4	5.4	5.4		
		3.0		2.56	2.4	2.46	V	*V_{IN} = V_{IL} or V_{IH} I_{OH} −12 mA
		4.5		3.86	3.7	3.76		I_{OH} −24 mA
		5.5		4.86	4.7	4.76		−24 mA
V_{OL}	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1	0.1	V	I_{OUT} = 50 μA
		4.5	0.001	0.1	0.1	0.1		
		5.5	0.001	0.1	0.1	0.1		
		3.0		0.36	0.50	0.44	V	*V_{IN} = V_{IL} or V_{IH} I_{OL} 12 mA
		4.5		0.36	0.50	0.44		I_{OL} 24 mA
		5.5		0.36	0.50	0.44		24 mA
I_{IN}	Maximum Input Leakage Current	5.5		±0.1	±1.0	±1.0	μA	V_I = V_{CC}, GND (Note)

*Maximum of 9 outputs loaded; thresholds on input associated with output under test.

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

DC Electrical Characteristics for 'AC Family Devices (Continued)

Symbol	Parameter	V_{CC} (V)	74AC $T_A = +25°C$		54AC $T_A = -55°C$ to $+125°C$	74AC $T_A = -40°C$ to $+85°C$	Units	Conditions
			Typ	Guaranteed Limits				
I_{OLD}	†Minimum Dynamic Output Current	5.5			50	75	mA	V_{OLD} = 1.65V Max
I_{OHD}		5.5			−50	−75	mA	V_{OHD} = 3.85V Min
I_{CC}	Maximum Quiescent Supply Current	5.5		8.0	160.0	80.0	μA	$V_{IN} = V_{CC}$ or GND (Note)
I_{OZ}	Maximum TRI-STATE Leakage Current	5.5		±0.5	±10.0	±5.0	μA	$V_I(OE) = V_{IL}, V_{IH}$ $V_I = V_{CC}$, GND $V_O = V_{CC}$, GND

*Maximum of 9 outputs loaded; thresholds on input associated with output under test.

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

Note: I_{IN} and I_{CC} @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V_{CC}. I_{CC} for 54AC @ 25°C is identical to 74AC @ 25°C.

DC Electrical Characteristics for 'ACT Family Devices

Symbol	Parameter	V_{CC} (V)	74ACT $T_A = +25°C$		54ACT $T_A = -55°C$ to $+125°C$	74ACT $T_A = -40°C$ to $+85°C$	Units	Conditions
			Typ	Guaranteed Limits				
V_{IH}	Minimum High Level Input Voltage	4.5 5.5	1.5 1.5	2.0 2.0	2.0 2.0	2.0 2.0	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
V_{IL}	Maximum Low Level Input Voltage	4.5 5.5	1.5 1.5	0.8 0.8	0.8 0.8	0.8 0.8	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
V_{OH}	Minimum High Level Output Voltage	4.5 5.5	4.49 5.49	4.4 5.4	4.4 5.4	4.4 5.4	V	I_{OUT} = −50 μA
		4.5 5.5		3.86 4.86	3.70 4.70	3.76 4.76	V	*$V_{IN} = V_{IL}$ or V_{IH} I_{OH} −24 mA −24 mA
V_{OL}	Maximum Low Level Output Voltage	4.5 5.5	0.001 0.001	0.1 0.1	0.1 0.1	0.1 0.1	V	I_{OUT} = 50 μA
		4.5 5.5		0.36 0.36	0.50 0.50	0.44 0.44	V	*$V_{IN} = V_{IL}$ or V_{IH} I_{OL} 24 mA 24 mA
I_{IN}	Maximum Input Leakage Current	5.5		±0.1	±1.0	±1.0	μA	$V_I = V_{CC}$, GND
I_{OZ}	Maximum TRI-STATE Leakage Current	5.5		±0.5	±10.0	±5.0	μA	$V_I = V_{IL}, V_{IH}$ $V_O = V_{CC}$, GND
I_{CCT}	Maximum I_{CC}/Input	5.5	0.6		1.6	1.5	mA	$V_I = V_{CC}$ − 2.1V
I_{OLD}	†Minimum Dynamic Output Current	5.5			50	75	mA	V_{OLD} = 1.65V Max
I_{OHD}		5.5			−50	−75	mA	V_{OHD} = 3.85V Min
I_{CC}	Maximum Quiescent Supply Current	5.5		8.0	160.0	80.0	μA	$V_{IN} = V_{CC}$ or GND (Note)

*Maximum of 9 outputs loaded; thresholds on input associated with output under test.

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

Note: I_{CC} for 54ACT @ 25°C is identical to 74ACT @ 25°C.

AC Electrical Characteristics

Symbol	Parameter	V_{CC}* (V)	74AC $T_A = +25°C$, $C_L = 50$ pF			54AC $T_A = -55°C$ to $+125°C$, $C_L = 50$ pF		74AC $T_A = -40°C$ to $+85°C$, $C_L = 50$ pF		Units	Fig. No.
			Min	Typ	Max	Min	Max	Min	Max		
t_{PLH} t_{PHL}	Propagation Delay A_n, B_n to B_n, A_n	3.3 5.0	2.5 1.5	12.0 7.0	15.0 10.0			2.5 1.5	15.5 10.5	ns	1
t_{PLH} t_{PHL}	Propagation Delay APAR, BPAR to BPAR, APAR	3.3 5.0	2.5 1.5	9.5 5.5	12.0 8.0			2.5 1.5	12.5 8.5	ns	1
t_{PLH} t_{PHL}	Propagation Delay A_n, B_n to BPAR, APAR	3.3 5.0	3.0 2.0	13.5 8.0	16.5 11.0			3.0 2.0	17.0 11.5	ns	2
t_{PLH} t_{PHL}	Propagation Delay A_n, B_n to $\overline{ERRA}$, $\overline{ERRB}$	3.3 5.0	2.5 1.5	12.5 7.5	15.5 10.5			2.5 1.5	16.5 11.0	ns	3
t_{PLH} t_{PHL}	Propagation Delay ODD/$\overline{EVEN}$ to $\overline{ERRA}$, $\overline{ERRB}$	3.3 5.0	2.5 1.5	12.5 7.5	15.5 10.5			2.5 1.5	16.5 11.0	ns	4
t_{PLH} t_{PHL}	Propagation Delay ODD/$\overline{EVEN}$ to APAR, BPAR	3.3 5.0	3.0 2.0	12.5 7.5	15.5 10.5			3.0 2.0	16.5 11.0	ns	5
t_{PLH} t_{PHL}	Propagation Delay APAR, BPAR to $\overline{ERRA}$, $\overline{ERRB}$	3.3 5.0	2.0 1.5	12.5 7.5	15.5 10.5			2.0 1.5	16.5 11.0	ns	6
t_{PLH} t_{PHL}	Propagation Delay $\overline{SEL}$ to APAR, BPAR	3.3 5.0	2.0 1.5	10.0 6.0	12.5 8.5			2.0 1.5	13.5 9.0	ns	9
t_{PLH} t_{PHL}	Propagation Delay LEB, LEA to A_n, B_n	3.3 5.0	4.0 2.5	12.0 7.0	15.5 10.5			4.0 2.5	16.5 11.0	ns	10, 11
t_{PLH} t_{PHL}	Propagation Delay LEB, LEA to APAR, BPAR	3.3 5.0	3.0 2.0	13.5 8.0	17.0 11.5			3.0 2.0	18.0 12.0	ns	10, 11
t_{PLH} t_{PHL}	Propagation Delay LEB, LEA to $\overline{ERRA}$, $\overline{ERRB}$	3.3 5.0	4.0 2.5	13.5 8.0	17.0 11.5			4.0 2.5	18.0 12.0	ns	12
t_{PZH} t_{PZL}	Output Enable Time $\overline{GBA}$, $\overline{GAB}$ to A_n, B_n	3.3 5.0	3.0 2.0	12.5 7.5	15.5 10.5			3.0 2.0	16.5 11.0	ns	7, 8
t_{PZH} t_{PZL}	Output Enable Time $\overline{GBA}$, $\overline{GAB}$ to APAR, BPAR	3.3 5.0	2.5 1.5	10.5 6.0	13.5 9.0			2.5 1.5	14.0 9.5	ns	7, 8
t_{PHZ} t_{PLZ}	Output Disable Time $\overline{GBA}$, $\overline{GAB}$ to A_n, B_n	3.3 5.0	1.5 1.0	11.0 6.5	14.0 9.5			1.5 1.0	14.0 9.5	ns	7, 8
t_{PHZ} t_{PHL}	Output Disable Time $\overline{GBA}$, $\overline{GAB}$ to APAR, BPAR	3.3 5.0	1.5 1.0	11.0 6.5	14.0 9.5			1.5 1.0	14.0 9.5	ns	7, 8

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

AC Operating Requirements

Symbol	Parameter	V_{CC}* (V)	74ACT $T_A = +25°C$, $C_L = 50$ pF	54ACT $T_A = -55°C$ to $+125°C$, $C_L = 50$ pF	74ACT $T_A = -40°C$ to $+85°C$, $C_L = 50$ pF	Units	Fig. No.
			Guaranteed Minimum				
t_s	Setup Time, HIGH or LOW A_n, B_n, PAR to LEA, LEB	3.3 5.0	3.0 3.0		3.0 3.0	ns	11, 12
t_h	Hold Time, HIGH or LOW A_n, B_n, PAR to LEA, LEB	3.3 5.0	2.0 1.5		2.0 1.5	ns	11, 12
t_w	Pulse Width for LEA, LEB	3.3 5.0	4.0 4.0		4.0 4.0	ns	13

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

AC Electrical Characteristics

Symbol	Parameter	V_{CC}* (V)	74ACT $T_A = +25°C$, $C_L = 50$ pF			54ACT $T_A = -55°C$ to $+125°C$, $C_L = 50$ pF		74ACT $T_A = -40°C$ to $+85°C$, $C_L = 50$ pF		Units	Fig. No.
			Min	Typ	Max	Min	Max	Min	Max		
t_{PLH} t_{PHL}	Propagation Delay A_n, B_n to B_n, A_n	5.0	2.5	7.5	11.5			2.5	12.0	ns	1
t_{PLH} t_{PHL}	Propagation Delay APAR, BPAR to BPAR , APAR	5.0	1.5	6.0	8.5			1.5	9.0	ns	1
t_{PLH} t_{PHL}	Propagation Delay A_n, B_n to BPAR, APAR	5.0	2.5	8.5	12.0			2.5	12.5	ns	2
t_{PLH} t_{PHL}	Propagation Delay A_n, B_n to $\overline{ERRA}$, $\overline{ERRB}$	5.0	2.0	8.0	11.5			2.0	12.0	ns	3
t_{PLH} t_{PHL}	Propagation Delay ODD/$\overline{EVEN}$ to $\overline{ERRA}$, $\overline{ERRB}$	5.0	2.0	8.0	11.5			2.0	12.0	ns	4
t_{PLH} t_{PHL}	Propagation Delay ODD/$\overline{EVEN}$ to APAR, BPAR	5.0	2.5	8.0	11.5			2.5	12.0	ns	5
t_{PLH} t_{PHL}	Propagation Delay APAR, BPAR to $\overline{ERRA}$, $\overline{ERRB}$	5.0	1.5	7.5	10.5			1.5	11.5	ns	6
t_{PLH} t_{PHL}	Propagation Delay $\overline{SEL}$ to APAR, BPAR	5.0	1.5	6.5	9.0			1.5	9.5	ns	9
t_{PLH} t_{PHL}	Propagation Delay LEB to A_n, B_n	5.0	2.5	7.0	10.5			2.5	11.0	ns	10, 11
t_{PLH} t_{PHL}	Propagation Delay LEA to APAR, BPAR	5.0	2.0	8.0	11.5			2.0	12.0	ns	10, 11
t_{PLH} t_{PHL}	Propagation Delay LEA, LEB to $\overline{ERRA}$, $\overline{ERRB}$	5.0	2.5	8.0	11.5			2.5	12.0	ns	12
t_{PZH} t_{PZL}	Output Enable Time $\overline{GBA}$ or $\overline{GAB}$ to A_n, B_n	5.0	2.5	7.0	10.5			2.5	11.0	ns	7, 8
t_{PZH} t_{PZL}	Output Enable Time $\overline{GBA}$ or $\overline{GAB}$ to BPAR or APAR	5.0	1.5	6.0	9.0			1.5	9.5	ns	7, 8
t_{PHZ} t_{PHL}	Output Disable Time $\overline{GBA}$ or $\overline{GAB}$ to A_n, B_n	5.0	1.5	6.5	9.5			1.5	9.5	ns	7, 8
t_{PHZ} t_{PLZ}	Output Disable Time $\overline{GBA}$ or $\overline{GAB}$ to BPAR, APAR	5.0	1.5	6.5	9.5			1.5	9.5	ns	7, 8

*Voltage Range 5.0 is 5.0V ± 0.5V.

AC Operating Requirements

Symbol	Parameter	V_{CC}* (V)	74ACT $T_A = +25°C$ $C_L = 50$ pF	54ACT $T_A = -55°C$ to $+125°C$ $C_L = 50$ pF	74ACT $T_A = -40°C$ to $+85°C$ $C_L = 50$ pF	Units	Fig. No.
			Guaranteed Minimum				
t_s	Setup Time, HIGH or LOW A_n, B_n, PAR to LEA, LEB	5.0	3.0		3.0	ns	11, 12
t_h	Hold Time, HIGH or LOW A_n, B_n, PAR to LEA, LEB	5.0	1.5		1.5	ns	11, 12
t_w	Pulse Width for LEB, LEA	5.0	4.0		4.0	ns	13

*Voltage Range 5.0 = 5.0V ±0.5V.

Capacitance

Symbol	Parameter	Typ	Units	Conditions
C_{IN}	Input Capacitance	4.5	pF	V_{CC} = 5.0V
C_{PD}	Power Dissipation Capacitance	210	pF	V_{CC} = 5.0V