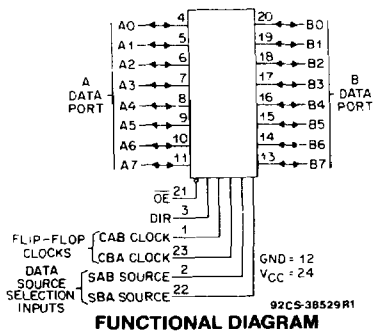


CD54/74AC646, CD54/74AC648 CD54/74ACT646, CD54/74ACT648



Octal-Bus Transceiver/Registers, 3-State

CD54/74AC/ACT646 - Non-Inverting

CD54/74AC/ACT648 - Inverting

Type Features:

- Buffered inputs
- Typical propagation delay:
5.3 ns @ $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{ C}$, $C_L = 50\text{ pF}$

The RCA CD54/74AC646 and CD54/74AC648 and the CD54/74ACT646 and CD54/74ACT648 3-state, octal-bus transceiver/registers use the RCA ADVANCED CMOS technology. The CD54/74AC648 and CD54/74ACT648 have inverting outputs. The CD54/74AC646 and CD54/74ACT646 have non-inverting outputs. These devices are bus transceivers with D-type flip-flops which act as internal storage registers on the LOW-to-HIGH transition of either CAB or CBA clock inputs. Output Enable (\overline{OE}) and Direction (DIR) inputs control the transceiver functions. Data present at the high-impedance output can be stored in either register or both but only one of the two buses can be enabled as outputs at any one time. The Select controls (SAB and SBA) can multiplex stored and transparent (real time) data. The Direction control determines which data bus will receive data when the Output Enable (\overline{OE}) is LOW. In the high-impedance mode (Output Enable HIGH), A data can be stored in one register and B data can be stored in the other register. The clocks are not gated with the Direction (DIR) and Output Enable (\overline{OE}) terminals; data at the A or B terminals can be clocked into the storage flip-flops at any time.

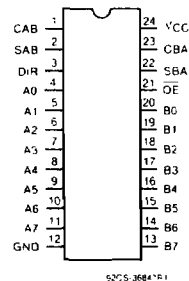
The CD74AC/ACT646 and CD74AC/ACT648 are supplied in 24-lead dual-in-line narrow-body plastic packages (EN suffix) and in 24-lead dual-in-line small-outline plastic packages (M suffix). Both package types are operable over the following temperature ranges: Commercial (0 to 70° C); Industrial (-40 to $+85^\circ\text{ C}$); and Extended Industrial/Military (-55 to $+125^\circ\text{ C}$).

The CD54AC/ACT646 and CD54AC/ACT648, available in chip form (H suffix), are operable over the -55 to $+125^\circ\text{ C}$ temperature range.

Family Features:

- Exceeds 2-kV ESD Protection - MIL-STD-883, Method 3015
- SCR-Latchup-resistant CMOS process and circuit design
- Speed of bipolar FAST*/AS/S with significantly reduced power consumption
- Balanced propagation delays
- AC types feature 1.5-V to 5.5-V operation and balanced noise immunity at 30% of the supply
- $\pm 24\text{-mA}$ output drive current
 - Fanout to 15 FAST* ICs
 - Drives 50-ohm transmission lines

*FAST is a Registered Trademark of Fairchild Semiconductor Corp.



TERMINAL ASSIGNMENT

CD54/74AC646, CD54/74AC648 CD54/74ACT646, CD54/74ACT648

FUNCTION TABLE

INPUTS						DATA I/O#		OPERATION OR FUNCTION	
OE	DIR	CAB	CBA	SAB	SBA	A0 THRU A7	B0 THRU B7	646	648
X	X		X	X	X	Input	Not specified	Store A, B unspecified	Store A, B unspecified
X	X	X		X	X	Not specified	Input	Store B, A unspecified	Store B, A unspecified
H	X			X	X	Input	Input	Store A and B Data Isolation, hold storage	Store A and B Data Isolation, hold storage
H	X	H or L	H or L	X	X				
L	L	X	X	X	L	Output	Input	Real-Time B Data to A Bus Stored B Data to A Bus	Real-Time \bar{B} Data to A Bus Stored \bar{B} Data to A Bus
L	L	X	H or L	X	H				
L	H	X	X	L	X	Input	Output	Real-Time A Data to B Bus Stored A Data to B Bus	Real-Time \bar{A} Data to B Bus Stored \bar{A} Data to B Bus
L	H	H or L	X	H	X				

#The data output functions may be enabled or disabled by various signals at the OE and DIR inputs. Data input functions are always enabled, i.e., data at the bus pins will be stored on every low-to-high transition on the clock inputs. To prevent excess currents in the High-Z modes, all I/O terminals should be terminated with 10 kΩ resistors.

MAXIMUM RATINGS, Absolute-Maximum Values:

DC SUPPLY-VOLTAGE (V_{CC})	-0.5 to 6 V
DC INPUT DIODE CURRENT, I_{IK} (for $V_i < -0.5$ V or $V_i > V_{CC} + 0.5$ V)	± 20 mA
DC OUTPUT DIODE CURRENT, I_{OK} (for $V_o < -0.5$ V or $V_o > V_{CC} + 0.5$ V)	± 50 mA
DC OUTPUT SOURCE OR SINK CURRENT per Output Pin, I_o (for $V_o > -0.5$ V or $V_o < V_{CC} + 0.5$ V)	± 50 mA
DC V_{CC} or GROUND CURRENT (I_{CC} or I_{GND})	± 100 mA*
POWER DISSIPATION PER PACKAGE (P_D):	
For $T_A = -55$ to $+100^\circ\text{C}$ (PACKAGE TYPE E)	500 mW
For $T_A = +100$ to $+125^\circ\text{C}$ (PACKAGE TYPE E)	Derate Linearly at 8 mW/ $^\circ\text{C}$ to 300 mW
For $T_A = -55$ to $+70^\circ\text{C}$ (PACKAGE TYPE M)	400 mW
For $T_A = +70$ to $+125^\circ\text{C}$ (PACKAGE TYPE M)	Derate Linearly at 6 mW/ $^\circ\text{C}$ to 70 mW
OPERATING-TEMPERATURE RANGE (T_A)	-55 to $+125^\circ\text{C}$
STORAGE TEMPERATURE (T_{STG})	-65 to $+150^\circ\text{C}$
LEAD TEMPERATURE (DURING SOLDERING):	
At distance 1/16 \pm 1/32 in. (1.59 \pm 0.79 mm) from case for 10 s maximum	$+265^\circ\text{C}$
Unit inserted into PC board min. thickness 1/16 in. (1.59 mm) with solder contacting lead tips only	$+300^\circ\text{C}$

*For up to 4 outputs per device; add ± 25 mA for each additional output.

RECOMMENDED OPERATING CONDITIONS:

For maximum reliability, normal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTICS	LIMITS		UNITS
	MIN.	MAX.	
Supply-Voltage Range, V_{CC} *: (For $T_A =$ Full Package-Temperature Range) AC Types ACT Types	1.5	5.5	V
	4.5	5.5	V
DC Input or Output Voltage, V_i, V_o	0	V_{CC}	V
Operating Temperature, T_A	-55	+125	$^\circ\text{C}$
Input Rise and Fall Slew Rate, dt/dv at 1.5 V to 3 V (AC Types) at 3.6 V to 5.5 V (AC Types) at 4.5 V to 5.5 V (ACT Types)	0	50	ns/V
	0	20	ns/V
	0	10	ns/V

*Unless otherwise specified, all voltages are referenced to ground.

CD54/74AC646, CD54/74AC648 CD54/74ACT646, CD54/74ACT648

STATIC ELECTRICAL CHARACTERISTICS: AC Series

CHARACTERISTICS	TEST CONDITIONS		V _{CC} (V)	AMBIENT TEMPERATURE (T _A) - °C						UNITS	
				+25		-40 to +85		-55 to +125			
	V _I (V)	I _O (mA)		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
High-Level Input Voltage V _{IH}			1.5 3 5.5	1.2 2.1 3.85	— — —	1.2 2.1 3.85	— — —	1.2 2.1 3.85	— — —	V	
Low-Level Input Voltage V _{IL}			1.5 3 5.5	— — —	0.3 0.9 1.65	— — —	0.3 0.9 1.65	— — —	0.3 0.9 1.65	V	
High-Level Output Voltage V _{OH}	V _{IH} or V _{IL}	#, * {	-0.05	1.5	1.4	—	1.4	—	1.4	—	V
			-0.05	3	2.9	—	2.9	—	2.9	—	
			-0.05	4.5	4.4	—	4.4	—	4.4	—	
			-4	3	2.58	—	2.48	—	2.4	—	
			-24	4.5	3.94	—	3.8	—	3.7	—	
			-75	5.5	—	—	3.85	—	—	—	
Low-Level Output Voltage V _{OL}	V _{IH} or V _{IL}	#, * {	0.05	1.5	—	0.1	—	0.1	—	0.1	V
			0.05	3	—	0.1	—	0.1	—	0.1	
			0.05	4.5	—	0.1	—	0.1	—	0.1	
			12	3	—	0.36	—	0.44	—	0.5	
			24	4.5	—	0.36	—	0.44	—	0.5	
			75	5.5	—	—	—	1.65	—	—	
Input Leakage Current I _I	V _{CC} or GND		5.5	—	±0.1	—	±1	—	±1	μA	
3-State Leakage Current I _{OZ}	V _{IH} or V _{IL} V _O = V _{CC} or GND		5.5	—	±0.5	—	±5	—	±10	μA	
Quiescent Supply Current, MSI I _{CC}	V _{CC} or GND	0	5.5	—	8	—	80	—	160	μA	

#Test one output at a time for a 1-second maximum duration. Measurement is made by forcing current and measuring voltage to minimize power dissipation.

*Test verifies a minimum 50-ohm transmission-line-drive capability at +85°C, 75 ohms at +125°C.

CD54/74AC646, CD54/74AC648 CD54/74ACT646, CD54/74ACT648

STATIC ELECTRICAL CHARACTERISTICS: ACT Series

CHARACTERISTICS	TEST CONDITIONS	V _{CC} (V)	AMBIENT TEMPERATURE (T _a) - °C						UNITS		
			+25		-40 to +85		-55 to +125				
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.			
High-Level Input Voltage	V _{IH}		4.5 to 5.5	2	—	2	—	2	—	V	
Low-Level Input Voltage	V _{IL}		4.5 to 5.5	—	0.8	—	0.8	—	0.8	V	
High-Level Output Voltage	V _{OH}	V _{IH} or V _{IL} #, * }	-0.05	4.5	4.4	—	4.4	—	4.4	—	V
			-24	4.5	3.94	—	3.8	—	3.7	—	
			-75	5.5	—	—	3.85	—	—	—	
			-50	5.5	—	—	—	—	3.85	—	
Low-Level Output Voltage	V _{OL}	V _{IH} or V _{IL} #, * }	0.05	4.5	—	0.1	—	0.1	—	0.1	V
			24	4.5	—	0.36	—	0.44	—	0.5	
			75	5.5	—	—	—	1.65	—	—	
			50	5.5	—	—	—	—	—	1.65	
Input Leakage Current	I _I	V _{CC} or GND	5.5	—	±0.1	—	±1	—	±1	μA	
3-State Leakage Current	I _{OZ}	V _{IH} or V _{IL} V _O = V _{CC} or GND	5.5	—	±0.5	—	±5	—	±10	μA	
Quiescent Supply Current, MSI	I _{CC}	V _{CC} or GND	0	5.5	—	8	—	80	—	160	μA
Additional Quiescent Supply Current per Input Pin TTL Inputs High 1 Unit Load	ΔI _{CC}	V _{CC} -2.1	4.5 to 5.5	—	2.4	—	2.8	—	3	mA	

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#Test one output at a time for a 1-second maximum duration. Measurement is made by forcing current and measuring voltage to minimize power dissipation.

*Test verifies a minimum 50-ohm transmission-line-drive capability at +85°C, 75 ohms at +125°C.

ACT INPUT LOADING TABLE

INPUT	UNIT LOAD*
CAB, CBA	1.25
SAB, SBA	1.2
DIR	0.67
OE	1.17
An, Bn	0.4

*Unit load is ΔI_{CC} limit specified in Static Characteristics Chart, e.g., 2.4 mA max. @ 25°C.

CD54/74AC646, CD54/74AC648 CD54/74ACT646, CD54/74ACT648

PREREQUISITE FOR SWITCHING: AC Series

CHARACTERISTICS	SYMBOL	V _{CC} (V)	AMBIENT TEMPERATURE (T _A) - °C				UNITS
			-40 to +85		-55 to +125		
			MIN.	MAX.	MIN.	MAX.	
Max. Frequency	f _{max}	1.5 3.3* 5†	11 101 143	— — —	10 89 125	— — —	MHz
Setup Time Data to Clock	t _{SU}	1.5 3.3 5	27 3.1 2.2	— — —	31 3.5 2.5	— — —	ns
Hold Time Data to Clock	t _H	1.5 3.3 5	2 2 2	— — —	2 2 2	— — —	ns
Clock Pulse Width	t _w	1.5 3.3 5	44 4.9 3.5	— — —	50 5.6 4	— — —	ns

*3.3 V: min. is @ 3 V

†5 V: min is @ 4.5 V

SWITCHING CHARACTERISTICS: AC Series; t_r, t_f = 3 ns, C_L = 50 pF

CHARACTERISTICS	SYMBOL	V _{CC} (V)	AMBIENT TEMPERATURE (T _A) - °C				UNITS
			-40 to +85		-55 to +125		
			MIN.	MAX.	MIN.	MAX.	
Propagation Delays: Store A Data to B Bus Store B Data to A Bus 646	t _{PLH} t _{PHL}	1.5 3.3* 5†	— 4.8 3.5	154 17.1 12.3	— 4.7 3.4	169 18.9 13.5	ns
Store \bar{A} Data to B Bus Store \bar{B} Data to A Bus 648	t _{PLH} t _{PHL}	1.5 3.3 5	— 4.8 3.5	154 17.1 12.3	— 4.7 3.4	169 18.9 13.5	ns
A Data to B Bus B Data to A Bus 646	t _{PLH} t _{PHL}	1.5 3.3 5	— 4 2.8	125 14 10	— 3.9 2.8	138 15.4 11	ns
\bar{A} Data to B Bus B Data to A Bus 648	t _{PLH} t _{PHL}	1.5 3.3 5	— 4 2.8	125 14 10	— 3.9 2.8	138 15.4 11	ns
Select to Data 646	t _{PLH} t _{PHL}	1.5 3.3 5	— 4.3 3.1	136 15.3 10.9	— 4.2 3	150 16.8 12	ns
Select to Data 648	t _{PLH} t _{PHL}	1.5 3.3 5	— 4.3 3.1	136 15.3 10.9	— 4.2 3	150 16.8 12	ns
3-State Enabling/ Disabling Time Bus to Output or Register to Output	t _{PZL} t _{PZH} t _{PLZ} t _{PHZ}	1.5 3.3 5	— 5.2 3.5	154 18.4 12.3	— 5.1 3.4	169 20.2 13.5	ns
Power Dissipation Capacitance	C _{PD} §	—	150 Typ.		150 Typ.		pF
Min. (Valley) During Switching of Other Outputs (Output Under Test Not Switching)	V _{OH} V _{OHV} See Fig. 1	5	4 Typ. @ 25° C				V
Max. (Peak) During Switching of Other Outputs (Output Under Test Not Switching)	V _{OL} V _{OLP} See Fig. 1	5	1 Typ. @ 25° C				V
Input Capacitance	C _I	—	—	10	—	10	pF
3-State Output Capacitance	C _O	—	—	15	—	15	pF

*3.3 V: min. is @ 3.6 V
max. is @ 3 V

†5 V: min. is @ 5.5 V
max. is @ 4.5 V

§C_{PD} is used to determine the dynamic power consumption, per package.

P_D = V_{CC}² C_{PD} f_i + Σ (V_{CC}² C_L f_o) where f_i = input frequency

f_o = output frequency

C_L = output load capacitance

V_{CC} = supply voltage.

CD54/74AC646, CD54/74AC648 CD54/74ACT646, CD54/74ACT648

PREREQUISITE FOR SWITCHING: ACT Series

CHARACTERISTICS	SYMBOL	V _{CC} (V)	AMBIENT TEMPERATURE (T _A) - °C				UNITS
			-40 to +85		-55 to +125		
			MIN.	MAX.	MIN.	MAX.	
Max. Frequency	f _{max}	5*	125	—	110	—	MHz
Setup Time Data to Clock	t _{SU}	5	2.2	—	2.5	—	ns
Hold Time Data to Clock	t _H	5	2	—	2	—	ns
Clock Pulse Width	t _W	5	3.9	—	4.5	—	ns

*5 V: min. is @ 4.5 V

SWITCHING CHARACTERISTICS: ACT Series; t_r, t_f = 3 ns, C_L = 50 pF

CHARACTERISTICS	SYMBOL	V _{CC} (V)	AMBIENT TEMPERATURE (T _A) - °C				UNITS
			-40 to +85		-55 to +125		
			MIN.	MAX.	MIN.	MAX.	
Propagation Delays: Store A Data to B Bus Store B Data to A Bus 646	t _{PLH} t _{PHL}	5*	4	14.1	3.9	15.5	ns
Store \bar{A} Data to B Bus Store \bar{B} Data to A Bus 648	t _{PLH} t _{PHL}	5	4	14.1	3.9	15.5	ns
A Data to B Bus B Data to A Bus 646	t _{PLH} t _{PHL}	5	3.2	11.4	3.1	12.5	ns
\bar{A} Data to B Bus \bar{B} Data to A Bus 648	t _{PLH} t _{PHL}	5	3.2	11.4	3.1	12.5	ns
Select to Data 646	t _{PLH} t _{PHL}	5	3.7	13.2	3.6	14.5	ns
Select to Data 648	t _{PLH} t _{PHL}	5	4	14.1	3.9	15.5	ns
3-State Enabling/ Disabling Time Bus to Output or Register to Output	t _{PZL} t _{PZH} t _{PLZ} t _{PHZ}	5	4	14.1	3.9	15.5	ns
Power Dissipation Capacitance	C _{PD} §	—	150 Typ.		150 Typ.		pF
Min. (Valley) During Switching of Other Outputs (Output Under Test Not Switching)	V _{OH} V _{OHV} See Fig. 1	5	4 Typ. @ 25°C				V
Max. (Peak) During Switching of Other Outputs (Output Under Test Not Switching)	V _{OL} V _{OLP} See Fig. 1	5	1 Typ. @ 25°C				V
Input Capacitance	C _I	—	—	10	—	10	pF
3-State Output Capacitance	C _O	—	—	15	—	15	pF

*5 V: min. is @ 5.5 V
max. is @ 4.5 V

§C_{PD} is used to determine the dynamic power consumption, per package.

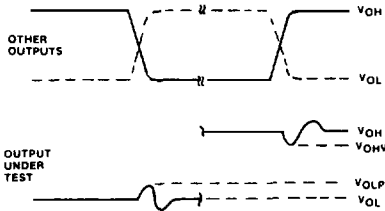
$$P_D = C_{PD}V_{CC}^2 f_i + \sum (C_L V_{CC}^2 f_o) + V_{CC}\Delta I_{CC}$$

where f_i = input frequency
 f_o = output frequency
 C_L = output load capacitance
 V_{CC} = supply voltage.

9

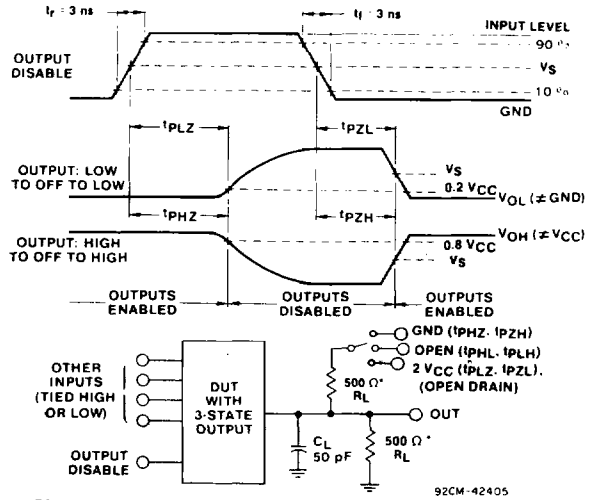
CD54/74AC646, CD54/74AC648 CD54/74ACT646, CD54/74ACT648

PARAMETER MEASUREMENT INFORMATION



- NOTES:
1. V_{OHV} AND V_{OLP} ARE MEASURED WITH RESPECT TO A GROUND REFERENCE NEAR THE OUTPUT UNDER TEST.
 2. INPUT PULSES HAVE THE FOLLOWING CHARACTERISTICS:
PRR = 1 MHz, $t_r = 3$ ns, $t_f = 3$ ns, SKEW 1 ns.
 3. R.F. FIXTURE WITH 700-MHz DESIGN RULES REQUIRED.
IC SHOULD BE SOLDERED INTO TEST BOARD AND BYPASSED WITH 0.1 μ F CAPACITOR. SCOPE AND PROBES REQUIRE 700-MHz BANDWIDTH.

92CS-42406

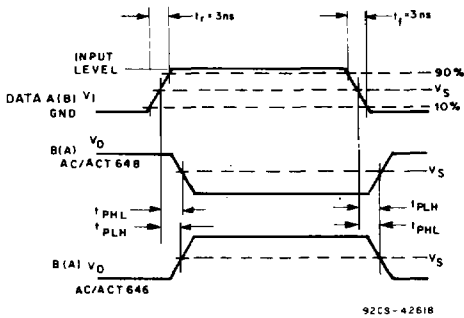


*FOR AC SERIES ONLY: WHEN $V_{CC} = 1.5$ V, $R_L = 1$ k Ω

92CM-42405

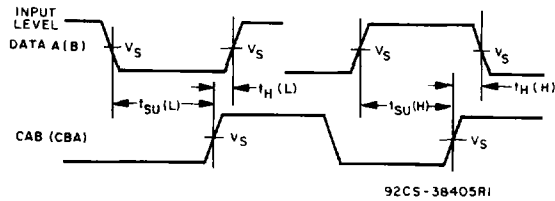
Fig. 1 - Simultaneous switching transient waveforms.

Fig. 2 - Three-state propagation delay waveforms and test circuit.



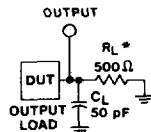
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Fig. 3 - Propagation delay times.



92CS-38405R1

Fig. 4 - Data setup and hold times.



*FOR AC SERIES ONLY: WHEN
 $V_{CC} = 1.5$ V, $R_L = 1$ k Ω

92CS-42389

Fig. 5 - Test circuit.

	CD54/74AC	CD54/74ACT
Input Level	V_{CC}	3 V
Input Switching Voltage, V_S	0.5 V_{CC}	1.5 V
Output Switching Voltage, V_S	0.5 V_{CC}	0.5 V_{CC}