

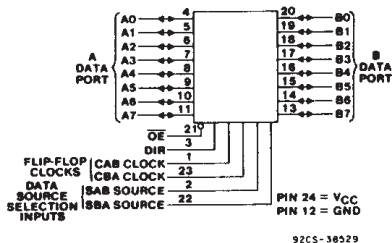
# CD54/74HC646, CD54/74HCT646 CD54/74HC648, CD54/74HCT648

File Number 1664



Data sheet acquired from Harris Semiconductor  
SCHS278

## High-Speed CMOS Logic



### Octal Bus Transceiver/Register, 3-State

**Type Features:**

- Independent Registers for A and B Buses
- CD54/74HC/HCT646 Non-Inverting  
CD54/74HC/HCT648 Inverting
- 3-State Outputs
- Drives 15LSTTL loads
- Typical Propagation Delay = 12ns (A ↔ B)  
@ V<sub>CC</sub> = 5 V, C<sub>L</sub> = 15 pF, T<sub>A</sub> = 25°C

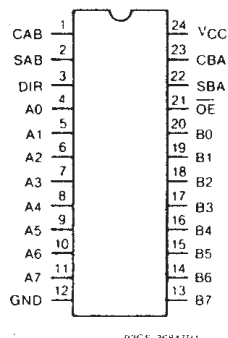
**FUNCTIONAL DIAGRAM**

The RCA-CD54/74HC646 and CD54/74HCT646 are octal bus transceivers/registers with 3-state non-inverting outputs. The RCA-CD54/74HC648 and CD54/74HCT648 are octal bus transceivers/registers with 3-state inverting outputs. These devices are bus transceivers with D-type flip-flops which act as internal storage registers. Data on the A bus or the B bus can be clocked into the 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 CD54HC646, 648 and CD54HCT646, 648 are supplied in 24-lead dual-in-line frit-seal ceramic packages (F suffix). The CD74HC646, 648 and CD74HCT646, 648 are supplied in 24-lead dual-in-line, narrow-body plastic packages (EN suffix), in 24-lead dual-in-line, wide-body plastic packages (E suffix), and in 24-lead dual-in-line surface-mount plastic packages (M suffix). Both types are also available in chip form (H suffix).

**Family Features:**

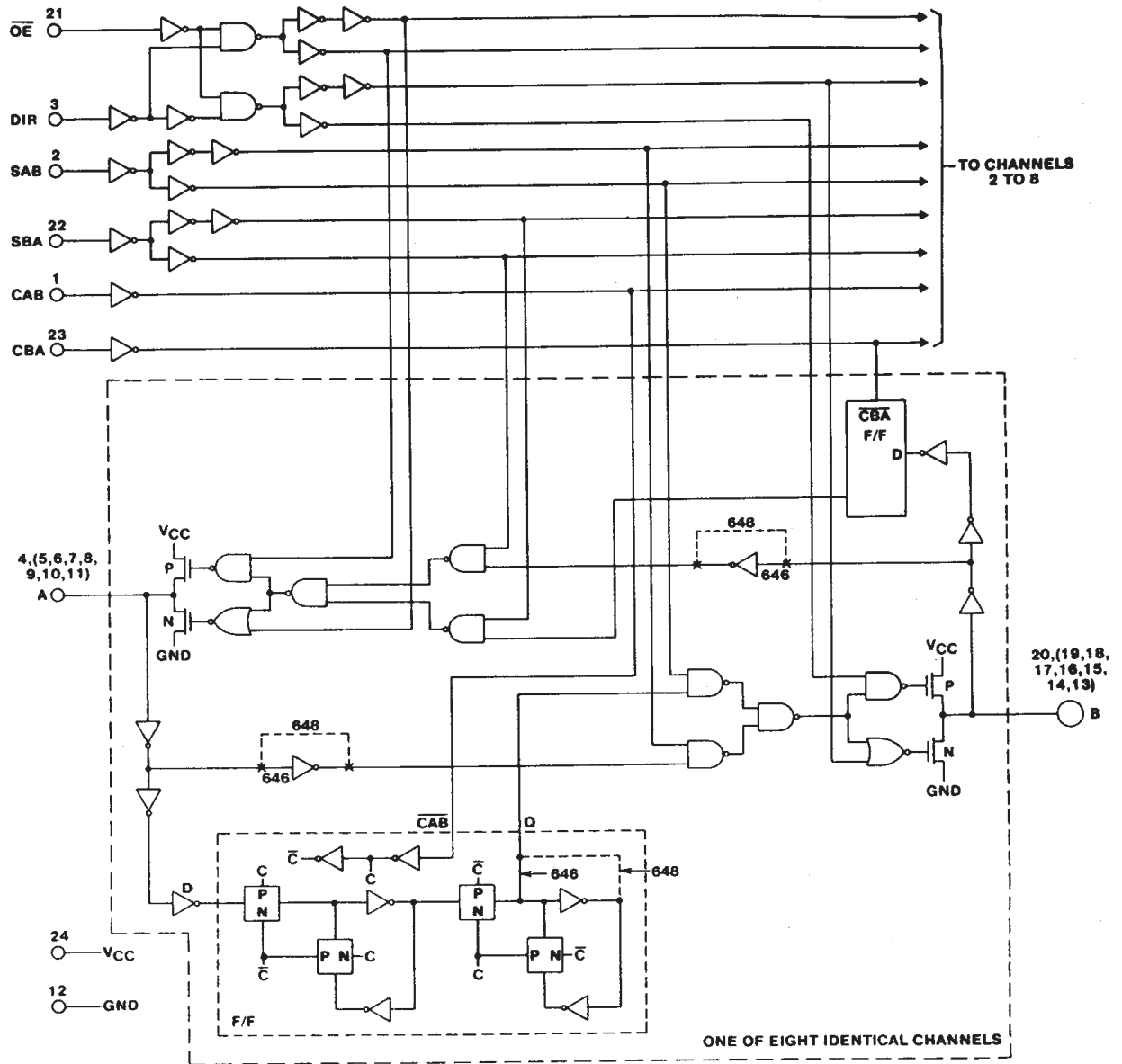
- Fanout (Over Temperature Range):  
Standard Outputs - 10 LSTTL Loads  
Bus Driver Outputs - 15 LSTTL Loads
- Wide Operating Temperature Range:  
CD74HC/HCT: -40 to +85°C
- Balanced Propagation Delay and Transition Times
- Significant Power Reduction Compared to LSTTL Logic ICs
- Alternate Source is Philips/Signetics
- CD54HC/CD74HC Types:  
2 to 6 V Operation  
High Noise Immunity:  
N<sub>IL</sub> = 30%, N<sub>IH</sub> = 30% of V<sub>CC</sub>; @ V<sub>CC</sub> = 5 V
- CD54HCT/CD74HCT Types:  
4.5 to 5.5 V Operation  
Direct LSTTL Input Logic Compatibility  
V<sub>IL</sub> = 0.8 V Max., V<sub>IH</sub> = 2 V Min.  
CMOS Input Compatibility  
I<sub>I</sub> ≤ 1 μA @ V<sub>OL</sub>, V<sub>OH</sub>



**TERMINAL ASSIGNMENT**

This data sheet is applicable to the CD54HC646 and CD74HCT646. The CD54HCT646, CD54HC648, CD54HCT648, and CD74HCT648 were not acquired from Harris Semiconductor. See SCHS193 for information on the CD74HC646.

# CD54/74HC646, CD54/74HCT646 CD54/74HC648, CD54/74HCT648



92CL-38530R1

Fig. 1 — Logic Diagram.

Technical Data

**CD54/74HC646, CD54/74HCT646  
CD54/74HC648, CD54/74HCT648**

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	Store A and B Data
H	X	H or L	H or L	X	X			Isolation, hold storage	Isolation, hold storage
L	L	X	X	X	L	Output	Input	Real-Time B Data to A Bus	Real-Time $\bar{B}$ Data to A Bus
L	L	X	H or L	X	H			Stored B Data to A Bus	Stored $\bar{B}$ Data to A Bus
L	H	X	X	L	X	Input	Output	Real-Time A Data to B Bus	Real-Time $\bar{A}$ Data to B Bus
L	H	H or L	X	H	X			Stored A Data to B Bus	Stored $\bar{A}$ Data to B Bus

# 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 10KΩ resistors.

**MAXIMUM RATINGS, Absolute-Maximum Values:**

DC SUPPLY-VOLTAGE, (V<sub>CC</sub>):

(Voltages referenced to ground) ..... -0.5 to + 7 V

DC INPUT DIODE CURRENT, I<sub>IK</sub> (FOR V<sub>i</sub> < -0.5 V OR V<sub>i</sub> > V<sub>CC</sub> + 0.5V) ..... ±20mA

DC OUTPUT DIODE CURRENT, I<sub>OK</sub> (FOR V<sub>o</sub> < -0.5 V OR V<sub>o</sub> > V<sub>CC</sub> + 0.5V) ..... ±20mA

DC DRAIN CURRENT, PER OUTPUT (I<sub>o</sub>) (FOR -0.5 V < V<sub>o</sub> < V<sub>CC</sub> + 0.5V) ..... ±35mA

DC V<sub>CC</sub> OR GROUND CURRENT (I<sub>CC</sub>) ..... ±70mA

POWER DISSIPATION PER PACKAGE (P<sub>D</sub>):

For T<sub>A</sub> = -40 to +60°C (PACKAGE TYPE E) ..... 500 mW

For T<sub>A</sub> = +60 to +85°C (PACKAGE TYPE E) ..... Derate Linearly at 8 mW/°C to 300 mW

For T<sub>A</sub> = -55 to +100°C (PACKAGE TYPE F, H) ..... 500 mW

For T<sub>A</sub> = +100 to +125°C (PACKAGE TYPE F, H) ..... Derate Linearly at 8 mW/°C to 300 mW

For T<sub>A</sub> = -40 to +70°C (PACKAGE TYPE M) ..... 400 mW

For T<sub>A</sub> = +70 to +125°C (PACKAGE TYPE M) ..... Derate Linearly at 6 mW/°C to 70 mW

OPERATING-TEMPERATURE RANGE (T<sub>A</sub>):

PACKAGE TYPE E, M ..... -40 to -85°C

PACKAGE TYPE F, H ..... -55 to +125°C

STORAGE TEMPERATURE (T<sub>stg</sub>) ..... -65 to -150°C

LEAD TEMPERATURE (DURING SOLDERING):

At distance 1/16 ± 1/32 in. (1.59 ± 0.79 mm) from case for 10 s max. .... 265°C

Unit inserted into a PC Board (min. thickness 1/16 in., 1.59 mm)  
with solder contacting lead tips only ..... 300°C

**RECOMMENDED OPERATING CONDITIONS:**

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

CHARACTERISTIC	LIMITS		UNITS
	MIN.	MAX.	
Supply-Voltage Range (For T <sub>A</sub> = Full Package-Temperature Range) V <sub>CC</sub> * CD54/74HC Types CD54/74HCT Types	2 4.5	6 5.5	V
DC Input or Output Voltage V <sub>IN</sub> , V <sub>OUT</sub>	0	V <sub>CC</sub>	V
Operating Temperature T <sub>A</sub> : CD74 Types CD54 Types	-40 -55	+85 +125	°C
Input Rise and Fall Times t <sub>r</sub> , t <sub>f</sub> at 2 V at 4.5 V at 6 V	0 0 0	1000 500 400	ns

\*Unless otherwise specified, all voltages are referenced to Ground.

# CD54/74HC646, CD54/74HCT646 CD54/74HC648, CD54/74HCT648

## STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CD74HC648/CD54HC648 CD74HC646/CD54HC646										CD74HCT648/CD54HCT648 CD74HCT646/CD54HCT646								UNITS		
	TEST CONDITIONS			74HC/54HC TYPES			74HC TYPES		54HC TYPES		TEST CONDITIONS		74HCT/54HCT TYPES			74HCT TYPES		54HCT TYPES			
	V <sub>i</sub> V	I <sub>o</sub> mA	V <sub>cc</sub> V	+25°C			-40/ +85°C		-55/ +125°C		V <sub>i</sub> V	V <sub>cc</sub> V	+25°C			-40/ +85°C		-55/ +125°C			
				Min	Typ	Max	Min	Max	Min	Max			Min	Typ	Max	Min	Max	Min		Max	
High-Level Input Voltage V <sub>ih</sub>			2	1.5	—	—	1.5	—	1.5	—	—	4.5	2	—	—	2	—	2	—	V	
			4.5	3.15	—	—	3.15	—	3.15	—	to	5.5	—	—	—	—	—	—	—		
			6	4.2	—	—	4.2	—	4.2	—											
Low-Level Input Voltage V <sub>il</sub>			2	—	—	0.5	—	0.5	—	0.5	—	4.5	—	—	0.8	—	0.8	—	0.8	V	
			4.5	—	—	1.35	—	1.35	—	1.35	to	5.5	—	—	—	—	—	—	—		
			6	—	—	1.8	—	1.8	—	1.8											
High-Level Output Voltage V <sub>oh</sub>	V <sub>ih</sub>		2	1.9	—	—	1.9	—	1.9	—	V <sub>ih</sub>	4.5	4.4	—	—	4.4	—	4.4	—	V	
or	-0.02		4.5	4.4	—	—	4.4	—	4.4	—	or	5.5	—	—	—	—	—	—			
CMOS Loads	V <sub>ih</sub>		6	5.9	—	—	5.9	—	5.9	—	V <sub>ih</sub>										
TTL Loads (Bus Driver)	V <sub>ih</sub>		6	5.48	—	—	5.34	—	5.2	—	V <sub>ih</sub>	4.5	3.98	—	—	3.84	—	3.7	—	V	
	-7.8		6	5.48	—	—	5.34	—	5.2	—	V <sub>ih</sub>										
Low-Level Output Voltage V <sub>ol</sub>	V <sub>il</sub>		2	—	—	0.1	—	0.1	—	0.1	V <sub>il</sub>	4.5	—	—	0.1	—	0.1	—	0.1	V	
or	0.02		4.5	—	—	0.1	—	0.1	—	0.1	or	5.5	—	—	—	—	—	—			
CMOS Loads	V <sub>il</sub>		6	—	—	0.1	—	0.1	—	0.1	V <sub>il</sub>										
TTL Loads (Bus Driver)	V <sub>il</sub>		6	4.5	—	—	0.26	—	0.33	—	0.4	4.5	—	—	0.26	—	0.33	—	0.4	V	
	7.8		6	4.5	—	—	0.26	—	0.33	—	0.4	V <sub>il</sub>									
Input Leakage Current I <sub>i</sub>	V <sub>cc</sub>		6	—	—	±0.1	—	±1	—	±1	Any Voltage Between V <sub>cc</sub> & Gnd	5.5	—	—	±0.1	—	±1	—	±1	µA	
or	Gnd																				
Quiescent Device Current I <sub>cc</sub>	V <sub>cc</sub>		6	—	—	8	—	80	—	160	V <sub>cc</sub>	5.5	—	—	8	—	80	—	160	µA	
or	Gnd	0									or										
Additional Quiescent Device Current per input pin: 1 unit load ΔI <sub>cc</sub> *											V <sub>cc</sub> -2.1	4.5	to	—	100	360	—	450	—	490	µA
											5.5										
3-State Leakage Current I <sub>oz</sub>	V <sub>ih</sub>	V <sub>o</sub> = V <sub>cc</sub>	6	—	—	±0.5	—	±5.0	—	±10	V <sub>ih</sub>	5.5	—	—	±0.5	—	±5.0	—	±10	µA	
or	V <sub>ih</sub>	Gnd									or										
	V <sub>ih</sub>	Gnd									V <sub>ih</sub>										

\*For dual-supply systems theoretical worst case (V<sub>i</sub> = 2.4 V, V<sub>cc</sub> = 5.5 V) specification is 1.8 mA.

HCT Input Loading Table

Input	Unit Loads*
OE	1.3
DIR	0.75
Clock A → B, B → A	0.6
Select A, Select B	0.45
Inputs A0-A7, B0-B7	0.3

\*Unit Load is ΔI<sub>cc</sub> limit specified in Static Characteristic Chart, e.g., 360 µA max. @ 25°C

Technical Data

**CD54/74HC646, CD54/74HCT646**  
**CD54/74HC648, CD54/74HCT648**

SWITCHING CHARACTERISTICS ( $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , Input  $t_r = 6\text{ ns}$ )

CHARACTERISTIC	$C_L$ (pF)	TYPICAL		UNITS	
		HC	HCT		
Propagation Delays					
Store A Data to B Bus (646)	$t_{PLH}, t_{PHL}$	15	18	18	ns
Store B Data to A Bus (646)	$t_{PLH}, t_{PHL}$	15	18	18	ns
Store A Data to B Bus (648)	$t_{PLH}, t_{PHL}$	15	20	23	ns
Store B Data to A Bus (648)	$t_{PLH}, t_{PHL}$	15	20	23	ns
A Data to B Bus (646)	$t_{PLH}, t_{PHL}$	15	12	15	ns
B Data to A Bus (646)	$t_{PLH}, t_{PHL}$	15	12	15	ns
A Data to B Bus (648)	$t_{PLH}, t_{PHL}$	15	12	15	ns
B Data to A Bus (648)	$t_{PLH}, t_{PHL}$	15	12	15	ns
Select to Data (646)	$t_{PLH}, t_{PHL}$	15	14	19	ns
Select to Data (648)	$t_{PLH}, t_{PHL}$	15	16	19	ns
3-State Disabling Time	$t_{PLZ}, t_{PHZ}$	15	14	14	ns
3-State Enabling Time	$t_{PZL}, t_{PZH}$	15	14	19	ns
Max Frequency	$f_{max}$	15	60	45	MHz
Power Dissipation Capacitance*	$C_{PD}$	—	52	52	pF

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

$$P_{Dq} = V_{CC}^2 C_{PD} f_i + \sum V_{CC}^2 C_L f_o$$

$C_L$  = output load capacitance

$V_{CC}$  = supply voltage

$f_i$  = input frequency

$f_o$  = output frequency

PREREQUISITE FOR SWITCHING FUNCTION

CHARACTERISTIC	$V_{CC}$	25°C				-40°C to +85°C				-55°C to +125°C				UNITS
		HC		HCT		74HC		74HCT		54HC		54HCT		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Maximum Frequency	2	6	—	—	—	5	—	—	—	4	—	—	—	MHz
	4.5	30	—	25	—	25	—	20	—	20	—	17	—	
	6	35	—	—	—	29	—	—	—	23	—	—	—	
Set Up Time Data to Clock	2	60	—	—	—	75	—	—	—	90	—	—	—	ns
	4.5	12	—	12	—	15	—	15	—	18	—	18	—	
	6	10	—	—	—	13	—	—	—	15	—	—	—	
Hold Time Data to Clock	2	35	—	—	—	45	—	—	—	55	—	—	—	ns
	4.5	7	—	5	—	9	—	5	—	11	—	5	—	
	6	6	—	—	—	8	—	—	—	9	—	—	—	
Clock Pulse Width	2	80	—	—	—	100	—	—	—	120	—	—	—	ns
	4.5	16	—	25	—	20	—	31	—	24	—	38	—	
	6	14	—	—	—	17	—	—	—	20	—	—	—	

# CD54/74HC646, CD54/74HCT646 CD54/74HC648, CD54/74HCT648

SWITCHING CHARACTERISTICS ( $C_L = 50 \text{ pF}$ , Input  $t_r, t_f = 6 \text{ ns}$ )

CHARACTERISTIC	$V_{CC}$	25°C				-40°C to +85°C				-55°C to +125°C				UNITS	
		HC		HCT		74HC		74HCT		54HC		54HCT			
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
Propagation Delay, Store A data to B bus	$t_{PLH}$	2	—	220	—	—	—	275	—	—	—	330	—	—	ns
Store B data to B bus (646)	$t_{PHL}$	4.5	—	44	—	44	—	55	—	55	—	66	—	66	
		6	—	37	—	—	—	47	—	—	—	5.6	—	—	
Store $\bar{A}$ data to B bus	$t_{PLH}$	2	—	240	—	—	—	300	—	—	—	360	—	—	ns
Store $\bar{B}$ data to A Bus (648)	$t_{PHL}$	4.5	—	48	—	54	—	60	—	68	—	72	—	81	
		6	—	41	—	—	—	51	—	—	—	61	—	—	
A data to B bus	$t_{PLH}$	2	—	135	—	—	—	170	—	—	—	205	—	—	ns
B data to A Bus (646)	$t_{PHL}$	4.5	—	27	—	37	—	34	—	46	—	41	—	56	
		6	—	23	—	—	—	29	—	—	—	35	—	—	
$\bar{A}$ data to B bus	$t_{PLH}$	2	—	150	—	—	—	190	—	—	—	225	—	—	ns
$\bar{B}$ data to A Bus (648)	$t_{PHL}$	4.5	—	30	—	37	—	38	—	46	—	45	—	56	
		6	—	26	—	—	—	33	—	—	—	38	—	—	
Select to Data (646)	$t_{PLH}$	2	—	170	—	—	—	215	—	—	—	255	—	—	ns
	$t_{PHL}$	4.5	—	34	—	46	—	43	—	58	—	51	—	69	
		6	—	29	—	—	—	37	—	—	—	43	—	—	
Select to Data (648)	$t_{PLH}$	2	—	190	—	—	—	240	—	—	—	285	—	—	ns
	$t_{PHL}$	4.5	—	38	—	46	—	48	—	58	—	57	—	69	
		6	—	32	—	—	—	39	—	—	—	48	—	—	
3-State Disabling Time Bus to Output or Register to Output	$t_{PLZ}$	2	—	175	—	—	—	220	—	—	—	265	—	—	ns
	$t_{PHZ}$	4.5	—	35	—	35	—	44	—	44	—	53	—	53	
3-State Enabling Time Bus to Output or Register to Output	$t_{PZL}$	2	—	175	—	—	—	220	—	—	—	265	—	—	ns
	$t_{PZH}$	4.5	—	35	—	45	—	44	—	56	—	53	—	68	
Output Transition Time	$t_{TLH}$	2	—	60	—	—	—	75	—	—	—	90	—	—	ns
	$t_{THL}$	4.5	—	12	—	12	—	15	—	15	—	18	—	18	
3-State Output Capacitance	$C_o$	—	—	—	—	—	—	—	—	—	—	—	—	—	pF
		—	—	20	—	20	—	20	—	20	—	20	—	20	
Input Capacitance	$C_i$	—	—	—	—	—	—	—	—	—	—	—	—	—	pF
		—	—	10	—	10	—	10	—	10	—	10	—	10	

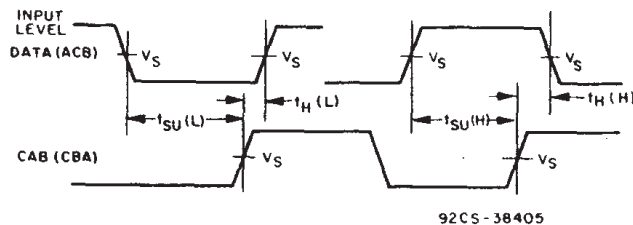
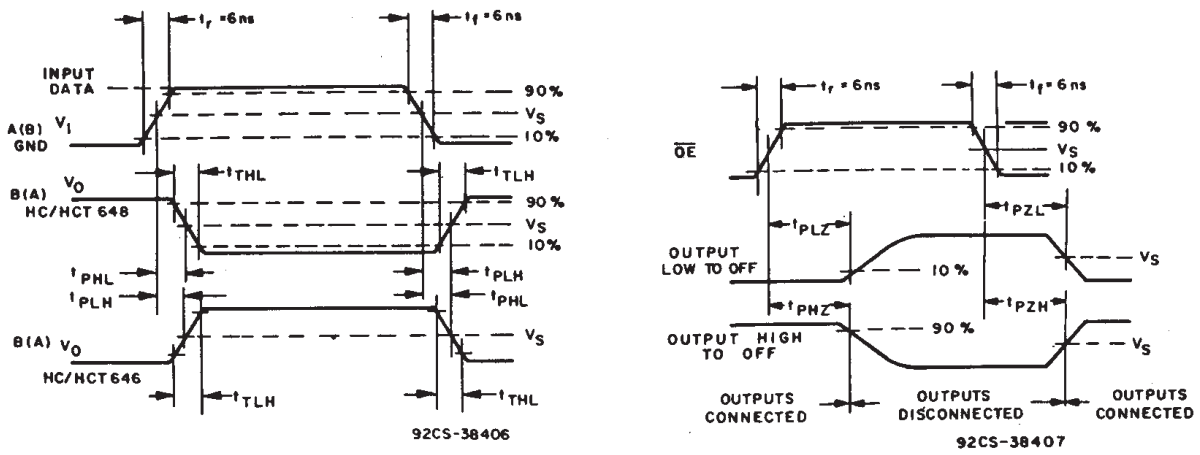


Fig. 2 — Data setup and hold times.

**CD54/74HC646, CD54/74HCT646  
CD54/74HC648, CD54/74HCT648**



	54/74HC	54/74HCT
Input Level	$V_{CC}$	3V
Switching Voltage, $V_S$	50% $V_{CC}$	1.3 V

Fig. 3 — Transition times and propagation delay times.

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