

# DATA SHEET

For a complete data sheet, please also download:

- The IC06 74HC/HCT/HCU/HCMOS Logic Family Specifications
- The IC06 74HC/HCT/HCU/HCMOS Logic Package Information
- The IC06 74HC/HCT/HCU/HCMOS Logic Package Outlines

Datasheet.Directory

## **74HC/HCT4051** 8-channel analog multiplexer/demultiplexer

Product specification  
File under Integrated Circuits, IC06

December 1990

# 8-channel analog multiplexer/demultiplexer

## 74HC/HCT4051

### FEATURES

- Wide analog input voltage range:  $\pm 5$  V.
- Low "ON" resistance:  
80  $\Omega$  (typ.) at  $V_{CC} - V_{EE} = 4.5$  V  
70  $\Omega$  (typ.) at  $V_{CC} - V_{EE} = 6.0$  V  
60  $\Omega$  (typ.) at  $V_{CC} - V_{EE} = 9.0$  V
- Logic level translation:  
to enable 5 V logic to communicate with  $\pm 5$  V analog signals
- Typical "break before make" built in
- Output capability: non-standard
- $I_{CC}$  category: MSI

### GENERAL DESCRIPTION

The 74HC/HCT4051 are high-speed Si-gate CMOS devices and are pin compatible with the "4051" of the

"4000B" series. They are specified in compliance with JEDEC standard no. 7A.

The 74HC/HCT4051 are 8-channel analog multiplexers/demultiplexers with three digital select inputs ( $S_0$  to  $S_2$ ), an active LOW enable input ( $\bar{E}$ ), eight independent inputs/outputs ( $Y_0$  to  $Y_7$ ) and a common input/output ( $Z$ ).

With  $\bar{E}$  LOW, one of the eight switches is selected (low impedance ON-state) by  $S_0$  to  $S_2$ . With  $\bar{E}$  HIGH, all switches are in the high impedance OFF-state, independent of  $S_0$  to  $S_2$ .

$V_{CC}$  and GND are the supply voltage pins for the digital control inputs ( $S_0$  to  $S_2$ , and  $\bar{E}$ ). The  $V_{CC}$  to GND ranges are 2.0 to 10.0 V for HC and 4.5 to 5.5 V for HCT. The analog inputs/outputs ( $Y_0$  to  $Y_7$ , and  $Z$ ) can swing between  $V_{CC}$  as a positive limit and  $V_{EE}$  as a negative limit.  $V_{CC} - V_{EE}$  may not exceed 10.0 V.

For operation as a digital multiplexer/demultiplexer,  $V_{EE}$  is connected to GND (typically ground).

### QUICK REFERENCE DATA

$V_{EE} = \text{GND} = 0$  V;  $T_{\text{amb}} = 25$  °C;  $t_r = t_f = 6$  ns

SYMBOL	PARAMETER	CONDITIONS	TYPICAL		UNIT
			HC	HCT	
$t_{PZH}/t_{PZL}$	turn "ON" time $\bar{E}$ to $V_{OS}$ $S_n$ to $V_{OS}$	$C_L = 15$ pF; $R_L = 1$ k $\Omega$ ; $V_{CC} = 5$ V	22	22	ns
			20	24	ns
$t_{PHZ}/t_{PLZ}$	turn "OFF" time $\bar{E}$ to $V_{OS}$ $S_n$ to $V_{OS}$		18	16	ns
			19	20	ns
$C_I$	input capacitance		3.5	3.5	pF
$C_{PD}$	power dissipation capacitance per switch	notes 1 and 2	25	25	pF
$C_S$	max. switch capacitance independent (Y) common (Z)		5	5	pF
			25	25	pF

### Notes

1.  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu$ W):

$$P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum \{ (C_L + C_S) \times V_{CC}^2 \times f_o \} \text{ where:}$$

$f_i$  = input frequency in MHz

$f_o$  = output frequency in MHz

$\sum \{ (C_L + C_S) \times V_{CC}^2 \times f_o \}$  = sum of outputs

$C_L$  = output load capacitance in pF

$C_S$  = max. switch capacitance in pF

$V_{CC}$  = supply voltage in V

2. For HC the condition is  $V_I = \text{GND}$  to  $V_{CC}$   
For HCT the condition is  $V_I = \text{GND}$  to  $V_{CC} - 1.5$  V

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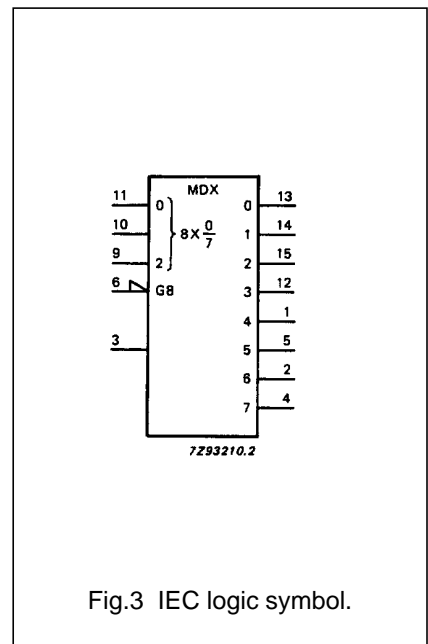
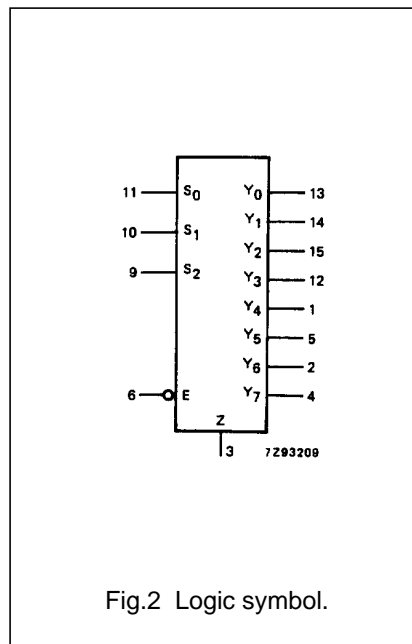
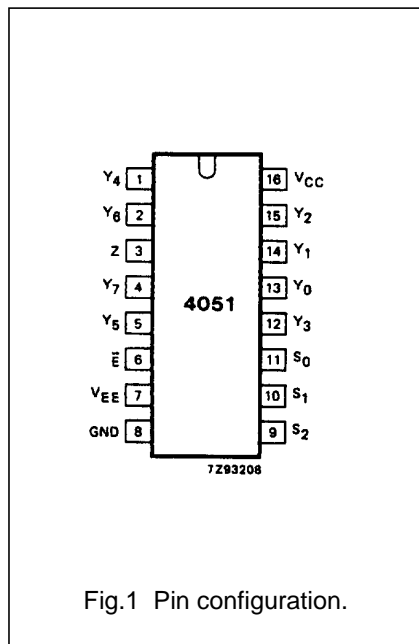
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ORDERING INFORMATION

See "74HC/HCT/HCU/HCMOS Logic Package Information".

PIN DESCRIPTION

PIN NO.	SYMBOL	NAME AND FUNCTION
3	Z	common input/output
6	$\bar{E}$	enable input (active LOW)
7	V <sub>EE</sub>	negative supply voltage
8	GND	ground (0 V)
11, 10, 9	S <sub>0</sub> to S <sub>2</sub>	select inputs
13, 14, 15, 12, 1, 5, 2, 4	Y <sub>0</sub> to Y <sub>7</sub>	independent inputs/outputs
16	V <sub>CC</sub>	positive supply voltage



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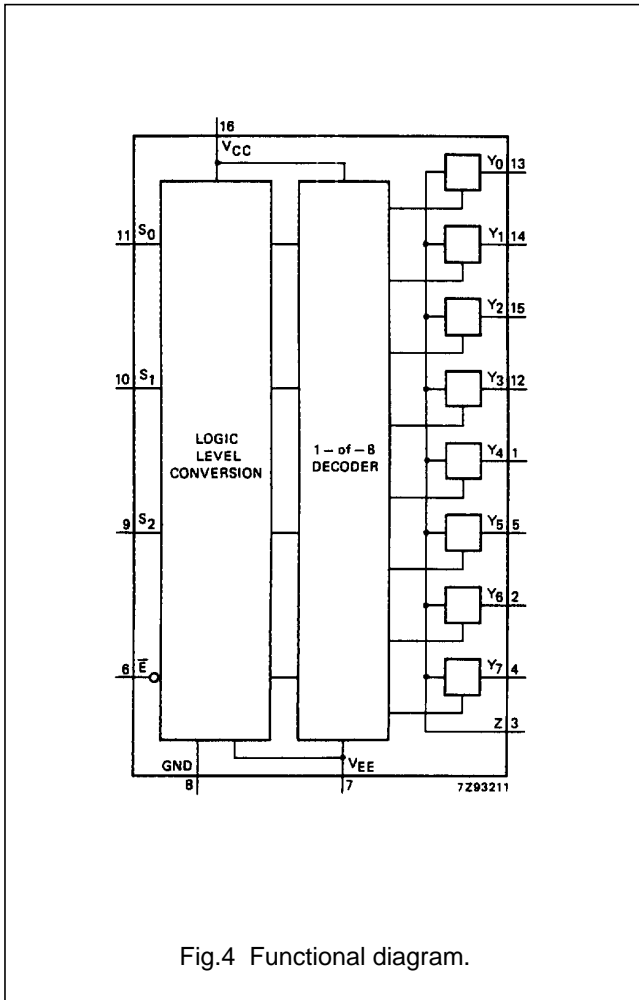


Fig.4 Functional diagram.

APPLICATIONS

- Analog multiplexing and demultiplexing
- Digital multiplexing and demultiplexing
- Signal gating

FUNCTION TABLE

INPUTS				channel ON
$\bar{E}$	$S_2$	$S_1$	$S_0$	
L	L	L	L	$Y_0 - Z$
L	L	L	H	$Y_1 - Z$
L	L	H	L	$Y_2 - Z$
L	L	H	H	$Y_3 - Z$
L	H	L	L	$Y_4 - Z$
L	H	L	H	$Y_5 - Z$
L	H	H	L	$Y_6 - Z$
L	H	H	H	$Y_7 - Z$
H	X	X	X	none

Notes

1. H = HIGH voltage level  
L = LOW voltage level  
X = don't care

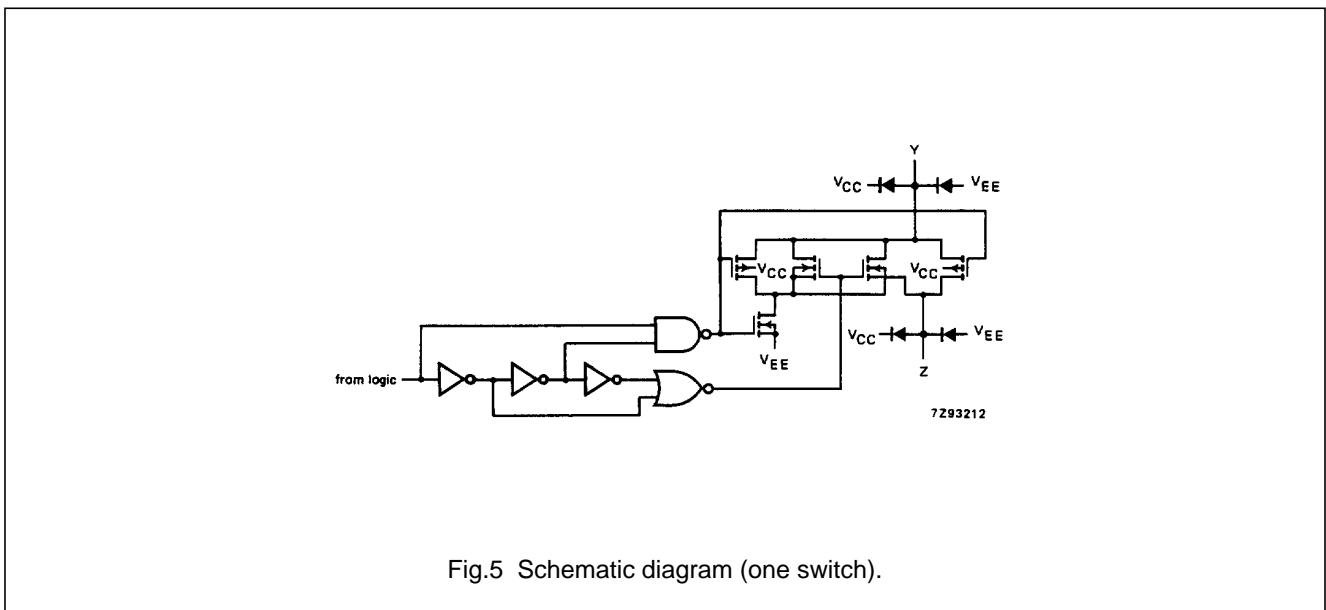


Fig.5 Schematic diagram (one switch).

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**RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages are referenced to  $V_{EE} = \text{GND}$  (ground = 0 V)

SYMBOL	PARAMETER	MIN.	MAX.	UNIT	CONDITIONS
$V_{CC}$	DC supply voltage	-0.5	+11.0	V	
$\pm I_{IK}$	DC digital input diode current		20	mA	for $V_I < -0.5 \text{ V}$ or $V_I > V_{CC} + 0.5 \text{ V}$
$\pm I_{SK}$	DC switch diode current		20	mA	for $V_S < -0.5 \text{ V}$ or $V_S > V_{CC} + 0.5 \text{ V}$
$\pm I_S$	DC switch current		25	mA	for $-0.5 \text{ V} < V_S < V_{CC} + 0.5 \text{ V}$
$\pm I_{EE}$	DC $V_{EE}$ current		20	mA	
$\pm I_{CC}; \pm I_{GND}$	DC $V_{CC}$ or GND current		50	mA	
$T_{stg}$	storage temperature range	-65	+150	°C	
$P_{tot}$	power dissipation per package				for temperature range: -40 to +125 °C 74HC/HCT
	plastic DIL		750	mW	above +70 °C: derate linearly with 12 mW/K
	plastic mini-pack (SO)		500	mW	above +70 °C: derate linearly with 8 mW/K
$P_S$	power dissipation per switch		100	mW	

**Note to ratings**

- To avoid drawing  $V_{CC}$  current out of terminal Z, when switch current flows in terminals  $Y_n$ , the voltage drop across the bidirectional switch must not exceed 0.4 V. If the switch current flows into terminal Z, no  $V_{CC}$  current will flow out of terminals  $Y_n$ . In this case there is no limit for the voltage drop across the switch, but the voltages at  $Y_n$  and Z may not exceed  $V_{CC}$  or  $V_{EE}$ .

**RECOMMENDED OPERATING CONDITIONS**

SYMBOL	PARAMETER	74HC			74HCT			UNIT	CONDITIONS
		min.	typ.	max.	min.	typ.	max.		
$V_{CC}$	DC supply voltage $V_{CC} - \text{GND}$	2.0	5.0	10.0	4.5	5.0	5.5	V	see Figs 6 and 7
$V_{CC}$	DC supply voltage $V_{CC} - V_{EE}$	2.0	5.0	10.0	2.0	5.0	10.0	V	see Figs 6 and 7
$V_I$	DC input voltage range	GND		$V_{CC}$	GND		$V_{CC}$	V	
$V_S$	DC switch voltage range	$V_{EE}$		$V_{CC}$	$V_{EE}$		$V_{CC}$	V	
$T_{amb}$	operating ambient temperature range	-40		+85	-40		+85	°C	see DC and AC CHARACTERISTICS
$T_{amb}$	operating ambient temperature range	-40		+125	-40		+125	°C	
$t_r, t_f$	input rise and fall times		6.0	1000 500 400 250		6.0	500	ns	$V_{CC} = 2.0 \text{ V}$ $V_{CC} = 4.5 \text{ V}$ $V_{CC} = 6.0 \text{ V}$ $V_{CC} = 10.0 \text{ V}$

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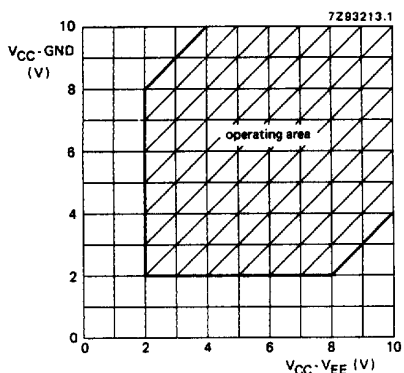


Fig.6 Guaranteed operating area as a function of the supply voltages for 74HC4051.

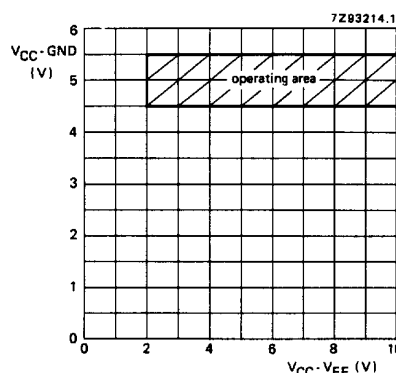


Fig.7 Guaranteed operating area as a function of the supply voltages for 74HCT4051.

DC CHARACTERISTICS FOR 74HC/HCT

For 74HC:  $V_{CC} - GND$  or  $V_{CC} - V_{EE} = 2.0, 4.5, 6.0$  and  $9.0$  V

For 74HCT:  $V_{CC} - GND = 4.5$  and  $5.5$  V;  $V_{CC} - V_{EE} = 2.0, 4.5, 6.0$  and  $9.0$  V

SYMBOL	PARAMETER	$T_{amb}$ (°C)						UNIT	TEST CONDITIONS					
		74HC/HCT							$V_{CC}$ (V)	$V_{EE}$ (V)	$I_S$ ( $\mu A$ )	$V_{is}$	$V_I$	
		+25			-40 to +85		-40 to +125							
		min.	typ.	max.	min.	max.	min.		max.					
$R_{ON}$	ON resistance (peak)		—	—		—		—	$\Omega$	2.0	0	100	$V_{CC}$ to $V_{EE}$	$V_{IH}$ or $V_{IL}$
			100	180		225		270	$\Omega$	4.5	0	1000		
			90	160		200		240	$\Omega$	6.0	0	1000		
			70	130		165		195	$\Omega$	4.5	-4.5	1000		
$R_{ON}$	ON resistance (rail)		150	—		—		—	$\Omega$	2.0	0	100	$V_{EE}$	$V_{IH}$ or $V_{IL}$
			80	140		175		210	$\Omega$	4.5	0	1000		
			70	120		150		180	$\Omega$	6.0	0	1000		
			60	105		130		160	$\Omega$	4.5	-4.5	1000		
$R_{ON}$	ON resistance (rail)		150	—		—		—	$\Omega$	2.0	0	100	$V_{CC}$	$V_{IH}$ or $V_{IL}$
			90	160		200		240	$\Omega$	4.5	0	1000		
			80	140		175		210	$\Omega$	6.0	0	1000		
			65	120		150		180	$\Omega$	4.5	-4.5	1000		
$\Delta R_{ON}$	maximum $\Delta ON$ resistance between any two channels		—						$\Omega$	2.0	0		$V_{CC}$ to $V_{EE}$	$V_{IH}$ or $V_{IL}$
			9						$\Omega$	4.5	0			
			8						$\Omega$	6.0	0			
			6						$\Omega$	4.5	-4.5			

Notes to DC characteristics

- At supply voltages ( $V_{CC} - V_{EE}$ ) approaching 2.0 V the analog switch ON-resistance becomes extremely non-linear. Therefore it is recommended that these devices be used to transmit digital signals only, when using these supply voltages.
- For test circuit measuring  $R_{ON}$  see Fig.8.

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**DC CHARACTERISTICS FOR 74HC**

Voltages are referenced to GND (ground = 0 V)

SYMBOL	PARAMETER	T <sub>amb</sub> (°C)							UNIT	TEST CONDITIONS			
		74HC								V <sub>CC</sub> (V)	V <sub>EE</sub> (V)	V <sub>i</sub>	OTHER
		+25			-40 to +85		-40 to +125						
		min.	typ.	max.	min.	max.	min.	max.					
V <sub>IH</sub>	HIGH level input voltage	1.5 3.15 4.2 6.3	1.2 2.4 3.2 4.7		1.5 3.15 4.2 6.3		1.5 3.15 4.2 6.3		V	2.0 4.5 6.0 9.0			
V <sub>IL</sub>	LOW level input voltage		0.8 2.1 2.8 4.3	0.5 1.35 1.8 2.7		0.5 1.35 1.8 2.7		0.5 1.35 1.8 2.7	V	2.0 4.5 6.0 9.0			
± I <sub>I</sub>	input leakage current			0.1 0.2		1.0 2.0		1.0 2.0	µA	6.0 10.0	0 0	V <sub>CC</sub> or GND	
± I <sub>S</sub>	analog switch OFF-state current per channel			0.1		1.0		1.0	µA	10.0	0	V <sub>IH</sub> or V <sub>IL</sub>	V <sub>S</sub>   = V <sub>CC</sub> - V <sub>EE</sub> Fig.10
± I <sub>S</sub>	analog switch OFF-state current all channels			0.4		4.0		4.0	µA	10.0	0	V <sub>IH</sub> or V <sub>IL</sub>	V <sub>S</sub>   = V <sub>CC</sub> - V <sub>EE</sub> Fig.10
± I <sub>S</sub>	analog switch ON-state current			0.4		4.0		4.0	µA	10.0	0	V <sub>IH</sub> or V <sub>IL</sub>	V <sub>S</sub>   = V <sub>CC</sub> - V <sub>EE</sub> Fig.11
I <sub>CC</sub>	quiescent supply current			8.0 16.0		80.0 160.0		160.0 320.0	µA	6.0 10.0	0 0	V <sub>CC</sub> or GND	V <sub>is</sub> = V <sub>EE</sub> or V <sub>CC</sub> ; V <sub>os</sub> = V <sub>CC</sub> or V <sub>EE</sub>

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## AC CHARACTERISTICS FOR 74HC

GND = 0 V;  $t_r = t_f = 6$  ns;  $C_L = 50$  pF

SYMBOL	PARAMETER	$T_{amb}$ (°C)							UNIT	TEST CONDITIONS		
		74HC								$V_{CC}$ (V)	$V_{EE}$ (V)	OTHER
		+25			-40 to +85		-40 to +125					
		min.	typ.	max.	min.	max.	min.	max.				
$t_{PHL}/t_{PLH}$	propagation delay $V_{is}$ to $V_{os}$		14	60		75		90	ns	2.0	0	$R_L = \infty$ ; $C_L = 50$ pF (see Fig.17)
			5	12		15		18		4.5	0	
			4	10		13		15		6.0	0	
			4	8		10		12		4.5	-4.5	
$t_{PZH}/t_{PZL}$	turn "ON" time $\bar{E}$ to $V_{os}$		72	345		430		520	ns	2.0	0	$R_L = 1$ k $\Omega$ ; $C_L = 50$ pF (see Fig.18, 19 and 20)
			29	69		86		104		4.5	0	
			21	59		73		88		6.0	0	
			18	51		64		77		4.5	-4.5	
$t_{PZH}/t_{PZL}$	turn "ON" time $S_n$ to $V_{os}$		66	345		430		520	ns	2.0	0	$R_L = 1$ k $\Omega$ ; $C_L = 50$ pF (see Fig.18, 19 and 20)
			28	69		86		104		4.5	0	
			19	59		73		88		6.0	0	
			16	51		64		77		4.5	-4.5	
$t_{PHZ}/t_{PLZ}$	turn "OFF" time $\bar{E}$ to $V_{os}$		58	290		365		435	ns	2.0	0	$R_L = 1$ k $\Omega$ ; $C_L = 50$ pF (see Fig.18, 19 and 20)
			31	58		73		87		4.5	0	
			17	49		62		74		6.0	0	
			18	42		53		72		4.5	-4.5	
$t_{PHZ}/t_{PLZ}$	turn "OFF" time $S_n$ to $V_{os}$		61	290		365		435	ns	2.0	0	$R_L = 1$ k $\Omega$ ; $C_L = 50$ pF (see Fig.18, 19 and 20)
			25	58		73		87		4.5	0	
			18	49		62		74		6.0	0	
			18	42		53		72		4.5	-4.5	



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**DC CHARACTERISTICS FOR 74HCT**

Voltages are referenced to GND (ground = 0)

SYMBOL	PARAMETER	$T_{amb}$ (°C)							UNIT	TEST CONDITIONS			
		74HCT								$V_{CC}$ (V)	$V_{EE}$ (V)	$V_i$	OTHER
		+25			-40 to +85		-40 to +125						
		min.	typ.	max.	min.	max.	min.	max.					
$V_{IH}$	HIGH level input voltage	2.0	1.6		2.0		2.0		V	4.5 to 5.5			
$V_{IL}$	LOW level input voltage		1.2	0.8		0.8		0.8	V	4.5 to 5.5			
$\pm I_I$	input leakage current			0.1		1.0		1.0	$\mu A$	5.5	0	$V_{CC}$ or GND	
$\pm I_S$	analog switch OFF-state current per channel			0.1		1.0		1.0	$\mu A$	10.0	0	$V_{IH}$ or $V_{IL}$	$ V_S  = V_{CC} - V_{EE}$ (see Fig.10)
$\pm I_S$	analog switch OFF-state current all channels			0.4		4.0		4.0	$\mu A$	10.0	0	$V_{IH}$ or $V_{IL}$	$ V_S  = V_{CC} - V_{EE}$ (see Fig.10)
$\pm I_S$	analog switch ON-state current			0.4		4.0		4.0	$\mu A$	10.0	0	$V_{IH}$ or $V_{IL}$	$ V_S  = V_{CC} - V_{EE}$ (see Fig.11)
$I_{CC}$	quiescent supply current			8.0 16.0		80.0 160.0		160.0 320.0	$\mu A$	5.5 5.0	0 -5.0	$V_{CC}$ or GND	$V_{is} = V_{EE}$ or $V_{CC}$ ; $V_{os} = V_{CC}$ or $V_{EE}$
$\Delta I_{CC}$	additional quiescent supply current per input pin for unit load coefficient is 1 (note 1)		100	360		450		490	$\mu A$	4.5 to 5.5	0	$V_{CC} - 2.1$ V	other inputs at $V_{CC}$ or GND

**Note to HCT types**

- The value of additional quiescent supply current ( $\Delta I_{CC}$ ) for a unit load of 1 is given here.  
To determine  $\Delta I_{CC}$  per input, multiply this value by the unit load coefficient shown in the table below.

INPUT	UNIT LOAD COEFFICIENT
$S_n$	0.50
$\overline{E}$	0.50

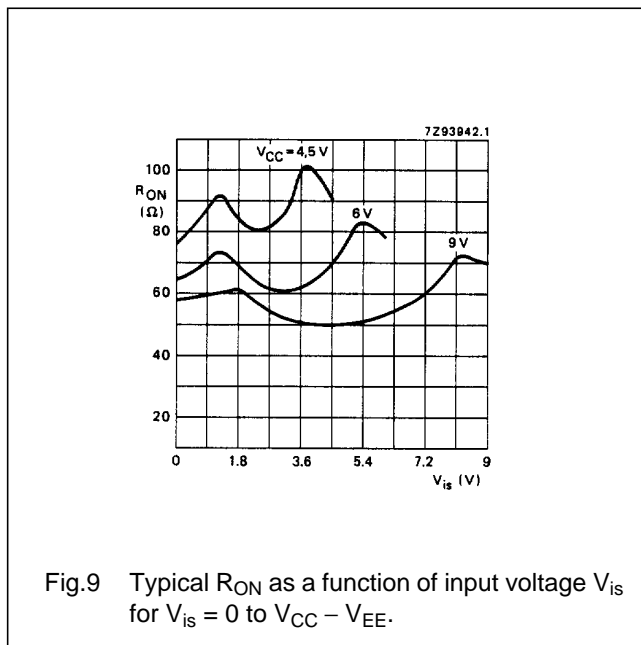
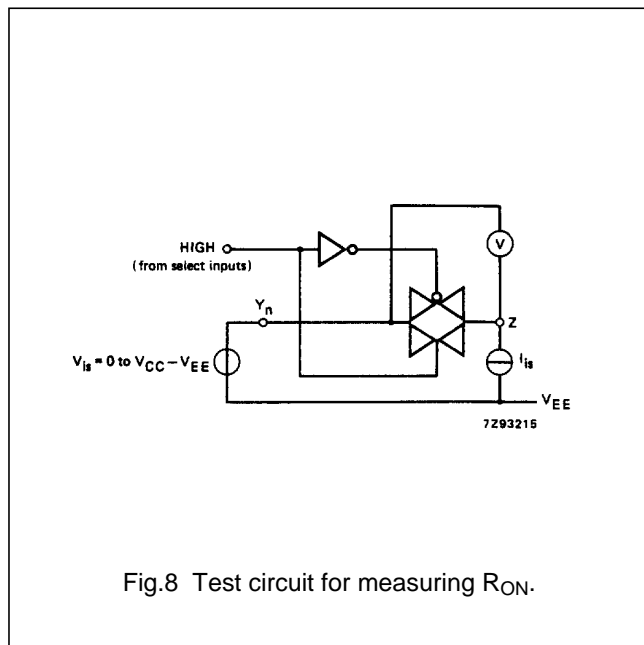
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AC CHARACTERISTICS FOR 74HCT

GND = 0 V;  $t_r = t_f = 6$  ns;  $C_L = 50$  pF

SYMBOL	PARAMETER	T <sub>amb</sub> (°C)						UNIT	TEST CONDITIONS		
		74HCT							V <sub>CC</sub> (V)	V <sub>EE</sub> (V)	OTHER
		+25			-40 to +85		-40 to +125				
		min.	typ.	max.	min.	max.	min.		max.		
t <sub>PHL</sub> / t <sub>PLH</sub>	propagation delay V <sub>is</sub> to V <sub>os</sub>	5	12	12	15	15	18	ns	4.5	0	R <sub>L</sub> = ∞; C <sub>L</sub> = 50 pF (see Fig.17)
t <sub>PZH</sub> / t <sub>PZL</sub>	turn "ON" time $\bar{E}$ to V <sub>os</sub>	26	55	55	69	69	83	ns	4.5	0	R <sub>L</sub> = 1 kΩ; C <sub>L</sub> = 50 pF (see Fig.18, 19 and 20)
t <sub>PZH</sub> / t <sub>PZL</sub>	turn "ON" time S <sub>n</sub> to V <sub>os</sub>	28	55	55	69	69	83	ns	4.5	0	R <sub>L</sub> = 1 kΩ; C <sub>L</sub> = 50 pF (see Fig.18, 19 and 20)
t <sub>PHZ</sub> / t <sub>PLZ</sub>	turn "OFF" time $\bar{E}$ to V <sub>os</sub>	19	45	45	56	56	68	ns	4.5	0	R <sub>L</sub> = 1 kΩ; C <sub>L</sub> = 50 pF (see Fig.18, 19 and 20)
t <sub>PHZ</sub> / t <sub>PLZ</sub>	turn "OFF" time S <sub>n</sub> to V <sub>os</sub>	23	45	45	56	56	68	ns	4.5	0	R <sub>L</sub> = 1 kΩ; C <sub>L</sub> = 50 pF (see Fig.18, 19 and 20)



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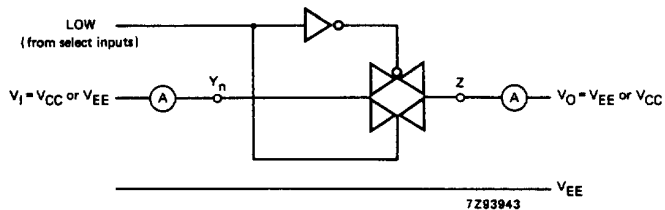


Fig.10 Test circuit for measuring OFF-state current.

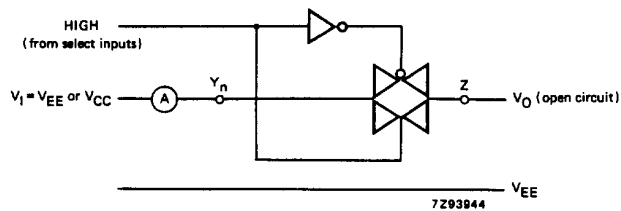


Fig.11 Test circuit for measuring ON-state current.

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ADDITIONAL AC CHARACTERISTICS FOR 74HC/HCT

Recommended conditions and typical values

GND = 0 V; T<sub>amb</sub> = 25 °C

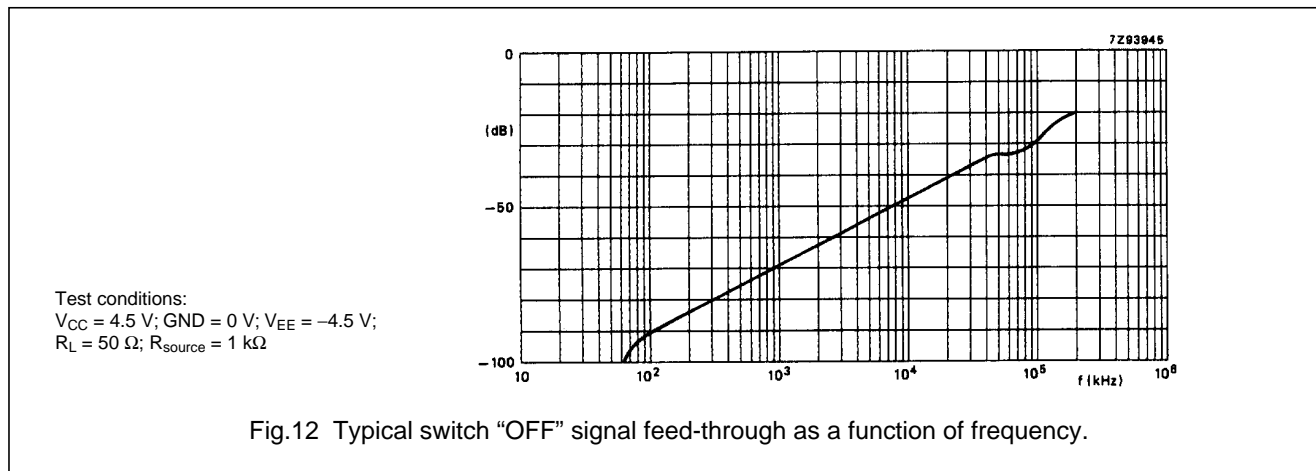
SYMBOL	PARAMETER	typ.	UNIT	V <sub>CC</sub> (V)	V <sub>EE</sub> (V)	V <sub>is(p-p)</sub> (V)	CONDITIONS
	sine-wave distortion f = 1 kHz	0.04 0.02	% %	2.25 4.5	-2.25 -4.5	4.0 8.0	R <sub>L</sub> = 10 kΩ; C <sub>L</sub> = 50 pF (see Fig.14)
	sine-wave distortion f = 10 kHz	0.12 0.06	% %	2.25 4.5	-2.25 -4.5	4.0 8.0	R <sub>L</sub> = 10 kΩ; C <sub>L</sub> = 50 pF (see Fig.14)
	switch "OFF" signal feed-through	-50 -50	dB dB	2.25 4.5	-2.25 -4.5	note 1	R <sub>L</sub> = 600 Ω; C <sub>L</sub> = 50 pF (see Figs 12 and 15)
V <sub>(p-p)</sub>	crosstalk voltage between control and any switch (peak-to-peak value)	110 220	mV mV	4.5 4.5	0 -4.5		R <sub>L</sub> = 600 Ω; C <sub>L</sub> = 50 pF; f = 1 MHz ( $\bar{E}$ or S <sub>n</sub> ), square-wave between V <sub>CC</sub> and GND, t <sub>r</sub> = t <sub>f</sub> = 6 ns (see Fig.16)
f <sub>max</sub>	minimum frequency response (-3dB)	170 180	MHz MHz	2.25 4.5	-2.25 -4.5	note 2	R <sub>L</sub> = 50 Ω; C <sub>L</sub> = 10 pF (see Fig.13 and 14)
C <sub>S</sub>	maximum switch capacitance independent (Y) common (Z)	5 25	pF pF				

Notes to AC characteristics

1. Adjust input voltage V<sub>is</sub> to 0 dBm level (0 dBm = 1 mW into 600 Ω).
2. Adjust input voltage V<sub>is</sub> to 0 dBm level at V<sub>os</sub> for 1 MHz (0 dBm = 1 mW into 50 Ω).

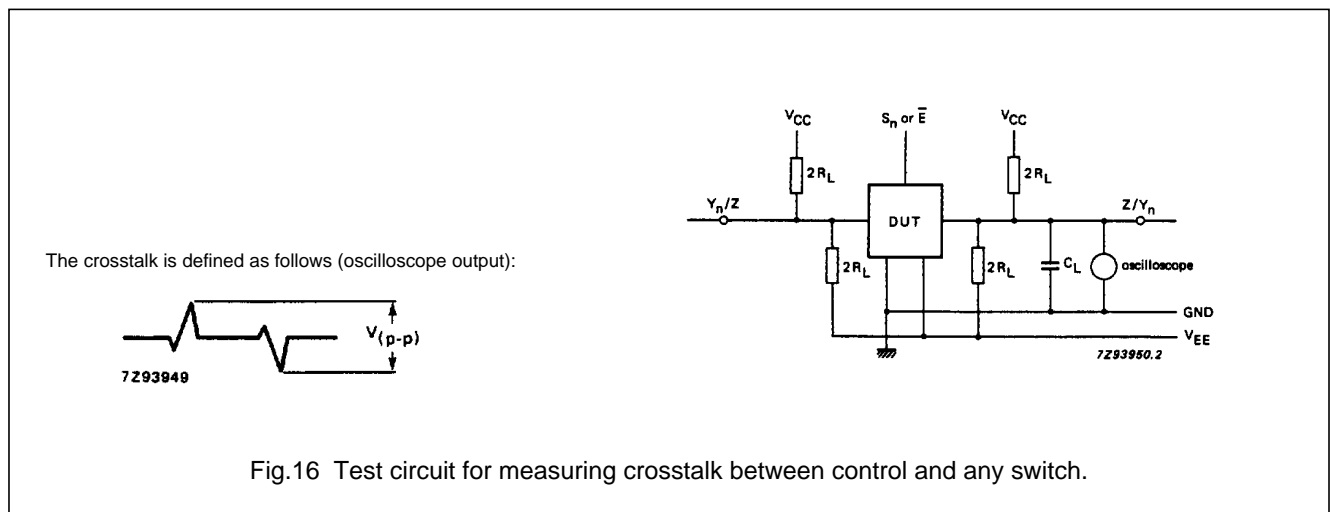
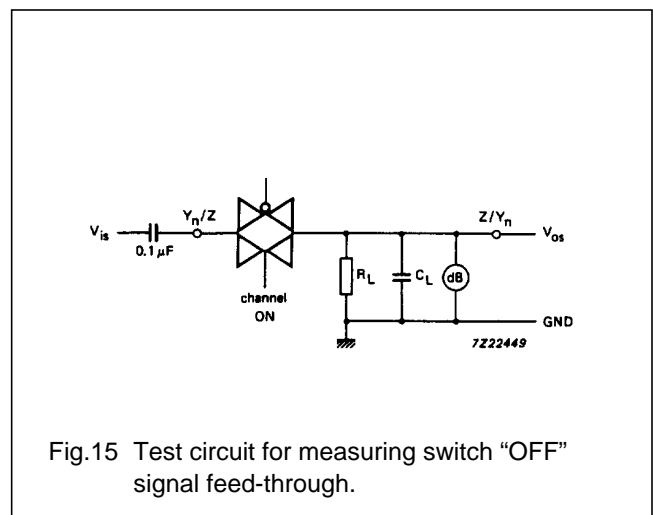
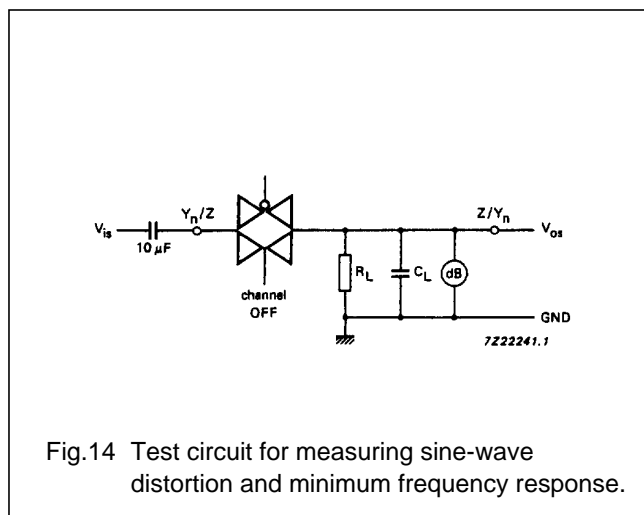
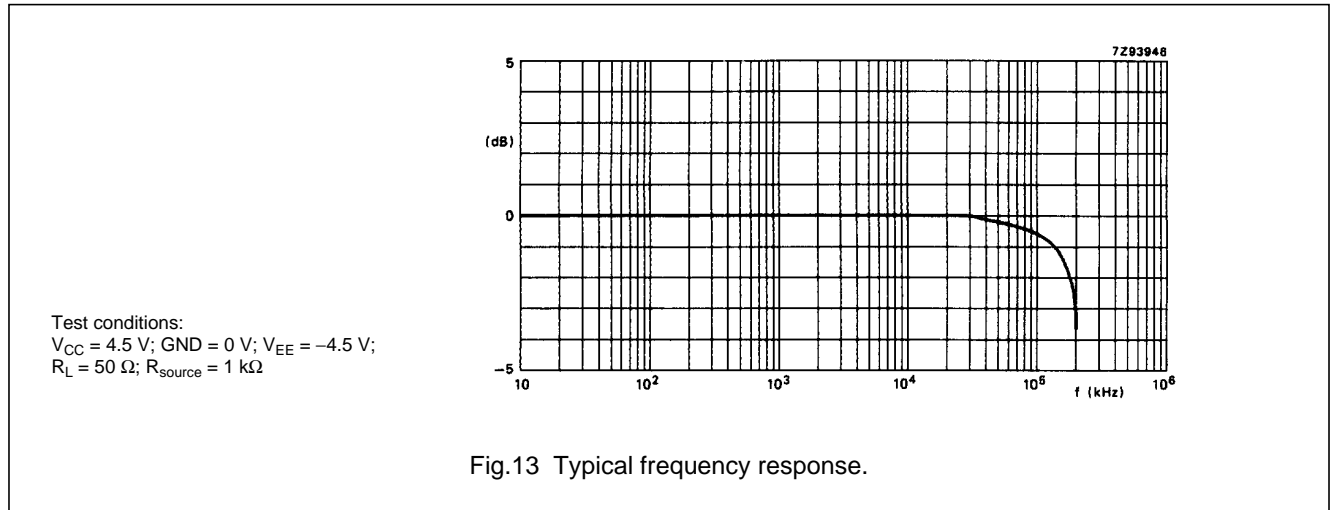
General note

V<sub>is</sub> is the input voltage at a Y<sub>n</sub> or Z terminal, whichever is assigned as an input.  
V<sub>os</sub> is the output voltage at a Y<sub>n</sub> or Z terminal, whichever is assigned as an output.



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AC WAVEFORMS

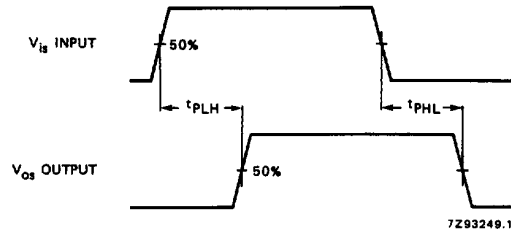
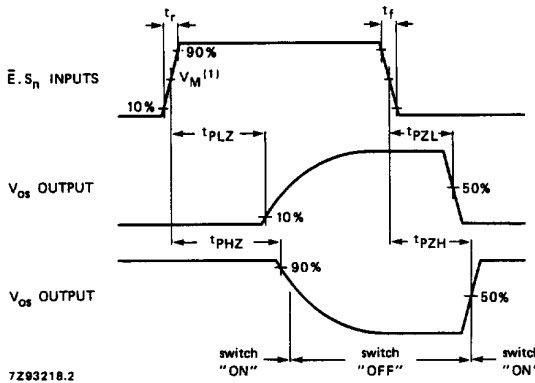


Fig.17 Waveforms showing the input ( $V_{is}$ ) to output ( $V_{os}$ ) propagation delays.



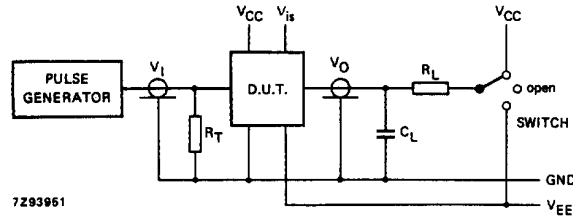
(1) HC :  $V_M = 50\%$ ;  $V_I = \text{GND to } V_{CC}$ .  
 HCT:  $V_M = 1.3 \text{ V}$ ;  $V_I = \text{GND to } 3 \text{ V}$ .

Fig.18 Waveforms showing the turn-ON and turn-OFF times.

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TEST CIRCUIT AND WAVEFORMS



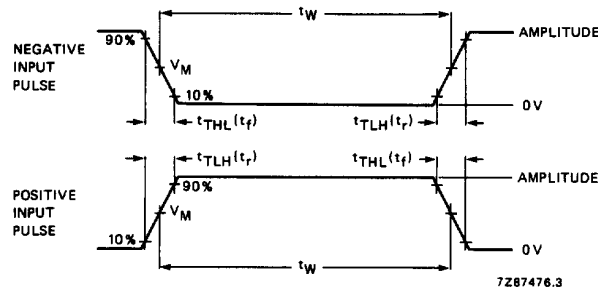
Conditions

TEST	SWITCH	V <sub>is</sub>
t <sub>PZH</sub>	V <sub>EE</sub>	V <sub>CC</sub>
t <sub>PZL</sub>	V <sub>CC</sub>	V <sub>EE</sub>
t <sub>PHZ</sub>	V <sub>EE</sub>	V <sub>CC</sub>
t <sub>PLZ</sub>	V <sub>CC</sub>	V <sub>EE</sub>
others	open	pulse

FAMILY	AMPLITUDE	V <sub>M</sub>	t <sub>r</sub> ; t <sub>f</sub>	
			f <sub>max</sub> ; PULSE WIDTH	OTHER
74HC	V <sub>CC</sub>	50%	< 2 ns	6 ns
74HCT	3.0 V	1.3 V	< 2 ns	6 ns

C<sub>L</sub> = load capacitance including jig and probe capacitance (see AC CHARACTERISTICS for values).  
 R<sub>T</sub> = termination resistance should be equal to the output impedance Z<sub>O</sub> of the pulse generator.  
 t<sub>r</sub> = t<sub>f</sub> = 6 ns; when measuring f<sub>max</sub>, there is no constraint to t<sub>r</sub>, t<sub>f</sub> with 50% duty factor.

Fig.19 Test circuit for measuring AC performance.



Conditions

TEST	SWITCH	V <sub>is</sub>
t <sub>PZH</sub>	V <sub>EE</sub>	V <sub>CC</sub>
t <sub>PZL</sub>	V <sub>CC</sub>	V <sub>EE</sub>
t <sub>PHZ</sub>	V <sub>EE</sub>	V <sub>CC</sub>
t <sub>PLZ</sub>	V <sub>CC</sub>	V <sub>EE</sub>
others	open	pulse

FAMILY	AMPLITUDE	V <sub>M</sub>	t <sub>r</sub> ; t <sub>f</sub>	
			f <sub>max</sub> ; PULSE WIDTH	OTHER
74HC	V <sub>CC</sub>	50%	< 2 ns	6 ns
74HCT	3.0 V	1.3 V	< 2 ns	6 ns

C<sub>L</sub> = load capacitance including jig and probe capacitance (see AC CHARACTERISTICS for values).  
 R<sub>T</sub> = termination resistance should be equal to the output impedance Z<sub>O</sub> of the pulse generator.  
 t<sub>r</sub> = t<sub>f</sub> = 6 ns; when measuring f<sub>max</sub>, there is no constraint to t<sub>r</sub>, t<sub>f</sub> with 50% duty factor.

Fig.20 Input pulse definitions.

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**PACKAGE OUTLINES**

See *"74HC/HCT/HCU/HCMOS Logic Package Outlines"*.