



# U74HC4053

CMOS IC

## TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/ DEMULTIPLEXER

### DESCRIPTION

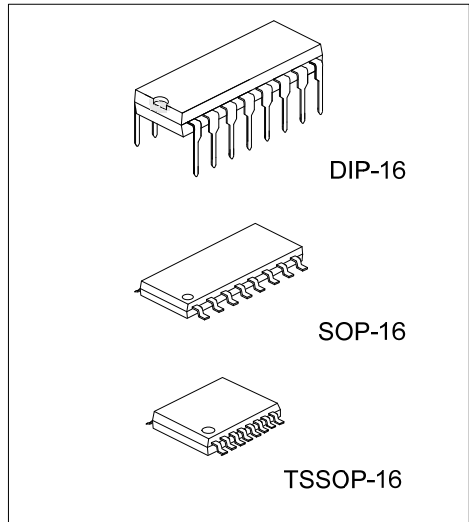
The UTC **U74HC4053** is a high-performance, triple 2-channel analog multiplexer/de-multiplexer.

### FEATURES

- \* Wide analog input voltage range from -5V to +5V
- \* Low ON-state resistance
- \* Logic level translation: to enable 5V logic to communicate with  $\pm 5V$  analog signals
- \* Typical "break before make" built in

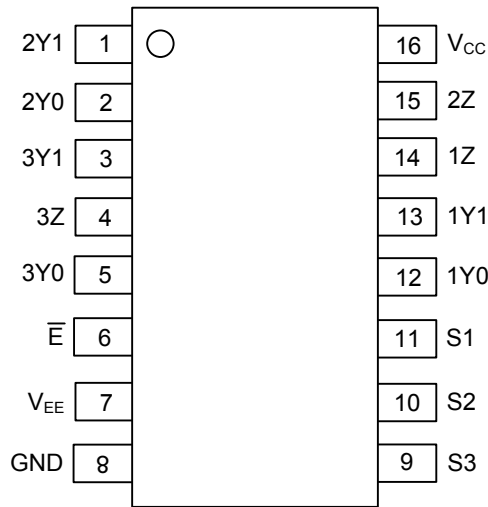
### ORDERING INFORMATION

Ordering Number		Package	Packing
Lead Free	Halogen Free		
U74HC4053L-D16-T	U74HC4053G-D16-T	DIP-16	Tube
U74HC4053L-S16-R	U74HC4053G-S16-R	SOP-16	Tape Reel
U74HC4053L-P16-R	U74HC4053G-P16-R	TSSOP-16	Tape Reel



<p>U74HC4053L-D16-T</p> <p>(1) Packing Type (2) Package Type (3) Lead Plating</p>	<p>(1) R: Tape Reel, T: Tube (2) D16: DIP-16, S16: SOP-16, P16: TSSOP-16 (3) G: Halogen Free, L: Lead Free</p>
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■ PIN CONFIGURATION

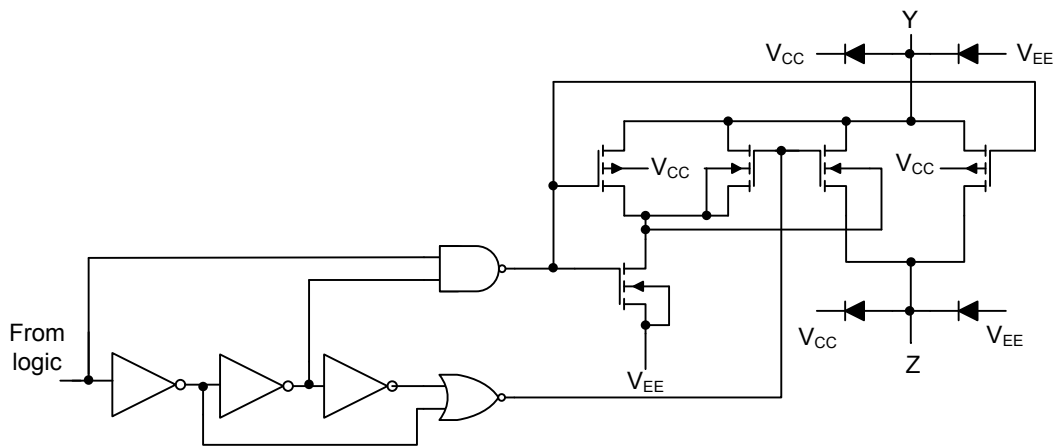


■ FUNCTION TABLE

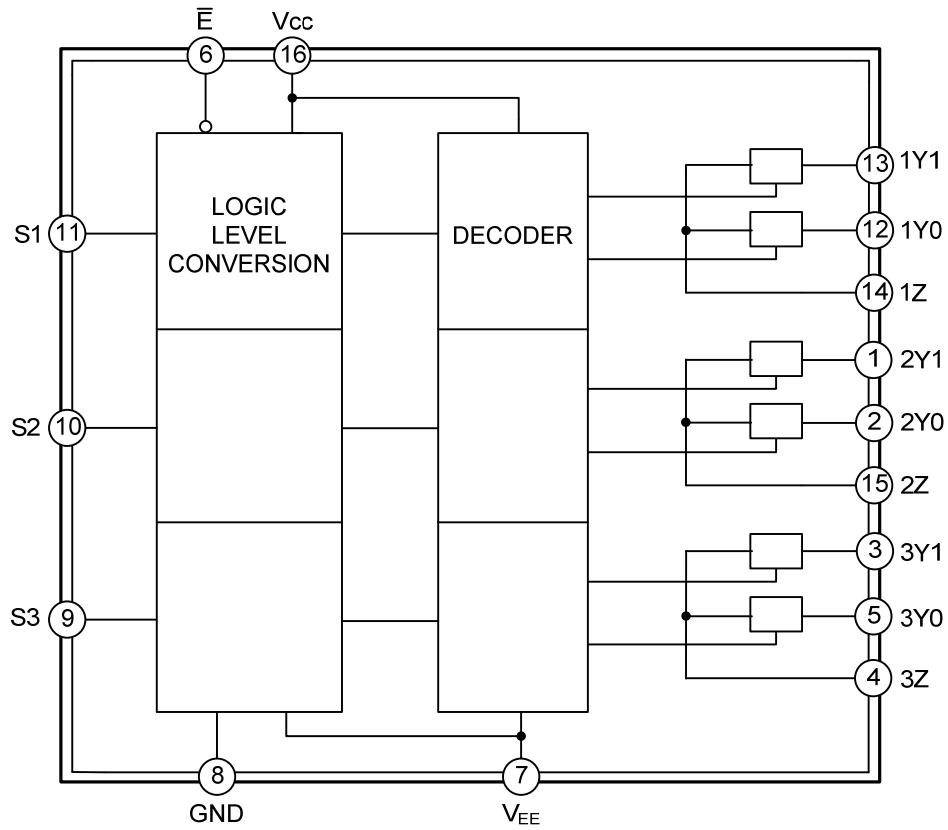
INPUT( $\bar{E}$ )	INPUT( $S_n$ )	CHANNEL ON
L	L	nY0 to nZ
L	H	nY1 to nZ
H	X	none

Note: H=High voltage level; L=Low voltage level; X=don't care

■ SCHEMATIC DIAGRAM (one switch)



## ■ FUNCTION DIAGRAM



## ■ ABSOLUTE MAXIMUM RATINGS

PARAMETER		SYMBOL	RATINGS	UNIT
Supply Voltage		$V_{CC}$	-0.5 ~ +11.0	V
Input Clamping Current ( $V_{IN} < -0.5V$ or $V_{IN} > V_{CC} + 0.5V$ )		$I_{IK}$	±20	mA
Switch Clamping Current ( $V_S < -0.5V$ or $V_S > V_{CC} + 0.5V$ )		$I_{SK}$	±20	mA
Switch Current ( $V_S = -0.5V$ to $V_{CC} + 0.5V$ )		$I_S$	±25	mA
Negative Supply Current		$I_{EE}$	-20	mA
Ground Supply Current		$I_{GND}$	-50	mA
Quiescent Supply Current		$I_{CC}$	50	mA
Power Dissipation	DIP-16	$P_D$	750	mW
	SOP-16/TSSOP-16		500	mW
Derate above $T_a > 70^\circ C$	DIP-16		12	mW/K
	SOP-16/TSSOP-16		8	mW/K
Operating Temperature		$T_{OPR}$	-40 ~ +125	$^\circ C$
Storage Temperature		$T_{STG}$	-65 ~ + 150	$^\circ C$

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

## ■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage Difference	$\Delta V_{CC}$	$V_{CC} - GND$	2.0	5.0	10.0	V
		$V_{CC} - V_{EE}$	2.0	5.0	10.0	v
Input Voltage	$V_{IN}$		GND		$V_{CC}$	V
Switch Voltage	$V_{SW}$		$V_{EE}$		$V_{CC}$	V
Input Rise and Fall Times	$t_R, t_F$	$V_{CC} = 2.0V$		6.0	1000	ns
		$V_{CC} = 4.5V$		6.0	500	ns
		$V_{CC} = 6.0V$		6.0	400	ns
		$V_{CC} = 10.0V$		6.0	250	ns

## ■ STATIC CHARACTERISTICS ( $T_a = 25^\circ C$ )

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT
High-Level Input Voltage	$V_{IH}$	$V_{CC} = 2.0V$		1.5	1.2		V
		$V_{CC} = 4.5V$		3.15	2.4		V
		$V_{CC} = 6.0V$		4.2	3.2		V
		$V_{CC} = 9.0V$		6.3	4.7		V
Low-Level Input Voltage	$V_{IL}$	$V_{CC} = 2.0V$			0.8	0.5	V
		$V_{CC} = 4.5V$			2.1	1.35	V
		$V_{CC} = 6.0V$			2.8	1.8	V
		$V_{CC} = 9.0V$			4.3	2.7	V
Analog Switch OFF-state Current	$I_{S(OFF)}$	$V_{CC} = 10V, V_{EE} = 0V, V_I = V_{IH}$ or $V_{IL}$ $ V_S  = V_{CC} - V_{EE}$	Per Channel			±0.1	$\mu A$
			All Channels			±0.1	$\mu A$
Analog Switch ON-state Current	$I_{S(ON)}$	$V_{CC} = 10V, V_{EE} = 0V, V_I = V_{IH}$ or $V_{IL}$ $ V_S  = V_{CC} - V_{EE}$				±0.1	$\mu A$
Input Leakage Current	$I_{I(LEAK)}$	$V_{EE} = 0V$ $V_I = V_{CC}$ or GND	$V_{CC} = 6V$			±0.1	$\mu A$
			$V_{CC} = 10V$			±0.2	$\mu A$
Quiescent Supply Current	$I_Q$	$V_I = V_{CC}$ or GND $V_{IS} = V_{EE}$ or $V_{CC}$ $V_{OS} = V_{CC}$ or $V_{EE}$	$V_{CC} = 6V, V_{EE} = 0V$			8	$\mu A$
			$V_{CC} = 10V, V_{EE} = 0V$			16	$\mu A$

## ■ STATIC CHARACTERISTICS(Cont.)

PARAMETER		SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT
ON-state Resistance	PEAK	$R_{ON(PEAK)}$	$V_{IS}=V_{CC}$ to $V_{EE}$ $V_{IN}=V_{IH}$ or $V_{IL}$	$V_{EE}=0V, I_S=0.1mA$ (Note) $V_{CC}=2.0V$				$\Omega$
				$V_{EE}=0V, I_S=1mA$ $V_{CC}=4.5V$		100	180	$\Omega$
				$V_{EE}=0V, I_S=1mA$ $V_{CC}=6.0V$		90	160	$\Omega$
				$V_{EE}=-4.5V, I_S=1mA$ $V_{CC}=4.5V$		70	130	$\Omega$
	RAIL	$R_{ON(RAIL)}$	$V_{IS}=V_{EE}$ $V_{IN}=V_{IH}$ or $V_{IL}$	$V_{EE}=0V, I_S=0.1mA$ (Note) $V_{CC}=2.0V$		150		$\Omega$
				$V_{EE}=0V, I_S=1mA$ $V_{CC}=4.5V$		80	140	$\Omega$
				$V_{EE}=0V, I_S=1mA$ $V_{CC}=6.0V$		70	120	$\Omega$
				$V_{EE}=-4.5V, I_S=1mA$ $V_{CC}=4.5V$		60	105	$\Omega$
		$R_{ON(RAIL)}$	$V_{IS}=V_{CC}$ $V_{IN}=V_{IH}$ or $V_{IL}$	$V_{EE}=0V, I_S=0.1mA$ (Note) $V_{CC}=2.0V$		150		$\Omega$
				$V_{EE}=0V, I_S=1mA$ $V_{CC}=4.5V$		90	160	$\Omega$
				$V_{EE}=0V, I_S=1mA$ $V_{CC}=6.0V$		80	140	$\Omega$
				$V_{EE}=-4.5V, I_S=1mA$ $V_{CC}=4.5V$		65	120	$\Omega$
Maximum ON-state Resistance Variation Between Any Two Channels	$\Delta R_{ON(MAX)}$	$V_{IS}=V_{CC}$ to $V_{EE}$ $V_{IN}=V_{IH}$ or $V_{IL}$	$V_{EE}=0V, I_S=0.1mA$ (Note) $V_{CC}=2.0V$				$\Omega$	
			$V_{EE}=0V, I_S=1mA$ $V_{CC}=4.5V$		9		$\Omega$	
			$V_{EE}=0V, I_S=1mA$ $V_{CC}=6.0V$		8		$\Omega$	
			$V_{EE}=-4.5V, I_S=1mA$ $V_{CC}=4.5V$		6		$\Omega$	

Note: 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.

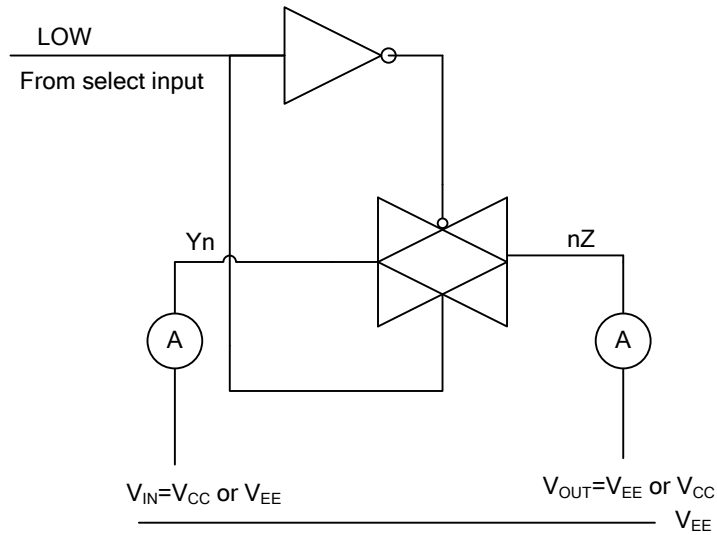
## ■ DYNAMIC CHARACTERISTICS (Ta=25°C, GND=0V, $t_R=t_F=6ns$ , unless otherwise specified)

PARAMETER		SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT	
Propagation Delay Form $V_{IS}$ to $V_{OS}$	$t_{PHL}/t_{PLH}$	$R_L=\infty, C_L=50pF$	$V_{EE}=0V$	$V_{CC}=2.0V$		15	60	ns	
				$V_{CC}=4.5V$		5	2	ns	
				$V_{CC}=6.0V$		4	10	ns	
				$V_{EE}=-4.5V, V_{CC}=4.5V$		4	8	ns	
Turn-ON Time	$\bar{E}$ to $V_{OS}$	$R_L=1k\Omega, C_L=50pF$	$V_{EE}=0V$	$V_{CC}=2.0V$		60	220	ns	
				$V_{CC}=4.5V$		20	44	ns	
				$V_{CC}=6.0V$		16	37	ns	
				$V_{EE}=-4.5V, V_{CC}=4.5V$		15	31	ns	
	Sn to $V_{OS}$	$t_{PHZ}/t_{PLZ}$	$R_L=1k\Omega, C_L=15pF$	$V_{EE}=0V$	$V_{CC}=5.0V$		17		ns
					$V_{CC}=2.0V$		75	220	ns
					$V_{CC}=4.5V$		25	44	ns
					$V_{CC}=6.0V$		20	37	ns
Turn-OFF Time	$\bar{E}$ to $V_{OS}$	$R_L=1k\Omega, C_L=50pF$	$V_{EE}=0V$	$V_{CC}=2.0V$		63	210	ns	
				$V_{CC}=4.5V$		21	42	ns	
				$V_{CC}=6.0V$		17	36	ns	
				$V_{EE}=-4.5V, V_{CC}=4.5V$		15	29	ns	
	Sn to $V_{OS}$	$t_{PHZ}/t_{PLZ}$	$R_L=1k\Omega, C_L=15pF$	$V_{EE}=0V$	$V_{CC}=5.0V$		18		ns
					$V_{CC}=2.0V$		60	210	ns
					$V_{CC}=4.5V$		20	42	ns
					$V_{CC}=6.0V$		16	36	ns
$R_L=1k\Omega, C_L=15pF$	$V_{EE}=0V$	$V_{CC}=4.5V$		15	29	ns			
		$V_{CC}=5.0V$		17		ns			

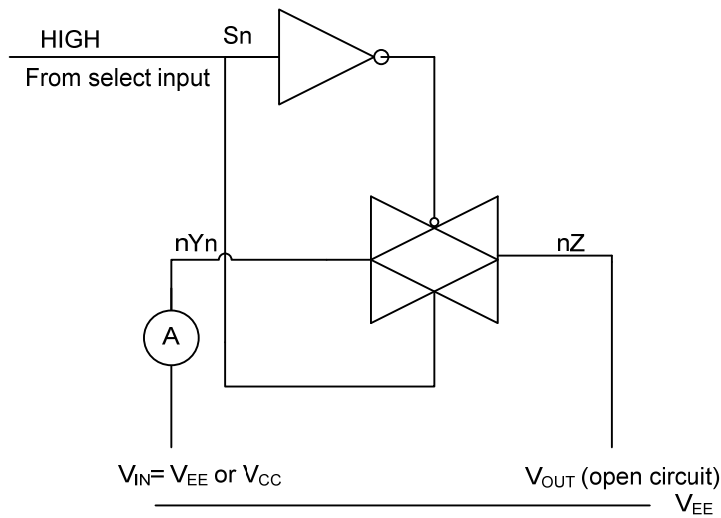
Note:  $V_{IS}$  is the input voltage at a nYn or nZ terminal, whichever is assigned as an input.  
 $V_{OS}$  is the output voltage at a nYn or nZ terminal, whichever is assigned as an output.

## ■ TEST CIRCUITS AND WAVEFORMS

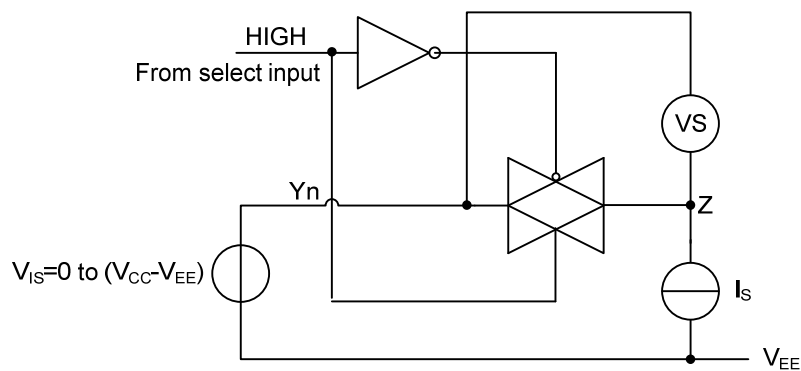
For OFF-state current



For ON-state current

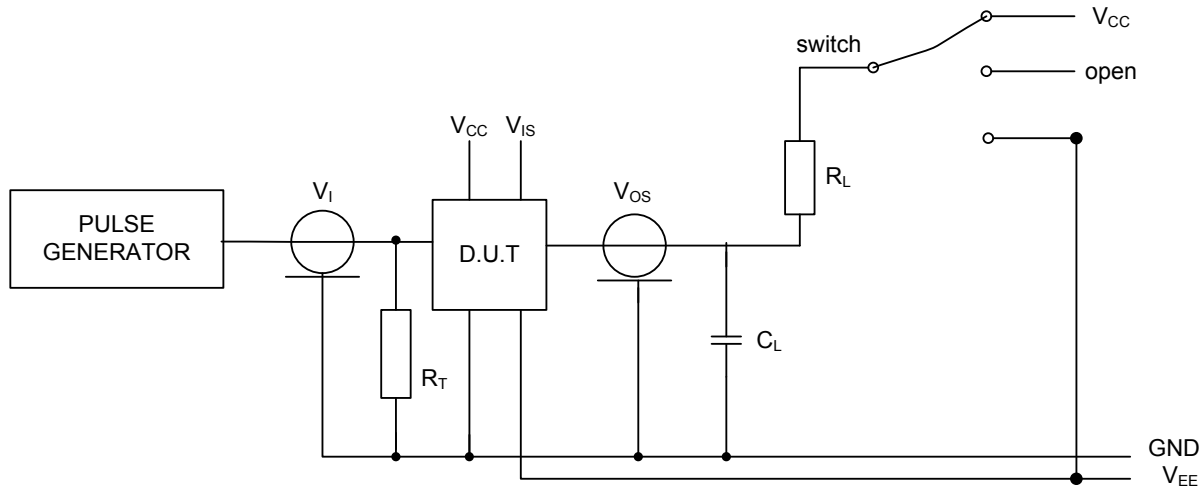


For  $R_{ON}$



## ■ TEST CIRCUITS AND WAVEFORMS(Cont.)

For AC performance



TEST	SWITCH	INPUT	
		$V_{IS}$	$t_R, t_F$
$t_{PZH}$	$V_{EE}$	$V_{CC}$	6ns
$t_{PZL}$	$V_{CC}$	$V_{EE}$	6ns
$t_{PHZ}$	$V_{EE}$	$V_{CC}$	6ns
$t_{PLZ}$	$V_{CC}$	$V_{EE}$	6ns
$t_{PLH}$	open	pulse	6ns
$t_{PHL}$	open	pulse	6ns

Note: Definitions for test circuit:

$R_L$  = load resistance

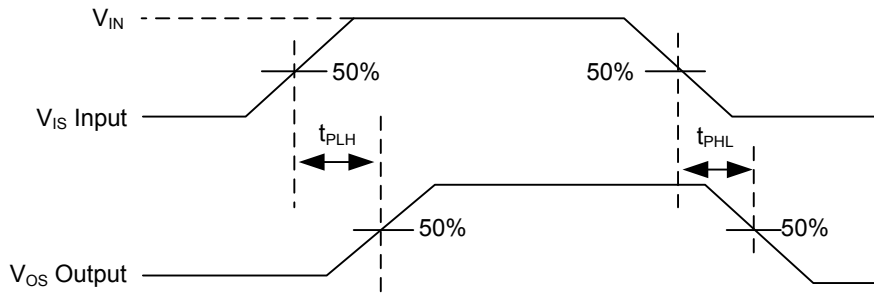
$C_L$  = load capacitance including jig and probe capacitance.

$R_T$  = termination resistance should be equal to the output impedance  $Z_O$  of the pulse generator.

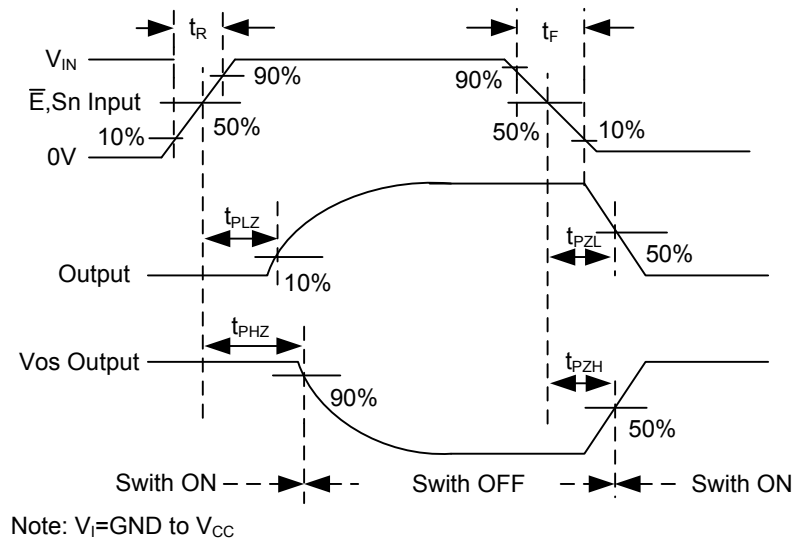
$t_R=t_F=6$  ns; when measuring  $f_{MAX}$ , there is no constraint to  $t_r$  and  $t_f$  with 50% duty factor (<2ns).

## ■ TEST CIRCUITS AND WAVEFORMS(Cont.)

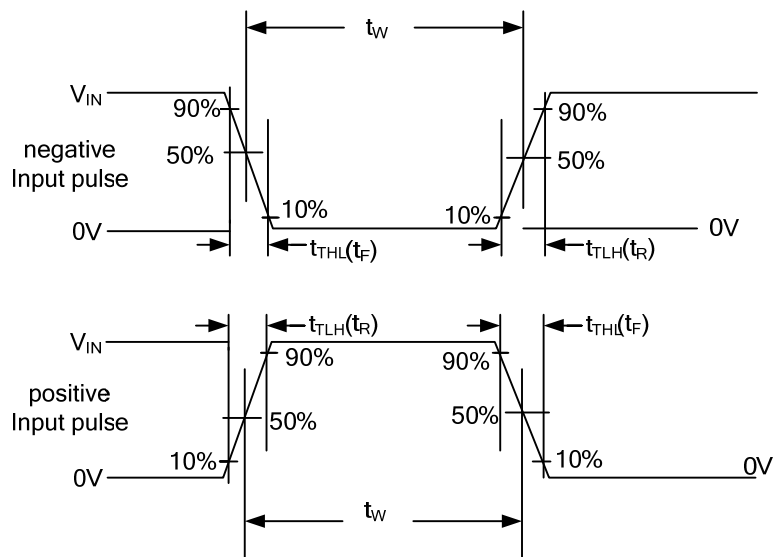
### The Input ( $V_{IS}$ ) to Output ( $V_{OS}$ ) propagation delays Waveform



### The turn-on and turn-off times Waveform



### Input pulse definition



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