



## U74HC4051

CMOS IC

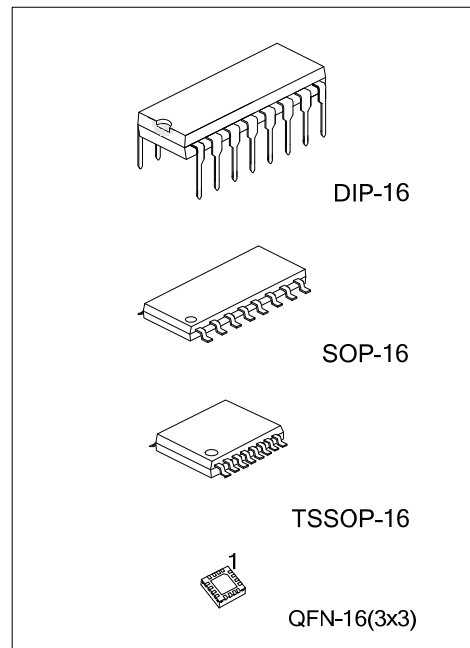
### 8-CHANNEL ANALOG MULTIPLEXER/ DEMULTIPLEXER

#### DESCRIPTION

The UTC **U74HC4051** is a high-performance, 8-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		
U74HC4051L-D16-T	U74HC4051G-D16-T	DIP-16	Tube
U74HC4051L-S16-T	U74HC4051G-S16-T	SOP-16	Tube
U74HC4051L-S16-R	U74HC4051G-S16-R	SOP-16	Tape Reel
U74HC4051L-P16-T	U74HC4051G-P16-T	TSSOP-16	Tube
U74HC4051L-P16-R	U74HC4051G-P16-R	TSSOP-16	Tape Reel
U74HC4051L-Q16-3030-R	U74HC4051G-Q16-3030-R	QFN-16(3x3)	Tape Reel

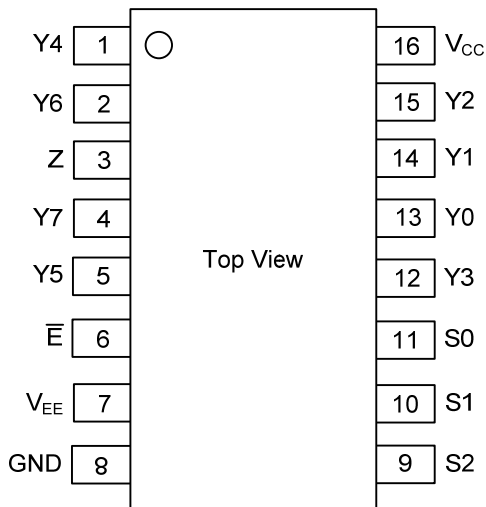
<p>U74HC4051G-D16-T</p> <p>(1) Packing Type (2) Package Type (3) Green Package</p>	<p>(1) T: Tube, R: Tape Reel (2) D16: DIP-16, S16: SOP-16, P16: TSSOP-16 Q16-3030: QFN-16(3x3) (3) G: Halogen Free and Lead Free, L: Lead Free</p>
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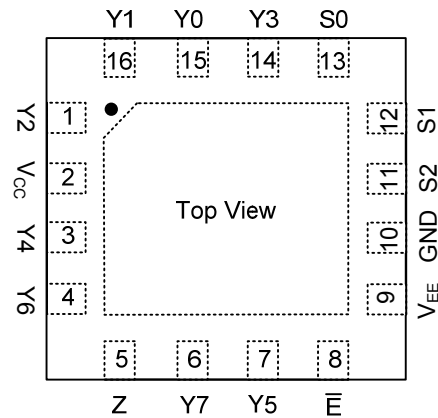
MARKING

PACKAGE	MARKING
DIP-16	
SOP-16 TSSOP-16	
QFN-16(3x3)	

PIN CONFIGURATION



DIP-16/SOP-16/TSSOP-16



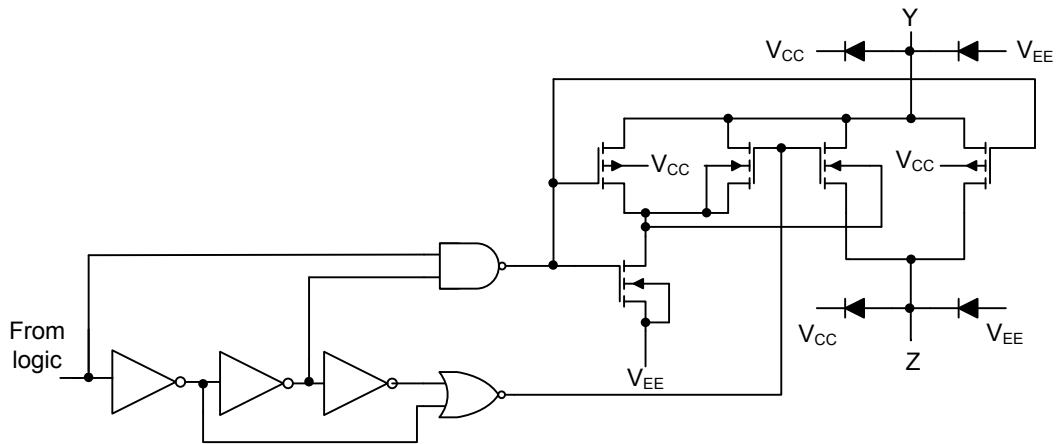
QFN-16(3x3)

FUNCTION TABLE

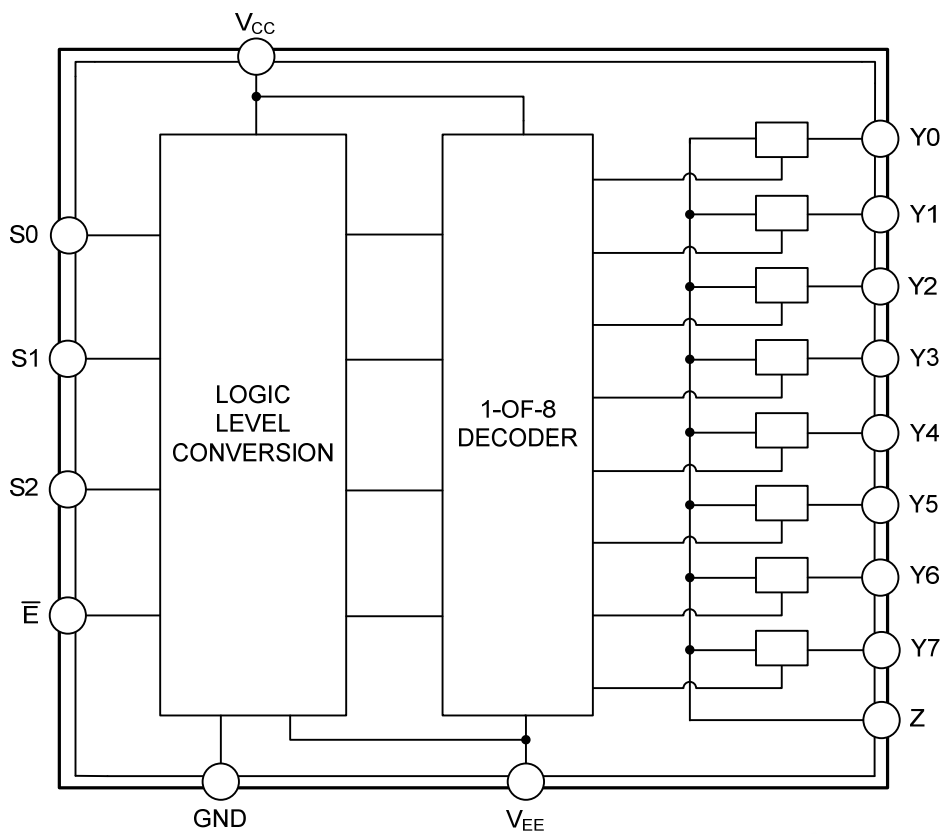
INPUT( $\bar{E}$ )	INPUT(S2)	INPUT(S1)	INPUT(S0)	CHANNEL ON
L	L	L	L	Y0 to Z
L	L	L	H	Y1 to Z
L	L	H	L	Y2 to Z
L	L	H	H	Y3 to Z
L	H	L	L	Y4 to Z
L	H	L	H	Y5 to Z
L	H	H	L	Y6 to Z
L	H	H	H	Y7 to Z
H	X	X	X	none

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 ( $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$ )	$I_{IK}$	±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	750	mW
	SOP-16/TSSOP-16	500	mW
	QFN-16(3×3)	500	mW
Derate above $T_a > 70^\circ C$	DIP-16	12	mW/K
	SOP-16/TSSOP-16	8	mW/K
	QFN-16(3×3)	8	mW/K
Operating Temperature	$T_{OPR}$	-40 ~ +125	°C
Storage Temperature	$T_{STG}$	-65 ~ +150	°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 $V_{IL}$	Per Channel		±0.1	µA
		$ V_S =V_{CC}-V_{EE}$	All Channels		±0.4	µA
Analog Switch ON-state Current	$I_{S(ON)}$	$V_{CC}=10V, V_{EE}=0V, V_I=V_{IH}$ or $V_{IL}$			±0.4	µA
Input Leakage Current	$I_{I(LEAK)}$	$V_{EE}=0V, V_I=V_{CC}$ or GND	$V_{CC}=6V$		±0.1	µA
			$V_{CC}=10V$		±0.2	µA
Quiescent Supply Current	$I_Q$	$V_I=V_{CC}$ or GND	$V_{CC}=6V, V_{EE}=0V$		8	µA
		$V_{IS}=V_{EE}$ or $V_{CC}$	$V_{CC}=10V, V_{EE}=0V$		16	µA

### ■ STATIC CHARACTERISTICS(Cont.)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT	
Input Capacitance	$C_i$				3.5		pF	
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	$\Omega$
				$V_{EE}=0V, I_S=0.1mA$ (Note)	$V_{CC}=2.0V$	150		$\Omega$
				$V_{EE}=0V, I_S=1mA$	$V_{CC}=4.5V$	80	140	$\Omega$
	RAIL	$R_{ON(RAIL)}$	$V_{IS}=V_{EE}$ $V_{IN}=V_{IH}$ or $V_{IL}$	$V_{EE}=0V, I_S=1mA$	$V_{CC}=6.0V$	70	120	$\Omega$
				$V_{EE}=-4.5V, I_S=1mA$	$V_{CC}=4.5V$	60	105	$\Omega$
				$V_{EE}=0V, I_S=0.1mA$ (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 ( $T_A=25^\circ C$ , $GND=0V$ , $t_R=t_F=6ns$ , unless otherwise specified)

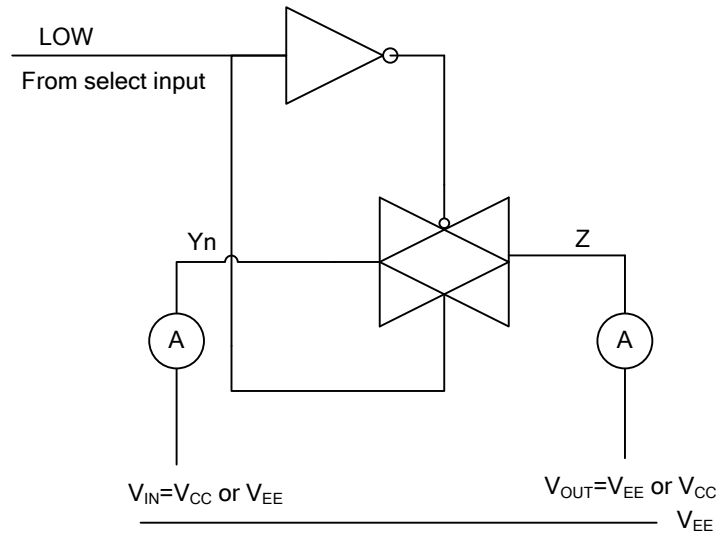
PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT	
Propagation Delay Form $V_{IS}$ to $V_{OS}$	$t_{PHL}/t_{PLH}$	$R_L=\infty, C_L=50pF$	$V_{EE}=0V$	$V_{CC}=2.0V$	14	60	ns	
				$V_{CC}=4.5V$	5	12	ns	
				$V_{CC}=6.0V$	4	10	ns	
			$V_{EE}=-4.5V$	$V_{CC}=4.5V$	4	8	ns	
Turn-ON Time	$\bar{E}$ to $V_{OS}$	$R_L=1k\Omega, C_L=50pF$	$V_{EE}=0V$	$V_{CC}=2.0V$	72	345	ns	
				$V_{CC}=4.5V$	29	69	ns	
				$V_{CC}=6.0V$	21	59	ns	
			$V_{EE}=-4.5V$	$V_{CC}=4.5V$	18	51	ns	
	$S_n$ to $V_{OS}$	$t_{PZH}/t_{PZL}$	$R_L=1k\Omega, C_L=15pF$	$V_{EE}=0V$	$V_{CC}=5.0V$	22		ns
					$V_{CC}=2.0V$	66	345	ns
					$V_{CC}=4.5V$	28	69	ns
				$V_{CC}=6.0V$	19	59	ns	
$V_{EE}=-4.5V$	$V_{CC}=4.5V$	16	51	ns				
Turn-OFF Time	$\bar{E}$ to $V_{OS}$	$R_L=1k\Omega, C_L=50pF$	$V_{EE}=0V$	$V_{CC}=2.0V$	58	290	ns	
				$V_{CC}=4.5V$	31	58	ns	
				$V_{CC}=6.0V$	17	49	ns	
			$V_{EE}=-4.5V$	$V_{CC}=4.5V$	18	42	ns	
	$S_n$ to $V_{OS}$	$t_{PHZ}/t_{PLZ}$	$R_L=1k\Omega, C_L=15pF$	$V_{EE}=0V$	$V_{CC}=5.0V$	18		ns
					$V_{CC}=2.0V$	61	290	ns
					$V_{CC}=4.5V$	25	58	ns
				$V_{CC}=6.0V$	18	49	ns	
$V_{EE}=-4.5V$	$V_{CC}=4.5V$	18	42	ns				
$V_{EE}=0V$	$V_{CC}=5.0V$	19		ns				

Note:  $V_{IS}$  is the input voltage at a Yn or Z terminal, whichever is assigned as an input.

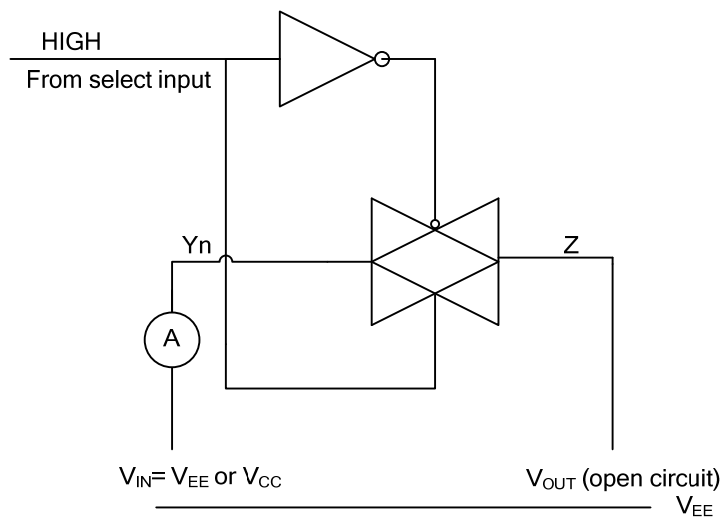
$V_{OS}$  is the output voltage at a Yn or Z terminal, whichever is assigned as an output.

## ■ TEST CIRCUITS AND WAVEFORMS

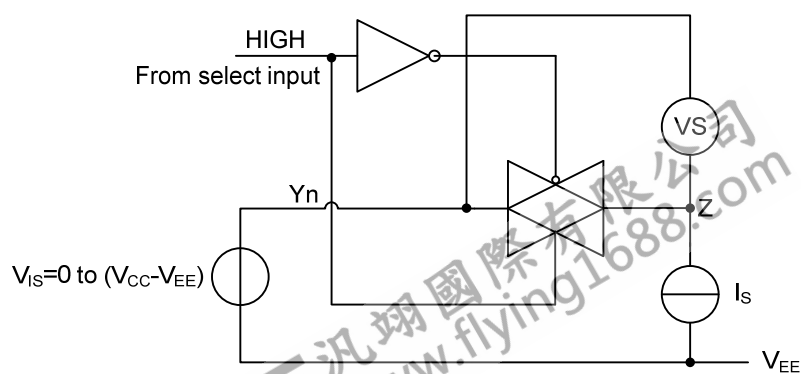
### For OFF-state current



### For ON-state current

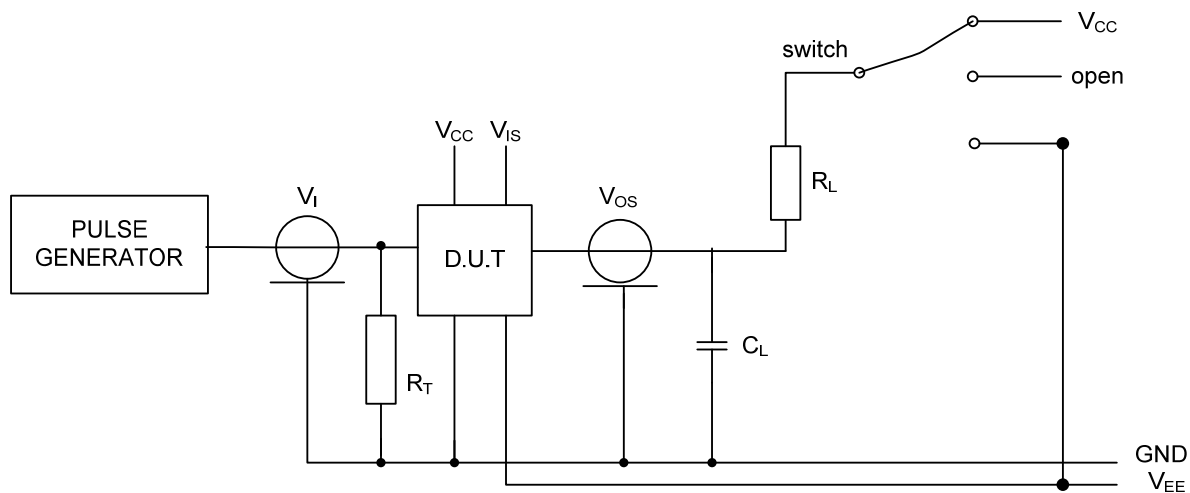


### For RON



## ■ 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

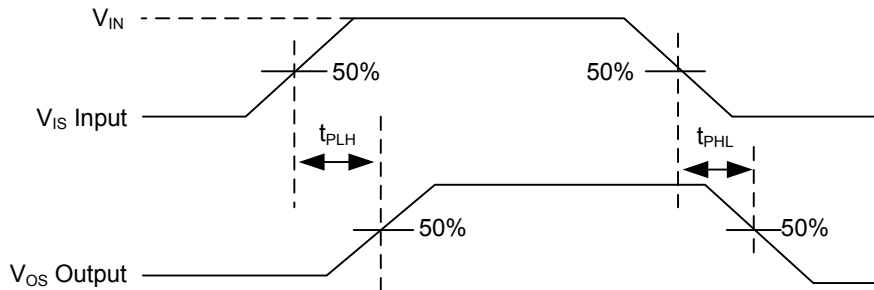
$C_L$  = load capacitance including jig and probe capacitance.

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

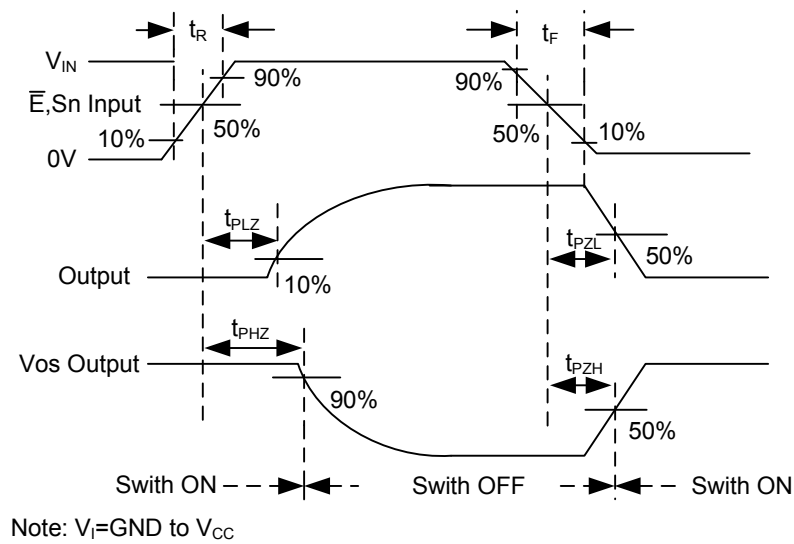
$t_r = t_f = 6$  ns; when measuring  $f_{MAX}$ , there is no constraint to  $t_r$  and  $t_f$  with 50% duty factor (<2ns).

## ■ TEST CIRCUITS AND WAVEFORMS(Cont.)

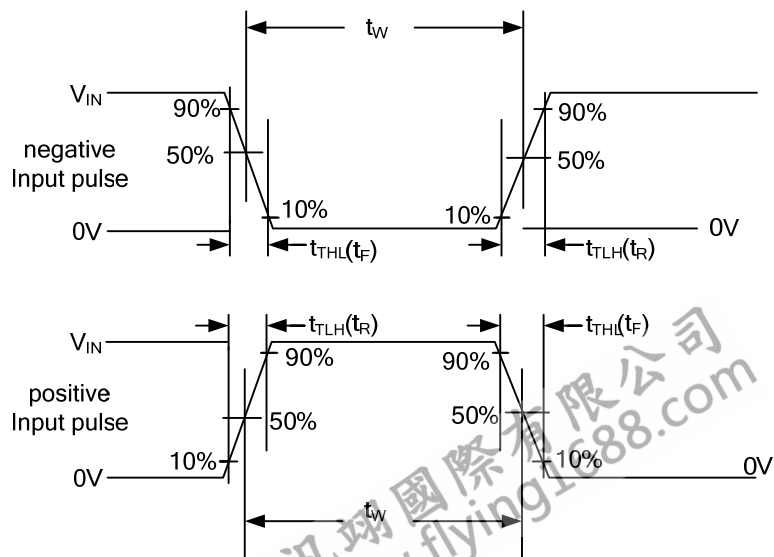
### The Input ( $V_{IS}$ ) to Output ( $V_{OS}$ ) propagation delays Waveform



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

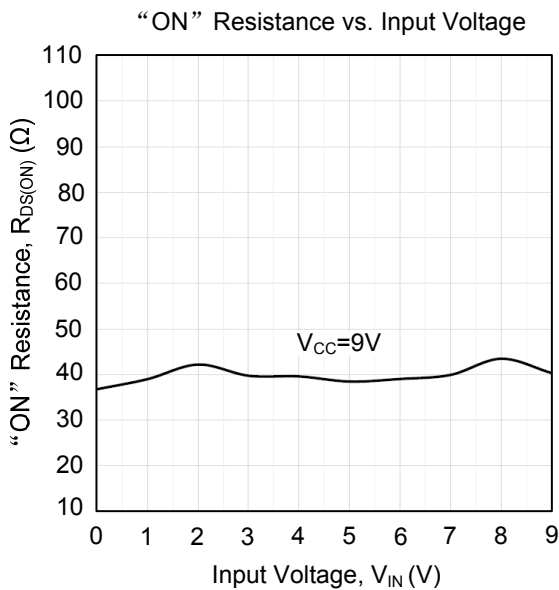
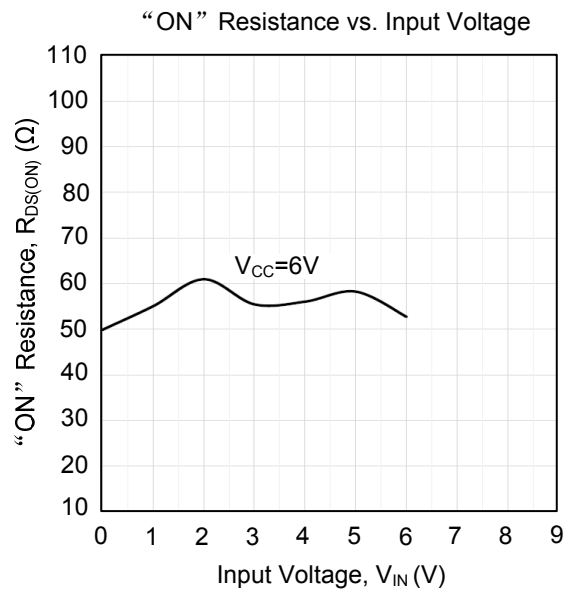
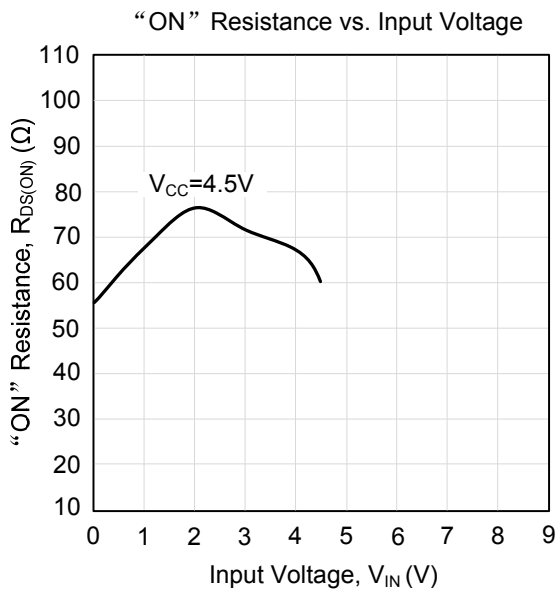


### Input pulse definition





■ TYPICAL CHARACTERISTICS



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