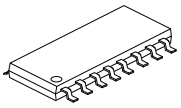
QUAD SINGLE-POLE SINGLE-THROW ANALOG SWITCH



SOP-16

■ DESCRIPTION

The **U74HC4316A** is a quad single pole, single throw analog switch (SPST). Each switch features two input/output terminals (nY and nZ) and an active HIGH enable input (nS). When nS is LOW, the analog switch is turned off. When $\overline{E}$ is HIGH all four analog switches are turned off.Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC}.

■ FEATURES

* CMOS low power dissipation
* High noise immunity
* Low ON resistance:
  160 Ω (typical) at V_{CC}-V_{EE}=4.5V
  120 Ω (typical) at V_{CC}-V_{EE}=6.0V
  80 Ω (typical) at V_{CC}-V_{EE}=9.0V
* Logic level translation:
  To enable 5V logic to communicate with ±5V analog signals
* Typical break-before-make built in

■ ORDERING INFORMATION

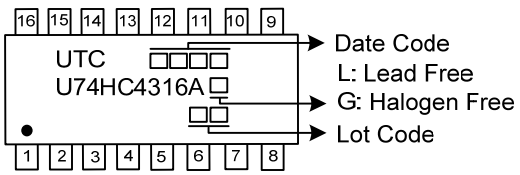
Ordering Number		Package	Packing
Lead Free	Halogen Free		
U74HC4316AL-S16-R	U74HC4316AG-S16-R	SOP-16	Tape Reel

U74HC4316AG-S16-R

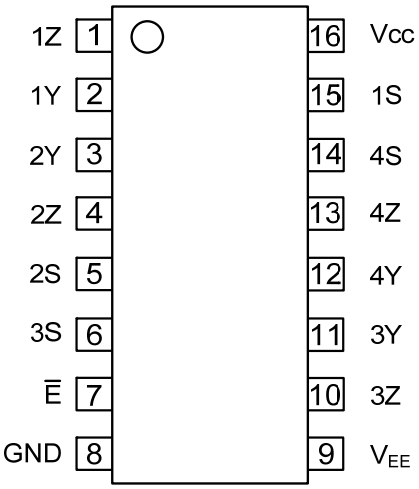
(1)Packing Type
(2)Package Type
(3)Green Package

(1) R: Tape Reel
(2) S16: SOP-16
(3) G: Halogen Free and Lead Free, L: Lead Free

■ MARKING



■ PIN CONFIGURATION



■ PIN DISCRIPTION

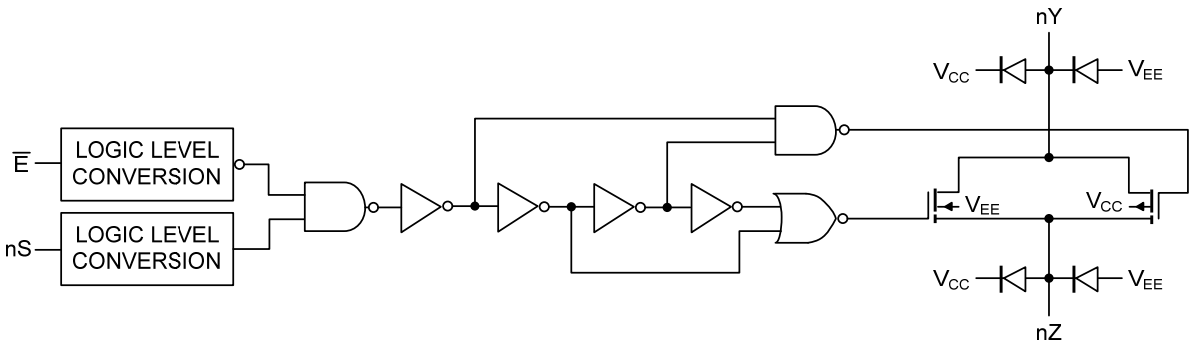
PIN NO	PIN NAME	DESCRIPTION
1、4、10、13	1Z, 2Z, 3Z, 4Z	Independent input or output
2、3、11、12	1Y, 2Y, 3Y, 4Y	Independent input or output
7	$\overline{E}$	Eenable input (active LOW)
8	GND	Ground (0V)
9	V_{EE}	Negative Supply Voltage
5、6、14、15	1S, 2S, 3S, 4S	Select input (active HIGH)
16	V_{CC}	Positive supply voltage

■ FUNCTION TABLE (each gate)

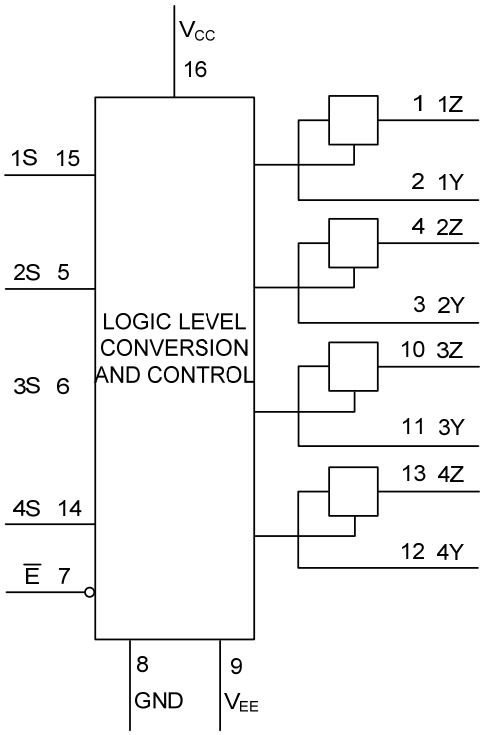
INPUT		State of Analog Switch
Enable	On/Off Control	
L	H	On
L	L	Off
H	X	Off

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	V
Supply Voltage		I_{CC}	50	mA
Supply Voltage		I_{EE}	20	mA
Input Clamp Current	V_I<-0.5V or V_I>V_{CC}+0.5V	I_{IK}	±20	mA
Switch Diode Current	V_{SW}<-0.5V or V_{SW}>V_{CC}+0.5V	I_{SK}	±20	mA
Switch Current	V_{SW}=-0.5V to V_{CC}+0.5V	I_{SW}	±25	mA
Ground Crrent			-50	mA
Power Dissipation		P_D	500	mW
Junction Temperature		T_J	+150	°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	V_{CC}	V_{CC}-GND	2	5	10	V
		V_{CC}-V_{EE}	2	5	10	V
Input Voltage	V_{IN}		GND		V_{CC}	V
Switch voltage	V_{SW}		V_{EE}		V_{CC}	V
Input Transition Rise or Fall Rate	$\Delta t/\Delta v$	V_{CC}=2V			325	ns/V
		V_{CC}=4.5V		1.67	139	ns/V
		V_{CC}=6V			83	ns/V
		V_{CC}=10V			35	ns/V
Operating Temperature	T_A		-40		+125	°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.

■ STATIC CHARACTERISTICS (Unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS		T_A=25°C			T_A=-40°C~+125°C			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
High-Level Input Voltage	V_{IH}	V_{CC}=2.0V		1.5	1.0		1.5			V
		V_{CC}=4.5V		3.15	2.2		3.15			V
		V_{CC}=6.0V		4.2	2.6		4.2			V
		V_{CC}=9.0V		6.3	4.3		6.3			V
Low-Level Input Voltage	V_{IL}	V_{CC}=2.0V			0.7	0.5			0.5	V
		V_{CC}=4.5V			1.8	1.35			1.35	V
		V_{CC}=6.0V			2.5	1.8			1.8	V
		V_{CC}=9.0V			3.8	2.7			2.7	V
Input Leakage Current	$I_{I(LEAK)}$	V_{CC}=6V, V_{EE}=0V, V_{IN}=V_{CC} or GND				±0.1			±1	μA
		V_{CC}=10V, V_{EE}=0V, V_{IN}=V_{CC} or GND				±0.2			±2	μA
OFF-state Leakage Current	$I_{S(OFF)}$	V_{CC}=10V, V_{EE}=0V, V_{IN}=V_{IH} or V_{IL} $\lvert V_{SW}\rvert$=V_{CC} - V_{EE} (Figure 3)				±0.1			±1	μA
ON-state Leakage Current	$I_{S(ON)}$	V_{CC}=10V, V_{EE}=0V, V_{IN}=V_{IH} or V_{IL} $\lvert V_{SW}\rvert$=V_{CC} - V_{EE} (Figure 4)				±0.1			±1	μA
Quiescent Supply Current	I_Q	V_{IN}=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			160	μA
			V_{CC}=10V, V_{EE}=0V			16			320	μA

■ STATIC CHARACTERISTICS (Unless otherwise specified)

V_I = V_{IH} or V_{IL}; for test circuit see Fig. 1.
V_{IS} is the input voltage at a nY or nZ terminal, whichever is assigned as an input.
V_{OS} is the output voltage at a nY or nZ terminal, whichever is assigned as an output.

PARAMETER		SYMBOL	TEST CONDITIONS	T_A=25°C			T_A=-40°C~+125°C			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
ON-Resistance	PEAK	$R_{ON(PEAK)}$	V_{CC}=2V, V_{EE}=0V, I_{SW}=100uA, V_{IS}=V_{CC} to V_{EE}, V_{IN}=V_{IH} or V_{IL}							Ω
			V_{CC}=4.5V, V_{EE}=0V, I_{SW}=1mA, V_{IS}=V_{CC} to V_{EE}, V_{IN}=V_{IH} or V_{IL},		90	320			480	Ω
			V_{CC}=6V, V_{EE}=0V, I_{SW}=1mA, V_{IS}=V_{CC} to V_{EE}, V_{IN}=V_{IH} or V_{IL}		55	240			360	Ω
			V_{CC}=4.5V, V_{EE}=-4.5V, I_{SW}=1mA, V_{IS}=V_{CC} to V_{EE}, V_{IN}=V_{IH} or V_{IL}		35	170			255	Ω
	RAIL	$R_{ON(RAIL)}$	V_{CC}=2V, V_{EE}=0V, I_{SW}=100uA, V_{IS}= V_{EE}, V_{IN}=V_{IH} or V_{IL}		85					Ω
			V_{CC}=4.5V, V_{EE}=0V, I_{SW}=1mA, V_{IS}= V_{EE}, V_{IN}=V_{IH} or V_{IL}		35	160			240	Ω
			V_{CC}=6V, V_{EE}=0V, I_{SW}=1mA, V_{IS}= V_{EE}, V_{IN}=V_{IH} or V_{IL}		30	140			210	Ω
			V_{CC}=4.5V, V_{EE}=-4.5V, I_{SW}=1mA, V_{IS}=V_{EE}, V_{IN}=V_{IH} or V_{IL}		20	120			180	Ω
			V_{CC}=2V, V_{EE}=0V, I_{SW}=100uA, V_{IS}= V_{CC}, V_{IN}=V_{IH} or V_{IL}		120					Ω
			V_{CC}=4.5V, V_{EE}=0V, I_{SW}=1mA, V_{IS}= V_{CC}, V_{IN}=V_{IH} or V_{IL}		45	180			270	Ω
			V_{CC}=6V, V_{EE}=0V, I_{SW}=1mA, V_{IS}= V_{CC}, V_{IN}=V_{IH} or V_{IL}		35	160			240	Ω
			V_{CC}=4.5V, V_{EE}=-4.5V, I_{SW}=1mA, V_{IS}=V_{CC} V_{IN}=V_{IH} or V_{IL}		25	135			205	Ω
Maximum On-Resistance Difference Between Any Two Channels		ΔR_{ON}	V_{CC}=2V, V_{EE}=0V V_{IS}=V_{CC} to V_{EE}							Ω
			V_{CC}=4.5V, V_{EE}=0V V_{IS}=V_{CC} to V_{EE}, V_{IN}=V_{IH} or V_{IL},		16					Ω
			V_{CC}=6V, V_{EE}=0V V_{IS}=V_{CC} to V_{EE}		13					Ω
			V_{CC}=4.5V, V_{EE}=-4.5V, V_{IS}=V_{CC} to V_{EE}		9					Ω

Note: When supply voltages (V_{CC} - V_{EE}) near 2.0V the analog switch ON resistance becomes extremely non-linear. When using a supply of 2V, it is recommended to use these devices only for transmitting digital signals

■ DYNAMIC CHARACTERISTICS (GND=0V; t_R=t_F=6ns; C_L=50pF, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	T_A=25°C			T_A=-40°C~+125°C			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
Propagation Delay From (nY) to (nZ) or (nZ) to (ny)	t_{PHL} / t_{PLH}	V_{CC}=2V, V_{EE}=0V, R_L=∞Ω		21	60			90	ns
		V_{CC}=4.5V, V_{EE}=0V, R_L=∞Ω		7	12			18	ns
		V_{CC}=6V, V_{EE}=0V, R_L=∞Ω		6	10			15	ns
		V_{CC}=4.5V, V_{EE}=-4.5V, R_L=∞Ω		3	8			12	ns
Turn-OFF Time From ($\overline{E}$) to (nY) to (nZ)	t_{PHZ} / t_{PLZ}	V_{CC}=2V, V_{EE}=0V		120	220			330	ns
		V_{CC}=4.5V, V_{EE}=0V		32	44			66	ns
		V_{CC}=5V, V_{EE}=0V, C_L=15pF		27					
		V_{CC}=6V, V_{EE}=0V		25	37			56	ns
		V_{CC}=4.5V, V_{EE}=-4.5V		28	39			59	ns
Turn-OFF Time From (nS) to (nY) to (nZ)	t_{PHZ} / t_{PLZ}	V_{CC}=2V, V_{EE}=0V		70	175			265	ns
		V_{CC}=4.5V, V_{EE}=0V		24	35			53	ns
		V_{CC}=5V, V_{EE}=0V, C_L=15pF		19					
		V_{CC}=6V, V_{EE}=0V		19	30			45	ns
		V_{CC}=4.5V, V_{EE}=-4.5V		21	36			54	ns
Turn-ON Time From ($\overline{E}$) to (nY) to (nZ)	t_{PZH} / t_{PZL}	V_{CC}=2V, V_{EE}=0V		140	205			310	ns
		V_{CC}=4.5V, V_{EE}=0V		31	41			62	ns
		V_{CC}=5V, V_{EE}=0V, C_L=15pF		27					
		V_{CC}=6V, V_{EE}=0V		25	35			53	ns
		V_{CC}=4.5V, V_{EE}=-4.5V		27	37			56	ns
Turn-ON Time From (nS) to (nY) to (nZ)	t_{PZH} / t_{PZL}	V_{CC}=2V, V_{EE}=0V		130	175			265	ns
		V_{CC}=4.5V, V_{EE}=0V		27	35			53	ns
		V_{CC}=5V, V_{EE}=0V, C_L=15pF		24					
		V_{CC}=6V, V_{EE}=0V		23	30			45	ns
		V_{CC}=4.5V, V_{EE}=-4.5V		25	34			51	ns

■ OPERATING CHARACTERISTICS (T_A=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
input capacitance	C_{IN}			3.5		pF
switch capacitance	C_{SW}			5		pF
Power Dissipation Capacitance per flip-flop	C_{PD}			13		pF

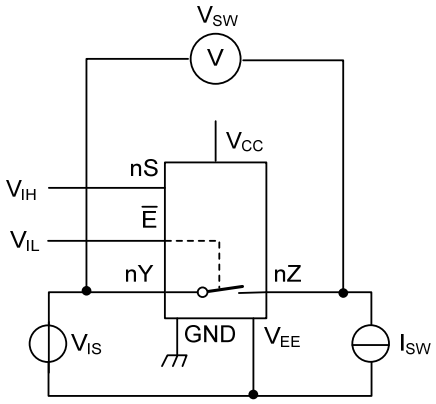
■ ADDITIONAL DYNAMIC CHARACTERISTICS

(GND=0V, C_L=50pF, T_A=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Total Harmonic Distortion	THD	f_i=1kHz, R_L=10kΩ (Figure 5)	V_{IS}=4V(p-p), V_{CC}=2.25V, V_{EE}=-2.25V		0.9		%
			V_{IS}=8V(p-p), V_{CC}=4.5V V_{EE}=-4.5V		0.5		%
		f_i=10kHz, R_L=10kΩ (Figure 5)	V_{IS}=4V(p-p), V_{CC}=2.25V V_{EE}=-2.25V		2.5		%
			V_{IS}=8V(p-p), V_{CC}=4.5V V_{EE}=-4.5V		1.4		%
-3 dB Frequency Response	$f_{(-3dB)}$	R_L=50Ω, C_L=10pF (Note 1) (Figure 6)	V_{CC}=2.25V, V_{EE}=-2.25V		150		MHz
			V_{CC}=4.5V, V_{EE}=-4.5V		160		MHz
Isolation (OFF-state)	α_{iso}	R_L=600Ω, f_i=1MHz (Note 2) (Figure 7)	V_{CC}=2.25V, V_{EE}=-2.25V		-50		dB
			V_{CC}=4.5V, V_{EE}=-4.5V		-50		dB
Crosstalk Voltage	V_{CT}	Between digital input and switch (Peak to peak value) R_L=600Ω, f_i=1MHz $\overline{E}$ or nS square wave between V_{CC} and GND, t_r=t_f=6ns (Figure 8)	V_{CC}=4.5V, V_{EE}=0V		110		mV
			V_{CC}=4.5V, V_{EE}=-4.5V		220		mV
Crosstalk	Xtalk	Between switches R_L=600Ω, f_i=1MHz (Note 2) (Figure 9)	V_{CC}=2.25V, V_{EE}=-2.25V		-60		dB
			V_{CC}=4.5V, V_{EE}=-4.5V		-60		dB

Notes: 1. Adjust input voltage V_{IS} to 0 dBm level at V_{OS} for 1 MHz (0 dBm = 1 mW into 50 Ω).
2. Adjust input voltage V_{IS} to 0 dBm level (0 dBm = 1 mW into 600 Ω).

■ TEST CIRCUIT

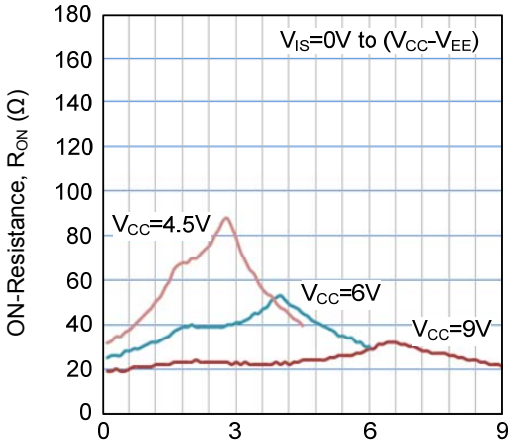


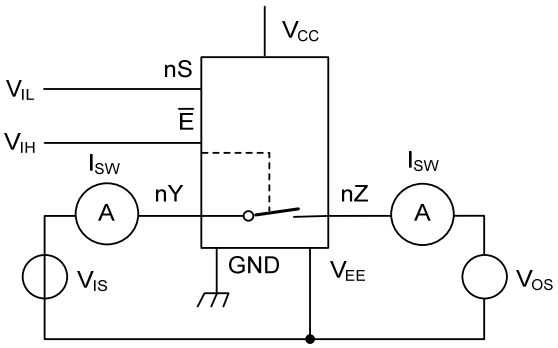
V_{IS}=0V to $(V_{CC}-V_{EE})$

$R_{ON}=\frac{V_{SW}}{I_{SW}}$

Figure 1. Test circuit for measuring R_{ON}

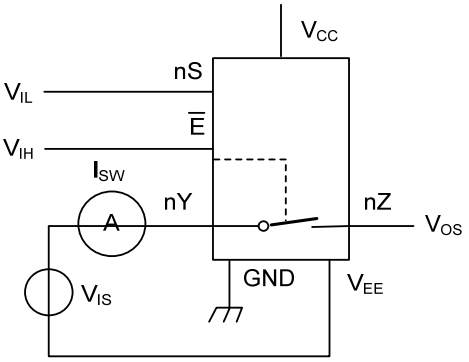
Figure 2. Typical R_{ON} as a function of input voltage V_{IS}





$V_{IS}=V_{CC}$ and $V_{OS}=V_{EE}$
$V_{IS}=V_{EE}$ and $V_{OS}=V_{CC}$

Figure 3. Test circuit for measuring OFF-state leakage current



$V_{IS}=V_{CC}$ and V_{OS}=OPEN
$V_{IS}=V_{EE}$ and V_{OS}=OPEN

Figure 4. Test circuit for measuring ON-state leakage current

■ TEST CIRCUIT (Cont.)

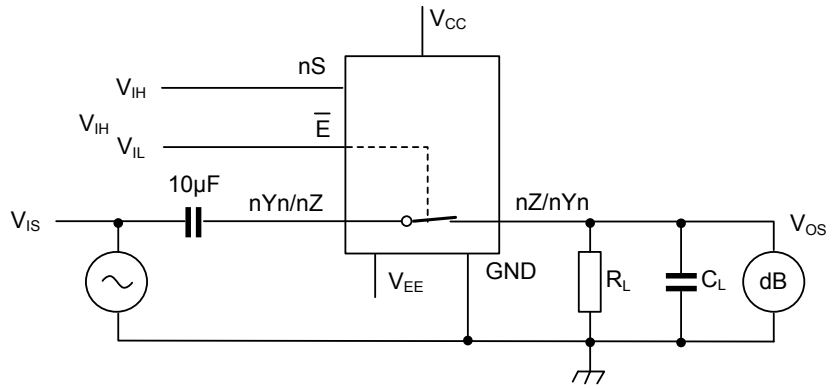
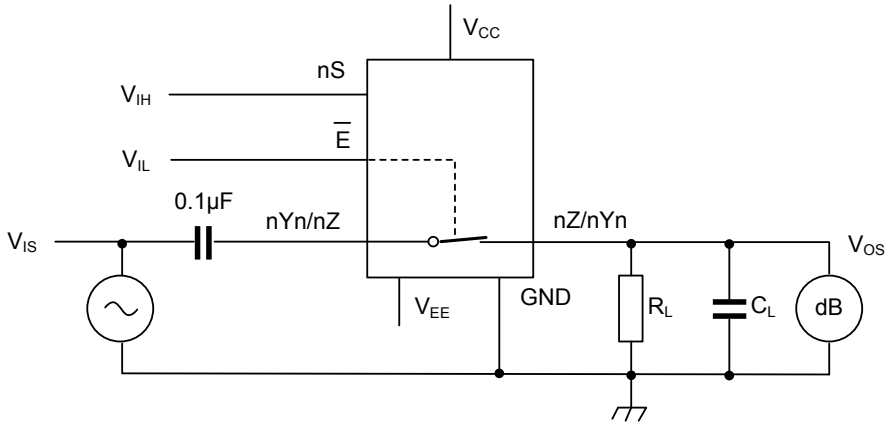
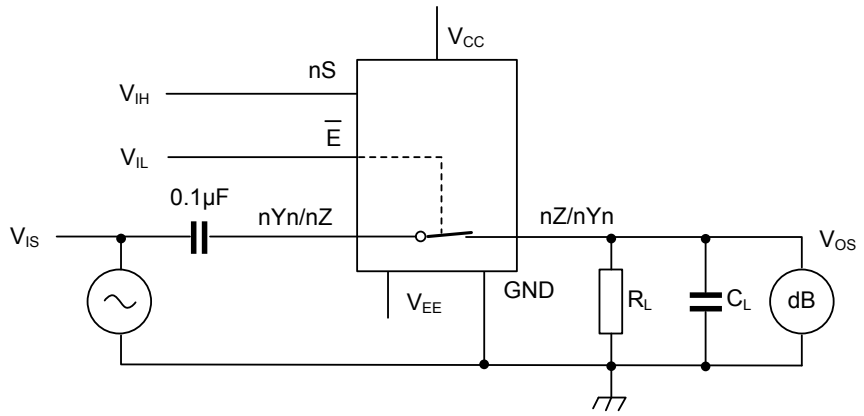


Figure 5. Test circuit for measuring total harmonic distortion



V_{CC}=4.5V; GND=0V, V_{EE}=-4.5V, R_L=50Ω, R_S=1kΩ

Figure 6. -3 dB frequency response



V_{CC}=4.5V; GND=0V, V_{EE}=-4.5V, R_L=600Ω, R_S=1kΩ

Figure 7. Isolation (OFF-state) as a function of frequency

■ TEST CIRCUIT (Cont.)

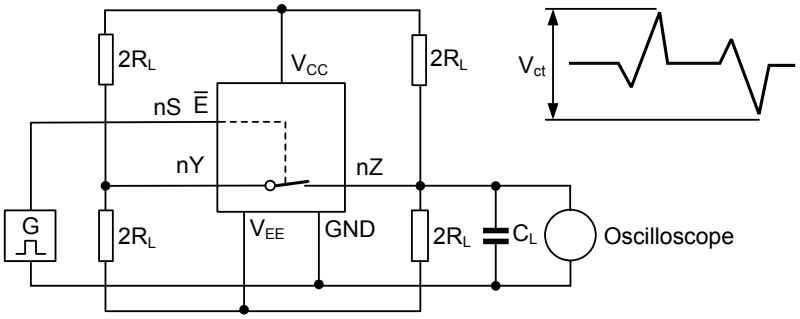


Figure 8. Test circuit for measuring crosstalk voltage (between the digital input and the switch)

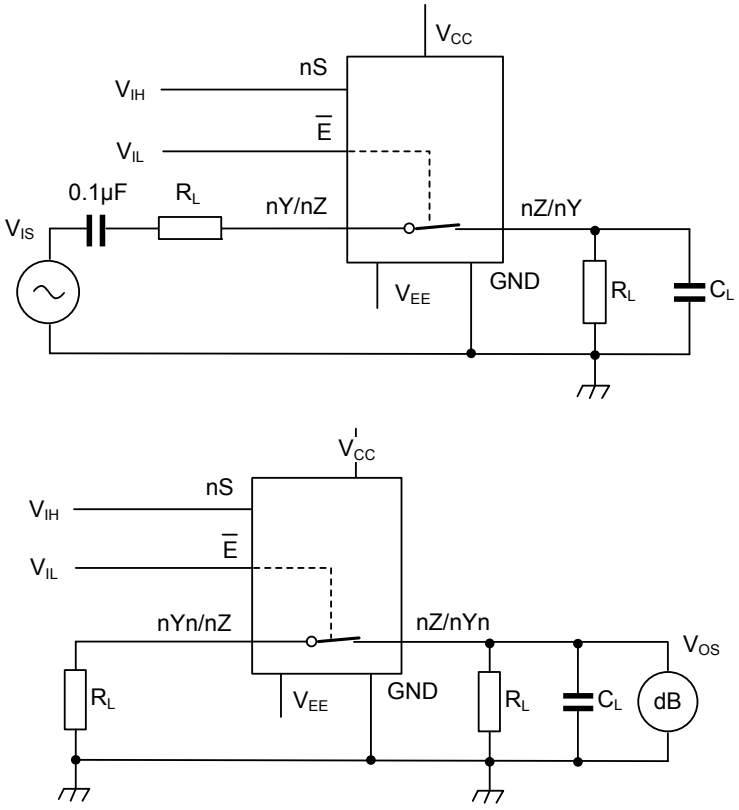


Figure 9. Test circuit for measuring crosstalk (between the switches)

■ TEST CIRCUIT AND WAVEFORMS

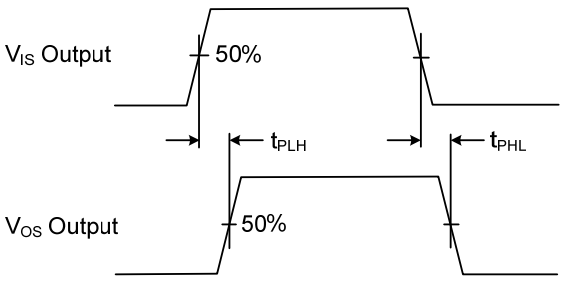


Figure 10. Input (V_{IS}) to Output (V_{OS}) Propagation Delays

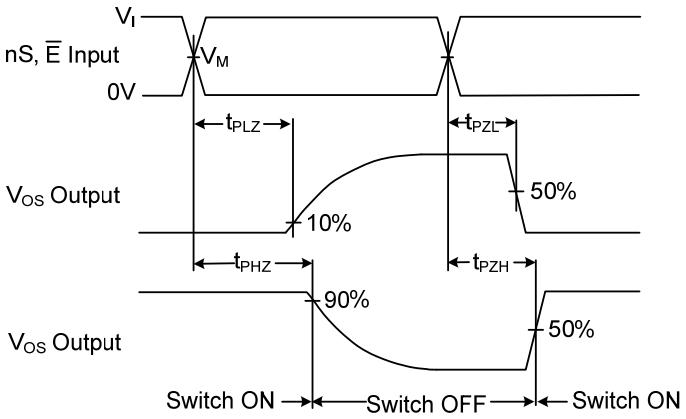
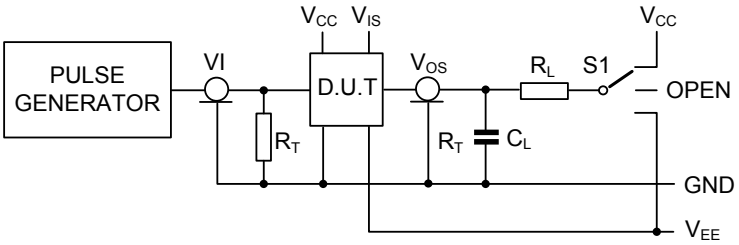
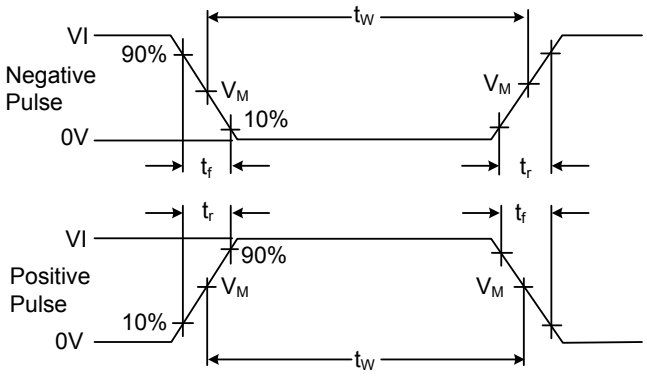


Figure 11. Turn-on and Turn-off Times

V_I	V_M
V_{CC}	0.5 × V_{CC}





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 ZO of the pulse generator.
S1 = Test selection switch

Figure 12. Test Circuit for Measuring Switching Times

TEST	INPUT					OUTPUT		S1 Position
	E	ns	Switch nY (nZ)	t_R, t_F		Switch nY (nZ)		
	V_I		V_{IS}	at f_{MAX}	Other	C_L	R_L	
t_{PHL} / t_{PLH}	V_{CC}		GND to V_{CC}	< 2 ns	6 ns	50 pF	-	OPEN
t_{PHZ} / t_{PZH}	V_{CC}		V_{CC}	< 2 ns	6 ns	50 pF,15 pF	1 kΩ	V_{EE}
t_{PLZ} / t_{PZL}	V_{CC}		V_{EE}	< 2 ns	6 ns	50 pF, 15 pF	1 kΩ	V_{CC}

Note: t_r = t_f = 6ns. when measuring fmax, there is no constraint to tr and tf with 50 % duty factor.