



## UCD4060B

Preliminary

CMOS IC

### CMOS 14-Stage Ripple-Carry Binary Counter/Divider and Oscillator

#### DESCRIPTION

**UCD4060B** consists of an oscillator section and 14 ripple-carry binary counter stages. The oscillator configuration allows design of either  $R_C$  or crystal oscillator circuits. A RESET input is provided which resets the counter to the all-O's state and disables the oscillator. A high level on the RESET line accomplishes the reset function. All counter stages are master-slave flip-flops. The state of the counter is advanced one step in binary order on the negative transition of  $\Phi I$  and  $\Phi O$ . All inputs and outputs are fully buffered. Schmitt trigger action on the input-pulse line permits unlimited input-pulse rise and fall times.

#### FEATURES

- \* 12MHz clock rate at 15V
- \* Common reset
- \* Fully static operation
- \* Buffered inputs and outputs
- \* Schmitt trigger input-pulse line

#### Oscillator Features

- \* All active components on chip
- \* RC or crystal oscillator configuration
- \* RC oscillator frequency of 690 kHz min. at 15V

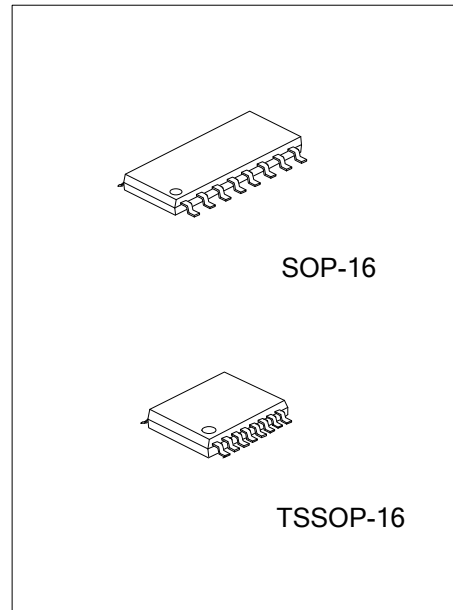
#### APPLICATIONS

- \* Control counters
- \* Timers
- \* Frequency dividers
- \* Time-delay circuits

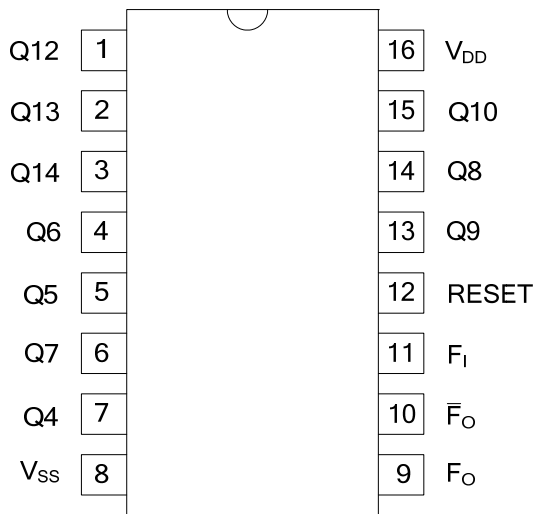
#### ORDERING INFORMATION

Ordering Number		Package	Packing
Lead Free	Halogen Free		
UCD4060BL-S16-R	UCD4060BG-S16-R	SOP-16	Tape Reel
UCD4060BL-S16-T	UCD4060BG-S16-T	SOP-16	Tube
UCD4060BL-P16-R	UCD4060BG-P16-R	TSSOP-16	Tape Reel
UCD4060BL-P16-T	UCD4060BG-P16-T	TSSOP-16	Tube

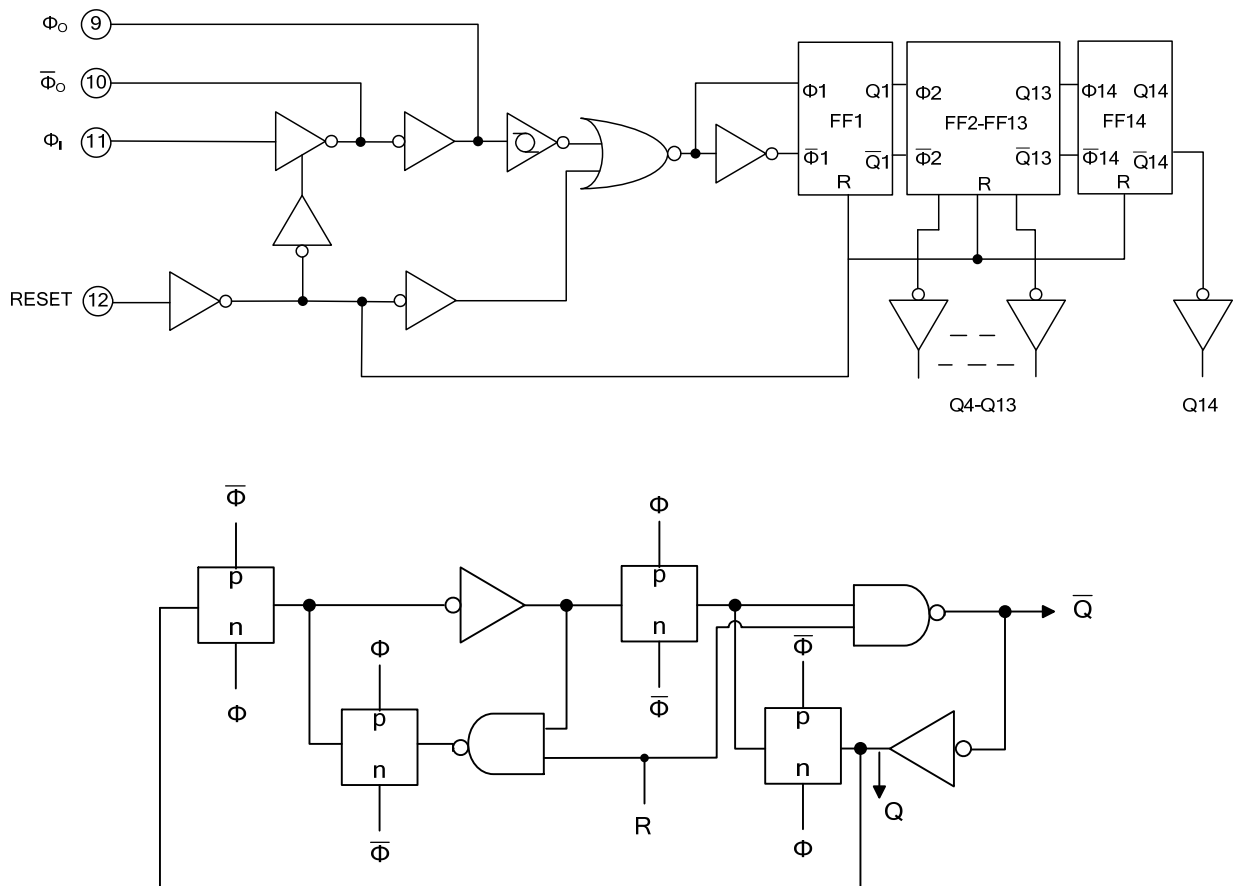
<p>UCD4060BL-S16-R</p>	<p>(1) Packing Type (2) Package Type (3) Lead Free</p>	<p>(1) T: Tube, R: Tape Reel (2) S16: SOP-16, TSSOP-16 (3) L: Lead Free, G: Halogen Free</p>
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■ PIN CONFIGURATION



■ LOGIC DIAGRAM



■ ABSOLUTE MAXIMUM RATING ( $T_A=25^{\circ}\text{C}$ , unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	$V_{DD}$	-0.5 ~ 20	V
Input Voltage	$V_{IN}$	-0.5 ~ $V_{CC}+0.5$	V
Output Voltage	$V_{OUT}$	-0.5 ~ $V_{CC}+0.5$	V
Input Clamp Current ( $V_{IN}<0$ , or $V_{IN}>V_{DD}$ )	$I_{IK}$	$\pm 10$	mA
Power Dissipation	$T_A=-40^{\circ}\text{C}\sim+85^{\circ}\text{C}$ $P_D$	500	mW
Operating Temperature	$T_{OPR}$	-40~+85	$^{\circ}\text{C}$
Storage Temperature	$T_{STG}$	-65~+150	$^{\circ}\text{C}$

Notes: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
 2. 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.

■ THERMAL DATA

PARAMETER	SYMBOL	RATINGS	UNIT
Junction to Ambient	SOP-16	90	$^{\circ}\text{C}/\text{W}$
	TSSOP-16	110	

■ RECOMMENDED OPERATING COMDITIONS

PARAMETER	SYMBOL	CONDITIONS	MIN	TPY	MAX	UNIT
Supply Voltage	$V_{DD}$		3		18	V
Input-Pulse Width	$t_w$	$V_{DD}=5\text{V}$	100			ns
		$V_{DD}=10\text{V}$	40			
		$V_{DD}=15\text{V}$	30			
Input-Pulse Frequency	$f_{\phi I}$	$V_{DD}=5\text{V}$			3.5	MHz
		$V_{DD}=10\text{V}$			8	
		$V_{DD}=15\text{V}$			12	
Input-Pulse Rise and Fall Time	$t_r / t_f$	$V_{DD}=5\text{V}$	Unlimited			$\mu\text{s}$
		$V_{DD}=10\text{V}$				
		$V_{DD}=15\text{V}$				
Reset Pulse Width	$t_w$	$V_{DD}=5\text{V}$	120			ns
		$V_{DD}=10\text{V}$	60			
		$V_{DD}=15\text{V}$	40			

■ ELECTRICAL CHARACTERISTICS (T<sub>A</sub>=25°C, unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	MIN	TPY	MAX	UNIT
Quiescent Supply Current	I <sub>CC</sub>	V <sub>IN</sub> =0, 5V, V <sub>DD</sub> =5V		0.04	5	μA
		V <sub>IN</sub> =0, 10V, V <sub>DD</sub> =10V		0.04	10	
		V <sub>IN</sub> =0, 15V, V <sub>DD</sub> =15V		0.04	20	
		V <sub>IN</sub> =0, 20V, V <sub>DD</sub> =20V		0.08	100	
Output Low (Sink) Current	I <sub>OL</sub>	V <sub>OUT</sub> =0.4V, V <sub>IN</sub> =0, 5V, V <sub>DD</sub> =5V	0.51	1		mA
		V <sub>OUT</sub> =0.5V, V <sub>IN</sub> =0, 10V, V <sub>DD</sub> =10V	1.3	2.6		
		V <sub>OUT</sub> =1.5V, V <sub>IN</sub> =0, 15V, V <sub>DD</sub> =15V	3.4	6.8		
Output High (Source) Current	I <sub>OH</sub>	V <sub>OUT</sub> =4.6V, V <sub>IN</sub> =0, 5V, V <sub>DD</sub> =5V	-0.51	-1		mA
		V <sub>OUT</sub> =2.5V, V <sub>IN</sub> =0, 5V, V <sub>DD</sub> =5V	-1.6	-3.2		
		V <sub>OUT</sub> =9.5V, V <sub>IN</sub> =0, 10V, V <sub>DD</sub> =10V	-1.3	-2.6		
		V <sub>OUT</sub> =13.5V, V <sub>IN</sub> =0, 15V, V <sub>DD</sub> =15V	-3.4	-6.8		
Output Voltage: Low-Level	V <sub>OL</sub>	V <sub>IN</sub> = 0, 5V, V <sub>DD</sub> =5V		0	0.05	V
		V <sub>IN</sub> = 0, 10V, V <sub>DD</sub> =10V		0	0.05	
		V <sub>IN</sub> = 0, 15V, V <sub>DD</sub> =15V		0	0.05	
Output Voltage: High-Level	V <sub>OH</sub>	V <sub>IN</sub> = 0, 5V, V <sub>DD</sub> =5V	4.95	5		V
		V <sub>IN</sub> = 0, 10V, V <sub>DD</sub> =10V	9.95	10		
		V <sub>IN</sub> = 0, 15V, V <sub>DD</sub> =15V	14.95	15		
Input Low Voltage	V <sub>IL</sub>	V <sub>OUT</sub> =0.5, 4.5V, V <sub>DD</sub> =5V			1.5	V
		V <sub>OUT</sub> =1, 9V, V <sub>DD</sub> =10V			3	
		V <sub>OUT</sub> =1.5, 13.5V, V <sub>DD</sub> =15V			4	
Input High Voltage	V <sub>IH</sub>	V <sub>OUT</sub> =0.5, 4.5V, V <sub>DD</sub> =5V	3.5			V
		V <sub>OUT</sub> =1, 9V, V <sub>DD</sub> =10V	7			
		V <sub>OUT</sub> =1.5, 13.5V, V <sub>DD</sub> =15V	11			
Input Leakage Current	I <sub>I(LEAK)</sub>	V <sub>IN</sub> =0, 18V, V <sub>DD</sub> =18V		±10 <sup>-5</sup>	±0.1	μA

■ SWITCHING CHARACTERISTICS (T<sub>A</sub>=25°C, Input t<sub>r</sub>/ t<sub>f</sub>=20ns, C<sub>L</sub>=50pF, R<sub>L</sub>=200kΩ)

PARAMETER	SYMBOL	CONDITIONS	MIN	TPY	MAX	UNIT
<b>CLOCKED OPERATION</b>						
Propagation Delay Time, Φ <sub>I</sub> to Q <sub>4</sub>	t <sub>PLH</sub> / t <sub>PHL</sub>	V <sub>DD</sub> =5V		370	740	ns
		V <sub>DD</sub> =10V		150	300	
		V <sub>DD</sub> =15V		100	200	
Propagation Delay Time, Q <sub>n</sub> to Q <sub>n+1</sub>	t <sub>PLH</sub> / t <sub>PHL</sub>	V <sub>DD</sub> =5V		100	200	ns
		V <sub>DD</sub> =10V		50	100	
		V <sub>DD</sub> =15V		40	80	
Transition Time	t <sub>THL</sub> / t <sub>TLH</sub>	V <sub>DD</sub> =5V		100	200	ns
		V <sub>DD</sub> =10V		50	100	
		V <sub>DD</sub> =15V		40	80	
Maximum Input-Pulse Frequency	f Φ <sub>I</sub>	V <sub>DD</sub> =5V	3.5	7		MHz
		V <sub>DD</sub> =10V	8	16		
		V <sub>DD</sub> =15V	12	24		
Minimum Input-Pulse Width	t <sub>w</sub>	V <sub>DD</sub> =5V		50	100	ns
		V <sub>DD</sub> =10V		20	40	
		V <sub>DD</sub> =15V		15	30	
Input-Pulse Rise and Fall Time	t <sub>r</sub> Φ / t <sub>f</sub> Φ	V <sub>DD</sub> =5V	Unlimited			
		V <sub>DD</sub> =10V				
		V <sub>DD</sub> =15V				
Average Input Capacitance	C <sub>I</sub>	Any Input		5	7.5	pF

■ SWITCHING CHARACTERISTICS(Cont.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TPY	MAX	UNIT	
<b>RESET OPERATION</b>							
Propagation Delay Time	$t_{PLH} / t_{PHL}$	$V_{DD}=5V$		180	360	ns	
		$V_{DD}=10V$		80	160		
		$V_{DD}=15V$		50	100		
Minimum Reset Pulse Width	$t_{WR}$	$V_{DD}=5V$		60	120	ns	
		$V_{DD}=10V$		30	60		
		$V_{DD}=15$		20	40		
<b>RC OPERATION</b>							
Variation of Frequency		$C_X=200pF,$ $R_S=560k\Omega,$ $R_X=50k\Omega$	$V_{DD}=5V$		$23\pm 10\%$	kHz	
			$V_{DD}=10V$		$24\pm 10\%$		
			$V_{DD}=15V$		$25\pm 10\%$		
Variation of Frequency with voltage change		$C_X=200pF,$ $R_S=560k\Omega,$ $R_X=50k\Omega$	$V_{DD}=5V\sim 10V$		1.5	kHz	
			$V_{DD}=10V\sim 15V$		0.5		
$R_X$ max			$C_X=10Mf, V_{DD}=5V$		20	M $\Omega$	
			$C_X=50\mu F, V_{DD}=10V$		20		
			$C_X=10\mu F, V_{DD}=15V$		10		
$C_X$ max			$R_X=500k\Omega, V_{DD}=5V$		1000	$\mu F$	
			$R_X=300k\Omega, V_{DD}=10V$		50		
			$R_X=300k\Omega, V_{DD}=15V$		50		
Maximum Oscillator Frequency		$C_X=15pF,$ $R_S=30k\Omega,$ $R_X=5k\Omega$	$V_{DD}=10V$	530	650	810	kHz
			$V_{DD}=15$	690	800	940	
Drive Current at Pin 9	$I_{OL}$		$V_O=0.4V, V_{DD}=5V$	0.16	0.35	mA	
			$V_O=0.5V, V_{DD}=10V$	0.42	0.8		
			$V_O=1.5V, V_{DD}=15$	1	2		
	$I_{OH}$			$V_O=4.6V, V_{DD}=5V$	-0.16	-0.35	mA
				$V_O=9.5V, V_{DD}=10V$	-0.42	-0.8	
				$V_O=13.5V, V_{DD}=15$	-1	-2	

■ TEST CIRCUIT AND WAVEFORMS

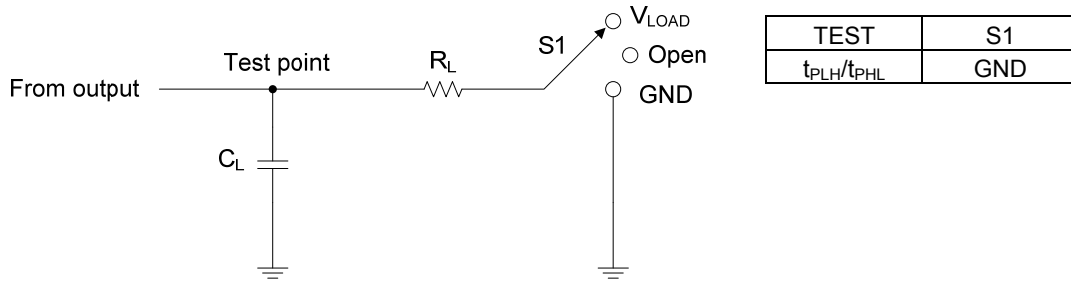


Fig. 1 Test Circuit

Inputs		$V_M$	$V_{LOAD}$	$C_L$	$R_L$
$V_{IN}$	$t_r, t_f$				
$V_{CC}$	20 ns	$V_{CC}/2$	$V_{CC}$	50 pF	200 K $\Omega$

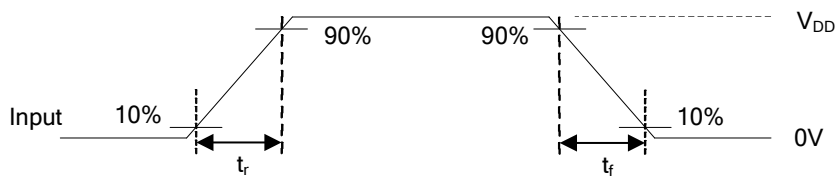


Fig. 2 Voltage Waveforms Input Rise And Fall Times

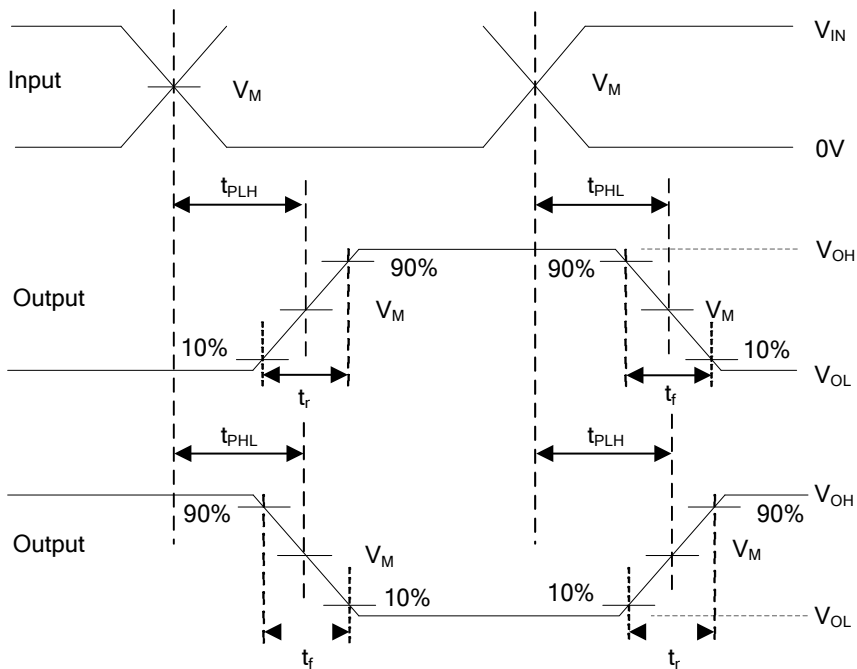


Fig. 3 Voltage Waveforms Propagation Delay And Output Transition Times

Notes: 1.  $C_L$  includes probe and jig capacitance.  
 2. All input pulses are supplied by generators having the following characteristics: PRR  $\leq$  1MHz,  $Z_O = 50\Omega$ .

■ TEST CIRCUIT AND WAVEFORMS(Cont.)

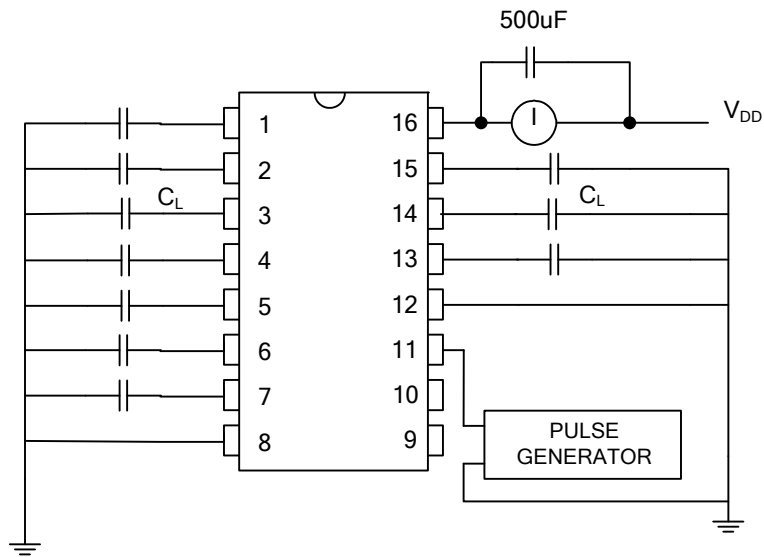


Fig. 4 Dynamic Power Dissipation Test Circuit

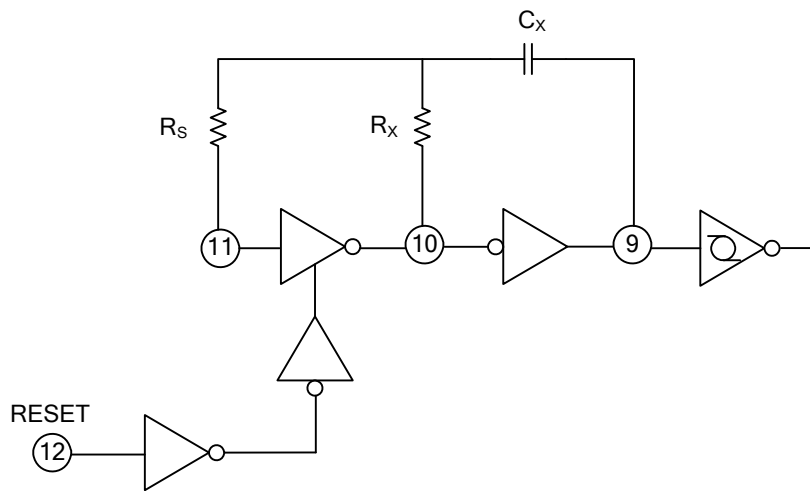


Fig. 5 Typical RC Circuit

■ TEST CIRCUIT AND WAVEFORMS(Cont.)

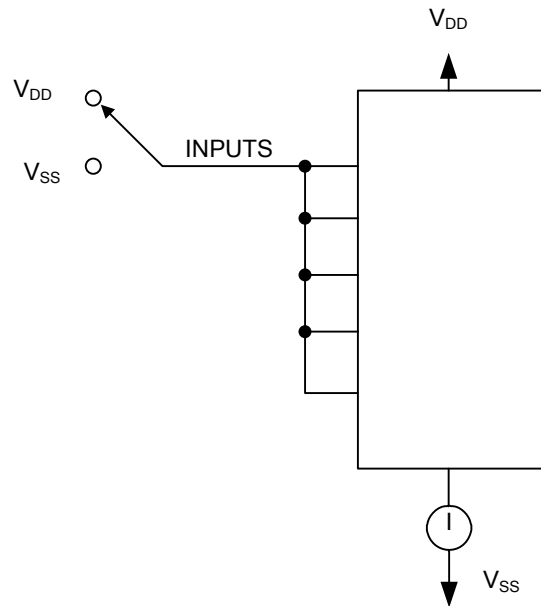


Fig. 6 Quiescent device current test circuit

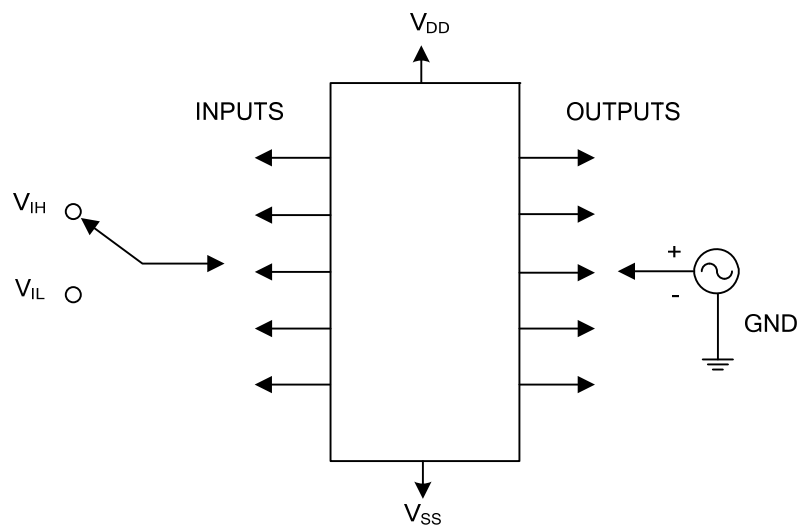
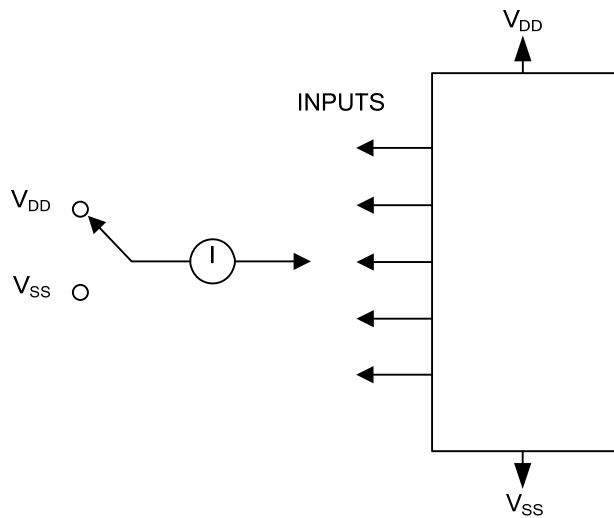


Fig. 7 Input voltage test circuit



## ■ TEST CIRCUIT AND WAVEFORMS(Cont.)

**Fig. 8 Input current test circuit**

Note: Measure inputs sequentially, to both  $V_{DD}$  and  $V_{SS}$ ; Connect all unused inputs to either  $V_{DD}$  or  $V_{SS}$ .

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