

# 14-STAGE ASYNCHRONOUS BINARY COUNTERS AND OSCILLATORS

SCLS161B – DECEMBER 1982 – REVISED MAY 1997

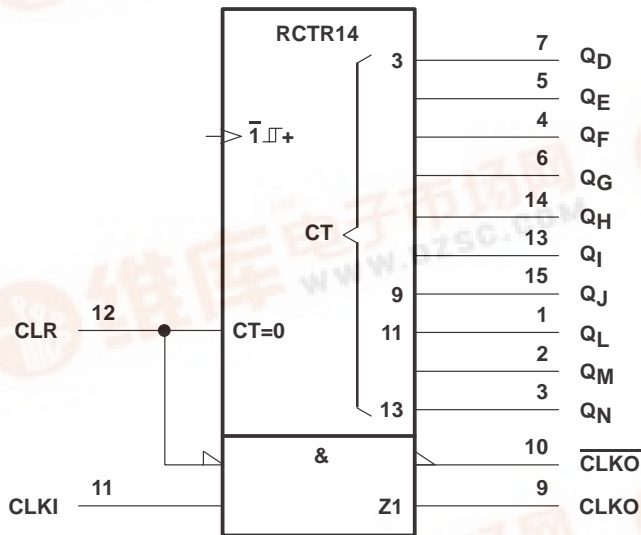
- Allow Design of Either RC or Crystal Oscillator Circuits
- Package Options Include Plastic Small-Outline (D) and Ceramic Flat (W) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs

## description

The 'HC4060 consist of an oscillator section and 14 ripple-carry binary counter stages. The oscillator configuration allows design of either RC or crystal-oscillator circuits. A high-to-low transition on the clock (CLKI) input increments the counter. A high level at the clear (CLR) input disables the oscillator ( $\overline{\text{CLKO}}$  goes high and CLKO goes low) and resets the counter to zero (all Q outputs low).

The SN54HC4060 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74HC4060 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

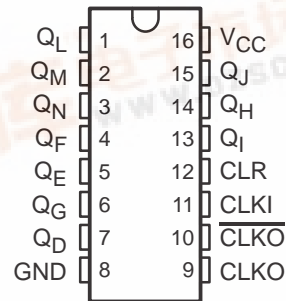
## logic symbol†



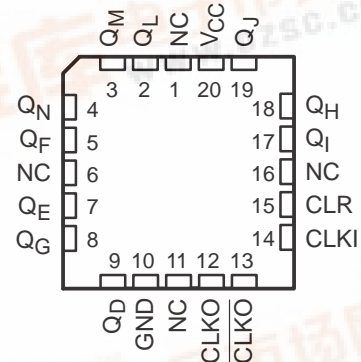
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

Pin numbers shown are for the D, J, N, and W packages.

SN54HC4060 ... J OR W PACKAGE  
SN74HC4060 ... D OR N PACKAGE  
(TOP VIEW)

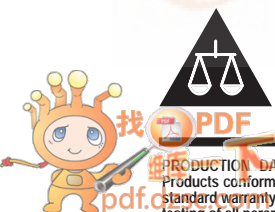


SN54HC4060 ... FK PACKAGE  
(TOP VIEW)



NC – No internal connection

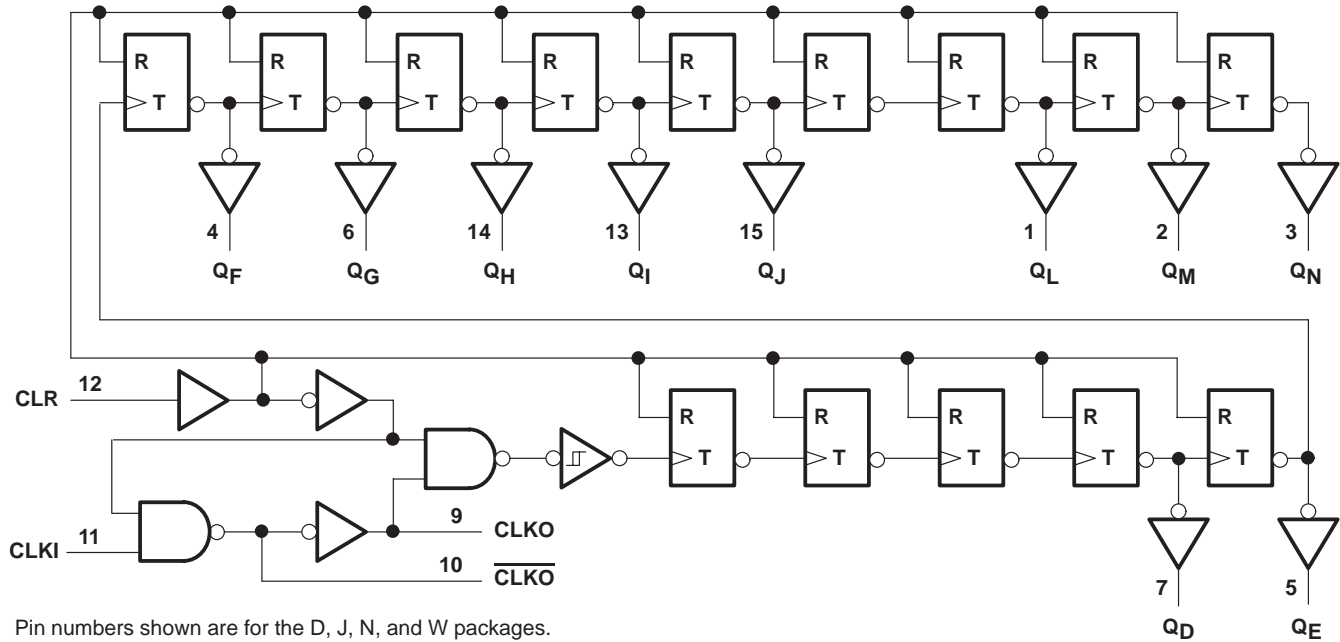
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# SN54HC4060, SN74HC4060 14-STAGE ASYNCHRONOUS BINARY COUNTERS AND OSCILLATORS

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## logic diagram (positive logic)



Pin numbers shown are for the D, J, N, and W packages.

## absolute maximum ratings over operating free-air temperature range†

Supply voltage range, $V_{CC}$ .....	-0.5 V to 7 V
Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) (see Note 1) .....	$\pm 20$ mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) (see Note 1) .....	$\pm 20$ mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....	$\pm 25$ mA
Continuous current through $V_{CC}$ or GND .....	$\pm 50$ mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): D package .....	113°C/W
N package .....	78°C/W
Storage temperature range, $T_{stg}$ .....	-65°C to 150°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The package thermal impedance is calculated in accordance with JESD 51, except for through-hole packages, which use a trace length of zero.

# SN54HC4060, SN74HC4060

## 14-STAGE ASYNCHRONOUS BINARY COUNTERS AND OSCILLATORS

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### recommended operating conditions

		SN54HC4060			SN74HC4060			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub>	Supply voltage	2	5	6	2	5	6	V
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 2 V		1.5	1.5		V	
		V <sub>CC</sub> = 4.5 V		3.15	3.15			
		V <sub>CC</sub> = 6 V		4.2	4.2			
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 2 V		0	0.5	0	0.5	V
		V <sub>CC</sub> = 4.5 V		0	1.35	0	1.35	
		V <sub>CC</sub> = 6 V		0	1.8	0	1.8	
V <sub>I</sub>	Input voltage	0	V <sub>CC</sub>		0	V <sub>CC</sub>		V
V <sub>O</sub>	Output voltage	0	V <sub>CC</sub>		0	V <sub>CC</sub>		V
t <sub>t</sub>	Input transition (rise and fall) time	V <sub>CC</sub> = 2 V		0	1000	0	1000	ns
		V <sub>CC</sub> = 4.5 V		0	500	0	500	
		V <sub>CC</sub> = 6 V		0	400	0	400	
T <sub>A</sub>	Operating free-air temperature	-55		125	-40		85	°C

### electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS		V <sub>CC</sub>	T <sub>A</sub> = 25°C			SN54HC4060		SN74HC4060		UNIT
					MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V <sub>OH</sub>	All outputs	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -20 μA	2 V	1.9	1.998		1.9		1.9	V	
				4.5 V	4.4	4.499		4.4		4.4		
				6 V	5.9	5.999		5.9		5.9		
	Q outputs	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -4 mA	4.5 V	3.98	4.3		3.7		3.84		
I <sub>OH</sub> = -5.2 mA			6 V	5.48	5.8		5.2		5.34			
V <sub>OL</sub>	All outputs	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 20 μA	2 V		0.002	0.1		0.1		V	
				4.5 V		0.001	0.1		0.1			0.1
				6 V		0.001	0.1		0.1			0.1
	Q outputs	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 4 mA	4.5 V		0.17	0.26		0.4			0.33
I <sub>OL</sub> = 5.2 mA			6 V		0.15	0.26		0.4		0.33		
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or 0			6 V		±0.1	±100		±1000		±1000	nA
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or 0, I <sub>O</sub> = 0			6 V			8		160		80	μA
C <sub>i</sub>				2 V to 6 V		3	10		10		10	pF

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## 14-STAGE ASYNCHRONOUS BINARY COUNTERS AND OSCILLATORS

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**timing requirements over recommended operating free-air temperature range (unless otherwise noted)**

		V <sub>CC</sub>	T <sub>A</sub> = 25°C		SN54HC4060		SN74HC4060		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f <sub>clock</sub>	Clock frequency	2 V	0	5.5	0	3.7	0	4.3	MHz
		4.5 V	0	28	0	19	0	22	
		6 V	0	33	0	22	0	25	
t <sub>w</sub>	Pulse duration	CLKI high or low	2 V	90		135		115	ns
			4.5 V	18		27		23	
			6 V	15		23		20	
	CLR high	2 V	90		135		115		
		4.5 V	18		27		23		
		6 V	15		23		20		
t <sub>su</sub>	Setup time, CLR inactive before CLKI↓	2 V	160		240		200	ns	
		4.5 V	32		48		40		
		6 V	27		41		34		

**switching characteristics over recommended operating free-air temperature range, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub>	T <sub>A</sub> = 25°C			SN54HC4060		SN74HC4060		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f <sub>max</sub>			2 V	5.5	10		3.7		4.3	MHz	
			4.5 V	28	45		19		22		
			6 V	33	53		22		25		
t <sub>pd</sub>	CLKI	Q <sub>D</sub>	2 V		240	490		735		615	ns
			4.5 V		58	98		147		123	
			6 V		42	83		125		105	
t <sub>PHL</sub>	CLR	Any Q	2 V		66	140		210		175	ns
			4.5 V		18	28		42		35	
			6 V		14	24		36		30	
t <sub>t</sub>		Any	2 V		28	75		110		95	ns
			4.5 V		8	15		22		19	
			6 V		6	30		19		16	

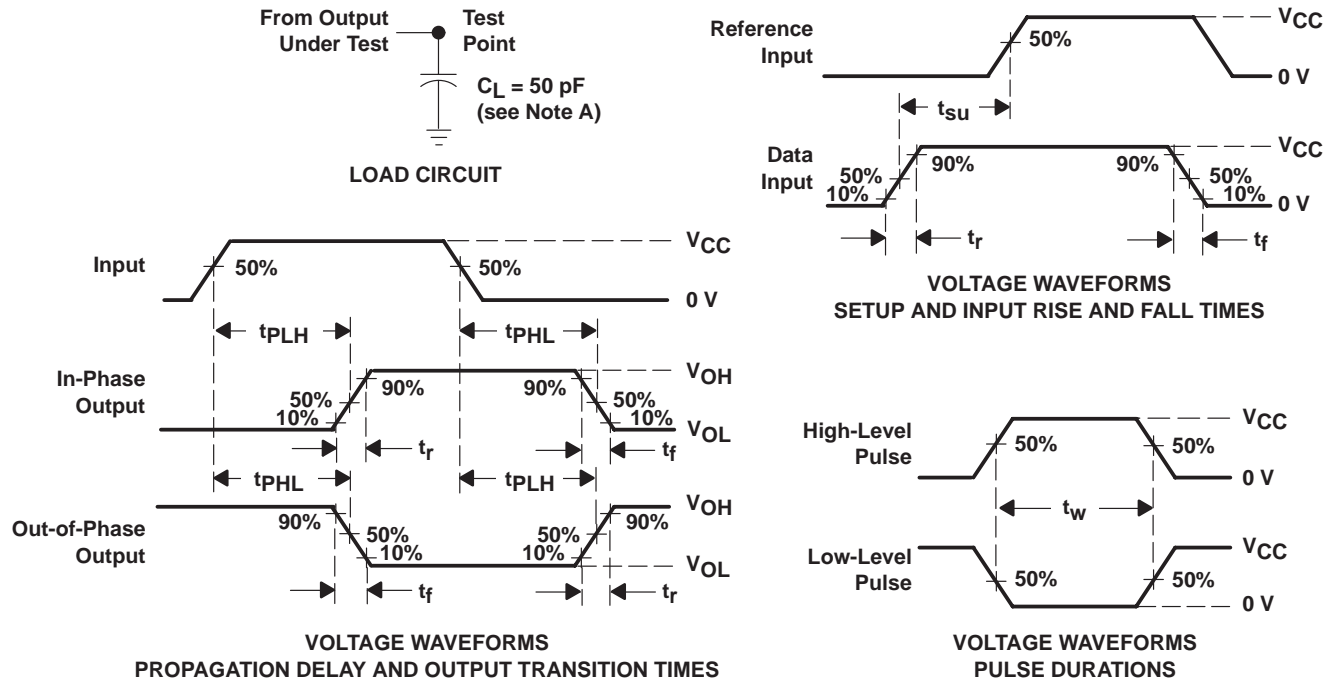
**operating characteristics, T<sub>A</sub> = 25°C**

PARAMETER	TEST CONDITIONS	TYP	UNIT
C <sub>pd</sub> Power dissipation capacitance	No load	88	pF

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## PARAMETER MEASUREMENT INFORMATION



- NOTES:
- A.  $C_L$  includes probe and test-fixture capacitance.
  - B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1$  MHz,  $Z_O = 50 \Omega$ ,  $t_r = 6$  ns,  $t_f = 6$  ns.
  - C. For clock inputs,  $f_{max}$  is measured when the input duty cycle is 50%.
  - D. The outputs are measured one at a time with one input transition per measurement.
  - E.  $t_{pLH}$  and  $t_{pHL}$  are the same as  $t_{pd}$ .

**Figure 1. Load Circuit and Voltage Waveforms**

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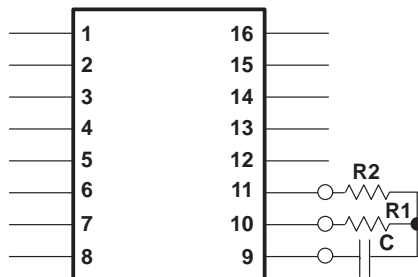
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## CONNECTING AN RC OSCILLATOR CIRCUIT TO THE 'HC4060

The 'HC4060 consist of an oscillator section and 14 ripple-carry binary counter stages. The oscillator configuration allows design of either RC or crystal-oscillator circuits.

When an RC oscillator circuit is implemented, two resistors and a capacitor are required. The components are attached to the terminals as shown below:



To determine the values of capacitance and resistance necessary to obtain a specific oscillator frequency (f), use this formula:

$$f = \frac{1}{2(R1)(C)\left(\frac{0.405 R2}{R1+R2} + 0.693\right)}$$

If  $R2 \gg R1$  (i.e.,  $R2 = 10R1$ ), the above formula simplifies to:

$$f = \frac{0.455}{RC}$$

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