

# SN54HC4040, SN74HC4040 12-BIT ASYNCHRONOUS BINARY COUNTERS

SCLS160B – DECEMBER 1982 – REVISED MAY 1997

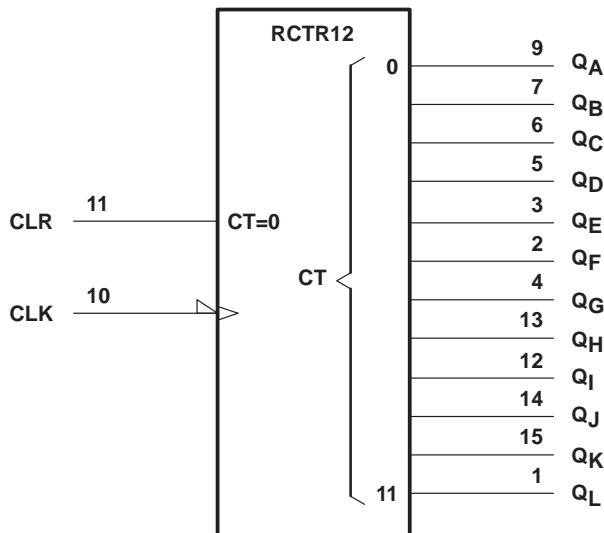
- Package Options Include Plastic Small-Outline (D), Shrink Small-Outline (DB), Thin Shrink Small-Outline (PW), and Ceramic Flat (W) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs

## description

The 'HC4040 are 12-stage asynchronous binary counters with the outputs of all stages available externally. A high level at the clear (CLR) input asynchronously clears the counter and resets all outputs low. The count is advanced on a high-to-low transition at the clock (CLK) input. Applications include time-delay circuits, counter controls, and frequency-dividing circuits.

The SN54HC4040 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74HC4040 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

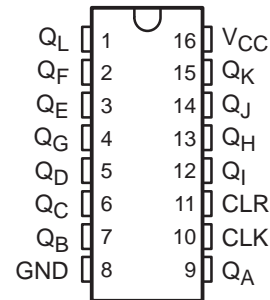
## logic symbol†



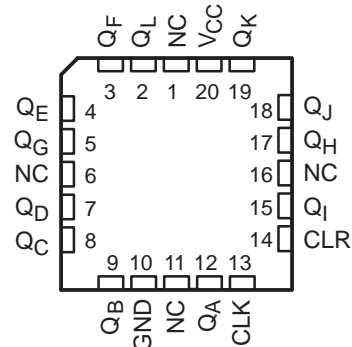
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

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

## SN54HC4040 . . . J OR W PACKAGE SN74HC4040 . . . D, DB, N, OR PW PACKAGE (TOP VIEW)



## SN54HC4040 . . . FK PACKAGE (TOP VIEW)



NC – No internal connection



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS  
INSTRUMENTS**

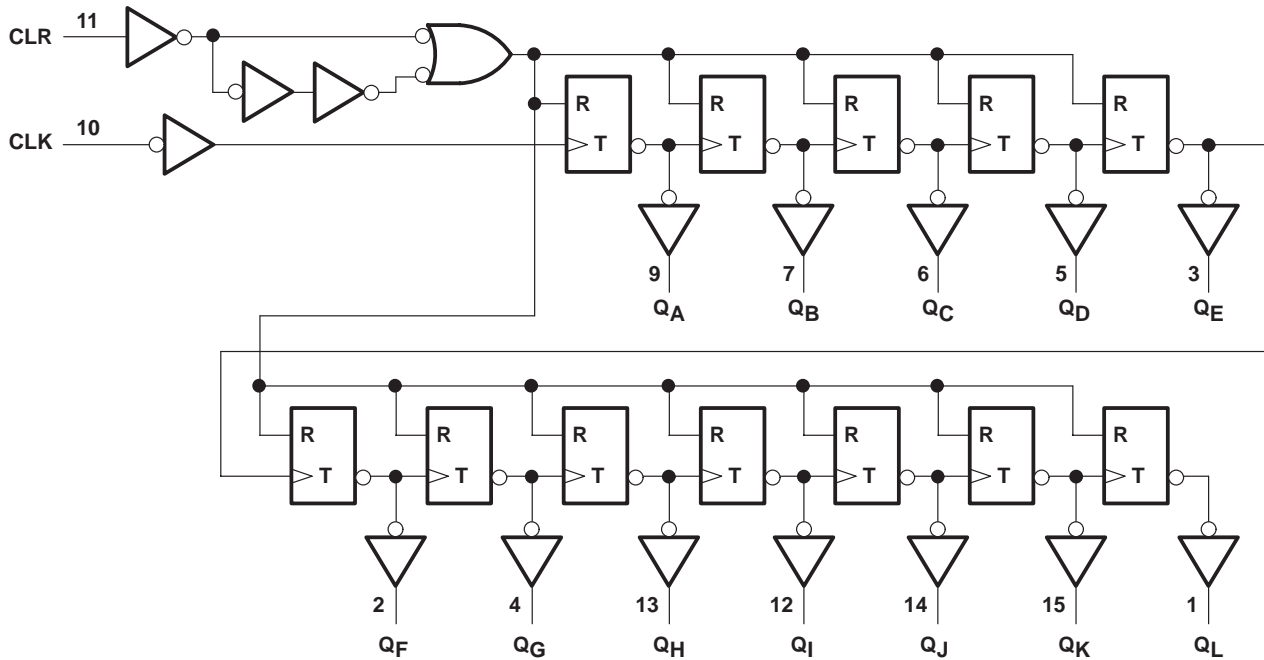
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## logic diagram (positive logic)



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

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

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
DB package .....	131°C/W
N package .....	78°C/W
PW package .....	149°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.

# SN54HC4040, SN74HC4040

## 12-BIT ASYNCHRONOUS BINARY COUNTERS

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### recommended operating conditions

		SN54HC4040			SN74HC4040			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> <sup>†</sup>	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

<sup>†</sup> If this device is used in the threshold region (from V<sub>ILmax</sub> = 0.5 V to V<sub>IHmin</sub> = 1.5 V), there is a potential to go into the wrong state from induced grounding, causing double clocking. Operating with the inputs at t<sub>t</sub> = 1000 ns and V<sub>CC</sub> = 2 V does not damage the device; however, functionally, the CLK inputs are not ensured while in the shift, count, or toggle operating modes.

### 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			SN54HC4040		SN74HC4040		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V <sub>OH</sub>	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			
		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>	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	0.1	V		
			4.5 V	0.001	0.1	0.1	0.1			
			6 V	0.001	0.1	0.1	0.1			
		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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SCLS160B – DECEMBER 1982 – REVISED MAY 1997

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

		V <sub>CC</sub>	T <sub>A</sub> = 25°C		SN54HC4040		SN74HC4040		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	CLK high or low	2 V	90		135		115	ns
			4.5 V	18		27		23	
			6 V	15		23		20	
	CLR high	2 V	70		105		90		
		4.5 V	14		21		18		
		6 V	12		18		15		
t <sub>su</sub>	Setup time, CLR inactive before CLK↓	2 V	60		90		75	ns	
		4.5 V	12		18		15		
		6 V	10		15		13		

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

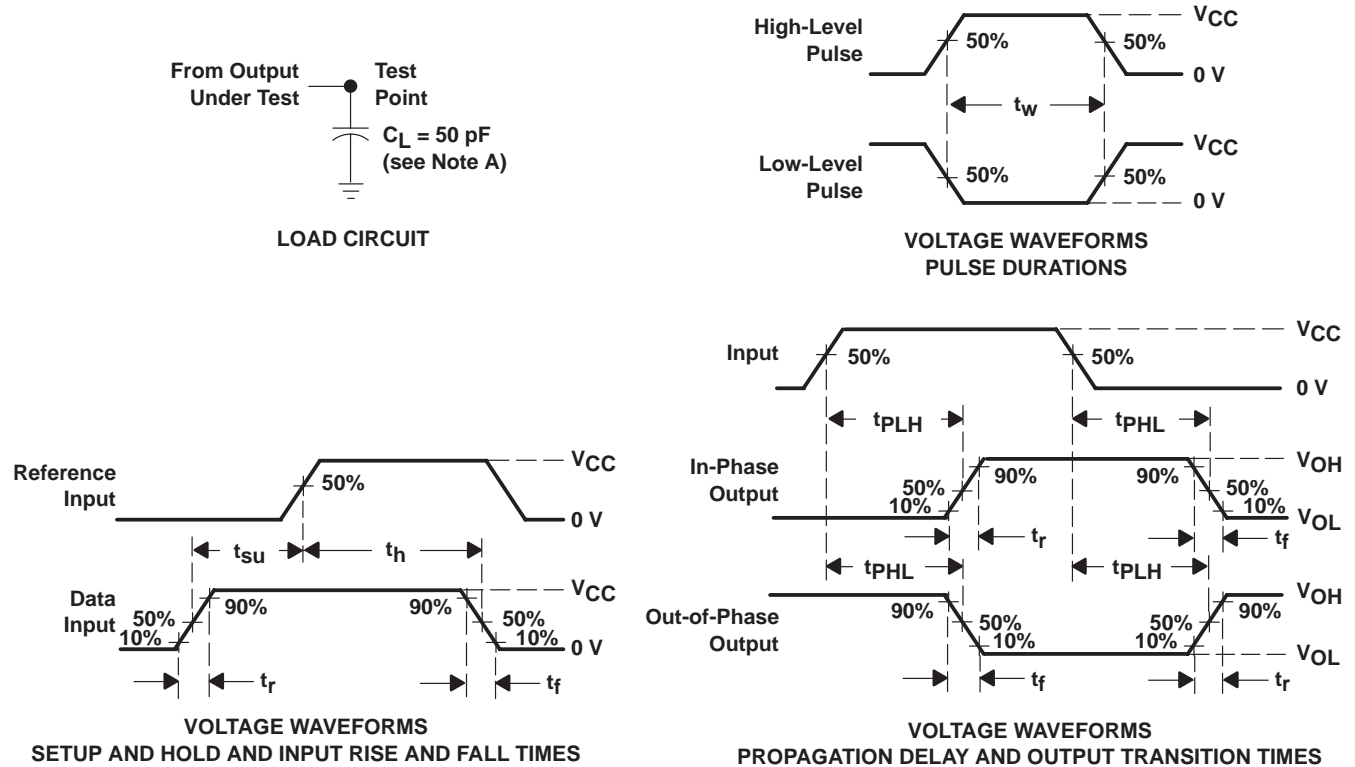
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub>	T <sub>A</sub> = 25°C			SN54HC4040		SN74HC4040		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f <sub>max</sub>			2 V	5.5	10		3.7		4.3	MHz	
			4.5 V	28	45		19		22		
			6 V	33	53		22		25		
t <sub>pd</sub>	CLK	Q <sub>A</sub>	2 V		62	150		225		190	ns
			4.5 V		16	30		45		38	
			6 V		12	26		38		32	
t <sub>PHL</sub>	CLR	Any	2 V		63	140		210		175	ns
			4.5 V		17	28		42		35	
			6 V		13	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	13		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



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:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r = 6 \text{ ns}$ ,  $t_f = 6 \text{ ns}$ .
  - 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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