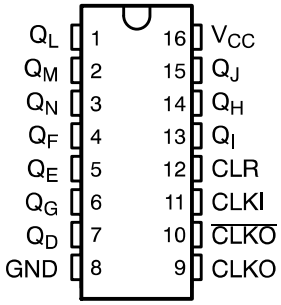
SN74HC4060–Q1
14-STAGE ASYNCHRONOUS BINARY COUNTERS AND OSCILLATORS

SCLS726 – DECEMBER 2011

- **Qualified for Automotive Applications**
- **Wide Operating Voltage Range of 2 V to 6 V**
- **Outputs Can Drive Up To 10 LSTTL Loads**
- **Low Power Consumption, 80-μA Max I_{CC}**
- **Typical t_{pd} = 14 ns**
- **±4-mA Output Drive at 5 V**
- **Low Input Current of 1 μA Max**
- **Allow Design of Either RC- or Crystal-Oscillator Circuits**

SN74HC4060–Q1 . . . D PACKAGE
(TOP VIEW)



description/ordering information

The ’HC4060–Q1 devices 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).

ORDERING INFORMATION

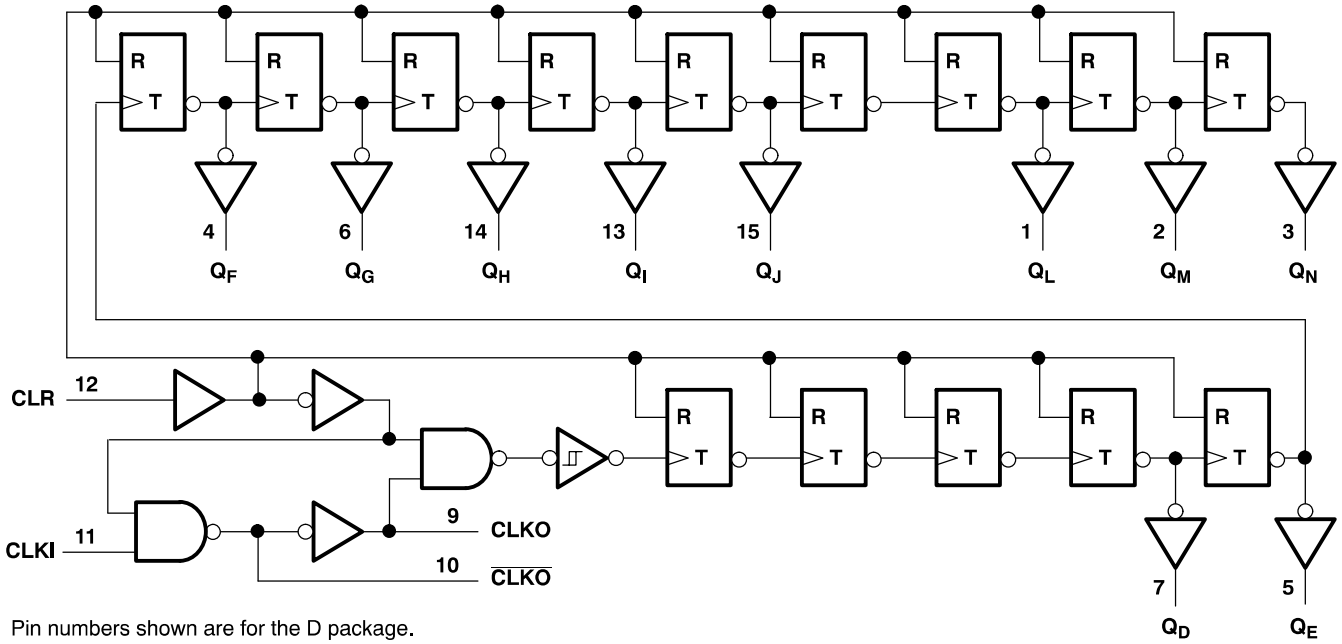
T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 125°C	SOIC – D	Reel of 2500	SN74HC4060QDRQ1	HC4060Q

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

FUNCTION TABLE
(each buffer)

INPUTS		FUNCTION
CLK	CLR	
↑	L	No change
↓	L	Advance to next stage
X	H	All outputs L

Logic diagram (positive logic)



Pin numbers shown are for the D package.

Absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

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) . . . . . ±20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$) (see Note 1) . . . . . ±20 mA
Continuous output current, I_O ($V_O = 0$ to V_{CC}) . . . . . ±25 mA
Package thermal impedance, θ_{JA} (see Note 2): D package . . . . . 73°C/W
Storage temperature range, T_{stg} . . . . . –65°C to 150°C
ESD rating: Human Body Model (HBM) . . . . . 2000 V
Charged Device Model (CDM) . . . . . 1000 V
Machine Model (MM) . . . . . 200 V

† 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 51-7.

Recommended operating conditions (see Note 3)

			MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage		2	5	6	V
V_{IH}	High-level input voltage	V_{CC} = 2 V	1.5			V
		V_{CC} = 4.5 V	3.15			
		V_{CC} = 6 V	4.2			
V_{IL}	Low-level input voltage	V_{CC} = 2 V			0.5	V
		V_{CC} = 4.5 V			1.35	
		V_{CC} = 6 V			1.8	
V_I	Input voltage		0		V_{CC}	V
V_O	Output voltage		0		V_{CC}	V
$\Delta t/\Delta v$	Input transition rise/fall time	V_{CC} = 2 V			1000	ns
		V_{CC} = 4.5 V			500	
		V_{CC} = 6 V			400	
T_A	Operating free-air temperature		–40		125	°C

NOTE 3: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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

PARAMETER		TEST CONDITIONS		V_{CC}	T_A = 25°C			'HC4060–Q1		UNIT
					MIN	TYP	MAX	MIN	MAX	
V_{OH}	All outputs	V_I = V_{IH} or V_{IL},	I_{OH} = –20 μA	2 V	1.9	1.998		1.9		V
				4.5 V	4.4	4.499		4.4		
				6 V	5.9	5.999		5.9		
	Q outputs	V_I = V_{IH} or V_{IL}	I_{OH} = –4 mA	4.5 V	3.98	4.3		3.7		
			I_{OH} = –5.2 mA	6 V	5.48	5.8		5.2		
V_{OL}	All outputs	V_I = V_{IH} or V_{IL},	I_{OL} = 20 μA	2 V		0.002	0.1		0.1	V
				4.5 V		0.001	0.1		0.1	
				6 V		0.001	0.1		0.1	
	Q outputs	V_I = V_{IH} or V_{IL}	I_{OL} = 4 mA	4.5 V		0.17	0.26		0.4	
			I_{OL} = 5.2 mA	6 V		0.15	0.26		0.4	
I_I		V_I = V_{CC} or 0		6 V		±0.1	±100		±1000	nA
I_{CC}		V_I = V_{CC} or 0,	I_O = 0	6 V			8		160	μA
C_i				2 V to 6 V		3	10		10	pF

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

			V_{CC}	T_A = 25°C		'HC4060–Q1		UNIT
				MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		2 V		5.5		3.7	MHz
			4.5 V		28		19	
			6 V		33		22	
t_w	Pulse duration	CLKI high or low	2 V	90		135		ns
			4.5 V	18		27		
			6 V	15		23		
		CLR high	2 V	90		135		
			4.5 V	18		27		
			6 V	15		23		
t_{su}	Setup time, CLR inactive before CLKI↓		2 V	160		240		ns
			4.5 V	32		48		
			6 V	27		41		

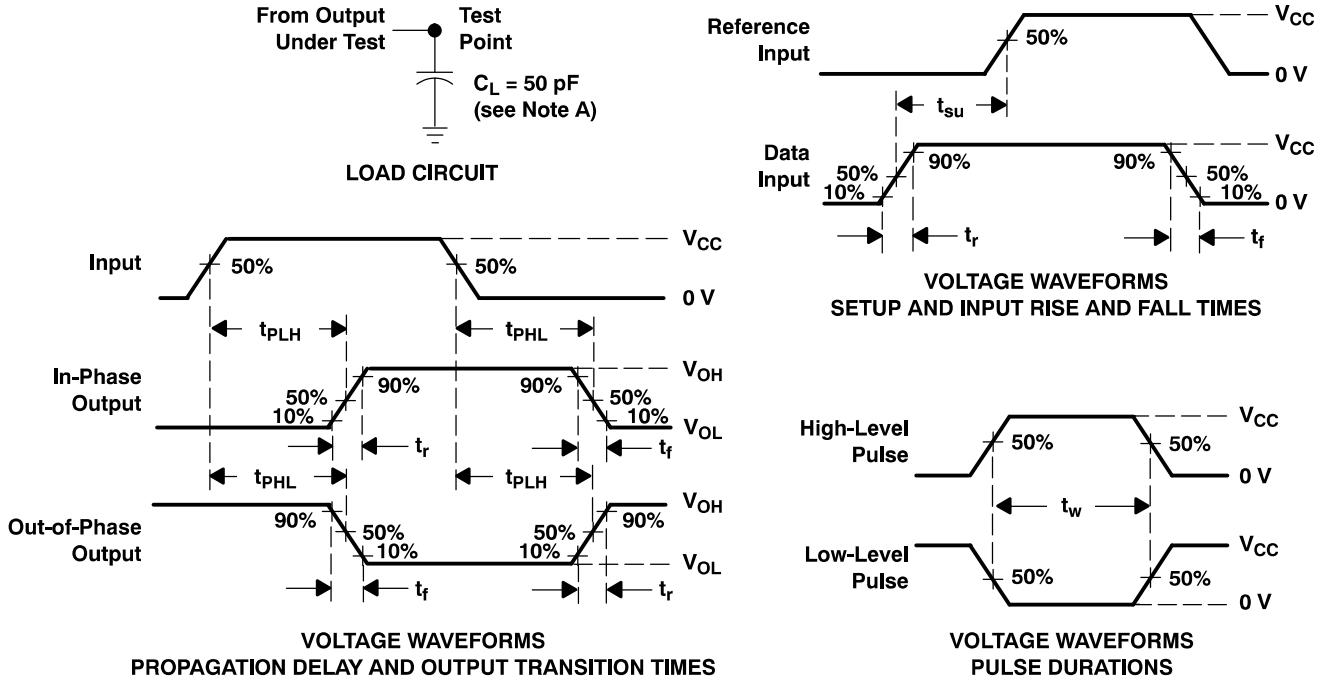
Switching characteristics over recommended operating free-air temperature range, C_L = 50 pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	T_A = 25°C			'HC4060–Q1		UNIT
				MIN	TYP	MAX	MIN	MAX	
f_{max}			2 V	5.5	10		3.7		MHz
			4.5 V	28	45		19		
			6 V	33	53		22		
t_{pd}	CLKI	Q_D	2 V		240	490		735	ns
			4.5 V		58	98		147	
			6 V		42	83		125	
t_{PHL}	CLR	Any Q	2 V		66	140		210	ns
			4.5 V		18	28		42	
			6 V		14	24		36	
t_t		Any	2 V		28	75		110	ns
			4.5 V		8	15		22	
			6 V		6	30		19	

Operating characteristics, T_A = 25°C

PARAMETER		TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance	No load	88	pF

PARAMETER MEASUREMENT INFORMATION



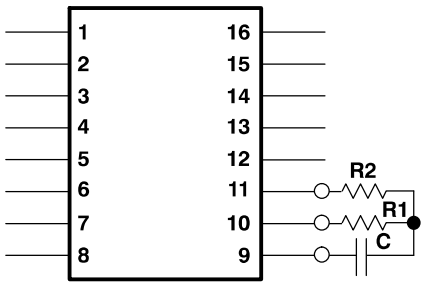
NOTES: A. C_L includes probe and test-fixture capacitance.
B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, Z_O = 50 Ω, t_r = 6 ns, t_f = 6 ns.
C. For clock inputs, f_{max} is measured when 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

CONNECTING AN RC-OSCILLATOR CIRCUIT TO THE ’HC4060–Q1 DEVICE

The ’HC4060–Q1 devices 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:



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 > > R1 (i.e., R2 = 10R1), the above formula simplifies to:

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