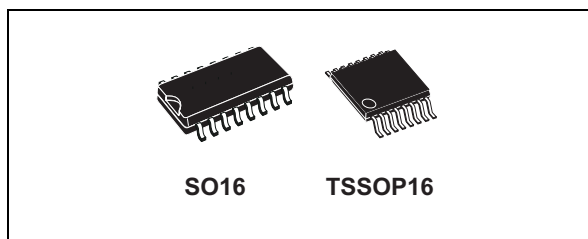


## 14-stage binary counter/oscillator

Datasheet - production data



### Applications

- Automotive
- Industrial
- Computer
- Consumer

### Description

The M74HC4060 device is a high speed CMOS 14-stage binary counter/oscillator fabricated with silicon gate C<sup>2</sup>MOS technology.

The oscillator configuration allows design of either RC or crystal oscillator circuits. A high level on the CLEAR accomplishes the reset function, i.e. all counter outputs are made low and the oscillator is disabled.

A negative transition on the clock input increments the counter. Ten kinds of divided output are provided; 4 to 10 and 12 to 14 stage inclusive. The maximum division available at Q12 is 1/16384 of the oscillator frequency.

The  $\bar{O}$ I input and the CLEAR input are equipped with protection circuits against static discharge and transient excess voltage.

### Features

- High speed:  
 $f_{\max} = 65 \text{ MHz (typ.) at } V_{CC} = 6 \text{ V}$
- Low power dissipation:  
 $I_{CC} = 4 \text{ A (max.) at } T_A = 25 \text{ }^\circ\text{C}$
- High noise immunity:  
 $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (min.)}$
- Symmetrical output impedance:  
 $|I_{OH}| = I_{OL} = 4 \text{ mA (min.)}$
- Balanced propagation delays:  $T_{PLH} \cong T_{PHL}$
- Wide operating voltage range:  
 $V_{CC} \text{ (opr.)} = 2 \text{ V to } 6 \text{ V}$
- Pin and function compatible with 74 series 4060
- ESD performance
  - HBM: 2 kV
  - MM: 200 V
  - CDM: 1 kV

Table 1. Device summary

Order code	Temperature range	Package	Packing	Marking
M74HC4060RM13TR	-55 °C to +125 °C	SO16	Tape and reel	74HC4060
M74HC4060YRM13TR <sup>(1)</sup>	-40 °C to +125 °C	SO16 (automotive version)		74HC4060Y
M74HC4060TTR	-55 °C to +125 °C	TSSOP16		HC4060
M74HC4060YTTR <sup>(1)</sup>	-40 °C to +125 °C	TSSOP16 (automotive version)		HC4060Y

1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 and Q002.

# Contents

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# 1 Pin description

Figure 1. Pin connection and IEC logic symbols

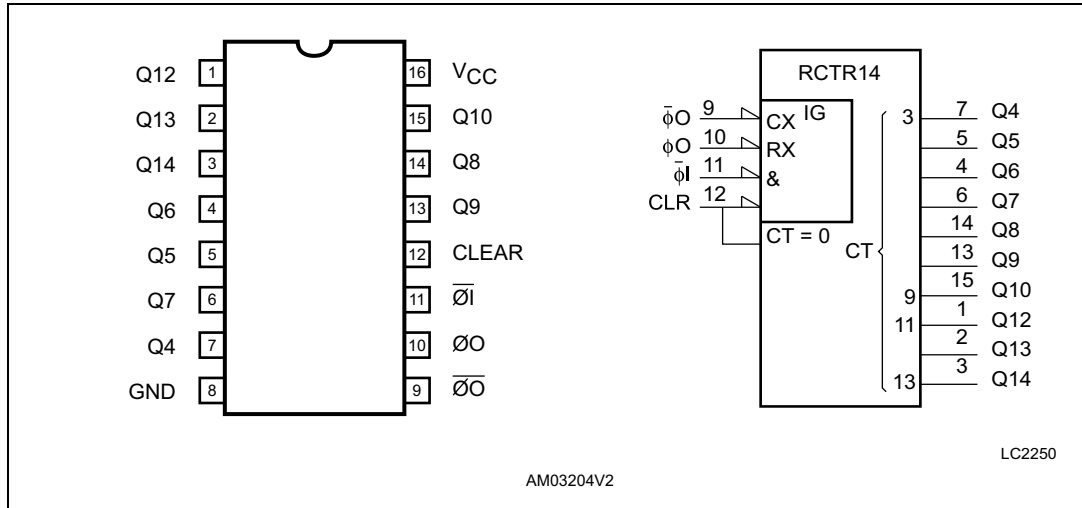
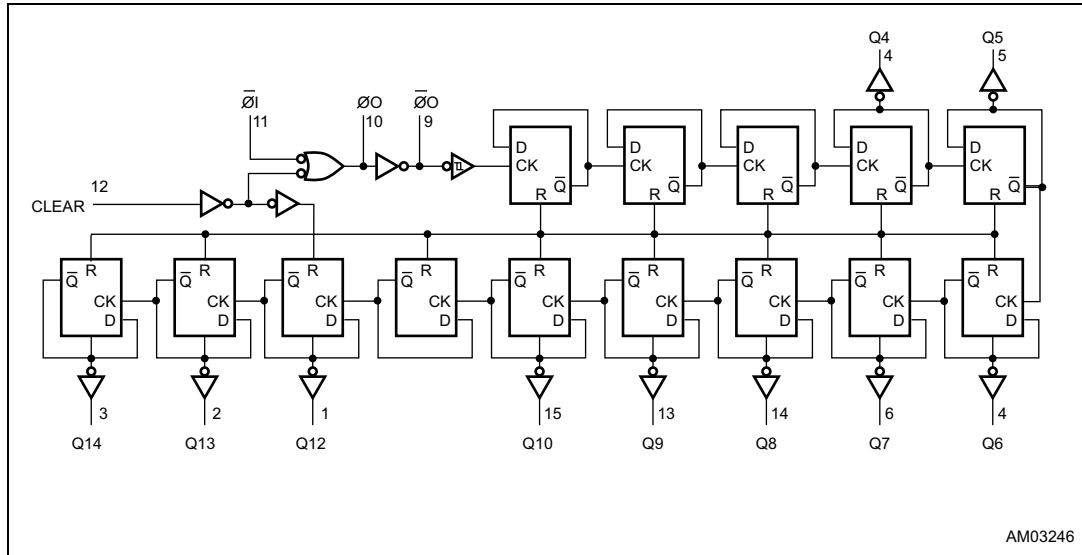


Table 2. Pin description

Pin no	Symbol	Name and function
1, 2, 3	Q12 to Q14	Counter outputs
7, 5, 4, 6, 14, 13, 15	Q4 to Q10	
9	$\overline{\phi O}$	External capacitor connection
10	$\phi O$	External resistor connection
11	$\overline{\phi I}$	Clock input / oscillator pin
12	CLEAR	Master reset
8	GND	Ground (0 V)
16	V <sub>CC</sub>	Positive supply voltage

## 2 Functional description

Figure 2. Logic diagram



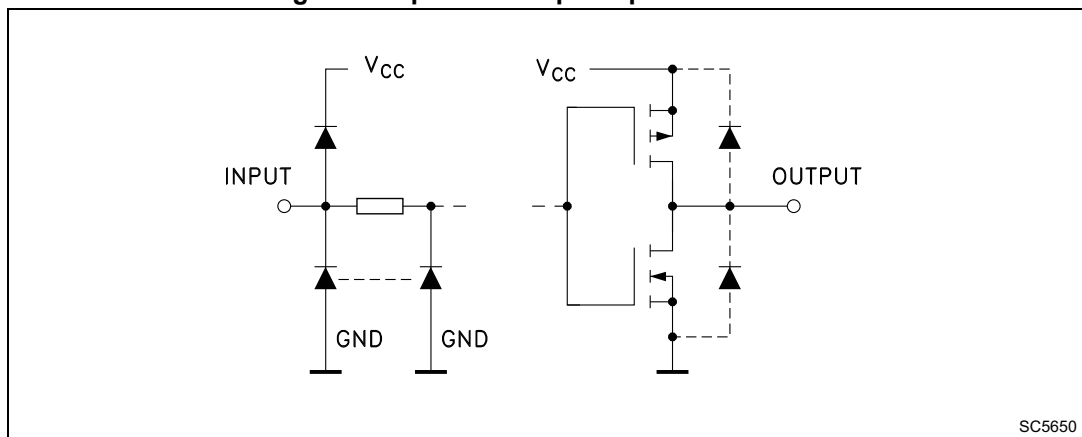
1. This logic diagram has not be used to estimate propagation delays.

Table 3. Truth table

$\bar{\emptyset}i$	CLEAR	Function
X <sup>(1)</sup>	H	Counter is reset to zero state $\emptyset O$ output goes to high level $\bar{\emptyset}O$ output goes to low level
	L	Count up one step
	L	No change

1. X: don't care.

Figure 3. Input and output equivalent circuit



SC5650

### 3 Electrical characteristics

**Table 4. Absolute maximum ratings<sup>(1)</sup>**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply voltage	-0.5 to +7	V
$V_I$	DC Input voltage	-0.5 to $V_{CC} + 0.5$	
$V_O$	DC output voltage		
$I_{IK}$	DC input diode current	20	mA
$I_{OK}$	DC output diode current		
$I_O$	DC output current	25	
$I_{CC}$ or $I_{GND}$	DC VCC or ground current	50	
$P_D$	Power dissipation	500 <sup>(2)</sup>	mW
$T_{stg}$	Storage temperature	-65 to +150	°C
$T_L$	Lead temperature (10 sec.)	300	

1. Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.
2. 500 mW at 65 °C; derate to 300 mW by 10 mW/ °C from 65 °C to 85 °C.

**Table 5. Recommended operating conditions**

Symbol	Parameter		Value	Unit
$V_C$	Supply voltage		2 to 6	V
$V_I$	Input voltage		0 to $V_{CC}$	
$V_O$	Output voltage			
$T_{op}$	Operating temperature		-55 to 125	°C
$t_r, t_f$	Input rise and fall time	$V_{CC} = 2.0\text{ V}$	0 to 1000	ns
		$V_{CC} = 4.5\text{ V}$	0 to 500	
		$V_{CC} = 6.0\text{ V}$	0 to 400	

Table 6. DC specifications

Symbol	Parameter	Test condition		Value						Unit	
		V <sub>CC</sub> (V)		T <sub>A</sub> = 25°C			-40 to 85 °C		-55 to 125 °C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
V <sub>IH</sub>	High level input voltage	2.0		1.5			1.5		1.5		V
		4.5		3.15			3.15		3.15		
		6.0		4.2			4.2		4.2		
V <sub>IL</sub>	Low level input voltage	2.0				0.5		0.5		0.5	V
		4.5				1.35		1.35		1.35	
		6.0				1.8		1.8		1.8	
V <sub>OH</sub>	High level output voltage (Q output)	2.0	I <sub>O</sub> = -20 A	1.9	2.0		1.9		1.9		V
		4.5	I <sub>O</sub> = -20 A	4.4	4.5		4.4		4.4		
		6.0	I <sub>O</sub> = -20 A	5.9	6.0		5.9		5.9		
		4.5	I <sub>O</sub> = -4.0 mA	4.18	4.31		4.13		4.10		
		6.0	I <sub>O</sub> = -5.2 mA	5.68	5.8		5.63		5.60		
V <sub>OL</sub>	Low level output voltage (Q output)	2.0	I <sub>O</sub> = 20 A		0.0	0.1		0.1		0.1	V
		4.5	I <sub>O</sub> = 20 A		0.0	0.1		0.1		0.1	
		6.0	I <sub>O</sub> = 20 A		0.0	0.1		0.1		0.1	
		4.5	I <sub>O</sub> = 4.0 mA		0.17	0.26		0.33		0.40	
		6.0	I <sub>O</sub> = 5.2 mA		0.18	0.26		0.33		0.40	
V <sub>OH</sub>	High level output voltage (ØO, ØØ output)	2.0	I <sub>O</sub> = -20 A	1.8	2.0		1.8		1.8	2.0	V
		4.5	I <sub>O</sub> = -20 A	4.4	4.5		4.0		4.0		
		6.0	I <sub>O</sub> = -20 A	5.5	5.9		5.5		5.5		
V <sub>OL</sub>	Low level output voltage (ØO, ØØ output)	2.0	I <sub>O</sub> = -20 A		0.0	0.2		0.2		0.2	V
		4.5	I <sub>O</sub> = -20 A		0.0	0.5		0.5		0.5	
		6.0	I <sub>O</sub> = -20 A		0.1	0.5		0.5		0.5	
I <sub>I</sub>	Input leakage current	6.0	V <sub>I</sub> = V <sub>CC</sub> or GND			0.1		±1		±1	µA
I <sub>CC</sub>	Quiescent supply current	6.0	V <sub>I</sub> = V <sub>CC</sub> or GND			4		40		80	µA

Table 7. AC electrical characteristics ( $C_L = 50$  pF, input  $t_r = t_f = 6$  ns)

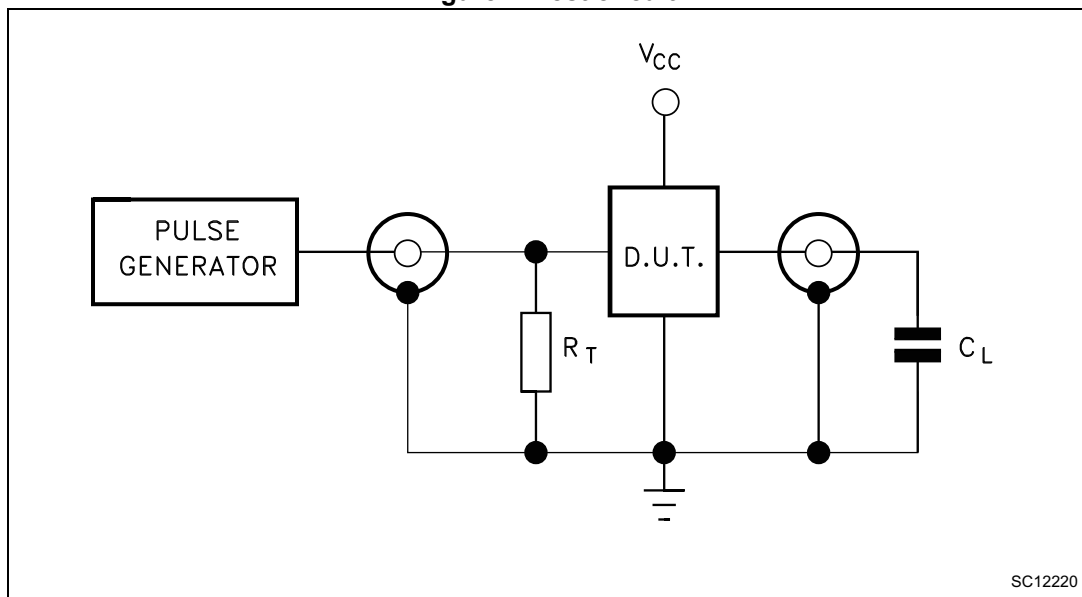
Symbol	Parameter	Test condition	Value						Unit		
			$V_{CC}$ (V)	$T_A = 25$ °C			-40 to 85 °C			-55 to 125 °C	
				Min.	Typ.	Max.	Min.	Max.		Min.	Max.
$t_{TLH}$ $t_{THL}$	Output transition time	2.0		30	75		95		110	ns	
		4.5		8	15		19		22		
		6.0		7	13		16		19		
$t_{PLH}$ $t_{PHL}$	Propagation delay time ( $\overline{Q1} - Q4$ )	2.0		170	300		375		450	ns	
		4.5		41	60		75		90		
		6.0		30	51		64		76		
$t_{PD}$	Propagation delay time difference ( $Q_n - Q_{n+1}$ )	2.0		32	75		95		110	ns	
		4.5		7	15		19		22		
		6.0		5	13		16		19		
$t_{PHL}$	Propagation delay time (CLEAR - $Q_n$ )	2.0		85	195		245		295	ns	
		4.5		23	39		49		59		
		6.0		17	33		42		50		
$f_{MAX}$	Maximum clock frequency	2.0	6	12		5		4		MHz	
		4.5	30	50		24		20			
		6.0	35	65		28		24			
$t_{W(H)}$ , $t_{W(L)}$	Minimum pulse width ( $\overline{Q1}$ )	2.0		30	75		95		110	ns	
		4.5		8	15		19		22		
		6.0		7	13		16		19		
$t_{W(H)}$	Minimum pulse width (CLEAR)	2.0		30	75		95		110	ns	
		4.5		8	15		19		22		
		6.0		7	13		16		19		
$t_{REM}$	Minimum removal time	2.0		40	100		125		150	ns	
		4.5		10	20		25		30		
		6.0		9	17		21		26		

Table 8. Capacitive characteristics

Symbol	Parameter	Test condition	Value						Unit	
		V <sub>CC</sub> (V)	T <sub>A</sub> = 25 °C			-40 to 85 °C		-55 to 125 °C		
			Min.	Typ.	Max.	Min.	Max.	Min.		Max.
C <sub>IN</sub>	Input capacitance	5.0	5	10		10		10		pF
C <sub>PD</sub>	Power dissipation capacitance <sup>(1)</sup>	5.0		27						

1. C<sub>PD</sub> is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to [Figure 4: Test circuit](#)). Average operating current can be obtained by the following equation.  $I_{CC(opr.)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$ .

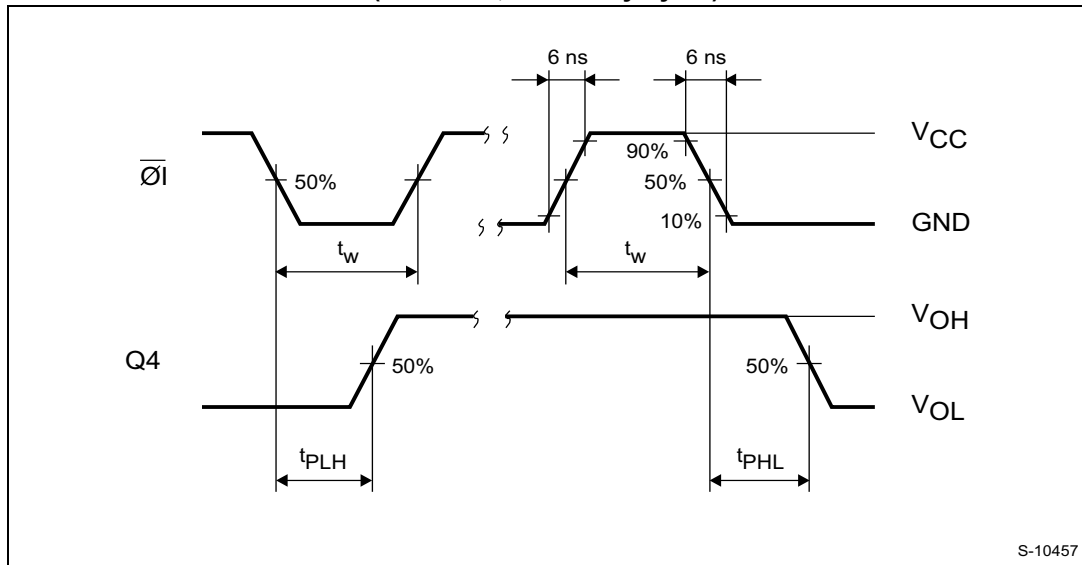
Figure 4. Test circuit



1. C<sub>L</sub> = 50 pF or equivalent (includes jig and probe capacitance)  
 R<sub>T</sub> = Z<sub>OUT</sub> of pulse generator (typically 50 Ω).

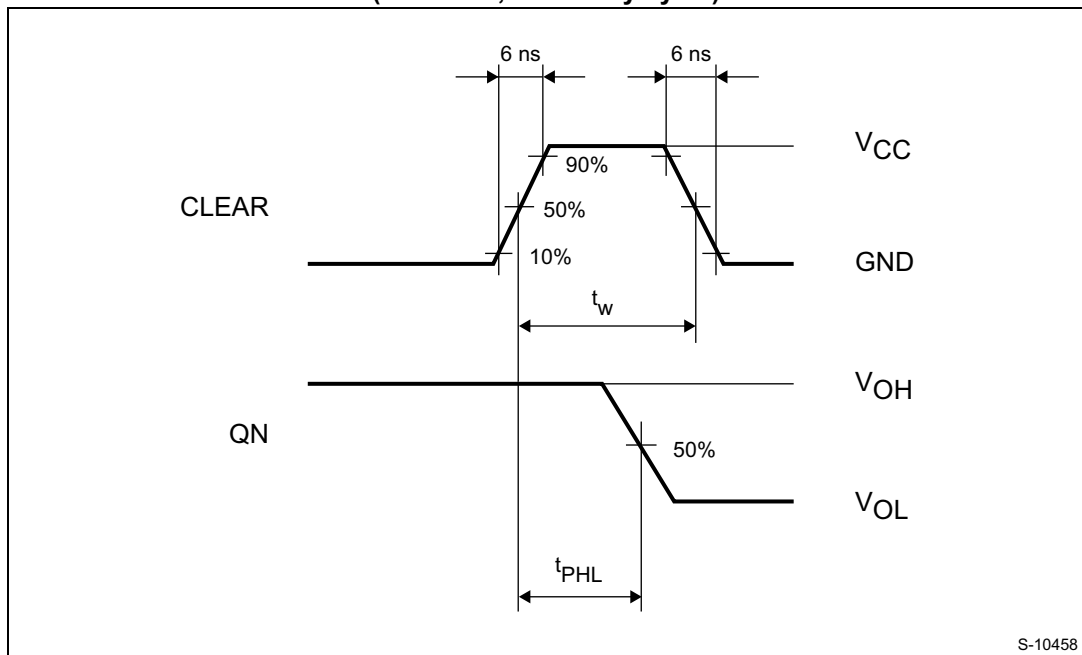


**Figure 5. Waveform 1: propagation delay times, minimum pulse width ( $\overline{\text{Q1}}$ )  
(f = 1 MHz; 50 % duty cycle)**



S-10457

**Figure 6. Waveform 2: propagation delay times, minimum pulse width (CLEAR)  
(f = 1 MHz; 50 % duty cycle)**



S-10458

Figure 7. Waveform 3: propagation delay times (f = 1 MHz; 50 % duty cycle)

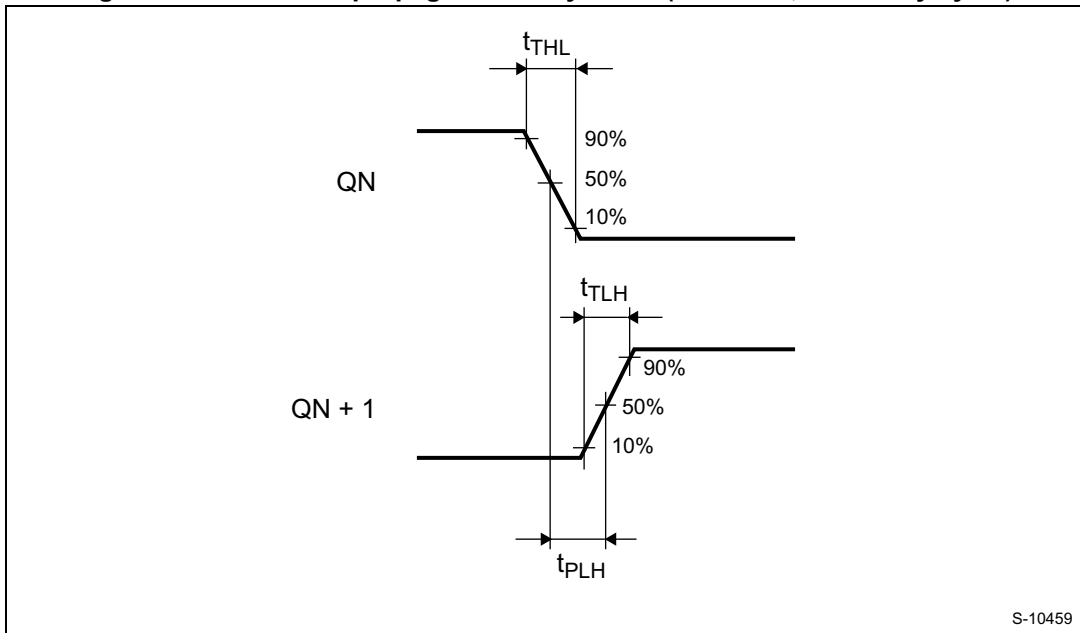


Figure 8. Waveform 4: propagation delay times (f = 1 MHz; 50 % duty cycle)

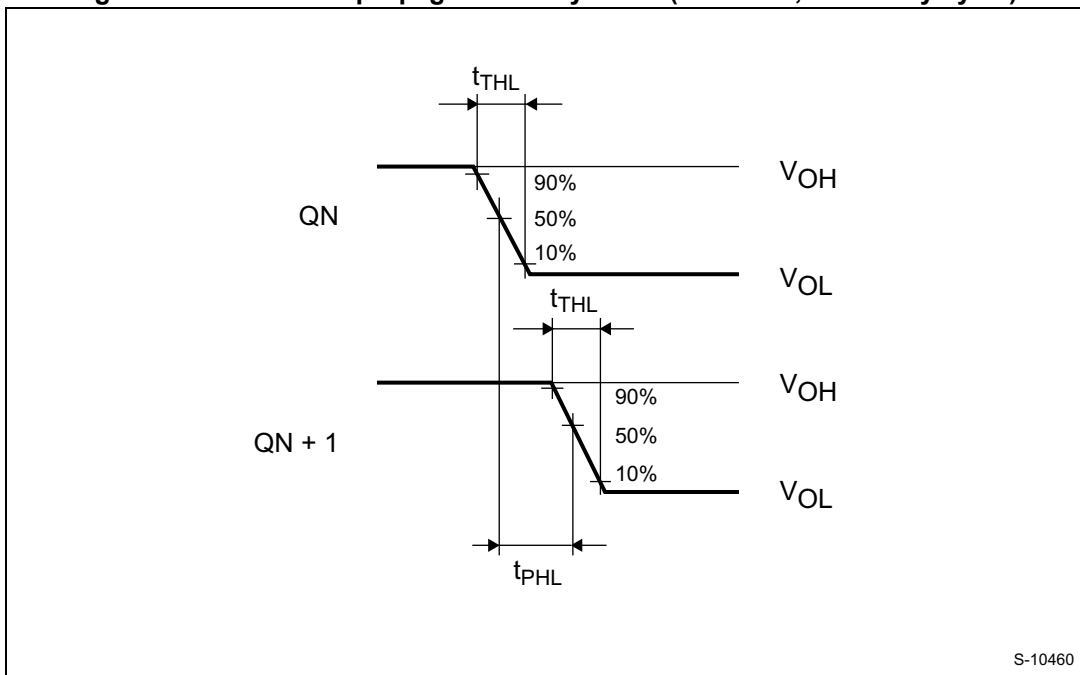
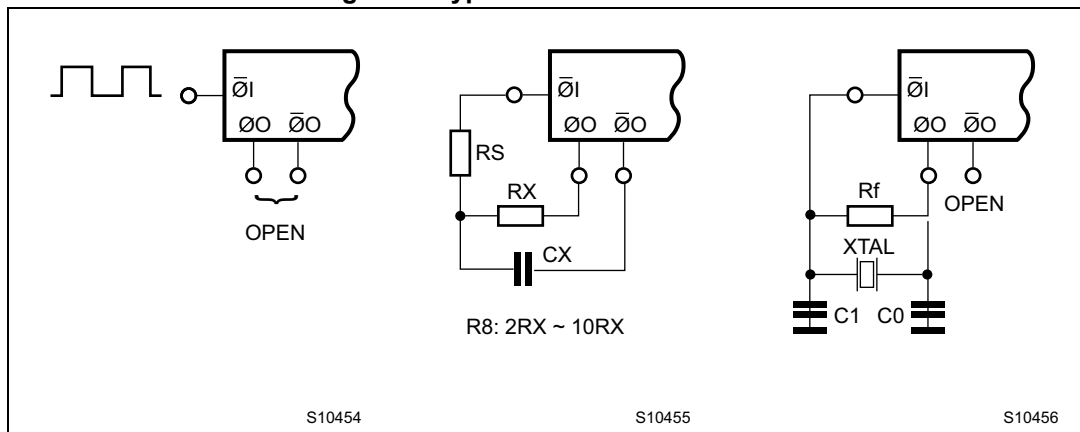


Figure 9. Typical clock drive circuits

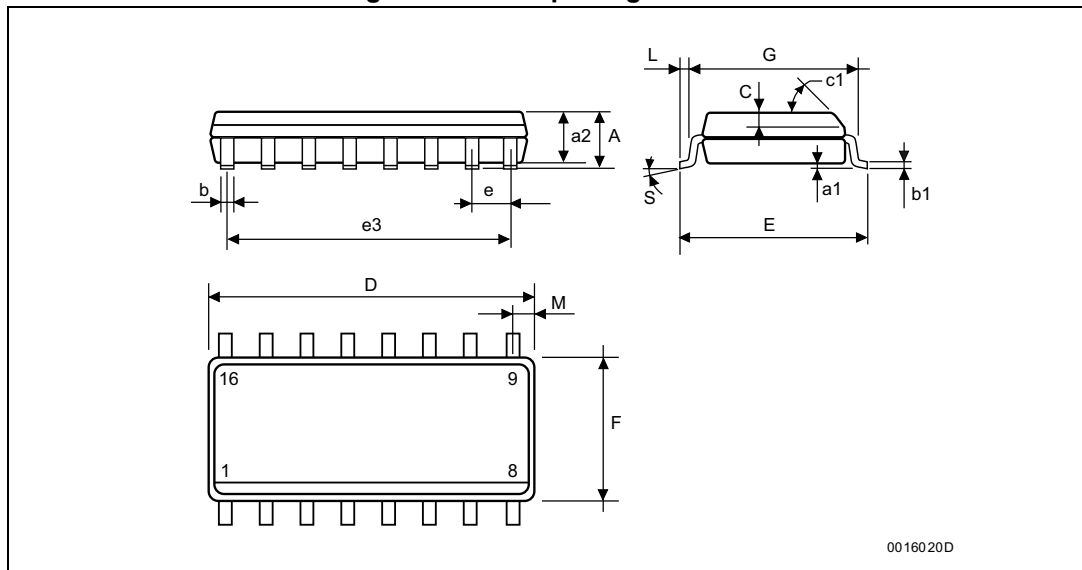


## 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

## 4.1 SO16 package information

Figure 10. SO16 package outline



0016020D

Table 9. SO16 package mechanical data

Symbol	Dimensions					
	mm			inch		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8° (max.)					

## 4.2 TSSOP16 package information

Figure 11. TSSOP16 package outline

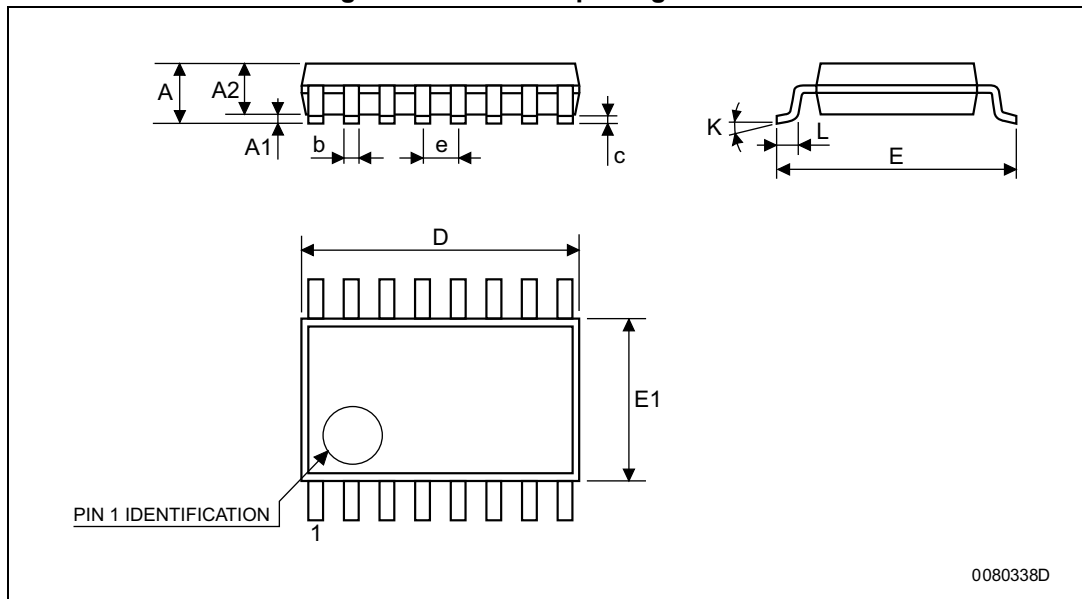


Table 10. TSSOP16 mechanical data

Symbol	Dimensions					
	mm			inch		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65			0.0256	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030

## 5 Ordering information

**Table 11. Device summary**

Order code	Temperature range	Package	Packing	Marking
M74HC4060RM13TR	-55 °C to +125 °C	SO16	Tape and reel	74HC4060
M74HC4060YRM13TR <sup>(1)</sup>	-40 °C to +125 °C	SO16 (automotive version)		74HC4060Y
M74HC4060TTR	-55 °C to +125 °C	TSSOP16		HC4060
M74HC4060YTTR <sup>(1)</sup>	-40 °C to +125 °C	TSSOP16 (automotive version)		HC4060Y

1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 and Q002.

## 6 Revision history

**Table 12. Document revision history**

Date	Revision	Changes
1-Feb-2008	1	Initial release.
15-May-2013	2	<p>Added <a href="#">Applications</a> on page 1.</p> <p>Corrected <a href="#">Description</a> (replaced “The maximum division available at Q12 is 1/16384 f oscillator.” by “The maximum division available at Q12 is 1/16384 of the oscillator frequency.”).</p> <p>Updated <a href="#">Table 1</a> (added order codes, temperature range, updated package, added marking).</p> <p>Moved <a href="#">Figure 1</a> to page 3.</p> <p>Redrawn <a href="#">Figure 1</a>, <a href="#">Figure 2</a>, <a href="#">Figure 5</a> to <a href="#">Figure 9</a>.</p> <p>Added <a href="#">Contents</a>.</p> <p>Added titles to <a href="#">Section 1: Pin description</a> to <a href="#">Section 6: Revision history</a>.</p> <p>Added numbers to <a href="#">Table 1</a> to <a href="#">Table 12</a> and <a href="#">Figure 1</a> to <a href="#">Figure 11</a>.</p> <p>Updated <a href="#">Section 4: Package information</a> (added ECOPACK text, reversed order of <a href="#">Figure 10</a> to <a href="#">Figure 11</a> and <a href="#">Table 9</a> to <a href="#">Table 10</a>).</p> <p>Minor corrections throughout document.</p>
10-Jan-2014	3	<p>Removed PDIP16 package</p> <p>Added ESD data to <a href="#">Features</a></p> <p><a href="#">Table 1: Device summary</a>: added “Packing” and updated footnote 1.</p> <p>Added <a href="#">Section 5: Ordering information</a></p> <p>Updated layout</p>



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