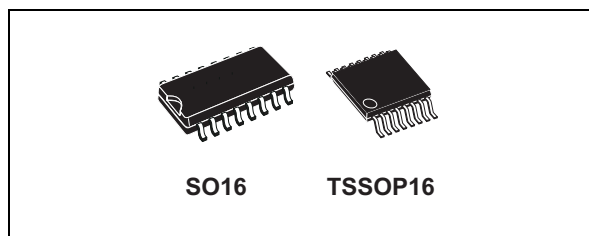


14-stage binary counter/oscillator

Datasheet - production data



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

Applications

- Automotive
- Industrial
- Computer
- Consumer

Description

The M74HC4060 device is a high speed CMOS 14-stage binary counter/oscillator fabricated with silicon gate C²MOS 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 $\overline{QI}$ input and the CLEAR input are equipped with protection circuits against static discharge and transient excess voltage.

Table 1. Device summary

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

1	Pin description	3
2	Functional description	4
3	Electrical characteristics	5
4	Package information	12
	4.1 SO16 package information	13
	4.2 TSSOP16 package information	14
5	Ordering information	15
6	Revision history	16

1 Pin description

Figure 1. Pin connection and IEC logic symbols

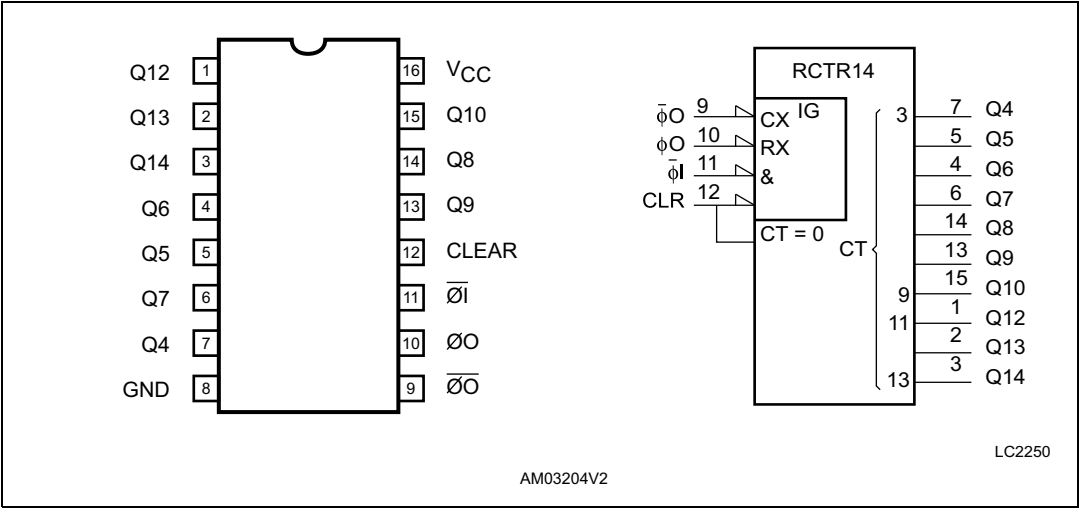


Table 2. Pin description

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	$\overline{QO}$	External capacitor connection
10	QO	External resistor connection
11	$\overline{QI}$	Clock input / oscillator pin
12	CLEAR	Master reset
8	GND	Ground (0 V)
16	V _{CC}	Positive supply voltage

2

Figure 2. Logic diagram



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

Table 3. Truth table

$\bar{\phi}_i$	CLEAR	Function
$X^{(1)}$	H	Counter is reset to zero state $\bar{\phi}\bar{\phi}$ output goes to high level $\bar{\phi}\bar{\phi}$ 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



3 Electrical characteristics

Table 4. Absolute maximum ratings⁽¹⁾

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 ⁽²⁾	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 V	0 to 1000	ns
		V _{CC} = 4.5 V	0 to 500	
		V _{CC} = 6.0 V	0 to 400	

Table 6. DC specifications

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.	
V _{IH}	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 _{IL}	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 _{OH}	High level output voltage (Q output)	2.0	I _O = -20 A	1.9	2.0		1.9		1.9		V
		4.5	I _O = -20 A	4.4	4.5		4.4		4.4		
		6.0	I _O = -20 A	5.9	6.0		5.9		5.9		
		4.5	I _O = -4.0 mA	4.18	4.31		4.13		4.10		
		6.0	I _O = -5.2 mA	5.68	5.8		5.63		5.60		
V _{OL}	Low level output voltage (Q output)	2.0	I _O = 20 A		0.0	0.1		0.1		0.1	V
		4.5	I _O = 20 A		0.0	0.1		0.1		0.1	
		6.0	I _O = 20 A		0.0	0.1		0.1		0.1	
		4.5	I _O = 4.0 mA		0.17	0.26		0.33		0.40	
		6.0	I _O = 5.2 mA		0.18	0.26		0.33		0.40	
V _{OH}	High level output voltage (Q̅O, Q̅Q̅O output)	2.0	I _O = -20 A	1.8	2.0		1.8		1.8	2.0	V
		4.5	I _O = -20 A	4.4	4.5		4.0		4.0		
		6.0	I _O = -20 A	5.5	5.9		5.5		5.5		
V _{OL}	Low level output voltage (Q̅O, Q̅Q̅O output)	2.0	I _O = -20 A		0.0	0.2		0.2		0.2	V
		4.5	I _O = -20 A		0.0	0.5		0.5		0.5	
		6.0	I _O = -20 A		0.1	0.5		0.5		0.5	
I _I	Input leakage current	6.0	V _I = V _{CC} or GND			0.1		±1		±1	μA
I _{CC}	Quiescent supply current	6.0	V _I = V _{CC} or GND			4		40		80	μA

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

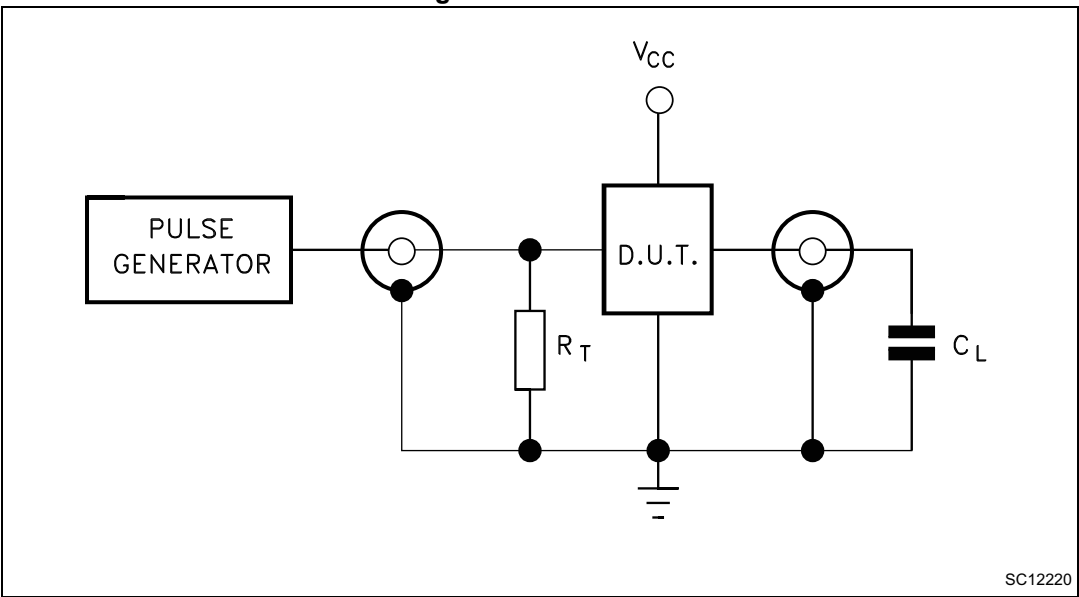
Symbol	Parameter	Test condition	Value							Unit
		V _{CC} (V)	T _A = 25 °C			-40 to 85 °C		-55 to 125 °C		
			Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t _{TLH} t _{THL}	Output transition time	2.0		30	75		95		110	ns
		4.5		8	15		19		22	
		6.0		7	13		16		19	
t _{PLH} t _{PHL}	Propagation delay time ($\overline{Q1}$ - 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 (Qn - Qn+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 - Qn)	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 _{CC} (V)	T _A = 25 °C			-40 to 85 °C		-55 to 125 °C			
			Min.	Typ.	Max.	Min.	Max.	Min.	Max.		
C _{IN}	Input capacitance	5.0	5	10		10		10		pF	
C _{PD}	Power dissipation capacitance ⁽¹⁾	5.0		27							

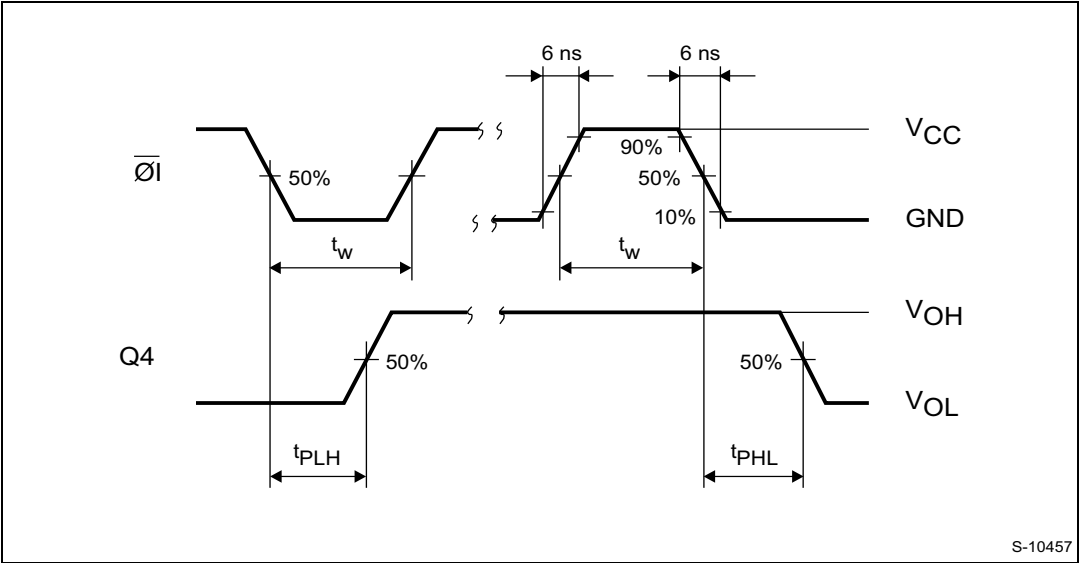
1. C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to [Figure 4: Test circuit](#)). Average operating current can be obtained by the following equation. $I_{CC(opr.)} = C_{PD} \times V_{CC} \times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

Figure 4. Test circuit



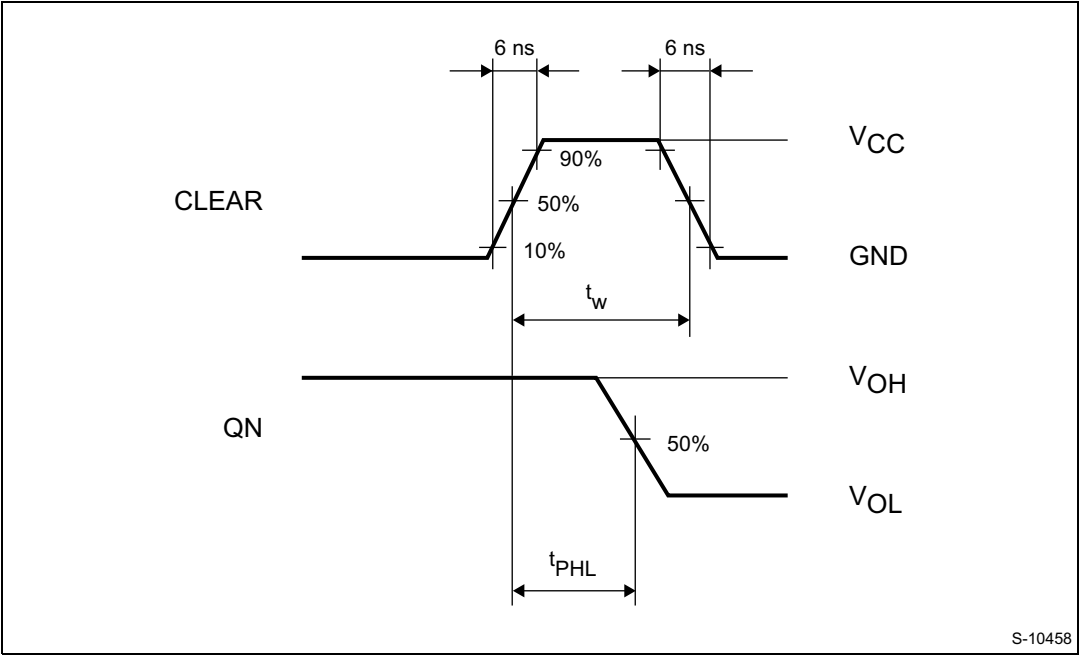
1. C_L = 50 pF or equivalent (includes jig and probe capacitance)
R_T = Z_{OUT} of pulse generator (typically 50 Ω).

Figure 5. Waveform 1: propagation delay times, minimum pulse width ($\overline{\text{OI}}$)
(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)

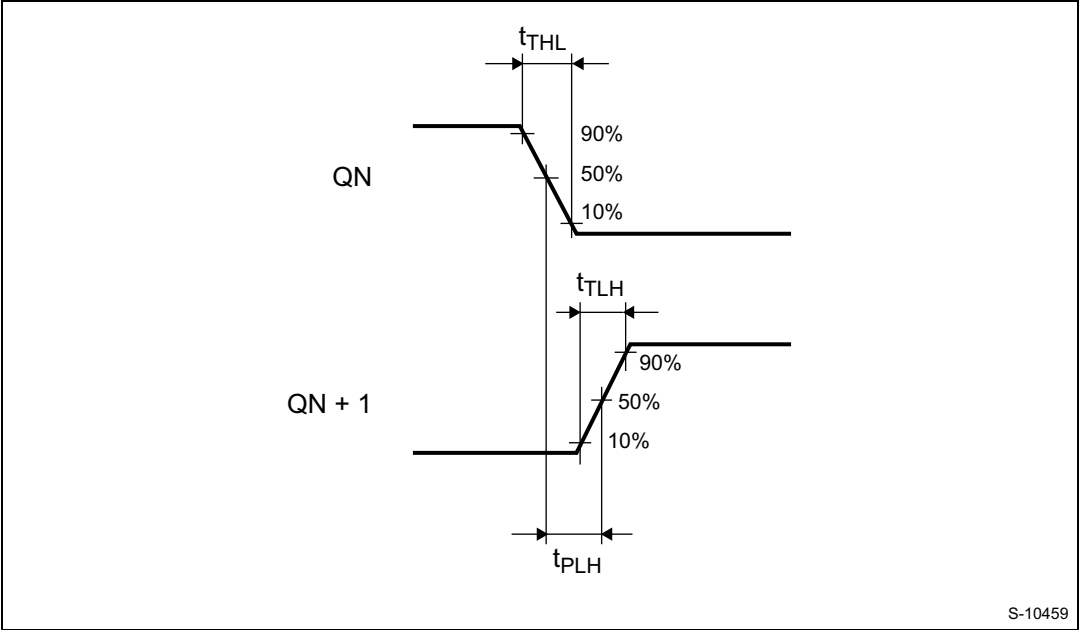


Figure 8. Waveform 4: propagation delay times (f = 1 MHz; 50 % duty cycle)

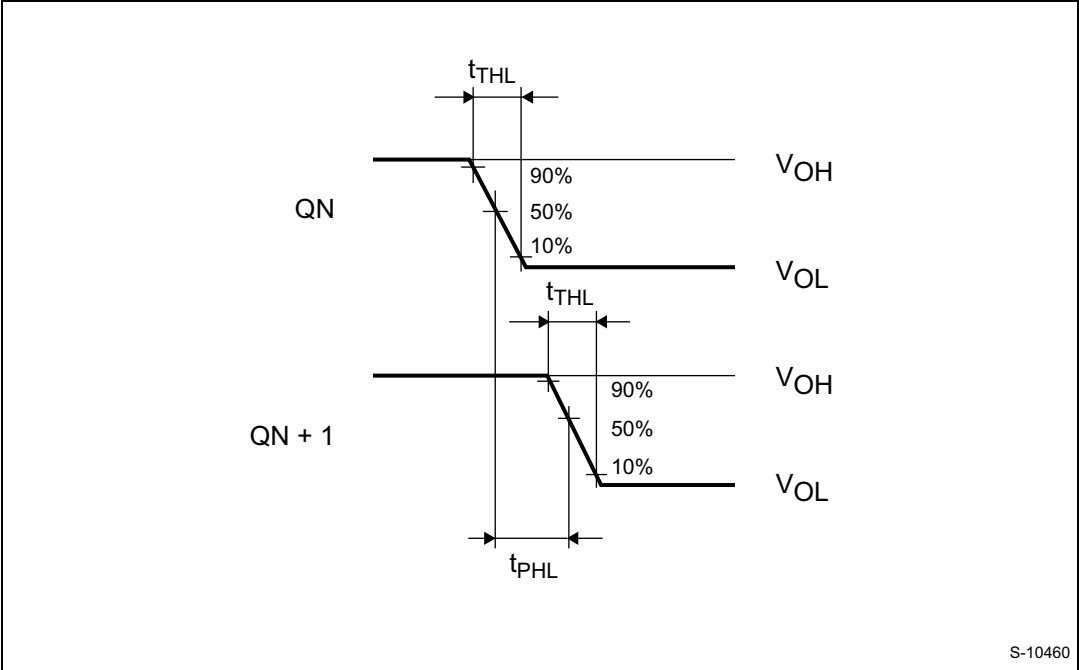
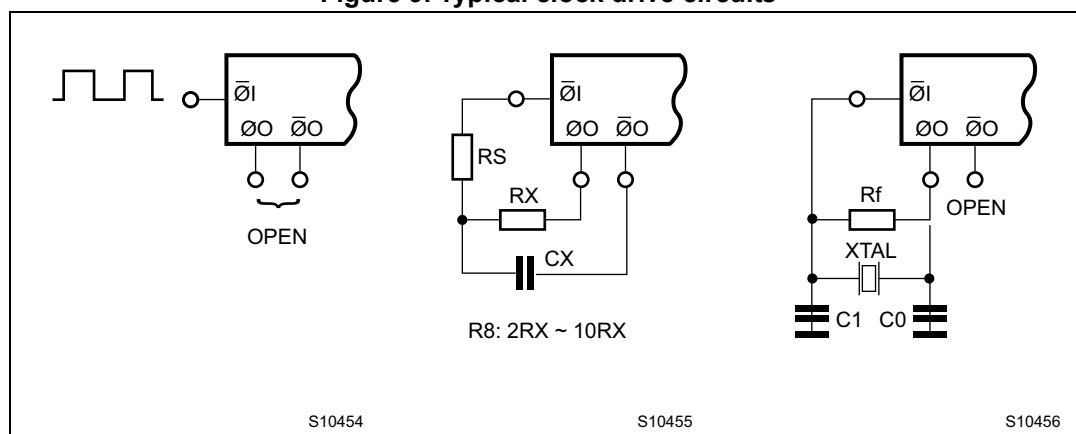


Figure 9. Typical clock drive circuits



4 Package information

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

4.1 SO16 package information

Figure 10. SO16 package outline

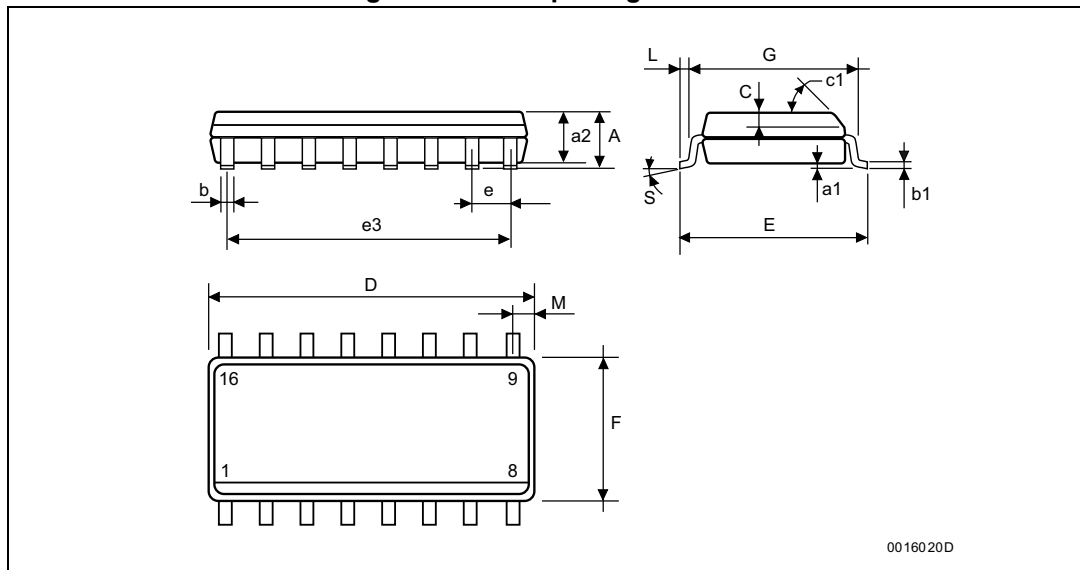


Table 9. SO16 package mechanical data

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

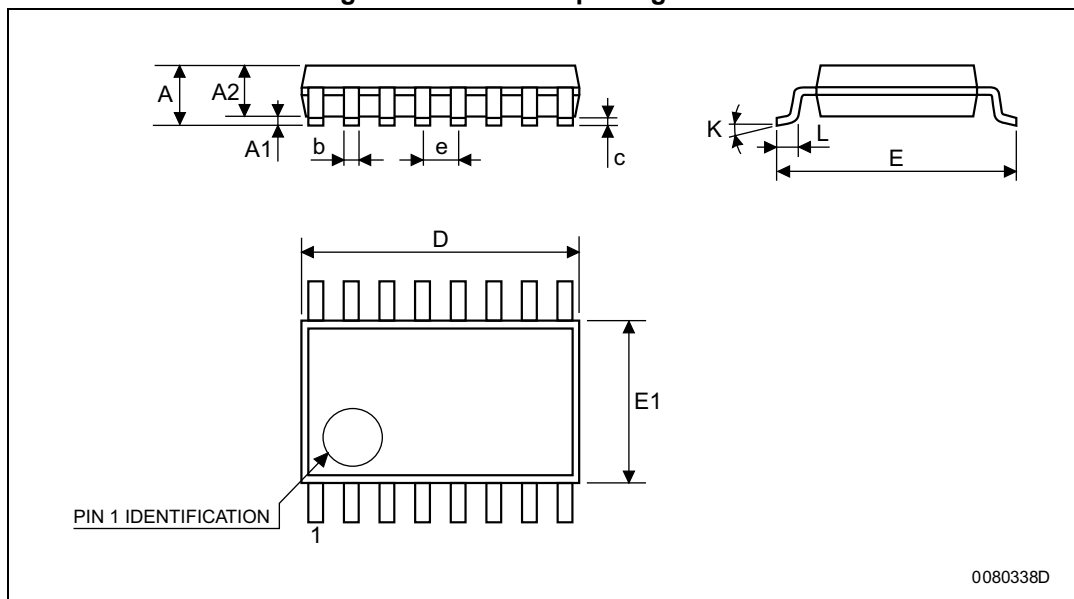


Table 10. TSSOP16 mechanical data

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 ⁽¹⁾	-40 °C to +125 °C	SO16 (automotive version)		74HC4060Y
M74HC4060TTR	-55 °C to +125 °C	TSSOP16		HC4060
M74HC4060YTTR ⁽¹⁾	-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	Added Applications on page 1. Corrected Description (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.”). Updated Table 1 (added order codes, temperature range, updated package, added marking). Moved Figure 1 to page 3. Redrawn Figure 1, Figure 2, Figure 5 to Figure 9. Added Contents. Added titles to Section 1: Pin description to Section 6: Revision history. Added numbers to Table 1 to Table 12 and Figure 1 to Figure 11. Updated Section 4: Package information (added ECOPACK text, reversed order of Figure 10 to Figure 11 and Table 9 to Table 10). Minor corrections throughout document.
10-Jan-2014	3	Removed PDIP16 package Added ESD data to Features Table 1: Device summary: added “Packing” and updated footnote 1. Added Section 5: Ordering information Updated layout

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

ST PRODUCTS ARE NOT DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2014 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com

