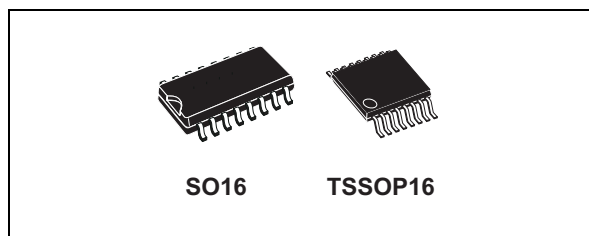


## 14-stage binary counter/oscillator

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 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  $\overline{QI}$  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 <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

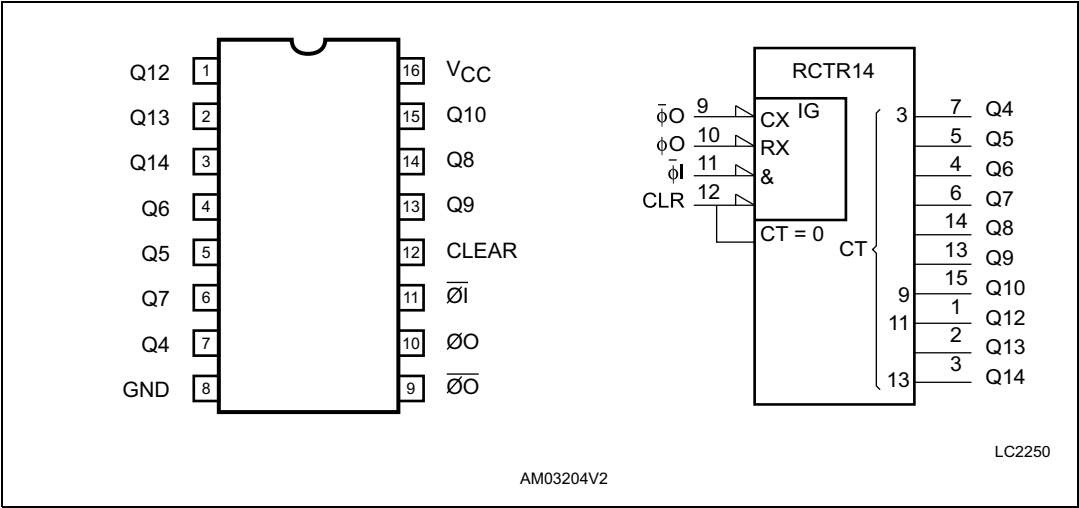


Table 2. Pin description

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

## 2

**Figure 2. Logic diagram**



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

### Table 3. Truth table

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



### 3 Electrical characteristics

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

| Symbol                              | Parameter                  | Value                         | Unit |
|-------------------------------------|----------------------------|-------------------------------|------|
| V <sub>CC</sub>                     | Supply voltage             | -0.5 to +7                    | V    |
| V <sub>I</sub>                      | DC Input voltage           | -0.5 to V <sub>CC</sub> + 0.5 |      |
| V <sub>O</sub>                      | DC output voltage          |                               |      |
| I <sub>IK</sub>                     | DC input diode current     | 20                            | mA   |
| I <sub>OK</sub>                     | DC output diode current    |                               |      |
| I <sub>O</sub>                      | DC output current          | 25                            |      |
| I <sub>CC</sub> or I <sub>GND</sub> | DC VCC or ground current   | 50                            |      |
| P <sub>D</sub>                      | Power dissipation          | 500 <sup>(2)</sup>            | mW   |
| T <sub>stg</sub>                    | Storage temperature        | -65 to +150                   | °C   |
| T <sub>L</sub>                      | 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 <sub>C</sub>                | Supply voltage           |                         | 2 to 6               | V    |
| V <sub>I</sub>                | Input voltage            |                         | 0 to V <sub>CC</sub> |      |
| V <sub>O</sub>                | Output voltage           |                         |                      |      |
| T <sub>op</sub>               | Operating temperature    |                         | -55 to 125           | °C   |
| t <sub>r</sub> t <sub>f</sub> | Input rise and fall time | V <sub>CC</sub> = 2.0 V | 0 to 1000            | ns   |
|                               |                          | V <sub>CC</sub> = 4.5 V | 0 to 500             |      |
|                               |                          | V <sub>CC</sub> = 6.0 V | 0 to 400             |      |

Table 6. DC specifications

| Symbol          | Parameter                                                                       | Test condition         |                                         | Value                 |      |      |              |      |               | Unit |      |
|-----------------|---------------------------------------------------------------------------------|------------------------|-----------------------------------------|-----------------------|------|------|--------------|------|---------------|------|------|
|                 |                                                                                 | V <sub>CC</sub><br>(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 (∅O, $\overline{\text{Q}}\overline{\text{O}}$ 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 (∅O, $\overline{\text{Q}}\overline{\text{O}}$ 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)

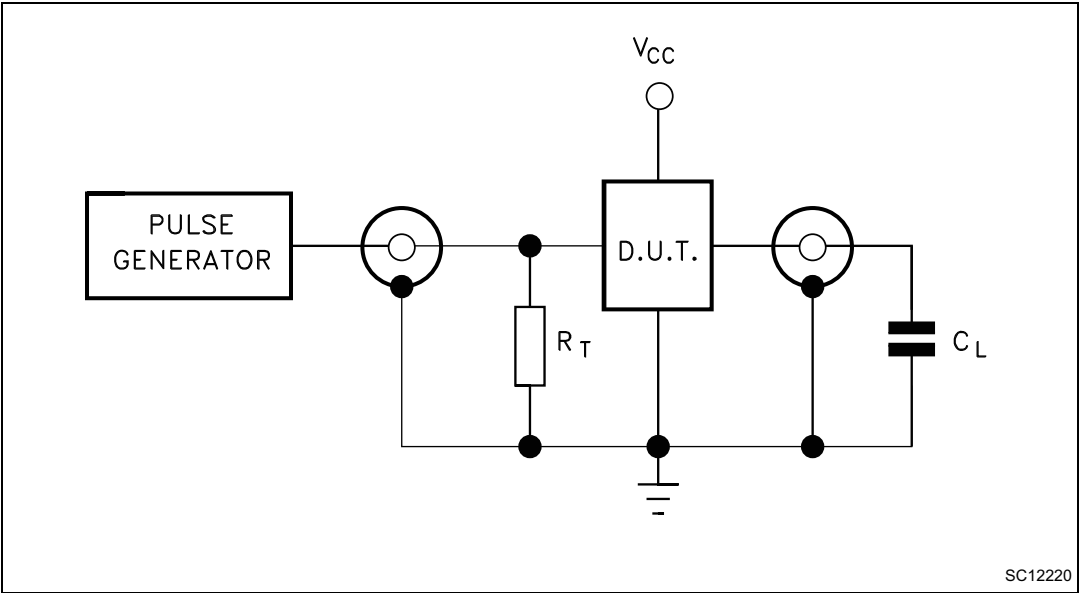
| Symbol                                | Parameter                                      | Test condition      | Value                  |      |      |              |      |               | Unit |      |
|---------------------------------------|------------------------------------------------|---------------------|------------------------|------|------|--------------|------|---------------|------|------|
|                                       |                                                | V <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. |
| t <sub>TLH</sub> t <sub>THL</sub>     | Output transition time                         | 2.0                 |                        | 30   | 75   |              | 95   |               | 110  | ns   |
|                                       |                                                | 4.5                 |                        | 8    | 15   |              | 19   |               | 22   |      |
|                                       |                                                | 6.0                 |                        | 7    | 13   |              | 16   |               | 19   |      |
| t <sub>PLH</sub> t <sub>PHL</sub>     | 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 <sub>PD</sub>                       | 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 <sub>PHL</sub>                      | 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 <sub>MAX</sub>                      | Maximum clock frequency                        | 2.0                 | 6                      | 12   |      | 5            |      | 4             |      | MHz  |
|                                       |                                                | 4.5                 | 30                     | 50   |      | 24           |      | 20            |      |      |
|                                       |                                                | 6.0                 | 35                     | 65   |      | 28           |      | 24            |      |      |
| t <sub>W(H)</sub> , t <sub>W(L)</sub> | 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 <sub>W(H)</sub>                     | Minimum pulse width (CLEAR)                    | 2.0                 |                        | 30   | 75   |              | 95   |               | 110  | ns   |
|                                       |                                                | 4.5                 |                        | 8    | 15   |              | 19   |               | 22   |      |
|                                       |                                                | 6.0                 |                        | 7    | 13   |              | 16   |               | 19   |      |
| t <sub>REM</sub>                      | 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).



Timing diagram for the CLEAR input of the 74VHC00. The diagram shows two signals: CLEAR and QN. CLEAR is a pulse with a width of 6 ns. QN is the output, which transitions from  $V_{OH}$  to  $V_{OL}$  when CLEAR is active. The propagation delay  $t_{PL}$  is shown from the falling edge of CLEAR to the 50% point of the QN transition. The pulse width  $t_W$  is shown from the 10% point to the 90% point of the CLEAR pulse.

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

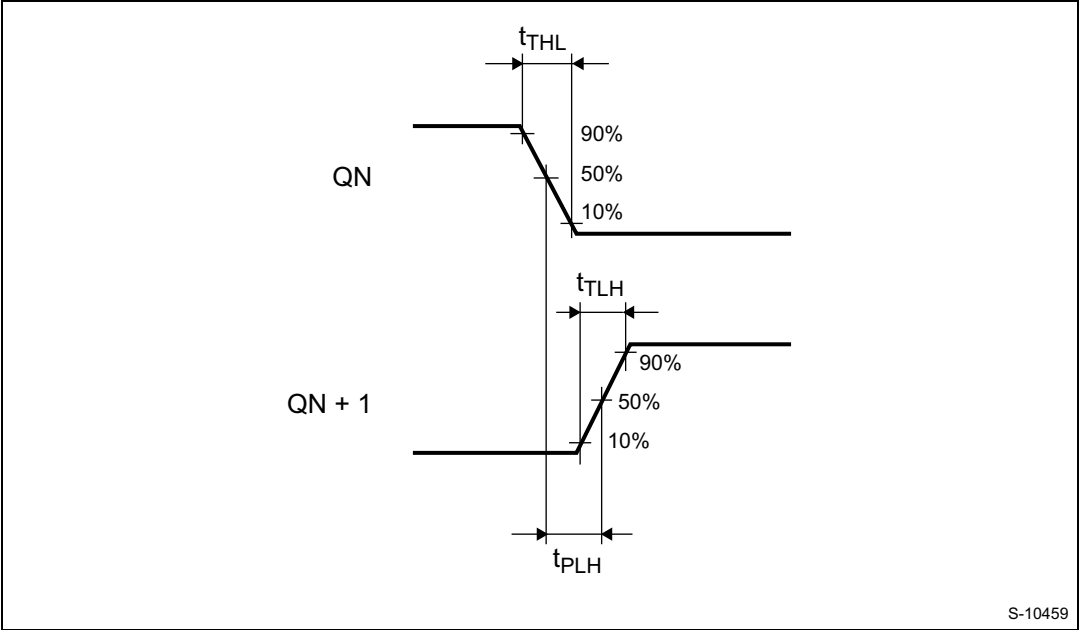


Figure 8. Waveform 4: propagation delay times (f = 1 MHz; 50 % duty cycle)

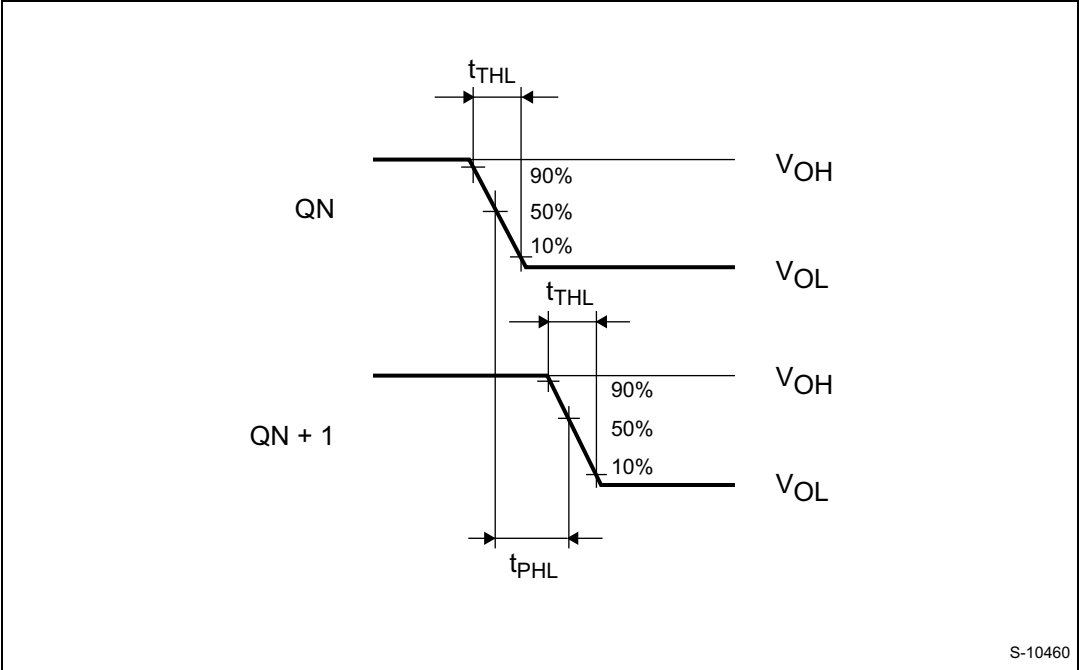
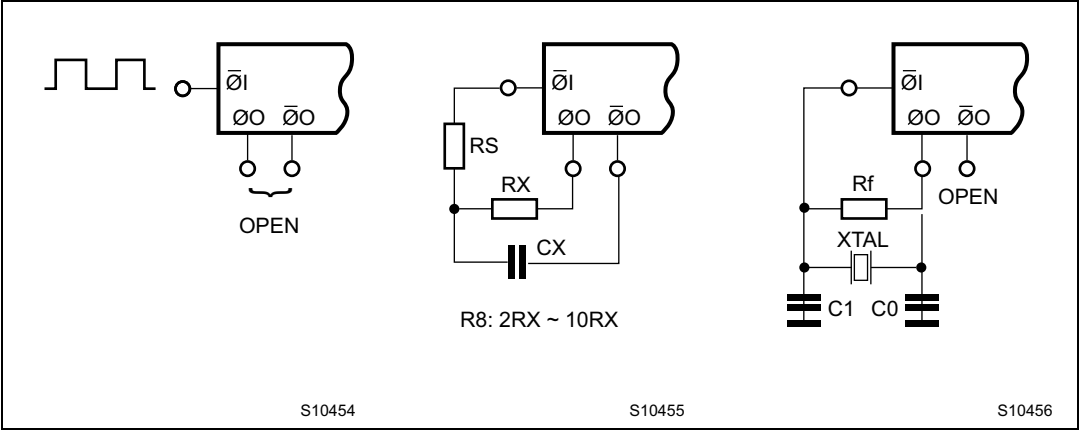


Figure 9. Typical clock drive circuits



## 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](http://www.st.com). ECOPACK is an ST trademark.

## 4.1 SO16 package information

Figure 10. SO16 package outline

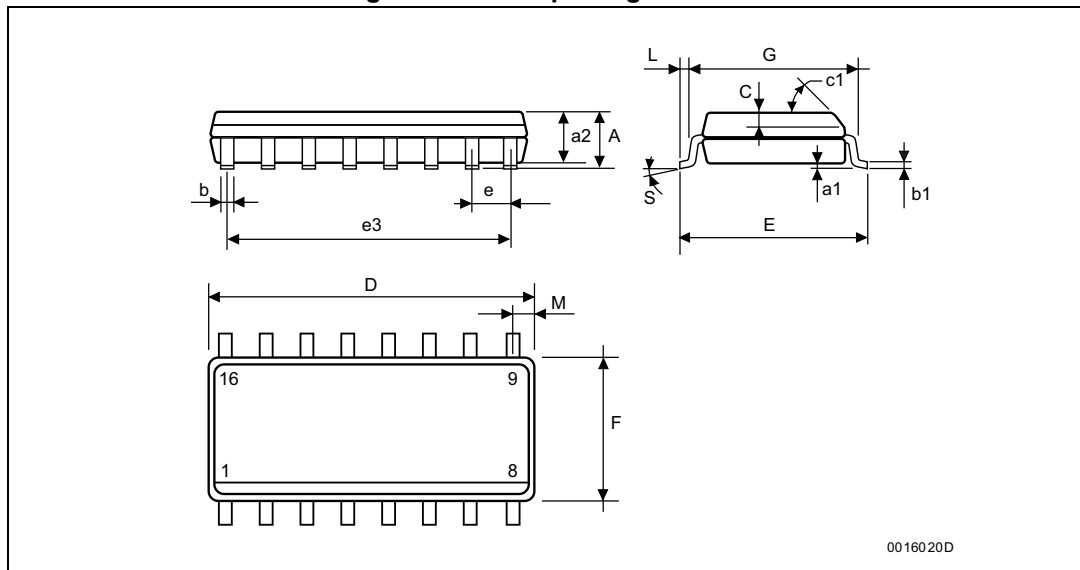


Table 9. SO16 package mechanical data

| 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

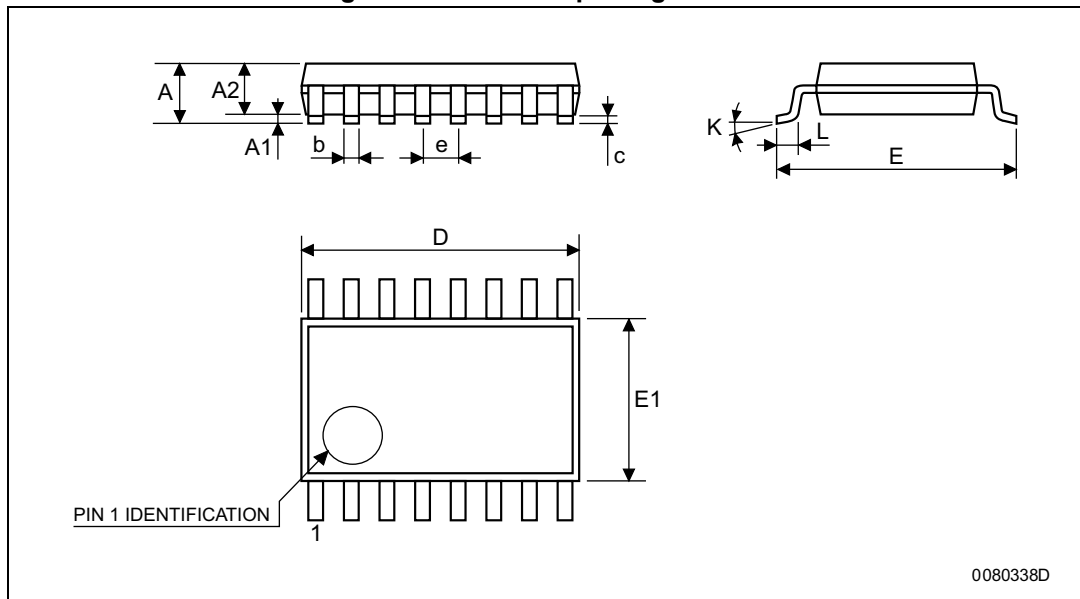


Table 10. TSSOP16 mechanical data

| 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 <sup>(1)</sup> | -40 °C to +125 °C | SO16<br>(automotive version)    |               | 74HC4060Y |
| M74HC4060TTR                    | -55 °C to +125 °C | TSSOP16                         |               | HC4060    |
| M74HC4060YTTR <sup>(1)</sup>    | -40 °C to +125 °C | TSSOP16<br>(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 <a href="#">1</a>.</p> <p>Added <a href="#">Section 5: Ordering information</a></p> <p>Updated layout</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |



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