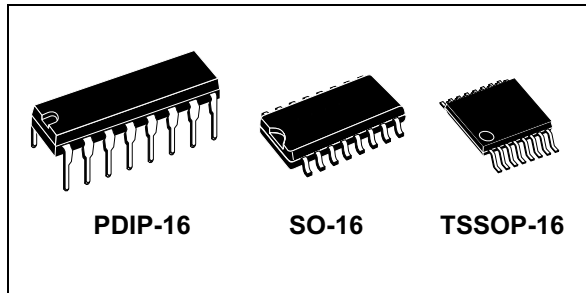


## 14-stage binary counter/oscillator

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

### 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  $\overline{\text{OI}}$  input and the CLEAR input are equipped with protection circuits against static discharge and transient excess voltage.

**Table 1. Device summary**

| Ordering code                   | Temperature range | Package                       | Marking     |
|---------------------------------|-------------------|-------------------------------|-------------|
| M74HC4060B1R                    | -55 °C to +125 °C | PDIP-16                       | M74HC4060B1 |
| M74HC4060RM13TR                 | -55 °C to +125 °C | SO-16                         | 74HC4060    |
| M74HC4060YRM13TR <sup>(1)</sup> | -40 °C to +125 °C | SO-16 (automotive version)    | 74HC4060Y   |
| M74HC4060TTR                    | -55 °C to +125 °C | TSSOP-16                      | HC4060      |
| M74HC4060YTTR <sup>(1)</sup>    | -40 °C to +125 °C | TSSOP-16 (automotive version) | HC4060Y     |

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

# Contents

|   |                                  |    |
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| 1 | Pin description .....            | 3  |
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# 1 Pin description

Figure 1. Pin connection and IEC logic symbols

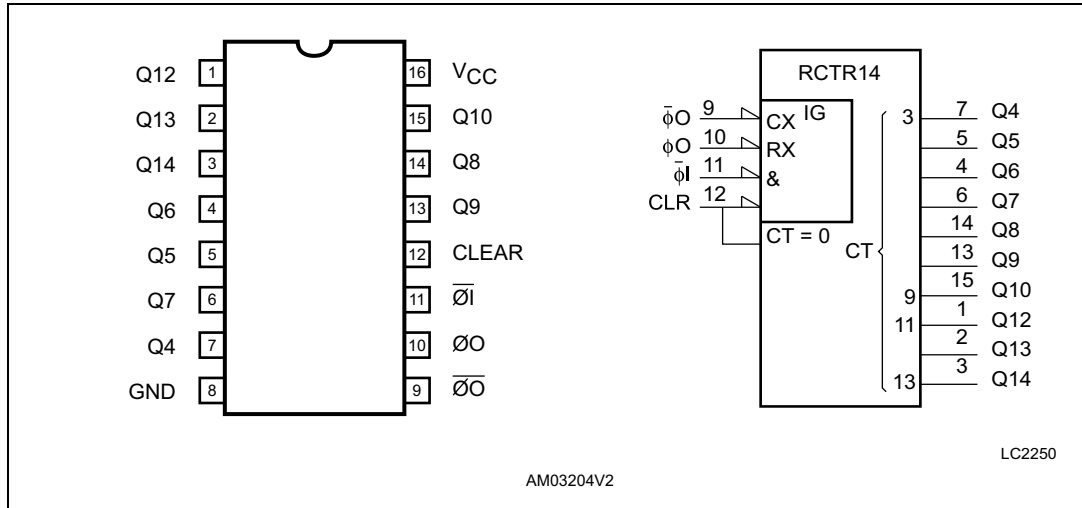


Figure 2. Input and output equivalent circuit

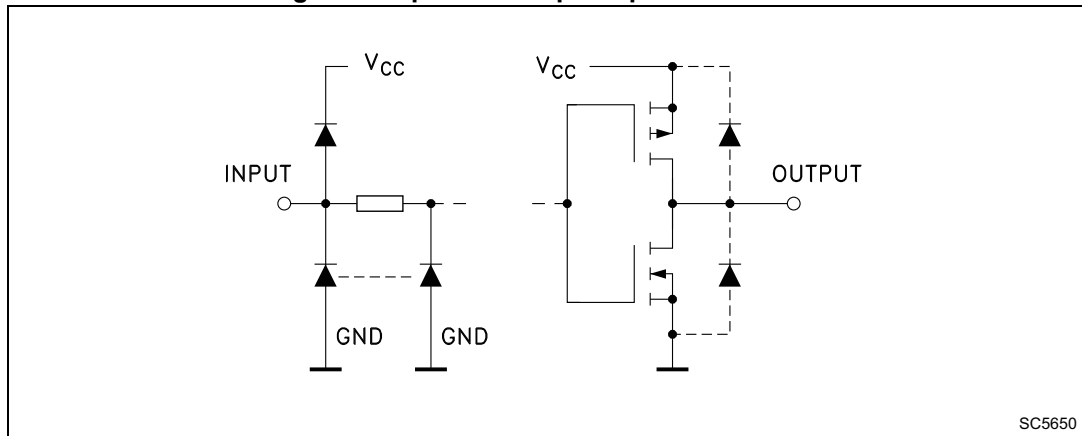
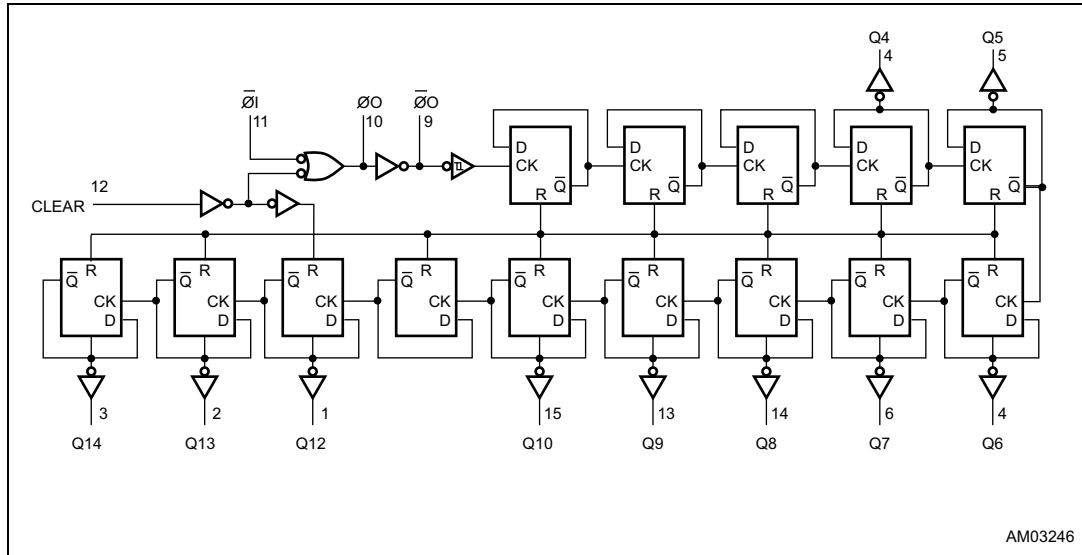


Table 2. Pin description

| Pin no                 | Symbol          | Name and function             |
|------------------------|-----------------|-------------------------------|
| 1, 2, 3                | Q12 to Q14      | Counter outputs               |
| 7, 5, 4, 6, 14, 13, 15 | Q4 to Q10       | Counter outputs               |
| 9                      | ØO              | External capacitor connection |
| 10                     | ØO              | External resistor connection  |
| 11                     | ØI              | 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 3. Logic diagram



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

Table 3. Truth table

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

1. X: don't care.

### 3 Maximum ratings

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

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    |
| $V_O$      | Output voltage           |                         | 0 to $V_{CC}$ | V    |
| $T_{op}$   | 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      | ns   |
|            |                          | $V_{CC} = 6.0\text{ V}$ | 0 to 400      | ns   |

## 4 Electrical characteristics

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 ( $\overline{0}0$ , $\overline{0}\overline{0}$ 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 ( $\overline{0}0$ , $\overline{0}\overline{0}$ 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)

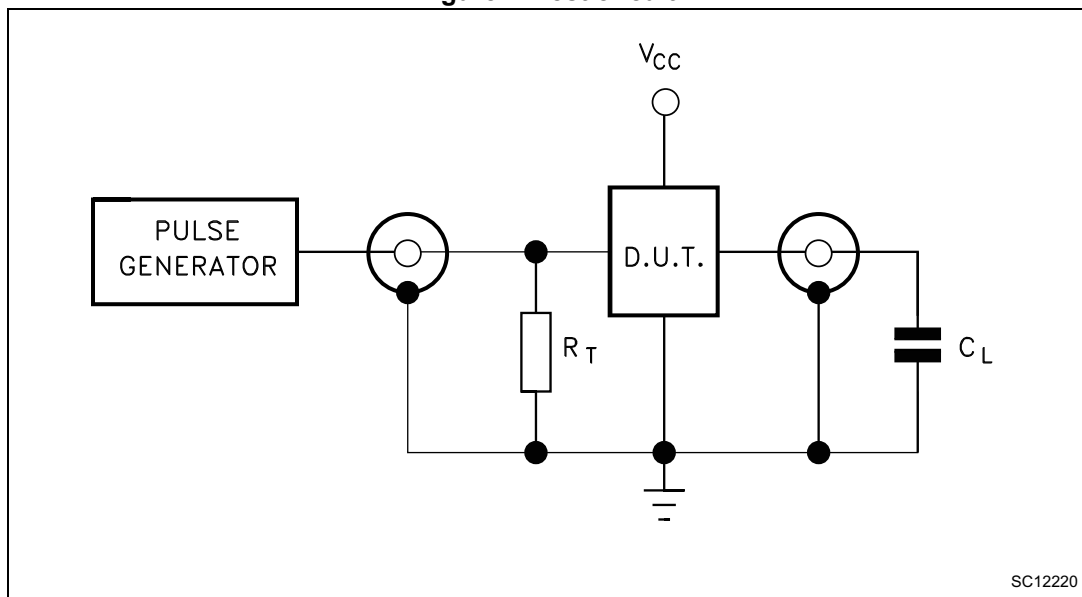
| Symbol                  | Parameter  | Test condition | Value        |                                  |      |      |  |      | Unit |   |      |
|-------------------------|--|----------------|--------------|----------------------------------|------|------|--|------|------|---|------|
|                         |  |                | $V_{CC}$ (V) | $T_A = 25\text{ }^\circ\text{C}$ |      |      | $-40\text{ to }85\text{ }^\circ\text{C}$ |      |      | $-55\text{ to }125\text{ }^\circ\text{C}$ |      |
|                         |  |                |              | 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 ( $\overline{Q1} - \overline{Q4}$ ) | 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   |      |              |      |               |      | pF   |

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

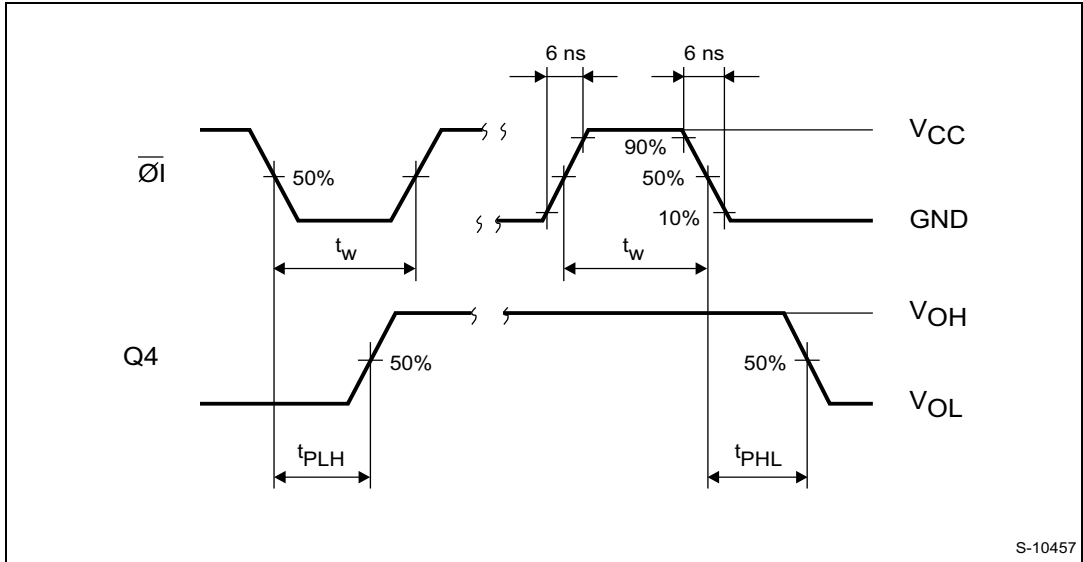


1. C<sub>L</sub> = 50 pF or equivalent (includes jig and probe capacitance)  
 R<sub>T</sub> = Z<sub>OUT</sub> of pulse generator (typically 50 Ω).



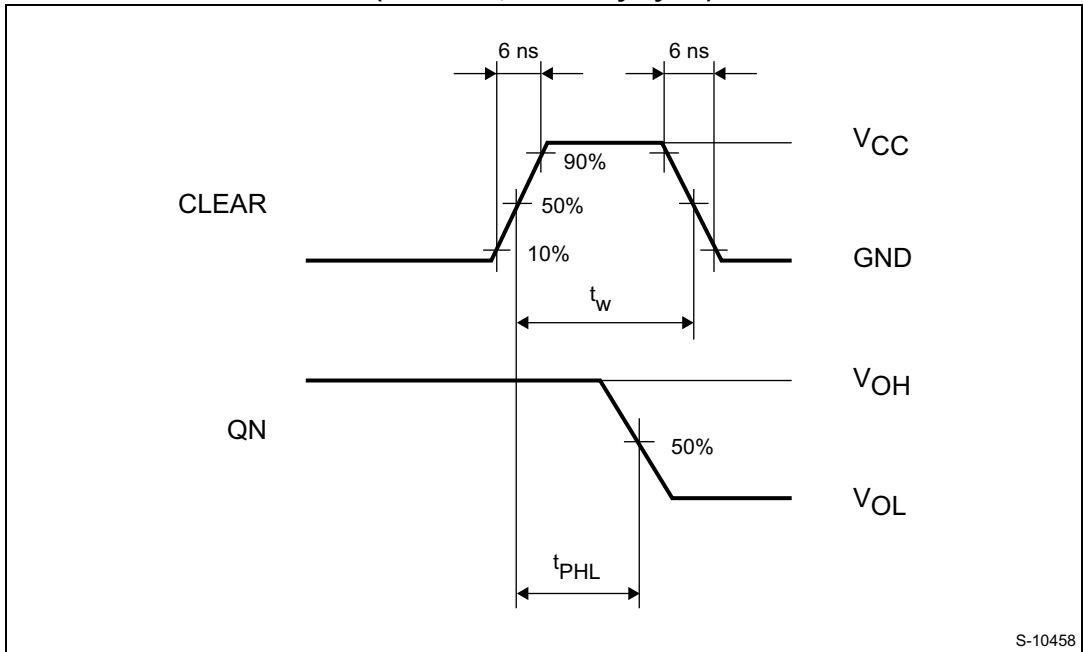
# 5 Waveforms

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

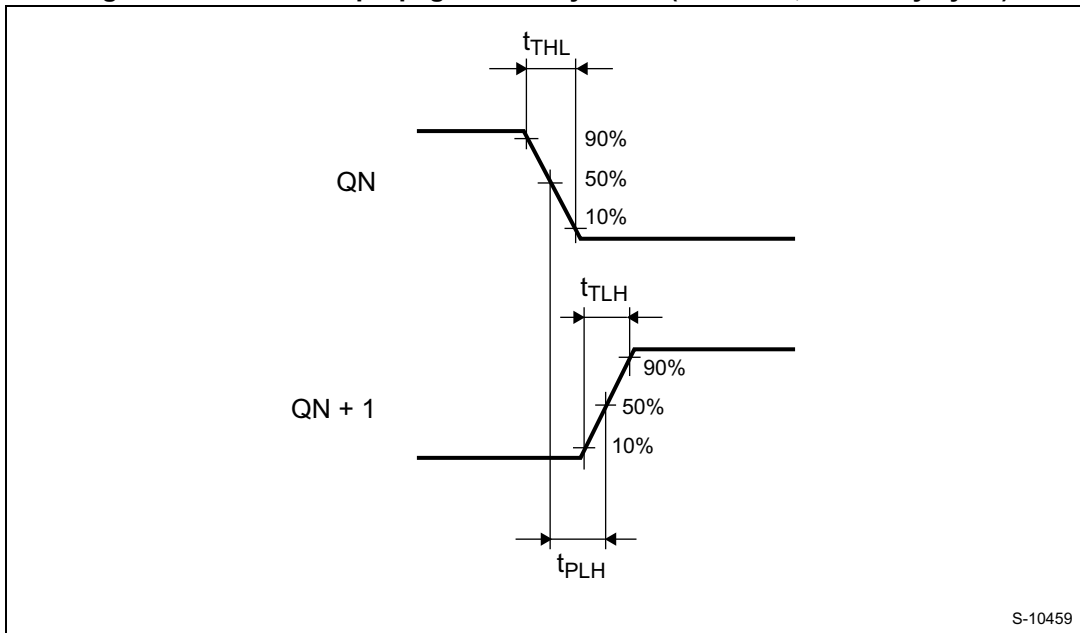


Figure 8. Waveform 4: propagation delay times (f = 1 MHz; 50% duty cycle)

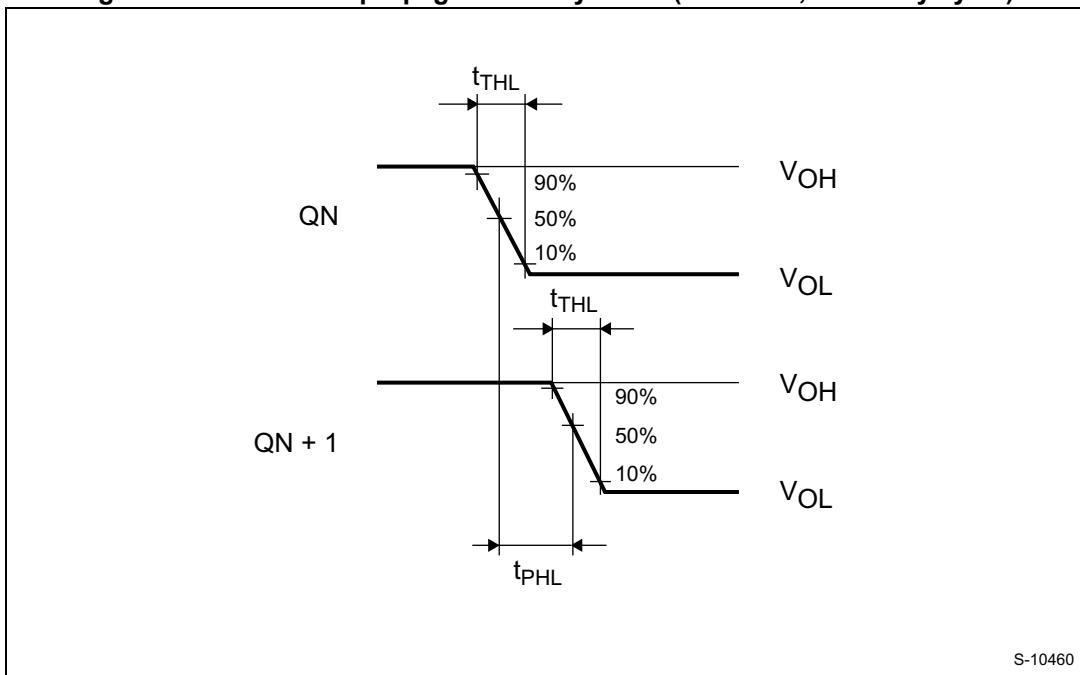
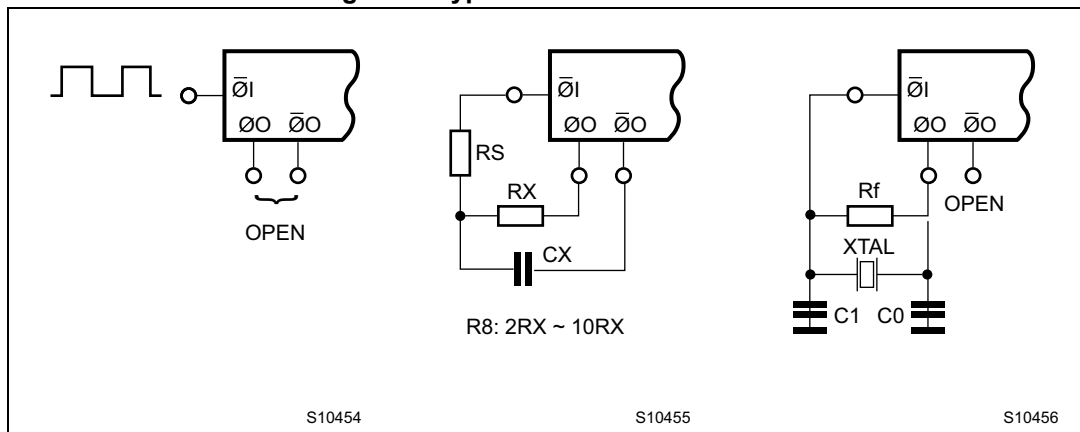


Figure 9. Typical clock drive circuits



## 6 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.

Figure 10. Plastic DIP-16 package outline

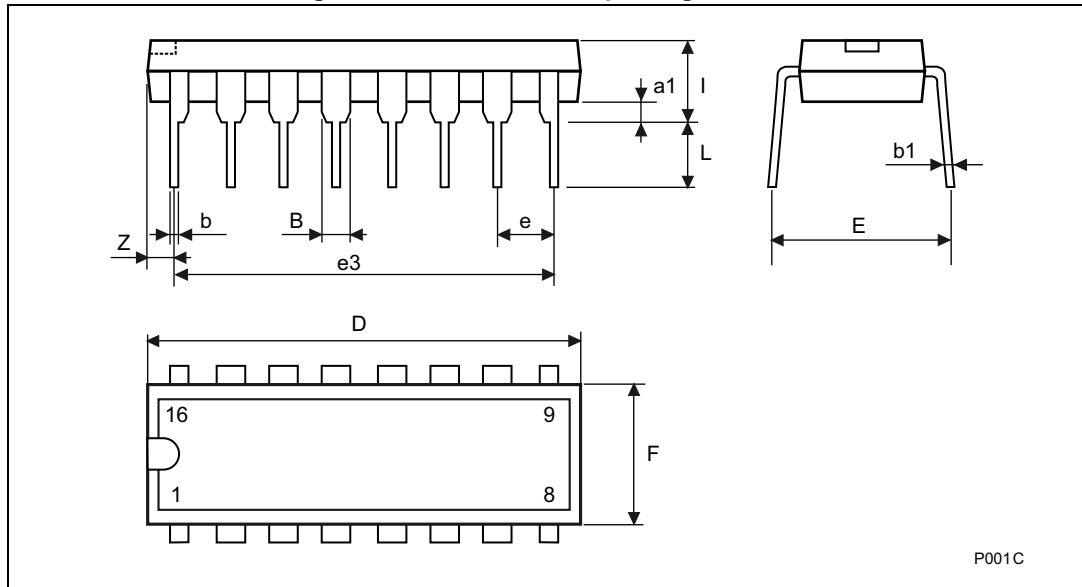
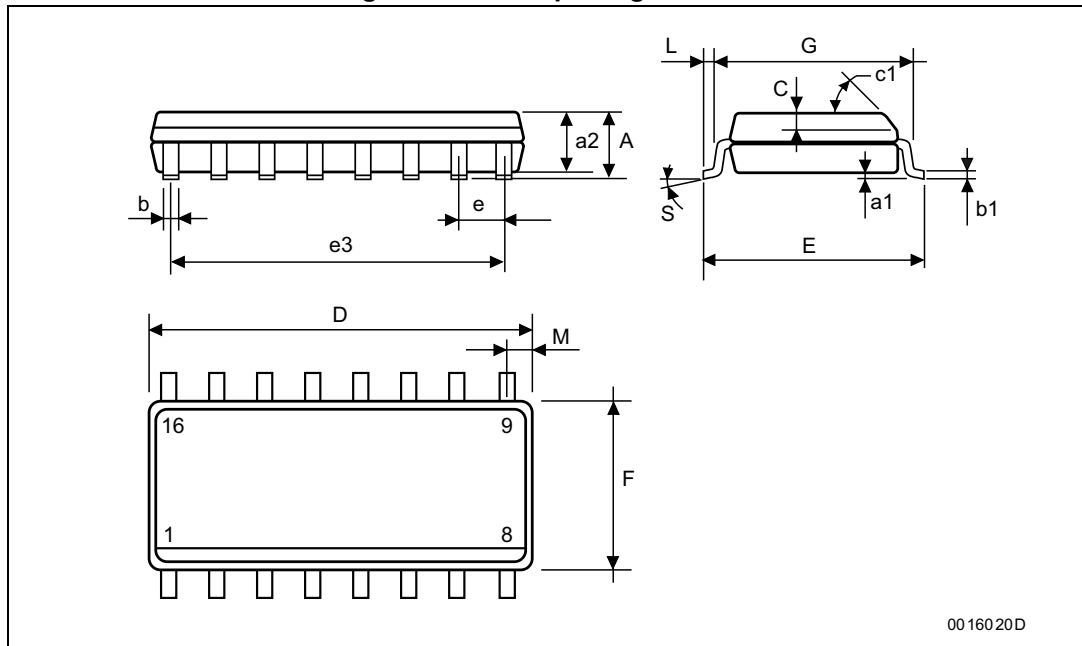


Table 9. Plastic DIP-16 (0.25) package mechanical data

| Symbol | Dimensions |       |      |       |       |       |
|--------|------------|-------|------|-------|-------|-------|
|        | mm         |       |      | inch  |       |       |
|        | Min.       | Typ.  | Max. | Min.  | Typ.  | Max.  |
| a1     | 0.51       |       |      | 0.020 |       |       |
| B      | 0.77       |       | 1.65 | 0.030 |       | 0.065 |
| b      |            | 0.5   |      |       | 0.020 |       |
| b1     |            | 0.25  |      |       | 0.010 |       |
| D      |            |       | 20   |       |       | 0.787 |
| E      |            | 8.5   |      |       | 0.335 |       |
| e      |            | 2.54  |      |       | 0.100 |       |
| e3     |            | 17.78 |      |       | 0.700 |       |
| F      |            |       | 7.1  |       |       | 0.280 |
| l      |            |       | 5.1  |       |       | 0.201 |
| L      |            | 3.3   |      |       | 0.130 |       |
| Z      |            |       | 1.27 |       |       | 0.050 |

Figure 11. SO-16 package outline



00 16020D

Table 10. SO-16 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.)  |      |      |       |       |       |

Figure 12. TSSOP-16 package outline

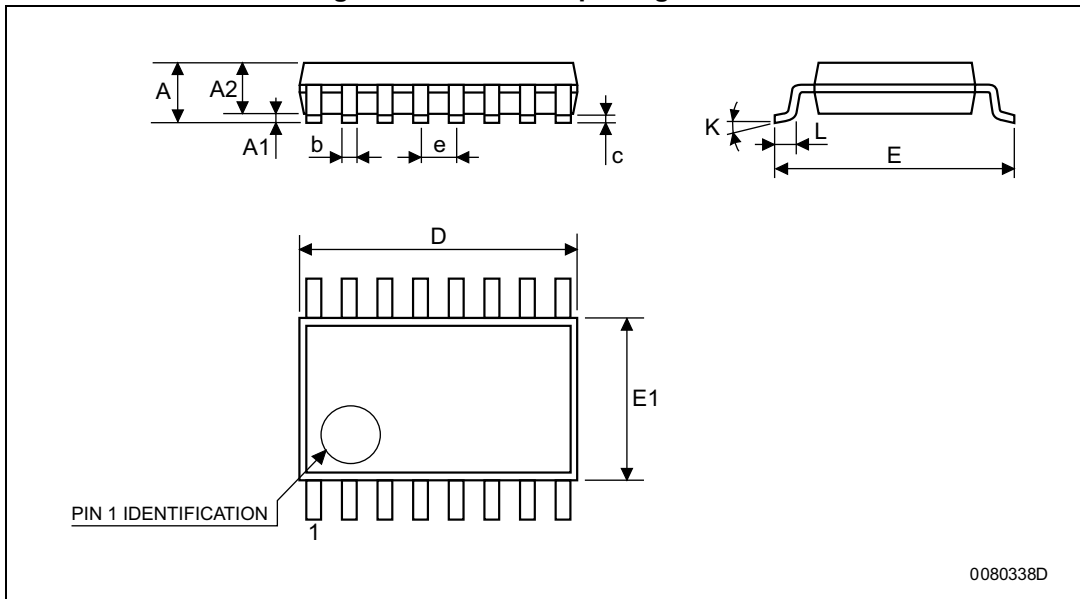


Table 11. TSSOP-16 mechanical data

| 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 BSC |      |       | 0.0256 BSC |        |
| K      | 0°         |          | 8°   | 0°    |            | 8°     |
| L      | 0.45       | 0.60     | 0.75 | 0.018 | 0.024      | 0.030  |

## 7 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 3</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 7: 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 12</a>.</p> <p>Updated <a href="#">Section 6: Package information</a> (added ECOPACK text, reversed order of <a href="#">Figure 10</a> to <a href="#">Figure 12</a> and <a href="#">Table 10</a> to <a href="#">Table 11</a>).</p> <p>Minor corrections throughout document.</p> |

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