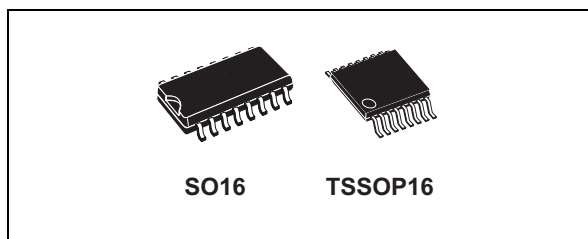


14-stage binary counter/oscillator

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

Features

- High speed:
 $f_{\max} = 65$ MHz (typ.) at $V_{CC} = 6$ V
- Low power dissipation:
 $I_{CC} = 4$ A (max.) at $T_A = 25$ °C
- High noise immunity:
 $V_{NIH} = V_{NIL} = 28\%$ V_{CC} (min.)
- Symmetrical output impedance:
 $I_{OH} = I_{OL} = 4$ mA (min.)
- Balanced propagation delays: $T_{PLH} \cong T_{PHL}$
- Wide operating voltage range:
 V_{CC} (opr.) = 2 V to 6 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 ⁽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

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1 Pin description

Figure 1. Pin connection and IEC logic symbols

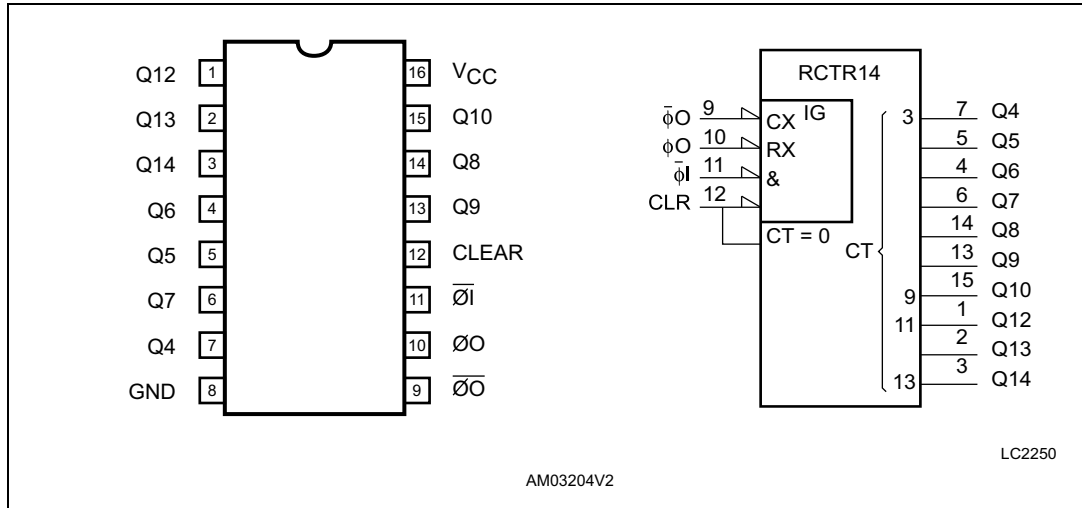


Table 2. Pin description

| 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 | ØØ | 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 _{CC} | Positive supply voltage |

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 | $V_{CC} = 2.0\text{ V}$ | 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 _{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 (ØO, ØØ 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 (ØO, ØØ 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)

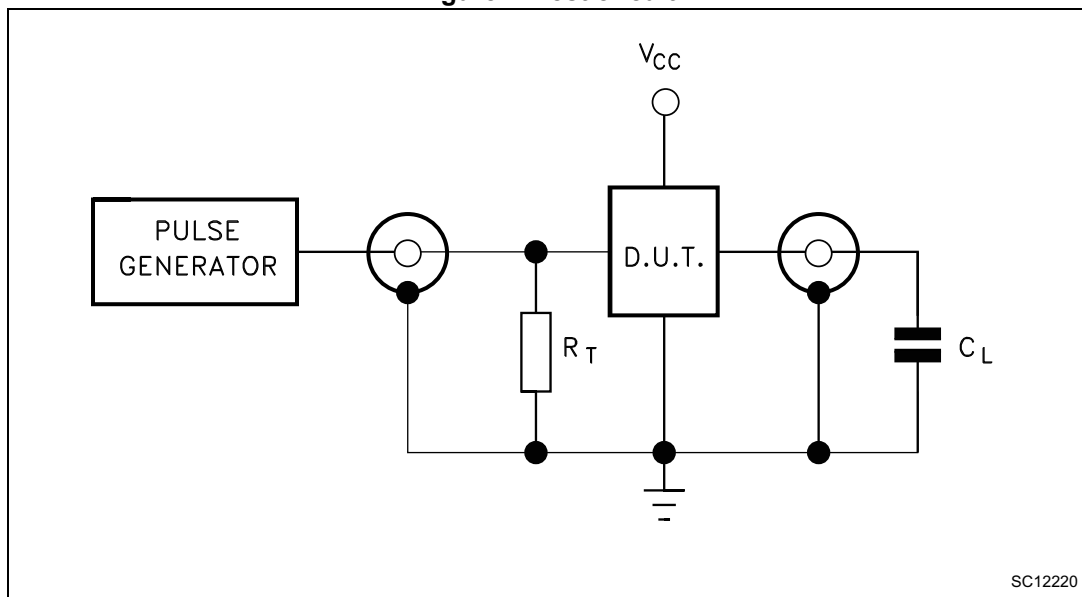
| Symbol | Parameter | Test condition | Value | | | | | | Unit | | |
|-------------------------|---|----------------|--------------|----------------------------------|------|------|-------------------------------------|------|------|--------------------------------------|------|
| | | | V_{CC} (V) |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

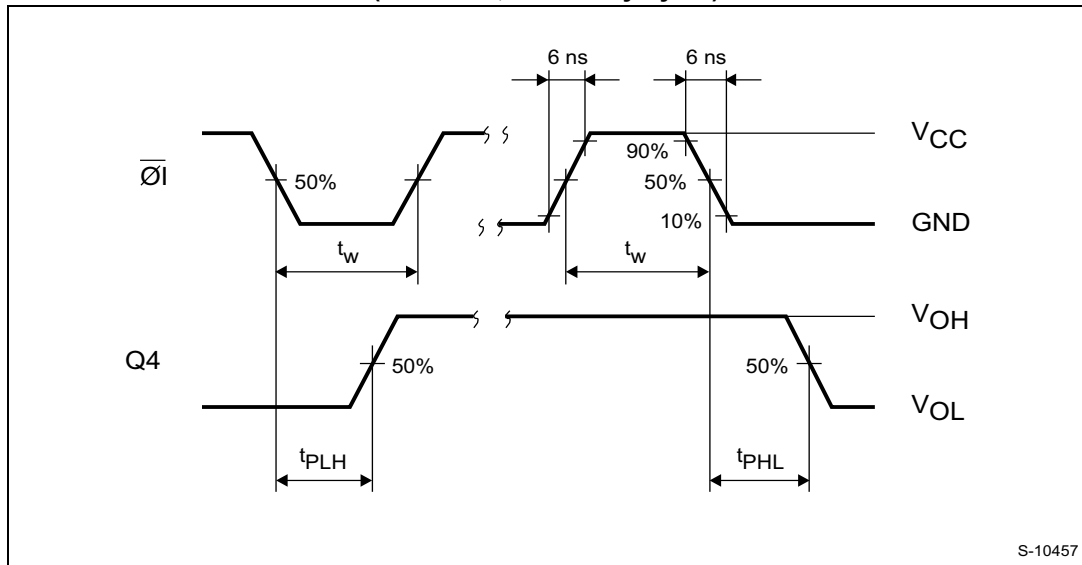
1. C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to [Figure 4: Test circuit](#)). Average operating current can be obtained by the following equation. $I_{CC(opr.)} = C_{PD} \times V_{CC} \times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

Figure 4. Test circuit



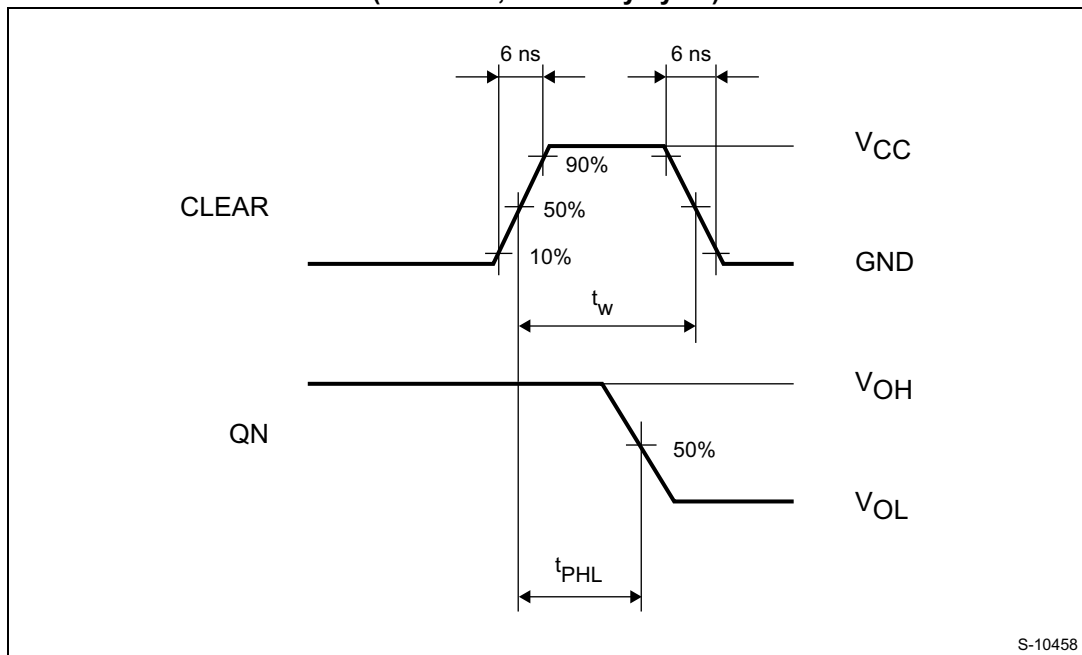
1. C_L = 50 pF or equivalent (includes jig and probe capacitance)
 R_T = Z_{OUT} of pulse generator (typically 50 Ω).

**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)

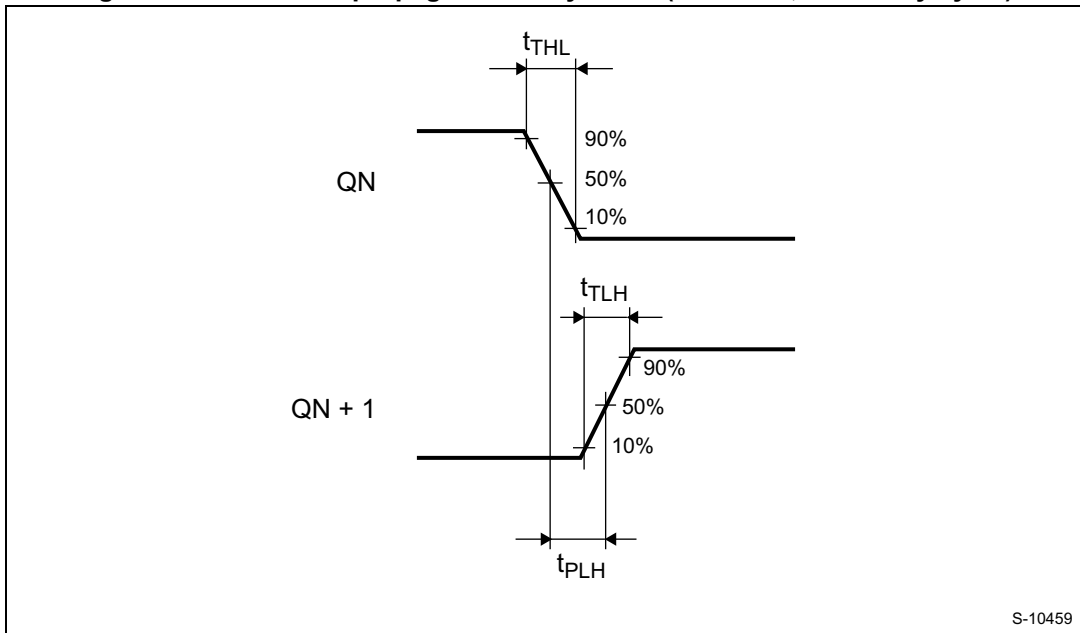


Figure 8. Waveform 4: propagation delay times (f = 1 MHz; 50 % duty cycle)

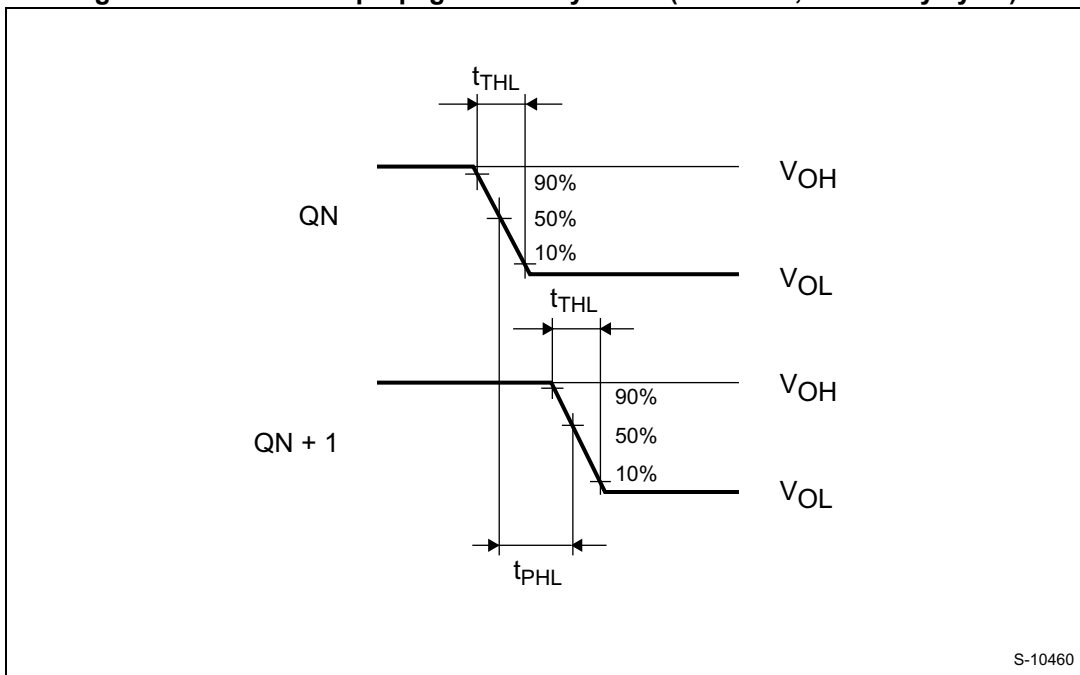
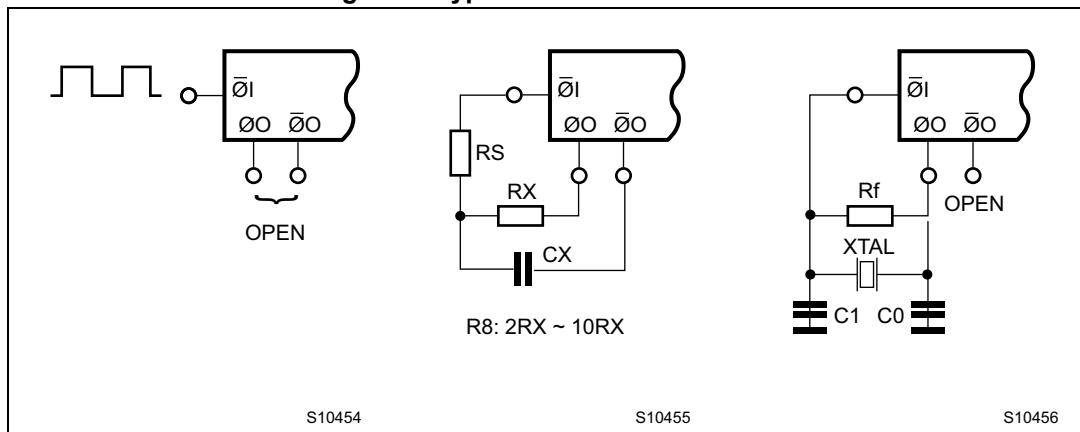


Figure 9. Typical clock drive circuits

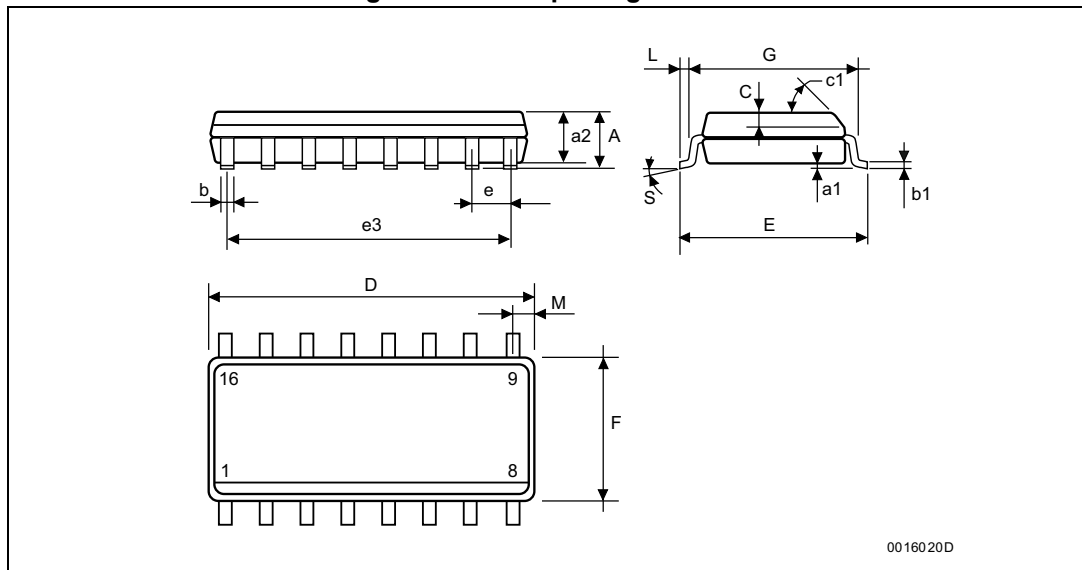


4 Package information

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



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

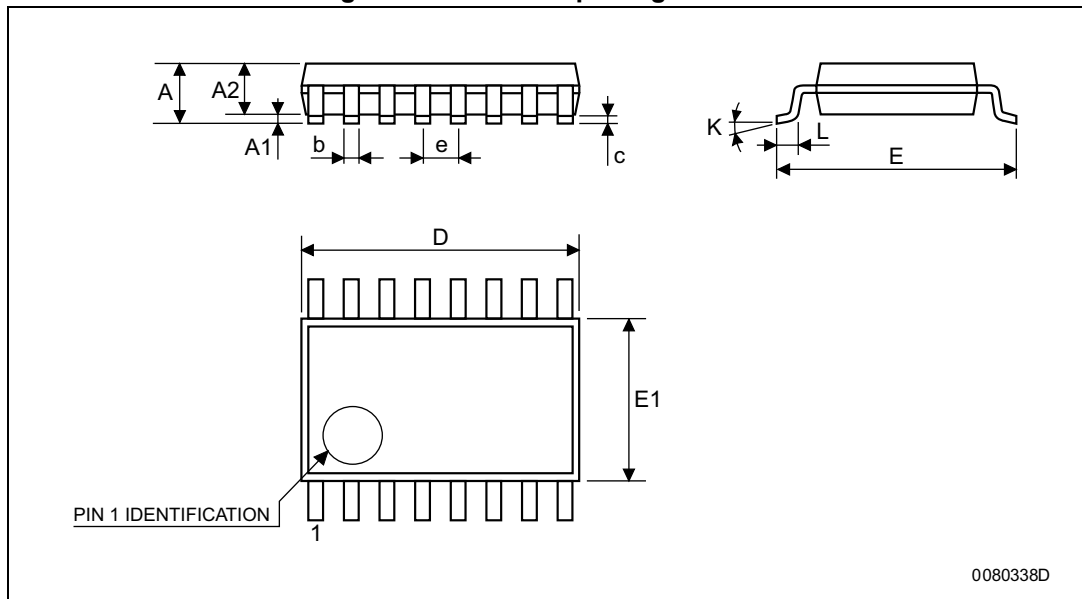


Table 10. TSSOP16 mechanical data

| 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 ⁽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 | <p>Added Applications on page 1.</p> <p>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.”).</p> <p>Updated Table 1 (added order codes, temperature range, updated package, added marking).</p> <p>Moved Figure 1 to page 3.</p> <p>Redrawn Figure 1, Figure 2, Figure 5 to Figure 9.</p> <p>Added Contents.</p> <p>Added titles to Section 1: Pin description to Section 6: Revision history.</p> <p>Added numbers to Table 1 to Table 12 and Figure 1 to Figure 11.</p> <p>Updated Section 4: Package information (added ECOPACK text, reversed order of Figure 10 to Figure 11 and Table 9 to Table 10).</p> <p>Minor corrections throughout document.</p> |
| 10-Jan-2014 | 3 | <p>Removed PDIP16 package</p> <p>Added ESD data to Features</p> <p>Table 1: Device summary: added “Packing” and updated footnote 1.</p> <p>Added Section 5: Ordering information</p> <p>Updated layout</p> |

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