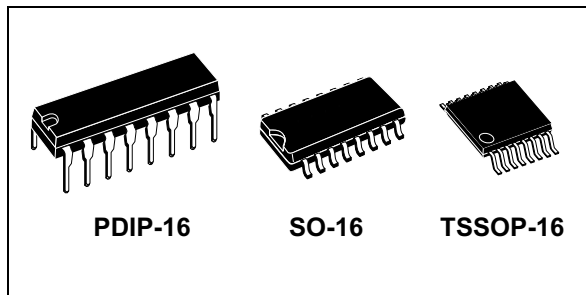


14-stage binary counter/oscillator

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 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 $\bar{\text{O}}\text{I}$ 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 ⁽¹⁾ | -40 °C to +125 °C | SO-16 (automotive version) | 74HC4060Y |
| M74HC4060TTR | -55 °C to +125 °C | TSSOP-16 | HC4060 |
| M74HC4060YTTR ⁽¹⁾ | -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

| | | |
|---|----------------------------------|----|
| 1 | Pin description | 3 |
| 2 | Functional description | 4 |
| 3 | Maximum ratings | 5 |
| 4 | Electrical characteristics | 6 |
| 5 | Waveforms | 9 |
| 6 | Package information | 12 |
| 7 | Revision history | 15 |

1 Pin description

Figure 1. Pin connection and IEC logic symbols

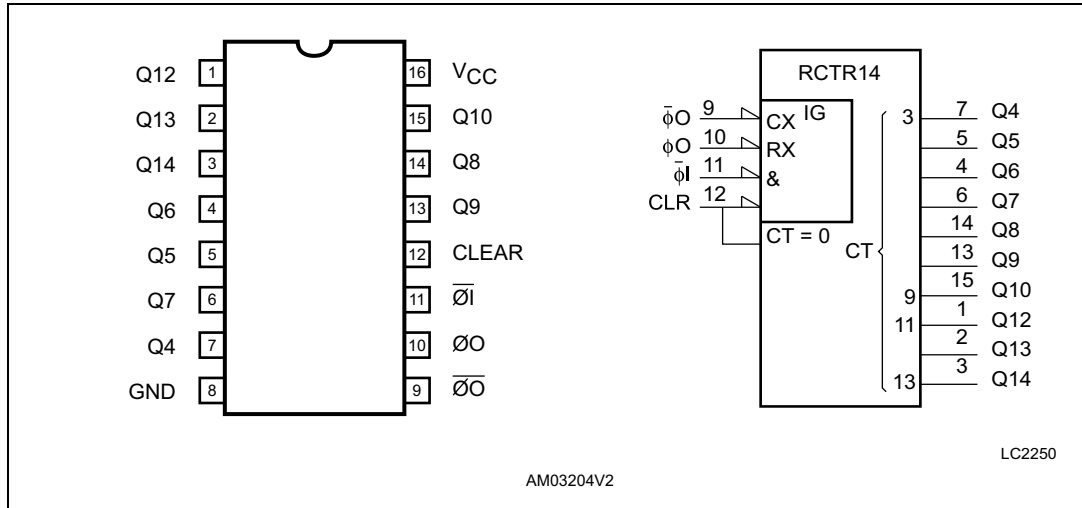


Figure 2. Input and output equivalent circuit

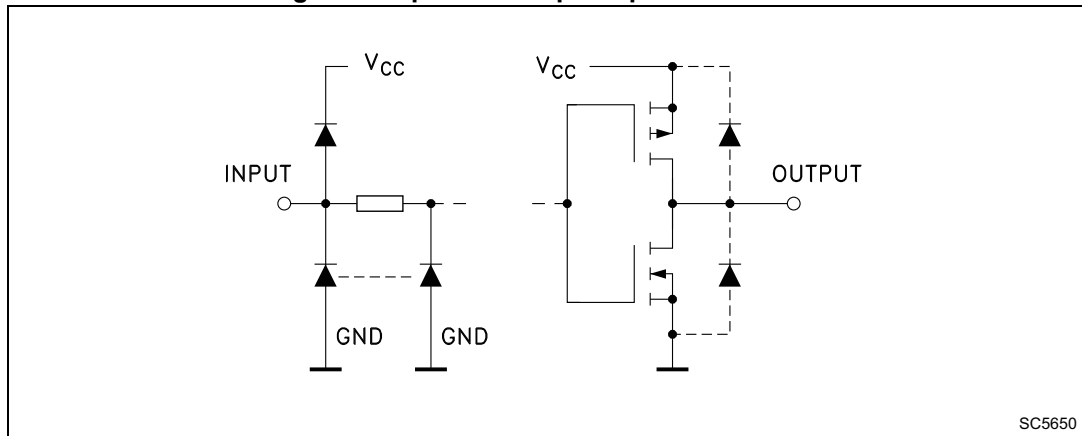
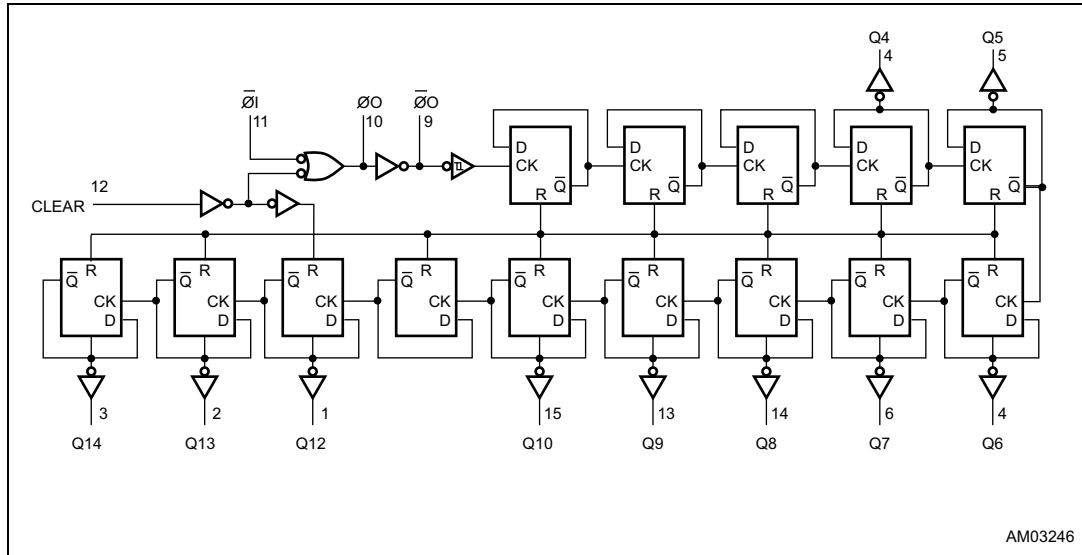


Table 2. Pin description

| 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 | VCC | 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

| $\bar{\emptyset}i$ | CLEAR | Function |
|--------------------|-------|--|
| X ⁽¹⁾ | 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.

3 Maximum ratings

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 |
| 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 ⁽²⁾ | 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 _{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 ($\overline{0}0$, $\overline{0}\overline{0}$ 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 ($\overline{0}0$, $\overline{0}\overline{0}$ 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)

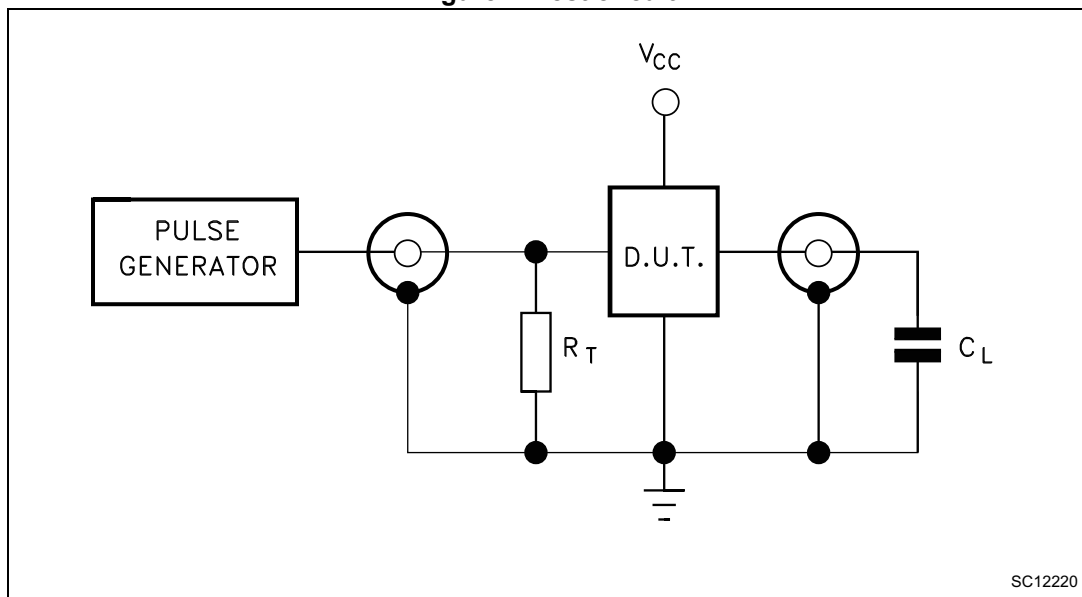
| Symbol | Parameter | Test condition | Value | | | | | | Unit | | |
|-------------------------|--|----------------|--------------|----------------------------------|------|------|--|------|------|---|------|
| | | | V_{CC} (V) | $T_A = 25\text{ }^\circ\text{C}$ | | | $-40\text{ to }85\text{ }^\circ\text{C}$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

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. $I_{CC(opr.)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$.

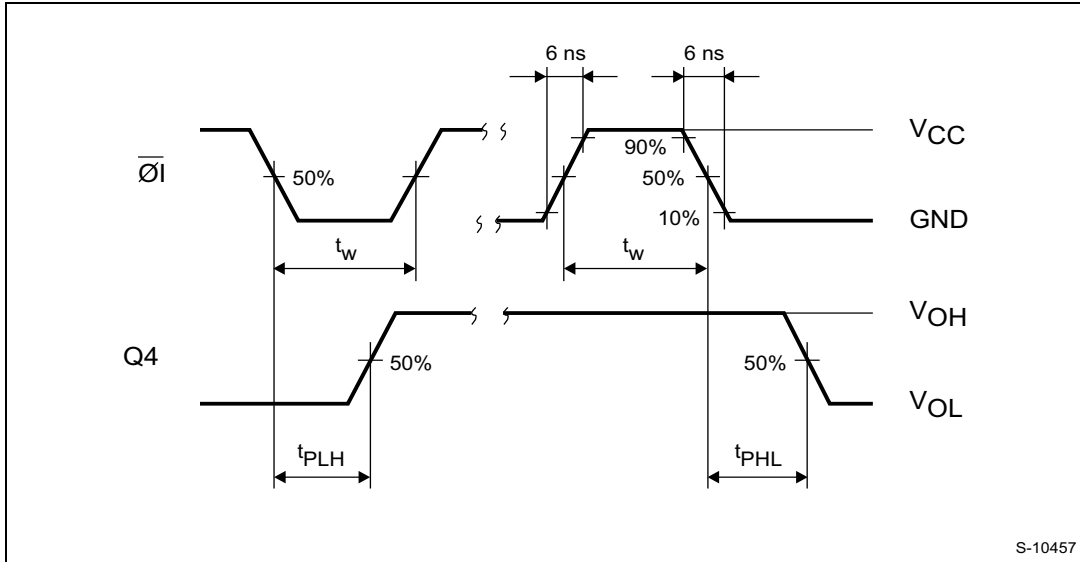
Figure 4. Test circuit



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

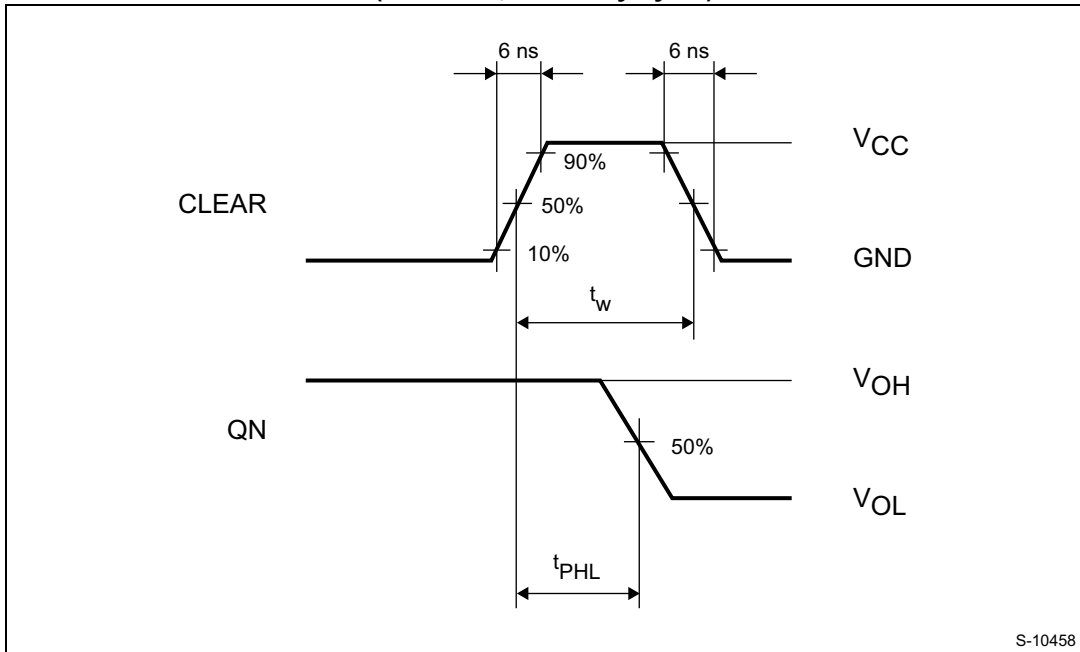
5 Waveforms

**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)

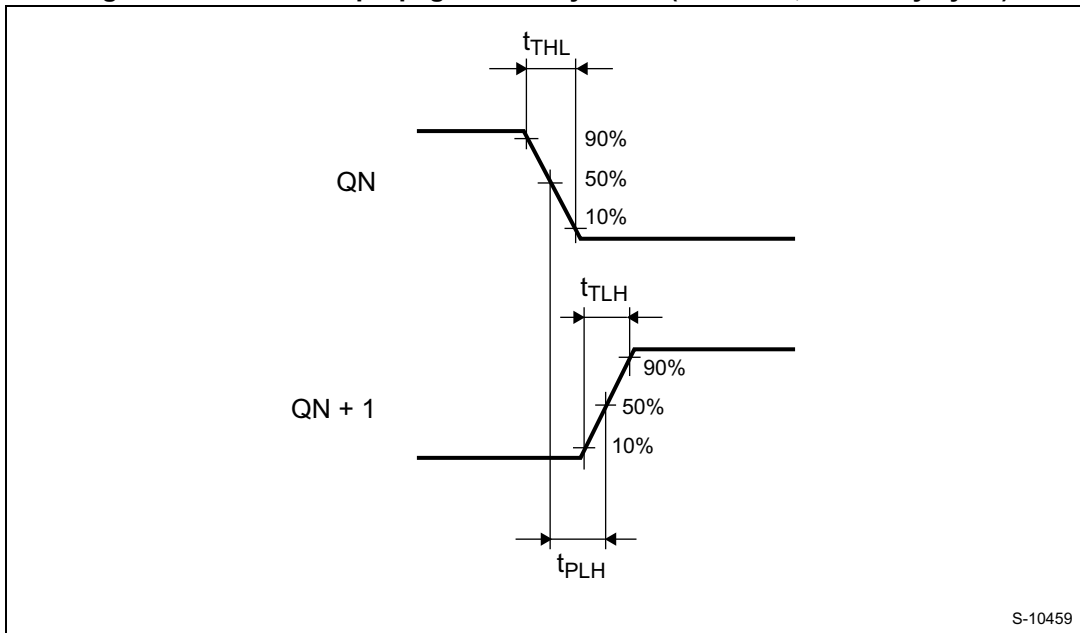


Figure 8. Waveform 4: propagation delay times (f = 1 MHz; 50% duty cycle)

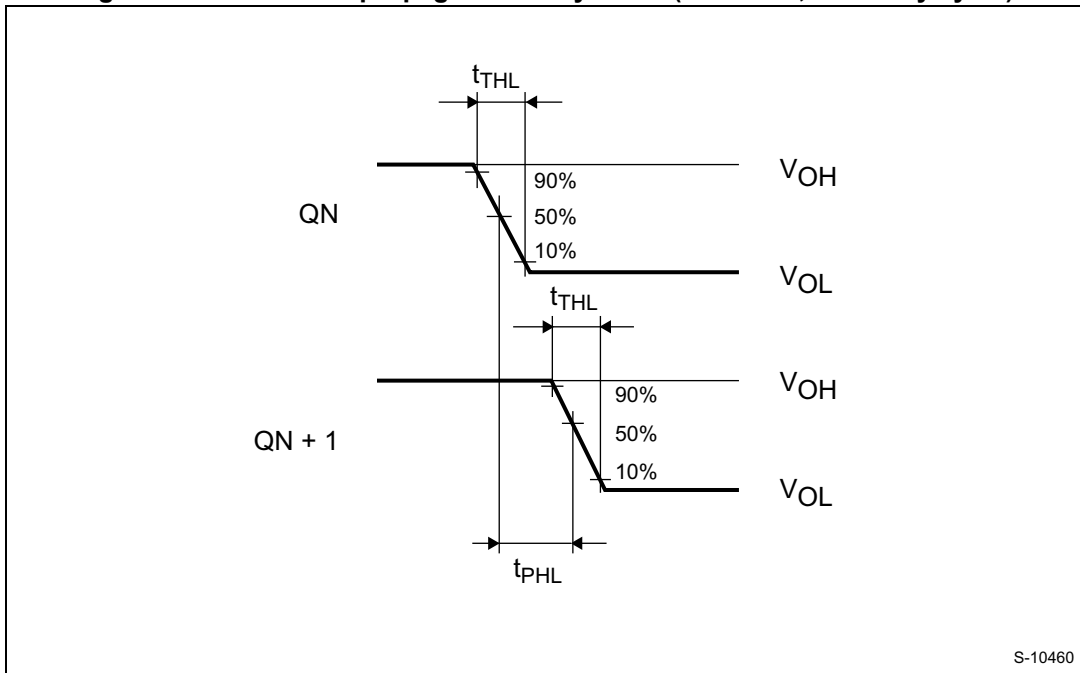
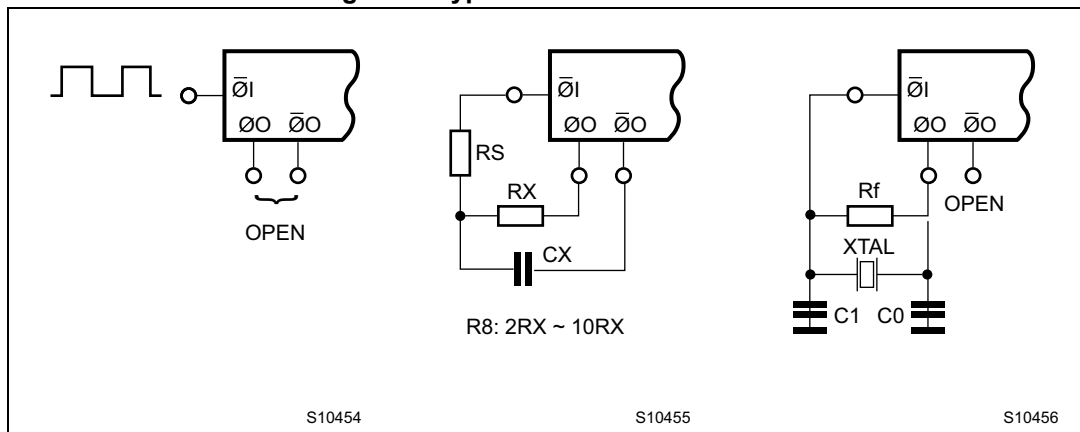


Figure 9. Typical clock drive circuits



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. ECOPACK is an ST trademark.

Figure 10. Plastic DIP-16 package outline

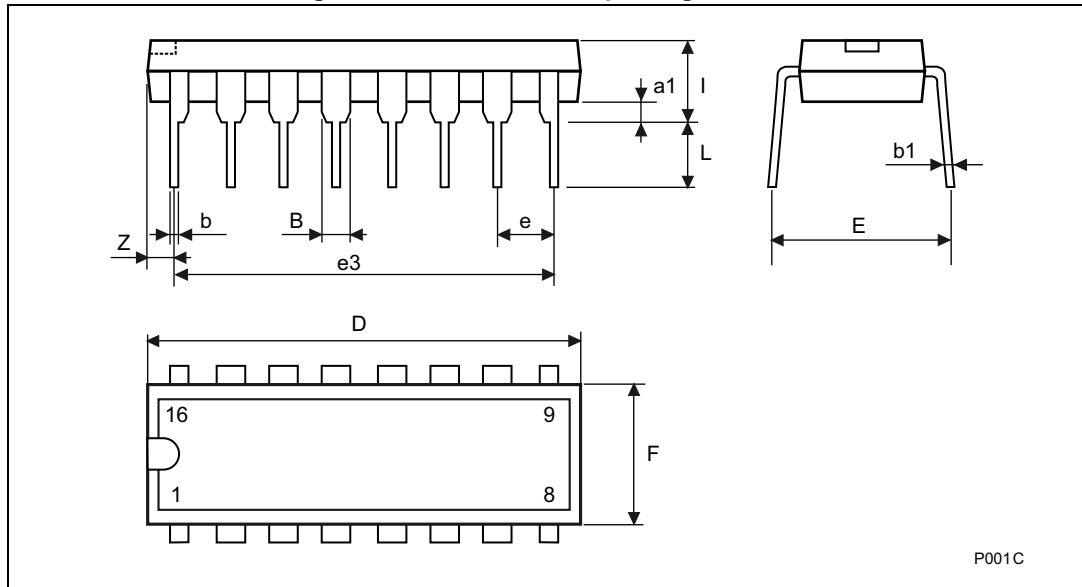
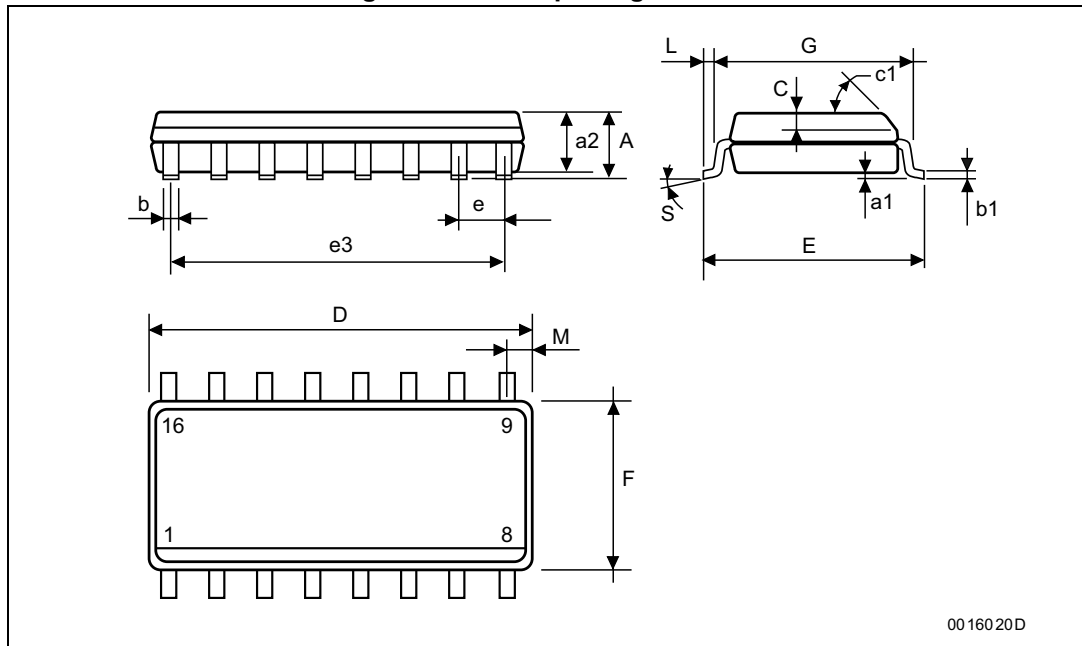


Table 9. Plastic DIP-16 (0.25) package mechanical data

| 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

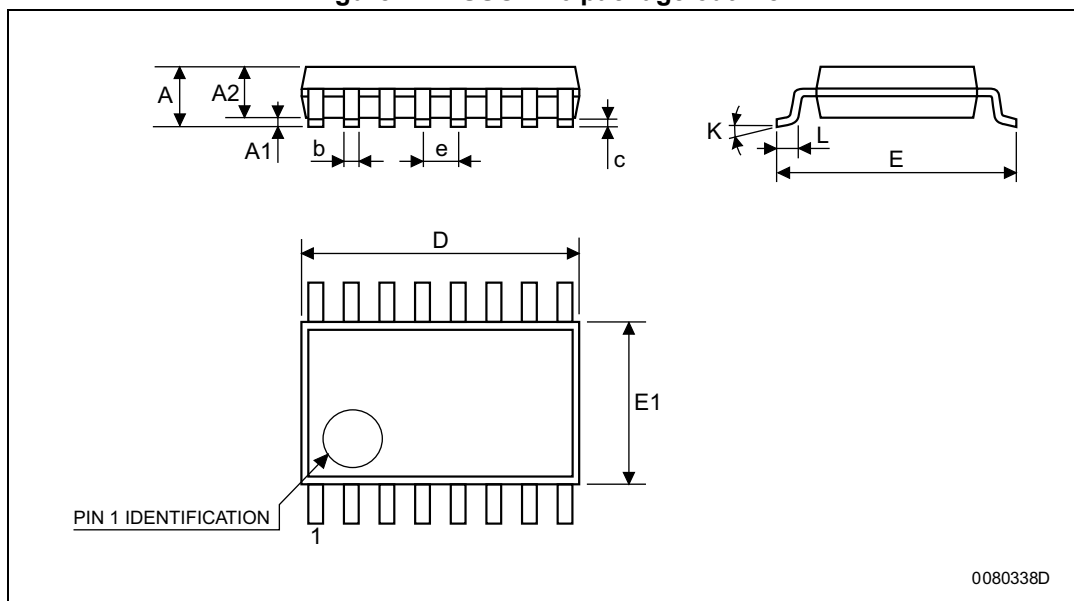


Table 11. TSSOP-16 mechanical data

| 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 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 3, Figure 5 to Figure 9.</p> <p>Added Contents.</p> <p>Added titles to Section 1: Pin description to Section 7: Revision history.</p> <p>Added numbers to Table 1 to Table 12 and Figure 1 to Figure 12.</p> <p>Updated Section 6: Package information (added ECOPACK text, reversed order of Figure 10 to Figure 12 and Table 10 to Table 11).</p> <p>Minor corrections throughout document.</p> |

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 AUTHORIZED FOR USE IN WEAPONS. NOR ARE ST PRODUCTS 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.

© 2013 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