

74HC4060; 74HCT4060

14-stage binary ripple counter with oscillator

Rev. 5 — 8 May 2020

Product data sheet

1. General description

The 74HC4060; 74HCT4060 is a 14-stage ripple-carry counter/divider and oscillator with three oscillator terminals (RS, RTC and CTC), ten buffered parallel outputs (Q3 to Q9 and Q11 to Q13) and an overriding asynchronous master reset (MR). The oscillator configuration allows design of either RC or crystal oscillator circuits. The oscillator may be replaced by an external clock signal at input RS. In this case, keep the oscillator pins (RTC and CTC) floating. The counter advances on the HIGH-to-LOW transition of RS. A HIGH level on MR clears all counter stages and forces all outputs LOW, independent of the other input conditions. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

2. Features and benefits

- All active components on chip
- RC or crystal oscillator configuration
- Complies with JEDEC standard no. 7 A
- Input levels:
 - For 74HC4060: CMOS level
 - For 74HCT4060: TTL level
- ESD protection:
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

3. Applications

- Control counters
- Timers
- Frequency dividers
- Time-delay circuits

4. Ordering information

Table 1. Ordering information

| Type number | Package | | | Version |
|-------------|-------------------|----------|--|----------|
| | Temperature range | Name | Description | |
| 74HC4060D | -40 °C to +125 °C | SO16 | plastic small outline package; 16 leads; body width 3.9 mm | SOT109-1 |
| 74HCT4060D | | | | |
| 74HC4060DB | -40 °C to +125 °C | SSOP16 | plastic shrink small outline package; 16 leads; body width 5.3 mm | SOT338-1 |
| 74HC4060PW | -40 °C to +125 °C | TSSOP16 | plastic thin shrink small outline package; 16 leads; body width 4.4 mm | SOT403-1 |
| 74HC4060BQ | -40 °C to +125 °C | DHWQFN16 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 × 3.5 × 0.85 mm | SOT763-1 |
| 74HCT4060BQ | | | | |

5. Functional diagram

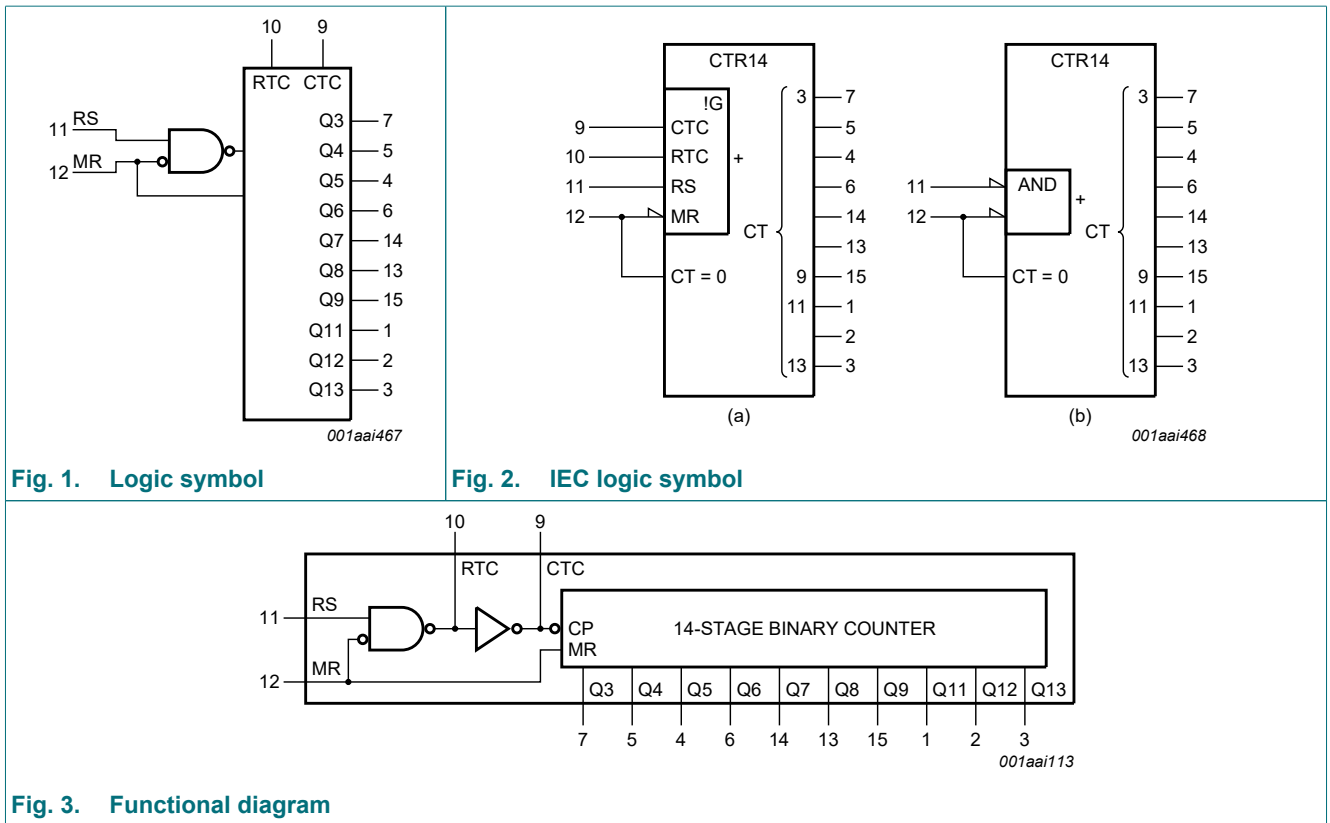




Fig. 4. Logic diagram

6. Pinning information

6.1. Pinning

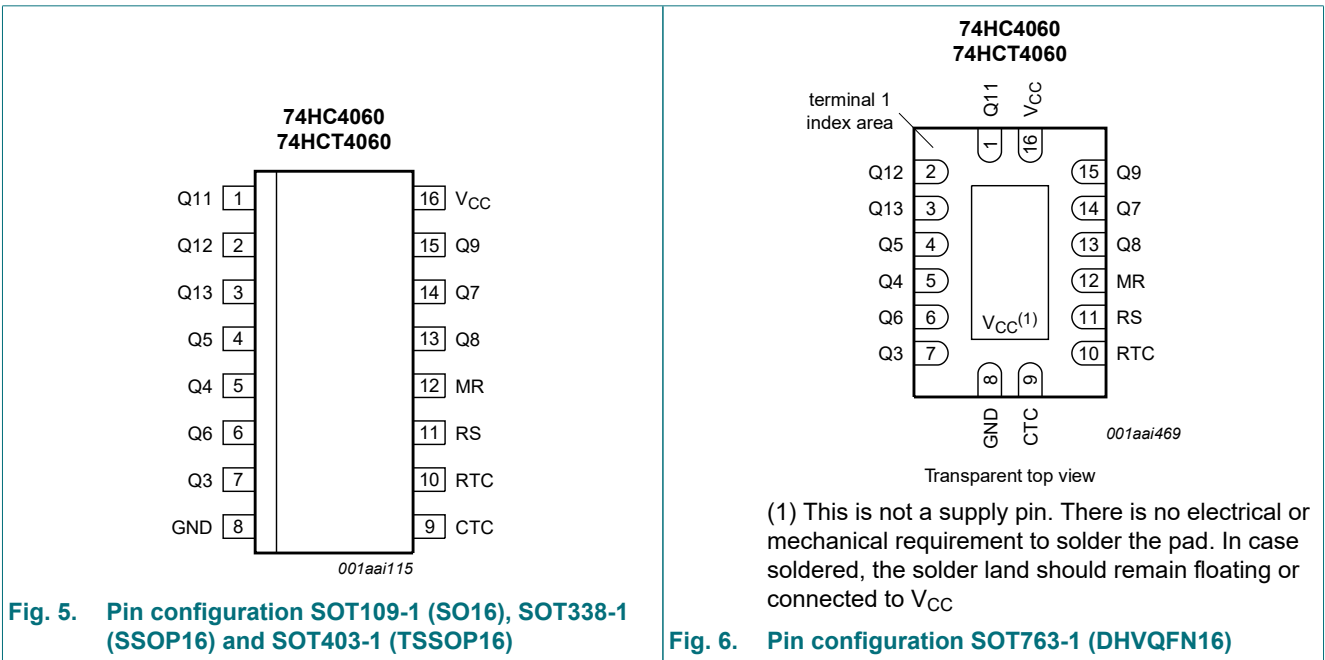


Fig. 5. Pin configuration SOT109-1 (SO16), SOT338-1 (SSOP16) and SOT403-1 (TSSOP16)

Fig. 6. Pin configuration SOT763-1 (DHVQFN16)

6.2. Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|----------------------------|------------------------|----------------------------------|
| Q11, Q12, Q13 | 1, 2, 3 | counter output |
| Q3, Q4, Q5, Q6, Q7, Q8, Q9 | 7, 5, 4, 6, 14, 13, 15 | counter output |
| GND | 8 | ground (0 V) |
| CTC | 9 | external capacitor connection |
| RTC | 10 | external resistor connection |
| RS | 11 | clock input /oscillator pin |
| MR | 12 | master reset input (active HIGH) |
| V _{CC} | 16 | supply voltage |

7. Functional description

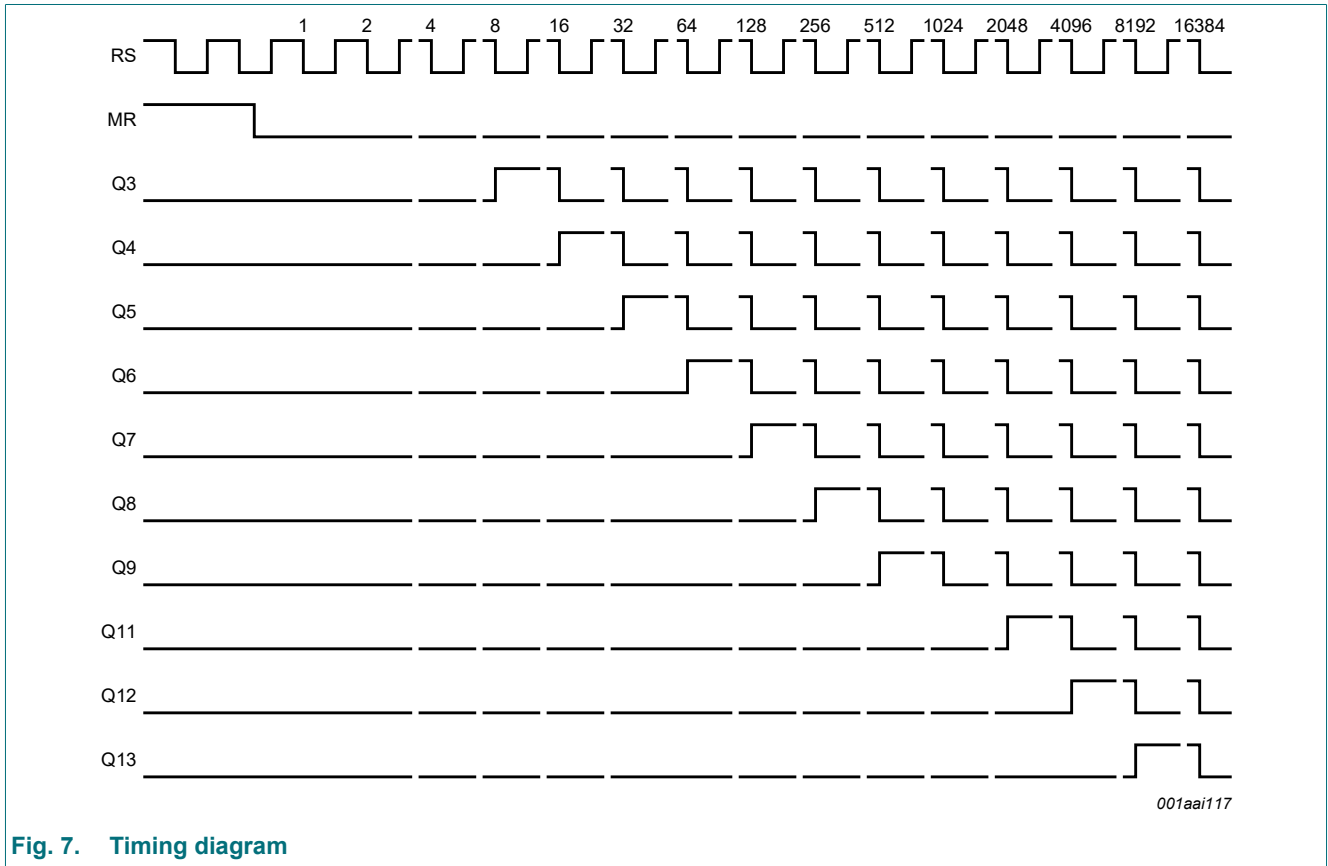


Fig. 7. Timing diagram

8. Limiting values

Table 3. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------|-------------------------|--|------|----------|------|
| V_{CC} | supply voltage | | -0.5 | +7 | V |
| I_{IK} | input clamping current | $V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ [1] | - | ± 20 | mA |
| I_{OK} | output clamping current | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ [1] | - | ± 20 | mA |
| I_O | output current | $-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$ | - | ± 25 | mA |
| I_{CC} | supply current | | - | 50 | mA |
| I_{GND} | ground current | | -50 | - | mA |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| P_{tot} | total power dissipation | $T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$ [2] | - | 500 | mW |

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

[2] For SOT109-1 (SO16) package: P_{tot} derates linearly with 12.4 mW/K above 110 °C.
 For SOT338-1 (SSOP16) package: P_{tot} derates linearly with 8.5 mW/K above 91 °C.
 For SOT403-1 (TSSOP16) package: P_{tot} derates linearly with 8.5 mW/K above 91 °C.
 For SOT763-1 (DHVQFN16) package: P_{tot} derates linearly with 11.2 mW/K above 106 °C.

9. Recommended operating conditions

Table 4. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

| Symbol | Parameter | Conditions | 74HC4060 | | | 74HCT4060 | | | Unit |
|---------------------|-------------------------------------|-------------------------|----------|------|----------|-----------|------|----------|------|
| | | | Min | Typ | Max | Min | Typ | Max | |
| V_{CC} | supply voltage | | 2.0 | 5.0 | 6.0 | 4.5 | 5.0 | 5.5 | V |
| V_I | input voltage | | 0 | - | V_{CC} | 0 | - | V_{CC} | V |
| V_O | output voltage | | 0 | - | V_{CC} | 0 | - | V_{CC} | V |
| T_{amb} | ambient temperature | | -40 | - | +125 | -40 | - | +125 | °C |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 2.0\text{ V}$ | - | - | 625 | - | - | - | ns/V |
| | | $V_{CC} = 4.5\text{ V}$ | - | 1.67 | 139 | - | 1.67 | 139 | ns/V |
| | | $V_{CC} = 6.0\text{ V}$ | - | - | 83 | - | - | - | ns/V |

10. Static characteristics

Table 5. Static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|-------------------------|--------------------------|-------------------------|-------|-----|------|------------------|------|-------------------|------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 74HC4060 | | | | | | | | | | |
| V_{IH} | HIGH-level input voltage | MR input | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | 1.5 | 1.3 | - | 1.5 | - | 1.5 | - | V |
| | | $V_{CC} = 4.5\text{ V}$ | 3.15 | 2.4 | - | 3.15 | - | 3.15 | - | V |
| | | $V_{CC} = 6.0\text{ V}$ | 4.2 | 3.1 | - | 4.2 | - | 4.2 | - | V |
| | | RS input | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | 1.7 | - | - | 1.7 | - | 1.7 | - | V |
| | | $V_{CC} = 4.5\text{ V}$ | 3.6 | - | - | 3.6 | - | 3.6 | - | V |
| V_{IL} | LOW-level input voltage | MR input | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | 0.8 | 0.5 | - | 0.5 | - | 0.5 | V |
| | | $V_{CC} = 4.5\text{ V}$ | - | 2.1 | 1.35 | - | 1.35 | - | 1.35 | V |
| | | $V_{CC} = 6.0\text{ V}$ | - | 2.8 | 1.8 | - | 1.8 | - | 1.8 | V |
| | | RS input | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | - | 0.3 | - | 0.3 | - | 0.3 | V |
| | | $V_{CC} = 4.5\text{ V}$ | - | - | 0.9 | - | 0.9 | - | 0.9 | V |
| $V_{CC} = 6.0\text{ V}$ | - | - | 1.2 | - | 1.2 | - | 1.2 | V | | |

14-stage binary ripple counter with oscillator

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|---|---------------------------|--|-------|------|------|------------------|------|-------------------|-----|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| V _{OH} | HIGH-level output voltage | RTC output; RS = MR = GND | | | | | | | | |
| | | I _O = -20 µA; V _{CC} = 2.0 V | 1.9 | 2.0 | - | 1.9 | - | 1.9 | - | V |
| | | I _O = -20 µA; V _{CC} = 4.5 V | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | I _O = -20 µA; V _{CC} = 6.0 V | 5.9 | 6.0 | - | 5.9 | - | 5.9 | - | V |
| | | I _O = -2.6 mA; V _{CC} = 4.5 V | 3.98 | - | - | 3.84 | - | 3.7 | - | V |
| | | I _O = -3.3 mA; V _{CC} = 6.0 V | 5.48 | - | - | 5.34 | - | 5.2 | - | V |
| | | RTC output; RS = MR = V _{CC} | | | | | | | | |
| | | I _O = -20 µA; V _{CC} = 2.0 V | 1.9 | 2.0 | - | 1.9 | - | 1.9 | - | V |
| | | I _O = -20 µA; V _{CC} = 4.5 V | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | I _O = -20 µA; V _{CC} = 6.0 V | 5.9 | 6.0 | - | 5.9 | - | 5.9 | - | V |
| | | I _O = -0.65 mA; V _{CC} = 4.5 V | 3.98 | - | - | 3.84 | - | 3.7 | - | V |
| | | I _O = -0.85 mA; V _{CC} = 6.0 V | 5.48 | - | - | 5.34 | - | 5.2 | - | V |
| | | CTC output; RS = V _{IH} ; MR = V _{IL} | | | | | | | | |
| | | I _O = -3.2 mA; V _{CC} = 4.5 V | 3.98 | - | - | 3.84 | - | 3.7 | - | V |
| | | I _O = -4.2 mA; V _{CC} = 6.0 V | 5.48 | - | - | 5.34 | - | 5.2 | - | V |
| | | V _I = V _{IH} or V _{IL} ; except RTC output | | | | | | | | |
| | | I _O = -20 µA; V _{CC} = 2.0 V | 1.9 | 2.0 | - | 1.9 | - | 1.9 | - | V |
| | | I _O = -20 µA; V _{CC} = 4.5 V | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | I _O = -20 µA; V _{CC} = 6.0 V | 5.9 | 6.0 | - | 5.9 | - | 5.9 | - | V |
| | | V _I = V _{IH} or V _{IL} ; except RTC and CTC outputs | | | | | | | | |
| I _O = -4.0 mA; V _{CC} = 4.5 V | 3.98 | - | - | 3.84 | - | 3.7 | - | V | | |
| I _O = -5.2 mA; V _{CC} = 6.0 V | 5.48 | - | - | 5.34 | - | 5.2 | - | V | | |
| V _{OL} | LOW-level output voltage | RTC output; RS = V _{CC} ; MR = GND | | | | | | | | |
| | | I _O = 20 µA; V _{CC} = 2.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 20 µA; V _{CC} = 4.5 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 20 µA; V _{CC} = 6.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 2.6 mA; V _{CC} = 4.5 V | - | - | 0.26 | - | 0.33 | - | 0.4 | V |
| | | I _O = 3.3 mA; V _{CC} = 6.0 V | - | - | 0.26 | - | 0.33 | - | 0.4 | V |
| | | CTC output; RS = V _{IL} ; MR = V _{IH} | | | | | | | | |
| | | I _O = 3.2 mA; V _{CC} = 4.5 V | - | - | 0.26 | - | 0.33 | - | 0.4 | V |
| | | I _O = 4.2 mA; V _{CC} = 6.0 V | - | - | 0.26 | - | 0.33 | - | 0.4 | V |
| | | V _I = V _{IH} or V _{IL} ; except RTC output | | | | | | | | |
| | | I _O = 20 µA; V _{CC} = 2.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 20 µA; V _{CC} = 4.5 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 20 µA; V _{CC} = 6.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | V _I = V _{IH} or V _{IL} ; except RTC and CTC outputs | | | | | | | | |
| | | I _O = 4.0 mA; V _{CC} = 4.5 V | - | - | 0.26 | - | 0.33 | - | 0.4 | V |
| | | I _O = 5.2 mA; V _{CC} = 6.0 V | - | - | 0.26 | - | 0.33 | - | 0.4 | V |

14-stage binary ripple counter with oscillator

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|---------------------------------|---------------------------|--|-------|-----|------|------------------|------|-------------------|------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| I_I | input leakage current | $V_I = V_{CC}$ or GND; $V_{CC} = 6.0$ V | - | - | ±0.1 | - | ±1.0 | - | ±1.0 | µA |
| I_{CC} | supply current | $V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 6.0$ V | - | - | 8.0 | - | 80 | - | 160 | µA |
| C_I | input capacitance | | - | 3.5 | - | - | - | - | - | pF |
| 74HCT4060 | | | | | | | | | | |
| V_{IH} | HIGH-level input voltage | MR input; $V_{CC} = 4.5$ V to 5.5 V [1] | 2.0 | - | - | 2.0 | - | 2.0 | - | V |
| | | RS input; $V_{CC} = 4.5$ V | 3.6 | - | - | 3.6 | - | 3.6 | - | V |
| V_{IL} | LOW-level input voltage | MR input; $V_{CC} = 4.5$ V to 5.5 V [1] | - | - | 0.8 | - | 0.8 | - | 0.8 | V |
| | | RS input; $V_{CC} = 4.5$ V | - | - | 0.9 | - | 0.9 | - | 0.9 | V |
| V_{OH} | HIGH-level output voltage | RTC output; RS = MR = V_{CC} | | | | | | | | |
| | | $I_O = -20$ µA; $V_{CC} = 4.5$ V | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | $I_O = -0.65$ mA; $V_{CC} = 4.5$ V | 3.98 | - | - | 3.84 | - | 3.7 | - | V |
| | | RTC output; RS = MR = GND | | | | | | | | |
| | | $I_O = -20$ µA; $V_{CC} = 4.5$ V | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | $I_O = -2.6$ mA; $V_{CC} = 4.5$ V | 3.98 | - | - | 3.84 | - | 3.7 | - | V |
| | | CTC output; RS = V_{IH} ; MR = V_{IL} | | | | | | | | |
| | | $I_O = -3.2$ mA; $V_{CC} = 4.5$ V | 3.98 | - | - | 3.84 | - | 3.7 | - | V |
| | | $V_I = V_{IH}$ or V_{IL} ; except RTC output | | | | | | | | |
| | | $I_O = -20$ µA; $V_{CC} = 4.5$ V | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| V_{OL} | LOW-level output voltage | $V_I = V_{IH}$ or V_{IL} ; except RTC and CTC outputs | | | | | | | | |
| | | $I_O = -4.0$ mA; $V_{CC} = 4.5$ V | 3.98 | - | - | 3.84 | - | 3.7 | - | V |
| | | RTC output; RS = V_{CC} ; MR = GND | | | | | | | | |
| | | $I_O = 20$ µA; $V_{CC} = 4.5$ V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O = 2.6$ mA; $V_{CC} = 4.5$ V | - | - | 0.26 | - | 0.33 | - | 0.4 | V |
| | | CTC output; RS = V_{IL} ; MR = V_{IH} | | | | | | | | |
| | | $I_O = 3.2$ mA; $V_{CC} = 4.5$ V | - | - | 0.26 | - | 0.33 | - | 0.4 | V |
| | | $V_I = V_{IH}$ or V_{IL} ; except RTC output | | | | | | | | |
| $I_O = 20$ µA; $V_{CC} = 4.5$ V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V | | |
| I_I | input leakage current | $V_I = V_{CC}$ or GND; $V_{CC} = 5.5$ V | - | - | ±0.1 | - | ±1.0 | - | ±1.0 | µA |
| | | $V_I = V_{CC}$ or GND; $V_{CC} = 5.5$ V; $I_O = 0$ A | - | - | 8.0 | - | 80 | - | 160 | µA |
| ΔI_{CC} | additional supply current | per input pin; $V_I = V_{CC} - 2.1$ V; other inputs at V_{CC} or GND; $V_{CC} = 4.5$ V to 5.5 V; $I_O = 0$ A | - | 40 | 144 | - | 180 | - | 196 | µA |
| C_I | input capacitance | | - | 3.5 | - | - | - | - | - | pF |

[1] For HCT4060, only input MR (pin 12) has TTL input switching levels.

11. Dynamic characteristics

Table 6. Dynamic characteristics

$GND = 0\text{ V}$; $C_L = 50\text{ pF}$ unless otherwise specified; for test circuit see [Fig. 11](#).

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|-------------------------|-------------------------------|--|-------|-----|-----|------------------|-----|-------------------|-----|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 74HC4060 | | | | | | | | | | |
| t_{pd} | propagation delay | RS to Q3; see Fig. 8 [1] | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | 99 | 300 | - | 375 | - | 450 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | - | 36 | 60 | - | 75 | - | 90 | ns |
| | | $V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$ | - | 31 | - | - | - | - | - | ns |
| | | $V_{CC} = 6.0\text{ V}$ | - | 29 | 51 | - | 64 | - | 77 | ns |
| | | Qn to Qn+1; see Fig. 9 [2] | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | 22 | 80 | - | 100 | - | 120 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | - | 8 | 16 | - | 20 | - | 24 | ns |
| | | $V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$ | - | 6 | - | - | - | - | - | ns |
| $V_{CC} = 6.0\text{ V}$ | - | 6 | 14 | - | 17 | - | 20 | ns | | |
| t_{PHL} | HIGH to LOW propagation delay | MR to Qn; see Fig. 10 | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | 55 | 175 | - | 220 | - | 265 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | - | 20 | 35 | - | 44 | - | 53 | ns |
| | | $V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$ | - | 17 | - | - | - | - | - | ns |
| | | $V_{CC} = 6.0\text{ V}$ | - | 16 | 30 | - | 37 | - | 45 | ns |
| t_t | transition time | Qn; see Fig. 8 [3] | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | 19 | 75 | - | 95 | - | 110 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | - | 7 | 15 | - | 19 | - | 22 | ns |
| | | $V_{CC} = 6.0\text{ V}$ | - | 6 | 13 | - | 16 | - | 19 | ns |
| t_w | pulse width | RS (HIGH or LOW); see Fig. 8 | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | 80 | 17 | - | 100 | - | 120 | - | ns |
| | | $V_{CC} = 4.5\text{ V}$ | 16 | 6 | - | 20 | - | 24 | - | ns |
| | | $V_{CC} = 6.0\text{ V}$ | 14 | 5 | - | 17 | - | 20 | - | ns |
| | | MR (HIGH); see Fig. 10 | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | 80 | 25 | - | 100 | - | 120 | - | ns |
| | | $V_{CC} = 4.5\text{ V}$ | 16 | 9 | - | 20 | - | 24 | - | ns |
| | | $V_{CC} = 6.0\text{ V}$ | 14 | 7 | - | 17 | - | 20 | - | ns |
| t_{rec} | recovery time | MR to RS; see Fig. 10 | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | 100 | 28 | - | 125 | - | 150 | - | ns |
| | | $V_{CC} = 4.5\text{ V}$ | 20 | 10 | - | 25 | - | 30 | - | ns |
| | | $V_{CC} = 6.0\text{ V}$ | 17 | 8 | - | 21 | - | 26 | - | ns |

14-stage binary ripple counter with oscillator

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|------------------|-------------------------------|--|-------|-----|-----|------------------|-----|-------------------|-----|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| f _{max} | maximum frequency | RS; see Fig. 8 | | | | | | | | |
| | | V _{CC} = 2.0 V | 6 | 26 | - | 4.8 | - | 4 | - | MHz |
| | | V _{CC} = 4.5 V | 30 | 80 | - | 24 | - | 20 | - | MHz |
| | | V _{CC} = 5.0 V; C _L = 15 pF | - | 87 | - | - | - | - | - | MHz |
| | | V _{CC} = 6.0 V | 35 | 95 | - | 28 | - | 24 | - | MHz |
| C _{PD} | power dissipation capacitance | V _I = GND to V _{CC} ; V _{CC} = 5 V; f _i = 1 MHz [4] | - | 40 | - | - | - | - | - | pF |
| 74HCT4060 | | | | | | | | | | |
| t _{pd} | propagation delay | RS to Q3; see Fig. 8 [1] | | | | | | | | |
| | | V _{CC} = 4.5 V | - | 33 | 66 | - | 83 | - | 99 | ns |
| | | V _{CC} = 5.0 V; C _L = 15 pF | - | 31 | - | - | - | - | - | ns |
| | | Qn to Qn+1; see Fig. 9 [2] | | | | | | | | |
| | | V _{CC} = 4.5 V | - | 8 | 16 | - | 20 | - | 24 | ns |
| | | V _{CC} = 5.0 V; C _L = 15 pF | - | 6 | - | - | - | - | - | ns |
| t _{PHL} | HIGH to LOW propagation delay | MR to Qn; see Fig. 10 | | | | | | | | |
| | | V _{CC} = 4.5 V | - | 21 | 44 | - | 55 | - | 66 | ns |
| | | V _{CC} = 5.0 V; C _L = 15 pF | - | 18 | - | - | - | - | - | ns |
| t _t | transition time | Qn; see Fig. 8 [3] | | | | | | | | |
| | | V _{CC} = 4.5 V | - | 7 | 15 | - | 19 | - | 22 | ns |
| t _w | pulse width | RS (HIGH or LOW); see Fig. 8 | | | | | | | | |
| | | V _{CC} = 4.5 V | 16 | 6 | - | 20 | - | 24 | - | ns |
| | | MR (HIGH); see Fig. 10 | | | | | | | | |
| | | V _{CC} = 4.5 V | 16 | 6 | - | 20 | - | 24 | - | ns |
| t _{rec} | recovery time | MR to RS; see Fig. 10 | | | | | | | | |
| | | V _{CC} = 4.5 V | 26 | 13 | - | 33 | - | 39 | - | ns |
| f _{max} | maximum frequency | RS; see Fig. 8 | | | | | | | | |
| | | V _{CC} = 4.5 V | 30 | 80 | - | 24 | - | 20 | - | MHz |
| | | V _{CC} = 5.0 V; C _L = 15 pF | - | 88 | - | - | - | - | - | MHz |
| C _{PD} | power dissipation capacitance | V _I = GND to V _{CC} - 1.5 V; V _{CC} = 5 V; f _i = 1 MHz [4] | - | 40 | - | - | - | - | - | pF |

[1] t_{pd} is the same as t_{PHL} and t_{PLH}.

[2] Qn+1 is the next Qn output.

[3] t_t is the same as t_{THL} and t_{TLH}.

[4] C_{PD} is used to determine the dynamic power dissipation (P_D in μW):

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

f_i = input frequency in MHz;

f_o = output frequency in MHz;

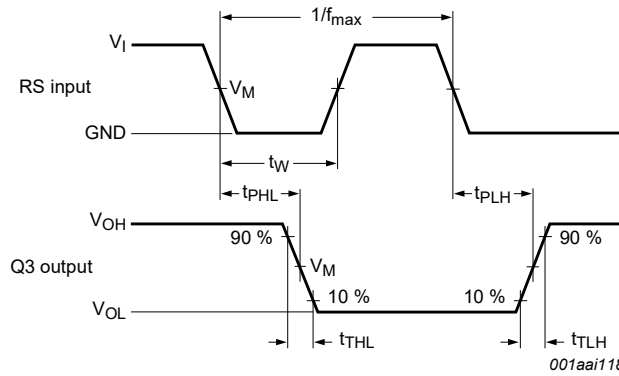
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

∑(C_L × V_{CC}² × f_o) = sum of outputs.

11.1. Waveforms and test circuit



Measurement points are given in [Table 7](#).

V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

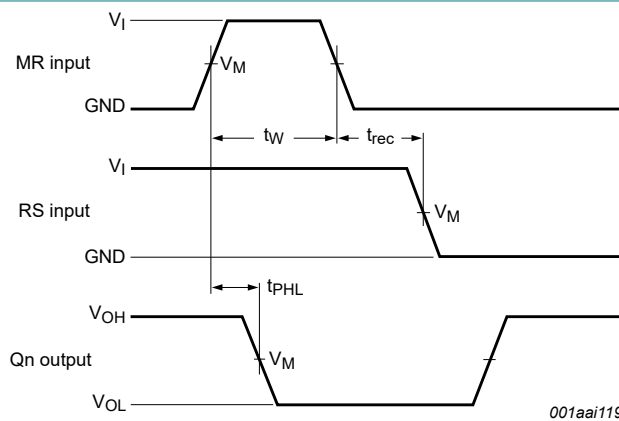
Fig. 8. Waveforms showing the clock (RS) to output (Q3) propagation delays, the clock pulse width, the output transition times and the maximum clock frequency



Measurement points are given in [Table 7](#).

V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig. 9. Waveforms showing the output Qn to output Qn+1 propagation delays



Measurement points are given in [Table 7](#).

V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig. 10. Waveforms showing the master reset (MR) pulse width, the master reset to output (Qn) propagation delays and the master reset to clock (RS) recovery time

Table 7. Measurement points

| Type | Input | Output |
|-----------|---------------------|---------------------|
| | V_M | V_M |
| 74HC4060 | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 74HCT4060 | 1.3 V | 1.3 V |



Fig. 11. Test circuit for measuring switching times

Table 8. Test data

| Type | Input | | Load |
|-----------|----------|------------|--------------|
| | V_I | t_r, t_f | C_L |
| 74HC4060 | V_{CC} | 6 ns | 15 pF, 50 pF |
| 74HCT4060 | 3 V | 6 ns | 15 pF, 50 pF |

12. RC oscillator

12.1. Timing component limitations

The oscillator frequency is mainly determined by $R_t C_t$, provided $R_2 \approx 2R_t$ and $R_2 C_2 \ll R_t C_t$. The function of R_2 is to minimize the influence of the forward voltage across the input protection diodes on the frequency. The stray capacitance C_2 should be kept as small as possible. In consideration of accuracy, C_t must be larger than the inherent stray capacitance. R_t must be larger than the ON resistance in series with it, which typically is 280 Ω at $V_{CC} = 2.0$ V, 130 Ω at $V_{CC} = 4.5$ V and 100 Ω at $V_{CC} = 6.0$ V.



Fig. 12. Example of a RC oscillator

The recommended values for these components to maintain agreement with the typical oscillation formula are:

- $C_t > 50 \text{ pF}$, up to any practical value and $10 \text{ k}\Omega < R_t < 1 \text{ M}\Omega$.
- In order to avoid start-up problems, $R_t \geq 1 \text{ k}\Omega$.

12.2. Typical crystal oscillator circuit

In Fig. 13, R₂ is the power limiting resistor. For starting and maintaining oscillation a minimum transconductance is necessary, so R₂ should not be too large. A practical value for R₂ is 2.2 kΩ.



Fig. 13. External component connection for a crystal oscillator

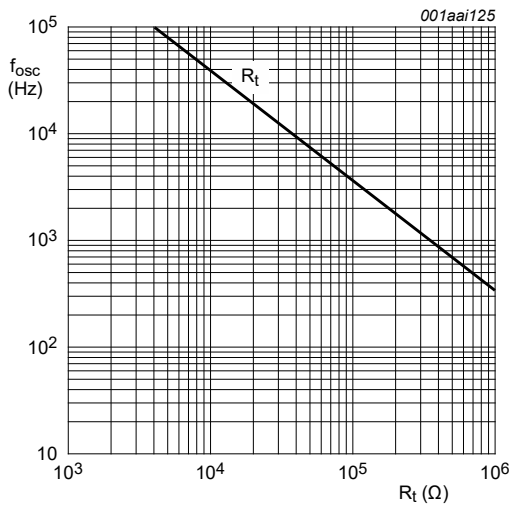


Fig. 14. Test set-up for measuring forward transconductance



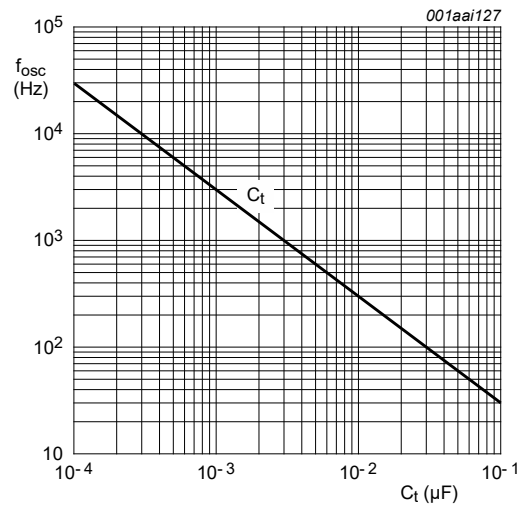
- (1) Maximum.
 - (2) Typical.
 - (3) Minimum.
- $T_{amb} = 25\text{ }^{\circ}\text{C}.$

Fig. 15. Typical forward transconductance as function of the supply voltage



$V_{CC} = 2.0\text{ V to }6.0\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}.$
 For R_t curve: $C_t = 1\text{ nF}; R_2 = 2 \times R_t.$

Fig. 16. RC oscillator frequency as a function of R_t



$V_{CC} = 2.0\text{ V to }6.0\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}.$
 For C_t curve: $R_t = 100\text{ k}\Omega; R_2 = 200\text{ k}\Omega.$

Fig. 17. RC oscillator frequency as a function of C_t

13. Package outline

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1



Fig. 18. Package outline SOT109-1 (SO16)

SSOP16: plastic shrink small outline package; 16 leads; body width 5.3 mm

SOT338-1

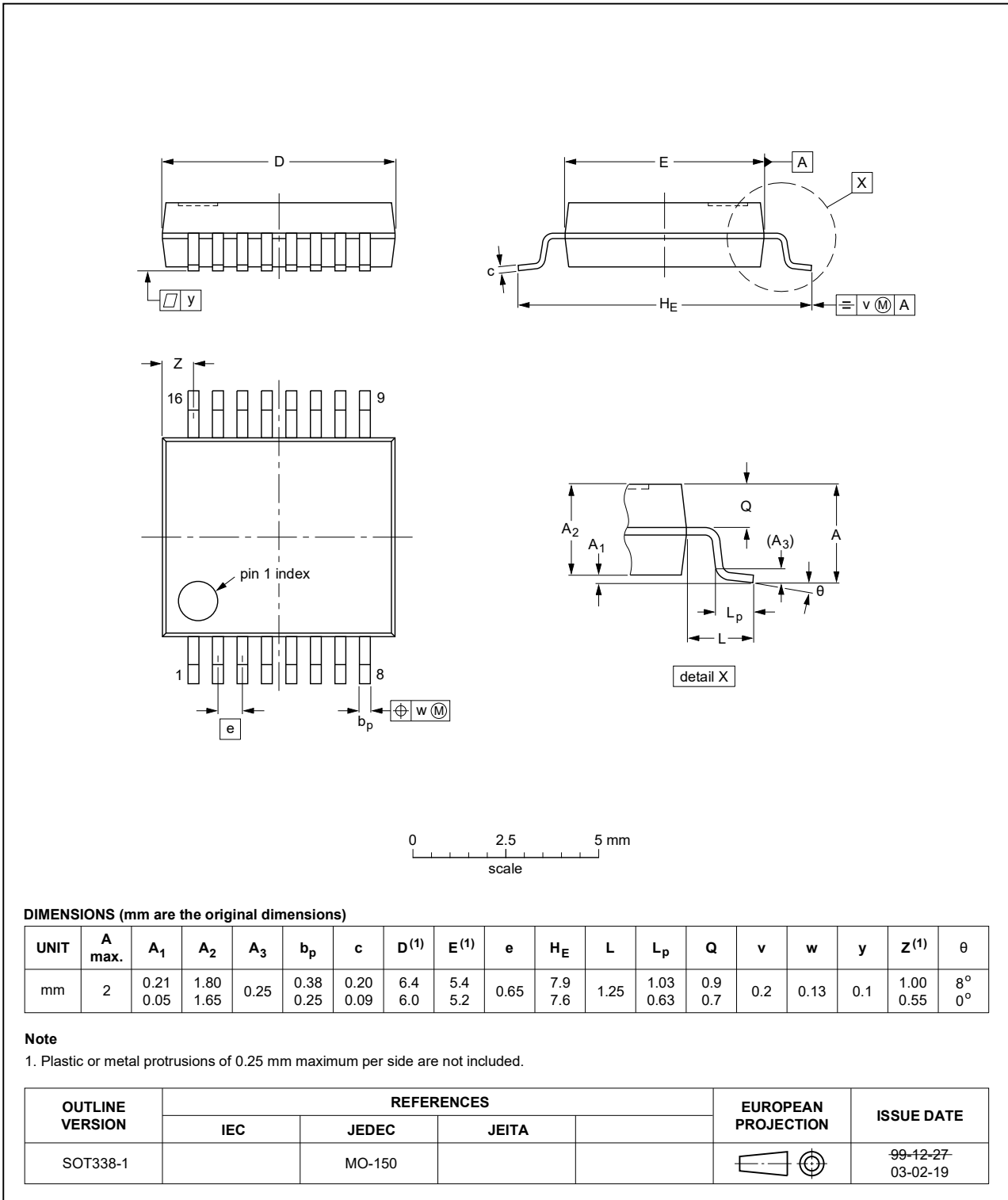


Fig. 19. Package outline SOT338-1 (SSOP16)

TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm

SOT403-1



Fig. 20. Package outline SOT403-1 (TSSOP16)

DHVQFN16: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 x 3.5 x 0.85 mm

SOT763-1



Fig. 21. Package outline SOT763-1 (DHVQFN16)

14. Abbreviations

Table 9. Abbreviations

| Acronym | Description |
|---------|---|
| CMOS | Complementary Metal-Oxide Semiconductor |
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| MM | Machine Model |
| TTL | Transistor-Transistor Logic |

15. Revision history

Table 10. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------------|--|-----------------------|---------------|----------------------|
| 74HC_HCT4060 v.5 | 20200508 | Product data sheet | - | 74HC_HCT4060 v.4 |
| Modifications: | <ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. Type number 74HCT4060DB (SSOP16/SOT338-1) removed. Table 3: Derating values for P_{tot} total power dissipation updated. | | | |
| 74HC_HCT4060 v.4 | 20160210 | Product data sheet | - | 74HC_HCT4060 v.3 |
| Modifications: | <ul style="list-style-type: none"> Type numbers 74HC4060N and 74HCT4060N (SOT38-4) removed. Table 5: HIGH and LOW input levels added for 74HCT4060. (errata) | | | |
| 74HC_HCT4060 v.3 | 20080714 | Product data sheet | - | 74HC_HCT4060_CNV v.2 |
| Modifications: | <ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. Legal texts have been adapted to the new company name where appropriate. Section 4: DHVQFN16 package added. Section 8: derating values added for DHVQFN16 package. Section 13: outline drawing added for DHVQFN16 package. | | | |
| 74HC_HCT4060_CNV v.2 | 19970901 | Product specification | - | - |

16. Legal information

Data sheet status

| Document status [1][2] | Product status [3] | Definition |
|--------------------------------|--------------------|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification | This document contains data from the preliminary specification. |
| Product [short] data sheet | Production | This document contains the product specification. |

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at <https://www.nexperia.com>.

Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Nexperia does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local Nexperia sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between Nexperia and its customer, unless Nexperia and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the Nexperia product is deemed to offer functions and qualities beyond those described in the Product data sheet.

Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, Nexperia does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. Nexperia takes no responsibility for the content in this document if provided by an information source outside of Nexperia.

In no event shall Nexperia be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, Nexperia's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms and conditions of commercial sale of Nexperia.

Right to make changes — Nexperia reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — Nexperia products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an Nexperia product can reasonably be expected to result in personal

injury, death or severe property or environmental damage. Nexperia and its suppliers accept no liability for inclusion and/or use of Nexperia products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Quick reference data — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. Nexperia makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using Nexperia products, and Nexperia accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the Nexperia product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

Nexperia does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using Nexperia products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). Nexperia does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — Nexperia products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nexperia.com/profile/terms>, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. Nexperia hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of Nexperia products by customer.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Non-automotive qualified products — Unless this data sheet expressly states that this specific Nexperia product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. Nexperia accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without Nexperia's warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond Nexperia's specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies Nexperia for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond Nexperia's standard warranty and Nexperia's product specifications.

Translations — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

Contents

| | |
|--|-----------|
| 1. General description | 1 |
| 2. Features and benefits | 1 |
| 3. Applications | 1 |
| 4. Ordering information | 2 |
| 5. Functional diagram | 2 |
| 6. Pinning information | 3 |
| 6.1. Pinning..... | 3 |
| 6.2. Pin description..... | 3 |
| 7. Functional description | 4 |
| 8. Limiting values | 4 |
| 9. Recommended operating conditions | 5 |
| 10. Static characteristics | 5 |
| 11. Dynamic characteristics | 8 |
| 11.1. Waveforms and test circuit..... | 10 |
| 12. RC oscillator | 11 |
| 12.1. Timing component limitations..... | 11 |
| 12.2. Typical crystal oscillator circuit..... | 12 |
| 13. Package outline | 14 |
| 14. Abbreviations | 18 |
| 15. Revision history | 18 |
| 16. Legal information | 19 |

© Nexperia B.V. 2020. All rights reserved

For more information, please visit: <http://www.nexperia.com>
For sales office addresses, please send an email to: salesaddresses@nexperia.com
Date of release: 8 May 2020