

74HC4060-Q100; 74HCT4060-Q100

14-stage binary ripple counter with oscillator

Rev. 3 — 8 May 2020

Product data sheet

1. General description

The 74HC4060-Q100; 74HCT4060-Q100 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} .

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
 - Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- All active components on chip
- RC or crystal oscillator configuration
- Complies with JEDEC standard no. 7 A
- Input levels:
 - For 74HC4060-Q100: CMOS level
 - For 74HCT4060-Q100: TTL level
- ESD protection:
 - MIL-STD-883, method 3015 exceeds 2000 V
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)
- Multiple package options
- DHVQFN package with Side-Wettable Flanks enabling Automatic Optical Inspection (AOI) of solder joints

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-Q100 | -40 °C to +125 °C | SO16 | plastic small outline package; 16 leads; body width 3.9 mm | SOT109-1 |
| 74HCT4060D-Q100 | | | | |
| 74HC4060DB-Q100 | -40 °C to +125 °C | SSOP16 | plastic shrink small outline package; 16 leads; body width 5.3 mm | SOT338-1 |
| 74HC4060PW-Q100 | -40 °C to +125 °C | TSSOP16 | plastic thin shrink small outline package; 16 leads; body width 4.4 mm | SOT403-1 |
| 74HC4060BQ-Q100 | -40 °C to +125 °C | DHVQFN16 | 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-Q100 | | | | |

5. Functional diagram

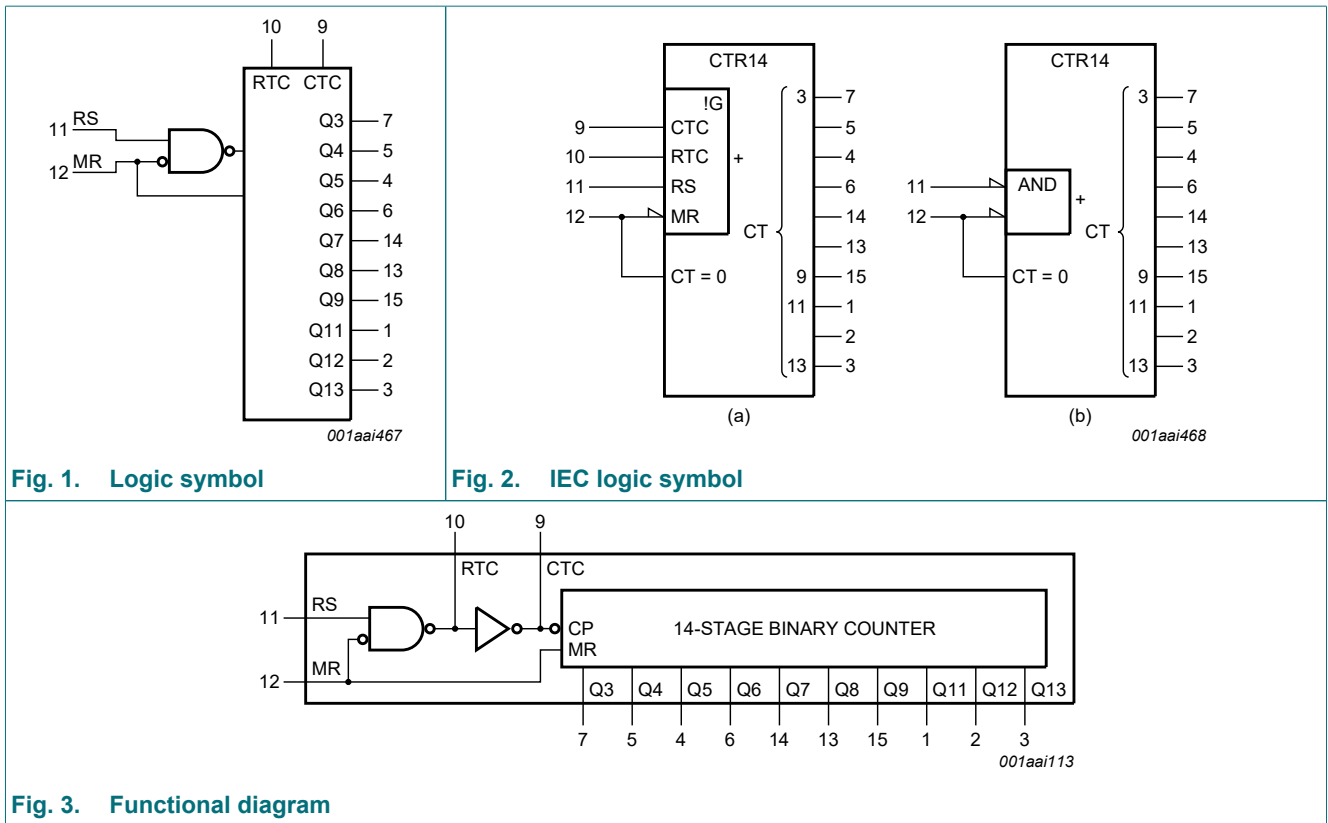


Fig. 1. Logic symbol

Fig. 2. IEC logic symbol

Fig. 3. Functional diagram

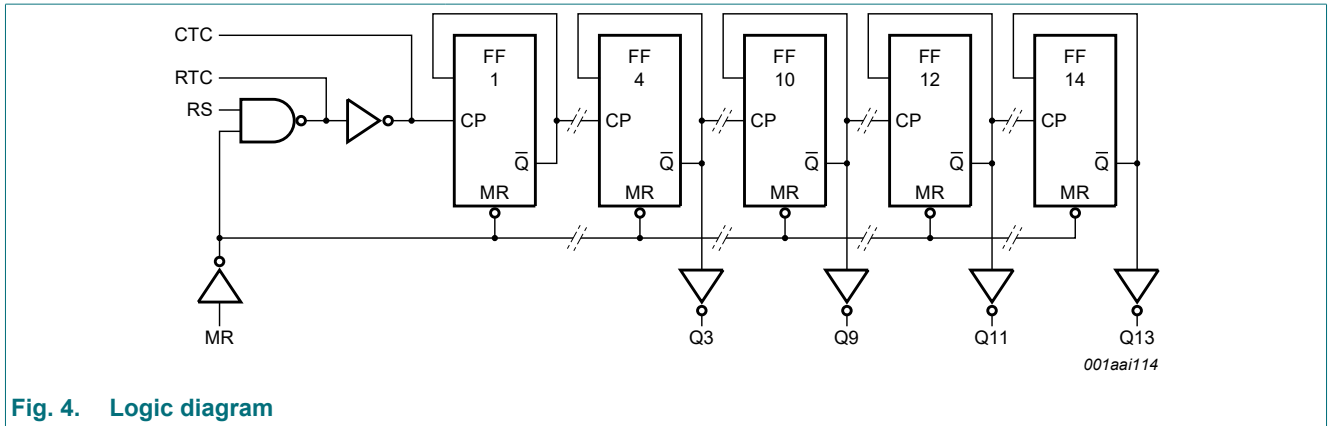


Fig. 4. Logic diagram

6. Pinning information

6.1. Pinning

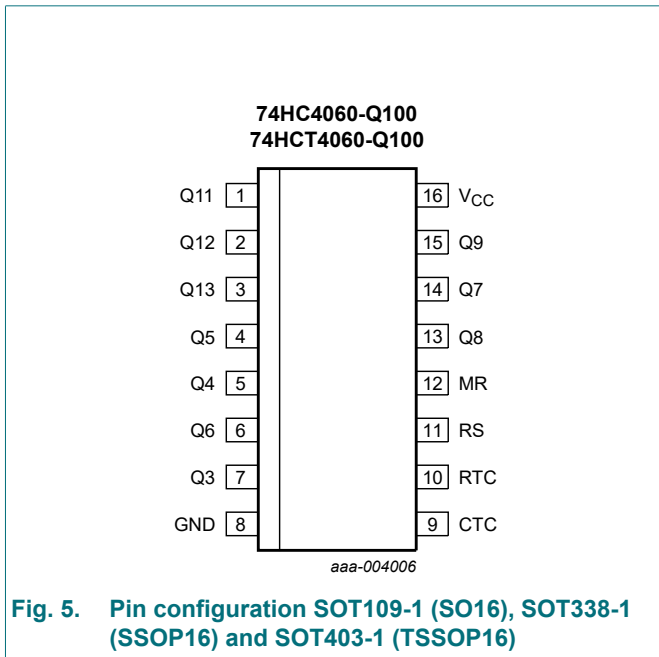


Fig. 5. Pin configuration SOT109-1 (SO16), SOT338-1 (SSOP16) and SOT403-1 (TSSOP16)

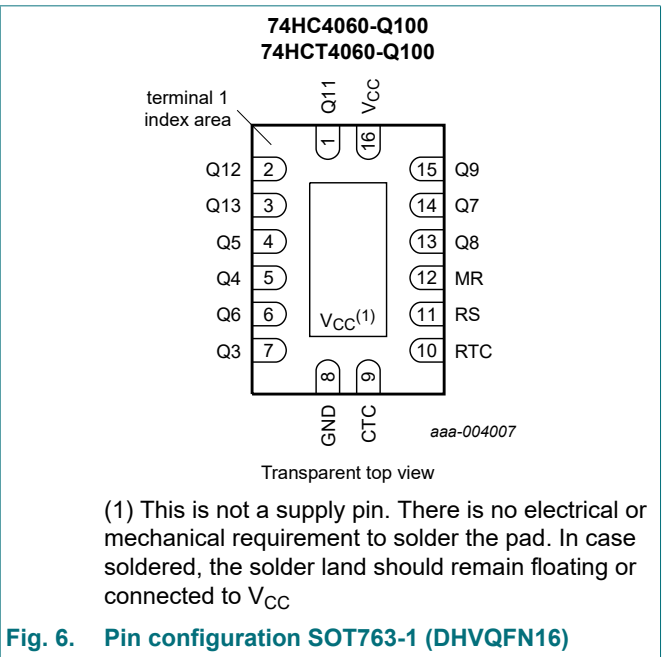


Fig. 6. Pin configuration SOT763-1 (DHVQFN16)

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-Q100 | | | 74HCT4060-Q100 | | | 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 |
| Δt/ΔV | input transition rise and fall rate | V _{CC} = 2.0 V | - | - | 625 | - | - | - | ns/V |
| | | V _{CC} = 4.5 V | - | 1.67 | 139 | - | 1.67 | 139 | ns/V |
| | | V _{CC} = 6.0 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-Q100 | | | | | | | | | | |
| V _{IH} | HIGH-level input voltage | MR input | | | | | | | | |
| | | V _{CC} = 2.0 V | 1.5 | 1.3 | - | 1.5 | - | 1.5 | - | V |
| | | V _{CC} = 4.5 V | 3.15 | 2.4 | - | 3.15 | - | 3.15 | - | V |
| | | V _{CC} = 6.0 V | 4.2 | 3.1 | - | 4.2 | - | 4.2 | - | V |
| | | RS input | | | | | | | | |
| | | V _{CC} = 2.0 V | 1.7 | - | - | 1.7 | - | 1.7 | - | V |
| | | V _{CC} = 4.5 V | 3.6 | - | - | 3.6 | - | 3.6 | - | V |
| V _{CC} = 6.0 V | 4.8 | - | - | 4.8 | - | 4.8 | - | V | | |
| V _{IL} | LOW-level input voltage | MR input | | | | | | | | |
| | | V _{CC} = 2.0 V | - | 0.8 | 0.5 | - | 0.5 | - | 0.5 | V |
| | | V _{CC} = 4.5 V | - | 2.1 | 1.35 | - | 1.35 | - | 1.35 | V |
| | | V _{CC} = 6.0 V | - | 2.8 | 1.8 | - | 1.8 | - | 1.8 | V |
| | | RS input | | | | | | | | |
| | | V _{CC} = 2.0 V | - | - | 0.3 | - | 0.3 | - | 0.3 | V |
| | | V _{CC} = 4.5 V | - | - | 0.9 | - | 0.9 | - | 0.9 | V |
| V _{CC} = 6.0 V | - | - | 1.2 | - | 1.2 | - | 1.2 | V | | |

| 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 |

| 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-Q100 | | | | | | | | | | |
| 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 V; C_L = 50 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-Q100 | | | | | | | | | | |
| t _{pd} | propagation delay | RS to Q3; see Fig. 8 [1] | | | | | | | | |
| | | V _{CC} = 2.0 V | - | 99 | 300 | - | 375 | - | 450 | ns |
| | | V _{CC} = 4.5 V | - | 36 | 60 | - | 75 | - | 90 | ns |
| | | V _{CC} = 5.0 V; C _L = 15 pF | - | 31 | - | - | - | - | - | ns |
| | | V _{CC} = 6.0 V | - | 29 | 51 | - | 64 | - | 77 | ns |
| | | Qn to Qn+1; see Fig. 9 [2] | | | | | | | | |
| | | V _{CC} = 2.0 V | - | 22 | 80 | - | 100 | - | 120 | ns |
| | | V _{CC} = 4.5 V | - | 8 | 16 | - | 20 | - | 24 | ns |
| | | V _{CC} = 5.0 V; C _L = 15 pF | - | 6 | - | - | - | - | - | ns |
| V _{CC} = 6.0 V | - | 6 | 14 | - | 17 | - | 20 | ns | | |
| t _{PHL} | HIGH to LOW propagation delay | MR to Qn; see Fig. 10 | | | | | | | | |
| | | V _{CC} = 2.0 V | - | 55 | 175 | - | 220 | - | 265 | ns |
| | | V _{CC} = 4.5 V | - | 20 | 35 | - | 44 | - | 53 | ns |
| | | V _{CC} = 5.0 V; C _L = 15 pF | - | 17 | - | - | - | - | - | ns |
| | | V _{CC} = 6.0 V | - | 16 | 30 | - | 37 | - | 45 | ns |
| t _t | transition time | Qn; see Fig. 8 [3] | | | | | | | | |
| | | V _{CC} = 2.0 V | - | 19 | 75 | - | 95 | - | 110 | ns |
| | | V _{CC} = 4.5 V | - | 7 | 15 | - | 19 | - | 22 | ns |
| | | V _{CC} = 6.0 V | - | 6 | 13 | - | 16 | - | 19 | ns |
| t _w | pulse width | RS (HIGH or LOW); see Fig. 8 | | | | | | | | |
| | | V _{CC} = 2.0 V | 80 | 17 | - | 100 | - | 120 | - | ns |
| | | V _{CC} = 4.5 V | 16 | 6 | - | 20 | - | 24 | - | ns |
| | | V _{CC} = 6.0 V | 14 | 5 | - | 17 | - | 20 | - | ns |
| | | MR (HIGH); see Fig. 10 | | | | | | | | |
| | | V _{CC} = 2.0 V | 80 | 25 | - | 100 | - | 120 | - | ns |
| | | V _{CC} = 4.5 V | 16 | 9 | - | 20 | - | 24 | - | ns |
| | | V _{CC} = 6.0 V | 14 | 7 | - | 17 | - | 20 | - | ns |
| t _{rec} | recovery time | MR to RS; see Fig. 10 | | | | | | | | |
| | | V _{CC} = 2.0 V | 100 | 28 | - | 125 | - | 150 | - | ns |
| | | V _{CC} = 4.5 V | 20 | 10 | - | 25 | - | 30 | - | ns |
| | | V _{CC} = 6.0 V | 17 | 8 | - | 21 | - | 26 | - | ns |

| 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-Q100 | | | | | | | | | | |
| 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;

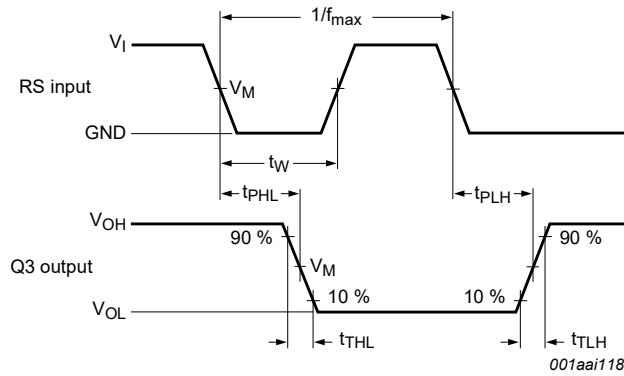
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

$\sum(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

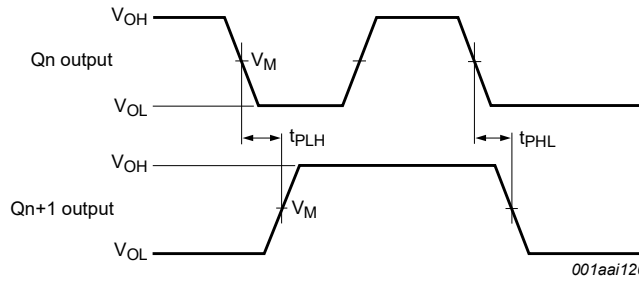
11.1. Waveforms and test circuit



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

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

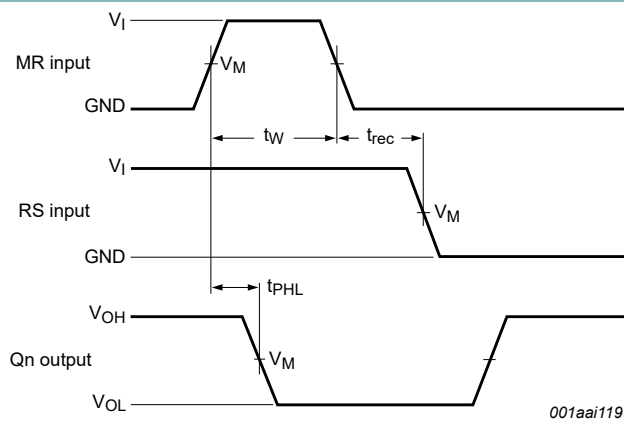
Fig. 8. Waveforms showing the clock (RS) to output (Q3) propagation delays, the clock pulse width, the output transition times and the maximum clock frequency



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-Q100 | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 74HCT4060-Q100 | 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-Q100 | V_{CC} | 6 ns | 15 pF, 50 pF |
| 74HCT4060-Q100 | 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:

- $C_t > 50$ 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

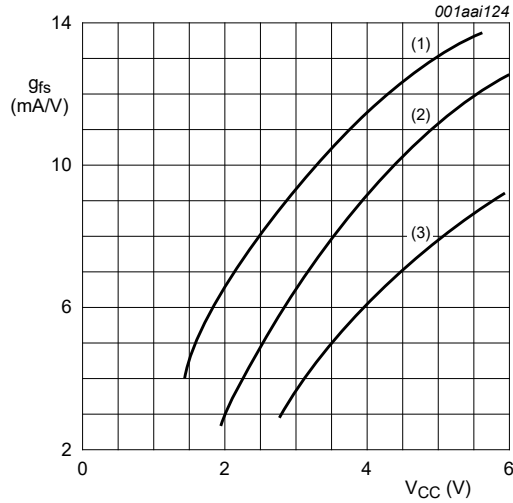
In Fig. 13, R2 is the power limiting resistor. For starting and maintaining oscillation a minimum transconductance is necessary, so R2 should not be too large. A practical value for R2 is 2.2 kΩ.



Fig. 13. External component connection for a crystal oscillator

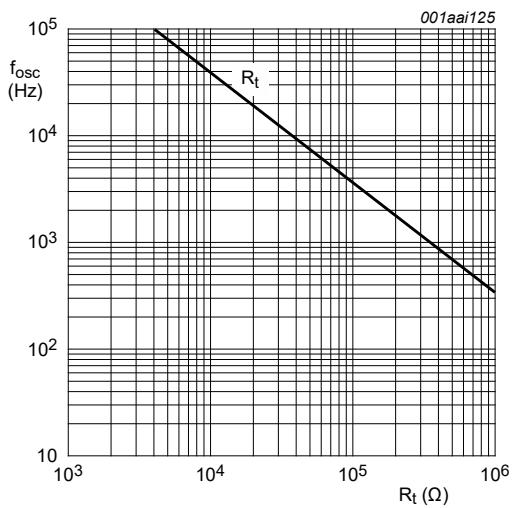


Fig. 14. Test set-up for measuring forward transconductance



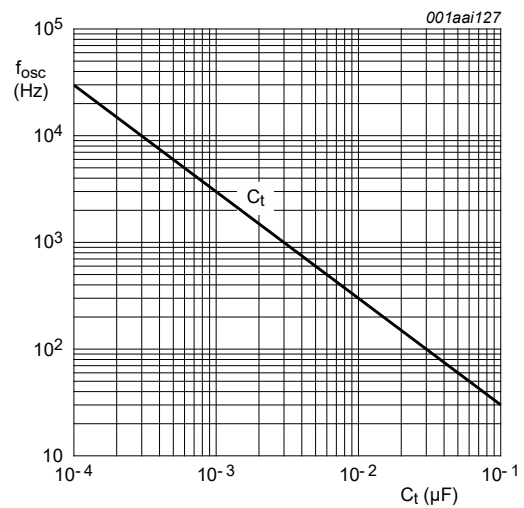
- (1) Maximum.
 - (2) Typical.
 - (3) Minimum.
- $T_{amb} = 25\text{ }^{\circ}\text{C}.$

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

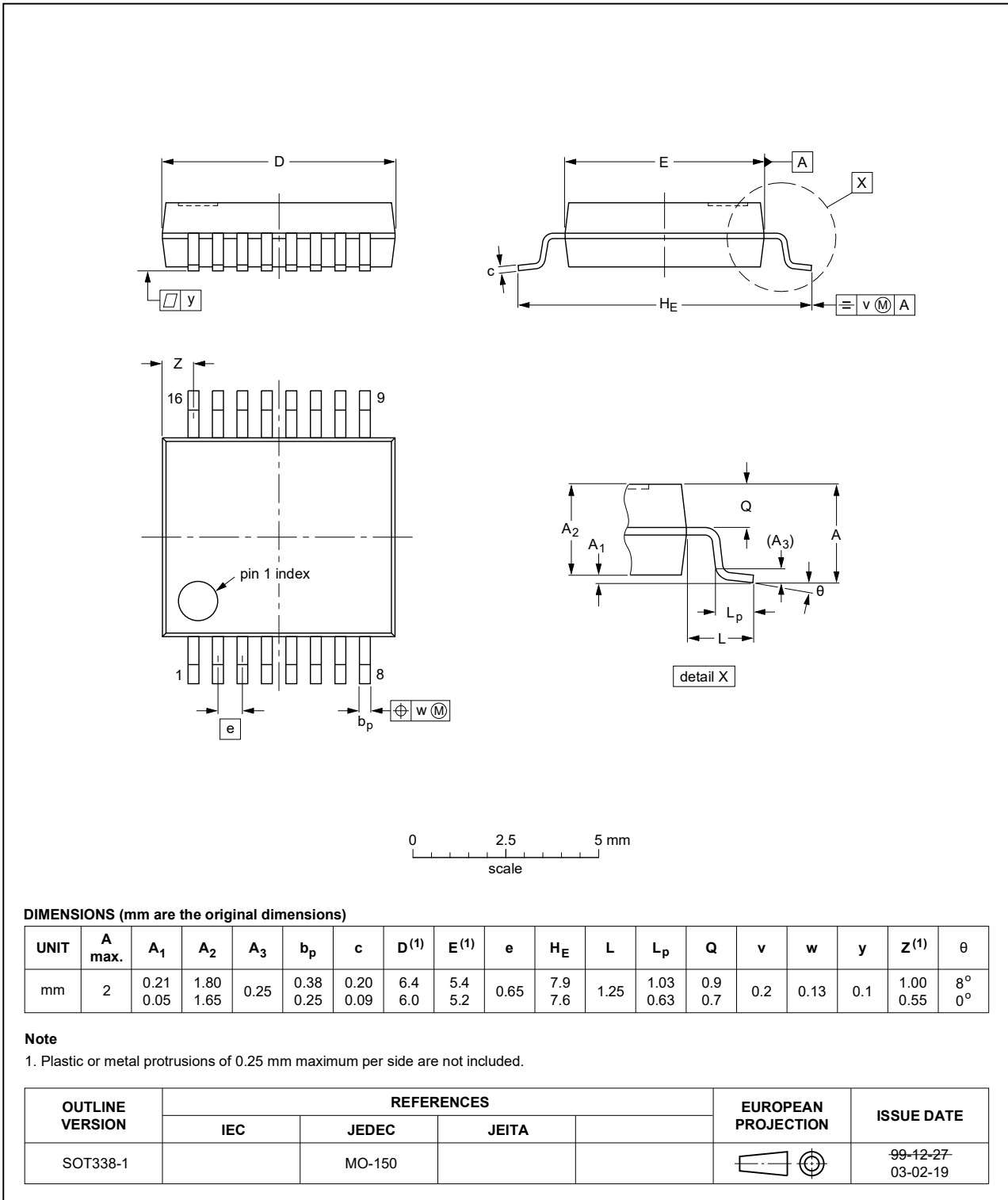


Fig. 19. Package outline SOT338-1 (SSOP16)

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

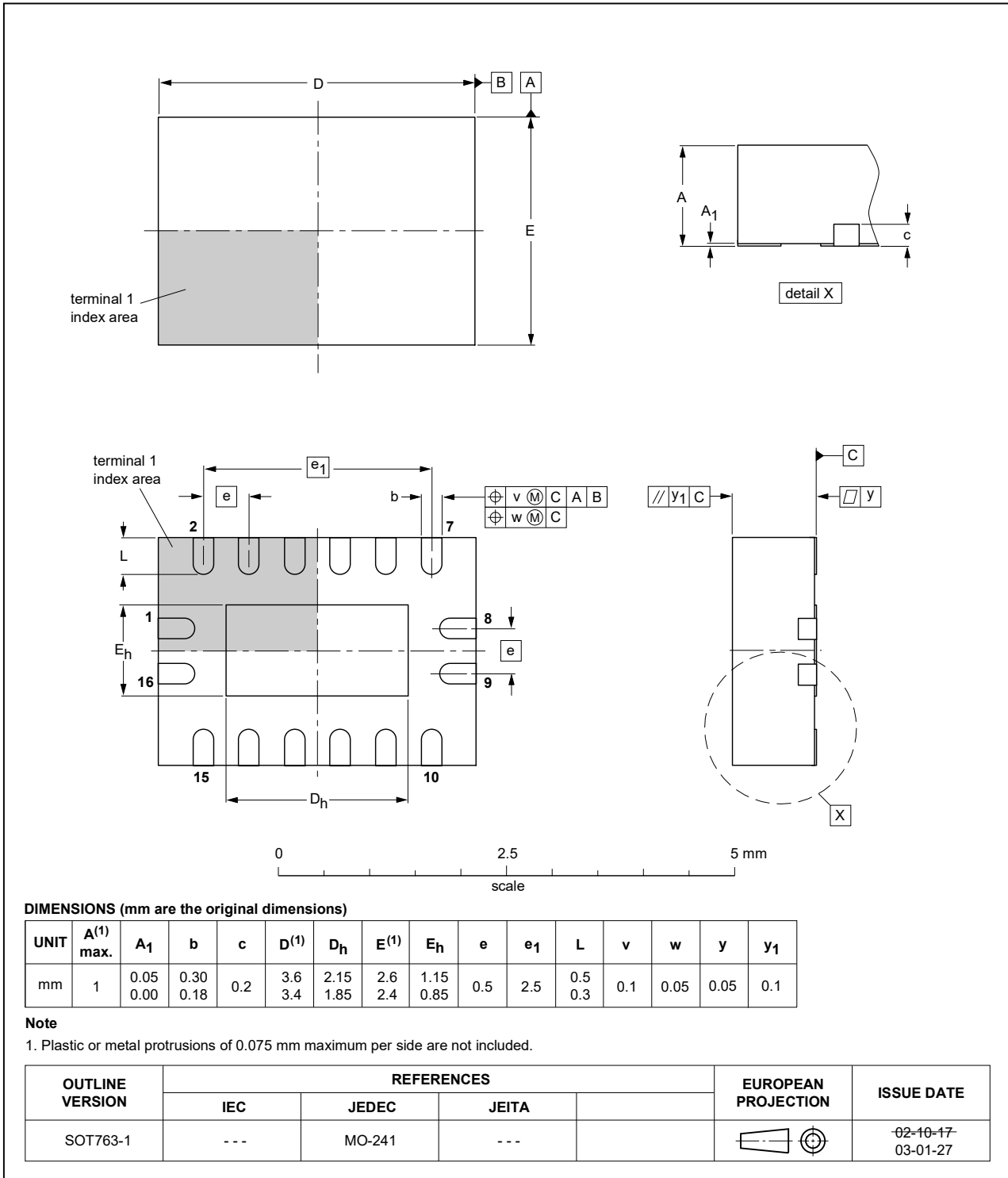


Fig. 21. Package outline SOT763-1 (DHVQFN16)

14. Abbreviations

Table 9. Abbreviations

| Acronym | Description |
|---------|---|
| CMOS | Complementary Metal-Oxide Semiconductor |
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| MIL | Military |
| 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_Q100 v.3 | 20200508 | Product data sheet | - | 74HC_HCT4060_Q100 v.2 |
| 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. Section 1 and Section 2 updated. Fig. 2: Pinnames corrected. (errata) Table 3: Derating values for P_{tot} total power dissipation updated. Table 5: HIGH and LOW input levels added for 74HCT4060-Q100. (errata) Type number 74HCT4060DB-Q100 (SSOP16/SOT338-1) removed. | | | |
| 74HC_HCT4060_Q100 v.2 | 20130410 | Product data sheet | - | 74HC_HCT4060_Q100 v.1 |
| Modifications: | <ul style="list-style-type: none"> 74HC4060DB-Q100 and 74HCT4060DB-Q100 added. | | | |
| 74HC_HCT4060_Q100 v.1 | 20120802 | Product data sheet | - | - |

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".
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Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:

moschip.ru

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