

# 74HC4060-Q100; 74HCT4060-Q100

14-stage binary ripple counter with oscillator

Rev. 2 — 10 April 2013

Product data sheet

## 1. General description

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The 74HC4060-Q100; 74HCT4060-Q100 are high-speed Si-gate CMOS devices that comply with JEDEC standard no. 7A. They are pin compatible with Low-power Schottky TTL (LSTTL).

The 74HC4060-Q100; 74HCT4060-Q100 are 14-stage ripple-carry counter/dividers and oscillators with three oscillator terminals (RS, RTC and CTC), ten buffered 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 other oscillator pins (RTC and CTC) floating. The counter advances on the negative-going transition of RS. A HIGH level on MR resets the counter (Q3 to Q9 and Q11 to Q13 = LOW), independent of other input conditions. In the HCT version, the MR input is TTL compatible, but the RS input has CMOS input switching levels and can be driven by a TTL output by using a pull-up resistor to  $V_{CC}$ .

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

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- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - ◆ Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$
- All active components on chip
- RC or crystal oscillator configuration
- ESD protection:
  - ◆ MIL-STD-883, method 3015 exceeds 2000 V
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V ( $C = 200\text{ pF}$ ,  $R = 0\text{ }\Omega$ )
- Multiple package options

## 3. Applications

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



4. Ordering information

Table 1. Ordering information

| Type number                         | Package           |          |                                                                                                                                      |          |
|-------------------------------------|-------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------|----------|
|                                     | Temperature range | Name     | Description                                                                                                                          | Version  |
| 74HC4060D-Q100<br>74HCT4060D-Q100   | −40 °C to +125 °C | SO16     | plastic small outline package; 16 leads;<br>body width 3.9 mm                                                                        | SOT109-1 |
| 74HC4060DB-Q100<br>74HCT4060DB-Q100 | −40 °C to +125 °C | SSOP16   | plastic shrink small outline package; 16 leads;<br>body width 5.3 mm                                                                 | SOT338-1 |
| 74HC4060PW-Q100                     | −40 °C to +125 °C | TSSOP16  | plastic thin shrink small outline package; 16 leads;<br>body width 4.4 mm                                                            | SOT403-1 |
| 74HC4060BQ-Q100<br>74HCT4060BQ-Q100 | −40 °C to +125 °C | DHVQFN16 | plastic dual in-line compatible thermal-enhanced<br>very thin quad flat package; no leads; 16 terminals;<br>body 2.5 × 3.5 × 0.85 mm | SOT763-1 |

5. Functional diagram

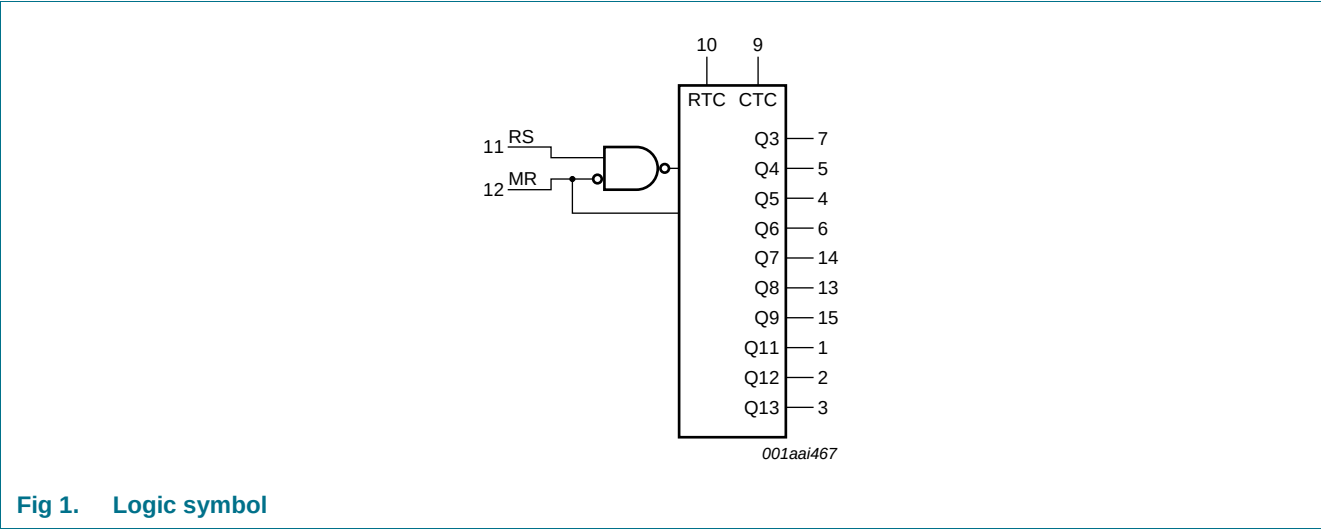


Fig 1. Logic symbol

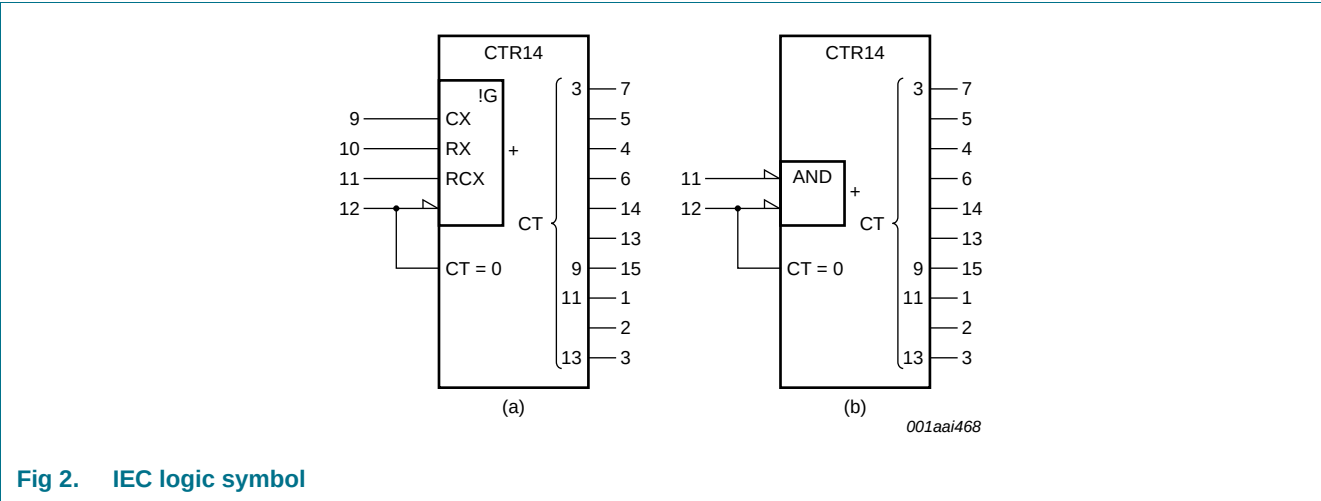


Fig 2. IEC logic symbol

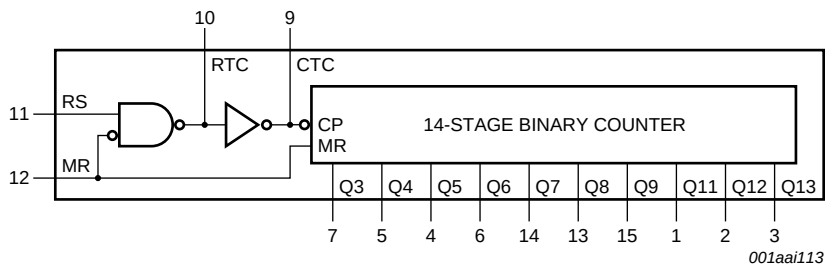


Fig 3. Functional diagram

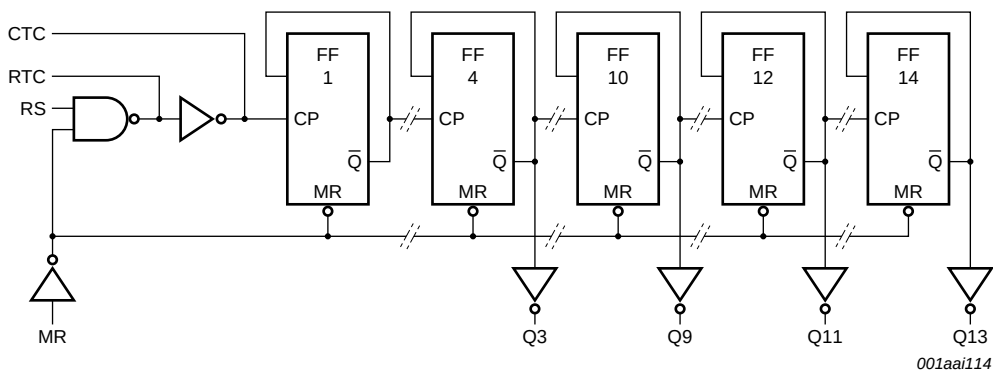
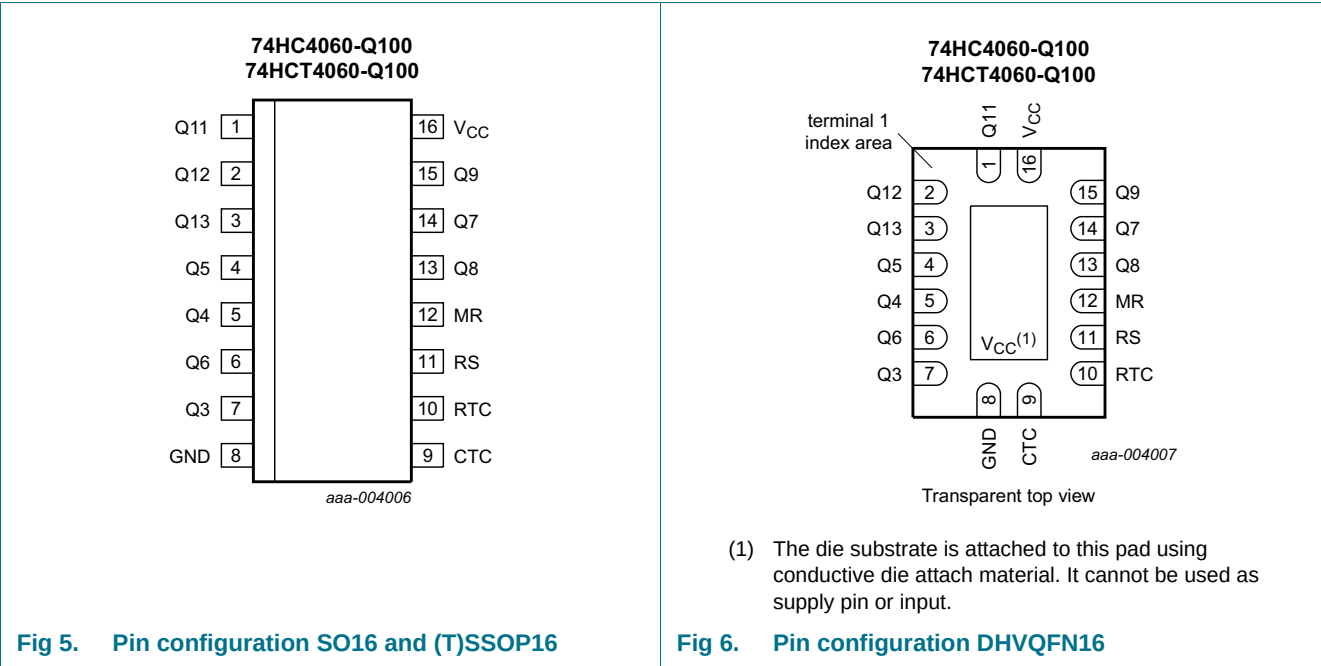


Fig 4. Logic diagram

6. Pinning information

6.1 Pinning



6.2 Pin description

Table 2. Pin description

| Symbol          | Pin                    | Description                      |
|-----------------|------------------------|----------------------------------|
| Q11 to Q13      | 1, 2, 3                | counter output                   |
| Q3 to 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 <sub>CC</sub> | 16                     | supply voltage                   |

## 7. Functional description

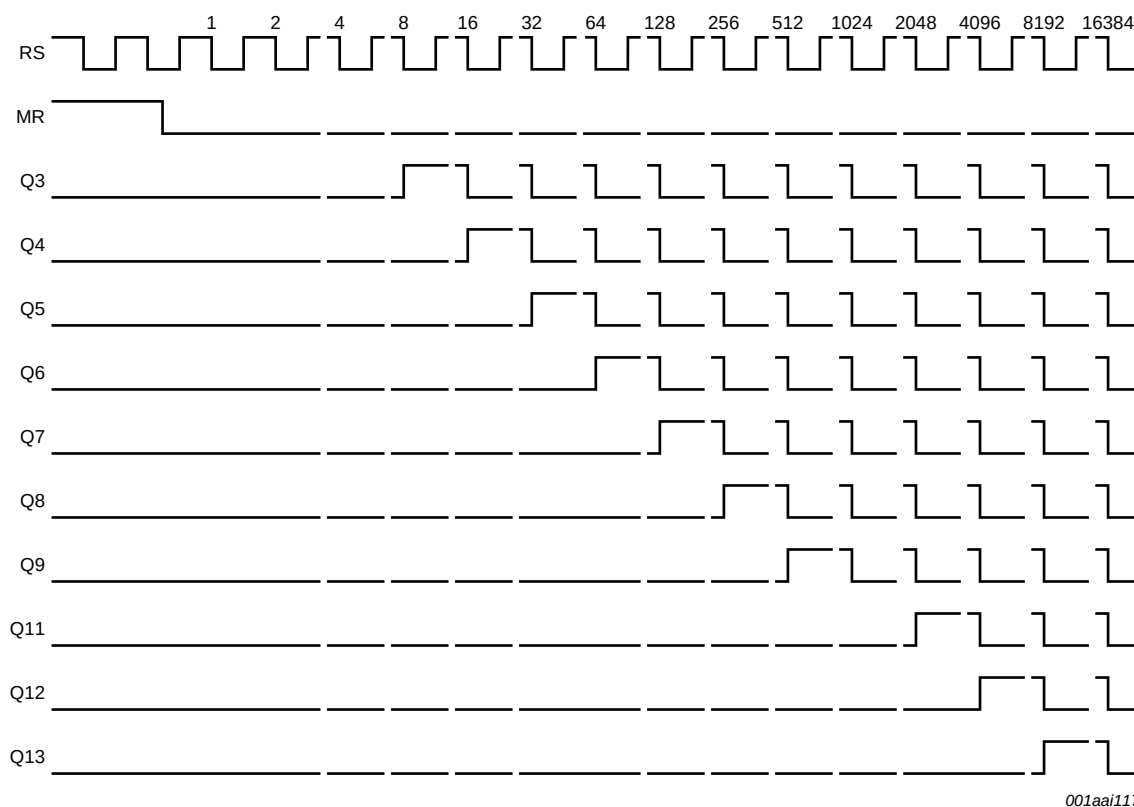


Fig 7. Timing diagram

## 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 $V_I > V_{CC} + 0.5 \text{ V}$ | <a href="#">1</a> - | $\pm 20$ | mA   |
| $I_{OK}$  | output clamping current | $V_O < -0.5 \text{ V}$ or $V_O > V_{CC} + 0.5 \text{ V}$ | <a href="#">1</a> - | $\pm 20$ | mA   |
| $I_O$     | output current          | $-0.5 \text{ V} < V_O < V_{CC} + 0.5 \text{ V}$          | -                   | $\pm 25$ | mA   |
| $I_{CC}$  | supply current          |                                                          | -                   | 50       | mA   |
| $I_{GND}$ | ground current          |                                                          | -50                 | -        | mA   |
| $T_{stg}$ | storage temperature     |                                                          | -65                 | +150     | °C   |

**Table 3.** Limiting values ...continued

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

| Symbol           | Parameter               | Conditions                           | Min   | Max | Unit |
|------------------|-------------------------|--------------------------------------|-------|-----|------|
| P <sub>tot</sub> | total power dissipation | T <sub>amb</sub> = -40 °C to +125 °C |       |     |      |
|                  |                         | SO16 package                         | [2] - | 500 | mW   |
|                  |                         | (T)SSOP16 package                    | [3] - | 500 | mW   |
|                  |                         | DHVQFN16 package                     | [4] - | 500 | mW   |

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

[2] P<sub>tot</sub> derates linearly with 8 mW/K above 70 °C.[3] P<sub>tot</sub> derates linearly with 5.5 mW/K above 60 °C.[4] P<sub>tot</sub> derates linearly with 4.5 mW/K above 60 °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 <sub>CC</sub>  | supply voltage                      |                         | 2.0           | 5.0  | 6.0             | 4.5            | 5.0  | 5.5             | V    |
| V <sub>I</sub>   | input voltage                       |                         | 0             | -    | V <sub>CC</sub> | 0              | -    | V <sub>CC</sub> | V    |
| V <sub>O</sub>   | output voltage                      |                         | 0             | -    | V <sub>CC</sub> | 0              | -    | V <sub>CC</sub> | V    |
| T <sub>amb</sub> | ambient temperature                 |                         | -40           | -    | +125            | -40            | -    | +125            | °C   |
| Δt/ΔV            | input transition rise and fall rate | V <sub>CC</sub> = 2.0 V | -             | -    | 625             | -              | -    | -               | ns/V |
|                  |                                     | V <sub>CC</sub> = 4.5 V | -             | 1.67 | 139             | -              | 1.67 | 139             | ns/V |
|                  |                                     | V <sub>CC</sub> = 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 <sub>IH</sub> | HIGH-level input voltage | MR input                |       |     |     |                  |     |                   |     |      |
|                 |                          | V <sub>CC</sub> = 2.0 V | 1.5   | 1.3 | -   | 1.5              | -   | 1.5               | -   | V    |
|                 |                          | V <sub>CC</sub> = 4.5 V | 3.15  | 2.4 | -   | 3.15             | -   | 3.15              | -   | V    |
|                 |                          | V <sub>CC</sub> = 6.0 V | 4.2   | 3.1 | -   | 4.2              | -   | 4.2               | -   | V    |
|                 |                          | RS input                |       |     |     |                  |     |                   |     |      |
|                 |                          | V <sub>CC</sub> = 2.0 V | 1.7   | -   | -   | 1.7              | -   | 1.7               | -   | V    |
|                 |                          | V <sub>CC</sub> = 4.5 V | 3.6   | -   | -   | 3.6              | -   | 3.6               | -   | V    |
|                 |                          | V <sub>CC</sub> = 6.0 V | 4.8   | -   | -   | 4.8              | -   | 4.8               | -   | V    |

**Table 5.** Static characteristics ...continued

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  |      |
| V <sub>IL</sub> | LOW-level input voltage   | MR input                                                                            |       |     |      |                  |      |                   |      |      |
|                 |                           | V <sub>CC</sub> = 2.0 V                                                             | -     | 0.8 | 0.5  | -                | 0.5  | -                 | 0.5  | V    |
|                 |                           | V <sub>CC</sub> = 4.5 V                                                             | -     | 2.1 | 1.35 | -                | 1.35 | -                 | 1.35 | V    |
|                 |                           | V <sub>CC</sub> = 6.0 V                                                             | -     | 2.8 | 1.8  | -                | 1.8  | -                 | 1.8  | V    |
|                 |                           | RS input                                                                            |       |     |      |                  |      |                   |      |      |
|                 |                           | V <sub>CC</sub> = 2.0 V                                                             | -     | -   | 0.3  | -                | 0.3  | -                 | 0.3  | V    |
|                 |                           | V <sub>CC</sub> = 4.5 V                                                             | -     | -   | 0.9  | -                | 0.9  | -                 | 0.9  | V    |
| V <sub>OH</sub> | HIGH-level output voltage | V <sub>CC</sub> = 6.0 V                                                             | -     | -   | 1.2  | -                | 1.2  | -                 | 1.2  | V    |
|                 |                           | RTC output; RS = MR = GND                                                           |       |     |      |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 2.0 V                                    | 1.9   | 2.0 | -    | 1.9              | -    | 1.9               | -    | V    |
|                 |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 4.5 V                                    | 4.4   | 4.5 | -    | 4.4              | -    | 4.4               | -    | V    |
|                 |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 6.0 V                                    | 5.9   | 6.0 | -    | 5.9              | -    | 5.9               | -    | V    |
|                 |                           | I <sub>O</sub> = -2.6 mA; V <sub>CC</sub> = 4.5 V                                   | 3.98  | -   | -    | 3.84             | -    | 3.7               | -    | V    |
|                 |                           | I <sub>O</sub> = -3.3 mA; V <sub>CC</sub> = 6.0 V                                   | 5.48  | -   | -    | 5.34             | -    | 5.2               | -    | V    |
|                 |                           | RTC output; RS = MR = V <sub>CC</sub>                                               |       |     |      |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 2.0 V                                    | 1.9   | 2.0 | -    | 1.9              | -    | 1.9               | -    | V    |
|                 |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 4.5 V                                    | 4.4   | 4.5 | -    | 4.4              | -    | 4.4               | -    | V    |
|                 |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 6.0 V                                    | 5.9   | 6.0 | -    | 5.9              | -    | 5.9               | -    | V    |
|                 |                           | I <sub>O</sub> = -0.65 mA; V <sub>CC</sub> = 4.5 V                                  | 3.98  | -   | -    | 3.84             | -    | 3.7               | -    | V    |
|                 |                           | I <sub>O</sub> = -0.85 mA; V <sub>CC</sub> = 6.0 V                                  | 5.48  | -   | -    | 5.34             | -    | 5.2               | -    | V    |
|                 |                           | CTC output;<br>RS = V <sub>IH</sub> ; MR = V <sub>IL</sub>                          |       |     |      |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = -3.2 mA; V <sub>CC</sub> = 4.5 V                                   | 3.98  | -   | -    | 3.84             | -    | 3.7               | -    | V    |
|                 |                           | I <sub>O</sub> = -4.2 mA; V <sub>CC</sub> = 6.0 V                                   | 5.48  | -   | -    | 5.34             | -    | 5.2               | -    | V    |
|                 |                           | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br>except RTC output          |       |     |      |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 2.0 V                                    | 1.9   | 2.0 | -    | 1.9              | -    | 1.9               | -    | V    |
|                 |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 4.5 V                                    | 4.4   | 4.5 | -    | 4.4              | -    | 4.4               | -    | V    |
|                 |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 6.0 V                                    | 5.9   | 6.0 | -    | 5.9              | -    | 5.9               | -    | V    |
|                 |                           | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br>except RTC and CTC outputs |       |     |      |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 4.5 V                                   | 3.98  | -   | -    | 3.84             | -    | 3.7               | -    | V    |
|                 |                           | I <sub>O</sub> = -5.2 mA; V <sub>CC</sub> = 6.0 V                                   | 5.48  | -   | -    | 5.34             | -    | 5.2               | -    | V    |

**Table 5.** Static characteristics ...continued

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 |       |
| V <sub>OL</sub>       | LOW-level output voltage | RTC output; RS = V <sub>CC</sub> ;<br>MR = GND                                            |                     |     |      |                  |      |                   |     |       |
|                       |                          | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 2.0 V                                           | -                   | 0   | 0.1  | -                | 0.1  | -                 | 0.1 | V     |
|                       |                          | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 4.5 V                                           | -                   | 0   | 0.1  | -                | 0.1  | -                 | 0.1 | V     |
|                       |                          | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 6.0 V                                           | -                   | 0   | 0.1  | -                | 0.1  | -                 | 0.1 | V     |
|                       |                          | I <sub>O</sub> = 2.6 mA; V <sub>CC</sub> = 4.5 V                                          | -                   | -   | 0.26 | -                | 0.33 | -                 | 0.4 | V     |
|                       |                          | I <sub>O</sub> = 3.3 mA; V <sub>CC</sub> = 6.0 V                                          | -                   | -   | 0.26 | -                | 0.33 | -                 | 0.4 | V     |
|                       |                          | CTC output; RS = V <sub>IL</sub> ;<br>MR = V <sub>IH</sub>                                |                     |     |      |                  |      |                   |     |       |
|                       |                          | I <sub>O</sub> = 3.2 mA; V <sub>CC</sub> = 4.5 V                                          | -                   | -   | 0.26 | -                | 0.33 | -                 | 0.4 | V     |
|                       |                          | I <sub>O</sub> = 4.2 mA; V <sub>CC</sub> = 6.0 V                                          | -                   | -   | 0.26 | -                | 0.33 | -                 | 0.4 | V     |
|                       |                          | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br>except RTC output                |                     |     |      |                  |      |                   |     |       |
|                       |                          | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 2.0 V                                           | -                   | 0   | 0.1  | -                | 0.1  | -                 | 0.1 | V     |
|                       |                          | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 4.5 V                                           | -                   | 0   | 0.1  | -                | 0.1  | -                 | 0.1 | V     |
|                       |                          | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 6.0 V                                           | -                   | 0   | 0.1  | -                | 0.1  | -                 | 0.1 | V     |
|                       |                          | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br>except RTC and CTC outputs       |                     |     |      |                  |      |                   |     |       |
| I <sub>I</sub>        | input leakage current    | I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 4.5 V                                          | -                   | -   | 0.26 | -                | 0.33 | -                 | 0.4 | V     |
|                       |                          | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V                                          | -                   | -   | 0.26 | -                | 0.33 | -                 | 0.4 | V     |
| I <sub>CC</sub>       | supply current           | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;<br>V <sub>CC</sub> = 6.0 V | -                   | -   | 8.0  | -                | 80   | -                 | 160 | µA    |
| C <sub>I</sub>        | input capacitance        |                                                                                           | -                   | 3.5 | -    | -                | -    | -                 | -   | pF    |
| <b>74HCT4060-Q100</b> |                          |                                                                                           |                     |     |      |                  |      |                   |     |       |
| V <sub>IH</sub>       | HIGH-level input voltage | MR input;<br>V <sub>CC</sub> = 4.5 V to 5.5 V                                             | <a href="#">[1]</a> | 2.0 | -    | -                | 2.0  | -                 | 2.0 | V     |
| V <sub>IL</sub>       | LOW-level input voltage  | MR input;<br>V <sub>CC</sub> = 4.5 V to 5.5 V                                             | <a href="#">[1]</a> | -   | -    | 0.8              | -    | 0.8               | -   | 0.8 V |



**Table 5.** Static characteristics ...continued

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  |      |
| V <sub>OH</sub>  | HIGH-level output voltage | RTC output; RS = MR = V <sub>CC</sub>                                                                                                                            |       |     |      |                  |      |                   |      |      |
|                  |                           | I <sub>O</sub> = –20 µA; V <sub>CC</sub> = 4.5 V                                                                                                                 | 4.4   | 4.5 | -    | 4.4              | -    | 4.4               | -    | V    |
|                  |                           | I <sub>O</sub> = –0.65 mA; V <sub>CC</sub> = 4.5 V                                                                                                               | 3.98  | -   | -    | 3.84             | -    | 3.7               | -    | V    |
|                  |                           | RTC output; RS = MR = GND                                                                                                                                        |       |     |      |                  |      |                   |      |      |
|                  |                           | I <sub>O</sub> = –20 µA; V <sub>CC</sub> = 4.5 V                                                                                                                 | 4.4   | 4.5 | -    | 4.4              | -    | 4.4               | -    | V    |
|                  |                           | I <sub>O</sub> = –2.6 mA; V <sub>CC</sub> = 4.5 V                                                                                                                | 3.98  | -   | -    | 3.84             | -    | 3.7               | -    | V    |
|                  |                           | CTC output; RS = V <sub>IH</sub> ;<br>MR = V <sub>IL</sub>                                                                                                       |       |     |      |                  |      |                   |      |      |
|                  |                           | I <sub>O</sub> = –3.2 mA; V <sub>CC</sub> = 4.5 V                                                                                                                | 3.98  | -   | -    | 3.84             | -    | 3.7               | -    | V    |
|                  |                           | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br>except RTC output                                                                                       |       |     |      |                  |      |                   |      |      |
|                  |                           | I <sub>O</sub> = –20 µA; V <sub>CC</sub> = 4.5 V                                                                                                                 | 4.4   | 4.5 | -    | 4.4              | -    | 4.4               | -    | V    |
|                  |                           | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br>except RTC and CTC outputs                                                                              |       |     |      |                  |      |                   |      |      |
|                  |                           | I <sub>O</sub> = –4.0 mA; V <sub>CC</sub> = 4.5 V                                                                                                                | 3.98  | -   | -    | 3.84             | -    | 3.7               | -    | V    |
| V <sub>OL</sub>  | LOW-level output voltage  | RTC output; RS = V <sub>CC</sub> ;<br>MR = GND                                                                                                                   |       |     |      |                  |      |                   |      |      |
|                  |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 4.5 V                                                                                                                  | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                  |                           | I <sub>O</sub> = 2.6 mA; V <sub>CC</sub> = 4.5 V                                                                                                                 | -     | -   | 0.26 | -                | 0.33 | -                 | 0.4  | V    |
|                  |                           | CTC output; RS = V <sub>IL</sub> ;<br>MR = V <sub>IH</sub>                                                                                                       |       |     |      |                  |      |                   |      |      |
|                  |                           | I <sub>O</sub> = 3.2 mA; V <sub>CC</sub> = 4.5 V                                                                                                                 | -     | -   | 0.26 | -                | 0.33 | -                 | 0.4  | V    |
|                  |                           | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br>except RTC output                                                                                       |       |     |      |                  |      |                   |      |      |
|                  |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 4.5 V                                                                                                                  | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                  |                           | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br>except RTC and CTC outputs                                                                              |       |     |      |                  |      |                   |      |      |
|                  |                           | I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 4.5 V                                                                                                                 | -     | -   | 0.26 | -                | 0.33 | -                 | 0.4  | V    |
| I <sub>I</sub>   | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V                                                                                                 | -     | -   | ±0.1 | -                | ±1.0 | -                 | ±1.0 | µA   |
| I <sub>CC</sub>  | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND;<br>V <sub>CC</sub> = 5.5 V; I <sub>O</sub> = 0 A                                                                        | -     | -   | 8.0  | -                | 80   | -                 | 160  | µA   |
| ΔI <sub>CC</sub> | additional supply current | per input pin;<br>V <sub>I</sub> = V <sub>CC</sub> – 2.1 V; other inputs<br>at V <sub>CC</sub> or GND;<br>V <sub>CC</sub> = 4.5 V to 5.5 V; I <sub>O</sub> = 0 A | -     | 40  | 144  | -                | 180  | -                 | 196  | µA   |
| C <sub>I</sub>   | input capacitance         |                                                                                                                                                                  | -     | 3.5 | -    | -                | -    | -                 | -    | pF   |

[1] For HCT4060-Q100, 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 [Figure 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 <sub>pd</sub>  | propagation delay             | RS to Q3; see <a href="#">Figure 8</a> <a href="#">[1]</a>   |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                      | -     | 99  | 300 | -                | 375 | -                 | 450 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                      | -     | 36  | 60  | -                | 75  | -                 | 90  | ns   |
|                  |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF              | -     | 31  | -   | -                | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                      | -     | 29  | 51  | -                | 64  | -                 | 77  | ns   |
|                  |                               | Qn to Qn+1; see <a href="#">Figure 9</a> <a href="#">[2]</a> |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                      | -     | 22  | 80  | -                | 100 | -                 | 120 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                      | -     | 8   | 16  | -                | 20  | -                 | 24  | ns   |
|                  |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF              | -     | 6   | -   | -                | -   | -                 | -   | ns   |
|                  | V <sub>CC</sub> = 6.0 V       | -                                                            | 6     | 14  | -   | 17               | -   | 20                | ns  |      |
| t <sub>PHL</sub> | HIGH to LOW propagation delay | MR to Qn; see <a href="#">Figure 10</a>                      |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                      | -     | 55  | 175 | -                | 220 | -                 | 265 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                      | -     | 20  | 35  | -                | 44  | -                 | 53  | ns   |
|                  |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF              | -     | 17  | -   | -                | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                      | -     | 16  | 30  | -                | 37  | -                 | 45  | ns   |
| t <sub>t</sub>   | transition time               | Qn; see <a href="#">Figure 8</a> <a href="#">[3]</a>         |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                      | -     | 19  | 75  | -                | 95  | -                 | 110 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                      | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                      | -     | 6   | 13  | -                | 16  | -                 | 19  | ns   |
| t <sub>w</sub>   | pulse width                   | RS (HIGH or LOW); see <a href="#">Figure 8</a>               |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                      | 80    | 17  | -   | 100              | -   | 120               | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                      | 16    | 6   | -   | 20               | -   | 24                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                      | 14    | 5   | -   | 17               | -   | 20                | -   | ns   |
|                  |                               | MR (HIGH); see <a href="#">Figure 10</a>                     |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                      | 80    | 25  | -   | 100              | -   | 120               | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                      | 16    | 9   | -   | 20               | -   | 24                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                      | 14    | 7   | -   | 17               | -   | 20                | -   | ns   |
| t <sub>rec</sub> | recovery time                 | MR to RS; see <a href="#">Figure 10</a>                      |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                      | 100   | 28  | -   | 125              | -   | 150               | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                      | 20    | 10  | -   | 25               | -   | 30                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                      | 17    | 8   | -   | 21               | -   | 26                | -   | ns   |

**Table 6.** Dynamic characteristics ...continuedGND = 0 V;  $C_L = 50$  pF unless otherwise specified; for test circuit see [Figure 11](#).

| 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 <a href="#">Figure 8</a>                              |       |     |     |                  |     |                   |     |      |
|                       |                               | $V_{CC} = 2.0$ 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 | $V_I = \text{GND to } V_{CC}$ ; $V_{CC} = 5$ V; $f_i = 1$ MHz | [4]   | -   | 40  | -                | -   | -                 | -   | pF   |
| <b>74HCT4060-Q100</b> |                               |                                                               |       |     |     |                  |     |                   |     |      |
| $t_{pd}$              | propagation delay             | RS to Q3; see <a href="#">Figure 8</a>                        |       |     |     |                  |     |                   |     |      |
|                       |                               | $V_{CC} = 4.5$ V                                              | -     | 33  | 66  | -                | 83  | -                 | 99  | ns   |
|                       |                               | $V_{CC} = 5.0$ V; $C_L = 15$ pF                               | -     | 31  | -   | -                | -   | -                 | -   | ns   |
|                       |                               | Qn to Qn+1; see <a href="#">Figure 9</a>                      |       |     |     |                  |     |                   |     |      |
|                       |                               | $V_{CC} = 4.5$ 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 <a href="#">Figure 10</a>                       |       |     |     |                  |     |                   |     |      |
|                       |                               | $V_{CC} = 4.5$ V                                              | -     | 21  | 44  | -                | 55  | -                 | 66  | ns   |
|                       |                               | $V_{CC} = 5.0$ V; $C_L = 15$ pF                               | -     | 18  | -   | -                | -   | -                 | -   | ns   |
| $t_t$                 | transition time               | Qn; see <a href="#">Figure 8</a>                              |       |     |     |                  |     |                   |     |      |
|                       |                               | $V_{CC} = 4.5$ V                                              | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
| $t_w$                 | pulse width                   | RS (HIGH or LOW); see <a href="#">Figure 8</a>                |       |     |     |                  |     |                   |     |      |
|                       |                               | $V_{CC} = 4.5$ V                                              | 16    | 6   | -   | 20               | -   | 24                | -   | ns   |
|                       |                               | MR (HIGH); see <a href="#">Figure 10</a>                      |       |     |     |                  |     |                   |     |      |
|                       |                               | $V_{CC} = 4.5$ V                                              | 16    | 6   | -   | 20               | -   | 24                | -   | ns   |
| $t_{rec}$             | recovery time                 | MR to RS; see <a href="#">Figure 10</a>                       |       |     |     |                  |     |                   |     |      |
|                       |                               | $V_{CC} = 4.5$ V                                              | 26    | 13  | -   | 33               | -   | 39                | -   | ns   |
| $f_{\max}$            | maximum frequency             | RS; see <a href="#">Figure 8</a>                              |       |     |     |                  |     |                   |     |      |
|                       |                               | $V_{CC} = 4.5$ V                                              | 30    | 80  | -   | 24               | -   | 20                | -   | MHz  |
|                       |                               | $V_{CC} = 5.0$ V; $C_L = 15$ pF                               | -     | 88  | -   | -                | -   | -                 | -   | MHz  |

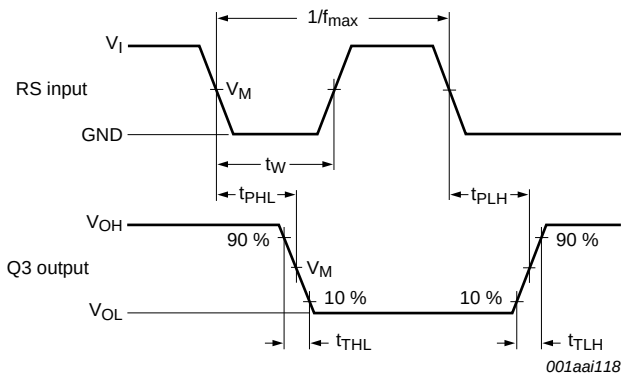
**Table 6. Dynamic characteristics ...continued**  
*GND = 0 V; C<sub>L</sub> = 50 pF unless otherwise specified; for test circuit see [Figure 11](#).*

| Symbol          | Parameter                     | Conditions                                                                                        | 25 °C |     |     | −40 °C to +85 °C |     | −40 °C to +125 °C |     | Unit |
|-----------------|-------------------------------|---------------------------------------------------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                 |                               |                                                                                                   | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| C <sub>PD</sub> | power dissipation capacitance | V <sub>I</sub> = GND to V <sub>CC</sub> − 1.5 V;<br>V <sub>CC</sub> = 5 V; f <sub>i</sub> = 1 MHz | [4]   | -   | 40  | -                | -   | -                 | -   | pF   |

- [1] t<sub>pd</sub> is the same as t<sub>PHL</sub> and t<sub>PLH</sub>.
- [2] Q<sub>n+1</sub> is the next Q<sub>n</sub> output.
- [3] t<sub>t</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.
- [4] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW):  

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$$
where:  
f<sub>i</sub> = input frequency in MHz;  
f<sub>o</sub> = output frequency in MHz;  
C<sub>L</sub> = output load capacitance in pF;  
V<sub>CC</sub> = supply voltage in V;  
N = number of inputs switching;  
 $\sum(C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.

## 12. Waveforms



Measurement points are given in [Table 7](#).  
V<sub>OL</sub> and V<sub>OH</sub> 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**

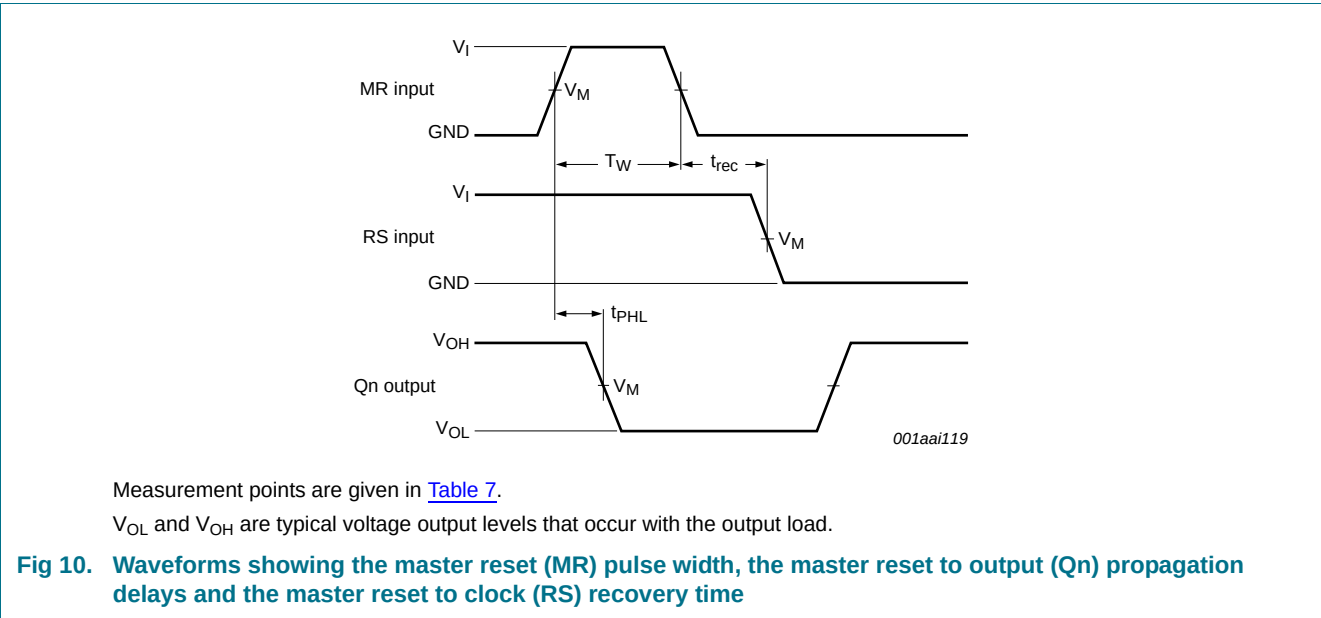
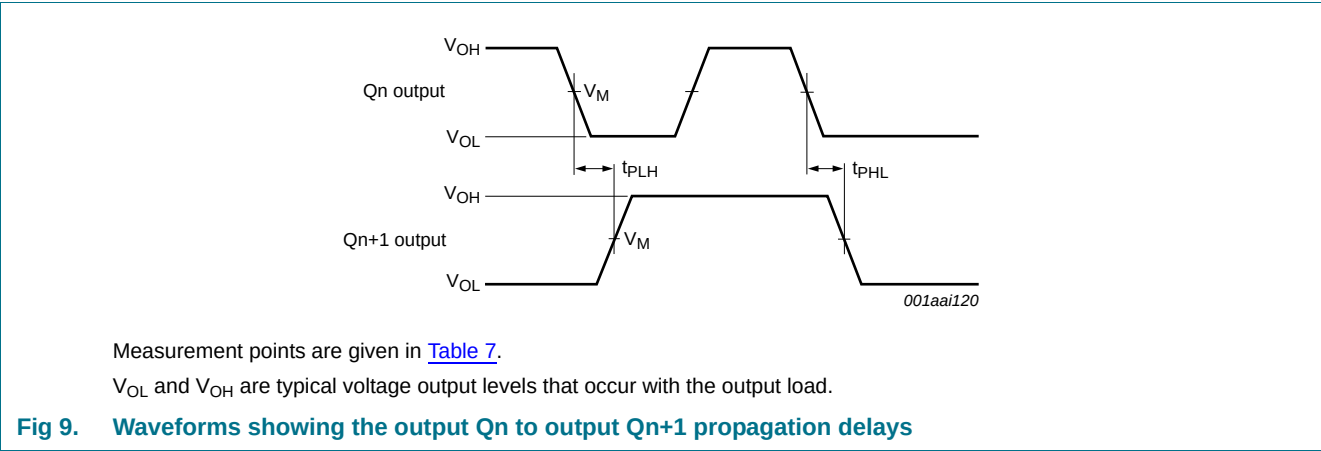
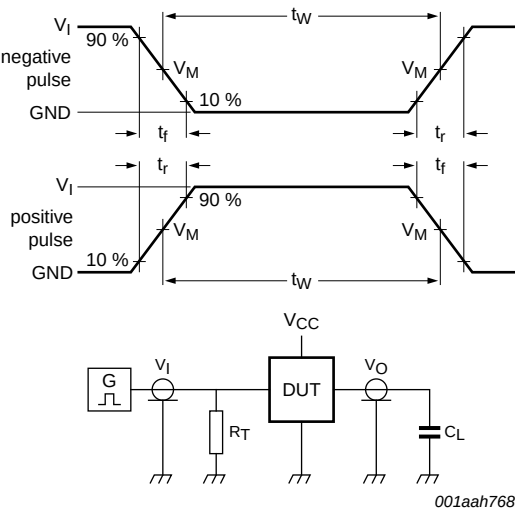


Table 7. Measurement points

| 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               |



Test data is given in [Table 8](#).

Definitions test circuit:

$R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator.

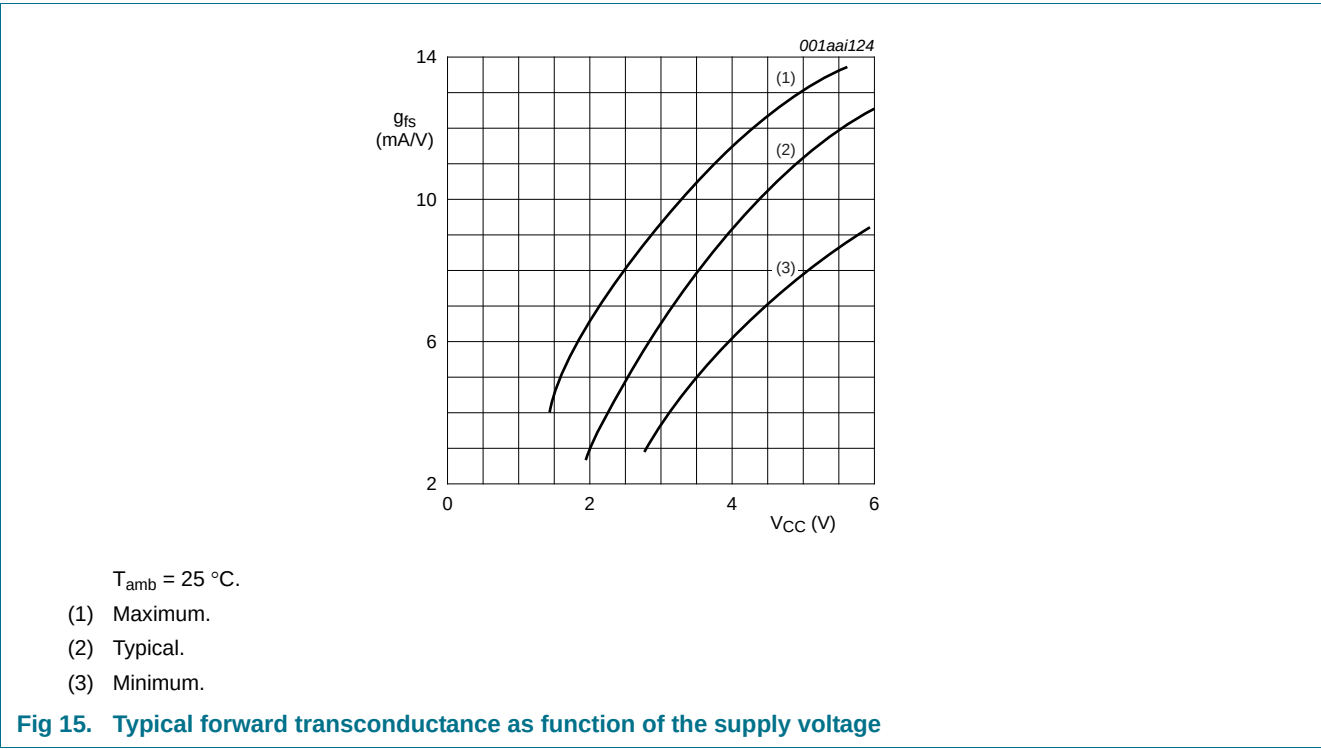
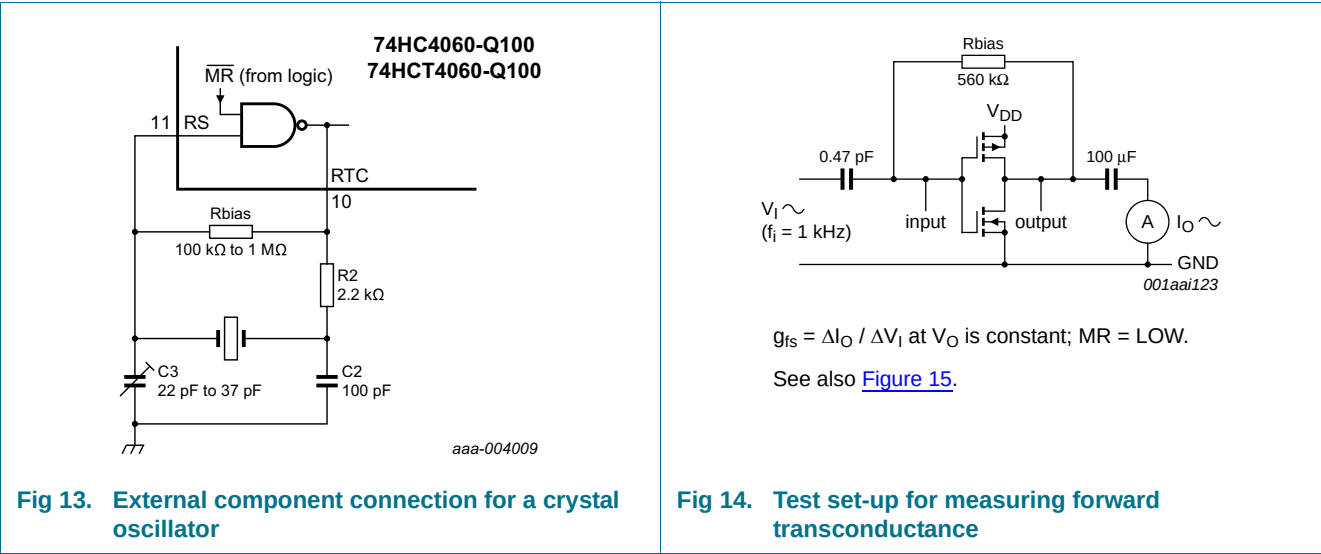
$C_L$  = Load capacitance including jig and probe capacitance.

Fig 11. Test circuit for measuring switching times

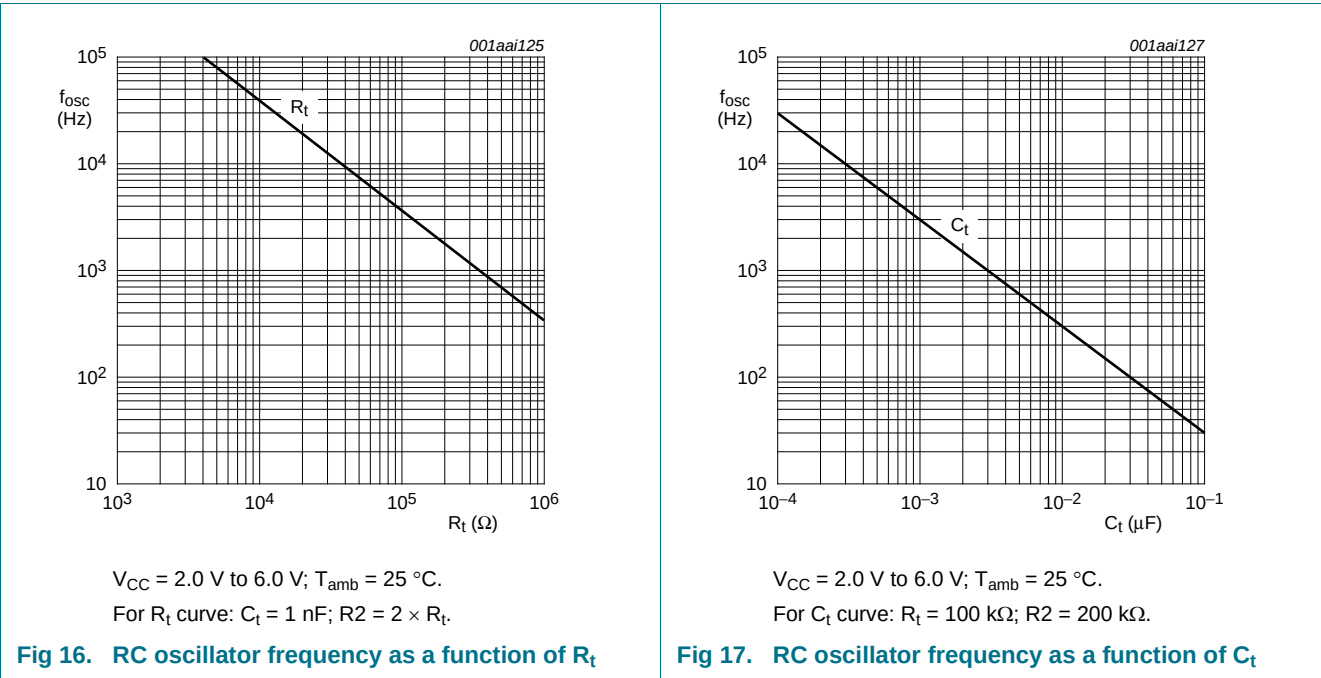
Table 8. Test data

| 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 |









14. Package outline

SO16: plastic small outline package; 16 leads; body width 3.9 mmSOT109-1

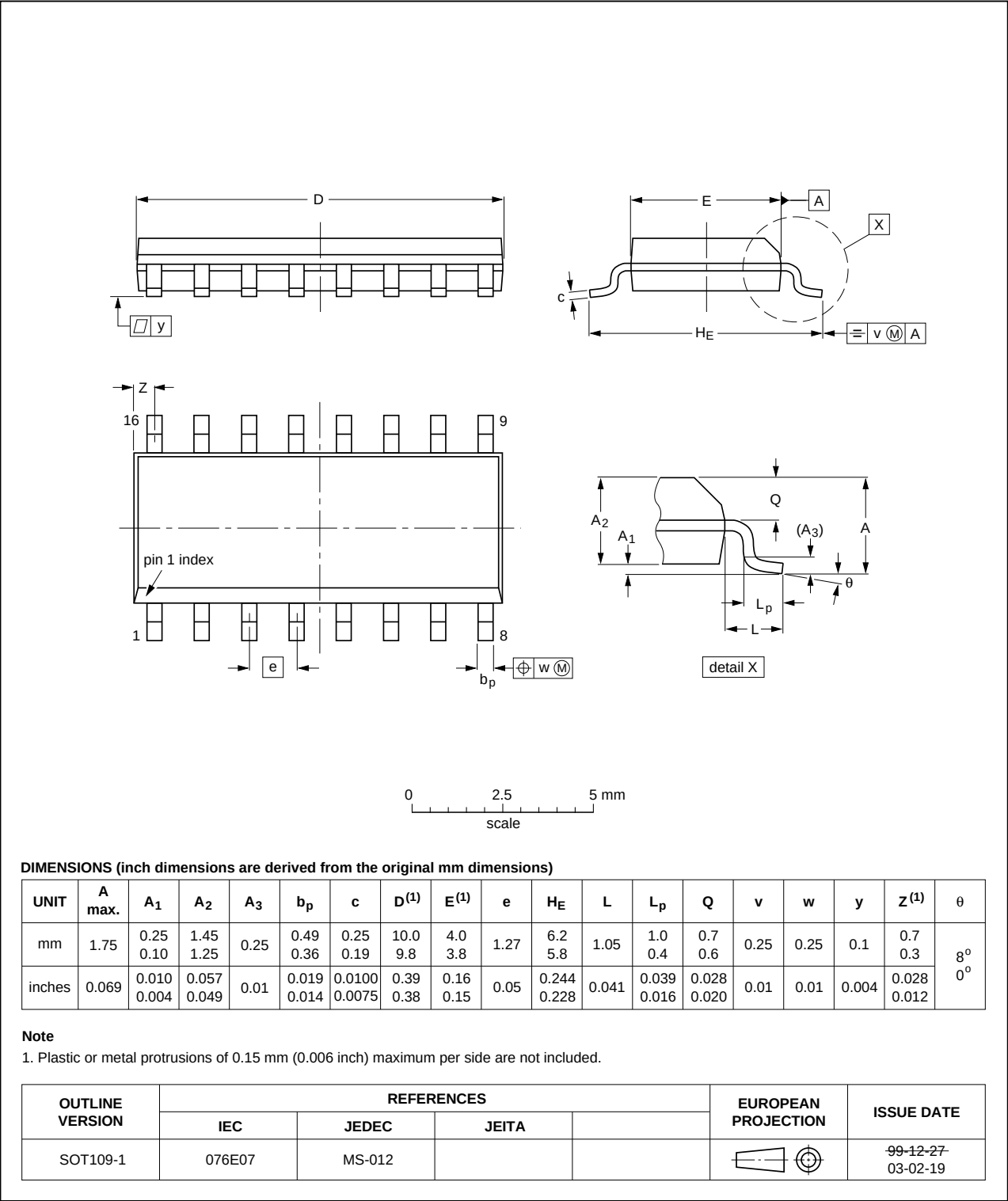


Fig 18. Package outline SOT109-1 (SO16)

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

SOT338-1

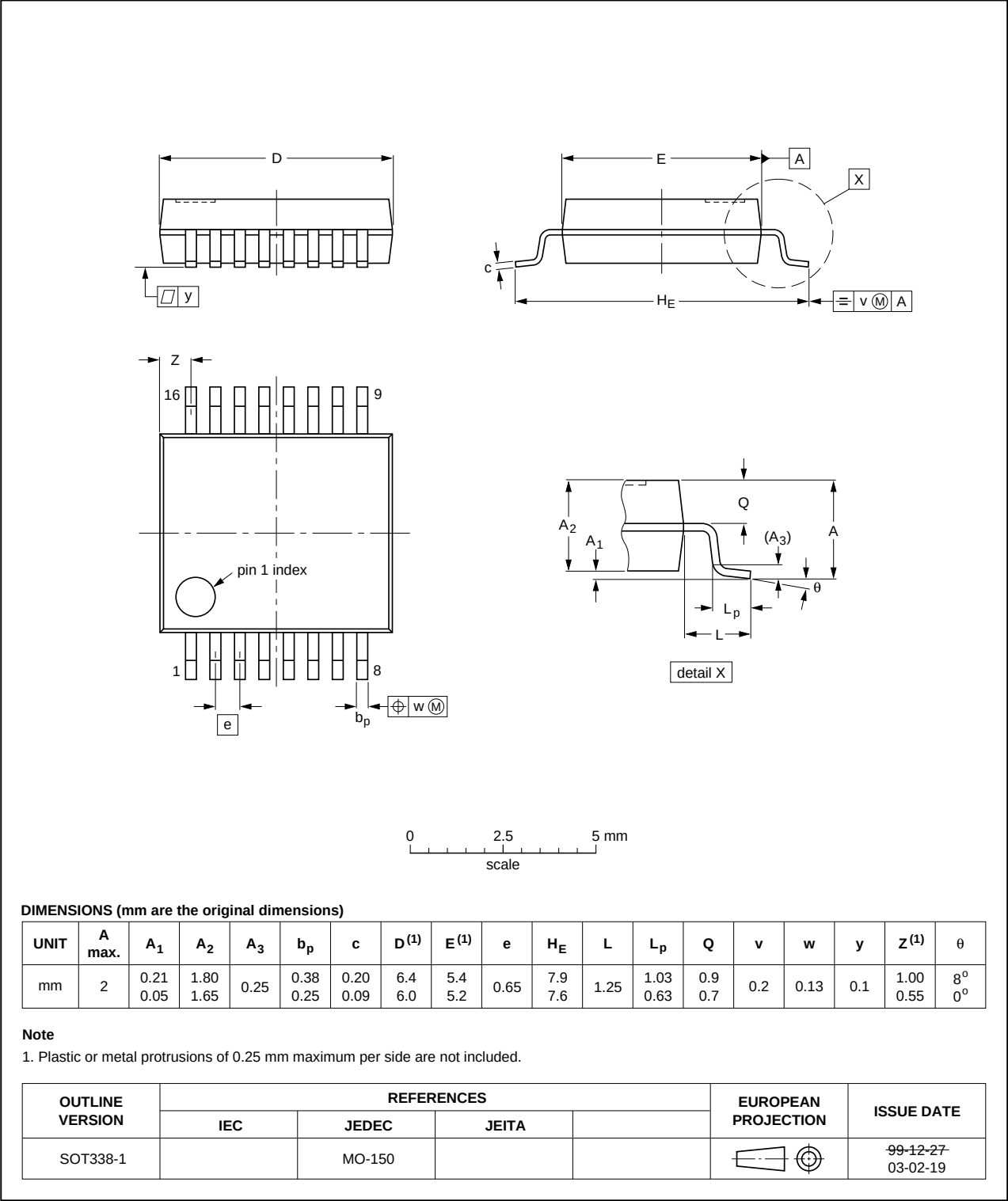


Fig 19. Package outline SOT338-1 (SSOP16)

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

SOT403-1

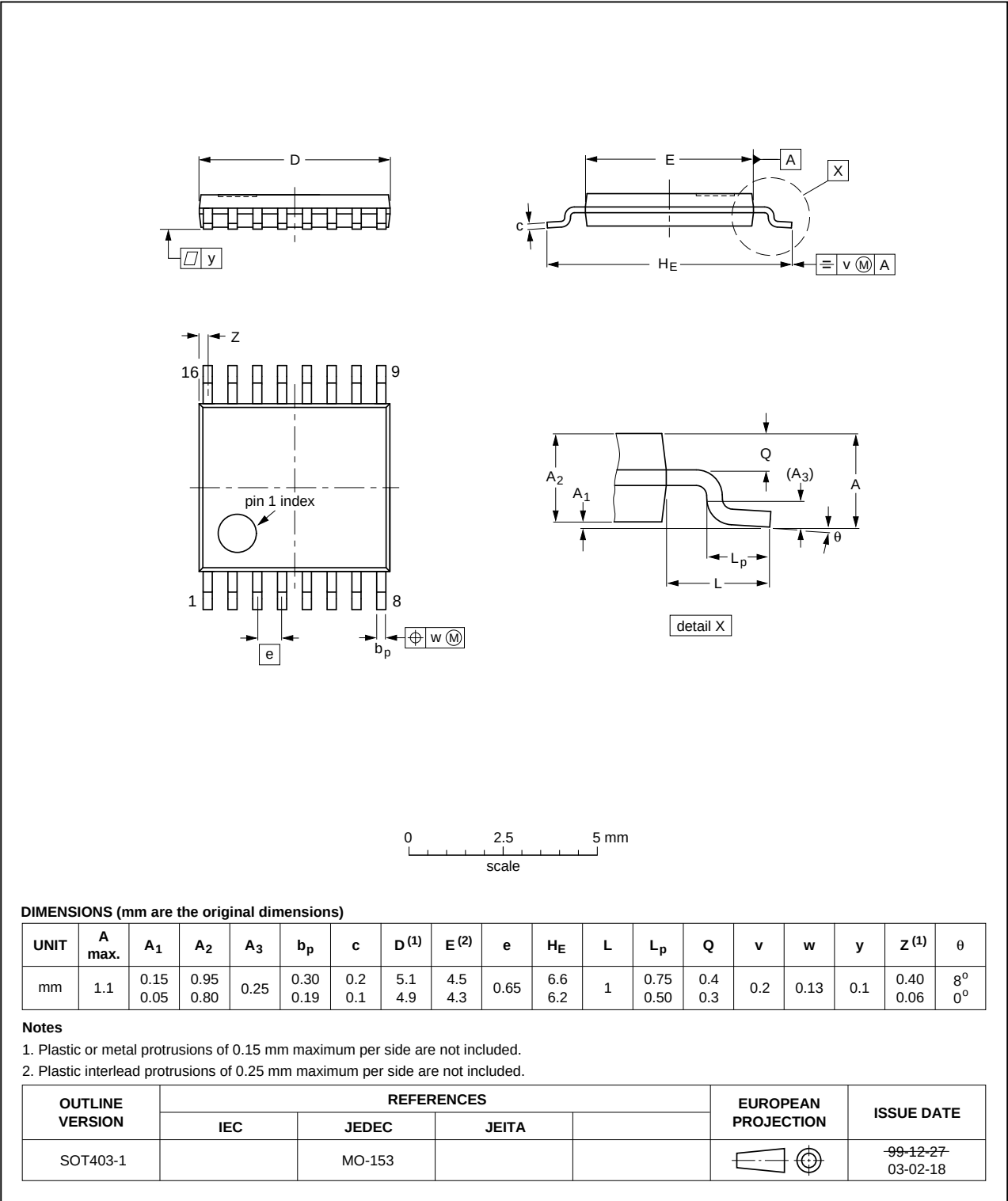


Fig 20. Package outline SOT403-1 (TSSOP16)

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

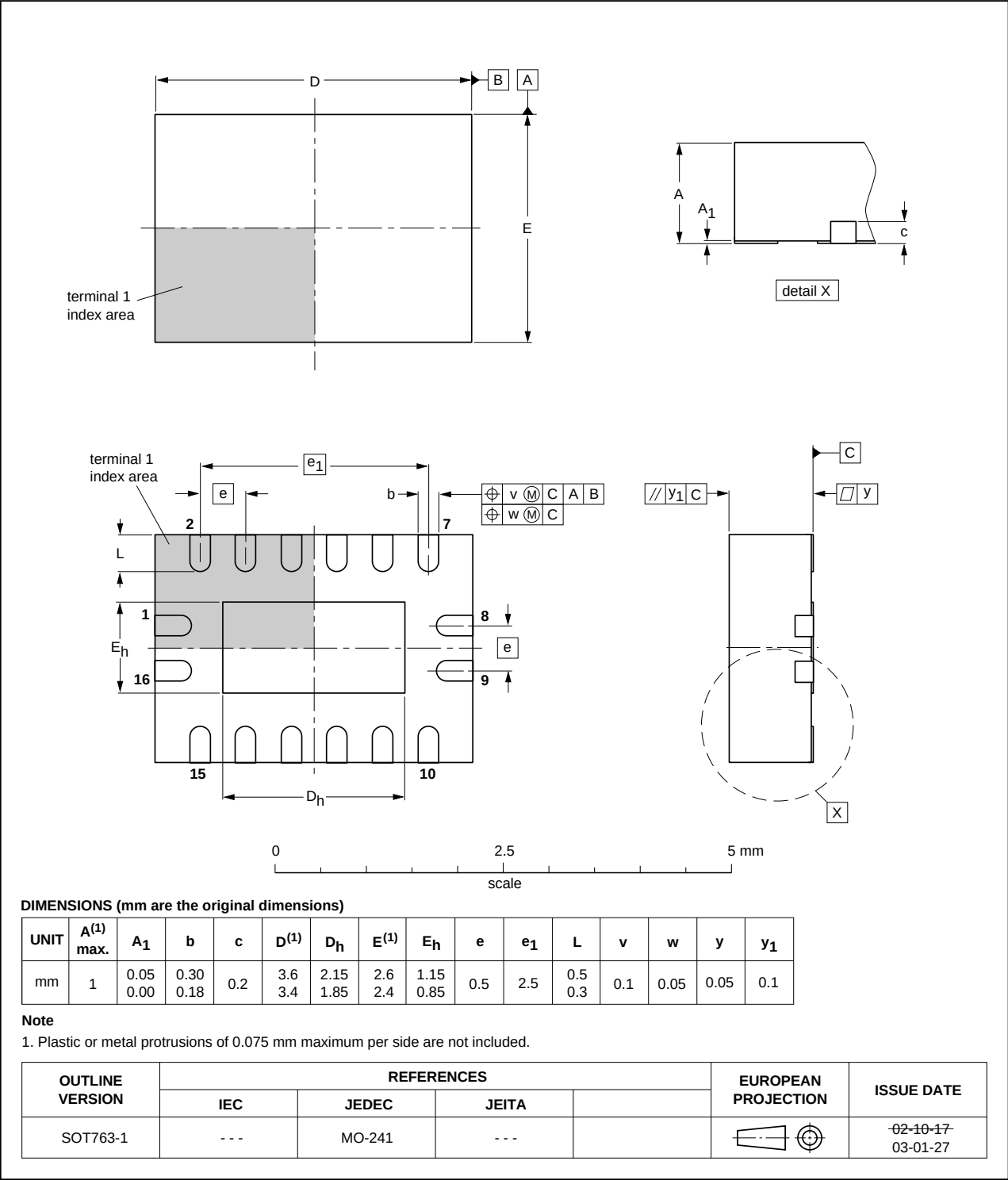


Fig 21. Package outline SOT763-1 (DHVQFN16)

## 15. 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             |
| MIL     | Military                                |

## 16. Revision history

**Table 10. Revision history**

| Document ID           | Release date                                  | Data sheet status  | Change notice | Supersedes            |
|-----------------------|-----------------------------------------------|--------------------|---------------|-----------------------|
| 74HC_HCT4060_Q100 v.2 | 20130410                                      | Product data sheet | -             | 74HC_HCT4060_Q100 v.1 |
| Modifications:        | • 74HC4060DB-Q100 and 74HCT4060DB-Q100 added. |                    |               |                       |
| 74HC_HCT4060_Q100 v.1 | 20120802                                      | Product data sheet | -             | -                     |

## 17. Legal information

### 17.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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 URL <http://www.nxp.com>.

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