

74HC4060-Q100; 74HCT4060-Q100

14-stage binary ripple counter with oscillator

Rev. 2 — 10 April 2013

Product data sheet

1. General description

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

- 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 pF, R = 0 Ω)
- Multiple package options

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 74HCT4060D-Q100 | -40 °C to +125 °C | SO16 | plastic small outline package; 16 leads; body width 3.9 mm | SOT109-1 |
| 74HC4060DB-Q100 74HCT4060DB-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 74HCT4060BQ-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 |

5. Functional diagram

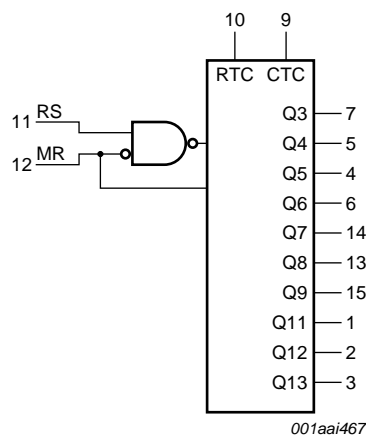


Fig 1. Logic symbol

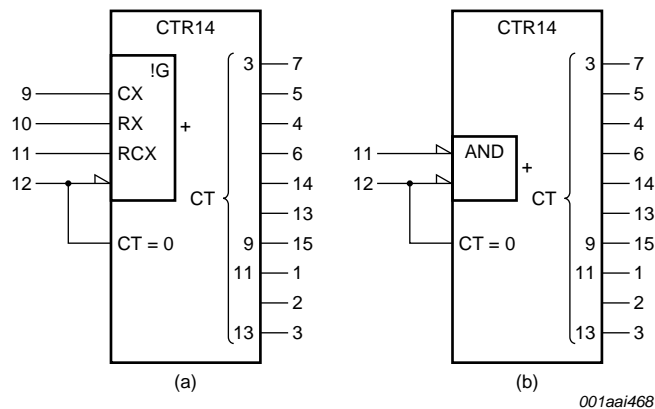
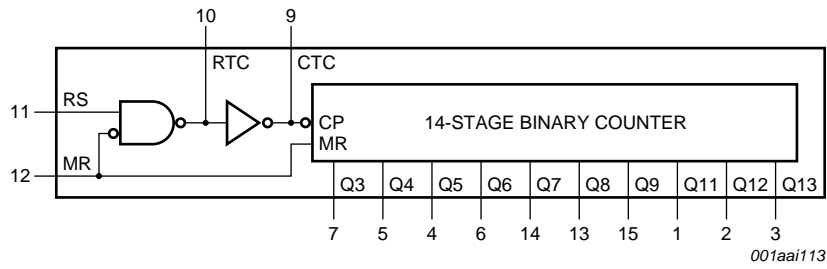
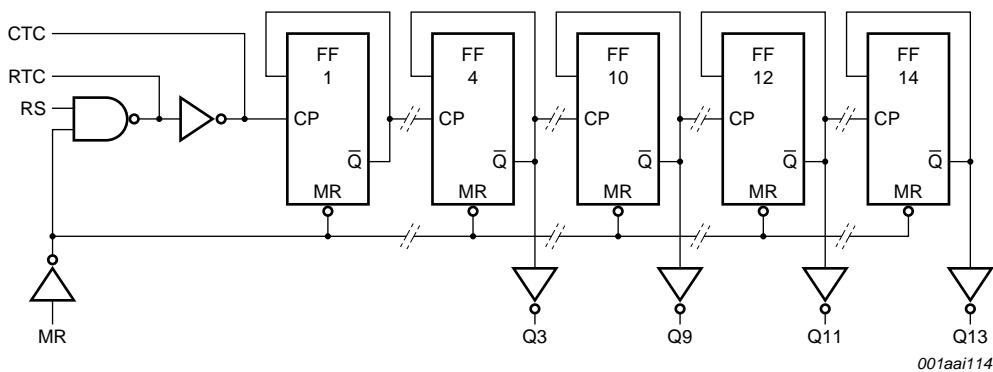


Fig 2. IEC logic symbol



001aa1113

Fig 3. Functional diagram

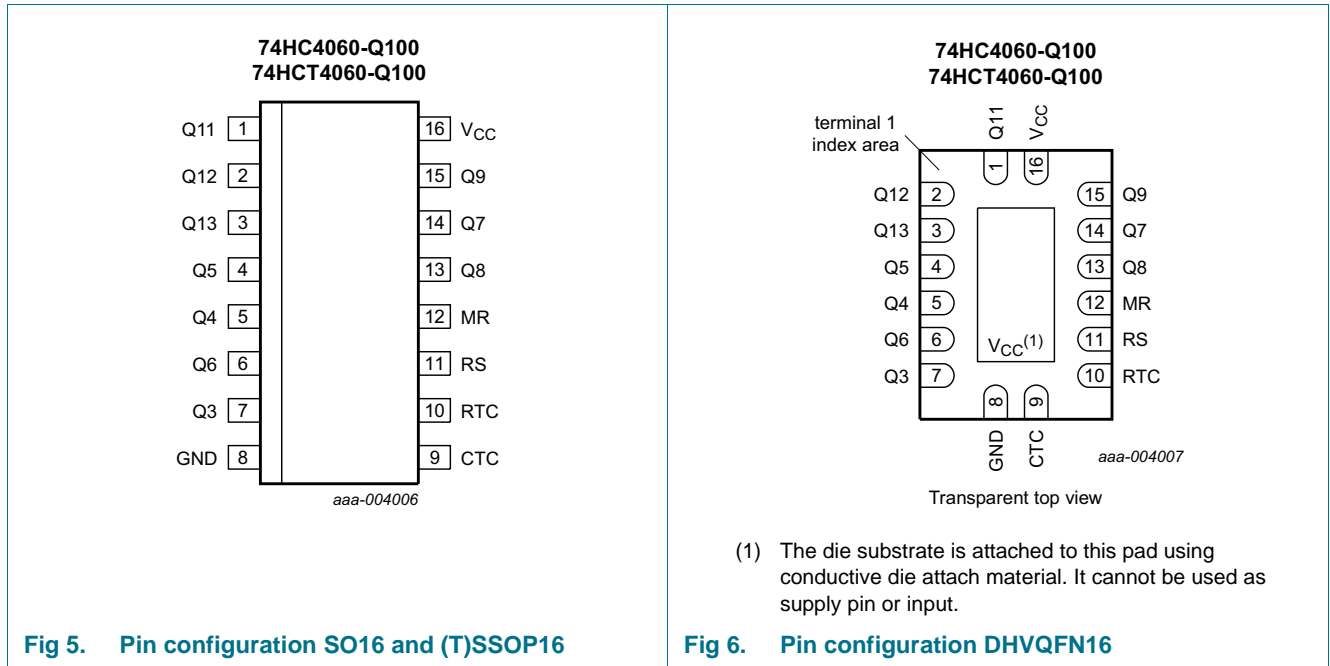


001aa1114

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 _{CC} | 16 | supply voltage |

7. Functional description

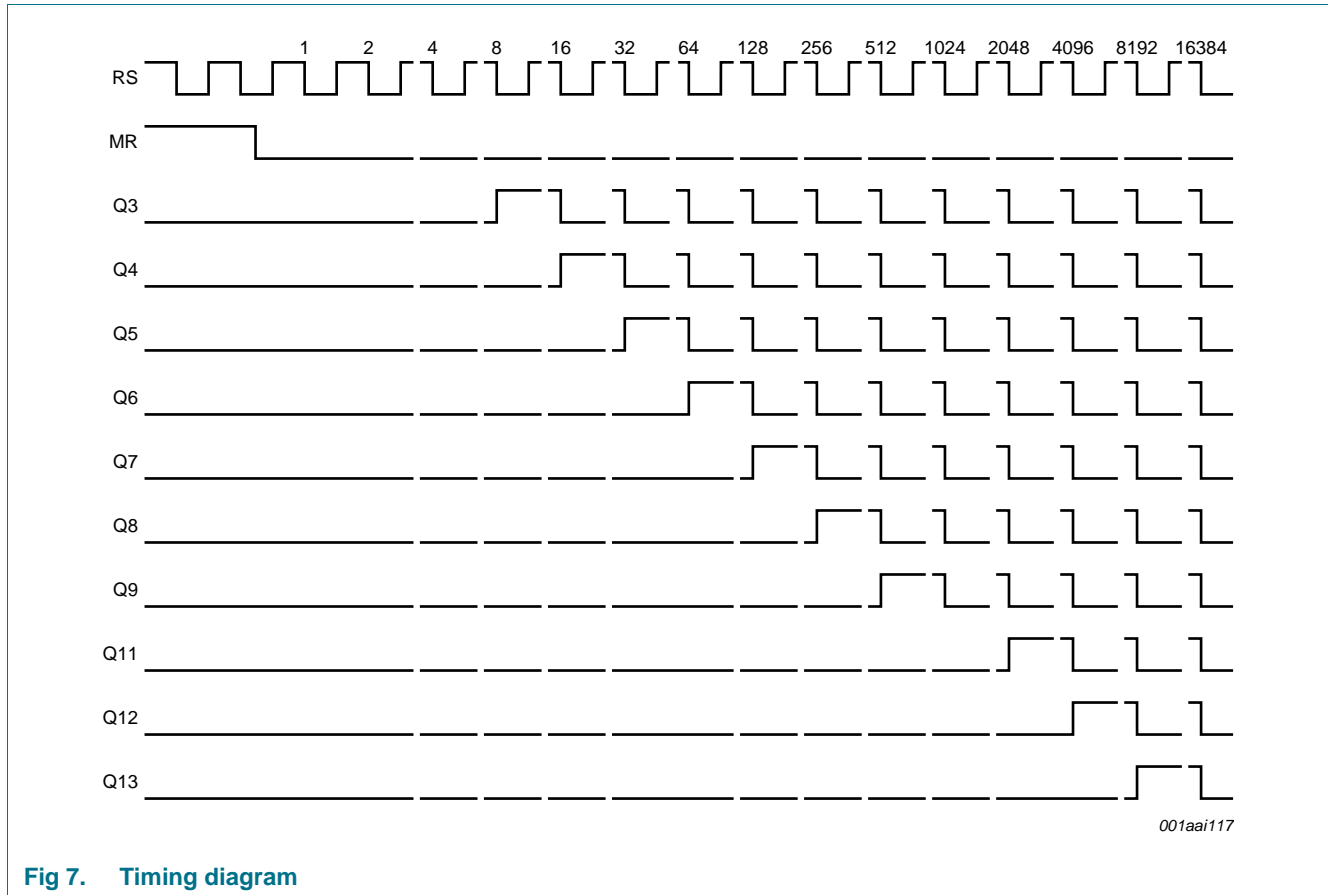


Fig 7. Timing diagram

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 V or V _I > V _{CC} + 0.5 V | [1] - | ±20 | mA |
| I _{OK} | output clamping current | V _O < -0.5 V or V _O > V _{CC} + 0.5 V | [1] - | ±20 | mA |
| I _O | output current | -0.5 V < V _O < V _{CC} + 0.5 V | - | ±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 _{tot} | total power dissipation | T _{amb} = -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_{tot} derates linearly with 8 mW/K above 70 °C.

[3] P_{tot} derates linearly with 5.5 mW/K above 60 °C.

[4] P_{tot} 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 _{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 |

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 _{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 |
| | | 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 | | |

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 _{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 | |
| 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 |
| 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 |

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 _{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 _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 | | |
| V _{OL} | LOW-level output voltage | 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 |
| 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 _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 5.5 V | - | - | ±0.1 | - | ±1.0 | - | ±1.0 | μA |
| I _{CC} | supply current | 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-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_{pd} | propagation delay | RS to Q3; see Figure 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 Figure 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 Figure 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 Figure 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 Figure 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 Figure 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 Figure 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 |

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

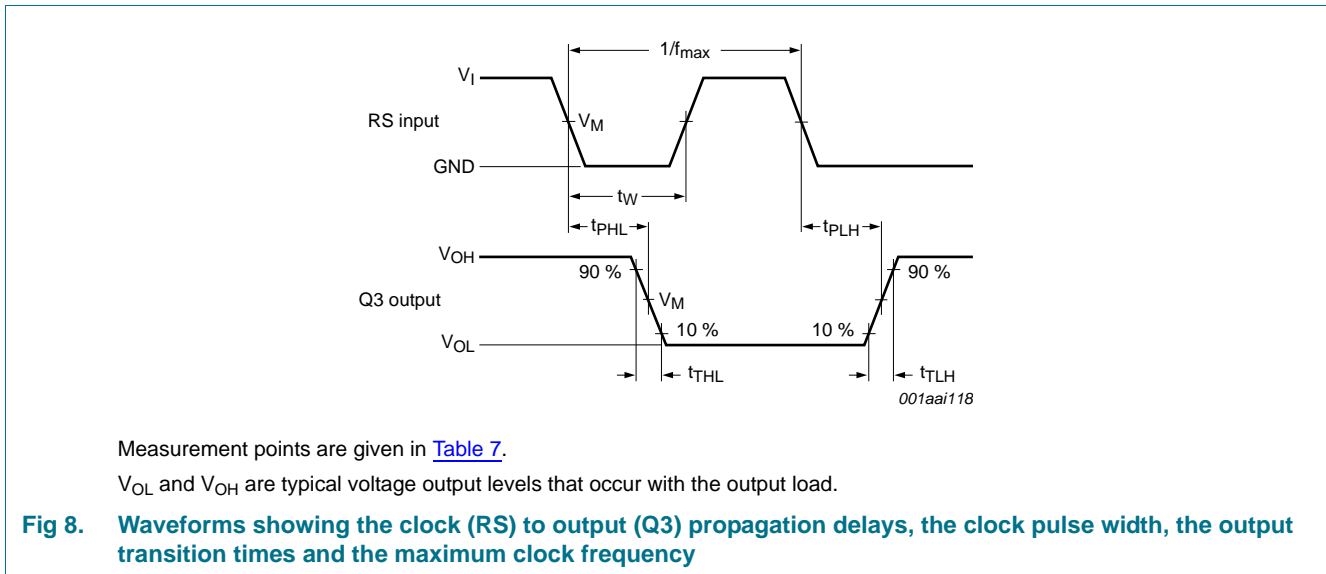
| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|-----------------------|-------------------------------|--|-------|-----|-----|------------------|-----|-------------------|-----|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| f_{\max} | maximum frequency | RS; see Figure 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 | $V_I = \text{GND to } V_{CC}$; $V_{CC} = 5$ V; $f_i = 1$ MHz | [4] | - | 40 | - | - | - | - | pF |
| 74HCT4060-Q100 | | | | | | | | | | |
| t_{pd} | propagation delay | RS to Q3; see Figure 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 Figure 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 Figure 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 Figure 8 | [3] | | | | | | | |
| | | $V_{CC} = 4.5$ V | - | 7 | 15 | - | 19 | - | 22 | ns |
| t_W | pulse width | RS (HIGH or LOW); see Figure 8 | | | | | | | | |
| | | $V_{CC} = 4.5$ V | 16 | 6 | - | 20 | - | 24 | - | ns |
| | | MR (HIGH); see Figure 10 | | | | | | | | |
| | | $V_{CC} = 4.5$ V | 16 | 6 | - | 20 | - | 24 | - | ns |
| t_{rec} | recovery time | MR to RS; see Figure 10 | | | | | | | | |
| | | $V_{CC} = 4.5$ V | 26 | 13 | - | 33 | - | 39 | - | ns |
| f_{\max} | maximum frequency | RS; see Figure 8 | | | | | | | | |
| | | $V_{CC} = 4.5$ 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_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 | |
| 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] Q_{n+1} is the next Q_n 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):
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$ 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.

12. Waveforms



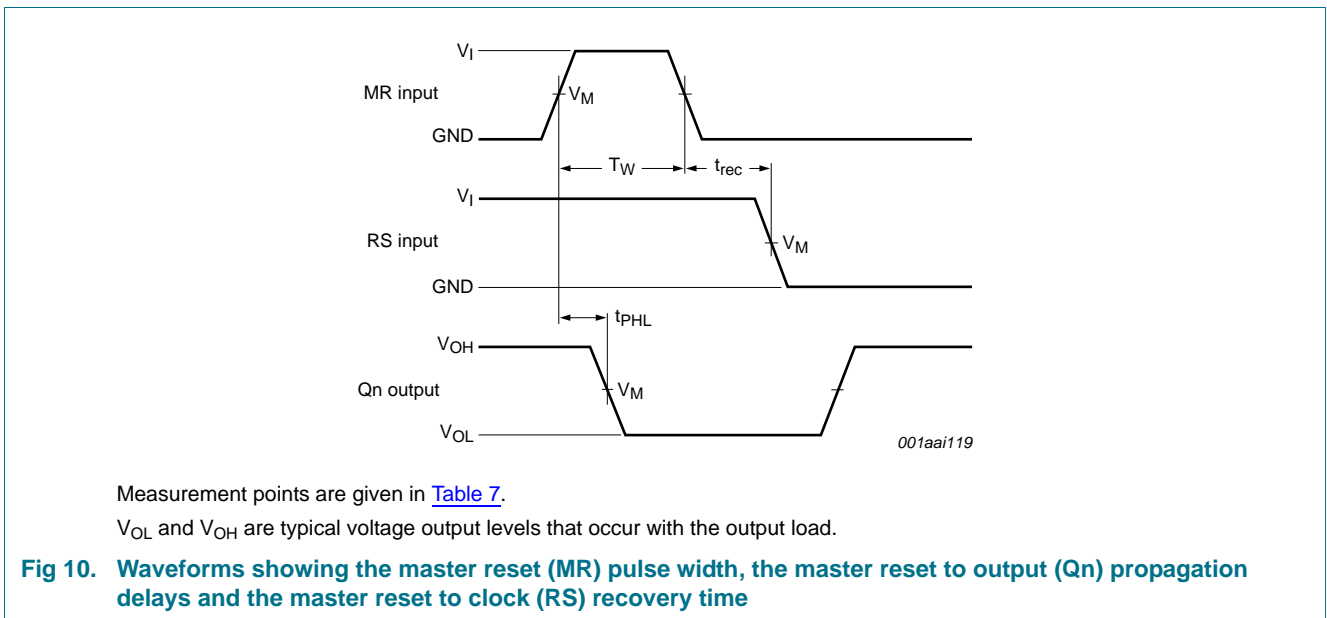
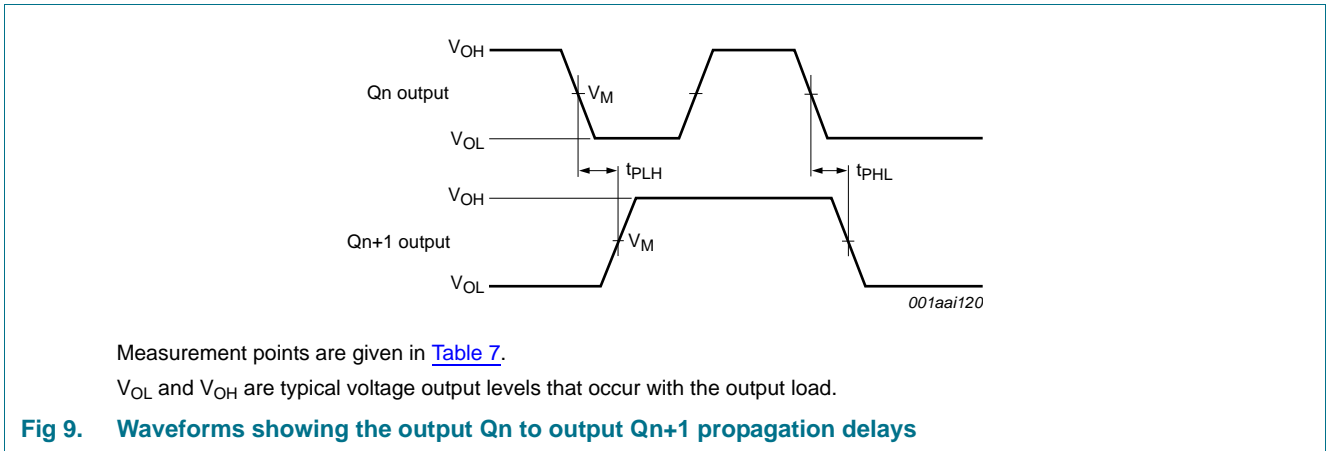
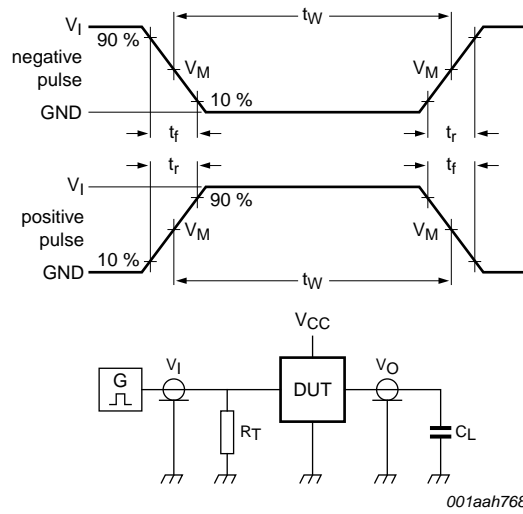


Table 7. Measurement points

| 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 |



001aah768

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 |

13. RC oscillator

13.1 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.

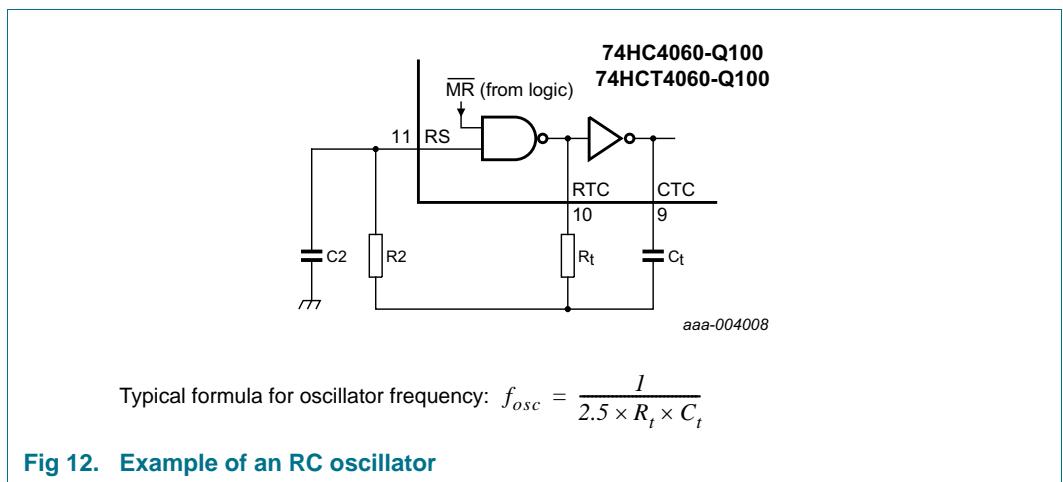


Fig 12. Example of an RC oscillator

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, $R_t \geq 1 \text{ k}\Omega$.

13.2 Typical crystal oscillator circuit

In [Figure 13](#), R_2 is the power limiting resistor. For starting and maintaining oscillation, a minimum transconductance is necessary, so R_2 must not be too large. A practical value for R_2 is 2.2 k Ω .

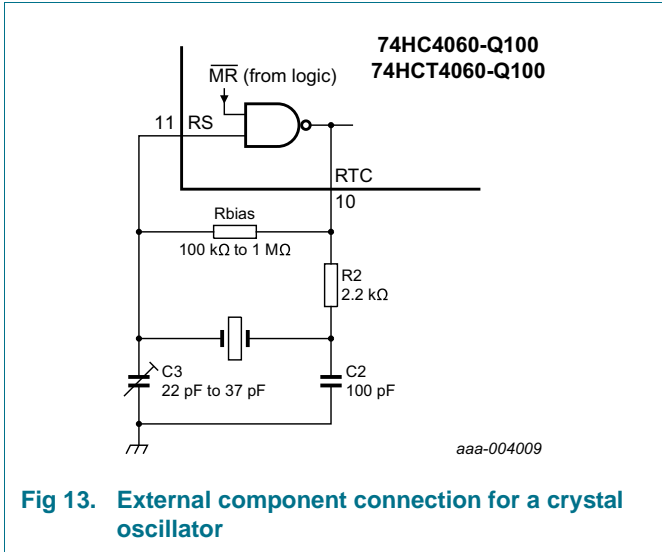


Fig 13. External component connection for a crystal oscillator

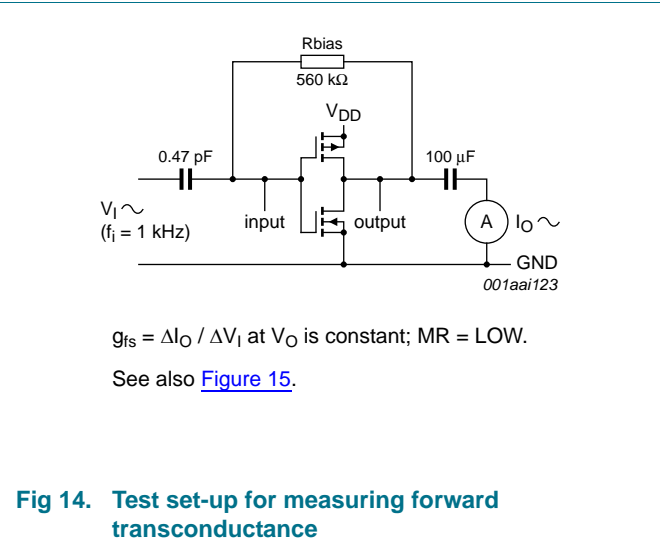


Fig 14. Test set-up for measuring forward transconductance

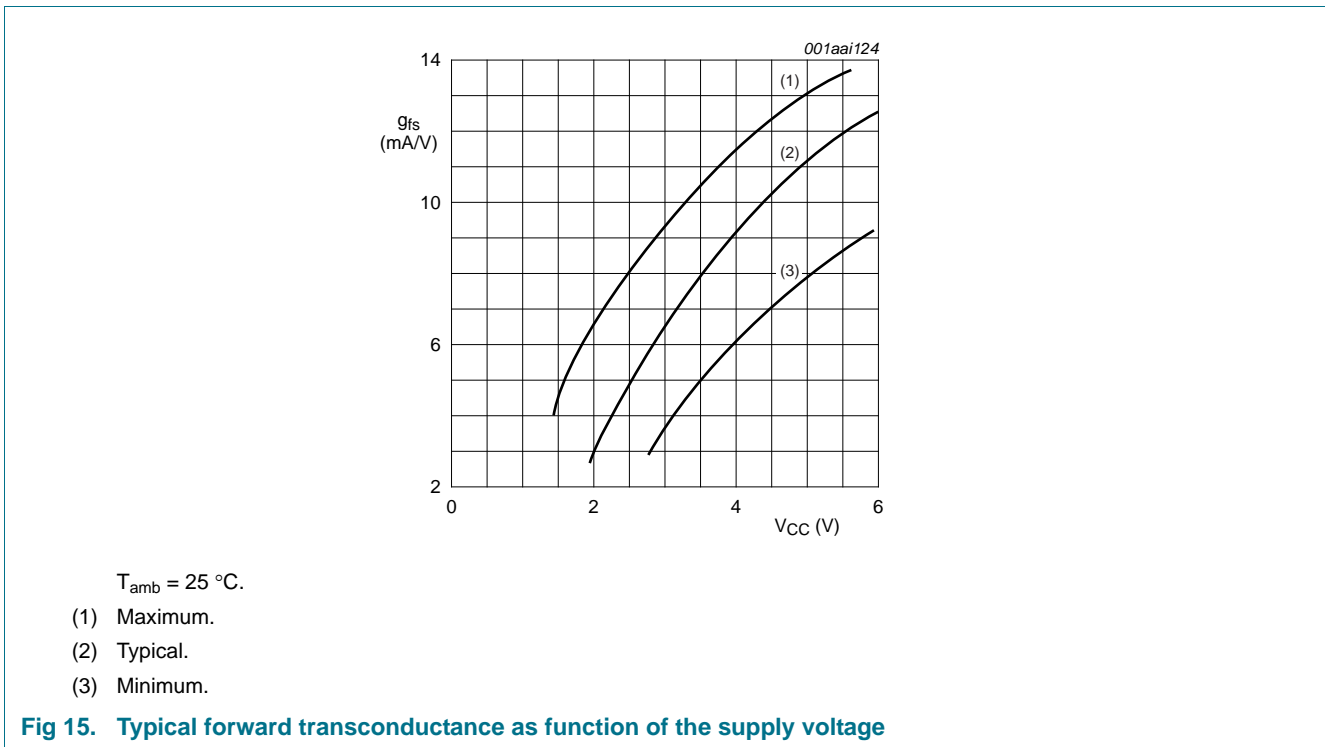
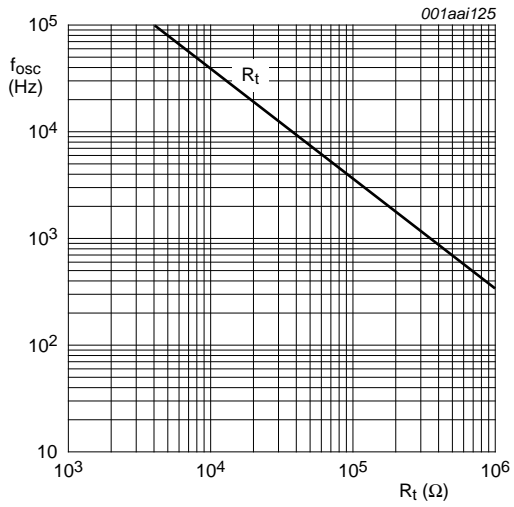
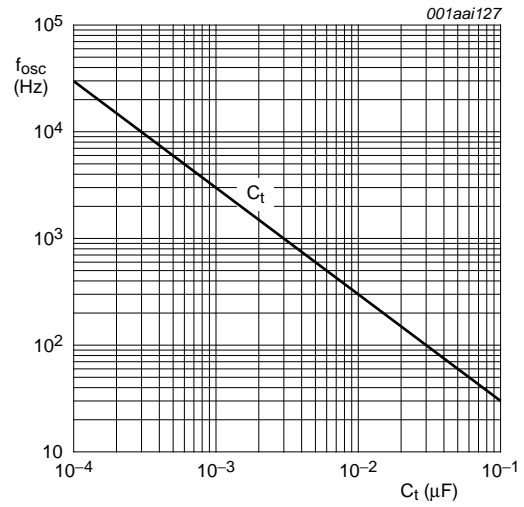


Fig 15. Typical forward transconductance as function of the supply voltage



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

Fig 16. RC oscillator frequency as a function of R_f



$V_{CC} = 2.0\text{ V to }6.0\text{ V}; T_{amb} = 25\text{ }^\circ\text{C}.$
 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

14. Package outline

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

SOT109-1

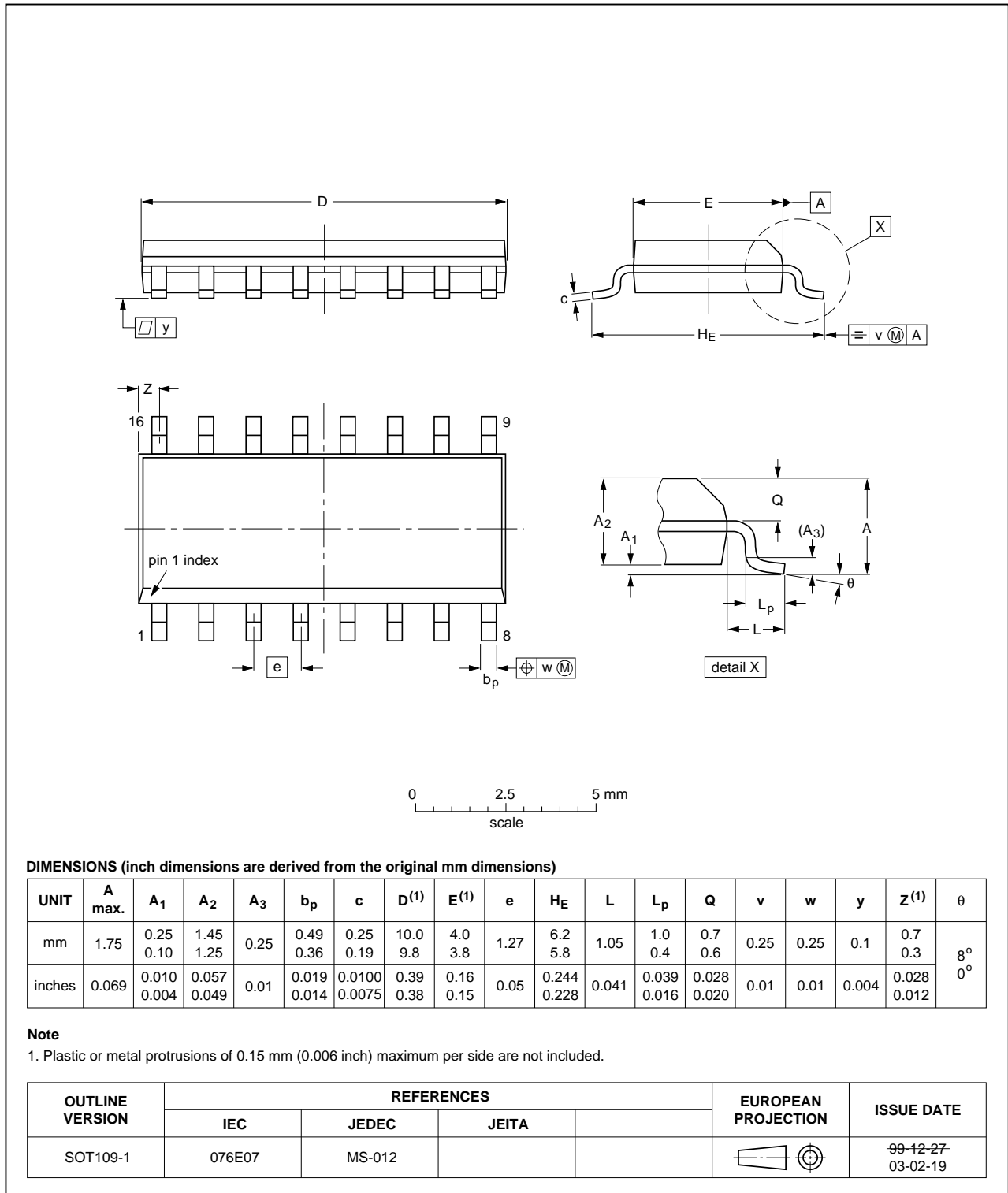


Fig 18. Package outline SOT109-1 (SO16)

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

SOT338-1

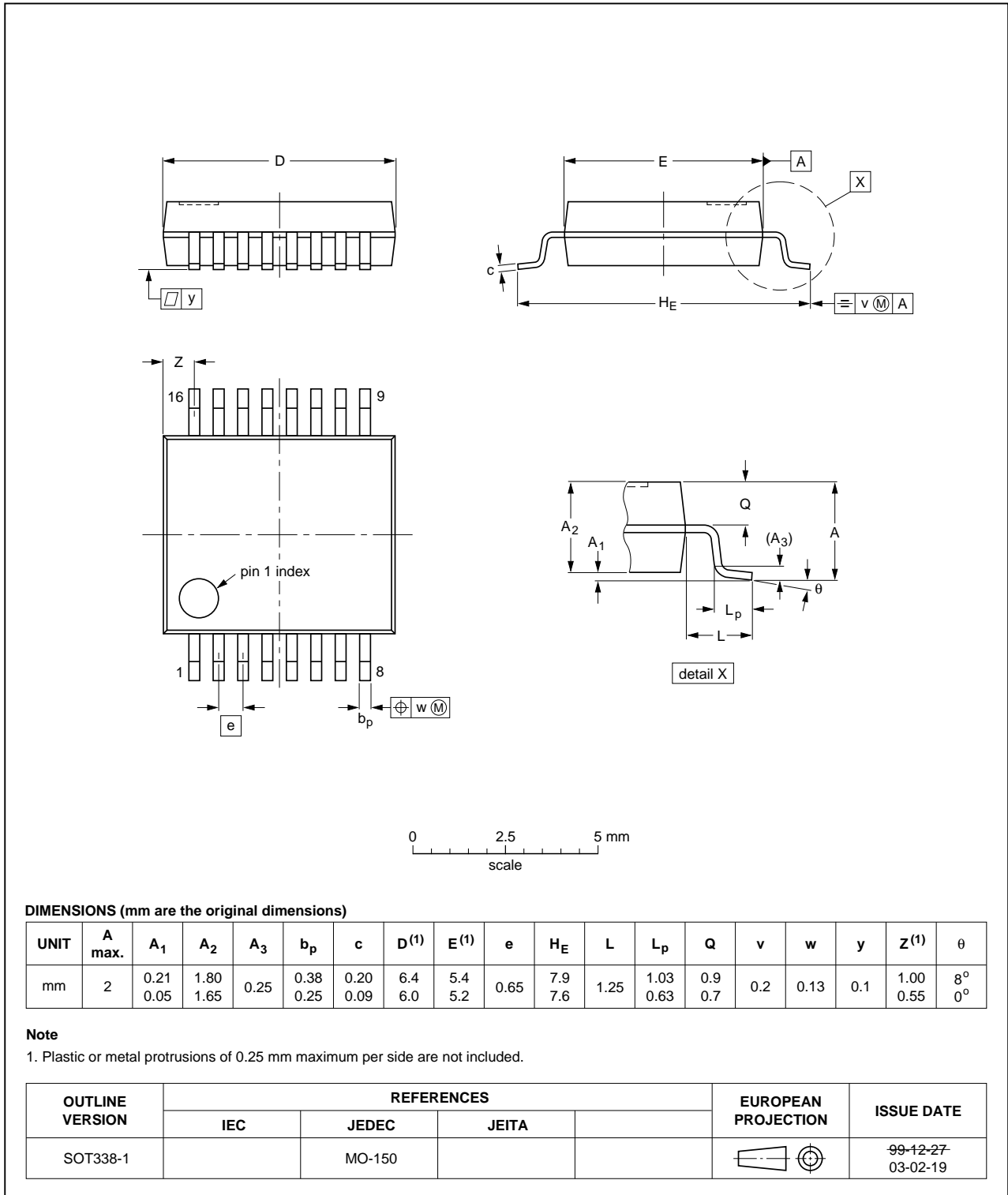


Fig 19. Package outline SOT338-1 (SSOP16)

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

SOT403-1

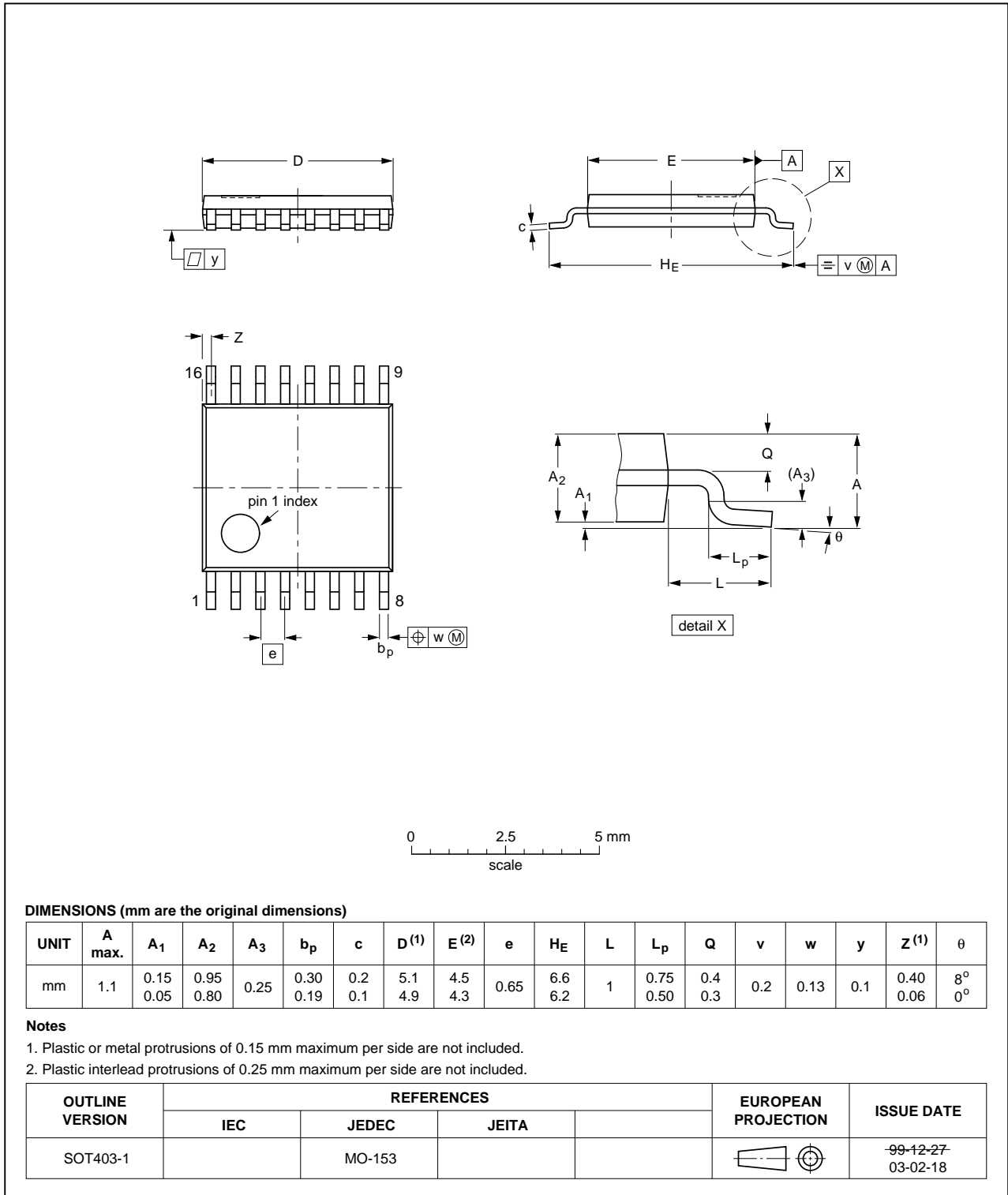


Fig 20. Package outline SOT403-1 (TSSOP16)

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

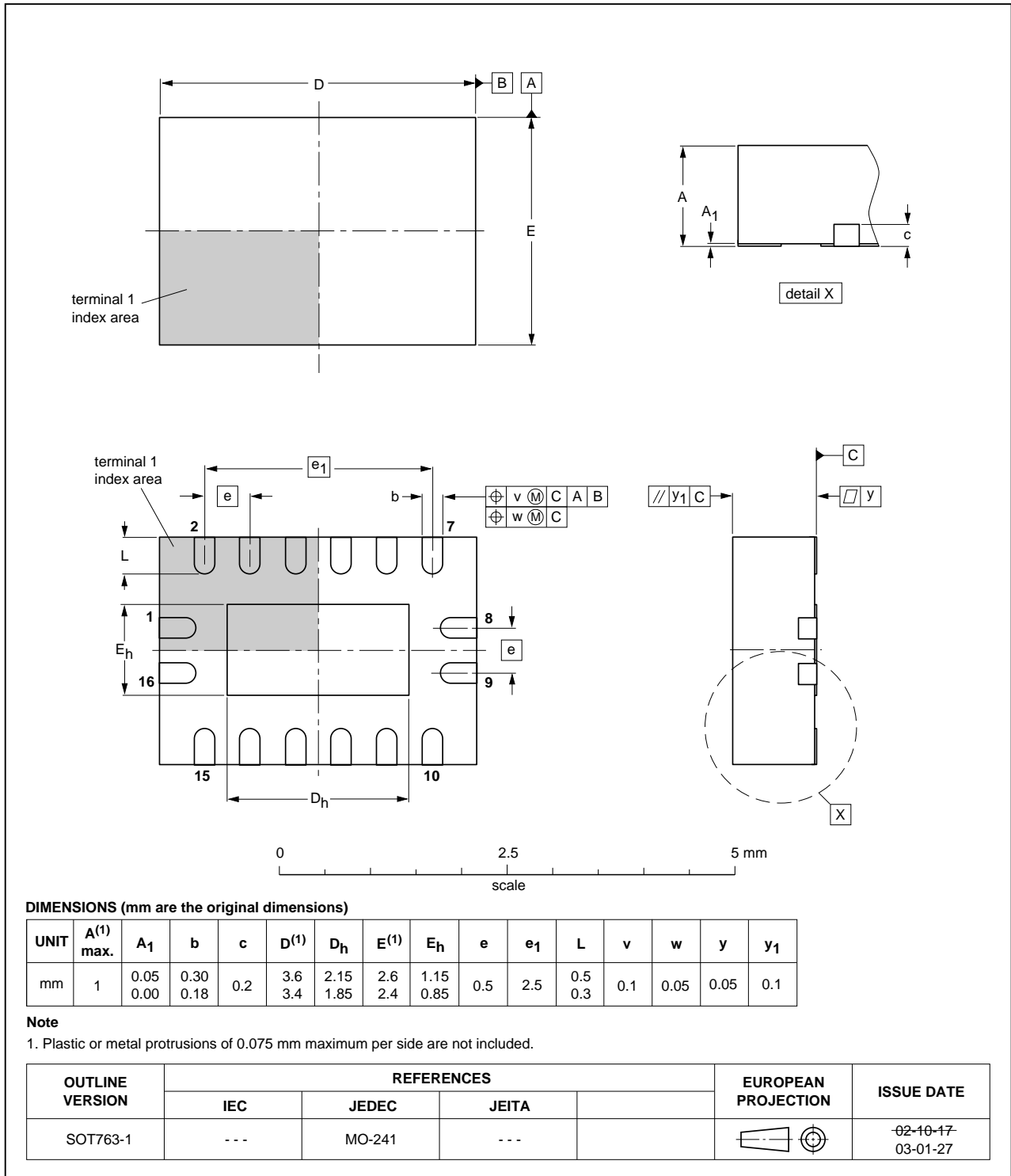


Fig 21. Package outline SOT763-1 (DHVQFN16)

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 | - | - |

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17.1 Data sheet status

| Document status ^{[1][2]} | Product status ^[3] | Definition |
|-----------------------------------|-------------------------------|---|
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| 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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Date of release: 10 April 2013

Document identifier: 74HC_HCT4060_Q100