

# 74HC4020; 74HCT4020

## 14-stage binary ripple counter

Rev. 5 — 6 August 2012

Product data sheet

## 1. General description

The 74HC4020; 74HCT4020 are high-speed Si-gate CMOS devices and are pin compatible with the HEF4020B series. They are specified in compliance with JEDEC standard no. 7A.

The 74HC4020; 74HCT4020 are 14-stage binary ripple counters with a clock input ( $\overline{CP}$ ), an overriding asynchronous master reset input (MR) and twelve parallel outputs (Q0, Q3 to Q13). The counter advances on the HIGH-to-LOW transition of  $\overline{CP}$ .

A HIGH on MR clears all counter stages and forces all outputs LOW, independent of the state of  $\overline{CP}$ .

Each counter stage is a static toggle flip-flop.

## 2. Features and benefits

- Multiple package options
- Complies with JEDEC standard no. 7A
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$

## 3. Applications

- Frequency dividing circuits
- Time delay circuits
- Control counters

## 4. Ordering information

Table 1. Ordering information

| Type number | Package                                                         |        |                                                                   |          |
|-------------|-----------------------------------------------------------------|--------|-------------------------------------------------------------------|----------|
|             | Temperature range                                               | Name   | Description                                                       | Version  |
| 74HC4020N   | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | DIP16  | plastic dual in-line package; 16 leads (300 mil)                  | SOT38-4  |
| 74HCT4020N  |                                                                 |        |                                                                   |          |
| 74HC4020D   | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | SO16   | plastic small outline package; 16 leads; body width 3.9 mm        | SOT109-1 |
| 74HCT4020D  |                                                                 |        |                                                                   |          |
| 74HC4020DB  | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | SSOP16 | plastic shrink small outline package; 16 leads; body width 5.3 mm | SOT338-1 |
| 74HCT4020DB |                                                                 |        |                                                                   |          |



Table 1. Ordering information ...continued

| Type number               | Package           |          |                                                                                                                                      |          |
|---------------------------|-------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------|----------|
|                           | Temperature range | Name     | Description                                                                                                                          | Version  |
| 74HC4020PW<br>74HCT4020PW | −40 °C to +125 °C | TSSOP16  | plastic thin shrink small outline package; 16 leads;<br>body width 4.4 mm                                                            | SOT403-1 |
| 74HC4020BQ<br>74HCT4020BQ | −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

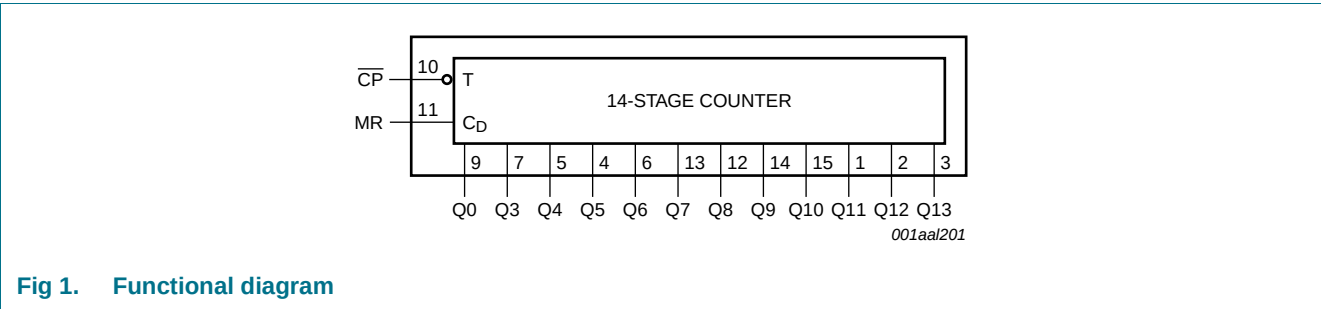
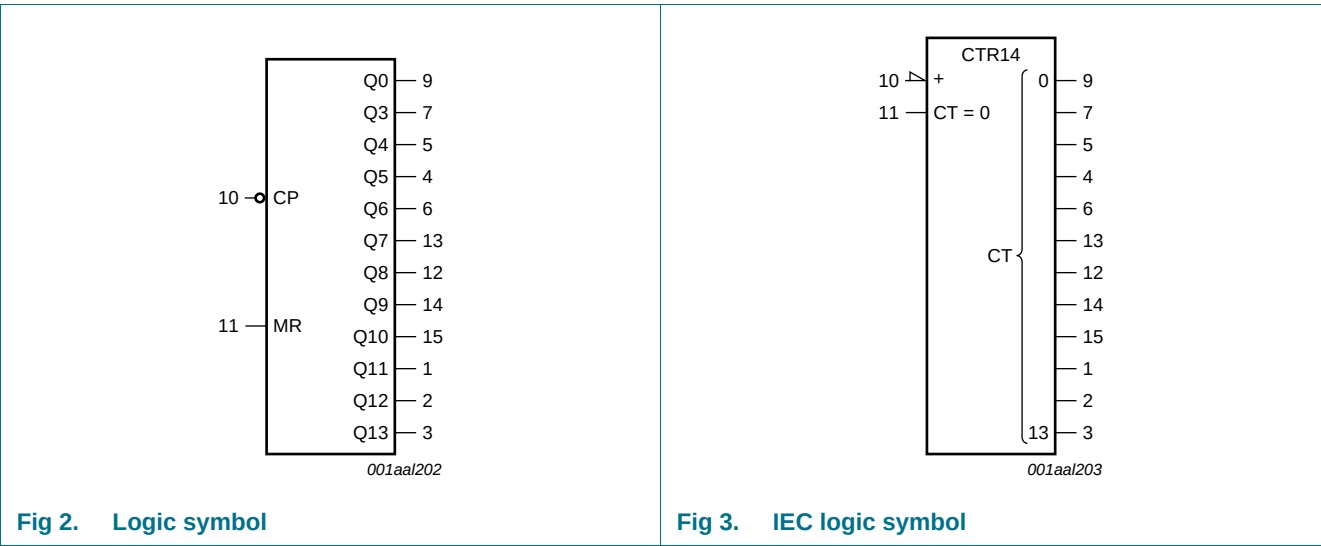
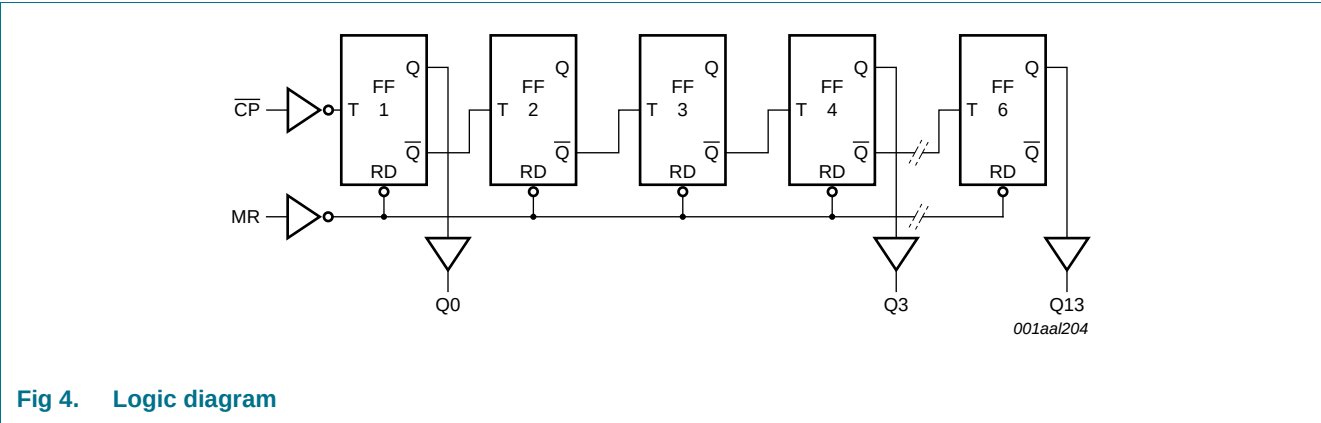


Fig 1. Functional diagram





## 6. Pinning information

### 6.1 Pinning

**74HC4020**  
**74HCT4020**

001aal205

**74HC4020**  
**74HCT4020**

001aal206

Transparent top view

(1) The substrate is attached to this pad using conductive die attach material. It cannot be used as supply pin or input. It is recommended that no connection is made at all.

Fig 5. Pin configuration DIP16, SO16, SSOP16 and TSSOP16

Fig 6. Pin configuration DHVQFN16

### 6.2 Pin description

Table 2. Pin description

| Symbol                 | Pin                                    | Description                               |
|------------------------|----------------------------------------|-------------------------------------------|
| Q0, Q3 to Q13          | 9, 7, 5, 4, 6, 13, 12, 14, 15, 1, 2, 3 | output                                    |
| GND                    | 8                                      | ground (0 V)                              |
| $\overline{\text{CP}}$ | 10                                     | clock input (HIGH-to-LOW, edge-triggered) |
| MR                     | 11                                     | master reset input (active HIGH)          |
| V <sub>CC</sub>        | 16                                     | positive supply voltage                   |

7. Functional description

Table 3. Function table

| Input |    | Output        |
|-------|----|---------------|
| CP    | MR | Q0, Q3 to Q13 |
| ↑     | L  | no change     |
| ↓     | L  | count         |
| X     | H  | L             |

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care; ↑ = LOW-to-HIGH clock transition; ↓ = HIGH-to-LOW clock transition.

7.1 Timing diagram

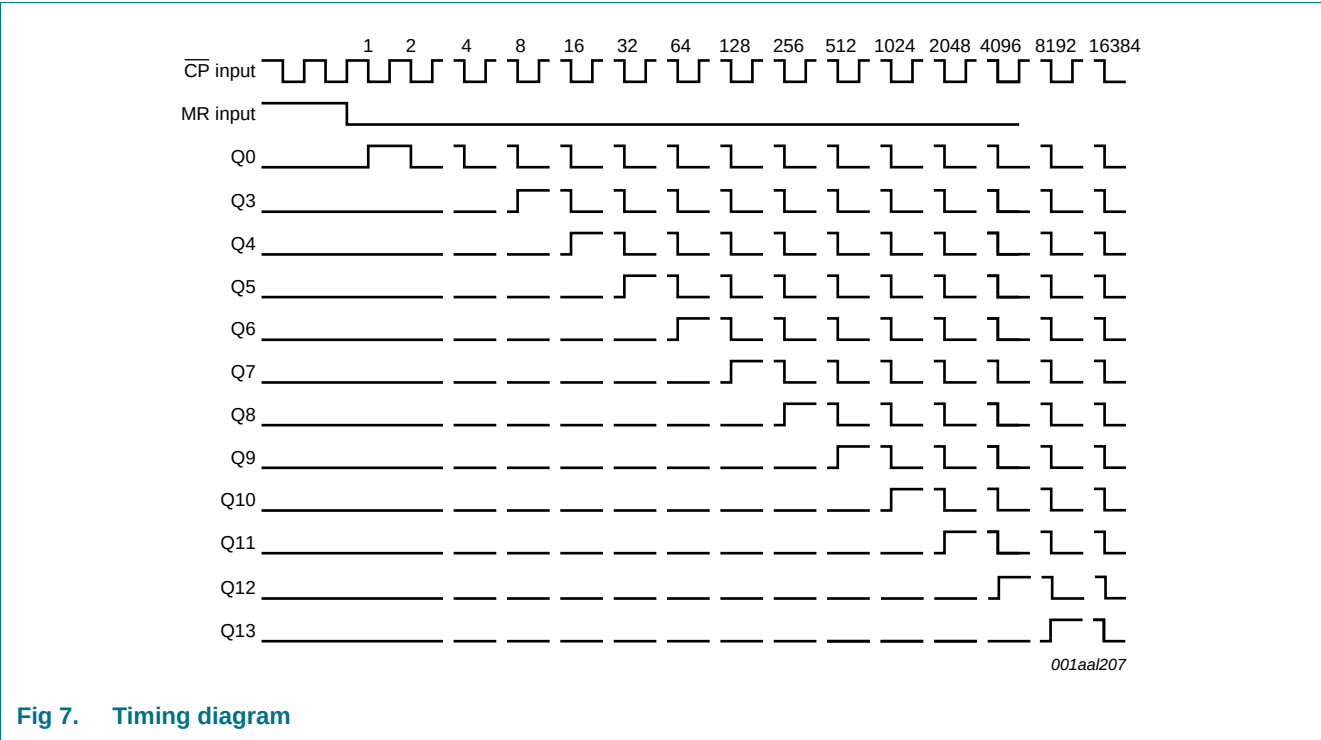


Fig 7. Timing diagram

## 8. Limiting values

**Table 4. 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 $V_I > V_{CC} + 0.5\text{ V}$ | -    | $\pm 20$ | mA   |
| $I_{OK}$  | output clamping current                     | $V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ | -    | $\pm 20$ | mA   |
| $I_O$     | output current                              | $-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$          | -    | $\pm 25$ | mA   |
| $I_{CC}$  | supply current                              |                                                        | -    | $\pm 50$ | mA   |
| $I_{GND}$ | ground current                              |                                                        | -    | $\pm 50$ | mA   |
| $T_{stg}$ | storage temperature                         |                                                        | -65  | +150     | °C   |
| $P_{tot}$ | total power dissipation                     | $T_{amb} = -40\text{ °C to }+125\text{ °C}$            | [1]  |          |      |
|           | DIP16 package                               |                                                        | -    | 750      | mW   |
|           | SO16, SSOP16, TSSOP16 and DHVQFN16 packages |                                                        | -    | 500      | mW   |

- [1] For DIP16 package:  $P_{tot}$  derates linearly with 12 mW/K above 70 °C.  
 For SO16 package:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.  
 For SSOP16 and TSSOP16 packages:  $P_{tot}$  derates linearly with 5.5 mW/K above 60 °C.  
 For DHVQFN16 package:  $P_{tot}$  derates linearly with 4.5 mW/K above 60 °C.

## 9. Recommended operating conditions

**Table 5. Recommended operating conditions**

| Symbol              | Parameter                           | Conditions                        | 74HC4020 |      |          | 74HCT4020 |      |          | 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    |
| $\Delta t/\Delta V$ | input transition rise and fall rate | except for Schmitt trigger inputs |          |      |          |           |      |          |      |
|                     |                                     | $V_{CC} = 2.0\text{ V}$           | -        | -    | 625      | -         | -    | -        | ns/V |
|                     |                                     | $V_{CC} = 4.5\text{ V}$           | -        | 1.67 | 139      | -         | 1.67 | 139      | ns/V |
|                     |                                     | $V_{CC} = 6.0\text{ V}$           | -        | -    | 83       | -         | -    | -        | ns/V |
| $T_{amb}$           | ambient temperature                 |                                   | -40      | +25  | +125     | -40       | +25  | +125     | °C   |

## 10. Static characteristics

**Table 6. 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  |      |
| 74HC4020        |                           |                                                                                        |       |      |      |                  |      |                   |      |      |
| V <sub>IH</sub> | HIGH-level input voltage  | V <sub>CC</sub> = 2.0 V                                                                | 1.5   | 1.2  | -    | 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   | 3.2  | -    | 4.2              | -    | 4.2               | -    | V    |
| V <sub>IL</sub> | LOW-level input voltage   | 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    |
| V <sub>OH</sub> | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</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> = –4.0 mA; V <sub>CC</sub> = 4.5 V                                      | 3.98  | 4.32 | -    | 3.84             | -    | 3.7               | -    | V    |
| V <sub>OL</sub> | LOW-level output voltage  | I <sub>O</sub> = –5.2 mA; V <sub>CC</sub> = 6.0 V                                      | 5.48  | 5.81 | -    | 5.34             | -    | 5.2               | -    | V    |
|                 |                           | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                    |       |      |      |                  |      |                   |      |      |
|                 |                           | 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> = 4.0 mA; V <sub>CC</sub> = 4.5 V                                       | -     | 0.15 | 0.26 | -                | 0.33 | -                 | 0.4  | V    |
| I <sub>I</sub>  | input leakage current     | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V                                       | -     | 0.16 | 0.26 | -                | 0.33 | -                 | 0.4  | V    |
|                 |                           | V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V                       | -     | -    | ±0.1 | -                | ±1   | -                 | ±1   | μA   |
| I <sub>CC</sub> | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 6.0 V | -     | -    | 8.0  | -                | 80   | -                 | 160  | μA   |
| C <sub>I</sub>  | input capacitance         |                                                                                        | -     | 3.5  | -    | -                | -    | -                 | -    | pF   |
| 74HCT4020       |                           |                                                                                        |       |      |      |                  |      |                   |      |      |
| V <sub>IH</sub> | HIGH-level input voltage  | V <sub>CC</sub> = 4.5 V to 5.5 V                                                       | 2.0   | 1.6  | -    | 2.0              | -    | 2.0               | -    | V    |
| V <sub>IL</sub> | LOW-level input voltage   | V <sub>CC</sub> = 4.5 V to 5.5 V                                                       | -     | 1.2  | 0.8  | -                | 0.8  | -                 | 0.8  | V    |
| V <sub>OH</sub> | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V          |       |      |      |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = –20 μA                                                                | 4.4   | 4.5  | -    | 4.4              | -    | 4.4               | -    | V    |
|                 |                           | I <sub>O</sub> = –4.0 mA                                                               | 3.98  | 4.32 | -    | 3.84             | -    | 3.7               | -    | V    |
| V <sub>OL</sub> | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 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> = 4.0 mA; V <sub>CC</sub> = 4.5 V                                       | -     | 0.15 | 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   | -                 | ±1   | μA   |

**Table 6.** 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 |         |
| $I_{CC}$        | supply current            | $V_I = V_{CC}$ or GND; $I_O = 0$ A;<br>$V_{CC} = 5.5$ V                                               | -     | -   | 8.0 | -                | 80  | -                 | 160 | $\mu$ A |
| $\Delta I_{CC}$ | additional supply current | $V_I = V_{CC} - 2.1$ V; $I_O = 0$ A;<br>other inputs at $V_{CC}$ or GND;<br>$V_{CC} = 4.5$ V to 5.5 V |       |     |     |                  |     |                   |     |         |
|                 | pin MR                    |                                                                                                       | -     | 110 | 396 | -                | 495 | -                 | 539 | $\mu$ A |
|                 | pin $\overline{CP}$       |                                                                                                       | -     | 85  | 306 | -                | 383 | -                 | 417 | $\mu$ A |
| $C_I$           | input capacitance         |                                                                                                       | -     | 3.5 | -   | -                | -   | -                 | -   | pF      |

## 11. Dynamic characteristics

**Table 7.** Dynamic characteristicsGND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit, see [Figure 10](#)

| Symbol           | Parameter                     | Conditions                                                 | 25 °C |     |     | −40 °C to +85 °C |     | −40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|------------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                  |                               |                                                            | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| 74HC4020         |                               |                                                            |       |     |     |                  |     |                   |     |      |
| t <sub>pd</sub>  | propagation delay             | CP to Q0; see <a href="#">Figure 8</a> <a href="#">[1]</a> |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V; C <sub>L</sub> = 50 pF            | -     | 39  | 140 | -                | 175 | -                 | 210 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V; C <sub>L</sub> = 50 pF            | -     | 14  | 28  | -                | 35  | -                 | 42  | ns   |
|                  |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF            | -     | 11  | -   | -                | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V; C <sub>L</sub> = 50 pF            | -     | 11  | 24  | -                | 30  | -                 | 36  | ns   |
|                  |                               | Qn to Qn+1; see <a href="#">Figure 9</a>                   |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V; C <sub>L</sub> = 50 pF            | -     | 22  | 75  | -                | 95  | -                 | 110 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V; C <sub>L</sub> = 50 pF            | -     | 8   | 15  | -                | 19  | -                 | 22  | ns   |
|                  |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF            | -     | 6   | -   | -                | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V; C <sub>L</sub> = 50 pF            | -     | 6   | 13  | -                | 16  | -                 | 19  | ns   |
| t <sub>PHL</sub> | HIGH to LOW propagation delay | MR to Qn; see <a href="#">Figure 8</a>                     |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V; C <sub>L</sub> = 50 pF            | -     | 55  | 170 | -                | 215 | -                 | 225 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V; C <sub>L</sub> = 50 pF            | -     | 20  | 34  | -                | 43  | -                 | 51  | ns   |
|                  |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF            | -     | 17  | -   | -                | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V; C <sub>L</sub> = 50 pF            | -     | 16  | 29  | -                | 37  | -                 | 43  | ns   |
| t <sub>t</sub>   | transition time               | Qn; see <a href="#">Figure 8</a> <a href="#">[2]</a>       |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V; C <sub>L</sub> = 50 pF            | -     | 19  | 75  | -                | 95  | -                 | 110 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V; C <sub>L</sub> = 50 pF            | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V; C <sub>L</sub> = 50 pF            | -     | 6   | 13  | -                | 16  | -                 | 19  | ns   |

**Table 7. Dynamic characteristics ...continued**GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit, see [Figure 10](#)

| Symbol    | Parameter                     | Conditions                                                | 25 °C |     |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|-----------|-------------------------------|-----------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|           |                               |                                                           | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| $t_W$     | pulse width                   | $\overline{CP}$ HIGH or LOW; see <a href="#">Figure 8</a> |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 2.0$ V; $C_L = 50$ pF                           | 80    | 14  | -   | 100              | -   | 120               | -   | ns   |
|           |                               | $V_{CC} = 4.5$ V; $C_L = 50$ pF                           | 16    | 4   | -   | 20               | -   | 24                | -   | ns   |
|           |                               | $V_{CC} = 6.0$ V; $C_L = 50$ pF                           | 14    | 3   | -   | 17               | -   | 20                | -   | ns   |
|           |                               | MR HIGH; see <a href="#">Figure 8</a>                     |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 2.0$ V; $C_L = 50$ pF                           | 80    | 17  | -   | 100              | -   | 120               | -   | ns   |
|           |                               | $V_{CC} = 4.5$ V; $C_L = 50$ pF                           | 16    | 6   | -   | 20               | -   | 24                | -   | ns   |
| $t_{rec}$ | recovery time                 | MR to $\overline{CP}$ ; see <a href="#">Figure 8</a>      |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 2.0$ V; $C_L = 50$ pF                           | 50    | 6   | -   | 65               | -   | 75                | -   | ns   |
|           |                               | $V_{CC} = 4.5$ V; $C_L = 50$ pF                           | 10    | 2   | -   | 13               | -   | 15                | -   | ns   |
|           |                               | $V_{CC} = 6.0$ V; $C_L = 50$ pF                           | 9     | 2   | -   | 11               | -   | 13                | -   | ns   |
| $f_{max}$ | maximum frequency             | see <a href="#">Figure 8</a>                              |       |     |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 2.0$ V; $C_L = 50$ pF                           | 6.0   | 30  | -   | 4.8              | -   | 4.0               | -   | MHz  |
|           |                               | $V_{CC} = 4.5$ V; $C_L = 50$ pF                           | 30    | 92  | -   | 24               | -   | 20                | -   | MHz  |
|           |                               | $V_{CC} = 5.0$ V; $C_L = 15$ pF                           | -     | 101 | -   | -                | -   | -                 | -   | MHz  |
|           |                               | $V_{CC} = 6.0$ V; $C_L = 50$ pF                           | 35    | 109 | -   | 28               | -   | 24                | -   | MHz  |
| $C_{PD}$  | power dissipation capacitance | <a href="#">[3]</a>                                       | -     | 19  | -   | -                | -   | -                 | -   | pF   |

**74HCT4020**

|           |                               |                                                           |                     |    |    |    |    |    |    |    |
|-----------|-------------------------------|-----------------------------------------------------------|---------------------|----|----|----|----|----|----|----|
| $t_{pd}$  | propagation delay             | $\overline{CP}$ to Q0; see <a href="#">Figure 8</a>       | <a href="#">[1]</a> |    |    |    |    |    |    |    |
|           |                               | $V_{CC} = 4.5$ V; $C_L = 50$ pF                           | -                   | 18 | 36 | -  | 45 | -  | 54 | ns |
|           |                               | $V_{CC} = 5.0$ V; $C_L = 15$ pF                           | -                   | 15 | -  | -  | -  | -  | -  | ns |
|           |                               | Qn to Qn+1; see <a href="#">Figure 9</a>                  |                     |    |    |    |    |    |    |    |
|           |                               | $V_{CC} = 4.5$ V; $C_L = 50$ pF                           | -                   | 8  | 15 | -  | 19 | -  | 22 | ns |
| $t_{PHL}$ | HIGH to LOW propagation delay | MR to Qn; see <a href="#">Figure 8</a>                    |                     |    |    |    |    |    |    |    |
|           |                               | $V_{CC} = 4.5$ V; $C_L = 50$ pF                           | -                   | 22 | 45 | -  | 56 | -  | 68 | ns |
|           |                               | $V_{CC} = 5.0$ V; $C_L = 15$ pF                           | -                   | 19 | -  | -  | -  | -  | -  | ns |
| $t_t$     | transition time               | Qn; see <a href="#">Figure 8</a>                          | <a href="#">[2]</a> |    |    |    |    |    |    |    |
|           |                               | $V_{CC} = 4.5$ V; $C_L = 50$ pF                           | -                   | 7  | 15 | -  | 19 | -  | 22 | ns |
| $t_W$     | pulse width                   | $\overline{CP}$ HIGH or LOW; see <a href="#">Figure 8</a> |                     |    |    |    |    |    |    |    |
|           |                               | $V_{CC} = 4.5$ V; $C_L = 50$ pF                           | 20                  | 7  | -  | 25 | -  | 30 | -  | ns |
|           |                               | MR HIGH; see <a href="#">Figure 8</a>                     |                     |    |    |    |    |    |    |    |
| $t_{rec}$ | recovery time                 | $V_{CC} = 4.5$ V; $C_L = 50$ pF                           | 20                  | 8  | -  | 25 | -  | 30 | -  | ns |
|           |                               | MR to $\overline{CP}$ ; see <a href="#">Figure 8</a>      |                     |    |    |    |    |    |    |    |
|           |                               | $V_{CC} = 4.5$ V; $C_L = 50$ pF                           | 10                  | 2  | -  | 13 | -  | 15 | -  | ns |



**Table 7. Dynamic characteristics ...continued**

GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit, see [Figure 10](#)

| Symbol           | Parameter                     | Conditions                                      | 25 °C |     |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|-------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                  |                               |                                                 | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| f <sub>max</sub> | maximum frequency             | see <a href="#">Figure 8</a>                    |       |     |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 4.5 V; C <sub>L</sub> = 50 pF | 25    | 47  | -   | 20               | -   | 17                | -   | MHz  |
|                  |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF | -     | 52  | -   | -                | -   | -                 | -   | MHz  |
| C <sub>PD</sub>  | power dissipation capacitance | <a href="#">[3]</a>                             | -     | 20  | -   | -                | -   | -                 | -   | pF   |

- [1]  $t_{pd}$  is the same as  $t_{PHL}$  and  $t_{PLH}$ .
- [2]  $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .
- [3]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu W$ ).

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

$f_i$  = input frequency in MHz;

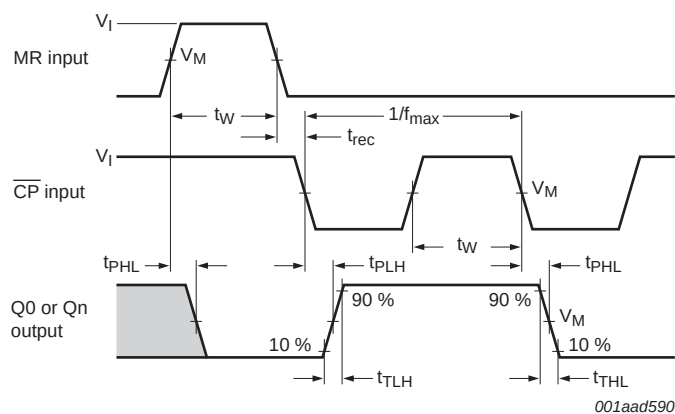
$f_0$  = output frequency in MHz;

$$\Sigma (C_L \times V_{CC}^2 \times f_0) = \text{sum of outputs};$$

$C_L$  = output load capacitance in pF;

$V_{CC}$  = supply voltage in V.

## 12. Waveforms



Measurement points are given in [Table 8](#).

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

**Fig 8. Clock timing, propagation delays, pulse widths and measurement points**

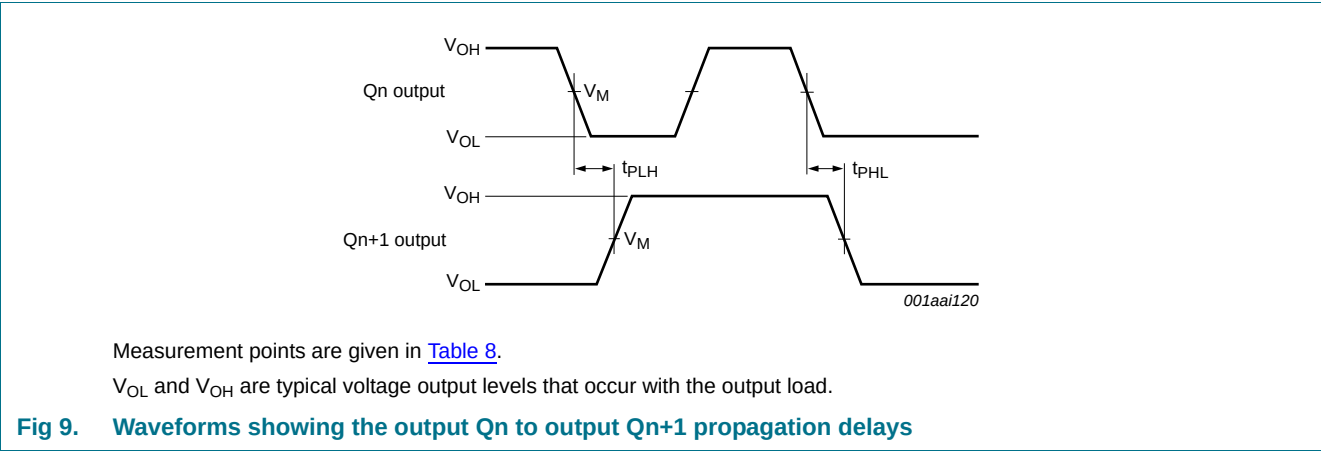
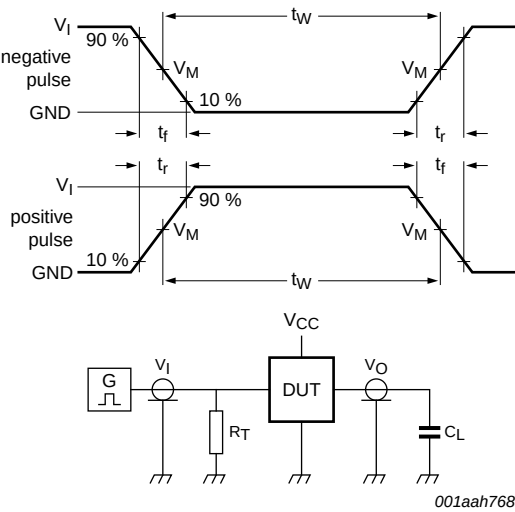


Table 8. Measurement points

| Type      | Input               | Output              |
|-----------|---------------------|---------------------|
|           | $V_M$               | $V_M$               |
| 74HC4020  | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 74HCT4020 | 1.3 V               | 1.3 V               |



Test data is given in [Table 9](#).

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 10. Test circuit for measuring switching times**

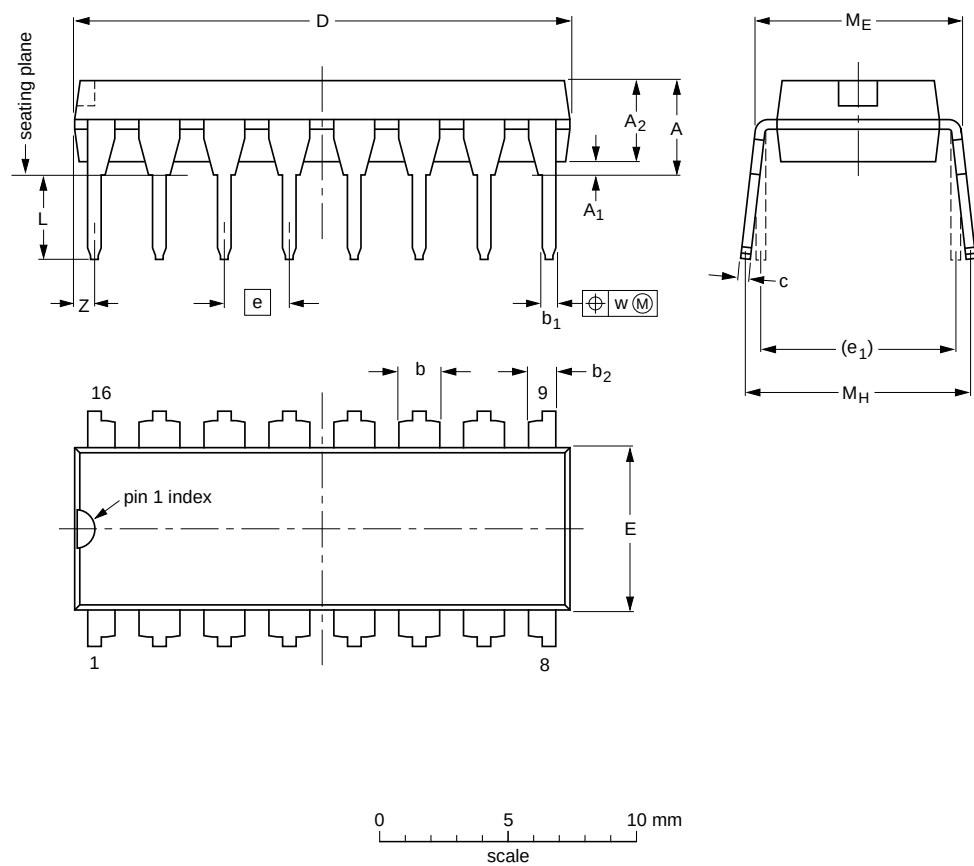
**Table 9. Test data**

| Type      | Input    |            | Load         |
|-----------|----------|------------|--------------|
|           | $V_I$    | $t_r, t_f$ | $C_L$        |
| 74HC4020  | $V_{CC}$ | 6 ns       | 15 pF, 50 pF |
| 74HCT4020 | 3 V      | 6 ns       | 15 pF, 50 pF |

13. Package outline

DIP16: plastic dual in-line package; 16 leads (300 mil)

SOT38-4



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT   | A<br>max. | A <sub>1</sub><br>min. | A <sub>2</sub><br>max. | b              | b <sub>1</sub> | b <sub>2</sub> | c              | D <sup>(1)</sup> | E <sup>(1)</sup> | e    | e <sub>1</sub> | L            | M <sub>E</sub> | M <sub>H</sub> | w     | Z <sup>(1)</sup><br>max. |
|--------|-----------|------------------------|------------------------|----------------|----------------|----------------|----------------|------------------|------------------|------|----------------|--------------|----------------|----------------|-------|--------------------------|
| mm     | 4.2       | 0.51                   | 3.2                    | 1.73<br>1.30   | 0.53<br>0.38   | 1.25<br>0.85   | 0.36<br>0.23   | 19.50<br>18.55   | 6.48<br>6.20     | 2.54 | 7.62           | 3.60<br>3.05 | 8.25<br>7.80   | 10.0<br>8.3    | 0.254 | 0.76                     |
| inches | 0.17      | 0.02                   | 0.13                   | 0.068<br>0.051 | 0.021<br>0.015 | 0.049<br>0.033 | 0.014<br>0.009 | 0.77<br>0.73     | 0.26<br>0.24     | 0.1  | 0.3            | 0.14<br>0.12 | 0.32<br>0.31   | 0.39<br>0.33   | 0.01  | 0.03                     |

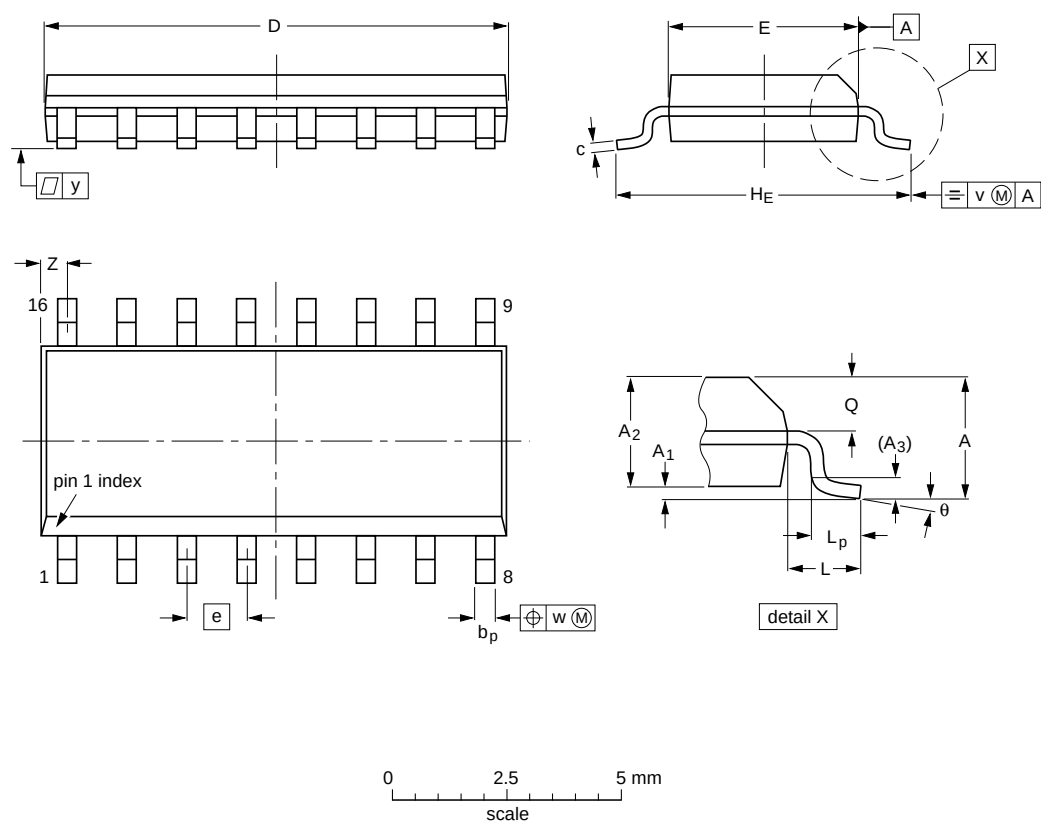
**Note**  
1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |       |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE           |
|--------------------|------------|-------|-------|--|------------------------|----------------------|
|                    | IEC        | JEDEC | JEITA |  |                        |                      |
| SOT38-4            |            |       |       |  |                        | 95-01-14<br>03-02-13 |

Fig 11. Package outline SOT38-4 (DIP16)

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

SOT109-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT   | A<br>max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c                | D <sup>(1)</sup> | E <sup>(1)</sup> | e    | H <sub>E</sub> | L     | L <sub>p</sub> | Q              | v    | w    | y     | z <sup>(1)</sup> | θ        |
|--------|-----------|----------------|----------------|----------------|----------------|------------------|------------------|------------------|------|----------------|-------|----------------|----------------|------|------|-------|------------------|----------|
| mm     | 1.75      | 0.25<br>0.10   | 1.45<br>1.25   | 0.25           | 0.49<br>0.36   | 0.25<br>0.19     | 10.0<br>9.8      | 4.0<br>3.8       | 1.27 | 6.2<br>5.8     | 1.05  | 1.0<br>0.4     | 0.7<br>0.6     | 0.25 | 0.25 | 0.1   | 0.7<br>0.3       | 8°<br>0° |
| inches | 0.069     | 0.010<br>0.004 | 0.057<br>0.049 | 0.01           | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.39<br>0.38     | 0.16<br>0.15     | 0.05 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.020 | 0.01 | 0.01 | 0.004 | 0.028<br>0.012   |          |

**Note**

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |        |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE           |
|--------------------|------------|--------|-------|--|------------------------|----------------------|
|                    | IEC        | JEDEC  | JEITA |  |                        |                      |
| SOT109-1           | 076E07     | MS-012 |       |  |                        | 99-12-27<br>03-02-19 |

Fig 12. Package outline SOT109-1 (SO16)

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

SOT338-1

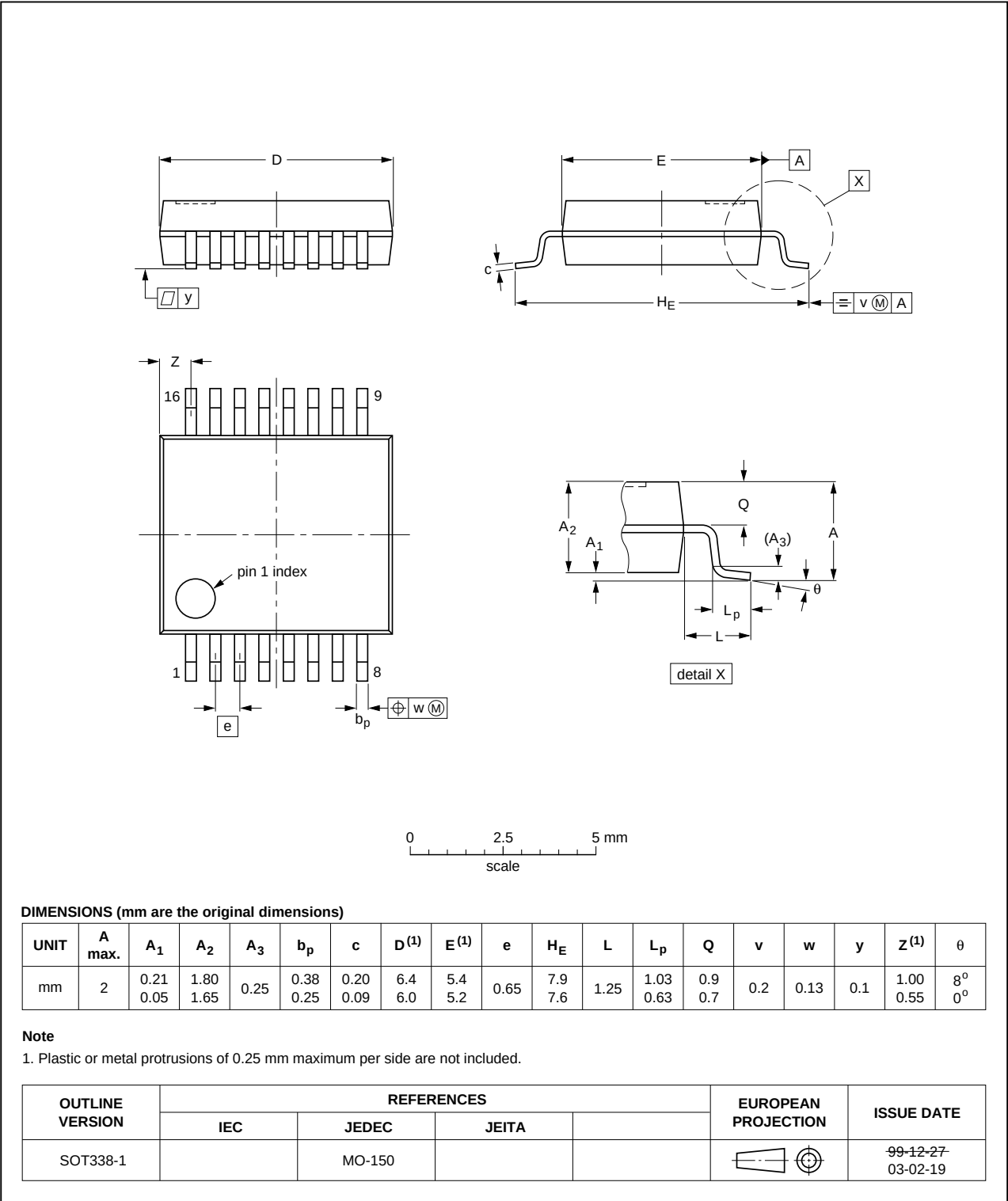


Fig 13. Package outline SOT338-1 (SSOP16)

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

SOT403-1

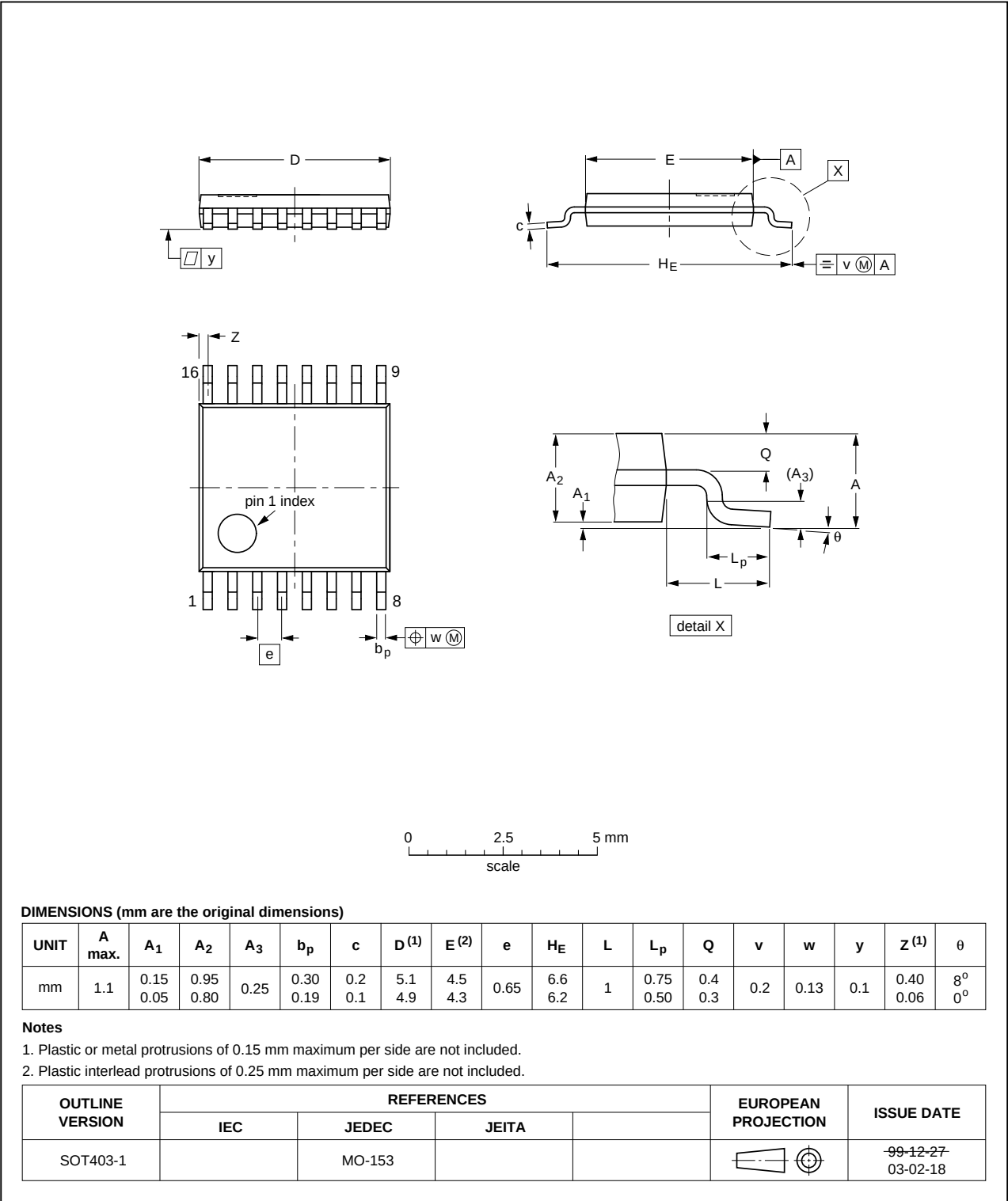


Fig 14. Package outline SOT403-1 (TSSOP16)

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

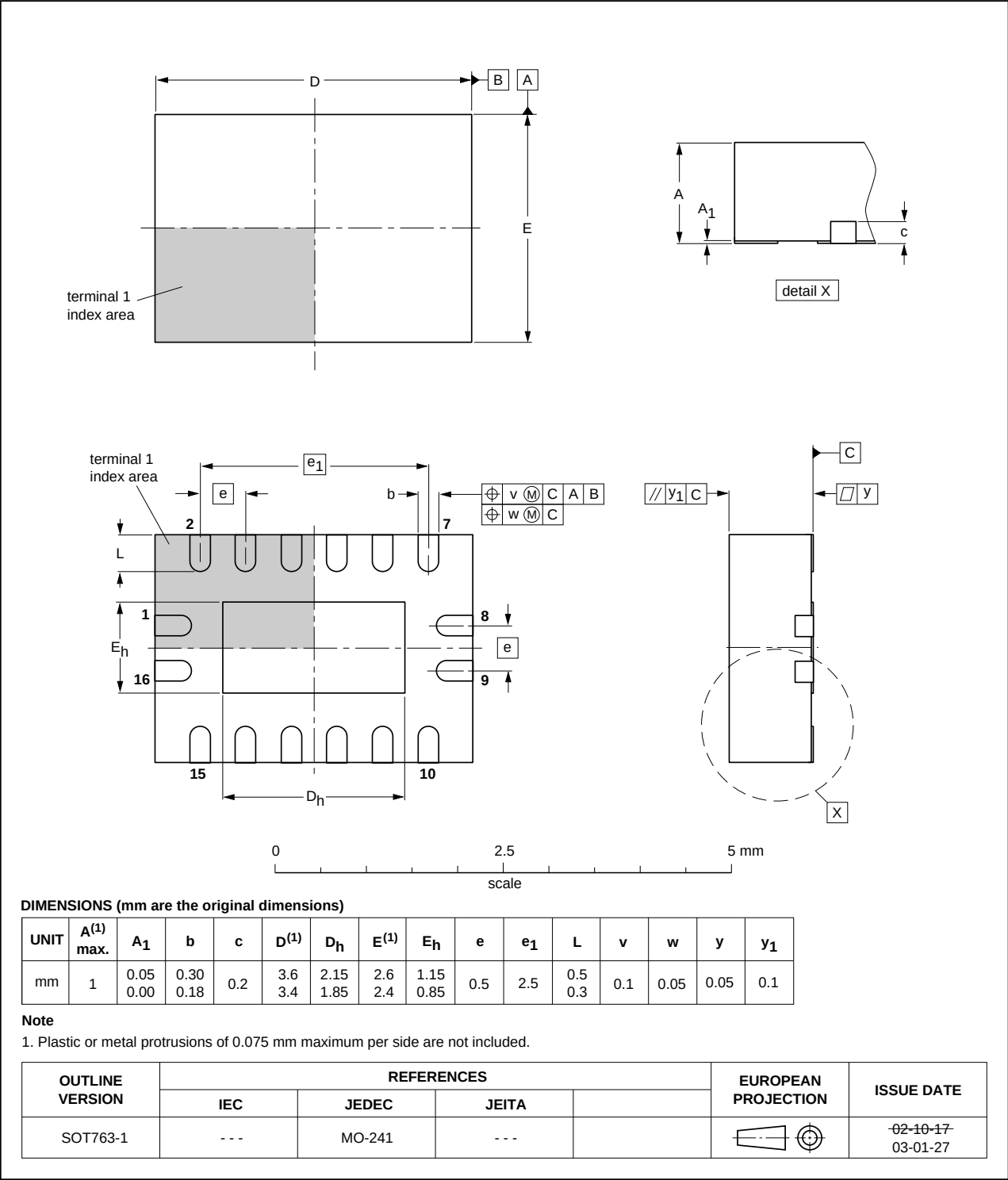


Fig 15. Package outline SOT763-1 (DHVQFN16)



## 14. Abbreviations

Table 10. Abbreviations

| Acronym | Abbreviation                            |
|---------|-----------------------------------------|
| CMOS    | Complementary Metal Oxide Semiconductor |
| DUT     | Device Under Test                       |

## 15. Revision history

Table 11. Revision history

| Document ID          | Release date                                     | Data sheet status     | Change notice | Supersedes           |
|----------------------|--------------------------------------------------|-----------------------|---------------|----------------------|
| 74HC_HCT4020 v.5     | 20120806                                         | Product data sheet    | -             | 74HC_HCT4020 v.4     |
| Modifications:       | • Measurement points added to figure 8 (errata). |                       |               |                      |
| 74HC_HCT4020 v.4     | 20111213                                         | Product data sheet    | -             | 74HC_HCT4020 v.3     |
| Modifications:       | • Legal pages updated.                           |                       |               |                      |
| 74HC_HCT4020 v.3     | 20100120                                         | Product data sheet    | -             | 74HC_HCT4020_CNV v.2 |
| 74HC_HCT4020_CNV v.2 | 19970901                                         | Product specification | -             | -                    |

## 16. Legal information

### 16.1 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.                                     |

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[2] The term 'short data sheet' is explained in section "Definitions".

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