

# 74HC390; 74HCT390

## Dual decade ripple counter

Rev. 3 — 16 August 2016

Product data sheet

## 1. General description

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The 74HC390; 74HCT390 is a dual 4-bit decade ripple counter divided into four separately clocked sections. The counters have two divide-by-2 sections and two divide-by-5 sections. These sections share an asynchronous master reset input (nMR) and can be used in a BCD decade or bi-quinary configuration. If master reset inputs 1MR and 2MR are used to clear all 8 bits of the counter simultaneously, numerous counting configurations are possible within one package. Section clocks  $\overline{\text{nCP0}}$  and  $\overline{\text{nCP1}}$ , allow ripple counter or frequency division applications of divide-by-2, 4, 5, 10, 20, 25, 50 or 100. The HIGH-to-LOW transition of the clock inputs  $\overline{\text{nCP0}}$  and  $\overline{\text{nCP1}}$  trigger each section. For BCD decade operation, the nQ0 output is connected to the  $\overline{\text{nCP1}}$  input of the divide-by-5 section. For bi-quinary decade operation, the nQ3 output is connected to the  $\overline{\text{nCP0}}$  input and nQ0 becomes the decade output. A HIGH on the nMR input overrides the clocks and sets the four outputs LOW. Inputs include clamp diodes. It enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{\text{CC}}$ .

## 2. Features and benefits

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- Input levels:
  - ◆ For 74HC390: CMOS level
  - ◆ For 74HCT390: TTL level
- Two BCD decade or bi-quinary counters
- One device can be configured to divide-by-2, 4, 5, 10, 20, 25, 50 or 100
- Two master reset inputs to clear each decade counter individually
- Specified in compliance with JEDEC standard no. 7A
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
- Multiple package options
- 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. Ordering information

Table 1. Ordering information

| Type number | Package           |         |  | Version  |
|-------------|-------------------|---------|--|----------|
|             | Temperature range | Name    | Description  |          |
| 74HC390D    | -40 °C to +125 °C | SO16    | plastic small outline package; 16 leads; body width 3.9 mm             | SOT109-1 |
| 74HCT390D   |                   |         |  |          |
| 74HC390DB   | -40 °C to +125 °C | SSOP16  | plastic shrink small outline package; 16 leads; body width 5.3 mm      | SOT338-1 |
| 74HCT390DB  |                   |         |  |          |
| 74HCT390PW  | -40 °C to +125 °C | TSSOP16 | plastic thin shrink small outline package; 16 leads; body width 4.4 mm | SOT403-1 |

## 4. Functional diagram



Fig 1. Logic symbol



Fig 2. Logic diagram (one counter)

## 5. Pinning information

### 5.1 Pinning



Fig 3. Pin configuration for SO16

Fig 4. Pin configuration for (T)SSOP16

### 5.2 Pin description

Table 2. Pin description

| Symbol                                | Pin           | Description   |
|---------------------------------------|---------------|---|
| $\overline{1CP0}$ , $\overline{2CP0}$ | 1, 15         | clock input divide-by-2 section (HIGH-to-LOW; edge-triggered) |
| 1MR, 2MR                              | 2, 14         | asynchronous master reset input (active HIGH)                 |
| 1Q0, 1Q1, 1Q2, 1Q3                    | 3, 5, 6, 7    | flip-flop outputs   |
| $\overline{1CP1}$ , $\overline{2CP1}$ | 4, 12         | clock input divide-by-5 section (HIGH-to-LOW; edge-triggered) |
| GND                                   | 8             | ground (0 V)  |
| 2Q0, 2Q1, 2Q2, 2Q3                    | 13, 11, 10, 9 | flip-flop outputs   |
| V <sub>CC</sub>                       | 16            | supply voltage  |

## 6. Functional description

Table 3. BCD count sequence<sup>[1]</sup>

| Count | Output |     |     |     |
|-------|--------|-----|-----|-----|
|       | nQ0    | nQ1 | nQ2 | nQ3 |
| 0     | L      | L   | L   | L   |
| 1     | H      | L   | L   | L   |
| 2     | L      | H   | L   | L   |
| 3     | H      | H   | L   | L   |
| 4     | L      | L   | H   | L   |
| 5     | H      | L   | H   | L   |
| 6     | L      | H   | H   | L   |
| 7     | H      | H   | H   | L   |
| 8     | L      | L   | L   | H   |
| 9     | H      | L   | L   | H   |

[1] Output nQ0 connected to  $\overline{\text{nCP1}}$ ; counter input on  $\overline{\text{nCP0}}$ .

H = HIGH voltage level

L = LOW voltage level

Table 4. Bi-quinary count sequence<sup>[1]</sup>

| Count | Output |     |     |     |
|-------|--------|-----|-----|-----|
|       | nQ0    | nQ1 | nQ2 | nQ3 |
| 0     | L      | L   | L   | L   |
| 1     | L      | H   | L   | L   |
| 2     | L      | L   | H   | L   |
| 3     | L      | H   | H   | L   |
| 4     | L      | L   | L   | H   |
| 5     | H      | L   | L   | L   |
| 6     | H      | H   | L   | L   |
| 7     | H      | L   | H   | L   |
| 8     | H      | H   | H   | L   |
| 9     | H      | L   | L   | H   |

[1] Output nQ3 connected to  $\overline{\text{nCP0}}$ ; counter input on  $\overline{\text{nCP1}}$ .

H = HIGH voltage level

L = LOW voltage level

## 7. Limiting values

**Table 5. 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 | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ | -    | $\pm 20$ | mA   |
| $I_O$     | output current          | $-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$          | -    | $\pm 25$ | mA   |
| $I_{CC}$  | supply current          |  | -    | +50      | mA   |
| $I_{GND}$ | ground current          |  | -50  | -        | mA   |
| $T_{stg}$ | storage temperature     |  | -65  | +150     | °C   |
| $P_{tot}$ | total power dissipation | SO16 and (T)SSOP16 packages <a href="#">[1]</a>        | -    | 500      | mW   |

- [1] For SO16 packages: above 70 °C, the value of  $P_{tot}$  derates linearly with 8 mW/K.  
For (T)SSOP16 packages: above 60 °C, the value of  $P_{tot}$  derates linearly with 5.5 mW/K.

## 8. Recommended operating conditions

**Table 6. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V)

| Symbol              | Parameter                           | Conditions              | 74HC390 |      |          | 74HCT390 |      |          | 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     | +25  | +125     | -40      | +25  | +125     | °C   |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 2.0\text{ V}$ | -       | -    | 625      | -        | -    | -        | ns/V |
|                     |                                     | $V_{CC} = 4.5\text{ V}$ | -       | 1.67 | 139      | -        | 1.67 | 139      | ns/V |
|                     |                                     | $V_{CC} = 6.0\text{ V}$ | -       | -    | 83       | -        | -    | -        | ns/V |

## 9. Static characteristics

**Table 7. 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  |      |
| <b>74HC390</b> |                          |                         |       |     |      |                  |      |                   |      |      |
| $V_{IH}$       | HIGH-level input voltage | $V_{CC} = 2.0\text{ V}$ | 1.5   | 1.2 | -    | 1.5              | -    | 1.5               | -    | V    |
|                |                          | $V_{CC} = 4.5\text{ V}$ | 3.15  | 2.4 | -    | 3.15             | -    | 3.15              | -    | V    |
|                |                          | $V_{CC} = 6.0\text{ V}$ | 4.2   | 3.2 | -    | 4.2              | -    | 4.2               | -    | V    |
| $V_{IL}$       | LOW-level input voltage  | $V_{CC} = 2.0\text{ V}$ | -     | 0.8 | 0.5  | -                | 0.5  | -                 | 0.5  | V    |
|                |                          | $V_{CC} = 4.5\text{ V}$ | -     | 2.1 | 1.35 | -                | 1.35 | -                 | 1.35 | V    |
|                |                          | $V_{CC} = 6.0\text{ V}$ | -     | 2.8 | 1.8  | -                | 1.8  | -                 | 1.8  | V    |

**Table 7. 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 | 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    |
|                  |                           | 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>OL</sub>  | LOW-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   | -     | 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>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V  | -     | 0.16 | 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> = 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   |
| <b>74HCT390</b>  |                           |   |       |      |      |                  |       |                   |       |      |
| 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> = 5.5 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   |
| 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> = 5.5 V  | -     | -    | 8.0  | -                | 80    | -                 | 160   | μA   |
| ΔI <sub>CC</sub> | additional supply current | per input pin; V <sub>I</sub> = V <sub>CC</sub> − 2.1 V; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V |       |      |      |                  |       |                   |       |      |
|                  |                           | nCP0 inputs   | -     | 45   | 162  | -                | 202.5 | -                 | 220.5 | μA   |
|                  |                           | nCP1, nMR inputs  | -     | 60   | 216  | -                | 270   | -                 | 294   | μA   |
| C <sub>I</sub>   | input capacitance         |   | -     | 3.5  | -    | -                | -     | -                 | -     | pF   |

## 10. Dynamic characteristics

**Table 8. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit, see [Figure 7](#).

| Symbol                        | Parameter                     | Conditions  | 25 °C |                    |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|-------------------------------|-------------------------------|---|-------|--------------------|-----|------------------|-----|-------------------|-----|------|
|                               |                               |   | Min   | Typ <sup>[1]</sup> | Max | Min              | Max | Min               | Max |      |
| <b>74HC390</b>                |                               |   |       |                    |     |                  |     |                   |     |      |
| $t_{pd}$                      | propagation delay             | $\overline{nCP0}$ to nQ0; see <a href="#">Figure 5</a> <sup>[2]</sup> |       |                    |     |                  |     |                   |     |      |
|                               |                               | $V_{CC} = 2.0$ V  | -     | 47                 | 145 | -                | 180 | -                 | 220 | ns   |
|                               |                               | $V_{CC} = 4.5$ V  | -     | 17                 | 29  | -                | 36  | -                 | 44  | ns   |
|                               |                               | $V_{CC} = 5$ V; $C_L = 15$ pF   | -     | 14                 | -   | -                | -   | -                 | -   | ns   |
|                               |                               | $V_{CC} = 6.0$ V  | -     | 14                 | 25  | -                | 31  | -                 | 38  | ns   |
|                               |                               | $\overline{nCP1}$ to nQ1; see <a href="#">Figure 5</a>                |       |                    |     |                  |     |                   |     |      |
|                               |                               | $V_{CC} = 2.0$ V  | -     | 50                 | 155 | -                | 195 | -                 | 235 | ns   |
|                               |                               | $V_{CC} = 4.5$ V  | -     | 18                 | 31  | -                | 39  | -                 | 47  | ns   |
|                               |                               | $V_{CC} = 5$ V; $C_L = 15$ pF   | -     | 15                 | -   | -                | -   | -                 | -   | ns   |
|                               |                               | $V_{CC} = 6.0$ V  | -     | 14                 | 26  | -                | 33  | -                 | 40  | ns   |
|                               |                               | $\overline{nCP1}$ to nQ2; see <a href="#">Figure 5</a>                |       |                    |     |                  |     |                   |     |      |
|                               |                               | $V_{CC} = 2.0$ V  | -     | 74                 | 210 | -                | 265 | -                 | 315 | ns   |
|                               |                               | $V_{CC} = 4.5$ V  | -     | 27                 | 42  | -                | 53  | -                 | 63  | ns   |
|                               |                               | $V_{CC} = 5$ V; $C_L = 15$ pF   | -     | 23                 | -   | -                | -   | -                 | -   | ns   |
|                               |                               | $V_{CC} = 6.0$ V  | -     | 22                 | 36  | -                | 45  | -                 | 54  | ns   |
|                               |                               | $\overline{nCP1}$ to nQ3; see <a href="#">Figure 5</a>                |       |                    |     |                  |     |                   |     |      |
| $V_{CC} = 2.0$ V              | -                             | 50  | 155   | -                  | 195 | -                | 235 | ns                |     |      |
| $V_{CC} = 4.5$ V              | -                             | 18  | 31    | -                  | 39  | -                | 47  | ns                |     |      |
| $V_{CC} = 5$ V; $C_L = 15$ pF | -                             | 15  | -     | -                  | -   | -                | -   | ns                |     |      |
| $V_{CC} = 6.0$ V              | -                             | 14  | 26    | -                  | 33  | -                | 40  | ns                |     |      |
| $t_{PHL}$                     | HIGH to LOW propagation delay | nMR to nQn; see <a href="#">Figure 6</a>                              |       |                    |     |                  |     |                   |     |      |
|                               |                               | $V_{CC} = 2.0$ V  | -     | 52                 | 165 | -                | 205 | -                 | 250 | ns   |
|                               |                               | $V_{CC} = 4.5$ V  | -     | 19                 | 33  | -                | 41  | -                 | 50  | ns   |
|                               |                               | $V_{CC} = 5$ V; $C_L = 15$ pF   | -     | 16                 | -   | -                | -   | -                 | -   | ns   |
|                               |                               | $V_{CC} = 6.0$ V  | -     | 15                 | 28  | -                | 35  | -                 | 43  | ns   |
| $t_t$                         | transition time               | nQn; see <a href="#">Figure 5</a> <sup>[3]</sup>                      |       |                    |     |                  |     |                   |     |      |
|                               |                               | $V_{CC} = 2.0$ V  | -     | 19                 | 75  | -                | 95  | -                 | 110 | ns   |
|                               |                               | $V_{CC} = 4.5$ V  | -     | 7                  | 15  | -                | 19  | -                 | 22  | ns   |
|                               |                               | $V_{CC} = 6.0$ V  | -     | 6                  | 13  | -                | 16  | -                 | 19  | ns   |

**Table 8. Dynamic characteristics ...continued**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit, see [Figure 7](#).

| Symbol          | Parameter                     | Conditions  | 25 °C |                    |     | −40 °C to +85 °C |     | −40 °C to +125 °C |     | Unit |
|-----------------|-------------------------------|---|-------|--------------------|-----|------------------|-----|-------------------|-----|------|
|                 |                               |   | Min   | Typ <sup>[1]</sup> | Max | Min              | Max | Min               | Max |      |
| $t_w$           | pulse width                   | $\overline{nCP0}$ , $\overline{nCP1}$ ; HIGH or LOW; see <a href="#">Figure 5</a>   |       |                    |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 2.0$ V  | 80    | 19                 | -   | 100              | -   | 120               | -   | ns   |
|                 |                               | $V_{CC} = 4.5$ V  | 16    | 7                  | -   | 20               | -   | 24                | -   | ns   |
|                 |                               | $V_{CC} = 6.0$ V  | 14    | 6                  | -   | 17               | -   | 20                | -   | ns   |
|                 |                               | $\overline{nMR}$ HIGH; see <a href="#">Figure 6</a>                                 |       |                    |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 2.0$ V  | 80    | 28                 | -   | 105              | -   | 130               | -   | ns   |
|                 |                               | $V_{CC} = 4.5$ V  | 17    | 10                 | -   | 21               | -   | 26                | -   | ns   |
| $t_{rec}$       | recovery time                 | $\overline{nMR}$ to $\overline{nCPn}$ ; see <a href="#">Figure 6</a>                |       |                    |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 2.0$ V  | 75    | 22                 | -   | 95               | -   | 110               | -   | ns   |
|                 |                               | $V_{CC} = 4.5$ V  | 15    | 8                  | -   | 19               | -   | 22                | -   | ns   |
|                 |                               | $V_{CC} = 6.0$ V  | 13    | 6                  | -   | 16               | -   | 19                | -   | ns   |
| $f_{max}$       | maximum frequency             | $\overline{nCPn}$ ; see <a href="#">Figure 5</a>                                    |       |                    |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 2.0$ V  | 6.0   | 20                 | -   | 4.8              | -   | 4.0               | -   | MHz  |
|                 |                               | $V_{CC} = 4.5$ V  | 30    | 60                 | -   | 24               | -   | 20                | -   | MHz  |
|                 |                               | $V_{CC} = 5$ V; $C_L = 15$ pF   | -     | 66                 | -   | -                | -   | -                 | -   | MHz  |
| $C_{PD}$        | power dissipation capacitance | $C_L = 50$ pF; $f = 1$ MHz; $V_I = \text{GND to } V_{CC}$ <sup>[4]</sup>            | -     | 20                 | -   | -                | -   | -                 | -   | pF   |
|                 |                               | $V_{CC} = 2.0$ V  |       |                    |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V  |       |                    |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 6.0$ V  |       |                    |     |                  |     |                   |     |      |
| <b>74HCT390</b> |                               |   |       |                    |     |                  |     |                   |     |      |
| $t_{pd}$        | propagation delay             | $\overline{nCP0}$ to $\overline{nQ0}$ ; see <a href="#">Figure 5</a> <sup>[2]</sup> |       |                    |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V  | -     | 21                 | 34  | -                | 43  | -                 | 51  | ns   |
|                 |                               | $V_{CC} = 5$ V; $C_L = 15$ pF   | -     | 18                 | -   | -                | -   | -                 | -   | ns   |
|                 |                               | $\overline{nCP1}$ to $\overline{nQ1}$ ; see <a href="#">Figure 5</a>                |       |                    |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V  | -     | 22                 | 38  | -                | 48  | -                 | 57  | ns   |
|                 |                               | $V_{CC} = 5$ V; $C_L = 15$ pF   | -     | 19                 | -   | -                | -   | -                 | -   | ns   |
|                 |                               | $\overline{nCP1}$ to $\overline{nQ2}$ ; see <a href="#">Figure 5</a>                |       |                    |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V  | -     | 30                 | 51  | -                | 64  | -                 | 77  | ns   |
|                 |                               | $V_{CC} = 5$ V; $C_L = 15$ pF   | -     | 26                 | -   | -                | -   | -                 | -   | ns   |
|                 |                               | $\overline{nCP1}$ to $\overline{nQ3}$ ; see <a href="#">Figure 5</a>                |       |                    |     |                  |     |                   |     |      |
| $t_{PHL}$       | HIGH to LOW propagation delay | $\overline{nMR}$ to $\overline{nQn}$ ; see <a href="#">Figure 6</a>                 |       |                    |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V  | -     | 21                 | 36  | -                | 45  | -                 | 54  | ns   |
|                 |                               | $V_{CC} = 5$ V; $C_L = 15$ pF   | -     | 18                 | -   | -                | -   | -                 | -   | ns   |
| $t_t$           | transition time               | $\overline{nQn}$ ; see <a href="#">Figure 5</a> <sup>[3]</sup>                      |       |                    |     |                  |     |                   |     |      |
|                 |                               | $V_{CC} = 4.5$ V  | -     | 7                  | 15  | -                | 19  | -                 | 22  | ns   |



**Table 8. Dynamic characteristics ...continued**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit, see [Figure 7](#).

| Symbol    | Parameter                     | Conditions  | 25 °C |                    |     | −40 °C to +85 °C |     | −40 °C to +125 °C |     | Unit |
|-----------|-------------------------------|---|-------|--------------------|-----|------------------|-----|-------------------|-----|------|
|           |                               |   | Min   | Typ <sup>[1]</sup> | Max | Min              | Max | Min               | Max |      |
| $t_W$     | pulse width                   | $\overline{nCP0}$ , $\overline{nCP1}$ ; HIGH or LOW; see <a href="#">Figure 5</a> |       |                    |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 4.5$ V  | 18    | 8                  | -   | 23               | -   | 27                | -   | ns   |
|           |                               | nMR HIGH; see <a href="#">Figure 6</a>  |       |                    |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 4.5$ V  | 17    | 10                 | -   | 21               | -   | 26                | -   | ns   |
| $t_{rec}$ | recovery time                 | nMR to $\overline{nCPn}$ ; see <a href="#">Figure 6</a>                           |       |                    |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 4.5$ V  | 15    | 8                  | -   | 19               | -   | 22                | -   | ns   |
| $f_{max}$ | maximum frequency             | $\overline{nCPn}$ ; see <a href="#">Figure 5</a>                                  |       |                    |     |                  |     |                   |     |      |
|           |                               | $V_{CC} = 4.5$ V  | 27    | 55                 | -   | 22               | -   | 18                | -   | MHz  |
|           |                               | $V_{CC} = 5$ V; $C_L = 15$ pF   | -     | 61                 | -   | -                | -   | -                 | -   | MHz  |
| $C_{PD}$  | power dissipation capacitance | $C_L = 50$ pF; $f = 1$ MHz; $V_I = \text{GND to } V_{CC} - 1.5$ V <sup>[4]</sup>  | -     | 21                 | -   | -                | -   | -                 | -   | pF   |

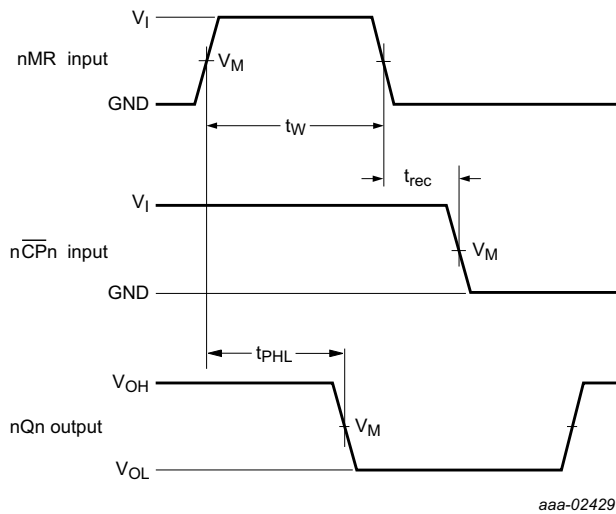
- [1] All typical values are measured at  $T_{amb} = 25$  °C.
- [2]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .
- [3]  $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .
- [4]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).
- $$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$$
- 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.

11. Waveforms



Measurement points are given in [Table 9](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig 5. The clock input (nCPn) to output (nQn) propagation delays, output transition time, clock pulse width and maximum clock frequency**



Measurement points are given in [Table 9](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig 6. The master reset (nMR) pulse width, master reset to output (nQn) propagation delays and master reset to clock (nCPn) recovery time**

**Table 9. Measurement points**

| Type     | Input       | Output      |
|----------|-------------|-------------|
|          | $V_M$       | $V_M$       |
| 74HC390  | $0.5V_{CC}$ | $0.5V_{CC}$ |
| 74HCT390 | 1.3 V       | 1.3 V       |



Test data is given in [Table 10](#).

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 7. Test circuit for measuring switching times**

**Table 10. Test data**

| Type     | Input    |            | Load         | Test               |
|----------|----------|------------|--------------|--------------------|
|          | $V_I$    | $t_r, t_f$ | $C_L$        |                    |
| 74HC390  | $V_{CC}$ | 6 ns       | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |
| 74HCT390 | 3 V      | 6 ns       | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |

12. Package outline

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

SOT109-1

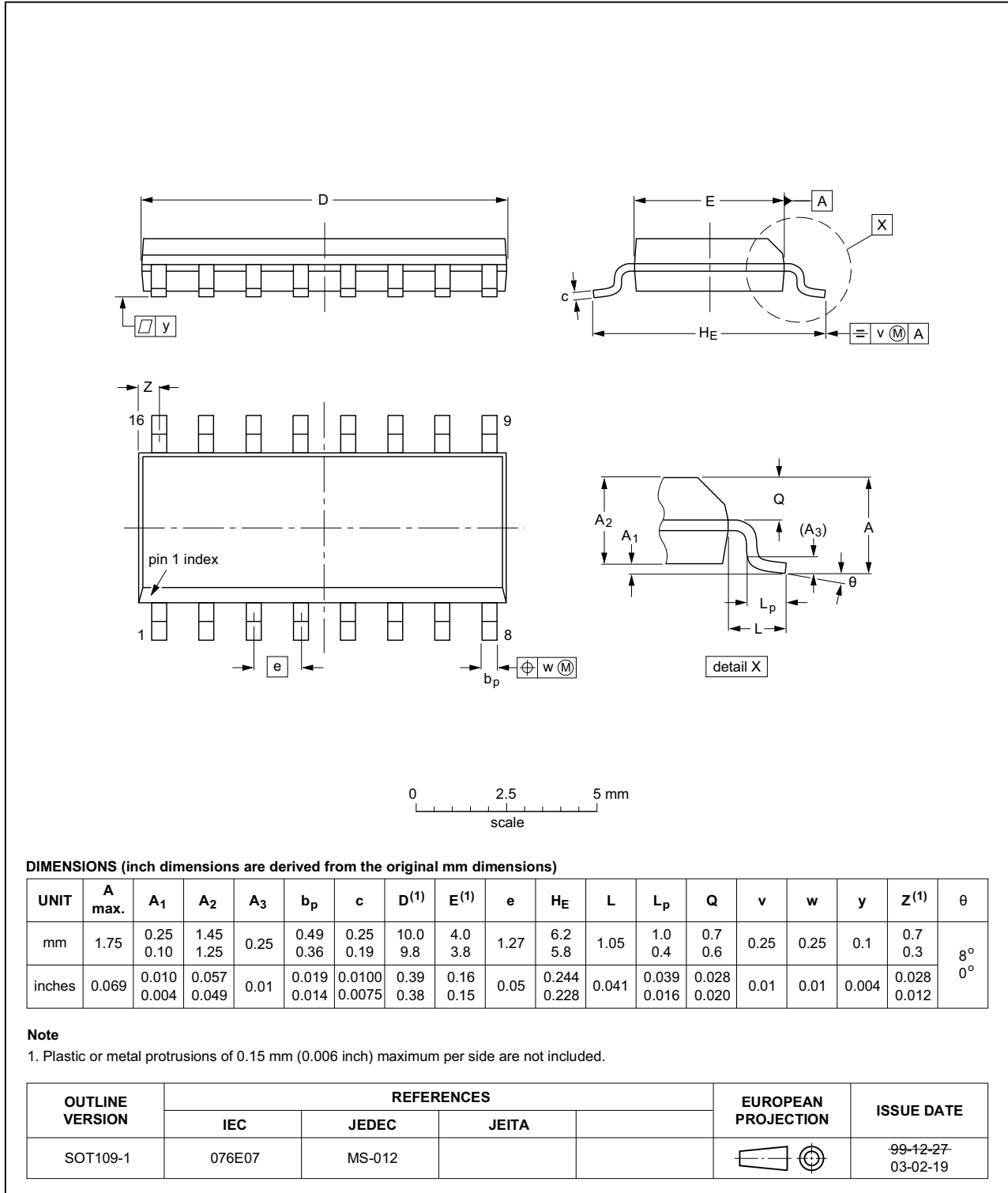


Fig 8. Package outline SOT109-1 (SO16)

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

SOT338-1



Fig 9. Package outline SOT338-1 (SSOP16)

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

SOT403-1



Fig 10. Package outline SOT403-1 (TSSOP16)

## 13. Abbreviations

Table 11. 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             |

## 14. Revision history

Table 12. Revision history

| Document ID         | Release date  | Data sheet status     | Change notice | Supersedes          |
|---------------------|---|-----------------------|---------------|---------------------|
| 74HC_HCT390 v.3     | 20160816  | Product data sheet    | -             | 74HC_HCT390_CNV v.2 |
| Modifications:      | <ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li>Type numbers 74HC390N and 74HCT390N removed.</li> </ul> |                       |               |                     |
| 74HC_HCT390_CNV v.2 | 19901201  | Product specification | -             | -                   |

## 15. Legal information

### 15.1 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.nexperia.com>.

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