



# CD54/74HC40103, CD74HCT40103

Data sheet acquired from Harris Semiconductor  
SCHS221A

November 1997 - Revised May 2000

## High Speed CMOS Logic 8-Stage Synchronous Down Counters

### Features

- Synchronous or Asynchronous Preset
- Cascadable in Synchronous or Ripple Mode
- Fanout (Over Temperature Range)
  - Standard Outputs . . . . . 10 LSTTL Loads
  - Bus Driver Outputs . . . . . 15 LSTTL Loads
- Wide Operating Temperature Range . . . -55°C to 125°C
- Balanced Propagation Delay and Transition Times
- Significant Power Reduction Compared to LSTTL Logic ICs
- HC Types
  - 2V to 6V Operation
  - High Noise Immunity:  $N_{IL} = 30\%$ ,  $N_{IH} = 30\%$  of  $V_{CC}$  at  $V_{CC} = 5V$
- HCT Types
  - 4.5V to 5.5V Operation
  - Direct LSTTL Input Logic Compatibility,  $V_{IL} = 0.8V$  (Max),  $V_{IH} = 2V$  (Min)
  - CMOS Input Compatibility,  $I_I \leq 1\mu A$  at  $V_{OL}$ ,  $V_{OH}$

### Ordering Information

| PART NUMBER    | TEMP. RANGE (°C) | PACKAGE      |
|----------------|------------------|--------------|
| CD54HC40103F   | -55 to 125       | 16 Ld Cerdip |
| CD54HC40103F3A | -55 to 125       | 16 Ld Cerdip |
| CD74HC40103E   | -55 to 125       | 16 Ld PDIP   |
| CD74HC40103M   | -55 to 125       | 16 Ld SOIC   |
| CD74HCT40103E  | -55 to 125       | 16 Ld PDIP   |
| CD74HCT40103M  | -55 to 125       | 16 Ld SOIC   |

#### NOTES:

1. When ordering, use the entire part number. Add the suffix 96 to obtain the variant in the tape and reel.
2. Wafer or die for this part number is available which meets all electrical specifications. Please contact your local TI sales office or customer service for ordering information.

### Description

The 'HC40103 and CD74HCT40103 are manufactured with high speed silicon gate technology and consist of an 8-stage synchronous down counter with a single output which is active when the internal count is zero. The 40103 contains a single 8-bit binary counter. Each has control inputs for enabling or disabling the clock, for clearing the counter to its maximum count, and for presetting the counter either synchronously or asynchronously. All control inputs and the  $\overline{TC}$  output are active-low logic.

In normal operation, the counter is decremented by one count on each positive transition of the CLOCK (CP). Counting is inhibited when the  $\overline{TE}$  input is high. The  $\overline{TC}$  output goes low when the count reaches zero if the  $\overline{TE}$  input is low, and remains low for one full clock period.

When the  $\overline{PE}$  input is low, data at the P0-P7 inputs are clocked into the counter on the next positive clock transition regardless of the state of the  $\overline{TE}$  input. When the  $\overline{PL}$  input is low, data at the P0-P7 inputs are asynchronously forced into the counter regardless of the state of the  $\overline{PE}$ ,  $\overline{TE}$ , or CLOCK inputs. Input P0-P7 represent a single 8-bit binary word for the 40103. When the MR input is low, the counter is asynchronously cleared to its maximum count of 255<sub>10</sub>, regardless of the state of any other input. The precedence relationship between control inputs is indicated in the truth table.

If all control inputs except  $\overline{TE}$  are high at the time of zero count, the counters will jump to the maximum count, giving a counting sequence of 100 or 256 clock pulses long.

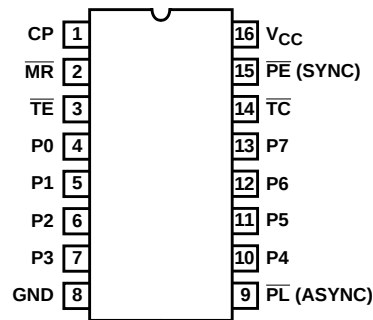
The 40103 may be cascaded using the  $\overline{TE}$  input and the  $\overline{TC}$  output, in either a synchronous or ripple mode. These circuits possess the low power consumption usually associated with CMOS circuitry, yet have speeds comparable to low power Schottky TTL circuits and can drive up to 10 LSTTL loads.



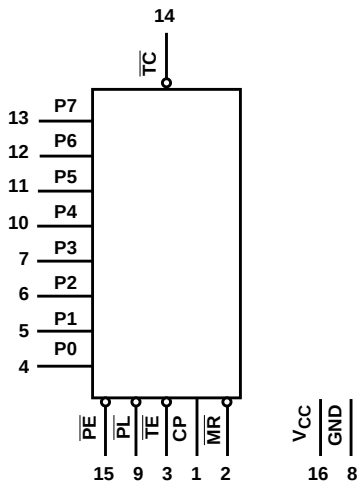
# CD54/74HC40103, CD74HCT40103

## Pinout

CD54HC40103  
(CERDIP)  
CD74HC40103, CD74HCT40103  
(PDIP, SOIC)  
TOP VIEW



## Functional Diagram



TRUTH TABLE

| CONTROL INPUTS |    |    |    | PRESET MODE    | ACTION                                   |
|----------------|----|----|----|----------------|------------------------------------------|
| MR             | PL | PE | TE |                |                                          |
| 1              | 1  | 1  | 1  | Synchronous    | Inhibit Counter                          |
| 1              | 1  | 1  | 0  |                | Count Down                               |
| 1              | 1  | 0  | X  |                | Preset On Next Positive Clock Transition |
| 1              | 0  | X  | X  | Asynchronously | Preset Asynchronously                    |
| 0              | X  | X  | X  |                | Clear to Maximum Count                   |

NOTE:

1 = High Level.

0 = Low Level.

X = Don't Care.

Clock connected to clock input.

Synchronous Operation: changes occur on negative-to-positive clock transitions.

Load Inputs: MSB = P7, LSB = P0.

## CD54/74HC40103, CD74HCT40103

### Absolute Maximum Ratings

|                                                        |             |
|--------------------------------------------------------|-------------|
| DC Supply Voltage, $V_{CC}$                            | -0.5V to 7V |
| DC Input Diode Current, $I_{IK}$                       |             |
| For $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$             | $\pm 20mA$  |
| DC Output Diode Current, $I_{OK}$                      |             |
| For $V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$             | $\pm 20mA$  |
| DC Output Source or Sink Current per Output Pin, $I_O$ |             |
| For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$             | $\pm 25mA$  |
| DC $V_{CC}$ or Ground Current, $I_{CC}$                | $\pm 50mA$  |

### Thermal Information

|                                          |                                           |
|------------------------------------------|-------------------------------------------|
| Thermal Resistance (Typical, Note 3)     | $\theta_{JA}$ ( $^{\circ}C/W$ )           |
| PDIP Package                             | 90                                        |
| SOIC Package                             | 160                                       |
| Maximum Junction Temperature             | $150^{\circ}C$                            |
| Maximum Storage Temperature Range        | $-65^{\circ}C$ to $150^{\circ}C$          |
| Maximum Lead Temperature (Soldering 10s) | $300^{\circ}C$<br>(SOIC - Lead Tips Only) |

### Operating Conditions

|                                           |                                  |
|-------------------------------------------|----------------------------------|
| Temperature Range, $T_A$                  | $-55^{\circ}C$ to $125^{\circ}C$ |
| Supply Voltage Range, $V_{CC}$            |                                  |
| HC Types                                  | .2V to 6V                        |
| HCT Types                                 | .4.5V to 5.5V                    |
| DC Input or Output Voltage, $V_I$ , $V_O$ | 0V to $V_{CC}$                   |
| Input Rise and Fall Time                  |                                  |
| 2V                                        | 1000ns (Max)                     |
| 4.5V                                      | 500ns (Max)                      |
| 6V                                        | 400ns (Max)                      |

**CAUTION:** Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

- $\theta_{JA}$  is measured with the component mounted on an evaluation PC board in free air.

### DC Electrical Specifications

| PARAMETER                               | SYMBOL          | TEST CONDITIONS                    |                     | V <sub>CC</sub> (V) | 25°C |      |      | -40°C TO 85°C |      | -55°C TO 125°C |      | UNITS |
|-----------------------------------------|-----------------|------------------------------------|---------------------|---------------------|------|------|------|---------------|------|----------------|------|-------|
|                                         |                 | V <sub>I</sub> (V)                 | I <sub>O</sub> (mA) |                     | MIN  | TYP  | MAX  | MIN           | MAX  | MIN            | MAX  |       |
| HC TYPES                                |                 |                                    |                     |                     |      |      |      |               |      |                |      |       |
| High Level Input Voltage                | V <sub>IH</sub> | -                                  | -                   | 2                   | 1.5  | -    | -    | 1.5           | -    | 1.5            | -    | V     |
|                                         |                 |                                    |                     | 4.5                 | 3.15 | -    | -    | 3.15          | -    | 3.15           | -    | V     |
|                                         |                 |                                    |                     | 6                   | 4.2  | -    | -    | 4.2           | -    | 4.2            | -    | V     |
| Low Level Input Voltage                 | V <sub>IL</sub> | -                                  | -                   | 2                   | -    | -    | 0.5  | -             | 0.5  | -              | 0.5  | V     |
|                                         |                 |                                    |                     | 4.5                 | -    | -    | 1.35 | -             | 1.35 | -              | 1.35 | V     |
|                                         |                 |                                    |                     | 6                   | -    | -    | 1.8  | -             | 1.8  | -              | 1.8  | V     |
| High Level Output Voltage<br>CMOS Loads | V <sub>OH</sub> | V <sub>IH</sub> or V <sub>IL</sub> | -0.02               | 2                   | 1.9  | -    | -    | 1.9           | -    | 1.9            | -    | V     |
|                                         |                 |                                    | -0.02               | 4.5                 | 4.4  | -    | -    | 4.4           | -    | 4.4            | -    | V     |
|                                         |                 |                                    | -0.02               | 6                   | 5.9  | -    | -    | 5.9           | -    | 5.9            | -    | V     |
| -                                       |                 |                                    | -                   | -                   | -    | -    | -    | -             | -    | -              | V    |       |
| -4                                      |                 |                                    | 4.5                 | 3.98                | -    | -    | 3.84 | -             | 3.7  | -              | V    |       |
| -5.2                                    |                 |                                    | 6                   | 5.48                | -    | -    | 5.34 | -             | 5.2  | -              | V    |       |
| High Level Output Voltage<br>TTL Loads  | V <sub>OL</sub> | V <sub>IH</sub> or V <sub>IL</sub> | 0.02                | 2                   | -    | -    | 0.1  | -             | 0.1  | -              | 0.1  | V     |
|                                         |                 |                                    | 0.02                | 4.5                 | -    | -    | 0.1  | -             | 0.1  | -              | 0.1  | V     |
|                                         |                 |                                    | 0.02                | 6                   | -    | -    | 0.1  | -             | 0.1  | -              | 0.1  | V     |
| -                                       |                 |                                    | -                   | -                   | -    | -    | -    | -             | -    | -              | V    |       |
| 4                                       |                 |                                    | 4.5                 | -                   | -    | 0.26 | -    | 0.33          | -    | 0.4            | V    |       |
| 5.2                                     |                 |                                    | 6                   | -                   | -    | 0.26 | -    | 0.33          | -    | 0.4            | V    |       |
| Low Level Output Voltage<br>CMOS Loads  | V <sub>OL</sub> | V <sub>IH</sub> or V <sub>IL</sub> | 0.02                | 2                   | -    | -    | 0.1  | -             | 0.1  | -              | 0.1  | V     |
| 0.02                                    |                 |                                    | 4.5                 | -                   | -    | 0.1  | -    | 0.1           | -    | 0.1            | V    |       |
| 0.02                                    |                 |                                    | 6                   | -                   | -    | 0.1  | -    | 0.1           | -    | 0.1            | V    |       |
| Low Level Output Voltage<br>TTL Loads   | V <sub>OL</sub> | V <sub>IH</sub> or V <sub>IL</sub> | -                   | -                   | -    | -    | -    | -             | -    | -              | -    | V     |
|                                         |                 |                                    | 4                   | 4.5                 | -    | -    | 0.26 | -             | 0.33 | -              | 0.4  | V     |
|                                         |                 |                                    | 5.2                 | 6                   | -    | -    | 0.26 | -             | 0.33 | -              | 0.4  | V     |
| Input Leakage Current                   | I <sub>I</sub>  | V <sub>CC</sub> or GND             | -                   | 6                   | -    | -    | ±0.1 | -             | ±1   | -              | ±1   | µA    |
| Quiescent Device Current                | I <sub>CC</sub> | V <sub>CC</sub> or GND             | 0                   | 6                   | -    | -    | 8    | -             | 80   | -              | 160  | µA    |

## CD54/74HC40103, CD74HCT40103

### DC Electrical Specifications (Continued)

| PARAMETER                                                      | SYMBOL           | TEST CONDITIONS                    |                     | V <sub>CC</sub> (V) | 25°C |     |      | -40°C TO 85°C |      | -55°C TO 125°C |     | UNITS |
|----------------------------------------------------------------|------------------|------------------------------------|---------------------|---------------------|------|-----|------|---------------|------|----------------|-----|-------|
|                                                                |                  | V <sub>I</sub> (V)                 | I <sub>O</sub> (mA) |                     | MIN  | TYP | MAX  | MIN           | MAX  | MIN            | MAX |       |
| HCT TYPES                                                      |                  |                                    |                     |                     |      |     |      |               |      |                |     |       |
| High Level Input Voltage                                       | V <sub>IH</sub>  | -                                  | -                   | 4.5 to 5.5          | 2    | -   | -    | 2             | -    | 2              | -   | V     |
| Low Level Input Voltage                                        | V <sub>IL</sub>  | -                                  | -                   | 4.5 to 5.5          | -    | -   | 0.8  | -             | 0.8  | -              | 0.8 | V     |
| High Level Output Voltage<br>CMOS Loads                        | V <sub>OH</sub>  | V <sub>IH</sub> or V <sub>IL</sub> | -0.02               | 4.5                 | 4.4  | -   | -    | 4.4           | -    | 4.4            | -   | V     |
| High Level Output Voltage<br>TTL Loads                         |                  |                                    | -4                  | 4.5                 | 3.98 | -   | -    | 3.84          | -    | 3.7            | -   | V     |
| Low Level Output Voltage<br>CMOS Loads                         | V <sub>OL</sub>  | V <sub>IH</sub> or V <sub>IL</sub> | 0.02                | 4.5                 | -    | -   | 0.1  | -             | 0.1  | -              | 0.1 | V     |
| Low Level Output Voltage<br>TTL Loads                          |                  |                                    | 4                   | 4.5                 | -    | -   | 0.26 | -             | 0.33 | -              | 0.4 | V     |
| Input Leakage Current                                          | I <sub>I</sub>   | V <sub>CC</sub> and GND            | 0                   | 5.5                 | -    | -   | ±0.1 | -             | ±1   | -              | ±1  | μA    |
| Quiescent Device Current                                       | I <sub>CC</sub>  | V <sub>CC</sub> or GND             | 0                   | 5.5                 | -    | -   | 8    | -             | 80   | -              | 160 | μA    |
| Additional Quiescent Device Current Per Input Pin: 1 Unit Load | ΔI <sub>CC</sub> | V <sub>CC</sub> -2.1               | -                   | 4.5 to 5.5          | -    | 100 | 360  | -             | 450  | -              | 490 | μA    |

NOTE: For dual-supply systems theoretical worst case (V<sub>I</sub> = 2.4V, V<sub>CC</sub> = 5.5V) specification is 1.8mA.

### HCT Input Loading Table

| INPUT                             | UNIT LOADS (NOTE) |
|-----------------------------------|-------------------|
| P0-P7                             | 0.20              |
| $\overline{TE}$ , $\overline{MR}$ | 0.40              |
| CP                                | 0.60              |
| $\overline{PE}$                   | 0.80              |
| $\overline{PL}$                   | 1.35              |

NOTE: Unit Load is ΔI<sub>CC</sub> limit specified in DC Electrical Table, e.g., 360μA max at 25°C.

### Prerequisite for Switching Specifications

| PARAMETER                   | SYMBOL         | V <sub>CC</sub> (V) | 25°C |     |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|-----------------------------|----------------|---------------------|------|-----|-----|---------------|-----|----------------|-----|-------|
|                             |                |                     | MIN  | TYP | MAX | MIN           | MAX | MIN            | MAX |       |
| HC TYPES                    |                |                     |      |     |     |               |     |                |     |       |
| CP Pulse Width              | t <sub>W</sub> | 2                   | 165  | -   | -   | 205           | -   | 250            | -   | ns    |
|                             |                | 4.5                 | 33   | -   | -   | 41            | -   | 50             | -   | ns    |
|                             |                | 6                   | 28   | -   | -   | 35            | -   | 43             | -   | ns    |
| $\overline{PL}$ Pulse Width | t <sub>W</sub> | 2                   | 125  | -   | -   | 155           | -   | 190            | -   | ns    |
|                             |                | 4.5                 | 25   | -   | -   | 31            | -   | 38             | -   | ns    |
|                             |                | 6                   | 21   | -   | -   | 26            | -   | 32             | -   | ns    |

# CD54/74HC40103, CD74HCT40103

## Prerequisite for Switching Specifications (Continued)

| PARAMETER                                                  | SYMBOL               | V <sub>CC</sub> (V) | 25°C |     |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|------------------------------------------------------------|----------------------|---------------------|------|-----|-----|---------------|-----|----------------|-----|-------|
|                                                            |                      |                     | MIN  | TYP | MAX | MIN           | MAX | MIN            | MAX |       |
| $\overline{\text{MR}}$ Pulse Width                         | $t_W$                | 2                   | 125  | -   | -   | 135           | -   | 190            | -   | ns    |
|                                                            |                      | 4.5                 | 25   | -   | -   | 31            | -   | 38             | -   | ns    |
|                                                            |                      | 6                   | 21   | -   | -   | 26            | -   | 32             | -   | ns    |
| CP Max. Frequency<br>(Note 4)                              | $f_{\text{CP(MAX)}}$ | 2                   | 3    | -   | -   | 2             | -   | 2              | -   | MHz   |
|                                                            |                      | 4.5                 | 15   | -   | -   | 12            | -   | 10             | -   | MHz   |
|                                                            |                      | 6                   | 18   | -   | -   | 14            | -   | 12             | -   | MHz   |
| P to CP Set-up Time                                        | $t_{\text{SU}}$      | 2                   | 100  | -   | -   | 125           | -   | 150            | -   | ns    |
|                                                            |                      | 4.5                 | 20   | -   | -   | 25            | -   | 30             | -   | ns    |
|                                                            |                      | 6                   | 17   | -   | -   | 21            | -   | 26             | -   | ns    |
| $\overline{\text{PE}}$ to CP Set-up Time                   | $t_{\text{SU}}$      | 2                   | 75   | -   | -   | 95            | -   | 110            | -   | ns    |
|                                                            |                      | 4.5                 | 15   | -   | -   | 19            | -   | 22             | -   | ns    |
|                                                            |                      | 6                   | 13   | -   | -   | 16            | -   | 19             | -   | ns    |
| $\overline{\text{TE}}$ to CP Set-up Time                   | $t_{\text{SU}}$      | 2                   | 150  | -   | -   | 190           | -   | 225            | -   | ns    |
|                                                            |                      | 4.5                 | 30   | -   | -   | 38            | -   | 45             | -   | ns    |
|                                                            |                      | 6                   | 26   | -   | -   | 33            | -   | 38             | -   | ns    |
| P to CP Hold Time                                          | $t_{\text{H}}$       | 2                   | 5    | -   | -   | 5             | -   | 5              | -   | ns    |
|                                                            |                      | 4.5                 | 5    | -   | -   | 5             | -   | 5              | -   | ns    |
|                                                            |                      | 6                   | 5    | -   | -   | 5             | -   | 5              | -   | ns    |
| $\overline{\text{TE}}$ to $\overline{\text{CP}}$ Hold Time | $t_{\text{H}}$       | 2                   | 0    | -   | -   | 0             | -   | 0              | -   | ns    |
|                                                            |                      | 4.5                 | 0    | -   | -   | 0             | -   | 0              | -   | ns    |
|                                                            |                      | 6                   | 0    | -   | -   | 0             | -   | 0              | -   | ns    |
| MR to CP Removal Time                                      | $t_{\text{REM}}$     | 2                   | 50   | -   | -   | 65            | -   | 75             | -   | ns    |
|                                                            |                      | 4.5                 | 10   | -   | -   | 13            | -   | 15             | -   | ns    |
|                                                            |                      | 6                   | 9    | -   | -   | 11            | -   | 13             | -   | ns    |
| $\overline{\text{PE}}$ to $\overline{\text{CP}}$ Hold Time | $t_{\text{H}}$       | 2                   | 2    | -   | -   | 2             | -   | 2              | -   | ns    |
|                                                            |                      | 4.5                 | 2    | -   | -   | 2             | -   | 2              | -   | ns    |
|                                                            |                      | 6                   | 2    | -   | -   | 2             | -   | 2              | -   | ns    |
| HCT TYPES                                                  |                      |                     |      |     |     |               |     |                |     |       |
| CP Pulse Width                                             | $t_W$                | 4.5                 | 35   | -   | -   | 44            | -   | 53             | -   | ns    |
| $\overline{\text{PL}}$ Pulse Width                         | $t_W$                | 4.5                 | 43   | -   | -   | 54            | -   | 65             | -   | ns    |
| $\overline{\text{MR}}$ Pulse Width                         | $t_W$                | 4.5                 | 35   | -   | -   | 44            | -   | 53             | -   | ns    |
| CP Max. Frequency<br>(Note 4)                              | $f_{\text{CP(MAX)}}$ | 4.5                 | 14   | -   | -   | 11            | -   | 9              | -   | MHz   |
| P to CP Set-up Time                                        | $t_{\text{SU}}$      | 4.5                 | 24   | -   | -   | 30            | -   | 36             | -   | ns    |
| $\overline{\text{PE}}$ to CP Set-up Time                   | $t_{\text{SU}}$      | 4.5                 | 20   | -   | -   | 25            | -   | 30             | -   | ns    |
| $\overline{\text{TE}}$ to CP Set-up Time                   | $t_{\text{SU}}$      | 4.5                 | 40   | -   | -   | 50            | -   | 60             | -   | ns    |
| P to CP Hold Time                                          | $t_{\text{H}}$       | 4.5                 | 5    | -   | -   | 5             | -   | 5              | -   | ns    |
| $\overline{\text{TE}}$ to $\overline{\text{CP}}$ Hold Time | $t_{\text{H}}$       | 4.5                 | 0    | -   | -   | 0             | -   | 0              | -   | ns    |
| MR to $\overline{\text{CP}}$ Removal Time                  | $t_{\text{REM}}$     | 4.5                 | 10   | -   | -   | 13            | -   | 15             | -   | ns    |
| $\overline{\text{PE}}$ to $\overline{\text{CP}}$ Hold Time | $t_{\text{H}}$       | 4.5                 | 2    | -   | -   | 2             | -   | 2              | -   | ns    |

# CD54/74HC40103, CD74HCT40103

## Switching Specifications Input $t_r, t_f = 6\text{ns}$

| PARAMETER                                                     | SYMBOL                                 | TEST CONDITIONS       | V <sub>CC</sub> (V) | 25°C |     |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|---------------------------------------------------------------|----------------------------------------|-----------------------|---------------------|------|-----|-----|---------------|-----|----------------|-----|-------|
|                                                               |                                        |                       |                     | MIN  | TYP | MAX | MIN           | MAX | MIN            | MAX |       |
| HC TYPES                                                      |                                        |                       |                     |      |     |     |               |     |                |     |       |
| Propagation Delay<br>CP to any $\overline{TC}$ (Async Preset) | t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    | -   | 300 | -             | 375 | -              | 450 | ns    |
|                                                               |                                        | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 60  | -             | 75  | -              | 90  | ns    |
|                                                               |                                        | C <sub>L</sub> = 15pF | 5                   | -    | 25  | -   | -             | -   | -              | -   | ns    |
|                                                               |                                        | C <sub>L</sub> = 50pF | 6                   | -    | -   | 51  | -             | 64  | -              | 77  | ns    |
| CP to $\overline{TC}$ (Sync Preset)                           | t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    | -   | 300 | -             | 375 | -              | 450 | ns    |
|                                                               |                                        | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 60  | -             | 75  | -              | 90  | ns    |
|                                                               |                                        | C <sub>L</sub> = 15pF | 5                   | -    | 25  | -   | -             | -   | -              | -   | ns    |
|                                                               |                                        | C <sub>L</sub> = 50pF | 6                   | -    | -   | 51  | -             | 64  | -              | 77  | ns    |
| $\overline{TE}$ to $\overline{TC}$                            | t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    | -   | 200 | -             | 250 | -              | 300 | ns    |
|                                                               |                                        | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 40  | -             | 50  | -              | 60  | ns    |
|                                                               |                                        | C <sub>L</sub> = 15pF | 5                   | -    | 17  | -   | -             | -   | -              | -   | ns    |
|                                                               |                                        | C <sub>L</sub> = 50pF | 6                   | -    | -   | 34  | -             | 43  | -              | 51  | ns    |
| $\overline{PL}$ to $\overline{TC}$                            | t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    | -   | 275 | -             | 345 | -              | 415 | ns    |
|                                                               |                                        | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 55  | -             | 69  | -              | 83  | ns    |
|                                                               |                                        | C <sub>L</sub> = 15pF | 5                   | -    | 23  | -   | -             | -   | -              | -   | ns    |
|                                                               |                                        | C <sub>L</sub> = 50pF | 6                   | -    | -   | 47  | -             | 59  | -              | 71  | ns    |
| $\overline{MR}$ to $\overline{TC}$                            | t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    | -   | 275 | -             | 345 | -              | 415 | ns    |
|                                                               |                                        | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 55  | -             | 69  | -              | 83  | ns    |
|                                                               |                                        | C <sub>L</sub> = 15pF | 5                   | -    | 23  | -   | -             | -   | -              | -   | ns    |
|                                                               |                                        | C <sub>L</sub> = 50pF | 6                   | -    | -   | 47  | -             | 59  | -              | 71  | ns    |
| Output Transition Time                                        | t <sub>TLH</sub> , t <sub>THL</sub>    | C <sub>L</sub> = 50pF | 2                   | -    | -   | 75  | -             | 95  | -              | 110 | ns    |
|                                                               |                                        | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 15  | -             | 19  | -              | 22  | ns    |
|                                                               |                                        | C <sub>L</sub> = 50pF | 6                   | -    | -   | 13  | -             | 16  | -              | 19  | ns    |
| Input Capacitance                                             | C <sub>I</sub>                         | C <sub>L</sub> = 50pF | -                   | -    | -   | 10  | -             | 10  | -              | 10  | pF    |
| CP Maximum Frequency                                          | f <sub>MAX</sub>                       | C <sub>L</sub> = 15pF | 5                   | -    | 25  | -   | -             | -   | -              | -   | MHz   |
| Power Dissipation Capacitance<br>(Notes 5, 6)                 | C <sub>PD</sub>                        | -                     | 5                   | -    | 25  | -   | -             | -   | -              | -   | pF    |
| HCT TYPES                                                     |                                        |                       |                     |      |     |     |               |     |                |     |       |
| Propagation Delay<br>CP to $\overline{TC}$ (Async Preset)     | t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 60  | -             | 75  | -              | 90  | ns    |
|                                                               |                                        | C <sub>L</sub> = 15pF | 5                   | -    | 25  | -   | -             | -   | -              | -   | ns    |
| $\overline{CE}$ to $\overline{TC}$ (Sync Preset)              | t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 63  | -             | 79  | -              | 95  | ns    |
|                                                               |                                        | C <sub>L</sub> = 15pF | 5                   | -    | 26  | -   | -             | -   | -              | -   | ns    |
| $\overline{TE}$ to $\overline{TC}$                            | t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 50  | -             | 63  | -              | 75  | ns    |
|                                                               |                                        | C <sub>L</sub> = 15pF | 5                   | -    | 21  | -   | -             | -   | -              | -   | ns    |
| $\overline{PL}$ to $\overline{TC}$                            | t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 68  | -             | 85  | -              | 102 | ns    |
|                                                               |                                        | C <sub>L</sub> = 15pF | 5                   | -    | 28  | -   | -             | -   | -              | -   | ns    |

## CD54/74HC40103, CD74HCT40103

### Switching Specifications Input $t_r, t_f = 6\text{ns}$ (Continued)

| PARAMETER                                     | SYMBOL             | TEST CONDITIONS     | $V_{CC}$<br>(V) | 25°C |     |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|-----------------------------------------------|--------------------|---------------------|-----------------|------|-----|-----|---------------|-----|----------------|-----|-------|
|                                               |                    |                     |                 | MIN  | TYP | MAX | MIN           | MAX | MIN            | MAX |       |
| $\overline{MR}$ to $\overline{TC}$            | $t_{PLH}, t_{PHL}$ | $C_L = 50\text{pF}$ | 4.5             | -    | -   | 55  | -             | 69  | -              | 83  | ns    |
|                                               |                    | $C_L = 15\text{pF}$ | 5               | -    | 23  | -   | -             | -   | -              | -   | ns    |
| Output Transition Time                        | $t_{THL}, t_{TLH}$ | $C_L = 50\text{pF}$ | 4.5             | -    | -   | 15  | -             | 19  | -              | 22  | ns    |
| Input Capacitance                             | $C_{IN}$           | $C_L = 50\text{pF}$ | -               | -    | -   | 10  | -             | 10  | -              | 10  | pF    |
| CP Maximum Frequency                          | $f_{MAX}$          | $C_L = 15\text{pF}$ | 5               | -    | 25  | -   | -             | -   | -              | -   | MHz   |
| Power Dissipation Capacitance<br>(Notes 5, 6) | $C_{PD}$           | -                   | 5               | -    | 27  | -   | -             | -   | -              | -   | pF    |

#### NOTES:

4. Noncascaded operation only. With cascaded counters clock-to-terminal count propagation delays, count enables ( $\overline{PE}$  or  $\overline{TE}$ )-to-clock SET UP TIMES, and count enables ( $\overline{PE}$  or  $\overline{TE}$ )-to-clock HOLD TIMES determine maximum clock frequency. For example, with these HC devices:

$$C_P f_{MAX} = \frac{1}{\text{CP-to-}\overline{TC} \text{ prop delay} + \overline{TE}\text{-to-CP Setup Time} + \overline{TE}\text{-to-CP Hold Time}} = \frac{1}{60 + 30 + 0} \approx 11\text{MHz}$$

5.  $C_{PD}$  is used to determine the dynamic power consumption, per package.  
6.  $P_D = V_{CC}^2 f_i + C_L V_{CC}^2 f_o$  where  $f_i$  = Input Frequency,  $C_L$  = Output Load Capacitance,  $V_{CC}$  = Supply Voltage,  $f_o$  = Output Frequency.

### Timing Diagrams

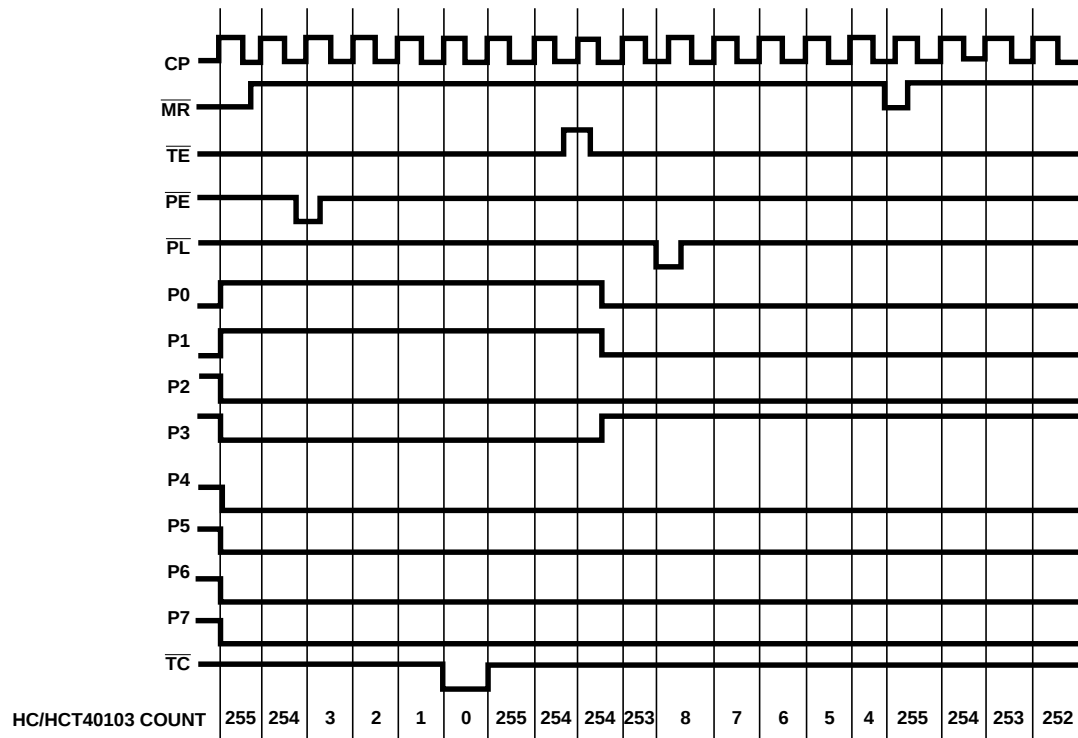


FIGURE 1.

## CD54/74HC40103, CD74HCT40103

### Test Circuits and Waveforms

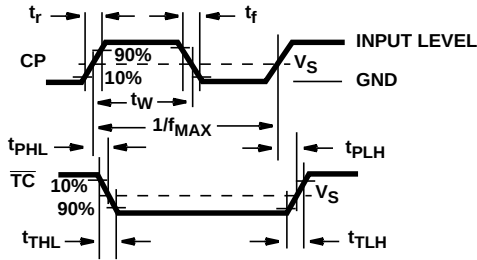


FIGURE 2.

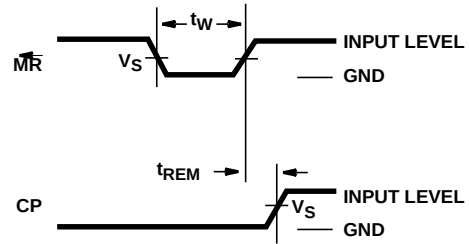


FIGURE 3.

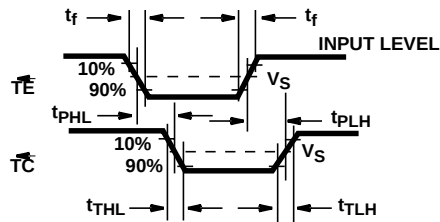


FIGURE 4.

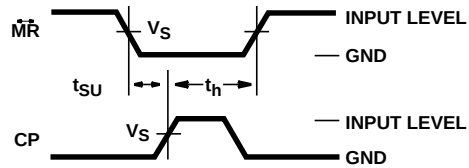


FIGURE 5.

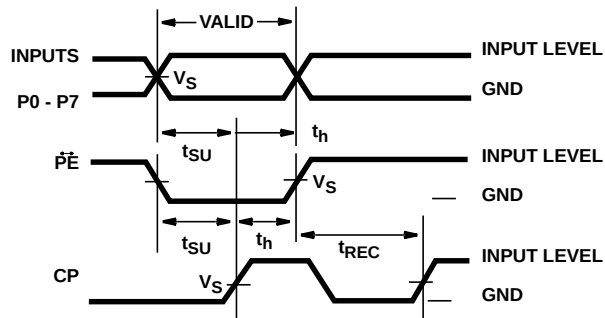


FIGURE 6.

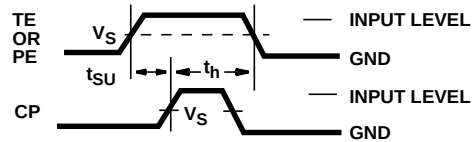
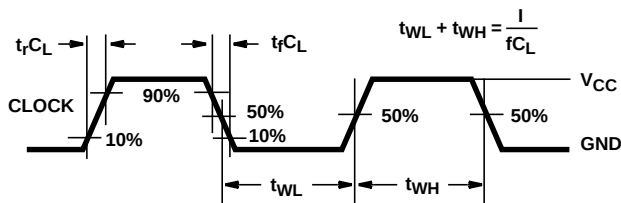
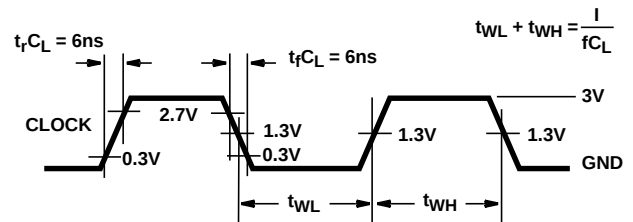


FIGURE 7.



NOTE: Outputs should be switching from 10%  $V_{CC}$  to 90%  $V_{CC}$  in accordance with device truth table. For  $f_{MAX}$ , input duty cycle = 50%.

FIGURE 8. HC CLOCK PULSE RISE AND FALL TIMES AND PULSE WIDTH



NOTE: Outputs should be switching from 10%  $V_{CC}$  to 90%  $V_{CC}$  in accordance with device truth table. For  $f_{MAX}$ , input duty cycle = 50%.

FIGURE 9. HCT CLOCK PULSE RISE AND FALL TIMES AND PULSE WIDTH

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