

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 |
|-----------------|------------------|--------------|
| CD54HC40103F3A | -55 to 125 | 16 Ld CERDIP |
| CD74HC40103E | -55 to 125 | 16 Ld PDIP |
| CD74HC40103M | -55 to 125 | 16 Ld SOIC |
| CD74HC40103MT | -55 to 125 | 16 Ld SOIC |
| CD74HC40103M96 | -55 to 125 | 16 Ld SOIC |
| CD74HCT40103E | -55 to 125 | 16 Ld PDIP |
| CD74HCT40103M | -55 to 125 | 16 Ld SOIC |
| CD74HCT40103MT | -55 to 125 | 16 Ld SOIC |
| CD74HCT40103M96 | -55 to 125 | 16 Ld SOIC |

NOTE: When ordering, use the entire part number. The suffix 96 denotes tape and reel. The suffix T denotes a small-quantity reel of 250.

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_{10} , regardless of the state of any other input. The precedence relationship between control inputs is indicated in the truth table.

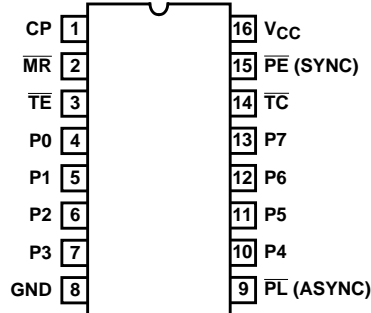
If all control inputs except \overline{TE} are high at the time of zero count, the counters will jump to the maximum count, giving a counting sequence of 100_{16} or 256_{10} clock pulses long.

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.

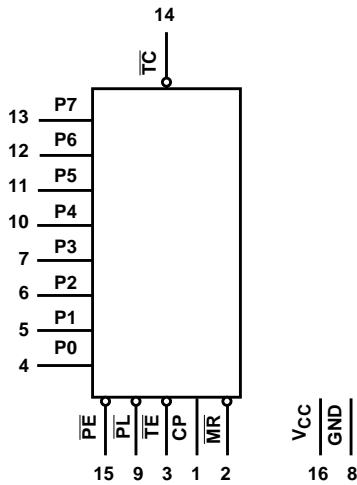
CD54HC40103, CD74HC40103, CD74HCT40103

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 |

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.

CD54HC40103, CD74HC40103, 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 1) | θ_{JA} (°C/W) |
| E (PDIP) Package | 67 |
| M (SOIC) Package | 73 |
| Maximum Junction Temperature | 150°C |
| Maximum Storage Temperature Range | -65°C to 150°C |
| Maximum Lead Temperature (Soldering 10s) | 300°C (SOIC - Lead Tips Only) |

Operating Conditions

| | |
|--|----------------|
| Temperature Range, T_A | -55°C to 125°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:

- The package thermal impedance is calculated in accordance with JESD 51-7.

DC Electrical Specifications

| PARAMETER | SYMBOL | TEST CONDITIONS | | V_{CC} (V) | 25°C | | | -40°C TO 85°C | | -55°C TO 125°C | | UNITS |
|---|----------|----------------------|------------|--------------|------|-----|-----------|---------------|---------|----------------|---------|---------|
| | | V_I (V) | I_O (mA) | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| HC TYPES | | | | | | | | | | | | |
| High Level Input Voltage | V_{IH} | - | - | 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_{IL} | - | - | 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 CMOS Loads | V_{OH} | V_{IH} or V_{IL} | -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 |
| High Level Output Voltage TTL Loads | V_{OH} | V_{IH} or V_{IL} | - | - | - | - | - | - | - | - | - | V |
| | | | -4 | 4.5 | 3.98 | - | - | 3.84 | - | 3.7 | - | V |
| | | | -5.2 | 6 | 5.48 | - | - | 5.34 | - | 5.2 | - | V |
| Low Level Output Voltage CMOS Loads | V_{OL} | V_{IH} or V_{IL} | 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 TTL Loads | V_{OL} | V_{IH} or V_{IL} | - | - | - | - | - | - | - | - | - | 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_I | V_{CC} or GND | - | 6 | - | - | ± 0.1 | - | ± 1 | - | ± 1 | μA |
| Quiescent Device Current | I_{CC} | V_{CC} or GND | 0 | 6 | - | - | 8 | - | 80 | - | 160 | μA |

CD54HC40103, CD74HC40103, CD74HCT40103

DC Electrical Specifications (Continued)

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

NOTE:

- For dual-supply systems theoretical worst case (V_I = 2.4V, V_{CC} = 5.5V) specification is 1.8mA.

HCT Input Loading Table

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

NOTE: Unit Load is ΔI_{CC} limit specified in DC Electrical Table, e.g., 360μA max at 25°C.

Prerequisite for Switching Specifications

| PARAMETER | SYMBOL | V _{CC} (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 _w | 2 | 165 | - | - | 205 | - | 250 | - | ns |
| | | 4.5 | 33 | - | - | 41 | - | 50 | - | ns |
| | | 6 | 28 | - | - | 35 | - | 43 | - | ns |
| PL Pulse Width | t _w | 2 | 125 | - | - | 155 | - | 190 | - | ns |
| | | 4.5 | 25 | - | - | 31 | - | 38 | - | ns |
| | | 6 | 21 | - | - | 26 | - | 32 | - | ns |

CD54HC40103, CD74HC40103, CD74HCT40103

Prerequisite for Switching Specifications (Continued)

| PARAMETER | SYMBOL | V _{CC} (V) | 25°C | | | -40°C TO 85°C | | -55°C TO 125°C | | UNITS |
|----------------------------|----------------------|---------------------|------|-----|-----|---------------|-----|----------------|-----|-------|
| | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| MR Pulse Width | t _W | 2 | 125 | - | - | 135 | - | 190 | - | ns |
| | | 4.5 | 25 | - | - | 31 | - | 38 | - | ns |
| | | 6 | 21 | - | - | 26 | - | 32 | - | ns |
| CP Max. Frequency (Note 3) | f _{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 _{SU} | 2 | 100 | - | - | 125 | - | 150 | - | ns |
| | | 4.5 | 20 | - | - | 25 | - | 30 | - | ns |
| | | 6 | 17 | - | - | 21 | - | 26 | - | ns |
| PE to CP Set-up Time | t _{SU} | 2 | 75 | - | - | 95 | - | 110 | - | ns |
| | | 4.5 | 15 | - | - | 19 | - | 22 | - | ns |
| | | 6 | 13 | - | - | 16 | - | 19 | - | ns |
| TE to CP Set-up Time | t _{SU} | 2 | 150 | - | - | 190 | - | 225 | - | ns |
| | | 4.5 | 30 | - | - | 38 | - | 45 | - | ns |
| | | 6 | 26 | - | - | 33 | - | 38 | - | ns |
| P to CP Hold Time | t _H | 2 | 5 | - | - | 5 | - | 5 | - | ns |
| | | 4.5 | 5 | - | - | 5 | - | 5 | - | ns |
| | | 6 | 5 | - | - | 5 | - | 5 | - | ns |
| TE to CP Hold Time | t _H | 2 | 0 | - | - | 0 | - | 0 | - | ns |
| | | 4.5 | 0 | - | - | 0 | - | 0 | - | ns |
| | | 6 | 0 | - | - | 0 | - | 0 | - | ns |
| MR to CP Removal Time | t _{REM} | 2 | 50 | - | - | 65 | - | 75 | - | ns |
| | | 4.5 | 10 | - | - | 13 | - | 15 | - | ns |
| | | 6 | 9 | - | - | 11 | - | 13 | - | ns |
| PE to CP Hold Time | t _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 |
| PL Pulse Width | t _W | 4.5 | 43 | - | - | 54 | - | 65 | - | ns |
| MR Pulse Width | t _W | 4.5 | 35 | - | - | 44 | - | 53 | - | ns |
| CP Max. Frequency (Note 3) | f _{CP(MAX)} | 4.5 | 14 | - | - | 11 | - | 9 | - | MHz |
| P to CP Set-up Time | t _{SU} | 4.5 | 24 | - | - | 30 | - | 36 | - | ns |
| PE to CP Set-up Time | t _{SU} | 4.5 | 20 | - | - | 25 | - | 30 | - | ns |
| TE to CP Set-up Time | t _{SU} | 4.5 | 40 | - | - | 50 | - | 60 | - | ns |
| P to CP Hold Time | t _H | 4.5 | 5 | - | - | 5 | - | 5 | - | ns |
| TE to CP Hold Time | t _H | 4.5 | 0 | - | - | 0 | - | 0 | - | ns |
| MR to CP Removal Time | t _{REM} | 4.5 | 10 | - | - | 13 | - | 15 | - | ns |
| PE to CP Hold Time | t _H | 4.5 | 2 | - | - | 2 | - | 2 | - | ns |

CD54HC40103, CD74HC40103, CD74HCT40103

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

| PARAMETER | SYMBOL | TEST CONDITIONS | V_{CC} (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 CP to any \overline{TC} (Async Preset) | $t_{PLH},$ t_{PHL} | $C_L = 50\text{pF}$ | 2 | - | - | 300 | - | 375 | - | 450 | ns |
| | | $C_L = 50\text{pF}$ | 4.5 | - | - | 60 | - | 75 | - | 90 | ns |
| | | $C_L = 15\text{pF}$ | 5 | - | 25 | - | - | - | - | - | ns |
| | | $C_L = 50\text{pF}$ | 6 | - | - | 51 | - | 64 | - | 77 | ns |
| CP to \overline{TC} (Sync Preset) | $t_{PLH},$ t_{PHL} | $C_L = 50\text{pF}$ | 2 | - | - | 300 | - | 375 | - | 450 | ns |
| | | $C_L = 50\text{pF}$ | 4.5 | - | - | 60 | - | 75 | - | 90 | ns |
| | | $C_L = 15\text{pF}$ | 5 | - | 25 | - | - | - | - | - | ns |
| | | $C_L = 50\text{pF}$ | 6 | - | - | 51 | - | 64 | - | 77 | ns |
| \overline{TE} to \overline{TC} | $t_{PLH},$ t_{PHL} | $C_L = 50\text{pF}$ | 2 | - | - | 200 | - | 250 | - | 300 | ns |
| | | $C_L = 50\text{pF}$ | 4.5 | - | - | 40 | - | 50 | - | 60 | ns |
| | | $C_L = 15\text{pF}$ | 5 | - | 17 | - | - | - | - | - | ns |
| | | $C_L = 50\text{pF}$ | 6 | - | - | 34 | - | 43 | - | 51 | ns |
| \overline{PL} to \overline{TC} | $t_{PLH},$ t_{PHL} | $C_L = 50\text{pF}$ | 2 | - | - | 275 | - | 345 | - | 415 | ns |
| | | $C_L = 50\text{pF}$ | 4.5 | - | - | 55 | - | 69 | - | 83 | ns |
| | | $C_L = 15\text{pF}$ | 5 | - | 23 | - | - | - | - | - | ns |
| | | $C_L = 50\text{pF}$ | 6 | - | - | 47 | - | 59 | - | 71 | ns |
| \overline{MR} to \overline{TC} | $t_{PLH},$ t_{PHL} | $C_L = 50\text{pF}$ | 2 | - | - | 275 | - | 345 | - | 415 | ns |
| | | $C_L = 50\text{pF}$ | 4.5 | - | - | 55 | - | 69 | - | 83 | ns |
| | | $C_L = 15\text{pF}$ | 5 | - | 23 | - | - | - | - | - | ns |
| | | $C_L = 50\text{pF}$ | 6 | - | - | 47 | - | 59 | - | 71 | ns |
| Output Transition Time | t_{TLH}, t_{THL} | $C_L = 50\text{pF}$ | 2 | - | - | 75 | - | 95 | - | 110 | ns |
| | | $C_L = 50\text{pF}$ | 4.5 | - | - | 15 | - | 19 | - | 22 | ns |
| | | $C_L = 50\text{pF}$ | 6 | - | - | 13 | - | 16 | - | 19 | ns |
| Input Capacitance | C_I | $C_L = 50\text{pF}$ | - | - | - | 10 | - | 10 | - | 10 | pF |
| CP Maximum Frequency | f_{MAX} | $C_L = 15\text{pF}$ | 5 | - | 25 | - | - | - | - | - | MHz |
| Power Dissipation Capacitance (Notes 4, 5) | C_{PD} | - | 5 | - | 25 | - | - | - | - | - | pF |
| HCT TYPES | | | | | | | | | | | |
| Propagation Delay CP to \overline{TC} (Async Preset) | $t_{PLH},$ t_{PHL} | $C_L = 50\text{pF}$ | 4.5 | - | - | 60 | - | 75 | - | 90 | ns |
| | | $C_L = 15\text{pF}$ | 5 | - | 25 | - | - | - | - | - | ns |
| \overline{CE} to \overline{TC} (Sync Preset) | $t_{PLH},$ t_{PHL} | $C_L = 50\text{pF}$ | 4.5 | - | - | 63 | - | 79 | - | 95 | ns |
| | | $C_L = 15\text{pF}$ | 5 | - | 26 | - | - | - | - | - | ns |
| \overline{TE} to \overline{TC} | $t_{PLH},$ t_{PHL} | $C_L = 50\text{pF}$ | 4.5 | - | - | 50 | - | 63 | - | 75 | ns |
| | | $C_L = 15\text{pF}$ | 5 | - | 21 | - | - | - | - | - | ns |
| \overline{PL} to \overline{TC} | $t_{PLH},$ t_{PHL} | $C_L = 50\text{pF}$ | 4.5 | - | - | 68 | - | 85 | - | 102 | ns |
| | | $C_L = 15\text{pF}$ | 5 | - | 28 | - | - | - | - | - | ns |

CD54HC40103, CD74HC40103, CD74HCT40103

Switching Specifications Input t_r , t_f = 6ns (Continued)

| PARAMETER | SYMBOL | TEST CONDITIONS | V_{CC} (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 (Notes 4, 5) | C_{PD} | - | 5 | - | 27 | - | - | - | - | - | pF |

NOTES:

- 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:

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

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

Timing Diagrams

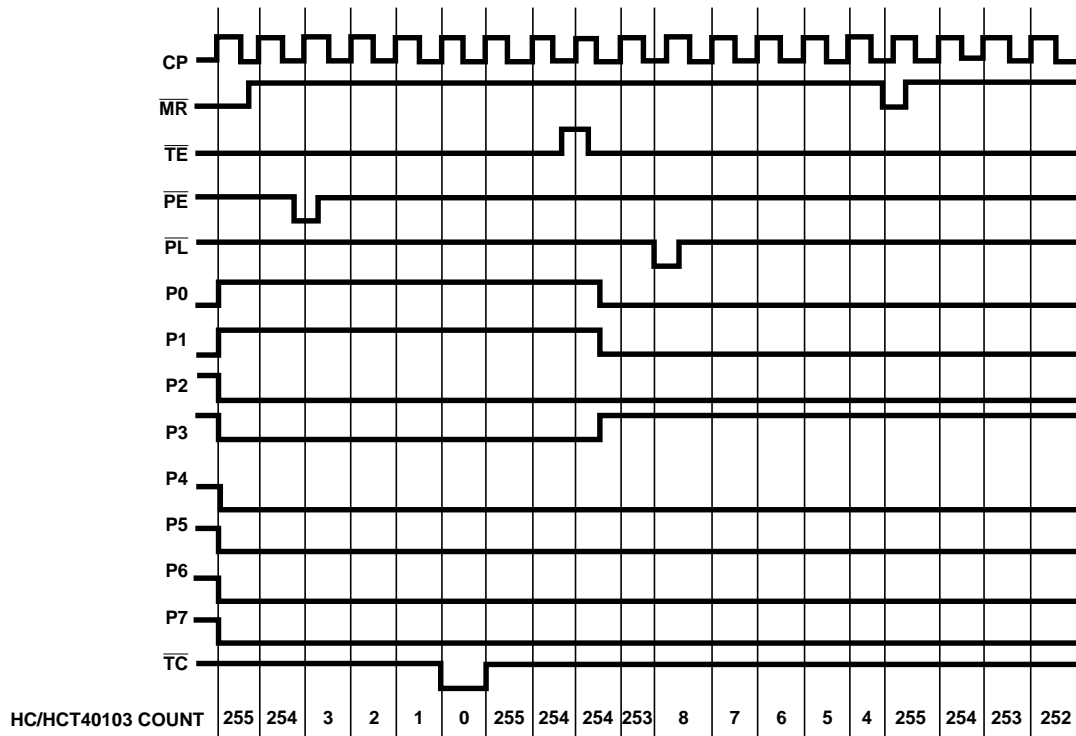


FIGURE 1.

Test Circuits and Waveforms

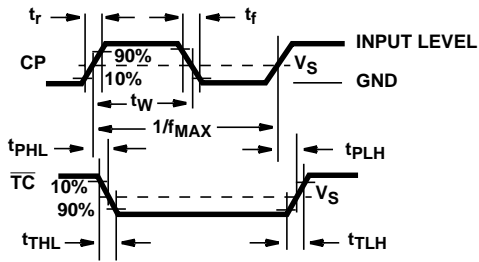


FIGURE 2.

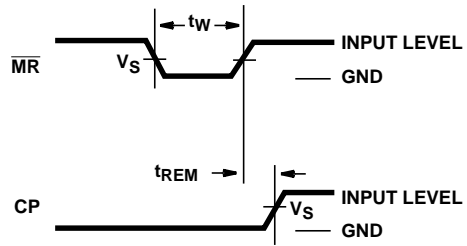


FIGURE 3.

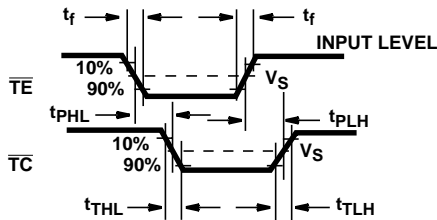


FIGURE 4.

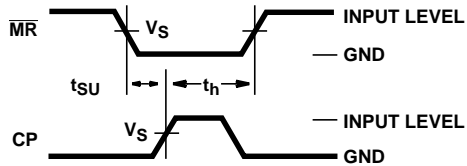


FIGURE 5.

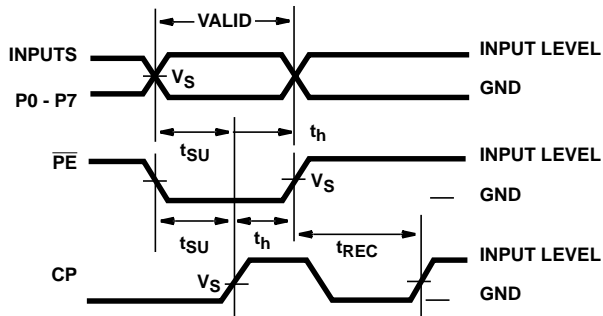


FIGURE 6.

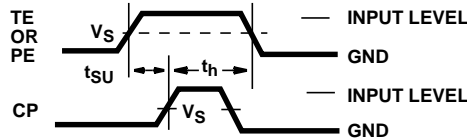
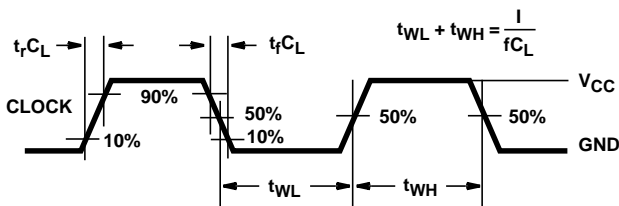
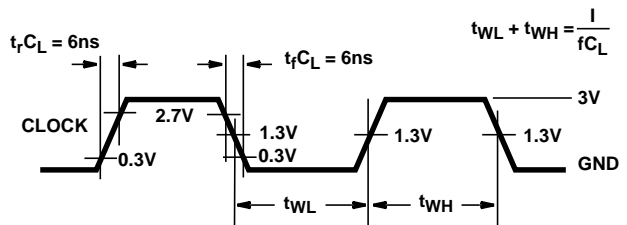


FIGURE 7.



NOTE: Outputs should be switching from 10% VCC to 90% VCC in accordance with device truth table. For fMAX, input duty cycle = 50%.

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



NOTE: Outputs should be switching from 10% VCC to 90% VCC in accordance with device truth table. For fMAX, input duty cycle = 50%.

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

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/ Ball Finish | MSL Peak Temp ⁽³⁾ | Samples (Requires Login) |
|-------------------|-----------------------|--------------|-----------------|------|-------------|----------------------------|----------------------|------------------------------|-----------------------------|
| 5962-9055301EA | ACTIVE | CDIP | J | 16 | 1 | TBD | Call TI | Call TI | |
| 5HC40103F3AS228 | OBSOLETE | CDIP | J | 16 | | TBD | Call TI | Call TI | |
| CD54HC40103F | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type | |
| CD54HC40103F3A | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type | |
| CD74HC40103E | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| CD74HC40103EE4 | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| CD74HC40103M | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HC40103M96 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HC40103M96E4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HC40103M96G4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HC40103ME4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HC40103MG4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HC40103MT | ACTIVE | SOIC | D | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HC40103MTE4 | ACTIVE | SOIC | D | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HC40103MTG4 | ACTIVE | SOIC | D | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HCT40103E | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| CD74HCT40103EE4 | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | |
| CD74HCT40103M | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HCT40103M96 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HCT40103M96E4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/ Ball Finish | MSL Peak Temp ⁽³⁾ | Samples (Requires Login) |
|-------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|----------------------|------------------------------|-----------------------------|
| CD74HCT40103M96G4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HCT40103ME4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HCT40103MG4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HCT40103MT | ACTIVE | SOIC | D | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HCT40103MTE4 | ACTIVE | SOIC | D | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HCT40103MTG4 | ACTIVE | SOIC | D | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF CD54HC40103, CD74HC40103 :

- Catalog: [CD74HC40103](#)
- Automotive: [CD74HC40103-Q1](#), [CD74HC40103-Q1](#)
- Enhanced Product: [CD74HC40103-EP](#), [CD74HC40103-EP](#)
- Military: [CD54HC40103](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Enhanced Product - Supports Defense, Aerospace and Medical Applications
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CD74HC40103M96 | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| CD74HCT40103M96 | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CD74HC40103M96 | SOIC | D | 16 | 2500 | 333.2 | 345.9 | 28.6 |
| CD74HCT40103M96 | SOIC | D | 16 | 2500 | 333.2 | 345.9 | 28.6 |

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---------------|------------------------|------------------------|------------------------|------------------------|
| A | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC |
| B MAX | 0.785 (19,94) | .840 (21,34) | 0.960 (24,38) | 1.060 (26,92) |
| B MIN | — | — | — | — |
| C MAX | 0.300 (7,62) | 0.300 (7,62) | 0.310 (7,87) | 0.300 (7,62) |
| C MIN | 0.245 (6,22) | 0.245 (6,22) | 0.220 (5,59) | 0.245 (6,22) |



4040083/F 03/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package is hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - $\triangle D$ The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4040047-6/M 06/11

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 -  C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 -  D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AC.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46C and to discontinue any product or service per JESD48B. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

Products

| | |
|------------------------|--|
| Audio | www.ti.com/audio |
| Amplifiers | amplifier.ti.com |
| Data Converters | dataconverter.ti.com |
| DLP® Products | www.dlp.com |
| DSP | dsp.ti.com |
| Clocks and Timers | www.ti.com/clocks |
| Interface | interface.ti.com |
| Logic | logic.ti.com |
| Power Mgmt | power.ti.com |
| Microcontrollers | microcontroller.ti.com |
| RFID | www.ti-rfid.com |
| OMAP Mobile Processors | www.ti.com/omap |
| Wireless Connectivity | www.ti.com/wirelessconnectivity |

Applications

| | |
|-------------------------------|--|
| Automotive and Transportation | www.ti.com/automotive |
| Communications and Telecom | www.ti.com/communications |
| Computers and Peripherals | www.ti.com/computers |
| Consumer Electronics | www.ti.com/consumer-apps |
| Energy and Lighting | www.ti.com/energy |
| Industrial | www.ti.com/industrial |
| Medical | www.ti.com/medical |
| Security | www.ti.com/security |
| Space, Avionics and Defense | www.ti.com/space-avionics-defense |
| Video and Imaging | www.ti.com/video |

TI E2E Community e2e.ti.com