

## High-Speed CMOS Logic Octal Three-State Bus Transceiver, Inverting

### Features

- Buffered Inputs
- Three-State Outputs
- Applications in Multiple-Data-Bus Architecture
- 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  $V_{OL}$ ,  $V_{OH}$

### Description

The 'HC640 and 'HCT640 silicon-gate CMOS three-state bidirectional inverting and non-inverting buffers are intended for two-way asynchronous communication between data buses. They have high drive current outputs which enable high-speed operation when driving large bus capacitances. These circuits possess the low power dissipation of CMOS circuits, and have speeds comparable to low power Schottky TTL circuits. They can drive 15 LSTTL loads. The 'HC640 and 'HCT640 are inverting buffers.

The direction of data flow (A to B, B to A) is controlled by the DIR input.

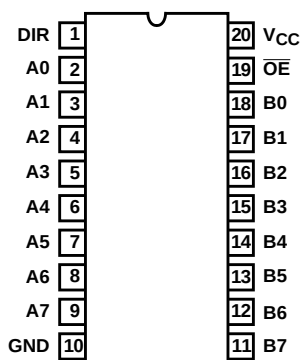
Outputs are enabled by a low on the Output Enable input ( $\overline{OE}$ ); a high  $\overline{OE}$  puts these devices in the high impedance mode.

### Ordering Information

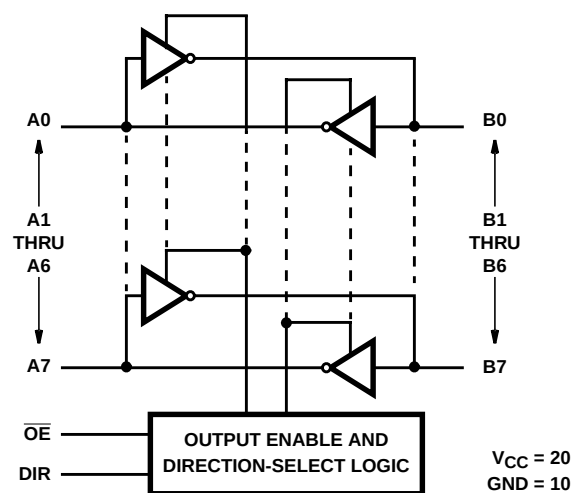
| PART NUMBER   | TEMP. RANGE (°C) | PACKAGE      |
|---------------|------------------|--------------|
| CD54HC640F3A  | -55 to 125       | 20 Ld CERDIP |
| CD54HCT640F3A | -55 to 125       | 20 Ld CERDIP |
| CD74HC640E    | -55 to 125       | 20 Ld PDIP   |
| CD74HC640M    | -55 to 125       | 20 Ld SOIC   |
| CD74HCT640E   | -55 to 125       | 20 Ld PDIP   |
| CD74HCT640M   | -55 to 125       | 20 Ld SOIC   |

### Pinout

CD54HC640, CD54HCT640  
(CERDIP)  
CD74HC640, CD74HCT640  
(PDIP, SOIC)  
TOP VIEW



## Functional Diagram



TRUTH TABLE

| CONTROL INPUTS  |     | DATA PORT STATUS |                |
|-----------------|-----|------------------|----------------|
| $\overline{OE}$ | DIR | $A_n$            | $B_n$          |
| L               | L   | $\overline{O}$   | I              |
| H               | H   | Z                | Z              |
| H               | L   | Z                | Z              |
| L               | H   | I                | $\overline{O}$ |

To prevent excess currents in the High-Z modes all I/O terminals should be terminated with 1k $\Omega$  to 1M $\Omega$  resistors.

H = High Level

L = Low Level

I = Input

$\overline{O}$  = Output (Inversion of Input Level)

Z = High Impedance

# CD54HC640, CD74HC640, CD54HCT640, CD74HCT640

## 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 Drain Current, per Output,  $I_O$   
 For  $-0.5V < V_O < V_{CC} + 0.5V$  .....  $\pm 35mA$   
 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)  $\theta_{JA}$  ( $^{\circ}C/W$ )  
 E (PDIP) Package ..... 69  
 M (SOIC) Package ..... 58  
 Maximum Junction Temperature .....  $150^{\circ}C$   
 Maximum Storage Temperature Range .....  $-65^{\circ}C$  to  $150^{\circ}C$   
 Maximum Lead Temperature (Soldering 10s) .....  $300^{\circ}C$   
 (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:

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

## 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    |       |   |
| -6                                      |                 |                                    | 4.5                 | 3.98                               | -    | -   | 3.84 | -             | 3.7  | -              | V    |       |   |
| -7.8                                    |                 |                                    | 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> | -                   | -                                  | -    | -   | -    | -             | -    | -              | -    | V     |   |
|                                         |                 |                                    | -6                  | 4.5                                | 3.98 | -   | -    | 3.84          | -    | 3.7            | -    | V     |   |
|                                         |                 |                                    | -7.8                | 6                                  | 5.48 | -   | -    | 5.34          | -    | 5.2            | -    | V     |   |
| 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>CMOS Loads  | V <sub>OL</sub> | V <sub>IH</sub> or V <sub>IL</sub> | -                   | -                                  | -    | -   | -    | -             | -    | -              | -    | V     |   |
|                                         |                 |                                    | 6                   | 4.5                                | -    | -   | 0.26 | -             | 0.33 | -              | 0.4  | V     |   |
|                                         |                 |                                    | 7.8                 | 6                                  | -    | -   | 0.26 | -             | 0.33 | -              | 0.4  | V     |   |
| Low Level Output Voltage<br>TTL Loads   |                 |                                    | V <sub>OL</sub>     | V <sub>IH</sub> or V <sub>IL</sub> | -    | -   | -    | -             | -    | -              | -    | -     | V |
| 6                                       |                 |                                    |                     |                                    | 4.5  | -   | -    | 0.26          | -    | 0.33           | -    | 0.4   | V |
| 7.8                                     |                 |                                    |                     |                                    | 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    |   |

**CD54HC640, CD74HC640, CD54HCT640, CD74HCT640**

**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 |       |
| Quiescent Device Current                                       | I <sub>CC</sub>           | V <sub>CC</sub> or GND             | 0                                       | 6                   | -    | -   | 8    | -             | 80   | -              | 160 | μA    |
| Three-State Leakage Current                                    | I <sub>OZ</sub>           | V <sub>IL</sub> or V <sub>IH</sub> | V <sub>O</sub> = V <sub>CC</sub> or GND | 6                   | -    | -   | ±0.5 | -             | ±5   | -              | ±10 | μA    |
| <b>HCT TYPES</b>                                               |                           |                                    |                                         |                     |      |     |      |               |      |                |     |       |
| 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                         |                           |                                    | -6                                      | 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                          |                           |                                    | 6                                       | 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    |
| Three-State Leakage Current                                    | I <sub>OZ</sub>           | V <sub>IL</sub> or V <sub>IH</sub> | V <sub>O</sub> = V <sub>CC</sub> or GND | 5.5                 | -    | -   | ±0.5 | -             | ±5   | -              | ±10 | μA    |
| Additional Quiescent Device Current Per Input Pin: 1 Unit Load | ΔI <sub>CC</sub> (Note 2) | 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 |
|---------------------|------------|
| DIR                 | 0.9        |
| $\overline{OE}$ , A | 1.5        |
| B                   | 1.5        |

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

# CD54HC640, CD74HC640, CD54HCT640, CD74HCT640

## Switching Specifications $C_L = 50\text{pF}$ , 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>A to $\overline{B}$<br>B to $\overline{A}$ | $t_{PHL}, t_{PLH}$ | C <sub>L</sub> = 50pF | 2                   | -    | -   | 90  | -             | 115 | -              | 135 | ns    |
|                                                                 |                    |                       | 4.5                 | -    | -   | 18  | -             | 23  | -              | 27  | ns    |
|                                                                 |                    | C <sub>L</sub> = 15pF | 5                   | -    | 7   | -   | -             | -   | -              | -   | ns    |
|                                                                 |                    | C <sub>L</sub> = 50pF | 6                   | -    | -   | 15  | -             | 20  | -              | 23  | ns    |
| Output High-Z<br>To High Level,<br>To Low Level                 | $t_{PHL}, t_{PLH}$ | C <sub>L</sub> = 50pF | 2                   | -    | -   | 150 | -             | 190 | -              | 225 | ns    |
|                                                                 |                    |                       | 4.5                 | -    | -   | 30  | -             | 38  | -              | 45  | ns    |
|                                                                 |                    | C <sub>L</sub> = 15pF | 5                   | -    | 12  | -   | -             | -   | -              | -   | ns    |
|                                                                 |                    | C <sub>L</sub> = 50pF | 6                   | -    | -   | 26  | -             | 33  | -              | 38  | ns    |
| Output High Level<br>Output Low Level to High Z                 | $t_{PHZ}, t_{PLZ}$ | C <sub>L</sub> = 50pF | 2                   | -    | -   | 150 | -             | 190 | -              | 225 | ns    |
|                                                                 |                    |                       | 4.5                 | -    | -   | 30  | -             | 38  | -              | 45  | ns    |
|                                                                 |                    | C <sub>L</sub> = 15pF | 5                   | -    | 12  | -   | -             | -   | -              | -   | ns    |
|                                                                 |                    | C <sub>L</sub> = 50pF | 6                   | -    | -   | 26  | -             | 33  | -              | 38  | ns    |
| Output Transition Time                                          | $t_{THL}, t_{TLH}$ | C <sub>L</sub> = 50pF | 2                   | -    | -   | 60  | -             | 75  | -              | 90  | ns    |
|                                                                 |                    |                       | 4.5                 | -    | -   | 12  | -             | 15  | -              | 18  | ns    |
|                                                                 |                    |                       | 6                   | -    | -   | 10  | -             | 13  | -              | 15  | ns    |
| Input Capacitance                                               | C <sub>IN</sub>    | C <sub>L</sub> = 50pF | -                   | 10   | -   | 10  | -             | 10  | -              | 10  | pF    |
| Three-State Output Capacitance                                  | C <sub>O</sub>     | -                     | -                   | -    | -   | 20  | -             | 20  | -              | 20  | pF    |
| Power Dissipation Capacitance<br>(Notes 3, 4)                   | C <sub>PD</sub>    | -                     | 5                   | -    | 38  | -   | -             | -   | -              | -   | pF    |
| HCT TYPES                                                       |                    |                       |                     |      |     |     |               |     |                |     |       |
| Propagation Delay<br>A to $\overline{B}$<br>B to $\overline{A}$ | $t_{PHL}, t_{PLH}$ | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 22  | -             | 28  | -              | 33  | ns    |
|                                                                 |                    | C <sub>L</sub> = 15pF | 5                   | -    | 9   | -   | -             | -   | -              | -   | ns    |
| Output High-Z<br>To High Level,<br>To Low Level                 | $t_{PHL}, t_{PLH}$ | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 30  | -             | 38  | -              | 45  | ns    |
|                                                                 |                    | C <sub>L</sub> = 15pF | 5                   | -    | 12  | -   | -             | -   | -              | -   | ns    |
| Output High Level<br>Output Low Level to High Z                 | $t_{PHZ}, t_{PLZ}$ | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 30  | -             | 38  | -              | 45  | ns    |
|                                                                 |                    | C <sub>L</sub> = 15pF | 5                   | -    | 12  | -   | -             | -   | -              | -   | ns    |
| Output Transition Time                                          | $t_{THL}, t_{TLH}$ | C <sub>L</sub> = 50pF | 4.5                 | -    | -   | 12  | -             | 15  | -              | 18  | ns    |
| Input Capacitance                                               | C <sub>IN</sub>    | C <sub>L</sub> = 50pF | -                   | 10   | -   | 10  | -             | 10  | -              | 10  | pF    |
| Three-State Output Capacitance                                  | C <sub>O</sub>     | -                     | -                   | -    | -   | 20  | -             | 20  | -              | 20  | pF    |
| Power Dissipation Capacitance<br>(Notes 3, 4)                   | C <sub>PD</sub>    | -                     | 5                   | -    | 41  | -   | -             | -   | -              | -   | pF    |

### NOTES:

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

## Test Circuits and Waveforms

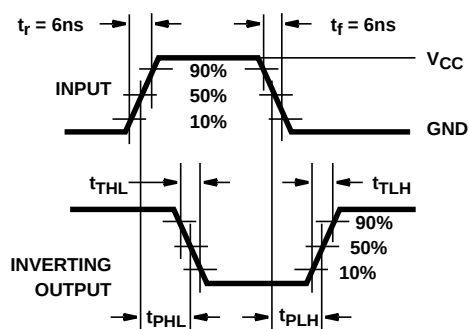


FIGURE 7. HC TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

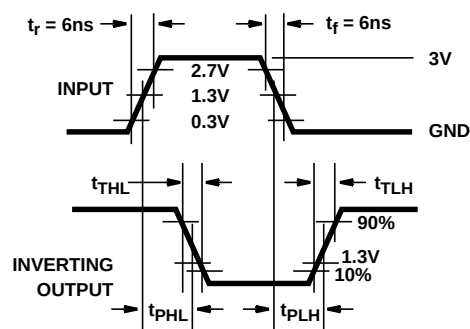


FIGURE 8. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

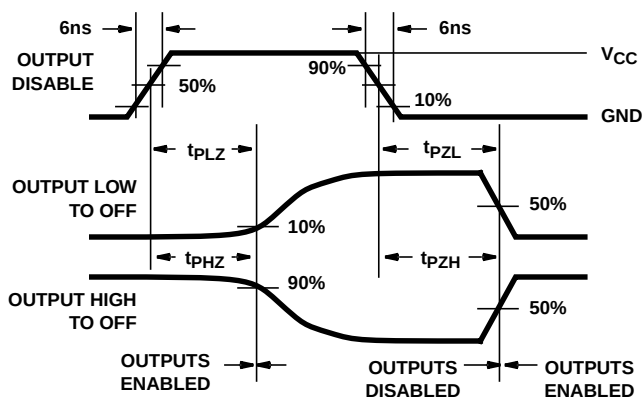


FIGURE 9. HC THREE-STATE PROPAGATION DELAY WAVEFORM

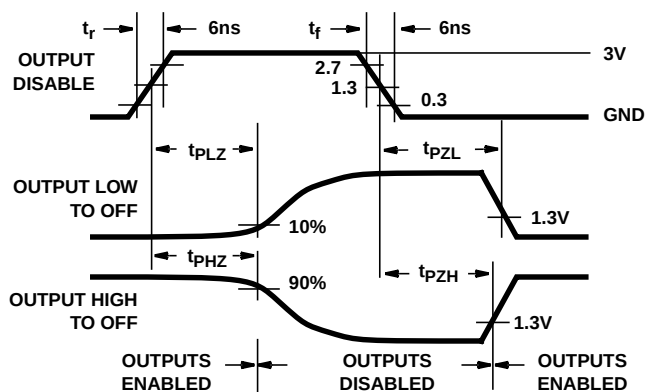
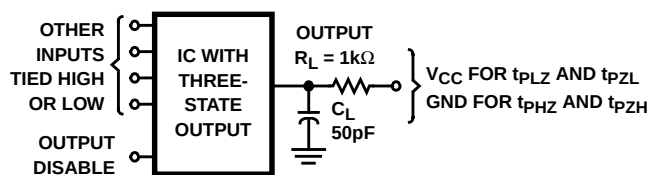


FIGURE 10. HCT THREE-STATE PROPAGATION DELAY WAVEFORM



NOTE: Open drain waveforms  $t_{PLZ}$  and  $t_{PZL}$  are the same as those for three-state shown on the left. The test circuit is Output  $R_L = 1k\Omega$  to  $V_{CC}$ ,  $C_L = 50pF$ .

FIGURE 11. HC AND HCT THREE-STATE PROPAGATION DELAY TEST CIRCUIT

**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup>    | Lead/<br>Ball Finish | MSL Peak Temp <sup>(3)</sup> | Samples<br>(Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|----------------------------|----------------------|------------------------------|-----------------------------|
| 5962-8974001RA   | ACTIVE                | CDIP         | J               | 20   | 1           | TBD                        | Call TI              | Call TI                      |                             |
| CD54HC640F3A     | ACTIVE                | CDIP         | J               | 20   | 1           | TBD                        | A42                  | N / A for Pkg Type           |                             |
| CD54HCT640F3A    | ACTIVE                | CDIP         | J               | 20   | 1           | TBD                        | A42                  | N / A for Pkg Type           |                             |
| CD74HC640E       | ACTIVE                | PDIP         | N               | 20   | 20          | Pb-Free (RoHS)             | CU NIPDAU            | N / A for Pkg Type           |                             |
| CD74HC640EE4     | ACTIVE                | PDIP         | N               | 20   | 20          | Pb-Free (RoHS)             | CU NIPDAU            | N / A for Pkg Type           |                             |
| CD74HC640M       | ACTIVE                | SOIC         | DW              | 20   | 25          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| CD74HC640ME4     | ACTIVE                | SOIC         | DW              | 20   | 25          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| CD74HC640MG4     | ACTIVE                | SOIC         | DW              | 20   | 25          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| CD74HCT640E      | ACTIVE                | PDIP         | N               | 20   | 20          | Pb-Free (RoHS)             | CU NIPDAU            | N / A for Pkg Type           |                             |
| CD74HCT640EE4    | ACTIVE                | PDIP         | N               | 20   | 20          | Pb-Free (RoHS)             | CU NIPDAU            | N / A for Pkg Type           |                             |
| CD74HCT640M      | ACTIVE                | SOIC         | DW              | 20   | 25          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| CD74HCT640ME4    | ACTIVE                | SOIC         | DW              | 20   | 25          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| CD74HCT640MG4    | ACTIVE                | SOIC         | DW              | 20   | 25          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |

<sup>(1)</sup> 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.

<sup>(2)</sup> 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.

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**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)

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

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**OTHER QUALIFIED VERSIONS OF CD54HC640, CD54HCT640, CD74HC640, CD74HCT640 :**

- Catalog: [CD74HC640](#), [CD74HCT640](#)
- Military: [CD54HC640](#), [CD54HCT640](#)

NOTE: Qualified Version Definitions:

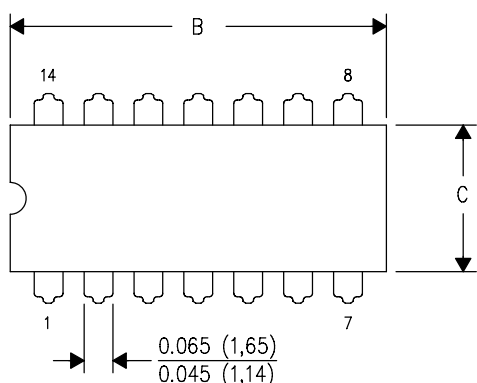
- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications



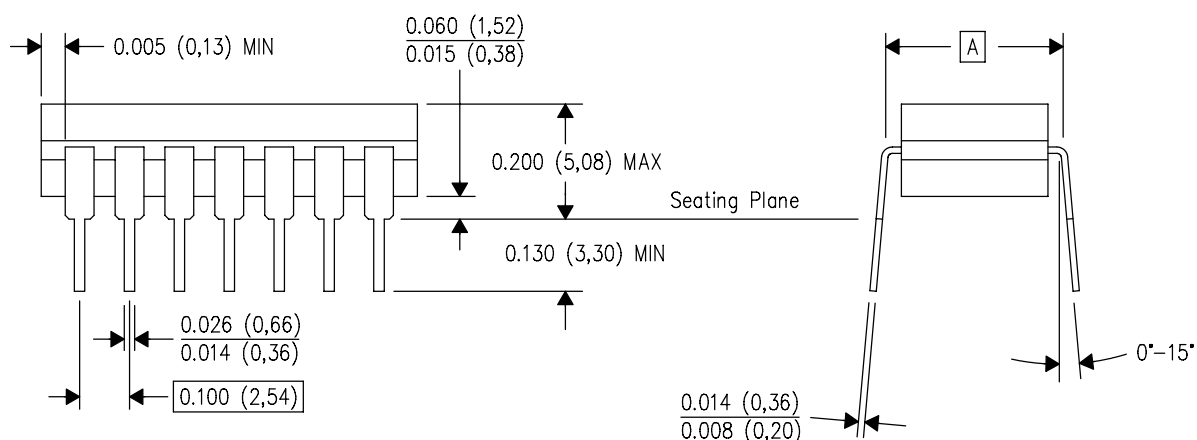
J (R-GDIP-T\*\*)

14 LEADS SHOWN

# CERAMIC DUAL IN-LINE PACKAGE



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



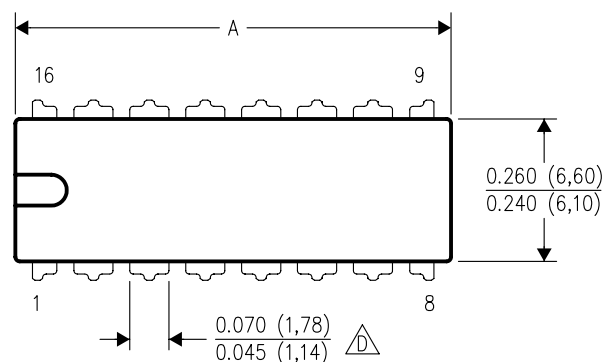
4040083/F 03/03

- 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.

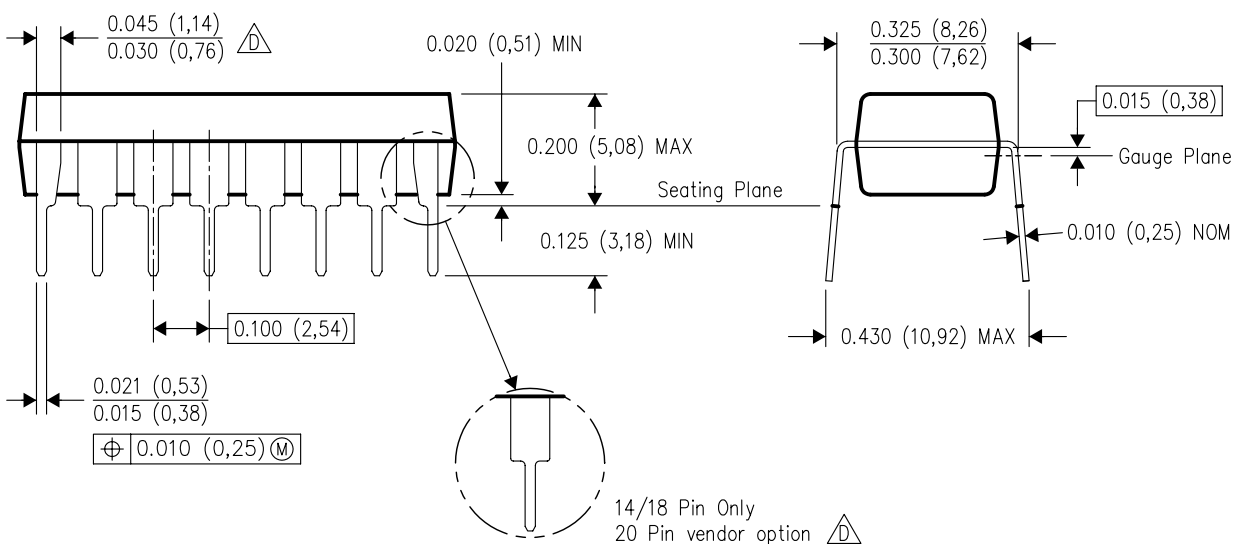
N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



| PINS **<br>DIM      | 14               | 16               | 18               | 20               |
|---------------------|------------------|------------------|------------------|------------------|
| A MAX               | 0.775<br>(19,69) | 0.775<br>(19,69) | 0.920<br>(23,37) | 1.060<br>(26,92) |
| A MIN               | 0.745<br>(18,92) | 0.745<br>(18,92) | 0.850<br>(21,59) | 0.940<br>(23,88) |
| MS-001<br>VARIATION | AA               | BB               | AC               | AD               |

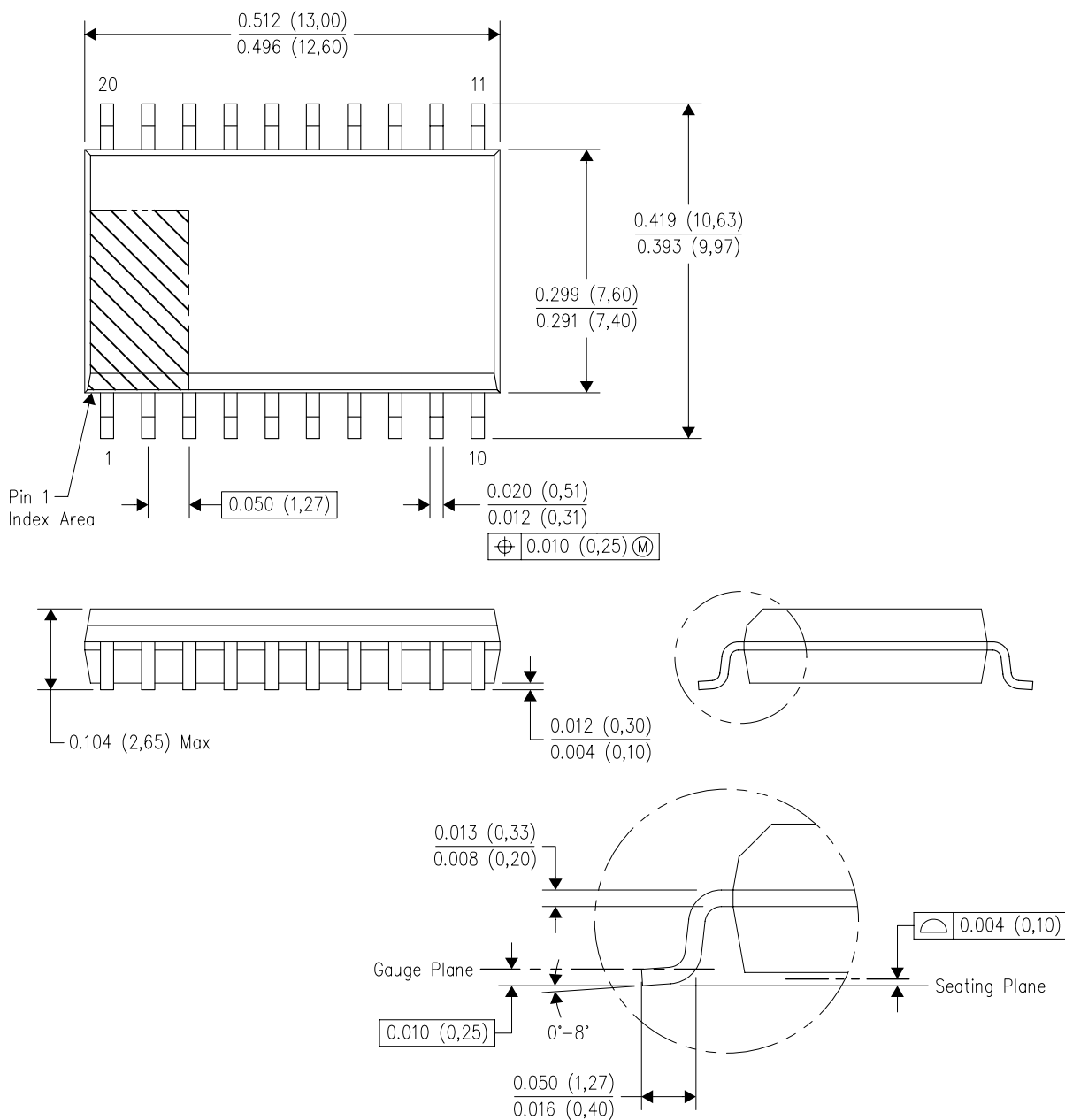


4040049/E 12/2002

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

DW (R-PDSO-G20)

## PLASTIC SMALL OUTLINE

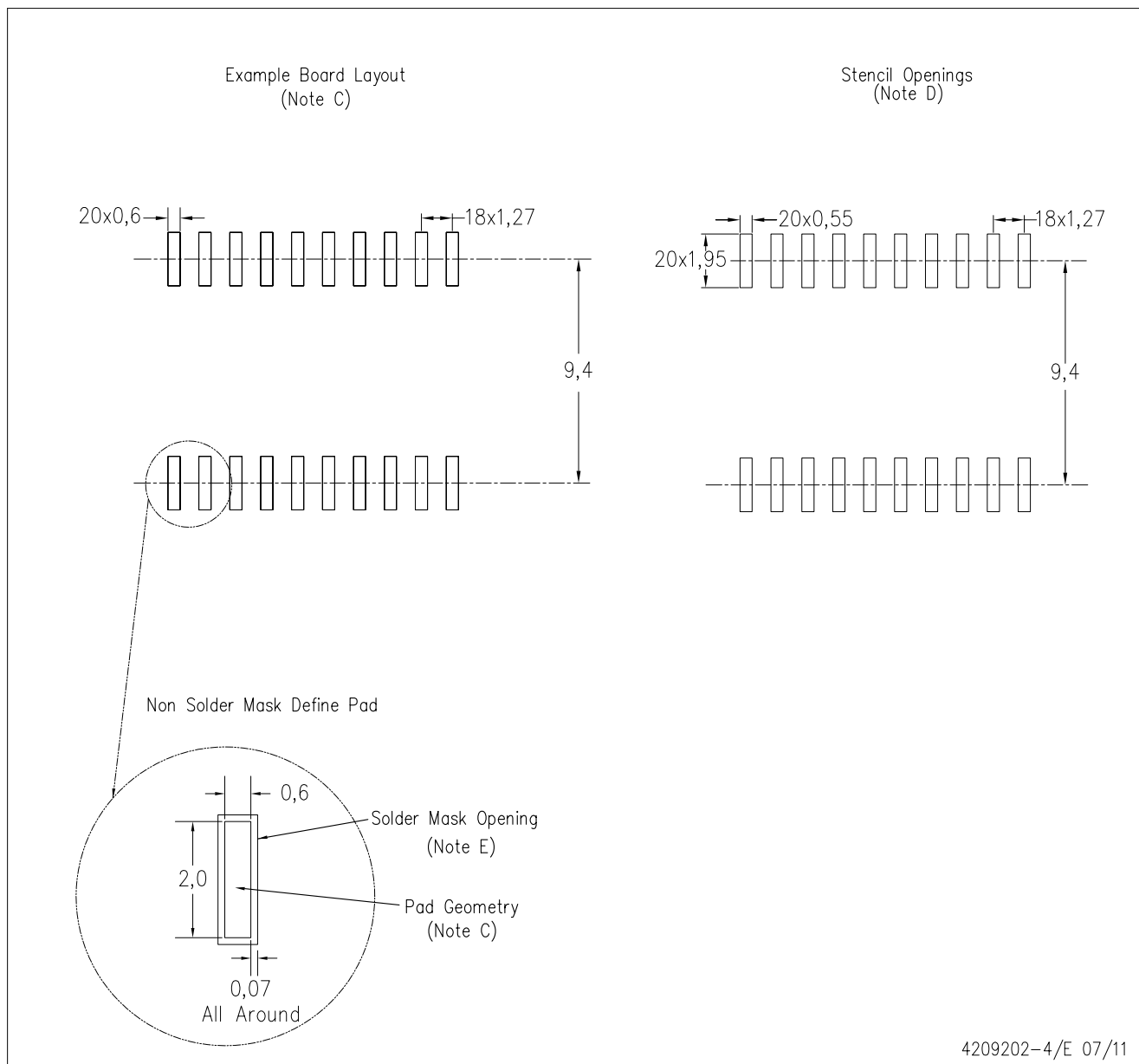


4040000-4/G 01/11

- NOTES: A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.  
B. This drawing is subject to change without notice.  
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).  
D. Falls within JEDEC MS-013 variation AC.

DW (R-PDSO-G20)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Refer to IPC7351 for alternate board design.
  - D. 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
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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