

# CD54HC245, CD74HC245, CD54HCT245, CD74HCT245

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

### Features

- Buffered Inputs
- Three-State Outputs
- Bus Line Driving Capability
- Typical Propagation Delay (A to B, B to A) 9ns at  $V_{CC} = 5V$ ,  $C_L = 15pF$ ,  $T_A = 25^\circ C$
- Fanout (Over Temperature Range)
  - Standard Outputs . . . . . 10 LSTTL Loads
  - Bus Driver Outputs . . . . . 15 LSTTL Loads
- Wide Operating Temperature Range . . .  $-55^\circ C$  to  $125^\circ C$
- 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 CD54HC245, CD54HCT245, and CD74HC245, CD74HCT245 are high-speed octal three-state bidirectional transceivers intended for two-way asynchronous communication between data buses. They have high drive current outputs which enable high-speed operation while driving large bus capacitances. They provide the low power consumption of standard CMOS circuits with speeds and drive capabilities comparable to that of LSTTL circuits.

The CD54HC245, CD54HCT245, CD74HC245 and CD74HCT245 allow data transmission of the B bus or from the B bus to the A bus. The logic level at the direction input (DIR) determines the direction. The output enable input ( $\overline{OE}$ ), when high, puts the I/O ports in the high-impedance state.

The HC/HCT245 is similar in operation to the HC/HCT640 and the HC/HCT643.

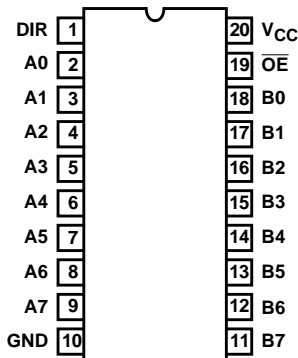
### Ordering Information

| PART NUMBER   | TEMP. RANGE ( $^\circ C$ ) | PACKAGE      |
|---------------|----------------------------|--------------|
| CD54HC245F3A  | -55 to 125                 | 20 Ld CERDIP |
| CD54HCT245F3A | -55 to 125                 | 20 Ld CERDIP |
| CD74HC245E    | -55 to 125                 | 20 Ld PDIP   |
| CD74HC245M    | -55 to 125                 | 20 Ld SOIC   |
| CD74HC245M96  | -55 to 125                 | 20 Ld SOIC   |
| CD74HCT245E   | -55 to 125                 | 20 Ld PDIP   |
| CD74HCT245M   | -55 to 125                 | 20 Ld SOIC   |
| CD74HCT245M96 | -55 to 125                 | 20 Ld SOIC   |

NOTE: When ordering, use the entire part number. The suffix 96 denotes tape and reel.

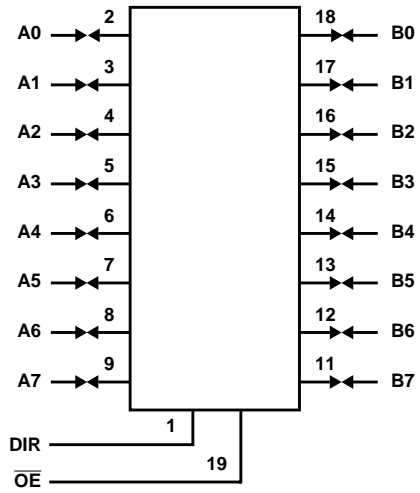
### Pinout

CD54HC245, CD54HCT245  
(CERDIP)  
CD74HC245, CD74HCT245  
(PDIP, SOIC)  
TOP VIEW



**CD54HC245, CD74HC245, CD54HCT245, CD74HCT245**

**Functional Diagram**



**TRUTH TABLE**

| CONTROL INPUTS |     | OPERATION       |
|----------------|-----|-----------------|
| OE             | DIR |                 |
| L              | L   | B Data to A Bus |
| L              | H   | A Data to B Bus |
| H              | X   | Isolation       |

H = High Level, L = Low Level, X = Irrelevant

To prevent excess currents in the High-Z (Isolation) modes all I/O terminals should be terminated with 10kΩ to 1MΩ resistors.

## CD54HC245, CD74HC245, CD54HCT245, CD74HCT245

### 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.

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

### DC Electrical Specifications

| PARAMETER                               | SYMBOL   | TEST CONDITIONS      |            | $V_{CC}$ (V) | 25 $^{\circ}C$ |      |      | -40 $^{\circ}C$ TO 85 $^{\circ}C$ |      | -55 $^{\circ}C$ TO 125 $^{\circ}C$ |      | UNITS       |   |
|---|----------|----------------------|------------|--------------|----------------|------|------|-----------------------------------|------|------------------------------------|------|-------------|---|
|   |          | $V_I$ (V)            | $I_O$ (mA) |              | MIN            | TYP  | MAX  | MIN                               | MAX  | MIN                                | MAX  |             |   |
| <b>HC TYPES</b>                         |          |                      |            |              |                |      |      |                                   |      |                                    |      |             |   |
| 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<br>CMOS Loads | $V_{OH}$ | $V_{IH}$ or $V_{IL}$ | -0.02      | -0.02        | 2              | 1.9  | -    | -                                 | 1.9  | -                                  | 1.9  | -           | V |
|   |          |                      | -0.02      | -0.02        | 4.5            | 4.4  | -    | -                                 | 4.4  | -                                  | 4.4  | -           | V |
|   |          |                      | -0.02      | -0.02        | 6              | 5.9  | -    | -                                 | 5.9  | -                                  | 5.9  | -           | V |
| High Level Output Voltage<br>TTL Loads  | $V_{OH}$ | $V_{IH}$ or $V_{IL}$ | -          | -            | -              | -    | -    | -                                 | -    | -                                  | -    | V           |   |
|   |          |                      | -4         | -4           | 4.5            | 3.98 | -    | -                                 | 3.84 | -                                  | 3.7  | -           | V |
|   |          |                      | -5.2       | -5.2         | 6              | 5.48 | -    | -                                 | 5.34 | -                                  | 5.2  | -           | V |
| Low Level Output Voltage<br>CMOS Loads  | $V_{OL}$ | $V_{IH}$ or $V_{IL}$ | 0.02       | 0.02         | 2              | -    | -    | 0.1                               | -    | 0.1                                | -    | 0.1         | V |
|   |          |                      | 0.02       | 0.02         | 4.5            | -    | -    | 0.1                               | -    | 0.1                                | -    | 0.1         | V |
|   |          |                      | 0.02       | 0.02         | 6              | -    | -    | 0.1                               | -    | 0.1                                | -    | 0.1         | V |
| Low Level Output Voltage<br>TTL Loads   | $V_{OL}$ | $V_{IH}$ or $V_{IL}$ | -          | -            | -              | -    | -    | -                                 | -    | -                                  | -    | V           |   |
|   |          |                      | 4          | 4            | 4.5            | -    | -    | 0.26                              | -    | 0.33                               | -    | 0.4         | V |
|   |          |                      | 5.2        | 5.2          | 6              | -    | -    | 0.26                              | -    | 0.33                               | -    | 0.4         | V |
| Input Leakage Current                   | $I_I$    | $V_{CC}$ or GND      | -          | -            | 6              | -    | -    | $\pm 0.1$                         | -    | $\pm 1$                            | -    | $\mu A$     |   |
| Quiescent Device Current                | $I_{CC}$ | $V_{CC}$ or GND      | 0          | 0            | 6              | -    | -    | 8                                 | -    | 80                                 | -    | 160 $\mu A$ |   |

**CD54HC245, CD74HC245, CD54HCT245, CD74HCT245**

**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 |       |
| 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                         |                           |                                    | -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    |
| 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    |
| 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:

2. 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 |
|----------|------------|
| An or Bn | 0.4        |
| OE       | 1.5        |
| DIR      | 0.9        |

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

**CD54HC245, CD74HC245, CD54HCT245, CD74HCT245**

**Switching Specifications**  $C_L = 50\text{pF}$ , 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 |       |
| <b>HC TYPES</b>                            |                    |                     |              |      |     |     |               |     |                |     |       |
| Propagation Delay<br>Data to Output        | $t_{PHL}, t_{PLH}$ | $C_L = 50\text{pF}$ | 2            | -    | -   | 110 | -             | 140 | -              | 165 | ns    |
|  |                    |                     | 4.5          | -    | -   | 22  | -             | 28  | -              | 33  | ns    |
|  |                    | $C_L = 15\text{pF}$ | 5            | -    | 9   | -   | -             | -   | -              | -   | ns    |
|  |                    | $C_L = 50\text{pF}$ | 6            | -    | -   | 19  | -             | 24  | -              | 28  | ns    |
| Output Disable to Output                   | $t_{PHL}, t_{PLH}$ | $C_L = 50\text{pF}$ | 2            | -    | -   | 150 | -             | 190 | -              | 225 | ns    |
|  |                    |                     | 4.5          | -    | -   | 30  | -             | 38  | -              | 45  | ns    |
|  |                    | $C_L = 15\text{pF}$ | 5            | -    | 12  | -   | -             | -   | -              | -   | ns    |
|  |                    | $C_L = 50\text{pF}$ | 6            | -    | -   | 26  | -             | 33  | -              | 38  | ns    |
| Output Enable to Output                    | $t_{PHL}, t_{PLH}$ | $C_L = 50\text{pF}$ | 2            | -    | -   | 150 | -             | 190 | -              | 225 | ns    |
|  |                    |                     | 4.5          | -    | -   | 30  | -             | 38  | -              | 45  | ns    |
|  |                    | $C_L = 15\text{pF}$ | 5            | -    | 12  | -   | -             | -   | -              | -   | ns    |
|  |                    | $C_L = 50\text{pF}$ | 6            | -    | -   | 26  | -             | 33  | -              | 38  | ns    |
| Output Transition Time                     | $t_{THL}, t_{TLH}$ | $C_L = 50\text{pF}$ | 2            | -    | -   | 60  | -             | 75  | -              | 90  | ns    |
|  |                    |                     | 4.5          | -    | -   | 12  | -             | 15  | -              | 18  | ns    |
|  |                    |                     | 6            | -    | -   | 10  | -             | 13  | -              | 15  | ns    |
| Input Capacitance                          | $C_{IN}$           | $C_L = 50\text{pF}$ | -            | 10   | -   | 10  | -             | 10  | -              | 10  | pF    |
| Three-State Output Capacitance             | $C_O$              | -                   | -            | -    | 20  | -   | 20            | -   | 20             | -   | pF    |
| Power Dissipation Capacitance (Notes 3, 4) | $C_{PD}$           | -                   | 5            | -    | 53  | -   | -             | -   | -              | -   | pF    |
| <b>HCT TYPES</b>                           |                    |                     |              |      |     |     |               |     |                |     |       |
| Propagation Delay<br>Data to Output        | $t_{PHL}, t_{PLH}$ | $C_L = 50\text{pF}$ | 4.5          | -    | -   | 26  | -             | 33  | -              | 39  | ns    |
|  |                    | $C_L = 15\text{pF}$ | 5            | -    | 10  | -   | -             | -   | -              | -   | ns    |
| Output Disable to Output                   | $t_{PHL}, t_{PLH}$ | $C_L = 50\text{pF}$ | 4.5          | -    | -   | 30  | -             | 38  | -              | 45  | ns    |
|  |                    | $C_L = 15\text{pF}$ | 5            | -    | 12  | -   | -             | -   | -              | -   | ns    |
| Output Enable to Output                    | $t_{PHL}, t_{PLH}$ | $C_L = 50\text{pF}$ | 4.5          | -    | -   | 32  | -             | 40  | -              | 48  | ns    |
|  |                    | $C_L = 15\text{pF}$ | 5            | -    | 13  | -   | -             | -   | -              | -   | ns    |
| Output Transition Time                     | $t_{THL}, t_{TLH}$ | $C_L = 50\text{pF}$ | 4.5          | -    | -   | 12  | -             | 15  | -              | 18  | ns    |
| Input Capacitance                          | $C_{IN}$           | $C_L = 50\text{pF}$ | -            | 10   | -   | 10  | -             | 10  | -              | 10  | pF    |
| Three-State Output Capacitance             | $C_O$              | -                   | -            | -    | 20  | -   | 20            | -   | 20             | -   | pF    |
| Power Dissipation Capacitance (Notes 3, 4) | $C_{PD}$           | -                   | 5            | -    | 55  | -   | -             | -   | -              | -   | pF    |

**NOTES:**

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

Test Circuits and Waveforms

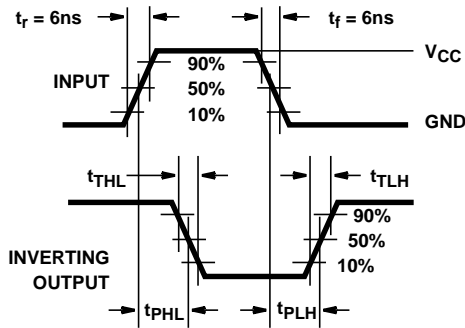


FIGURE 1. HC TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

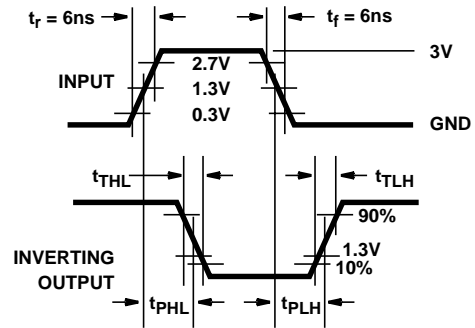


FIGURE 2. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

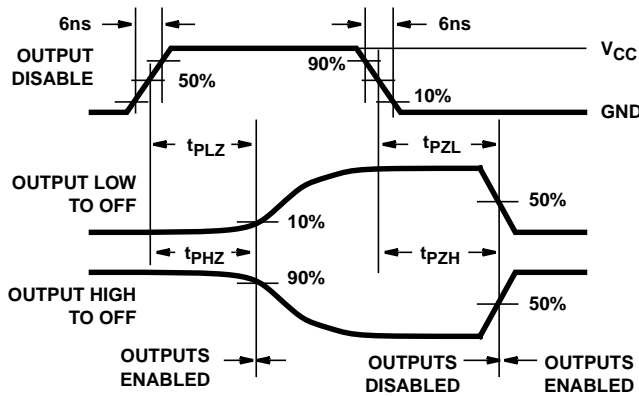


FIGURE 3. HC THREE-STATE PROPAGATION DELAY WAVEFORM

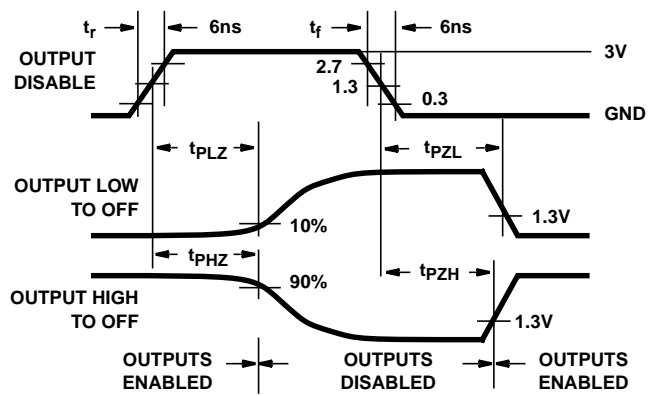
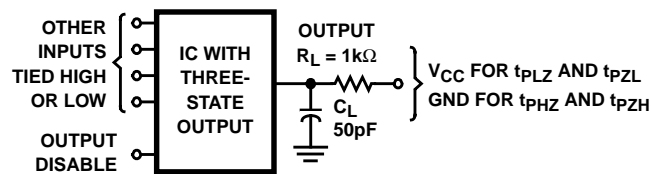


FIGURE 4. HCT THREE-STATE PROPAGATION DELAY WAVEFORM



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 5. 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/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| CD54HC245F       | ACTIVE                | CDIP         | J               | 20   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| CD54HC245F3A     | ACTIVE                | CDIP         | J               | 20   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| CD54HCT245F      | ACTIVE                | CDIP         | J               | 20   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| CD54HCT245F3A    | ACTIVE                | CDIP         | J               | 20   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| CD74HC245E       | ACTIVE                | PDIP         | N               | 20   | 20          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD74HC245EE4     | ACTIVE                | PDIP         | N               | 20   | 20          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD74HC245M       | ACTIVE                | SOIC         | DW              | 20   | 25          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC245M96     | ACTIVE                | SOIC         | DW              | 20   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC245M96E4   | ACTIVE                | SOIC         | DW              | 20   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC245ME4     | ACTIVE                | SOIC         | DW              | 20   | 25          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT245E      | ACTIVE                | PDIP         | N               | 20   | 20          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD74HCT245EE4    | ACTIVE                | PDIP         | N               | 20   | 20          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD74HCT245M      | ACTIVE                | SOIC         | DW              | 20   | 25          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT245M96    | ACTIVE                | SOIC         | DW              | 20   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT245M96E4  | ACTIVE                | SOIC         | DW              | 20   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT245ME4    | ACTIVE                | SOIC         | DW              | 20   | 25          | Green (RoHS & 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.

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

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



| DIM \ PINS ** | 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:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package is hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - 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.
  - 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 PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - 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.

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Mailing Address: Texas Instruments  
Post Office Box 655303 Dallas, Texas 75265