

# Octal 3-State Noninverting Bus Transceiver

## High-Performance Silicon-Gate CMOS

### MC74HC245A, MC74HCT245A

MC74HC245A/MC74HCT245A is identical in pinout to the LS245. The MC74HC245A inputs are compatible with Standard CMOS outputs. External pull-up resistors make them compatible with LSTTL outputs. The MC74HCT245A may be used as a level converter for interfacing TTL or NMOS outputs to high speed CMOS inputs.

The HC245A/HCT245A is a 3-state noninverting transceiver that is used for 2-way asynchronous communication between data buses. The device has an active-low Output Enable pin, which is used to place the I/O ports into high-impedance states. The Direction control determines whether data flows from A to B or from B to A.

#### Features

- Output Drive Capability: 15 LSTTL Loads
- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 2.0 to 6.0 V (HC), 4.5 to 5.5 V (HCT)
- Low Input Current: 1  $\mu$ A
- High Noise Immunity Characteristic of CMOS Devices
- In Compliance with the Requirements Defined by JEDEC Standard No. 7 A
- Chip Complexity: 308 FETs or 77 Equivalent Gates
- -Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free and are RoHS Compliant

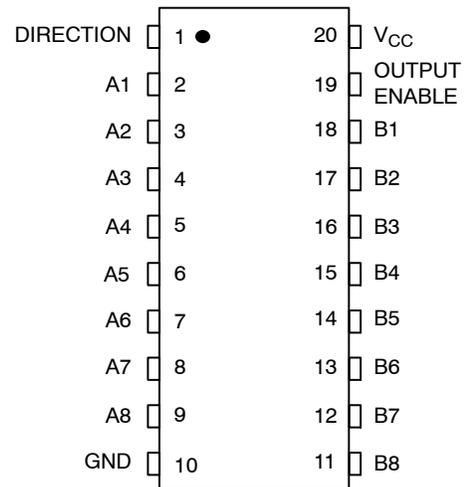


SOIC-20  
DW SUFFIX  
CASE 751D

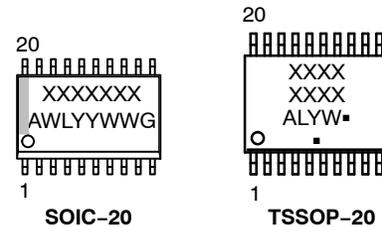


TSSOP-20  
DT SUFFIX  
CASE 948E

#### PIN ASSIGNMENT



#### MARKING DIAGRAMS



XXXXXXX = Specific Device Code  
A = Assembly Location  
WL, L = Wafer Lot  
YY, Y = Year  
WW, W = Work Week  
G or  $\blacksquare$  = Pb-Free Package  
(Note: Microdot may be in either location)

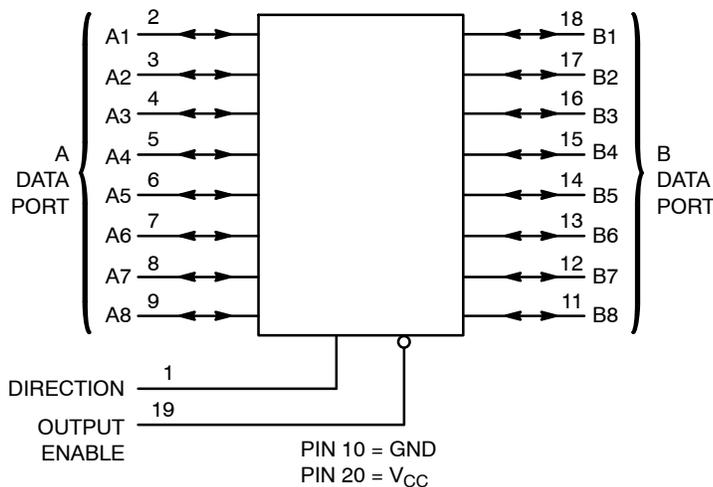


Figure 1. Logic Diagram

#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

# MC74HC245A, MC74HCT245A

## FUNCTION TABLE

| Control Inputs |           | Operation                             |
|----------------|-----------|---------------------------------------|
| Output Enable  | Direction |                                       |
| L              | L         | Data Transmitted from Bus B to Bus A  |
| L              | H         | Data Transmitted from Bus A to Bus B  |
| H              | X         | Buses Isolated (High-Impedance State) |

X = don't care

## MAXIMUM RATINGS

| Symbol               | Parameter  | Value                                    | Unit                        |      |
|----------------------|--|--|-----------------------------|------|
| V <sub>CC</sub>      | DC Supply Voltage  | -0.5 to +6.5                             | V                           |      |
| V <sub>IN</sub>      | DC Input Voltage   | -0.5 to V <sub>CC</sub> +0.5             | V                           |      |
| V <sub>OUT</sub>     | DC Output Voltage  | -0.5 to V <sub>CC</sub> +0.5             | V                           |      |
| I <sub>IN</sub>      | DC Input Diode Current, per Pin  | ±20                                      | mA                          |      |
| I <sub>OUT</sub>     | DC Input Diode Current, Per Pin  | ±35                                      | mA                          |      |
| I <sub>CC</sub>      | DC Supply Current, V <sub>CC</sub> and GND Pins                                    | ±75                                      | mA                          |      |
| I <sub>IK</sub>      | Input Clamp Current (V <sub>IN</sub> < 0 or V <sub>IN</sub> > V <sub>CC</sub> )    | ±20                                      | mA                          |      |
| I <sub>OK</sub>      | Output Clamp Current (V <sub>OUT</sub> < 0 or V <sub>OUT</sub> > V <sub>CC</sub> ) | ±20                                      | mA                          |      |
| T <sub>STG</sub>     | Storage Temperature Range  | -65 to +150                              | °C                          |      |
| T <sub>L</sub>       | Lead Temperature, 1 mm from Case for 10 secs                                       | 260                                      | °C                          |      |
| T <sub>J</sub>       | Junction Temperature Under Bias  | +150                                     | °C                          |      |
| θ <sub>JA</sub>      | Thermal Resistance (Note 1)  | SOIC-20W<br>WQFN20<br>QFN20<br>TSSOP-20  | 96<br>99<br>111<br>150      | °C/W |
| P <sub>D</sub>       | Power Dissipation in Still Air at 25°C   | SOIC-20W<br>WQFN20<br>QFN20<br>TSSOP-20  | 1302<br>1256<br>1127<br>833 | mW   |
| MSL                  | Moisture Sensitivity   | SOIC-20W<br>All Other Packages           | Level 3<br>Level 1          | -    |
| F <sub>R</sub>       | Flammability Rating  | Oxygen Index: 28 to 34                   | UL 94 V-0 @ 0.125 in        | -    |
| V <sub>ESD</sub>     | ESD Withstand Voltage (Note 2)   | Human Body Model<br>Charged Device Model | > 2000<br>> 1000            | V    |
| I <sub>LATCHUP</sub> | Latchup Performance (Note 3)   |  | ±100                        | mA   |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Measured with minimum pad spacing on an FR4 board, using 76mm-by-114mm, 2-ounce copper trace no air flow per JESD51-7.
2. HBM tested to EIA / JESD22-A114-A. CDM tested to JESD22-C101-A. JEDEC recommends that ESD qualification to EIA/JESD22-A115A (Machine Model) be discontinued.
3. Tested to EIA/JESD78 Class II.

# MC74HC245A, MC74HCT245A

## RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit |
|--------|-----------|-----|-----|------|
|--------|-----------|-----|-----|------|

### MC74HC

|                   |                                   |   |                    |    |
|-------------------|-----------------------------------|---|--------------------|----|
| $V_{CC}$          | DC Supply Voltage                 | 2.0   | 6.0                | V  |
| $V_{IN}, V_{OUT}$ | DC Input, Output Voltage (Note 4) | 0   | $V_{CC}$           | V  |
| $T_A$             | Operating Free-Air Temperature    | -55   | +125               | °C |
| $t_r, t_f$        | Input Rise or Fall Time           | $V_{CC} = 2.0\text{ V}$<br>$V_{CC} = 4.5\text{ V}$<br>$V_{CC} = 6.0\text{ V}$ | 1000<br>500<br>400 | ns |

### MC74HCT

|                   |                                   |     |          |    |
|-------------------|-----------------------------------|-----|----------|----|
| $V_{CC}$          | DC Supply Voltage                 | 4.5 | 5.5      | V  |
| $V_{IN}, V_{OUT}$ | DC Input, Output Voltage (Note 4) | 0   | $V_{CC}$ | V  |
| $T_A$             | Operating Free-Air Temperature    | -55 | +125     | °C |
| $t_r, t_f$        | Input Rise or Fall Time           | 0   | 500      | ns |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

4. Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or VCC). Unused outputs must be left open.

# MC74HC245A, MC74HCT245A

## DC ELECTRICAL CHARACTERISTICS (MC74HC245A)

| Symbol          | Parameter                                      | Test Conditions   | V <sub>CC</sub><br>V | Guaranteed Limit |        |         | Unit |
|-----------------|--|---|----------------------|------------------|--------|---------|------|
|                 |  |   |                      | -55 to 25°C      | ≤ 85°C | ≤ 125°C |      |
| V <sub>IH</sub> | Minimum High-Level Input Voltage               | V <sub>out</sub> = V <sub>CC</sub> - 0.1 V<br> I <sub>out</sub>   ≤ 20 μA   | 2.0                  | 1.5              | 1.5    | 1.5     | V    |
|                 |  |   | 3.0                  | 2.1              | 2.1    | 2.1     |      |
|                 |  |   | 4.5                  | 3.15             | 3.15   | 3.15    |      |
|                 |  |   | 6.0                  | 4.2              | 4.2    | 4.2     |      |
| V <sub>IL</sub> | Maximum Low-Level Input Voltage                | V <sub>out</sub> = 0.1 V<br> I <sub>out</sub>   ≤ 20 μA   | 2.0                  | 0.5              | 0.5    | 0.5     | V    |
|                 |  |   | 3.0                  | 0.9              | 0.9    | 0.9     |      |
|                 |  |   | 4.5                  | 1.35             | 1.35   | 1.35    |      |
|                 |  |   | 6.0                  | 1.8              | 1.8    | 1.8     |      |
| V <sub>OH</sub> | Minimum High-Level Output Voltage              | V <sub>in</sub> = V <sub>IH</sub><br> I <sub>out</sub>   ≤ 20 μA  | 2.0                  | 1.9              | 1.9    | 1.9     | V    |
|                 |  |   | 4.5                  | 4.4              | 4.4    | 4.4     |      |
|                 |  |   | 6.0                  | 5.9              | 5.9    | 5.9     |      |
|                 |  | V <sub>in</sub> = V <sub>IH</sub>  I <sub>out</sub>   ≤ 2.4 mA<br> I <sub>out</sub>   ≤ 6.0 mA<br> I <sub>out</sub>   ≤ 7.8 mA      | 3.0                  | 2.48             | 2.34   | 2.2     |      |
|                 |  |   | 4.5                  | 3.98             | 3.84   | 3.7     |      |
|                 |  |   | 6.0                  | 5.48             | 5.34   | 5.2     |      |
| V <sub>OL</sub> | Maximum Low-Level Output Voltage               | V <sub>in</sub> = V <sub>IL</sub><br> I <sub>out</sub>   ≤ 20 μA  | 2.0                  | 0.1              | 0.1    | 0.1     | V    |
|                 |  |   | 4.5                  | 0.1              | 0.1    | 0.1     |      |
|                 |  |   | 6.0                  | 0.1              | 0.1    | 0.1     |      |
|                 |  | V <sub>in</sub> = V <sub>IL</sub>  I <sub>out</sub>   ≤ 2.4 mA<br> I <sub>out</sub>   ≤ 6.0 mA<br> I <sub>out</sub>   ≤ 7.8 mA      | 3.0                  | 0.26             | 0.33   | 0.4     |      |
|                 |  |   | 4.5                  | 0.26             | 0.33   | 0.4     |      |
|                 |  |   | 6.0                  | 0.26             | 0.33   | 0.4     |      |
| I <sub>in</sub> | Maximum Input Leakage Current                  | V <sub>in</sub> = V <sub>CC</sub> or GND  | 6.0                  | ±0.1             | ±1.0   | ±1.0    | μA   |
| I <sub>oZ</sub> | Maximum Three-State Leakage Current            | Output in High-Impedance State<br>V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>V <sub>out</sub> = V <sub>CC</sub> or GND | 6.0                  | ±0.5             | ±5.0   | ±10     | μA   |
| I <sub>CC</sub> | Maximum Quiescent Supply Current (per Package) | V <sub>in</sub> = V <sub>CC</sub> or GND<br>I <sub>out</sub> = 0 μA   | 6.0                  | 4.0              | 40     | 160     | μA   |

## AC ELECTRICAL CHARACTERISTICS (MC74HC245A)

| Symbol                                 | Parameter   | V <sub>CC</sub><br>V                    | Guaranteed Limit |        |         | Unit |
|--|---|---|------------------|--------|---------|------|
|  |   |   | -55 to 25°C      | ≤ 85°C | ≤ 125°C |      |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay,<br>A to B, B to A<br>(Figures 2 and 3)                       | 2.0                                     | 75               | 95     | 110     | ns   |
|  |   | 3.0                                     | 55               | 70     | 80      |      |
|  |   | 4.5                                     | 15               | 19     | 22      |      |
|  |   | 6.0                                     | 13               | 16     | 19      |      |
| t <sub>PLZ</sub> ,<br>t <sub>PHZ</sub> | Maximum Propagation Delay,<br>Direction or Output Enable to A or B<br>(Figures 2 and 3) | 2.0                                     | 110              | 140    | 165     | ns   |
|  |   | 3.0                                     | 90               | 110    | 130     |      |
|  |   | 4.5                                     | 22               | 28     | 33      |      |
|  |   | 6.0                                     | 19               | 24     | 28      |      |
| t <sub>PZL</sub> ,<br>t <sub>PZH</sub> | Maximum Propagation Delay,<br>Output Enable to A or B<br>(Figures 2 and 3)              | 2.0                                     | 110              | 140    | 165     | ns   |
|  |   | 3.0                                     | 90               | 110    | 130     |      |
|  |   | 4.5                                     | 22               | 28     | 33      |      |
|  |   | 6.0                                     | 19               | 24     | 28      |      |
| t <sub>TLH</sub> ,<br>t <sub>THL</sub> | Maximum Output Transition Time,<br>Any Output<br>(Figures 2 and 3)                      | 2.0                                     | 60               | 75     | 90      | ns   |
|  |   | 3.0                                     | 23               | 27     | 32      |      |
|  |   | 4.5                                     | 12               | 15     | 18      |      |
|  |   | 6.0                                     | 10               | 13     | 15      |      |
| C <sub>in</sub>                        | Maximum Input Capacitance (Pin 1 or Pin 19)   | -                                       | 10               | 10     | 10      | pF   |
| C <sub>out</sub>                       | Maximum Three-State I/O Capacitance<br>(I/O in High-Impedance State)                    | -                                       | 15               | 15     | 15      | pF   |
| C <sub>PD</sub>                        | Power Dissipation Capacitance (Per Transceiver Channel) (Note 5)                        | Typical @ 25°C, V <sub>CC</sub> = 5.0 V |                  |        | pF      |      |
|  |   | 40                                      |                  |        |         |      |

5. Used to determine the no-load dynamic power consumption:  $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$ .

# MC74HC245A, MC74HCT245A

## DC ELECTRICAL CHARACTERISTICS (MC74HCT245A)

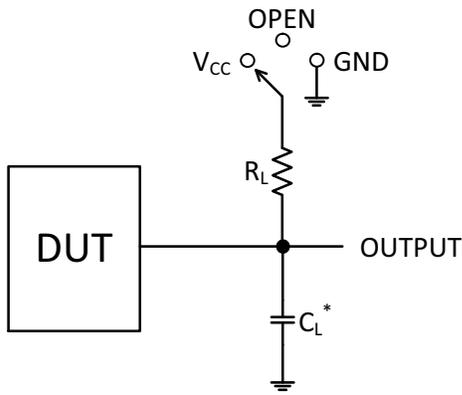
| Symbol           | Parameter                                      | Test Conditions   | V <sub>CC</sub><br>V | Guaranteed Limit |               |            | Unit |
|------------------|--|---|----------------------|------------------|---------------|------------|------|
|                  |  |   |                      | - 55 to<br>25°C  | ≤ 85°C        | ≤ 125°C    |      |
| V <sub>IH</sub>  | Minimum High-Level Input Voltage               | V <sub>out</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V<br> I <sub>out</sub>   ≤ 20 μA  | 4.5<br>5.5           | 2.0<br>2.0       | 2.0<br>2.0    | 2.0<br>2.0 | V    |
| V <sub>IL</sub>  | Maximum Low-Level Input Voltage                | V <sub>out</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V<br> I <sub>out</sub>   ≤ 20 μA  | 4.5<br>5.5           | 0.8<br>0.8       | 0.8<br>0.8    | 0.8<br>0.8 | V    |
| V <sub>OH</sub>  | Minimum High-Level Output Voltage              | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>out</sub>   ≤ 20 μA   | 4.5<br>5.5           | 4.4<br>5.4       | 4.4<br>5.4    | 4.4<br>5.4 | V    |
|                  |  | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>out</sub>   ≤ 6.0 mA  | 4.5                  | 3.98             | 3.84          | 3.7        |      |
| V <sub>OL</sub>  | Maximum Low-Level Output Voltage               | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>out</sub>   ≤ 20 μA   | 4.5<br>5.5           | 0.1<br>0.1       | 0.1<br>0.1    | 0.1<br>0.1 | V    |
|                  |  | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>out</sub>   ≤ 6.0 mA  | 4.5                  | 0.26             | 0.33          | 0.4        |      |
| I <sub>in</sub>  | Maximum Input Leakage Current                  | V <sub>in</sub> = V <sub>CC</sub> or GND, Pins 1 or 19  | 5.5                  | ± 0.1            | ± 1.0         | ± 1.0      | μA   |
| I <sub>CC</sub>  | Maximum Quiescent Supply Current (per Package) | V <sub>in</sub> = V <sub>CC</sub> or GND<br>I <sub>out</sub> = 0 μA   | 5.5                  | 4.0              | 40            | 160        | μA   |
| I <sub>oz</sub>  | Maximum Three-State Leakage Current            | Output in High-Impedance State<br>V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>V <sub>out</sub> = V <sub>CC</sub> or GND, I/O Pins | 5.5                  | ± 0.5            | ± 5.0         | ± 10       | μA   |
| ΔI <sub>CC</sub> | Additional Quiescent Supply Current            | V <sub>in</sub> = 2.4 V, Any One Input<br>V <sub>in</sub> = V <sub>CC</sub> or GND, Other Inputs<br>I <sub>out</sub> = 0 μA                   | 5.5                  | ≥ -55°C          | 25°C to 125°C |            | mA   |
|                  |  |   |                      | 2.9              | 2.4           |            |      |

## AC ELECTRICAL CHARACTERISTICS (MC74HCT245A)

| Symbol                                 | Parameter  | Guaranteed Limit                        |        |         | Unit |
|--|--|---|--------|---------|------|
|  |  | - 55 to<br>25°C                         | ≤ 85°C | ≤ 125°C |      |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay, A to B or B to A<br>(Figures 2 and 3)                     | 22                                      | 28     | 33      | ns   |
| t <sub>PLZ</sub> ,<br>t <sub>PHZ</sub> | Maximum Propagation Delay, Direction or Output Enable to A or B<br>(Figures 2 and 3) | 30                                      | 36     | 42      | ns   |
| t <sub>PZL</sub> ,<br>t <sub>PZH</sub> | Maximum Propagation Delay, Output Enable to A or B<br>(Figures 2 and 3)              | 30                                      | 36     | 42      | ns   |
| t <sub>TLH</sub> ,<br>t <sub>THL</sub> | Maximum Output Transition Time, any Output<br>(Figures 2 and 3)                      | 12                                      | 15     | 18      | ns   |
| C <sub>in</sub>                        | Maximum Input Capacitance (Pin 1 or 19)  | 10                                      | 10     | 10      | pF   |
| C <sub>out</sub>                       | Maximum Three-State I/O Capacitance, (I/O in High-Impedance State)                   | 15                                      | 15     | 15      | pF   |
| C <sub>PD</sub>                        | Power Dissipation Capacitance (Per Enabled Output)*                                  | Typical @ 25°C, V <sub>CC</sub> = 5.0 V |        |         | pF   |
|  |  | 97                                      |        |         |      |

\* Used to determine the no-load dynamic power consumption: P<sub>D</sub> = C<sub>PD</sub> V<sub>CC</sub><sup>2</sup>f + I<sub>CC</sub> V<sub>CC</sub>.

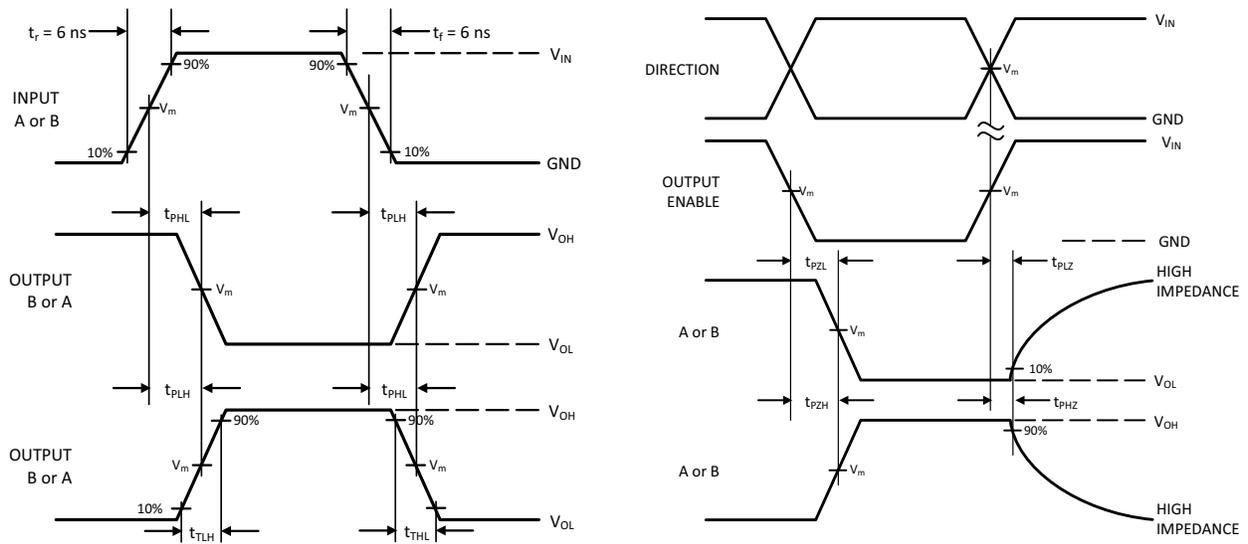
# MC74HC245A, MC74HCT245A



| Test                                | Switch Position | C <sub>L</sub> | R <sub>L</sub> |
|-------------------------------------|-----------------|----------------|----------------|
| t <sub>PLH</sub> / t <sub>PHL</sub> | Open            | 50 pF          | 1 kΩ           |
| t <sub>PLZ</sub> / t <sub>PZL</sub> | V <sub>CC</sub> |                |                |
| t <sub>PHZ</sub> / t <sub>PZH</sub> | GND             |                |                |

\*C<sub>L</sub> Includes probe and jig capacitance

Figure 2. Test Circuit



| Device      | V <sub>IN</sub> , V | V <sub>m</sub> , V    |
|-------------|---------------------|-----------------------|
| MC74HC245A  | V <sub>CC</sub>     | 50% x V <sub>CC</sub> |
| MC74HCT245A | 3 V                 | 1.3 V                 |

Figure 3. Switching Waveforms

## MC74HC245A, MC74HCT245A

### ORDERING INFORMATION

| Device              | Package      | Marking     | Shipping†                |
|---------------------|--------------|-------------|--------------------------|
| MC74HC245ADWG       | SOIC-20 Wide | HC245A      | 38 Units / Rail          |
| MC74HC245ADWR2G     | SOIC-20 Wide | HC245A      | 1000 Units / Tape & Reel |
| MC74HC245ADWR2G-Q*  | SOIC-20 Wide | HC245A      | 1000 Units / Tape & Reel |
| MC74HC245ADTG       | TSSOP-20     | HC<br>245A  | 75 Units / Rail          |
| MC74HC245ADTR2G     | TSSOP-20     | HC<br>245A  | 2500 Units / Tape & Reel |
| MC74HC245ADTR2G-Q*  | TSSOP-20     | HC<br>245A  | 2500 Units / Tape & Reel |
| MC74HCT245ADWG      | SOIC-20 Wide | HCT245A     | 38 Units / Rail          |
| MC74HCT245ADWR2G    | SOIC-20 Wide | HCT245A     | 1000 Units / Tape & Reel |
| MC74HCT245ADTG      | TSSOP-20     | HCT<br>245A | 75 Units / Rail          |
| MC74HCT245ADTR2G    | TSSOP-20     | HCT<br>245A | 2500 Units / Tape & Reel |
| MC74HCT245ADTR2G-Q* | TSSOP-20     | HCT<br>245A | 2500 Units / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

\*-Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC – Q100 Qualified and PPAP Capable.

# MC74HC245A, MC74HCT245A

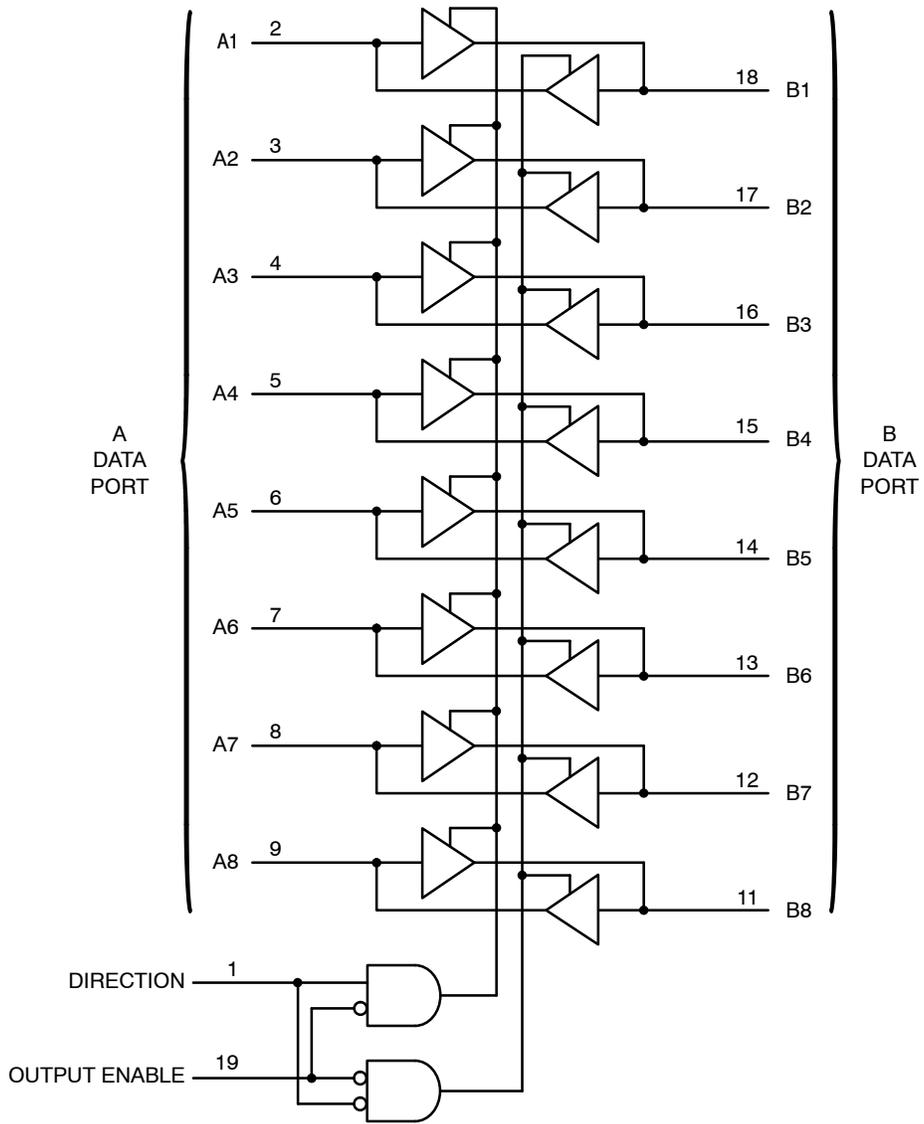


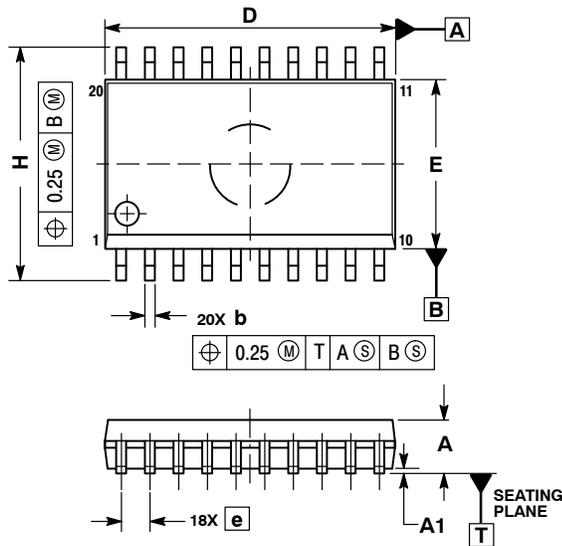
Figure 4. Expanded Logic Diagram



SCALE 1:1

SOIC-20 WB  
CASE 751D-05  
ISSUE H

DATE 22 APR 2015

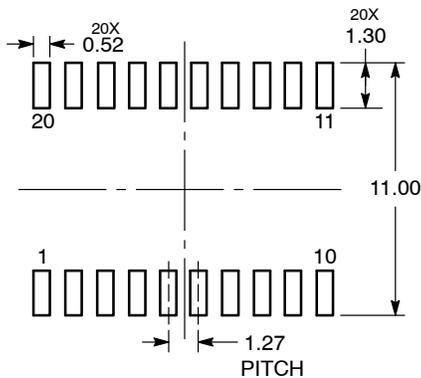


NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |       |
|-----|-------------|-------|
|     | MIN         | MAX   |
| A   | 2.35        | 2.65  |
| A1  | 0.10        | 0.25  |
| b   | 0.35        | 0.49  |
| c   | 0.23        | 0.32  |
| D   | 12.65       | 12.95 |
| E   | 7.40        | 7.60  |
| e   | 1.27 BSC    |       |
| H   | 10.05       | 10.55 |
| h   | 0.25        | 0.75  |
| L   | 0.50        | 0.90  |
| θ   | 0°          | 7°    |

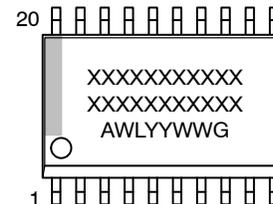
RECOMMENDED  
SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

GENERIC  
MARKING DIAGRAM\*



- XXXXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- YY = Year
- WW = Work Week
- G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

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