

# 54AC16245, 74AC16245 16-BIT BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SCAS235A – MARCH 1990 – REVISED APRIL 1996

- Members of the Texas Instruments *Widebus™* Family
- 3-State Outputs Drive Bus Lines or Buffer Memory Address Registers
- Flow-Through Architecture Optimizes PCB Layout
- Distributed  $V_{CC}$  and GND Configuration Minimizes High-Speed Switching Noise
- *EPIC™* (Enhanced-Performance Implanted CMOS) 1- $\mu$ m Process
- 500-mA Typical Latch-Up Immunity at 125°C
- Package Options Include Plastic Thin Shrink Small-Outline (DGG) Package, 300-mil Shrink Small-Outline (DL) Package Using 25-mil Center-to-Center Pin Spacings and 380-mil Fine-Pitch Ceramic Flat (WD) Package Using 25-mil Center-to-Center Pin Spacings

## description

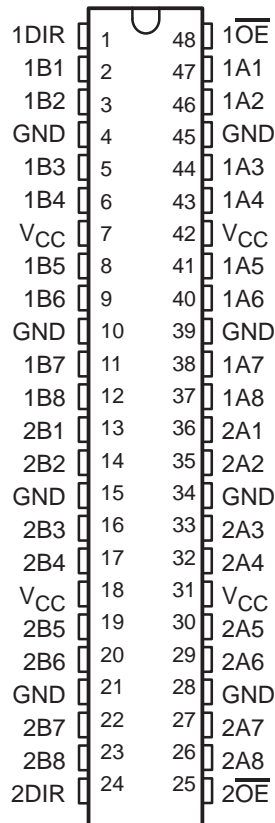
The 'AC16245 are 16-bit bus transceivers organized as dual-octal noninverting 3-state transceivers designed for asynchronous two-way communication between data buses. The control function implementation minimizes external timing requirements

These devices allow data transmission from the A bus to the B bus or from the B bus to the A bus, depending upon the logic level at the direction control (DIR) input. The output-enable input ( $\overline{OE}$ ) can be used to disable the devices so that the buses are effectively isolated.

The 74AC16245 is packaged in TI's shrink small-outline package, which provides twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

The 54AC16245 is characterized for operation over the full military temperature range of -55°C to 125°C. The 74AC16245 is characterized for operation from -40°C to 85°C.

54AC16245 . . . WD PACKAGE  
74AC16245 . . . DGG OR DL PACKAGE  
(TOP VIEW)



FUNCTION TABLE

| CONTROL INPUTS  |     | OPERATION       |
|-----------------|-----|-----------------|
| $\overline{OE}$ | DIR |                 |
| L               | L   | B data to A bus |
| L               | H   | A data to bus   |
| H               | X   | Isolation       |



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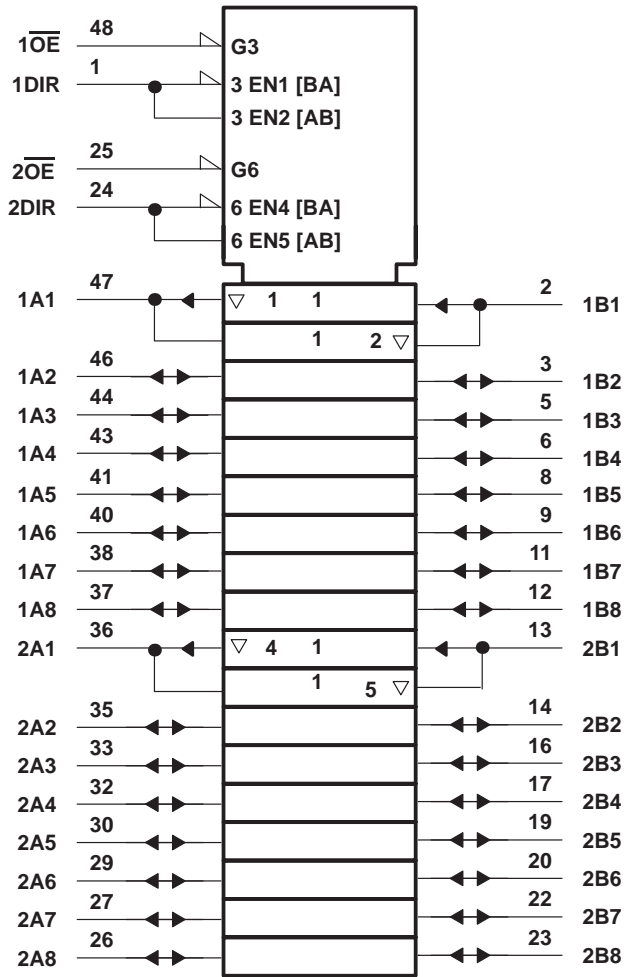
 **TEXAS  
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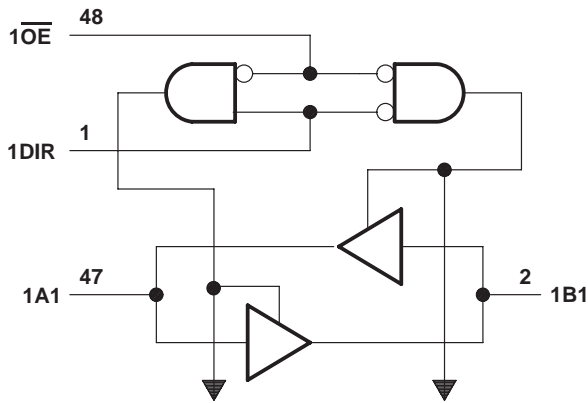
**54AC16245, 74AC16245**  
**16-BIT BUS TRANSCEIVERS**  
**WITH 3-STATE OUTPUTS**  
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**logic symbol†**

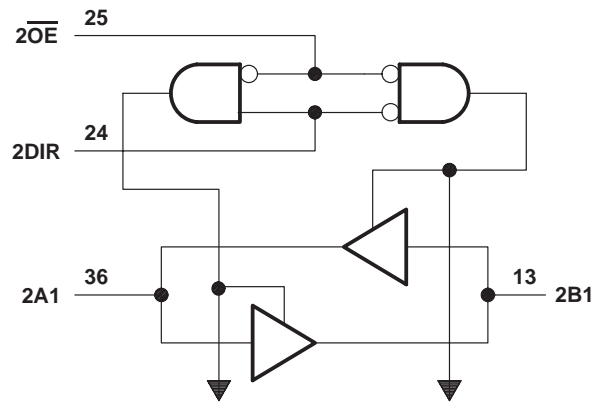


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

**logic diagram (positive logic)**



To Seven Other Transceivers



To Seven Other Transceivers



# 54AC16245, 74AC16245 16-BIT BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

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## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

|  |                            |
|--|----------------------------|
| Supply voltage range, $V_{CC}$ .....   | –0.5 V to 7 V              |
| Input voltage range, $V_I$ (see Note 1) .....  | –0.5 V to $V_{CC} + 0.5$ V |
| Output voltage range, $V_O$ (see Note 1) .....   | –0.5 V to $V_{CC} + 0.5$ V |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) .....                                  | ±20 mA                     |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) .....                                 | ±50 mA                     |
| Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....                                     | ±50 mA                     |
| Continuous current through $V_{CC}$ or GND .....   | ±400 mA                    |
| Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 2): DGG package ..... | 0.85 W                     |
| DL package .....   | 1.2 W                      |
| Storage temperature range, $T_{stg}$ .....   | –65°C to 150°C             |

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils.

## recommended operating conditions (see Note 3)

|                     |                                    | 54AC16245        |     |          | 74AC16245        |                  |          | UNIT |
|---------------------|------------------------------------|------------------|-----|----------|------------------|------------------|----------|------|
|                     |                                    | MIN              | NOM | MAX      | MIN              | NOM              | MAX      |      |
| $V_{CC}$            | Supply voltage (see Note 4)        | 3                | 5   | 5.5      | 3                | 5                | 5.5      | V    |
| $V_{IH}$            | High-level input voltage           | $V_{CC} = 3$ V   |     | 2.1      | $V_{CC} = 3$ V   |                  | 2.1      | V    |
|                     |                                    | $V_{CC} = 4.5$ V |     | 3.15     | $V_{CC} = 4.5$ V |                  | 3.15     |      |
|                     |                                    | $V_{CC} = 5.5$ V |     | 3.85     | $V_{CC} = 5.5$ V |                  | 3.85     |      |
| $V_{IL}$            | Low-level input voltage            | $V_{CC} = 3$ V   |     |          | 0.9              | $V_{CC} = 3$ V   |          | 0.9  |
|                     |                                    | $V_{CC} = 4.5$ V |     |          | 1.35             | $V_{CC} = 4.5$ V |          | 1.35 |
|                     |                                    | $V_{CC} = 5.5$ V |     |          | 1.65             | $V_{CC} = 5.5$ V |          | 1.65 |
| $V_I$               | Input voltage                      | 0                |     | $V_{CC}$ | 0                |                  | $V_{CC}$ | V    |
| $V_O$               | Output voltage                     | 0                |     | $V_{CC}$ | 0                |                  | $V_{CC}$ | V    |
| $I_{OH}$            | High-level output current          | $V_{CC} = 3$ V   |     |          | –4               | $V_{CC} = 3$ V   |          | –4   |
|                     |                                    | $V_{CC} = 4.5$ V |     |          | –24              | $V_{CC} = 4.5$ V |          | –24  |
|                     |                                    | $V_{CC} = 5.5$ V |     |          | –24              | $V_{CC} = 5.5$ V |          | –24  |
| $I_{OL}$            | Low-level output current           | $V_{CC} = 3$ V   |     |          | 12               | $V_{CC} = 3$ V   |          | 12   |
|                     |                                    | $V_{CC} = 4.5$ V |     |          | 24               | $V_{CC} = 4.5$ V |          | 24   |
|                     |                                    | $V_{CC} = 5.5$ V |     |          | 24               | $V_{CC} = 5.5$ V |          | 24   |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | 0                |     | 10       | 0                |                  | 10       | ns/V |
| $T_A$               | Operating free-air temperature     | –55              |     | 125      | –40              |                  | 85       | °C   |

- NOTES: 3. All unused pins (input and I/O) must be held high or low to prevent them from floating.  
4. All  $V_{CC}$  and GND pins must be connected to the proper voltage power supply.

**54AC16245, 74AC16245**  
**16-BIT BUS TRANSCEIVERS**  
**WITH 3-STATE OUTPUTS**  
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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER                 | TEST CONDITIONS   | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     |      | 54AC16245 |      | 74AC16245 |     | UNIT |
|---------------------------|---|-----------------|-----------------------|-----|------|-----------|------|-----------|-----|------|
|                           |   |                 | MIN                   | TYP | MAX  | MIN       | MAX  | MIN       | MAX |      |
| V <sub>OH</sub>           | I <sub>OH</sub> = -50 μA                                    | 3 V             | 2.9                   |     |      | 2.9       |      | 2.9       | V   |      |
|                           |   | 4.5 V           | 4.4                   |     |      | 4.4       |      | 4.4       |     |      |
|                           |   | 5.5 V           | 5.4                   |     |      | 5.4       |      | 5.4       |     |      |
|                           | I <sub>OH</sub> = -4 mA                                     | 3 V             | 2.58                  |     |      | 2.48      |      | 2.48      |     |      |
|                           |   | 4.5 V           | 3.94                  |     |      | 3.8       |      | 3.8       |     |      |
|                           |   | 5.5 V           | 4.94                  |     |      | 4.8       |      | 4.8       |     |      |
| I <sub>OH</sub> = -75 mA† | 5.5 V   |                 |                       |     | 3.85 |           | 3.85 |           |     |      |
| V <sub>OL</sub>           | I <sub>OL</sub> = 50 μA                                     | 3 V             |                       |     | 0.1  |           |      | 0.1       | V   |      |
|                           |   | 4.5 V           |                       |     | 0.1  |           |      | 0.1       |     |      |
|                           |   | 5.5 V           |                       |     | 0.1  |           |      | 0.1       |     |      |
|                           | I <sub>OL</sub> = 12 mA                                     | 3 V             |                       |     | 0.36 |           |      | 0.44      |     |      |
|                           |   | 4.5 V           |                       |     | 0.36 |           |      | 0.44      |     |      |
|                           |   | 5.5 V           |                       |     | 0.36 |           |      | 0.44      |     |      |
| I <sub>OL</sub> = 75 mA†  | 5.5 V   |                 |                       |     |      | 1.65      | 1.65 |           |     |      |
| I <sub>I</sub>            | V <sub>I</sub> = V <sub>CC</sub> or GND                     | 5.5 V           |                       |     | ±0.1 |           | ±1   | ±1        | μA  |      |
| I <sub>OZ</sub>           | V <sub>I</sub> = V <sub>CC</sub> or GND                     | 5.5 V           |                       |     | ±0.5 |           | ±5   | ±5        | μA  |      |
| I <sub>CC</sub>           | V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0 | 5.5 V           |                       |     | 8    |           | 80   | 80        | μA  |      |
| C <sub>i</sub>            | V <sub>I</sub> = V <sub>CC</sub> or GND                     | 5 V             |                       |     | 4.5  |           |      |           | pF  |      |
| C <sub>o</sub>            | V <sub>I</sub> = V <sub>CC</sub> or GND                     | 5 V             |                       |     | 16   |           |      |           |     |      |

† Not more than one output should be tested at a time, and the duration of the test should not exceed 10 ms.

‡ For I/O ports, the parameter I<sub>OZ</sub> includes the input leakage current.

**switching characteristics over recommended operating free-air temperature range,**  
**V<sub>CC</sub> = 3.3 V ± 0.3 V (see Figure 1)**

| PARAMETER        | FROM (INPUT) | TO (OUTPUT) | T <sub>A</sub> = 25°C |     |      | 54AC16245 |      | 74AC16245 |      | UNIT |
|------------------|--------------|-------------|-----------------------|-----|------|-----------|------|-----------|------|------|
|                  |              |             | MIN                   | TYP | MAX  | MIN       | MAX  | MIN       | MAX  |      |
| t <sub>PLH</sub> | A or B       | B or A      | 2.5                   | 7.6 | 10.4 | 2.5       | 11.9 | 2.5       | 11.9 | ns   |
| t <sub>PHL</sub> |              |             | 3.1                   | 9   | 12.3 | 3.1       | 13.5 | 3.1       | 13.5 |      |
| t <sub>PZH</sub> | OE           | A or B      | 2.8                   | 8.6 | 11.8 | 2.8       | 13.2 | 2.8       | 13.2 | ns   |
| t <sub>PZL</sub> |              |             | 3.9                   | 12  | 16.2 | 3.9       | 18   | 3.9       | 18   |      |
| t <sub>PHZ</sub> | OE           | A or B      | 5.3                   | 8.4 | 10.4 | 5.3       | 11.2 | 5.3       | 11.2 | ns   |
| t <sub>PLZ</sub> |              |             | 4.4                   | 7.7 | 9.7  | 4.4       | 10.3 | 4.4       | 10.3 |      |

**switching characteristics over recommended operating free-air temperature range,**  
**V<sub>CC</sub> = 5 V ± 0.5 V (see Figure 1)**

| PARAMETER        | FROM (INPUT) | TO (OUTPUT) | T <sub>A</sub> = 25°C |     |     | 54AC16245 |      | 74AC16245 |      | UNIT |
|------------------|--------------|-------------|-----------------------|-----|-----|-----------|------|-----------|------|------|
|                  |              |             | MIN                   | TYP | MAX | MIN       | MAX  | MIN       | MAX  |      |
| t <sub>PLH</sub> | A or B       | B or A      | 2                     | 4.6 | 6.9 | 2         | 7.9  | 2         | 7.9  | ns   |
| t <sub>PHL</sub> |              |             | 2.5                   | 5.2 | 7.9 | 2.5       | 8.9  | 2.5       | 8.9  |      |
| t <sub>PZH</sub> | OE           | A or B      | 2.3                   | 4.9 | 7.5 | 2.3       | 8.6  | 2.3       | 8.6  | ns   |
| t <sub>PZL</sub> |              |             | 3                     | 6.2 | 9.5 | 3         | 10.7 | 3         | 10.7 |      |
| t <sub>PHZ</sub> | OE           | A or B      | 5                     | 7.2 | 9.1 | 5         | 9.8  | 5         | 9.8  | ns   |
| t <sub>PLZ</sub> |              |             | 4.2                   | 6.2 | 8.1 | 4.2       | 8.7  | 4.2       | 8.7  |      |

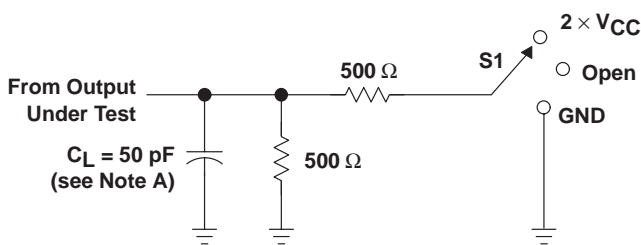
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operating characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

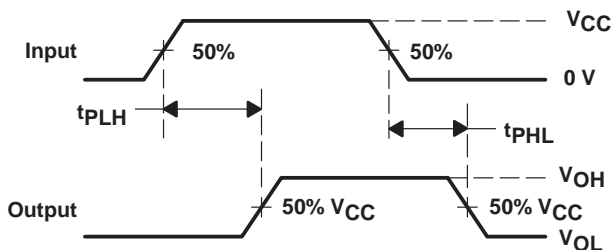
| PARAMETER |   | TEST CONDITIONS                           | TYP | UNIT |
|-----------|---|---|-----|------|
| $C_{pd}$  | Power dissipation capacitance per latch | $C_L = 50\text{ pF}$ , $f = 1\text{ MHz}$ | 43  | pF   |
|           |   |   | 8   |      |

PARAMETER MEASUREMENT INFORMATION

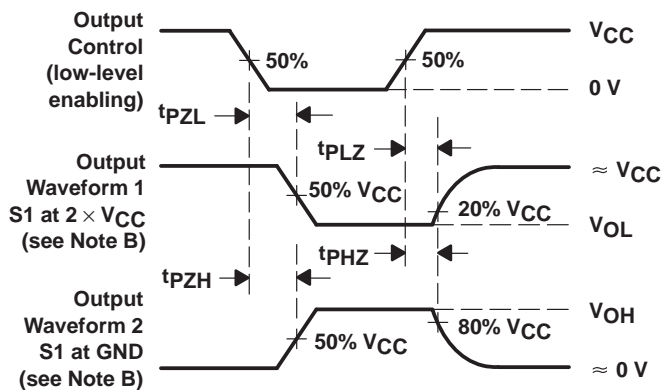


LOAD CIRCUIT

| TEST              | S1                |
|-------------------|-------------------|
| $t_{PLH}/t_{PHL}$ | Open              |
| $t_{PLZ}/t_{PZL}$ | $2 \times V_{CC}$ |
| $t_{PHZ}/t_{PZH}$ | GND               |



VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS

- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.  
 C. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r = 3\text{ ns}$ ,  $t_f = 3\text{ ns}$ .  
 D. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|---------|
| 74AC16245DL      | LIFEBUY       | SSOP         | DL              | 48   | 25          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | AC16245                 |         |
| 74AC16245DLR     | ACTIVE        | SSOP         | DL              | 48   | 1000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | AC16245                 | Samples |

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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**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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| 74AC16245DLR | SSOP         | DL              | 48   | 1000 | 330.0              | 32.4               | 11.35   | 16.2    | 3.1     | 16.0    | 32.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device       | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| 74AC16245DLR | SSOP         | DL              | 48   | 1000 | 367.0       | 367.0      | 55.0        |



**TUBE**


\*All dimensions are nominal

| Device      | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| 74AC16245DL | DL           | SSOP         | 48   | 25  | 473.7  | 14.24  | 5110   | 7.87   |

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