

Octal bus transceiver with direction pin with 5-volt tolerant inputs/outputs (3-State)

74LVC245A 74LVCH245A

FEATURES

- 5-volt tolerant inputs/outputs, for interfacing with 5-volt logic
- Supply voltage range of 2.7V to 3.6V
- Complies with JEDEC standard no. 8-1A
- CMOS low power consumption
- Direct interface with TTL levels
- High impedance when $V_{CC} = 0V$
- Bushold on all data inputs (74LVCH245A only)

DESCRIPTION

The 74LVC245A/74LVCH245A is a high-performance, low-power, low-voltage, Si-gate CMOS device, superior to most advanced CMOS compatible TTL families.

Inputs can be driven from either 3.3V or 5V devices. In 3-State operation, outputs can handle 5V. These features allow the use of these devices as translators in a mixed 3.3V/5V environment.

The 74LVC245A/74LVCH245A is an octal transceiver featuring non-inverting 3-State bus compatible outputs in both send and receive directions. The '245' features an output enable (\overline{OE}) input for easy cascading and a send/receive (DIR) input for direction control. \overline{OE} controls the outputs so that the buses are effectively isolated.

The '245' is functionally identical to the '640', but the '640' has true (non-inverting) outputs.

QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | TYPICAL | UNIT |
|-------------------|---|---------------------------------|---------|------|
| t_{PHL}/t_{PLH} | Propagation delay A_n to B_n ; B_n to A_n | $C_L = 50pF$ $V_{CC} = 3.3V$ | 3.6 | ns |
| C_I | Input capacitance | | 5.0 | pF |
| $C_{I/O}$ | Input/output capacitance | | 10.0 | pF |
| C_{PD} | Power dissipation capacitance per buffer | Notes 1 and 2 | 33 | pF |

NOTE:

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μW):
 $P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o)$ where:
 f_i = input frequency in MHz; C_L = output load capacity in pF;
 f_o = output frequency in MHz; V_{CC} = supply voltage in V;
 $\sum (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.
2. The condition is $V_I = GND$ to V_{CC}

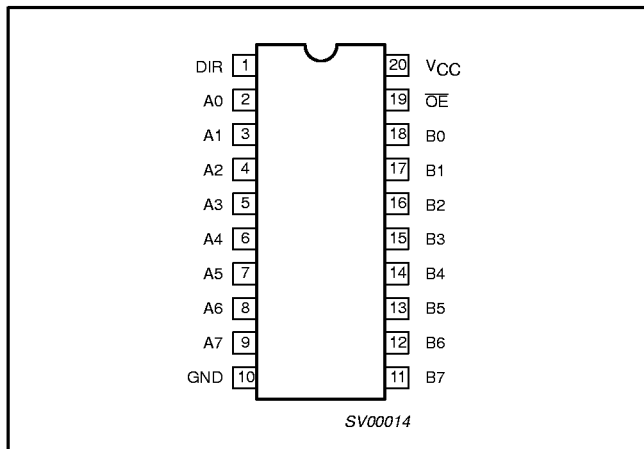
ORDERING INFORMATION

| PACKAGES | TEMPERATURE RANGE | OUTSIDE NORTH AMERICA | NORTH AMERICA | PKG. DWG. # |
|---|-------------------|-----------------------|---------------|-------------|
| 20-Pin Plastic Shrink Small Outline (SO) | -40°C to +85°C | 74LVC245A D | 74LVC245A D | SOT163-1 |
| 20-Pin Plastic Shrink Small Outline (SSOP) Type II | -40°C to +85°C | 74LVC245A DB | 74LVC245A DB | SOT339-1 |
| 20-Pin Plastic Thin Shrink Small Outline (TSSOP) Type I | -40°C to +85°C | 74LVC245A PW | 7LVC245APW DH | SOT360-1 |
| 20-Pin Plastic Shrink Small Outline (SO) | -40°C to +85°C | 74LVCH245A D | 74LVCH245A D | SOT163-1 |
| 20-Pin Plastic Shrink Small Outline (SSOP) Type II | -40°C to +85°C | 74LVCH245A DB | 74LVCH245A DB | SOT339-1 |
| 20-Pin Plastic Thin Shrink Small Outline (TSSOP) Type I | -40°C to +85°C | 74LVCH245A PW | LVCH245APW DH | SOT360-1 |

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74LVCH245A

PIN CONFIGURATION



PIN DESCRIPTION

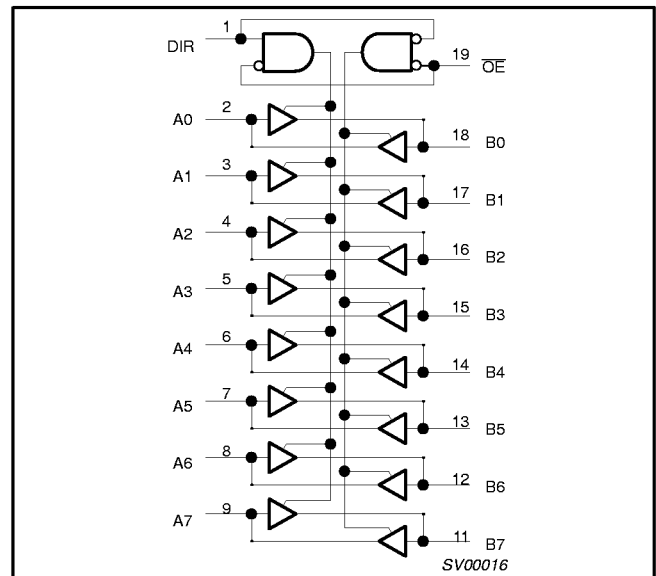
| PIN NUMBER | SYMBOL | FUNCTION |
|--------------------------------|----------------------------------|----------------------------------|
| 1 | DIR | Direction control |
| 2, 3, 4, 5, 6, 7, 8, 9 | A ₀ to A ₇ | Data inputs/outputs |
| 10 | GND | Ground (0V) |
| 18, 17, 16, 15, 14, 13, 12, 11 | B ₀ to B ₇ | Data inputs/outputs |
| 19 | \overline{OE} | Output enable input (active-Low) |
| 20 | V _{CC} | Positive supply voltage |

FUNCTION TABLE

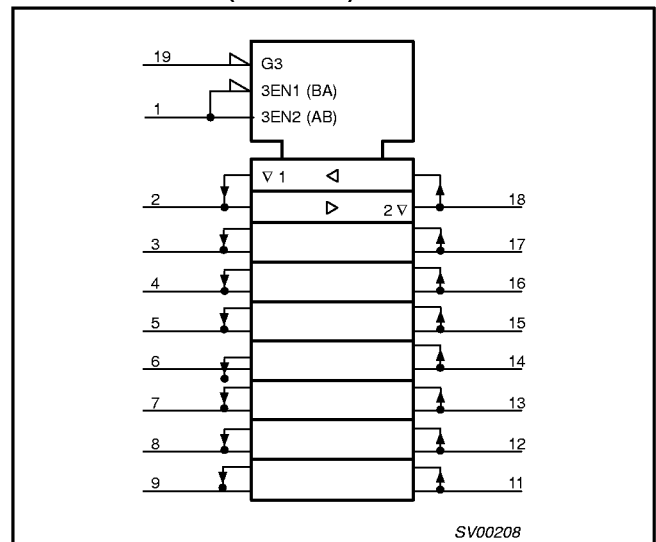
| INPUTS | | INPUTS/OUTPUTS | |
|-----------------|-----|----------------|----------------|
| \overline{OE} | DIR | A _n | B ₀ |
| L | L | A = B | Inputs |
| L | H | Inputs | B = A |
| H | X | Z | Z |

H = HIGH voltage level
L = LOW voltage level
X = Don't care
Z = High impedance OFF-state

LOGIC SYMBOL



LOGIC SYMBOL (IEEE/IEC)



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74LVC245A
74LVCH245A

RECOMMENDED OPERATING CONDITIONS

| SYMBOL | PARAMETER | CONDITIONS | LIMITS | | UNIT |
|---------------------------------|---|-------------------------------|--------|-----------------|------|
| | | | MIN | MAX | |
| V _{CC} | DC supply voltage (for max. speed performance) | | 2.7 | 3.6 | V |
| | DC supply voltage (for low-voltage applications) | | 1.2 | 3.6 | |
| V _I | DC Input voltage range | | 0 | 5.5 | V |
| V _O | DC Output voltage range; output HIGH or LOW state | | 0 | V _{CC} | V |
| | DC output voltage range; output 3-State | | 0 | 5.5 | |
| T _{amb} | Operating ambient temperature range in free-air | | -40 | +85 | °C |
| t _r , t _f | Input rise and fall times | V _{CC} = 1.2 to 2.7V | 0 | 20 | ns/V |
| | | V _{CC} = 2.7 to 3.6V | 0 | 10 | |

ABSOLUTE MAXIMUM RATINGS¹

In accordance with the Absolute Maximum Rating System (IEC 134)
Voltages are referenced to GND (ground = 0V)

| SYMBOL | PARAMETER | CONDITIONS | RATING | UNIT |
|------------------------------------|--|--|------------------------------|------|
| V _{CC} | DC supply voltage | | -0.5 to +6.5 | V |
| I _{IK} | DC input diode current | V _I < 0 | -50 | mA |
| V _I | DC input voltage | Note 2 | -0.5 to +6.5 | V |
| I _{OK} | DC output diode current | V _O > V _{CC} or V _O < 0 | ± 50 | mA |
| V _O | DC output voltage; output HIGH or LOW state | Note 2 | -0.5 to V _{CC} +0.5 | V |
| | DC output voltage; output 3-State | Note 2 | -0.5 to 6.5 | |
| I _O | DC output source or sink current | V _O = 0 to V _{CC} | ± 50 | mA |
| I _{GND} , I _{CC} | DC V _{CC} or GND current | | ± 100 | mA |
| T _{stg} | Storage temperature range | | -65 to +150 | °C |
| P _{TOT} | Power dissipation per package - plastic mini-pack (SO) - plastic shrink mini-pack (SSOP and TSSOP) | above +70°C derate linearly with 8 mW/K | 500 | mW |
| | | above +60°C derate linearly with 5.5 mW/K | 500 | |

NOTES:

1. Stresses beyond those listed 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.
2. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

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DC ELECTRICAL CHARACTERISTICS

Over recommended operating conditions voltages are referenced to GND (ground = 0V)

| SYMBOL | PARAMETER | TEST CONDITIONS | LIMITS | | | UNIT |
|-------------------|--|--|-----------------------|------------------|------|------|
| | | | Temp = -40°C to +85°C | | | |
| | | | MIN | TYP ¹ | MAX | |
| V _{IH} | HIGH level Input voltage | V _{CC} = 1.2V | V _{CC} | | | V |
| | | V _{CC} = 2.7 to 3.6V | 2.0 | | | |
| V _{IL} | LOW level Input voltage | V _{CC} = 1.2V | | | GND | V |
| | | V _{CC} = 2.7 to 3.6V | | | 0.8 | |
| V _{OH} | HIGH level output voltage | V _{CC} = 2.7V; V _I = V _{IH} or V _{IL} ; I _O = -12mA | V _{CC} - 0.5 | | | V |
| | | V _{CC} = 3.0V; V _I = V _{IH} or V _{IL} ; I _O = -100µA | V _{CC} - 0.2 | V _{CC} | | |
| | | V _{CC} = 3.0V; V _I = V _{IH} or V _{IL} ; I _O = -18mA | V _{CC} - 0.6 | | | |
| | | V _{CC} = 3.0V; V _I = V _{IH} or V _{IL} ; I _O = -24mA | V _{CC} - 0.8 | | | |
| V _{OL} | LOW level output voltage | V _{CC} = 2.7V; V _I = V _{IH} or V _{IL} ; I _O = 12mA | | | 0.40 | V |
| | | V _{CC} = 3.0V; V _I = V _{IH} or V _{IL} ; I _O = 100µA | | | 0.20 | |
| | | V _{CC} = 3.0V; V _I = V _{IH} or V _{IL} ; I _O = 24mA | | | 0.55 | |
| I _I | Input leakage current ⁶ | V _{CC} = 3.6V; V _I = 5.5V or GND | | ±0.1 | ±5 | µA |
| I _{OZ} | 3-State output OFF-state current ^{6, 7} | V _{CC} = 3.6V; V _I = V _{IH} or V _{IL} ; V _O = 5.5V or GND | | 0.1 | ±5 | µA |
| I _{off} | Power off leakage supply | V _{CC} = 0.0V; V _I or V _O = 5.5V | | 0.1 | ±10 | µA |
| I _{CC} | Quiescent supply current | V _{CC} = 3.6V; V _I = V _{CC} or GND; I _O = 0 | | 0.1 | 10 | µA |
| ΔI _{CC} | Additional quiescent supply current per input pin | V _{CC} = 2.7V to 3.6V; V _I = V _{CC} - 0.6V; I _O = 0 | | 5 | 500 | µA |
| I _{BHL} | Bushold LOW sustaining current ^{2, 3, 4} | V _{CC} = 3.0V; V _I = 0.8V | 75 | - | - | µA |
| I _{BHH} | Bushold HIGH sustaining current ^{2, 3, 4} | V _{CC} = 3.0V; V _I = 2.0V | -75 | - | - | µA |
| I _{BHLO} | Bushold LOW overdrive current ^{2, 3, 5} | V _{CC} = 3.6V | 500 | - | - | µA |
| I _{BHHO} | Bushold HIGH overdrive current ^{2, 3, 5} | V _{CC} = 3.6V | -500 | - | - | µA |

NOTES:

1. All typical values are at V_{CC} = 3.3V and T_{amb} = 25°C.
2. Valid for data inputs of bushold parts (LVCH-A) only.
3. For data inputs only, control inputs do not have a bushold circuit.
4. The specified sustaining current at the data input holds the input below the specified V_I level.
5. The specified overdrive current at the data input forces the data input to the opposite logic input state.
6. For bushold parts, the bushold circuit is switched off when V_I exceeds V_{CC} allowing 5.5V on the input terminal.
7. For I/O ports the parameter I_{OZ} includes the input leakage current.

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AC CHARACTERISTICS

GND = 0V; $t_r = t_f \leq 2.5\text{ns}$; $C_L = 50\text{pF}$; $R_L = 500\Omega$; $T_{\text{amb}} = -40^\circ\text{C}$ to $+85^\circ\text{C}$.

| SYMBOL | PARAMETER | WAVEFORM | LIMITS | | | | | | UNIT |
|--------------------------------------|---|----------|--------------------------|------------------|-----|-----------------|-----|-----------------|------|
| | | | $V_{CC} = 3.3V \pm 0.3V$ | | | $V_{CC} = 2.7V$ | | $V_{CC} = 1.2V$ | |
| | | | MIN | TYP ¹ | MAX | MIN | MAX | TYP | |
| t_{PHL} t_{PLH} | Propagation delay A_n to B_n ; B_n to A_n | 1, 3 | 1.5 | 3.6 | 6.3 | 1.5 | 7.3 | 16 | ns |
| t_{PZH} t_{PZL} | 3-State output enable time $\overline{\text{OE}}$ to A_n ; $\overline{\text{OE}}$ to B_n | 2, 3 | 1.5 | 5.1 | 8.5 | 1.5 | 9.5 | 23 | ns |
| t_{PHZ} t_{PLZ} | 3-State output disable time $\overline{\text{OE}}$ to A_n ; $\overline{\text{OE}}$ to B_n | 2, 3 | 1.5 | 4.5 | 7.0 | 1.5 | 8.0 | 16 | ns |

NOTE:

1. Unless otherwise stated, all typical values are at $V_{CC} = 3.3V$ and $T_{\text{amb}} = 25^\circ\text{C}$.

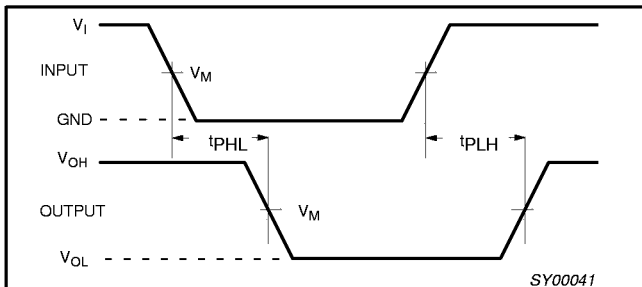
AC WAVEFORMS

$V_M = 1.5V$ at $V_{CC} \geq 2.7V$; $V_M = 0.5 V_{CC}$ at $V_{CC} < 2.7V$.

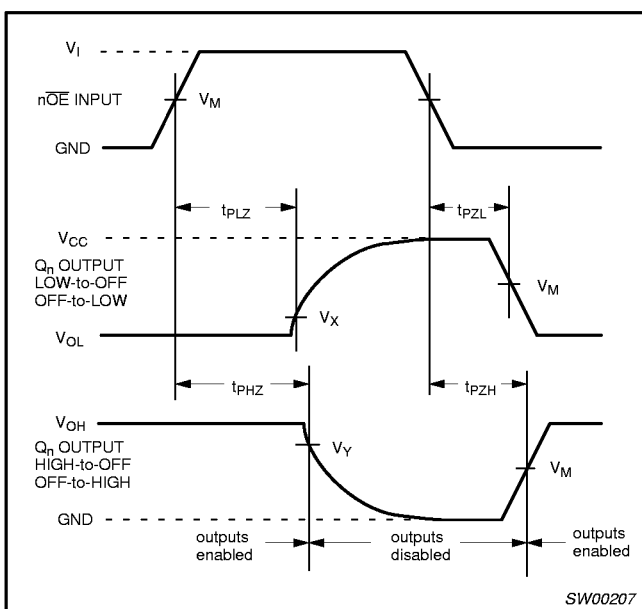
V_{OL} and V_{OH} are the typical output voltage drop that occur with the output load.

$V_X = V_{OL} + 0.3V$ at $V_{CC} \geq 2.7V$; $V_X = V_{OL} + 0.1 V_{CC}$ at $V_{CC} < 2.7V$

$V_Y = V_{OH} - 0.3V$ at $V_{CC} \geq 2.7V$; $V_Y = V_{OH} - 0.1 V_{CC}$ at $V_{CC} < 2.7V$

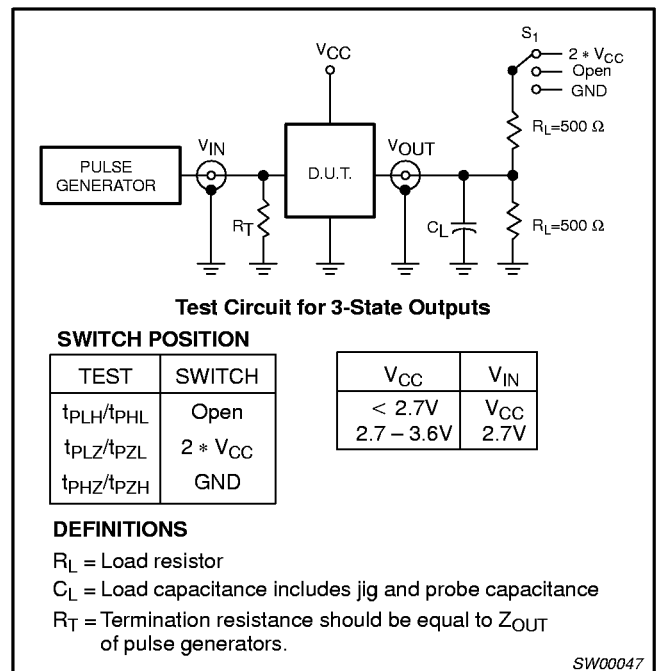


Waveform 1. Input (D_n) to output (Q_n) propagation delays.



Waveform 2. 3-State enable and disable times.

TEST CIRCUIT



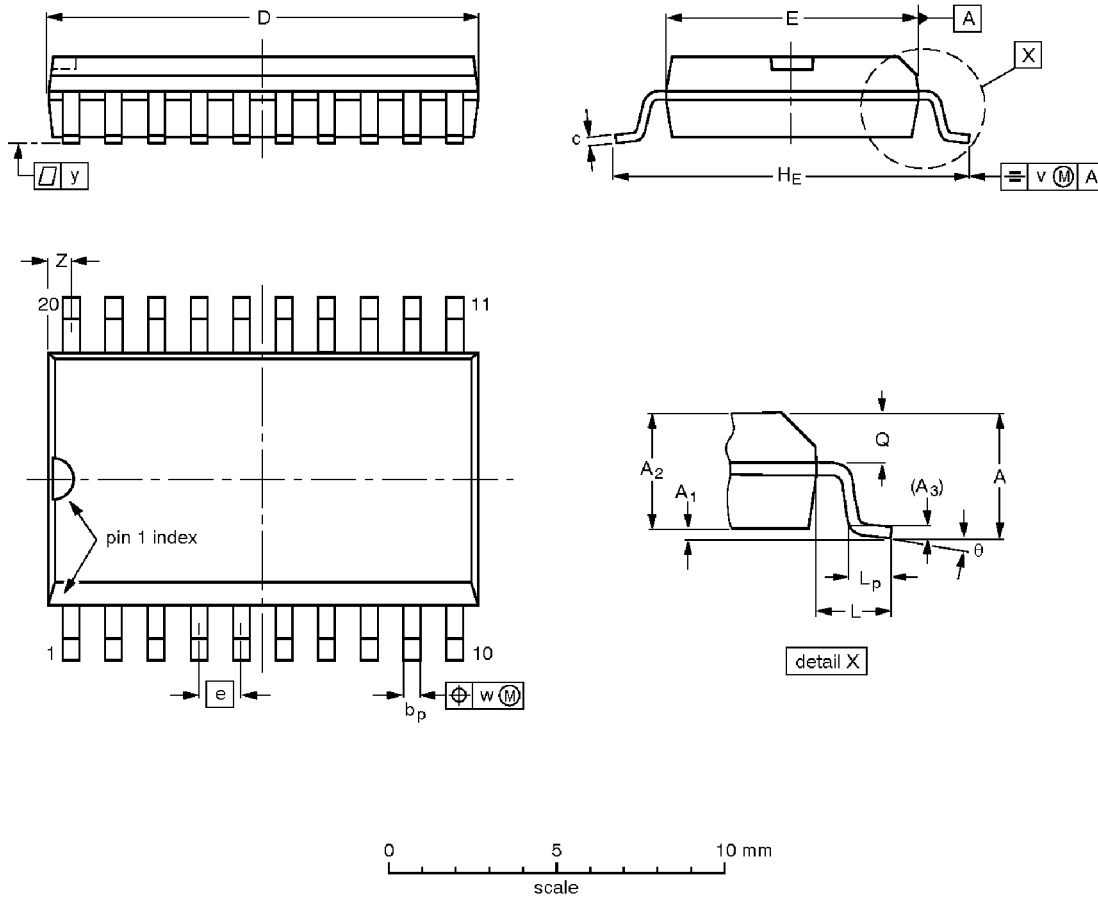
Waveform 3. Load circuitry for switching times.

Octal bus transceiver with direction pin with 5-volt tolerant inputs/outputs (3-State)

74LVC245A
74LVCH245A

SO20: plastic small outline package; 20 leads; body width 7.5 mm

SOT163-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽¹⁾ | e | H _E | L | L _p | Q | v | w | y | Z ⁽¹⁾ | θ |
|--------|--------|----------------|----------------|----------------|----------------|----------------|------------------|------------------|-------|----------------|-------|----------------|----------------|------|------|-------|------------------|----------|
| mm | 2.65 | 0.30 0.10 | 2.45 2.25 | 0.25 | 0.49 0.36 | 0.32 0.23 | 13.0 12.6 | 7.6 7.4 | 1.27 | 10.65 10.00 | 1.4 | 1.1 0.4 | 1.1 1.0 | 0.25 | 0.25 | 0.1 | 0.9 0.4 | 8° 0° |
| inches | 0.10 | 0.012 0.004 | 0.096 0.089 | 0.01 | 0.019 0.014 | 0.013 0.009 | 0.51 0.49 | 0.30 0.29 | 0.050 | 0.42 0.39 | 0.055 | 0.043 0.016 | 0.043 0.039 | 0.01 | 0.01 | 0.004 | 0.035 0.016 | |

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

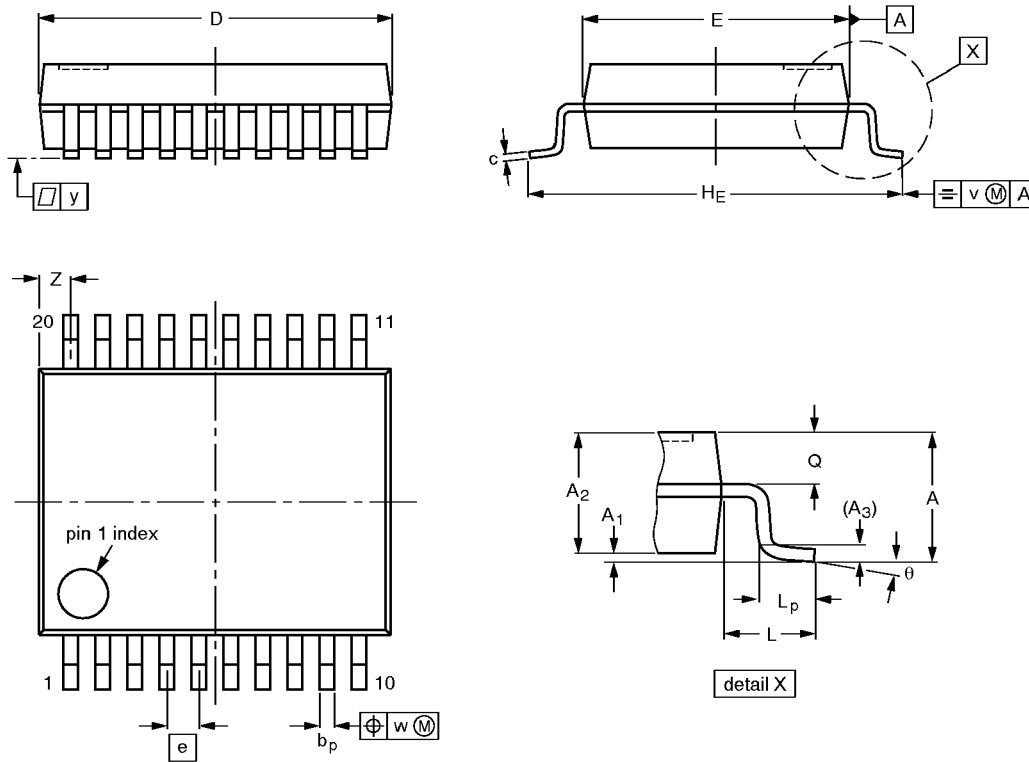
| OUTLINE VERSION | REFERENCES | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|----------|------|---------------------|----------------------|
| | IEC | JEDEC | EIAJ | | |
| SOT163-1 | 075E04 | MS-013AC | | | 92-11-17 95-01-24 |

Octal bus transceiver with direction pin with 5-volt tolerant inputs/outputs (3-State)

74LVC245A
74LVCH245A

SSOP20: plastic shrink small outline package; 20 leads; body width 5.3 mm

SOT339-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽¹⁾ | e | H _E | L | L _p | Q | v | w | y | Z ⁽¹⁾ | θ |
|------|--------|----------------|----------------|----------------|----------------|--------------|------------------|------------------|------|----------------|------|----------------|------------|-----|------|-----|------------------|----------|
| mm | 2.0 | 0.21 0.05 | 1.80 1.65 | 0.25 | 0.38 0.25 | 0.20 0.09 | 7.4 7.0 | 5.4 5.2 | 0.65 | 7.9 7.6 | 1.25 | 1.03 0.63 | 0.9 0.7 | 0.2 | 0.13 | 0.1 | 0.9 0.5 | 8° 0° |

Note

1. Plastic or metal protrusions of 0.20 mm maximum per side are not included.

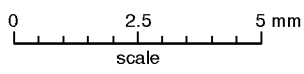
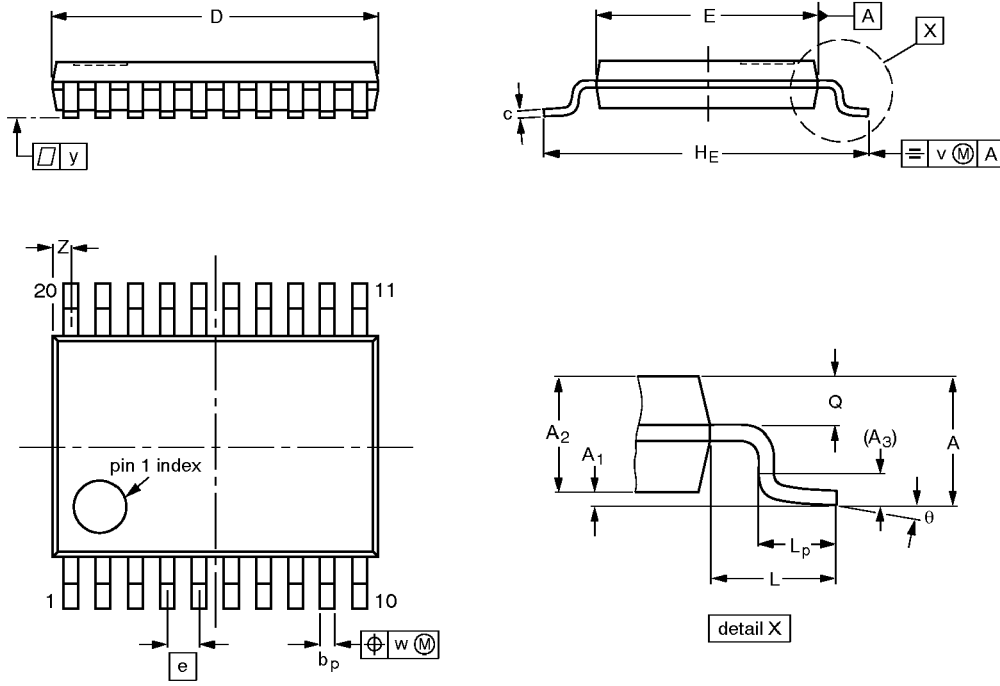
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|----------|------|--|---------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT339-1 | | MO-150AE | | | | 93-09-08 95-02-04 |

Octal bus transceiver with direction pin with 5-volt tolerant inputs/outputs (3-State)

74LVC245A
74LVCH245A

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm

SOT360-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽²⁾ | e | H _E | L | L _p | Q | v | w | y | Z ⁽¹⁾ | θ |
|------|--------|----------------|----------------|----------------|----------------|------------|------------------|------------------|------|----------------|-----|----------------|------------|-----|------|-----|------------------|----------|
| mm | 1.10 | 0.15 0.05 | 0.95 0.80 | 0.25 | 0.30 0.19 | 0.2 0.1 | 6.6 6.4 | 4.5 4.3 | 0.65 | 6.6 6.2 | 1.0 | 0.75 0.50 | 0.4 0.3 | 0.2 | 0.13 | 0.1 | 0.5 0.2 | 8° 0° |

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|----------|------|--|---------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT360-1 | | MO-153AC | | | | 93-06-16 95-02-04 |