

## 1. General Description

The 74HC244; 74HCT244 are 8-bit buffer/line drivers with 3-state outputs. The device can be used as two 4-bit buffers or one 8-bit buffer. The device features two output enables ( $\overline{1OE}$  and  $\overline{2OE}$ ), each controlling four of the 3-state outputs. A HIGH on  $\overline{nOE}$  causes the outputs to assume a high-impedance OFF-state. Inputs include clamp diodes that enable the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ .

## 2. Features and Benefits

- Wide supply voltage range from 2.0 V to 6.0 V
- High noise immunity
- CMOS low power dissipation
- Latch-up performance exceeds 250 mA
- Octal bus interface
- Non-inverting 3-state outputs
- Complies with JEDEC standards:
  - JESD8C (2.7 V to 3.6 V)
  - JESD7A (2.0 V to 6.0 V)
- Input levels:
  - For 74HC244: CMOS level
  - For 74HCT244: TTL level
- ESD protection:
  - HBM ANSI/ESDA/JEDEC JS-001 Class 3A exceeds 6000 V
  - CDM ANSI/ESDA/JEDEC JS-002 Class C3 exceeds 2000 V
- Multiple package options

## 3. Ordering Information

**Table 1. Ordering information**

| Type number | Package   |                                                                           |          |
|-------------|-----------|---------------------------------------------------------------------------|----------|
|             | Name      | Description                                                               | Quantity |
| 74HC244D    | SOP-20L   | plastic small outline package; 20 leads;<br>body width 7.5 mm             | 2000     |
| 74HCT244D   |           |                                                                           |          |
| 74HC244PW   | TSSOP-20L | plastic thin shrink small outline package; 20 leads;<br>body width 4.4 mm | 2000     |
| 74HCT244PW  |           |                                                                           |          |

4.Function Diagram

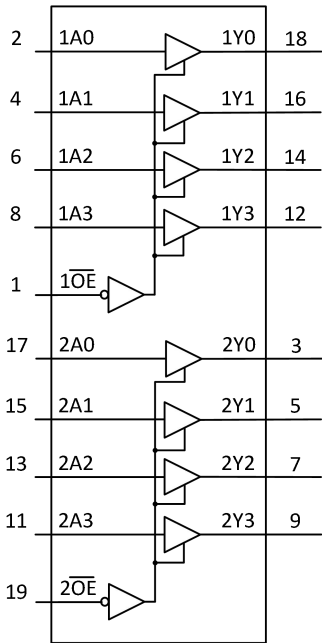


Fig. 1. Functional diagram

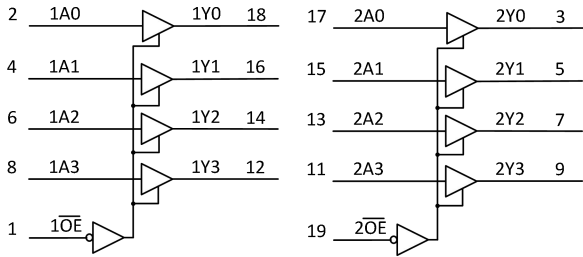


Fig. 2. Logic symbol

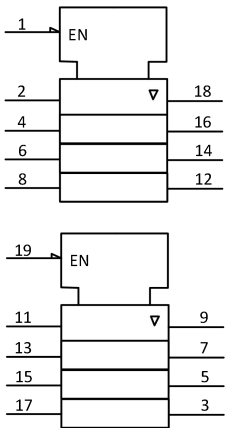
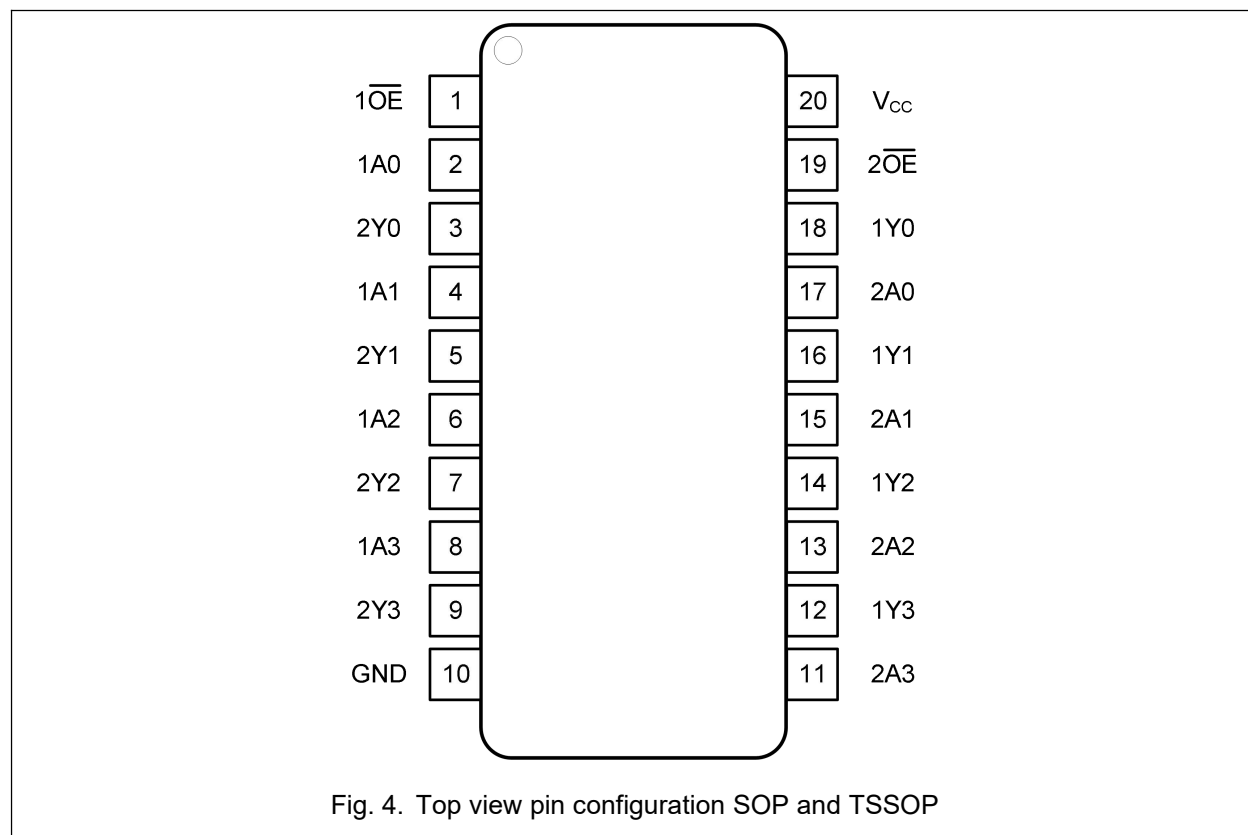


Fig. 3. IEC logic symbol

## 5. Pinning Information

### 5.1. Pinning



### 5.2. Pin description

Table 2. Pin description

| Symbol                              | Pin            | Description                     |
|-------------------------------------|----------------|---------------------------------|
| $\overline{1OE}$ , $\overline{2OE}$ | 1, 19          | Output enable input(active LOW) |
| 1A0, 1A1, 1A2, 1A3                  | 2, 4, 6, 8     | Data input                      |
| 2Y0, 2Y1, 2Y2, 2Y3                  | 3, 5, 7, 9     | Bus output                      |
| GND                                 | 10             | Ground (0V)                     |
| 2A0, 2A1, 2A2, 2A3                  | 17, 15, 13, 11 | Data input                      |
| 1Y0, 1Y1, 1Y2, 1Y3                  | 18, 16, 14, 12 | Bus output                      |
| V <sub>CC</sub>                     | 20             | Supply voltage                  |

## 6. Functional Description

**Table 3. Function table**

H = HIGH voltage level; L = LOW voltage level; X = don't care; Z = high-impedance OFF-state.

| Input            |     | Output |
|------------------|-----|--------|
| $\overline{nOE}$ | nAn | nYn    |
| L                | L   | L      |
| L                | H   | H      |
| H                | X   | Z      |

## 7. Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

**Table 4. Absolute Maximum Ratings**

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND.

| Symbol    | Parameter               | Conditions                                                 | Min  | Max      | Unit |
|-----------|-------------------------|------------------------------------------------------------|------|----------|------|
| $V_{CC}$  | supply voltage          |                                                            | -0.5 | 7.0      | V    |
| $I_{IK}$  | input clamping current  | $V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ [1] |      | $\pm 20$ | mA   |
| $I_{OK}$  | output clamping current | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ [1] |      | $\pm 20$ | mA   |
| $I_O$     | output current          | $V_O = -0.5\text{ V}$ to $(V_{CC} + 0.5\text{ V})$         |      | $\pm 25$ | mA   |
| $I_{CC}$  | supply current          |                                                            |      | 50       | mA   |
| $I_{GND}$ | ground current          |                                                            | -50  |          | mA   |
| $P_{tot}$ | total power dissipation |                                                            |      | 500      | mW   |
| $T_{stg}$ | storage temperature     |                                                            | -65  | 150      | °C   |

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

## 8. Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. MDD does not recommend exceeding them or designing to Absolute Maximum Ratings.

**Table 5. Recommended Operating Conditions**

| Symbol              | Parameter                           | Conditions              | 74HC244 |      |                 | 74HCT244 |      |                 | Unit |
|---------------------|-------------------------------------|-------------------------|---------|------|-----------------|----------|------|-----------------|------|
|                     |                                     |                         | Min     | Typ  | Max             | Min      | Typ  | Max             |      |
| V <sub>CC</sub>     | supply voltage                      |                         | 2.0     | 5.0  | 6.0             | 2.7      | 5.0  | 5.5             | V    |
| V <sub>I</sub>      | input voltage                       |                         | 0       |      | V <sub>CC</sub> | 0        |      | V <sub>CC</sub> | V    |
| V <sub>O</sub>      | output voltage                      |                         | 0       |      | V <sub>CC</sub> | 0        |      | V <sub>CC</sub> | V    |
| T <sub>amb</sub>    | ambient temperature                 |                         | -40     |      | 125             | -40      |      | 125             | °C   |
| $\Delta t/\Delta V$ | input transition rise and fall rate | V <sub>CC</sub> = 2.0 V |         |      | 625             |          |      |                 | ns/V |
|                     |                                     | V <sub>CC</sub> = 4.5 V |         | 1.67 | 139             |          | 1.67 | 139             | ns/V |
|                     |                                     | V <sub>CC</sub> = 6.0 V |         |      | 83              |          |      |                 | ns/V |

## 9.Static Characteristics

**Table 6. Static characteristics**

At recommended operating conditions. Voltages are referenced to GND (ground = 0 V). Typical values measured at  $T_{amb} = 25^{\circ}\text{C}$  (unless otherwise noted).

| Symbol          | Parameter                 | Conditions                                                                                                                 | -40 °C to +85 °C |     |      | -40 °C to +125 °C |      | Unit |
|-----------------|---------------------------|----------------------------------------------------------------------------------------------------------------------------|------------------|-----|------|-------------------|------|------|
|                 |                           |                                                                                                                            | Min              | Typ | Max  | Min               | Max  |      |
| 74HC244         |                           |                                                                                                                            |                  |     |      |                   |      |      |
| V <sub>IH</sub> | HIGH-level input voltage  | V <sub>CC</sub> = 2.0 V                                                                                                    | 1.5              |     |      | 1.5               |      | V    |
|                 |                           | V <sub>CC</sub> = 4.5 V                                                                                                    | 3.15             |     |      | 3.15              |      | V    |
|                 |                           | V <sub>CC</sub> = 6.0 V                                                                                                    | 4.2              |     |      | 4.2               |      | V    |
| V <sub>IL</sub> | LOW-level input voltage   | V <sub>CC</sub> = 2.0 V                                                                                                    |                  |     | 0.5  |                   | 0.5  | V    |
|                 |                           | V <sub>CC</sub> = 4.5 V                                                                                                    |                  |     | 1.35 |                   | 1.35 | V    |
|                 |                           | V <sub>CC</sub> = 6.0 V                                                                                                    |                  |     | 1.8  |                   | 1.8  | V    |
| V <sub>OH</sub> | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                                                        |                  |     |      |                   |      |      |
|                 |                           | I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 2.0 V                                                                           | 1.9              |     |      | 1.9               |      | V    |
|                 |                           | I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V                                                                           | 4.4              |     |      | 4.4               |      | V    |
|                 |                           | I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V                                                                           | 5.9              |     |      | 5.9               |      | V    |
|                 |                           | I <sub>O</sub> = -6.0 mA; V <sub>CC</sub> = 4.5 V                                                                          | 3.84             |     |      | 3.7               |      | V    |
|                 |                           | I <sub>O</sub> = -7.8 mA; V <sub>CC</sub> = 6.0 V                                                                          | 5.34             |     |      | 5.2               |      | V    |
| V <sub>OL</sub> | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                                                        |                  |     |      |                   |      |      |
|                 |                           | I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 2.0 V                                                                            |                  |     | 0.1  |                   | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V                                                                            |                  |     | 0.1  |                   | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V                                                                            |                  |     | 0.1  |                   | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 6.0 mA; V <sub>CC</sub> = 4.5 V                                                                           |                  |     | 0.33 |                   | 0.4  | V    |
|                 |                           | I <sub>O</sub> = 7.8 mA; V <sub>CC</sub> = 6.0 V                                                                           |                  |     | 0.33 |                   | 0.4  | V    |
| I <sub>I</sub>  | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND ;<br>V <sub>CC</sub> = 6.0 V                                                       |                  |     | ±1   |                   | ±1   | μA   |
| I <sub>OZ</sub> | OFF-state output current  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 6.0 V ;<br>V <sub>O</sub> = V <sub>CC</sub> or GND |                  |     | ±5   |                   | ±10  | μA   |
| I <sub>CC</sub> | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND ; I <sub>O</sub> = 0 A ;<br>V <sub>CC</sub> = 6.0 V                                |                  |     | 20   |                   | 40   | μA   |
| C <sub>I</sub>  | input capacitance         | Pin $\overline{\text{OE}}$                                                                                                 |                  | 4.0 |      |                   |      | pF   |
|                 |                           | Pin nAn                                                                                                                    |                  | 7.7 |      |                   |      | pF   |

## 74HC244; 74HCT244

Octal buffer/line driver; 3-state

| Symbol           | Parameter                 | Conditions                                                                                                                                         | -40 °C to +85 °C |     |      | -40 °C to +125 °C |     | Unit |
|------------------|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----|------|-------------------|-----|------|
|                  |                           |                                                                                                                                                    | Min              | Typ | Max  | Min               | Max |      |
| 74HCT244         |                           |                                                                                                                                                    |                  |     |      |                   |     |      |
| V <sub>IH</sub>  | HIGH-level input voltage  | V <sub>CC</sub> = 3 V                                                                                                                              | 2.0              |     |      | 2.0               |     | V    |
|                  |                           | V <sub>CC</sub> = 4.5 V                                                                                                                            | 2.0              |     |      | 2.0               |     | V    |
|                  |                           | V <sub>CC</sub> = 5.5 V                                                                                                                            | 2.1              |     |      | 2.1               |     | V    |
| V <sub>IL</sub>  | LOW-level input voltage   | V <sub>CC</sub> = 3 V                                                                                                                              |                  |     | 0.7  |                   | 0.7 | V    |
|                  |                           | V <sub>CC</sub> = 4.5 V                                                                                                                            |                  |     | 0.8  |                   | 0.8 | V    |
|                  |                           | V <sub>CC</sub> = 5.5 V                                                                                                                            |                  |     | 0.8  |                   | 0.8 | V    |
| V <sub>OH</sub>  | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;                                                                                              |                  |     |      |                   |     |      |
|                  |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 3 V                                                                                                     | 2.9              |     |      | 2.9               |     | V    |
|                  |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 4.5 V                                                                                                   | 4.4              |     |      | 4.4               |     | V    |
|                  |                           | I <sub>O</sub> = -6.0 mA; V <sub>CC</sub> = 4.5 V                                                                                                  | 3.84             |     |      | 3.7               |     | V    |
| V <sub>OL</sub>  | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;                                                                                              |                  |     |      |                   |     |      |
|                  |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 3 V                                                                                                      |                  |     | 0.1  |                   | 0.1 | V    |
|                  |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 4.5 V                                                                                                    |                  |     | 0.1  |                   | 0.1 | V    |
|                  |                           | I <sub>O</sub> = 6.0 mA; V <sub>CC</sub> = 4.5 V                                                                                                   |                  |     | 0.33 |                   | 0.4 | V    |
| I <sub>I</sub>   | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND ;<br>V <sub>CC</sub> = 5.5 V                                                                               |                  |     | ±1   |                   | ±1  | µA   |
| I <sub>OZ</sub>  | OFF-state output current  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 5.5 V ;<br>V <sub>O</sub> = V <sub>CC</sub> or GND                         |                  |     | ±5   |                   | ±10 | µA   |
| I <sub>CC</sub>  | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V                                                             |                  |     | 20   |                   | 40  | µA   |
| ΔI <sub>CC</sub> | additional supply current | per pin ; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; I <sub>O</sub> = 0 A; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V |                  |     | 400  |                   | 490 | µA   |
| C <sub>I</sub>   | input capacitance         | Pin $\overline{\text{OE}}$                                                                                                                         |                  | 4.0 |      |                   |     | pF   |
|                  |                           | Pin nAn                                                                                                                                            |                  | 7.7 |      |                   |     | pF   |

## 10. Dynamic Characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 7. Typical values measured at  $T_{amb} = 25^{\circ}\text{C}$  (unless otherwise noted).

| Symbol           | Parameter                     | Conditions                                                     | -40 °C to +85 °C |     |     | -40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|----------------------------------------------------------------|------------------|-----|-----|-------------------|-----|------|
|                  |                               |                                                                | Min              | Typ | Max | Min               | Max |      |
| 74HC244          |                               |                                                                |                  |     |     |                   |     |      |
| t <sub>pd</sub>  | propagation delay             | nAn to nYn; see Fig. 5 [1]                                     |                  |     |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                        |                  |     | 35  |                   | 40  | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                        |                  |     | 20  |                   | 25  | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                        |                  |     | 15  |                   | 20  | ns   |
| t <sub>en</sub>  | enable time                   | nOE to nYn; see Fig. 6 [2]                                     |                  |     |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                        |                  |     | 35  |                   | 40  | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                        |                  |     | 20  |                   | 25  | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                        |                  |     | 15  |                   | 20  | ns   |
| t <sub>dis</sub> | disable time                  | nOE to nYn; see Fig. 6 [3]                                     |                  |     |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                        |                  |     | 35  |                   | 40  | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                        |                  |     | 20  |                   | 25  | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                        |                  |     | 15  |                   | 20  | ns   |
| t <sub>t</sub>   | transition time               | see Fig. 5 [4]                                                 |                  |     |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                        |                  |     | 9   |                   | 11  | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                        |                  |     | 6   |                   | 8   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                        |                  |     | 4   |                   | 5   | ns   |
| C <sub>PD</sub>  | power dissipation capacitance | Per buffer ;<br>V <sub>I</sub> = GND to V <sub>CC</sub><br>[5] |                  | 18  |     |                   |     | pF   |

## 74HC244; 74HCT244

Octal buffer/line driver; 3-state

| Symbol           | Parameter                     | Conditions                                                               | -40 °C to +85 °C |     |     | -40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|--------------------------------------------------------------------------|------------------|-----|-----|-------------------|-----|------|
|                  |                               |                                                                          | Min              | Typ | Max | Min               | Max |      |
| 74HCT244         |                               |                                                                          |                  |     |     |                   |     |      |
| t <sub>pd</sub>  | propagation delay             | nA to nY; V <sub>CC</sub> = 4.5 V; see Fig. 5 [1]                        |                  |     | 20  |                   | 25  | ns   |
| t <sub>en</sub>  | enable time                   | n $\overline{\text{OE}}$ to nYn; V <sub>CC</sub> = 4.5 V; see Fig. 6 [2] |                  |     | 20  |                   | 25  | ns   |
| t <sub>dis</sub> | disable time                  | n $\overline{\text{OE}}$ to nYn; V <sub>CC</sub> = 4.5 V; see Fig. 6 [3] |                  |     | 20  |                   | 25  | ns   |
| t <sub>t</sub>   | transition time               | V <sub>CC</sub> = 4.5 V; see Fig. 5 [4]                                  |                  |     | 6   |                   | 8   | ns   |
| C <sub>PD</sub>  | power dissipation capacitance | per buffer ; V <sub>I</sub> = GND to (V <sub>CC</sub> -1.5 V) [5]        |                  | 18  |     |                   |     | pF   |

[1]  $t_{pd}$  is the same as  $t_{PHL}$  and  $t_{PLH}$ .

[2]  $t_{en}$  is the same as  $t_{PZH}$  and  $t_{PZL}$ .

[3]  $t_{dis}$  is the same as  $t_{PLZ}$  and  $t_{PHZ}$ .

[4]  $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .

[5]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$  where:

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

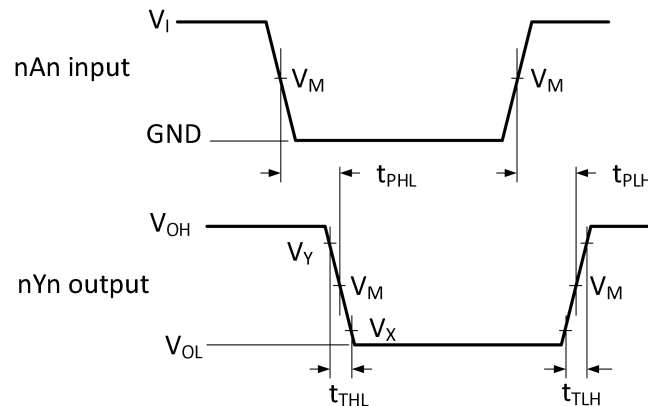
$C_L$  = output load capacitance in pF;

$V_{CC}$  = supply voltage in V;

$N$  = number of inputs switching;

$\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.

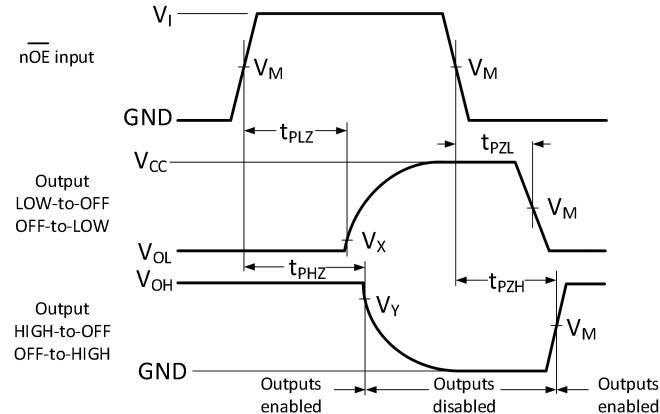
## 10.1. Waveforms and test circuit



Measurement points are given in Table 8.

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

Fig. 5. The input nAn to output nYn propagation delays



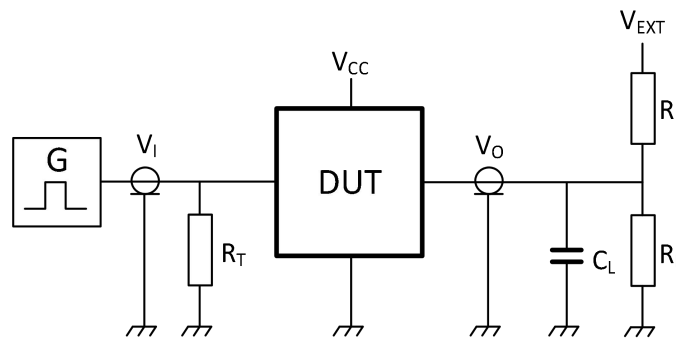
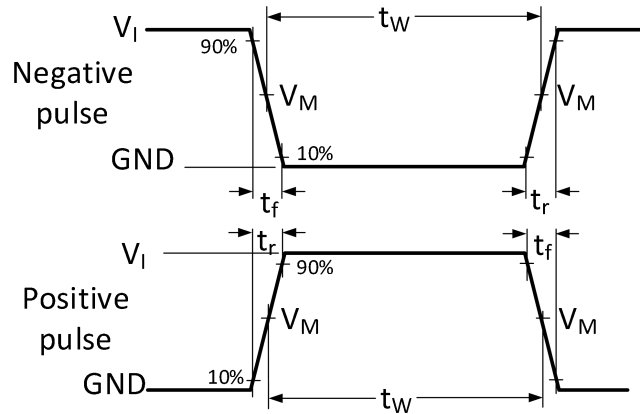
Measurement points are given in Table 8.

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

Fig. 6. 3-state enable and disable times

**Table 8. Measurement points**

| Type     | Input       | Output      |             |             |
|----------|-------------|-------------|-------------|-------------|
|          | $V_M$       | $V_M$       | $V_X$       | $V_Y$       |
| 74HC244  | $0.5V_{CC}$ | $0.5V_{CC}$ | $0.1V_{CC}$ | $0.9V_{CC}$ |
| 74HCT244 | 1.3 V       | 1.3 V       | $0.1V_{CC}$ | $0.9V_{CC}$ |



Test data is given in Table 9.

Definitions for test circuit:

$R_L$  = Load resistance.

$C_L$  = Load capacitance including jig and probe capacitance.

$R_T$  = Termination resistance should be equal to the output impedance  $Z_o$  of the pulse generator.

$V_{EXT}$  = External voltage for measuring switching times.

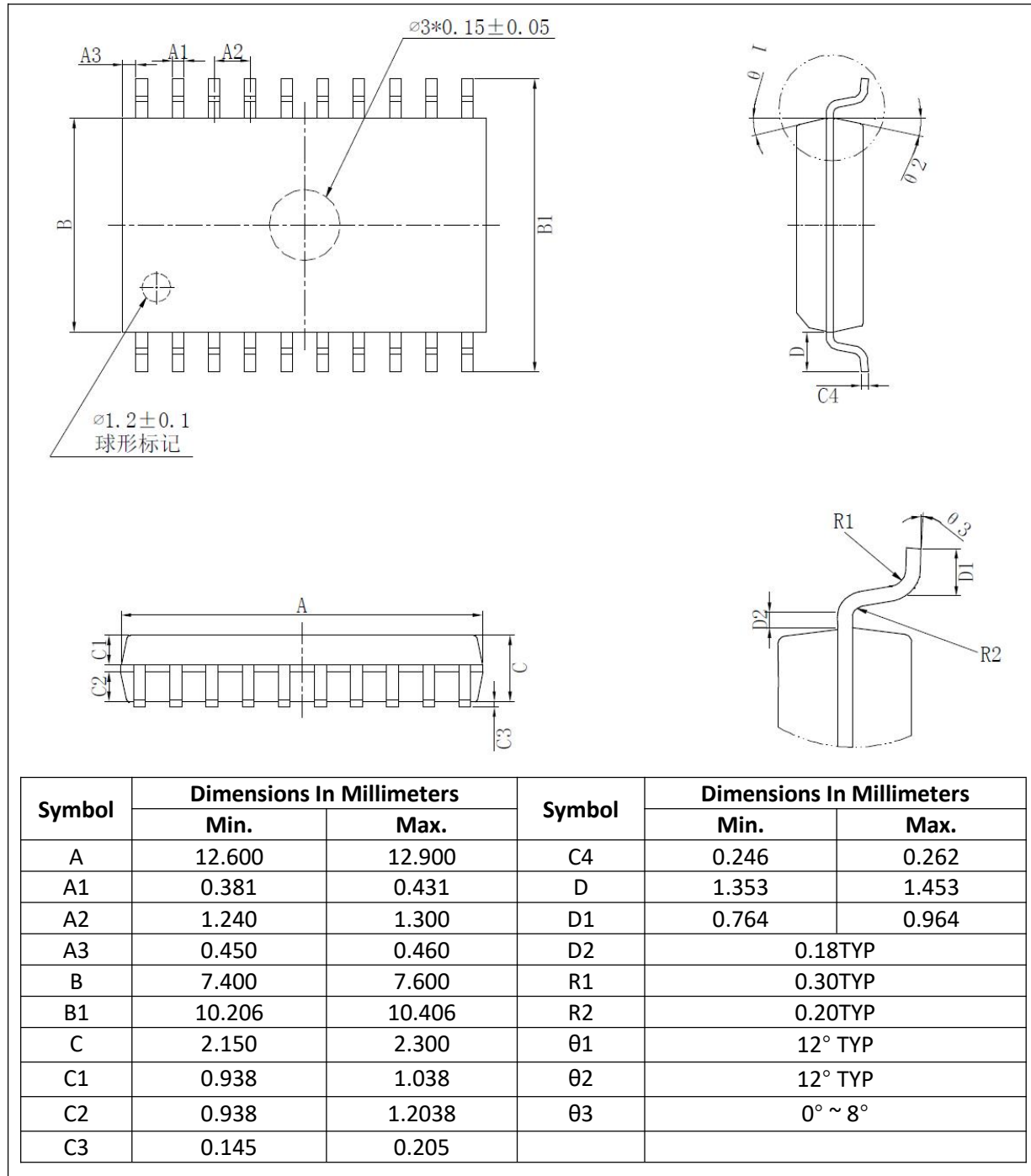
Fig. 7. Test circuit for measuring switching times

**Table 9. Test data**

| Type     | Input    |               | Load  |              | $V_{EXT}$          |                    |                    |
|----------|----------|---------------|-------|--------------|--------------------|--------------------|--------------------|
|          | $V_I$    | $t_r = t_f$   | $C_L$ | $R_L$        | $t_{PLH}, t_{PHL}$ | $t_{PZH}, t_{PHZ}$ | $t_{PZL}, t_{PLZ}$ |
| 74HC244  | $V_{CC}$ | $\leq 2.5$ ns | 50 pF | 500 $\Omega$ | open               | GND                | $2V_{CC}$          |
| 74HCT244 | 3 V      | $\leq 2.5$ ns | 50 pF | 500 $\Omega$ | open               | GND                | $2V_{CC}$          |

# 11. Package Outline

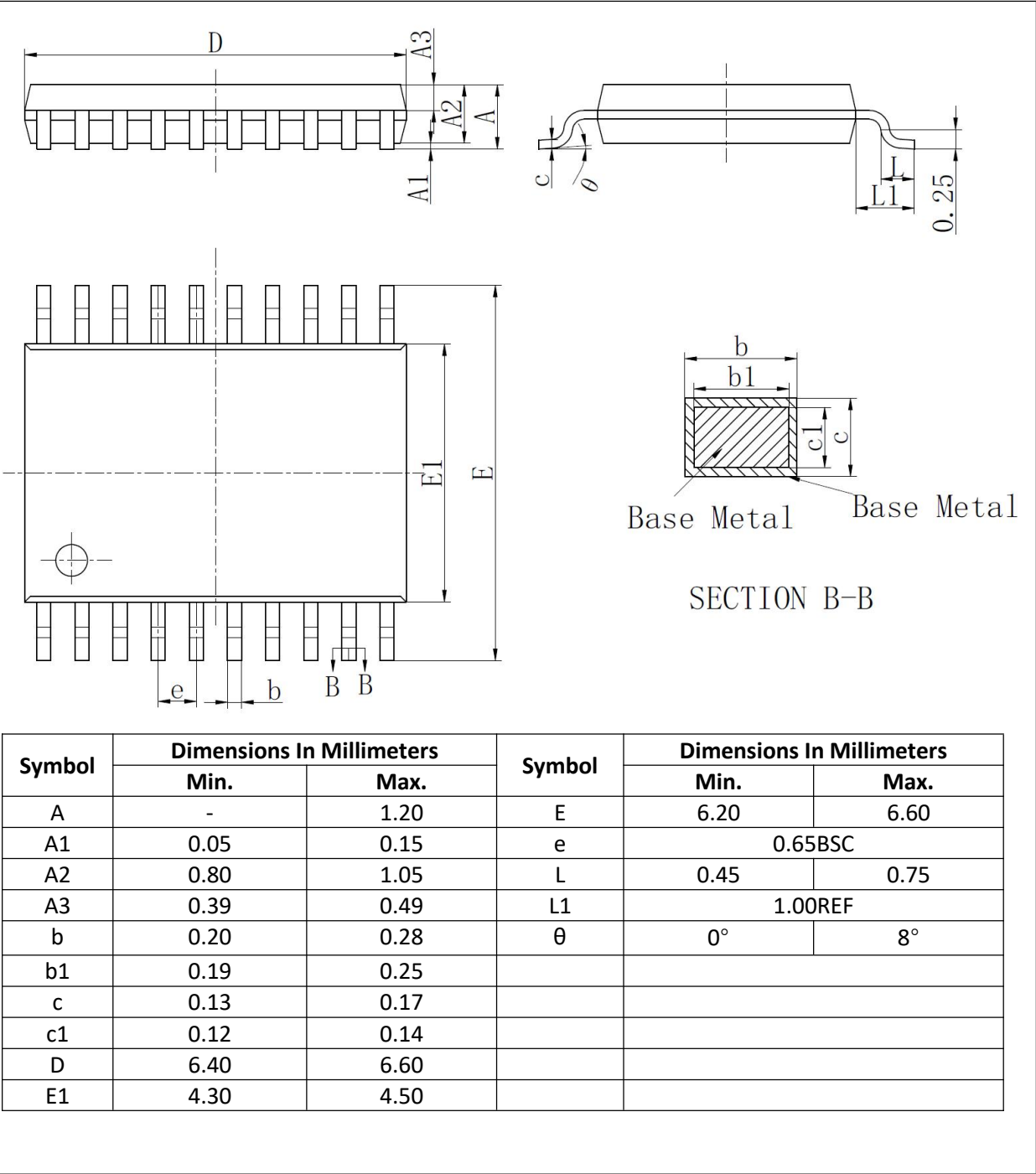
## SOP-20L



**74HC244; 74HCT244**

Octal buffer/line driver; 3-state

**TSSOP-20L**



## 12. Abbreviations

**Table 10. Abbreviations**

| Acronym | Description                             |
|---------|-----------------------------------------|
| CMOS    | Complementary Metal-Oxide Semiconductor |
| DUT     | Device Under Test                       |
| ESD     | ElectroStatic Discharge                 |
| HBM     | Human Body Model                        |
| CDM     | Charged Device Model                    |
| TTL     | Transistor-Transistor Logic             |

## 13. Revision History

**Table 11. Revision history**

| Document ID          | Release Date | Data sheet status | Change notice | Supersedes |
|----------------------|--------------|-------------------|---------------|------------|
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