

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC74HC240AP,TC74HC240AF,TC74HC241AP TC74HC241AF,TC74HC244AP,TC74HC244AF

### Octal Bus Buffer

|                |                               |
|----------------|-------------------------------|
| TC74HC240AP/AF | Inverted, 3-State Outputs     |
| TC74HC241AP/AF | Non-Inverted, 3-State Outputs |
| TC74HC244AP/AF | Non-Inverted, 3-State Outputs |

The TC74HC240A, 241A and 244A are high speed CMOS OCTAL BUS BUFFERS fabricated with silicon gate C2MOS technology.

They achieve the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

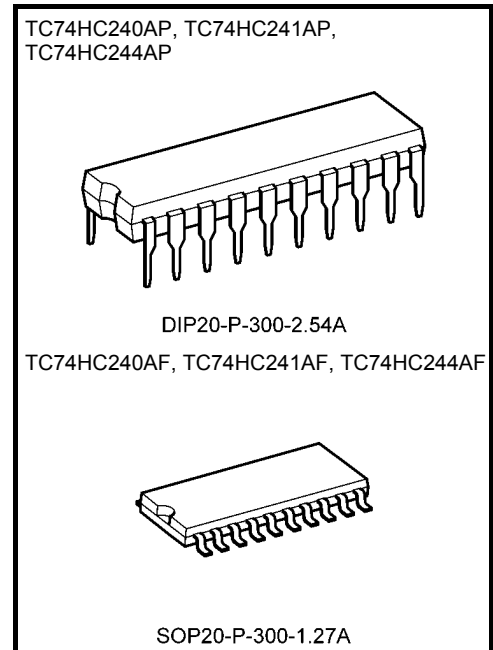
The 74HC240A is an inverting 3-state buffer having two active-low output enables. The TC74HC241A and TC74HC244A are non-inverting 3-state buffers that differ only in that the 241A has one active-high and one active-low output enable, and the 244A has two active-low output enables.

These devices are designed to be used with 3-state memory address drivers, etc.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

### Features

- High speed:  $t_{pd} = 10 \text{ ns}$  (typ.) at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 4 \mu\text{A}$  (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Output drive capability: 15 LSTTL loads
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 6 \text{ mA}$  (min)
- Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$
- Wide operating voltage range:  $V_{CC} (\text{opr}) = 2\sim 6 \text{ V}$
- Pin and function compatible with 74LS240/241/244

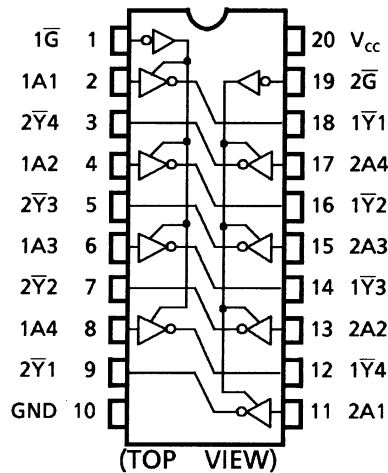


Weight

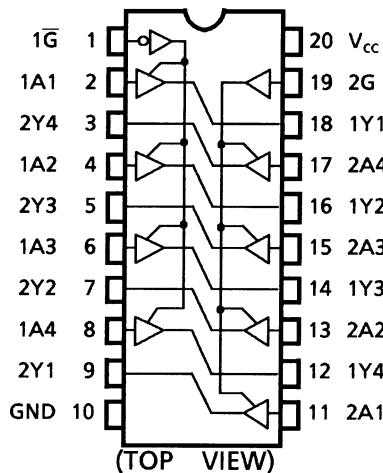
|                   |                 |
|-------------------|-----------------|
| DIP20-P-300-2.54A | : 1.30 g (typ.) |
| SOP20-P-300-1.27A | : 0.22 g (typ.) |

## Pin Assignment

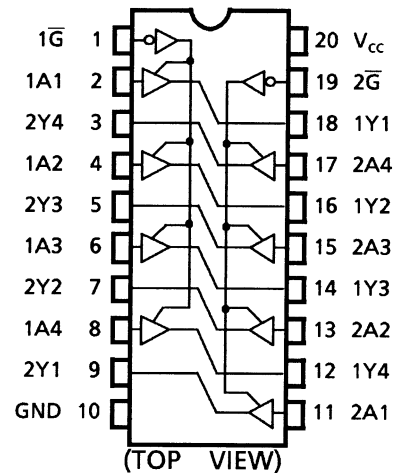
TC74HC240A



TC74HC241A

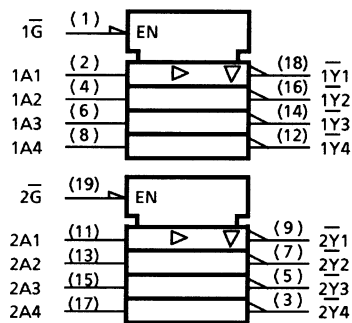


TC74HC244A

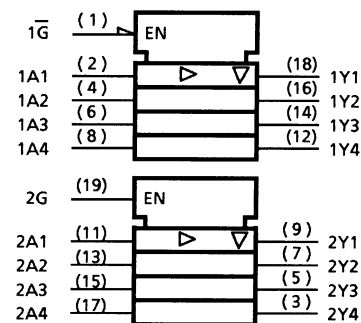


## IEC Logic Symbol

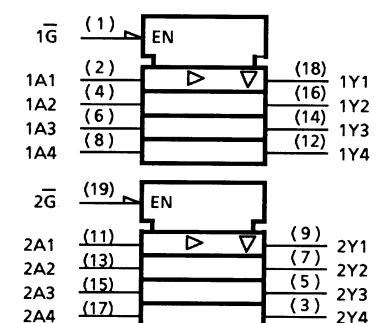
TC74HC240A



TC74HC241A



TC74HC244A



## Truth Table

| Inputs         |              |       | Outputs |                                 |
|----------------|--------------|-------|---------|---------------------------------|
| $\overline{G}$ | $G^{\Delta}$ | $A_n$ | $Y_n$   | $\overline{Y}_n^{\Delta\Delta}$ |
| L              | H            | L     | L       | H                               |
| L              | H            | H     | H       | L                               |
| H              | L            | X     | Z       | Z                               |

$\Delta$ : For TC74HC241A only

$\Delta\Delta$ : For TC74HC240A only

X: Don't care

Z: High impedance

## Absolute Maximum Ratings (Note 1)

| Characteristics             | Symbol    | Rating                       | Unit |
|-----------------------------|-----------|------------------------------|------|
| Supply voltage range        | $V_{CC}$  | -0.5~7                       | V    |
| DC input voltage            | $V_{IN}$  | -0.5~ $V_{CC} + 0.5$         | V    |
| DC output voltage           | $V_{OUT}$ | -0.5~ $V_{CC} + 0.5$         | V    |
| Input diode current         | $I_{IK}$  | ±20                          | mA   |
| Output diode current        | $I_{OK}$  | ±20                          | mA   |
| DC output current           | $I_{OUT}$ | ±35                          | mA   |
| DC $V_{CC}$ /ground current | $I_{CC}$  | ±75                          | mA   |
| Power dissipation           | $P_D$     | 500 (DIP) (Note 2)/180 (SOP) | mW   |
| Storage temperature         | $T_{stg}$ | -65~150                      | °C   |

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

Note 2: 500 mW in the range of  $T_a = -40$  to  $65^{\circ}\text{C}$ . From  $T_a = 65$  to  $85^{\circ}\text{C}$  a derating factor of  $-10\text{ mW}/^{\circ}\text{C}$  shall be applied until 300 mW.

## Operating Ranges (Note)

| Characteristics          | Symbol     | Rating                                                                                                       | Unit |
|--------------------------|------------|--------------------------------------------------------------------------------------------------------------|------|
| Supply voltage           | $V_{CC}$   | 2~6                                                                                                          | V    |
| Input voltage            | $V_{IN}$   | 0~ $V_{CC}$                                                                                                  | V    |
| Output voltage           | $V_{OUT}$  | 0~ $V_{CC}$                                                                                                  | V    |
| Operating temperature    | $T_{opr}$  | -40~85                                                                                                       | °C   |
| Input rise and fall time | $t_r, t_f$ | 0~1000 ( $V_{CC} = 2.0\text{ V}$ )<br>0~500 ( $V_{CC} = 4.5\text{ V}$ )<br>0~400 ( $V_{CC} = 6.0\text{ V}$ ) | ns   |

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either VCC or GND.

**Electrical Characteristics**
**DC Characteristics**

| Characteristics           | Symbol | Test Condition   |                              | Ta = 25°C         |                      |             |                      | Ta = -40~85°C        |                      | Unit |
|---------------------------|--------|------------------|------------------------------|-------------------|----------------------|-------------|----------------------|----------------------|----------------------|------|
|                           |        |                  |                              | VCC (V)           | Min                  | Typ.        | Max                  | Min                  | Max                  |      |
| High-level input voltage  | VIH    | —                |                              | 2.0<br>4.5<br>6.0 | 1.50<br>3.15<br>4.20 | —<br>—<br>— | —<br>—<br>—          | 1.50<br>3.15<br>4.20 | —<br>—<br>—          | V    |
| Low-level input voltage   | VIL    | —                |                              | 2.0<br>4.5<br>6.0 | —<br>—<br>—          | —<br>—<br>— | 0.50<br>1.35<br>1.80 | —<br>—<br>—          | 0.50<br>1.35<br>1.80 | V    |
| High-level output voltage | VOH    | VIN = VIH or VIL | IOH = -20 μA                 | 2.0               | 1.9                  | 2.0         | —                    | 1.9                  | —                    | V    |
|                           |        |                  |                              | 4.5               | 4.4                  | 4.5         | —                    | 4.4                  | —                    |      |
|                           |        |                  | IOH = -6 mA<br>IOH = -7.8 mA | 6.0               | 5.9                  | 6.0         | —                    | 5.9                  | —                    |      |
|                           |        |                  |                              | 4.5               | 4.18                 | 4.31        | —                    | 4.13                 | —                    |      |
| Low-level output voltage  | VOL    | VIN = VIH or VIL | IOL = 20 μA                  | 2.0               | —                    | 0.0         | 0.1                  | —                    | 0.1                  | V    |
|                           |        |                  |                              | 4.5               | —                    | 0.0         | 0.1                  | —                    | 0.1                  |      |
|                           |        |                  | IOL = 6 mA<br>IOL = 7.8 mA   | 6.0               | —                    | 0.0         | 0.1                  | —                    | 0.1                  |      |
|                           |        |                  |                              | 4.5               | —                    | 0.17        | 0.26                 | —                    | 0.33                 |      |
| Input leakage current     | IIN    | VIN = VCC or GND |                              | 6.0               | —                    | —           | ±0.1                 | —                    | ±1.0                 | μA   |
|                           |        | VIN = VCC or GND |                              | 6.0               | —                    | —           | 4.0                  | —                    | 40.0                 | μA   |

**AC Characteristics (input:  $t_r = t_f = 6 \text{ ns}$ )**

| Characteristics               | Symbol        | Test Condition  |         |         | Ta = 25°C |      |     | Ta = -40~85°C |     | Unit |
|-------------------------------|---------------|-----------------|---------|---------|-----------|------|-----|---------------|-----|------|
|                               |               |                 | CL (pF) | VCC (V) | Min       | Typ. | Max | Min           | Max |      |
| Output transition time        | tTLH<br>tTHL  | —               | 50      | 2.0     | —         | 25   | 60  | —             | 75  | ns   |
|                               |               |                 |         | 4.5     | —         | 7    | 12  | —             | 15  |      |
|                               |               |                 |         | 6.0     | —         | 6    | 10  | —             | 13  |      |
| Propagation delay time        | tPLH<br>tPHL  | —               | 50      | 2.0     | —         | 36   | 90  | —             | 115 | ns   |
|                               |               |                 |         | 4.5     | —         | 12   | 18  | —             | 23  |      |
|                               |               |                 |         | 6.0     | —         | 10   | 15  | —             | 20  |      |
|                               |               |                 | 150     | 2.0     | —         | 51   | 130 | —             | 165 |      |
|                               |               |                 |         | 4.5     | —         | 17   | 26  | —             | 33  |      |
|                               |               |                 |         | 6.0     | —         | 14   | 22  | —             | 28  |      |
| Output enable time            | tPZL<br>tPZH  | RL = 1 kΩ       | 50      | 2.0     | —         | 48   | 125 | —             | 155 | ns   |
|                               |               |                 |         | 4.5     | —         | 16   | 25  | —             | 31  |      |
|                               |               |                 |         | 6.0     | —         | 14   | 21  | —             | 26  |      |
|                               |               |                 | 150     | 2.0     | —         | 63   | 165 | —             | 205 |      |
|                               |               |                 |         | 4.5     | —         | 21   | 33  | —             | 41  |      |
|                               |               |                 |         | 6.0     | —         | 18   | 28  | —             | 35  |      |
| Output disable time           | tPLZ<br>tPHZ  | RL = 1 kΩ       | 50      | 2.0     | —         | 32   | 125 | —             | 155 | ns   |
|                               |               |                 |         | 4.5     | —         | 15   | 25  | —             | 31  |      |
|                               |               |                 |         | 6.0     | —         | 14   | 21  | —             | 26  |      |
| Input capacitance             | CIN           | —               |         |         | —         | 5    | 10  | —             | 10  | pF   |
| Output capacitance            | COUT          | —               |         |         | —         | 10   | —   | —             | —   | pF   |
| Power dissipation capacitance | CPD<br>(Note) | TC74HC240A      |         |         | —         | 31   | —   | —             | —   | pF   |
|                               |               | TC74HC241A/244A |         |         | —         | 33   | —   | —             | —   |      |

Note: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

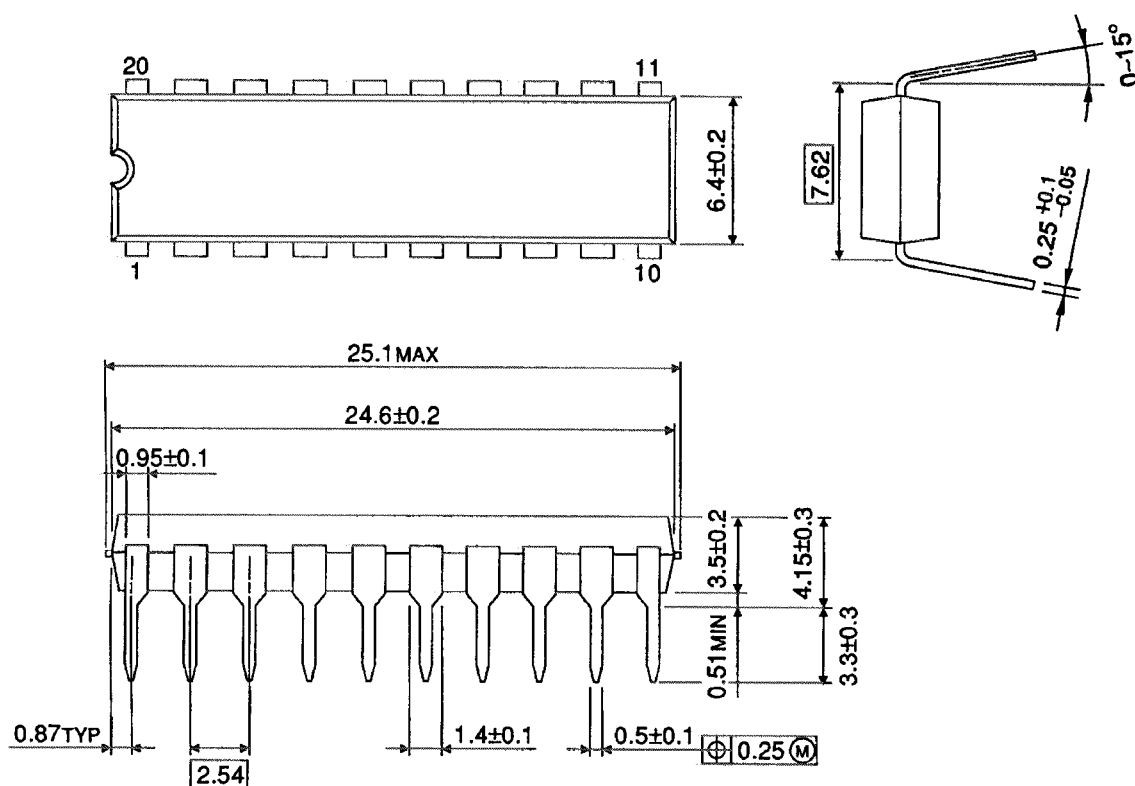
Average operating current can be obtained by the equation:

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/8 \text{ (per bit)}$$

## Package Dimensions

DIP20-P-300-2.54A

Unit : mm

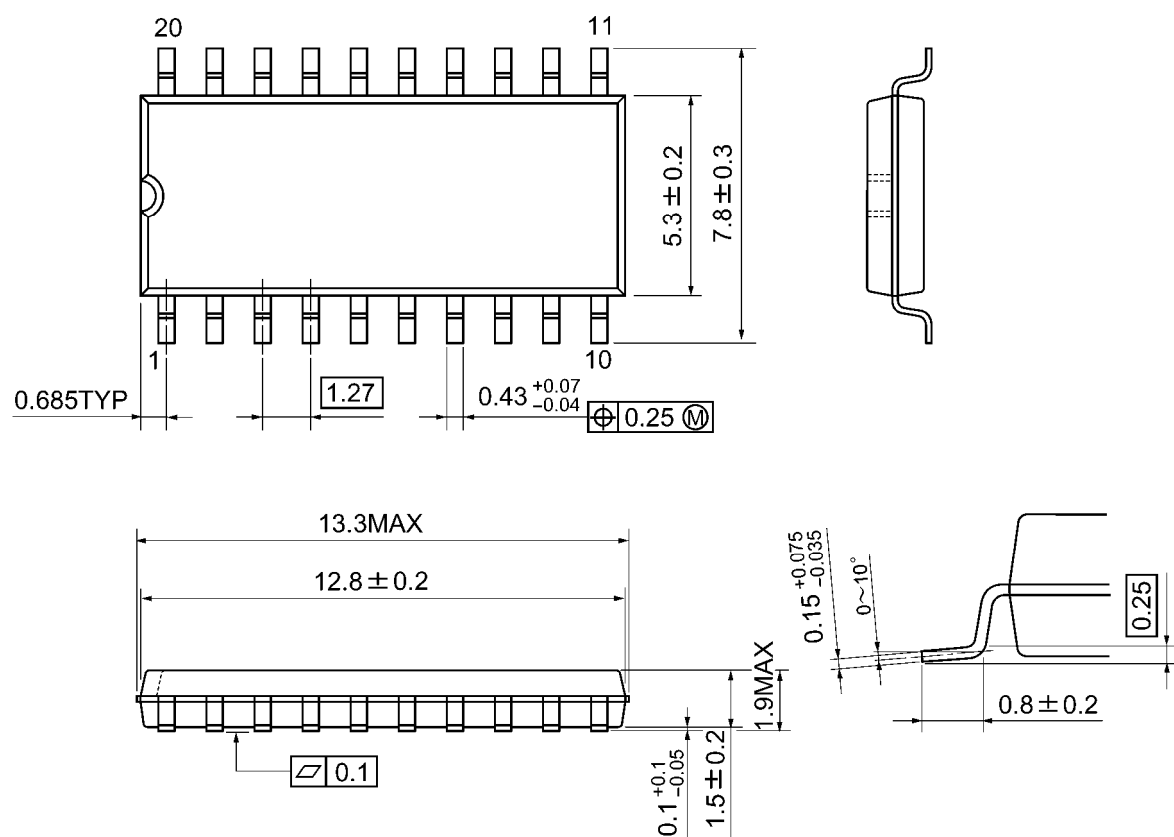


Weight: 1.30 g (typ.)

## Package Dimensions

SOP20-P-300-1.27A

Unit: mm



Weight: 0.22 g (typ.)

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