

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 C<sup>2</sup>MOS technology.

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

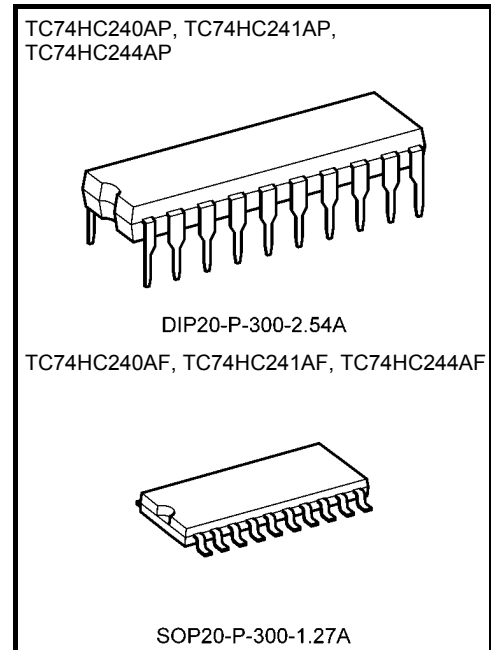
The 74HC240A is an inverting 3-state buffer having two active-low output enables. The TC74HC241A and TC74HC244A are non-inverting 3-state buffers that differ only in that the 241A has one active-high and one active-low output enable, and the 244A has two active-low output enables.

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:  $V_{CC} (\text{opr}) = 2 \text{ to } 6 \text{ V}$
- Pin and function compatible with 74LS240/241/244



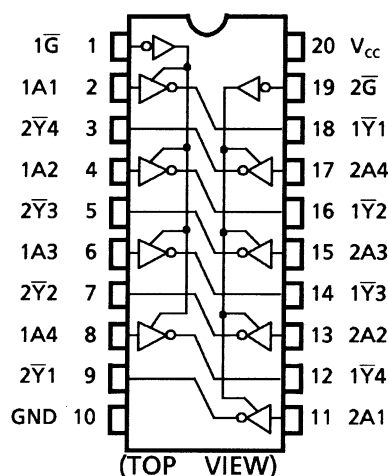
#### Weight

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

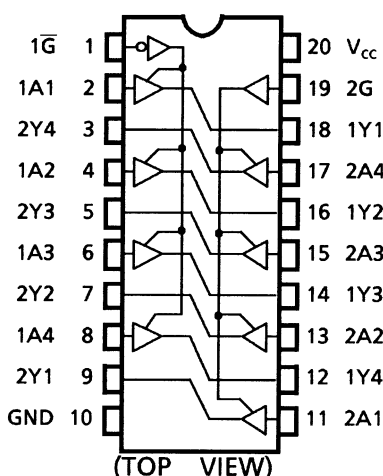
Start of commercial production  
1986-05

## Pin Assignment

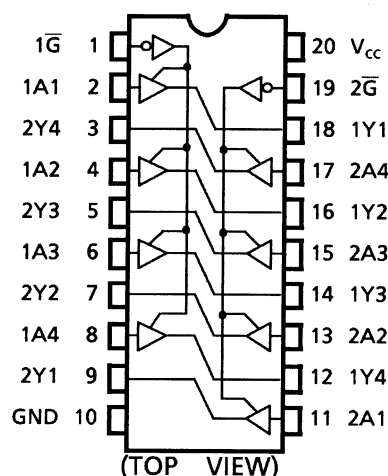
TC74HC240A



TC74HC241A

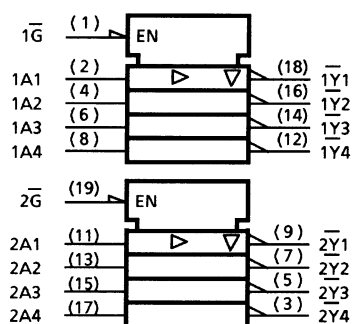


TC74HC244A

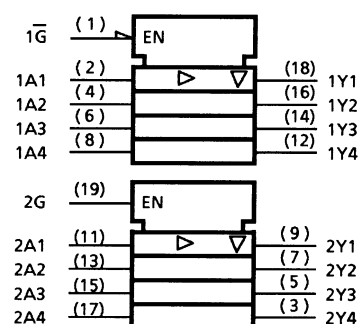


## IEC Logic Symbol

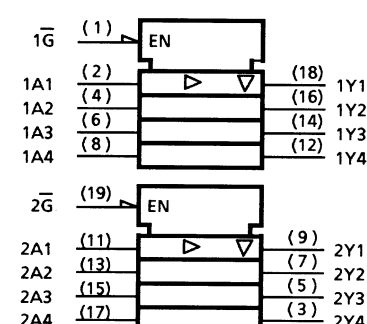
TC74HC240A



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 to 7                    | V    |
| DC input voltage            | $V_{IN}$  | -0.5 to $V_{CC} + 0.5$       | V    |
| DC output voltage           | $V_{OUT}$ | -0.5 to $V_{CC} + 0.5$       | V    |
| Input diode current         | $I_{IK}$  | $\pm 20$                     | mA   |
| Output diode current        | $I_{OK}$  | $\pm 20$                     | mA   |
| DC output current           | $I_{OUT}$ | $\pm 35$                     | mA   |
| DC $V_{CC}$ /ground current | $I_{CC}$  | $\pm 75$                     | mA   |
| Power dissipation           | $P_D$     | 500 (DIP) (Note 2)/180 (SOP) | mW   |
| Storage temperature         | $T_{stg}$ | -65 to 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 to 6                                                                                                                | V    |
| Input voltage            | $V_{IN}$   | 0 to $V_{CC}$                                                                                                         | V    |
| Output voltage           | $V_{OUT}$  | 0 to $V_{CC}$                                                                                                         | V    |
| Operating temperature    | $T_{opr}$  | -40 to 85                                                                                                             | °C   |
| Input rise and fall time | $t_r, t_f$ | 0 to 1000 ( $V_{CC} = 2.0\text{ V}$ )<br>0 to 500 ( $V_{CC} = 4.5\text{ V}$ )<br>0 to 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  $V_{CC}$  or GND.

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

| Characteristics                  | Symbol          | Test Condition                                                                                    |                                                      | Ta = 25°C           |                      |             | Ta =<br>−40 to 85°C  |                      | Unit                 |     |
|----------------------------------|-----------------|---------------------------------------------------------------------------------------------------|------------------------------------------------------|---------------------|----------------------|-------------|----------------------|----------------------|----------------------|-----|
|                                  |                 |                                                                                                   |                                                      | V <sub>CC</sub> (V) | Min                  | Typ.        | Max                  | Min                  |                      | Max |
| High-level input voltage         | V <sub>IH</sub> | —                                                                                                 |                                                      | 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          | V <sub>IL</sub> | —                                                                                                 |                                                      | 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        | V <sub>OH</sub> | V <sub>IN</sub><br>= V <sub>IH</sub> or V <sub>IL</sub>                                           | I <sub>OH</sub> = −20 μA                             | 2.0                 | 1.9                  | 2.0         | —                    | 1.9                  | —                    | V   |
|                                  |                 |                                                                                                   |                                                      | 4.5                 | 4.4                  | 4.5         | —                    | 4.4                  | —                    |     |
|                                  |                 |                                                                                                   |                                                      | 6.0                 | 5.9                  | 6.0         | —                    | 5.9                  | —                    |     |
|                                  |                 |                                                                                                   | I <sub>OH</sub> = −6 mA<br>I <sub>OH</sub> = −7.8 mA | 4.5                 | 4.18                 | 4.31        | —                    | 4.13                 | —                    |     |
| 6.0                              | 5.68            | 5.80                                                                                              |                                                      | —                   | 5.63                 | —           |                      |                      |                      |     |
| Low-level output voltage         | V <sub>OL</sub> | V <sub>IN</sub><br>= V <sub>IH</sub> or V <sub>IL</sub>                                           | I <sub>OL</sub> = 20 μA                              | 2.0                 | —                    | 0.0         | 0.1                  | —                    | 0.1                  | V   |
|                                  |                 |                                                                                                   |                                                      | 4.5                 | —                    | 0.0         | 0.1                  | —                    | 0.1                  |     |
|                                  |                 |                                                                                                   |                                                      | 6.0                 | —                    | 0.0         | 0.1                  | —                    | 0.1                  |     |
|                                  |                 |                                                                                                   | I <sub>OL</sub> = 6 mA<br>I <sub>OL</sub> = 7.8 mA   | 4.5                 | —                    | 0.17        | 0.26                 | —                    | 0.33                 |     |
| 6.0                              | —               | 0.18                                                                                              |                                                      | 0.26                | —                    | 0.33        |                      |                      |                      |     |
| 3-state output off-state current | I <sub>OZ</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>OUT</sub> = V <sub>CC</sub> or GND |                                                      | 6.0                 | —                    | —           | ±0.5                 | —                    | ±5.0                 | μA  |
| Input leakage current            | I <sub>IN</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND                                                          |                                                      | 6.0                 | —                    | —           | ±0.1                 | —                    | ±1.0                 | μA  |
| Quiescent supply current         | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> 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 =<br>−40 to 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:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

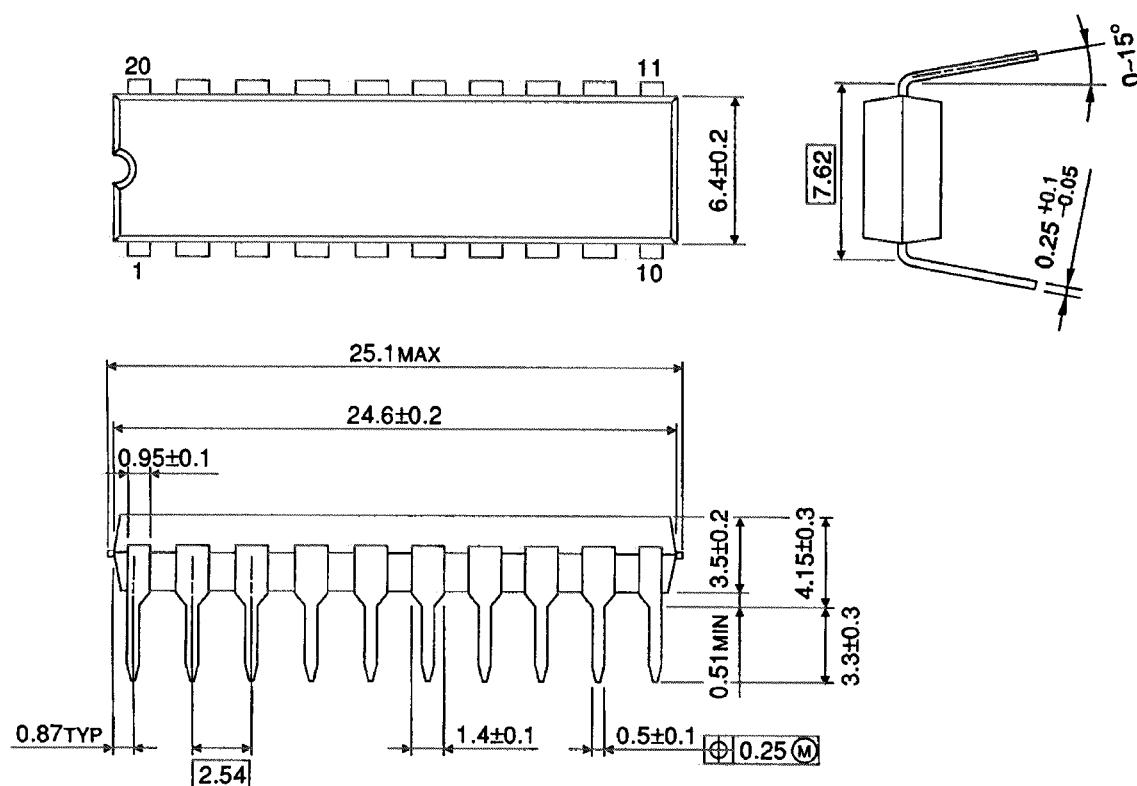
Average operating current can be obtained by the equation:

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

## Package Dimensions

DIP20-P-300-2.54A

Unit : mm

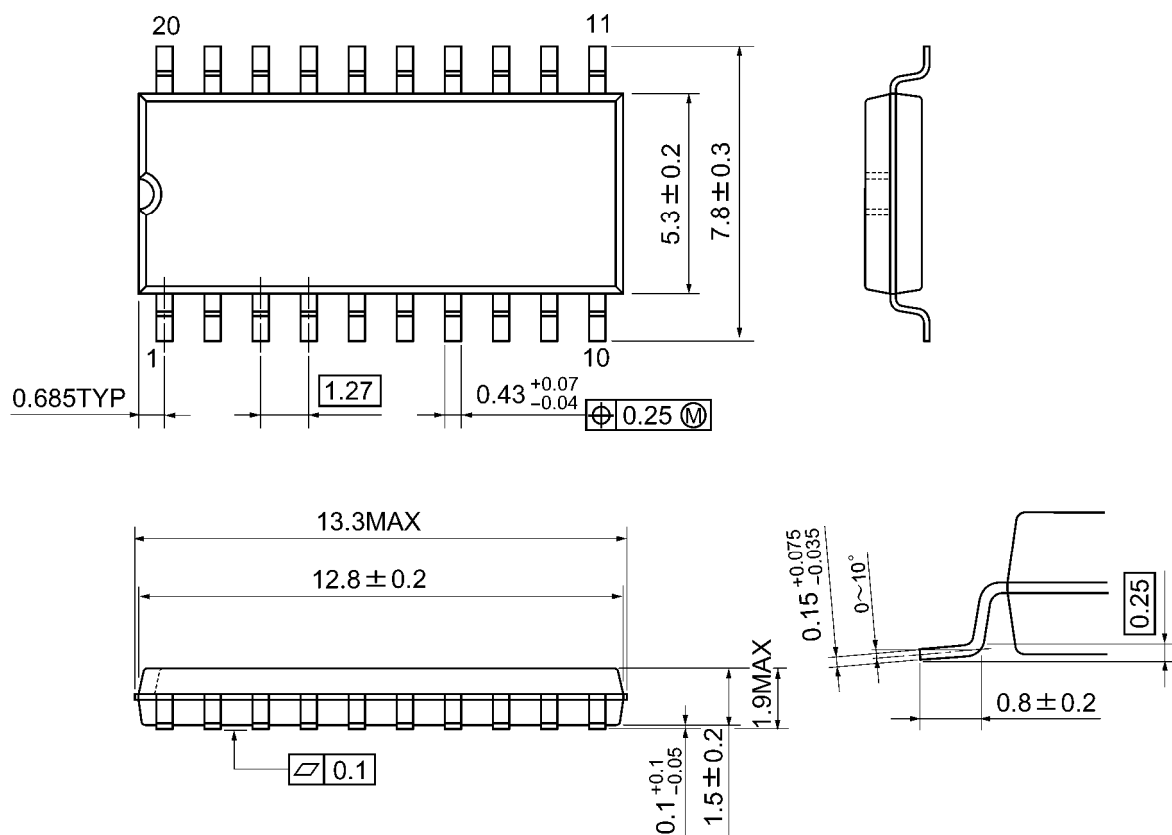


Weight: 1.30 g (typ.)

## Package Dimensions

SOP20-P-300-1.27A

Unit: mm



Weight: 0.22 g (typ.)

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