

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC74VHCT240AF, TC74VHCT240AFT, TC74VHCT240AFK TC74VHCT244AF, TC74VHCT244AFT, TC74VHCT244AFK

### Octal Bus Buffer

TC74VHCT240AF/AFT/AFK  
Inverted, 3-State Outputs

TC74VHCT244AF/AFT/AFK  
Non-Inverted, 3-State Outputs

The TC74VHCT240A and 244A are advanced 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 Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

The TC74VHCT240A is an inverting 3-state buffer having two active-low output enables. The TC74VHCT244A is a non-inverting 3-state buffer, and has two active-low output enables.

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

The input voltage are compatible with TTL output voltage.

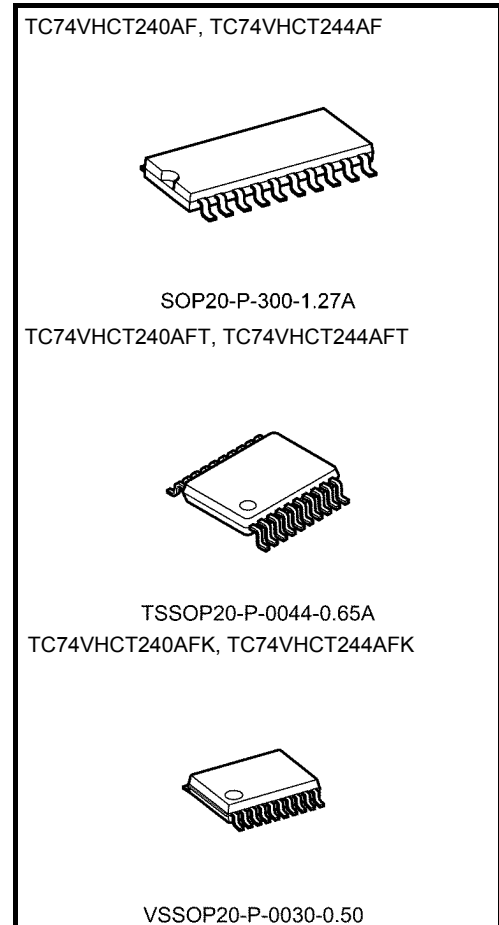
These devices may be used as a level converter for interfacing 3.3 V to 5 V system.

Input protection and output circuit ensure that 0 to 5.5 V can be applied to the input and output (Note) pins without regard to the supply voltage. These structure prevents device destruction due to mismatched supply and input/output voltages such as battery back up, hot board insertion, etc.

Note: Output in off-state

### Features

- High speed:  $t_{pd} = 6.1 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 4 \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- Compatible with TTL inputs:  $V_{IL} = 0.8 \text{ V (max)}$   
 $V_{IH} = 2.0 \text{ V (min)}$
- Power down protection is provided on all inputs and outputs
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Low noise:  $V_{OLP} = 1.0 \text{ V (max)}$
- Pin and function compatible with the 74 series (74AC/HC/F/ALS/LS etc.) 240/244 type.

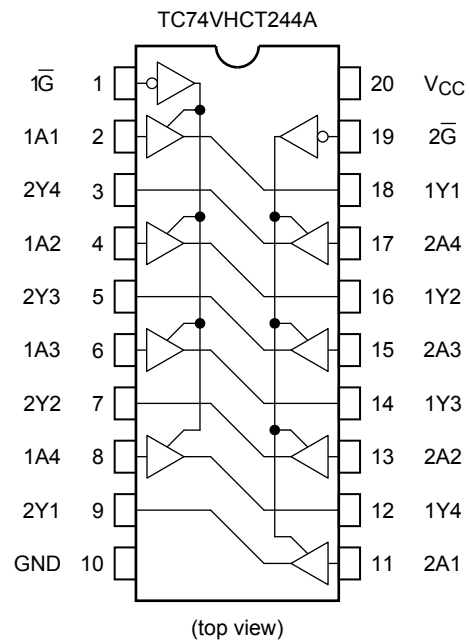
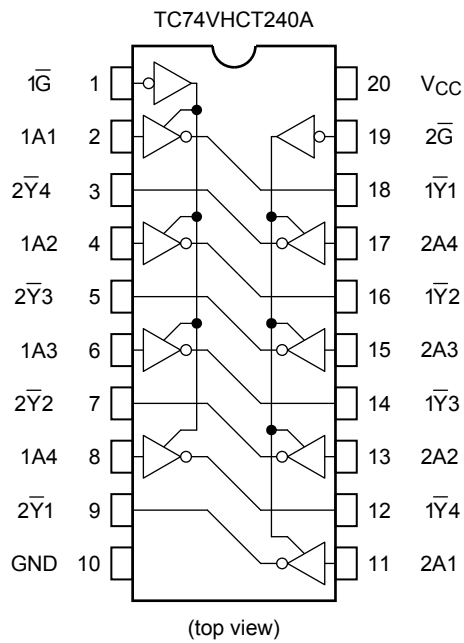


#### Weight

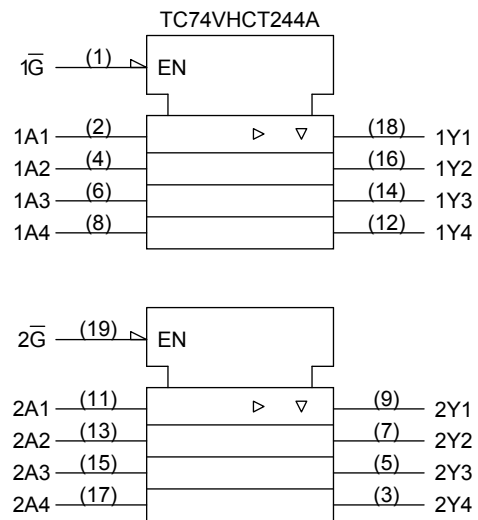
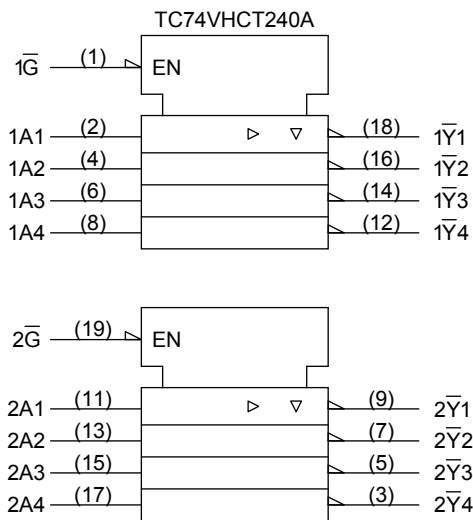
SOP20-P-300-1.27A:	0.22 g (typ.)
TSSOP20-P-0044-0.65A:	0.08 g (typ.)
VSSOP20-P-0030-0.50:	0.03 g (typ.)

Start of commercial production  
1995-04

## Pin Assignment



## IEC Logic Symbol



## Truth Table

Inputs		Outputs	
$\bar{G}$	$A_n$	$Y_n$	$\bar{Y}_n$
L	L	L	H
L	H	H	L
H	X	Z	Z

X: Don't care

Z: High impedance

$Y_n$ : TC74VHCT244A

$\bar{Y}_n$ : TC74VHCT240A

## Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-0.5 to 7.0	V
DC input voltage	$V_{IN}$	-0.5 to 7.0	V
DC output voltage	$V_{OUT}$	-0.5 to 7.0 (Note 2)	V
		-0.5 to $V_{CC} + 0.5$ (Note 3)	
Input diode current	$I_{IK}$	-20	mA
Output diode current	$I_{OK}$	$\pm 20$ (Note 4)	mA
DC output current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 75$	mA
Power dissipation	$P_D$	180	mW
Storage temperature	$T_{stg}$	-65 to 150	$^{\circ}C$

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: Output in off-state

Note 3: High or low state.  $I_{OUT}$  absolute maximum rating must be observed.

Note 4:  $V_{OUT} < GND$ ,  $V_{OUT} > V_{CC}$

## Operating Ranges (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	4.5 to 5.5	V
Input voltage	$V_{IN}$	0 to 5.5	V
Output voltage	$V_{OUT}$	0 to 5.5 (Note 2)	V
		0 to $V_{CC}$ (Note 3)	
Operating temperature	$T_{opr}$	-40 to 85	$^{\circ}C$
Input rise and fall time	$dt/dV$	0 to 20	ns/V

Note 1: 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.

Note 2: Output in off-state

Note 3: High or low state

## Electrical Characteristics

### DC Characteristics

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
				V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
High-level input voltage	V <sub>IH</sub>	—		4.5 to 5.5	2.0	—	—	2.0	—	V
Low-level input voltage	V <sub>IL</sub>	—		4.5 to 5.5	—	—	0.8	—	0.8	V
High-level output voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -50 μA	4.5	4.40	4.50	—	4.40	—	V
			I <sub>OH</sub> = -8 mA	4.5	3.94	—	—	3.80	—	
Low-level output voltage	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 50 μA	4.5	—	0.0	0.10	—	0.10	V
			I <sub>OL</sub> = 8 mA	4.5	—	—	0.36	—	0.44	
3-state output off-state current	I <sub>OZ</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>OUT</sub> = V <sub>CC</sub> or GND		5.5	—	—	±0.25	—	±2.50	μA
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V or GND		0 to 5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		5.5	—	—	4.0	—	40.0	μA
	I <sub>CC(T)</sub>	Per input: V <sub>IN</sub> = 3.4 V Other input: V <sub>CC</sub> or GND		5.5	—	—	1.35	—	1.50	mA
Output leakage current	I <sub>OPD</sub>	V <sub>OUT</sub> = 5.5 V		0	—	—	0.5	—	5.0	μA

## AC Characteristics (input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit		
			V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Typ.	Max		Min	Max
Propagation delay time (TC74VHCT240A)	t <sub>pLH</sub>	—	5.0 ± 0.5	15	—	5.6	7.8	1.0	9.0	ns
	t <sub>pHL</sub>			50	—	6.1	8.8	1.0	10.0	
Propagation delay time (TC74VHCT244A)	t <sub>pLH</sub>	—	5.0 ± 0.5	15	—	5.4	7.4	1.0	8.5	ns
	t <sub>pHL</sub>			50	—	5.9	8.4	1.0	9.5	
3-state output enable time	t <sub>pZL</sub>	R <sub>L</sub> = 1 kΩ	5.0 ± 0.5	15	—	7.7	10.4	1.0	12.0	ns
	t <sub>pZH</sub>			50	—	8.2	11.4	1.0	13.0	
3-state output disable time	t <sub>pLZ</sub>	R <sub>L</sub> = 1 kΩ	5.0 ± 0.5	50	—	8.8	11.4	1.0	13.0	ns
	t <sub>pHZ</sub>			50	—	8.8	11.4	1.0	13.0	
Output to output skew	t <sub>osLH</sub>	(Note 1)	5.0 ± 0.5	50	—	—	1.0	—	1.0	ns
	t <sub>osHL</sub>			50	—	—	1.0	—	1.0	
Input capacitance	C <sub>IN</sub>	—	—	—	—	4	10	—	10	pF
Output capacitance	C <sub>OUT</sub>	—	—	—	—	9	—	—	—	pF
Power dissipation capacitance (Note 2)	C <sub>PD</sub>	TC74VHCT240A	—	—	—	19	—	—	—	pF
		TC74VHCT244A	—	—	—	18	—	—	—	

Note 1: Parameter guaranteed by design.

$$t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|$$

Note 2: 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:

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

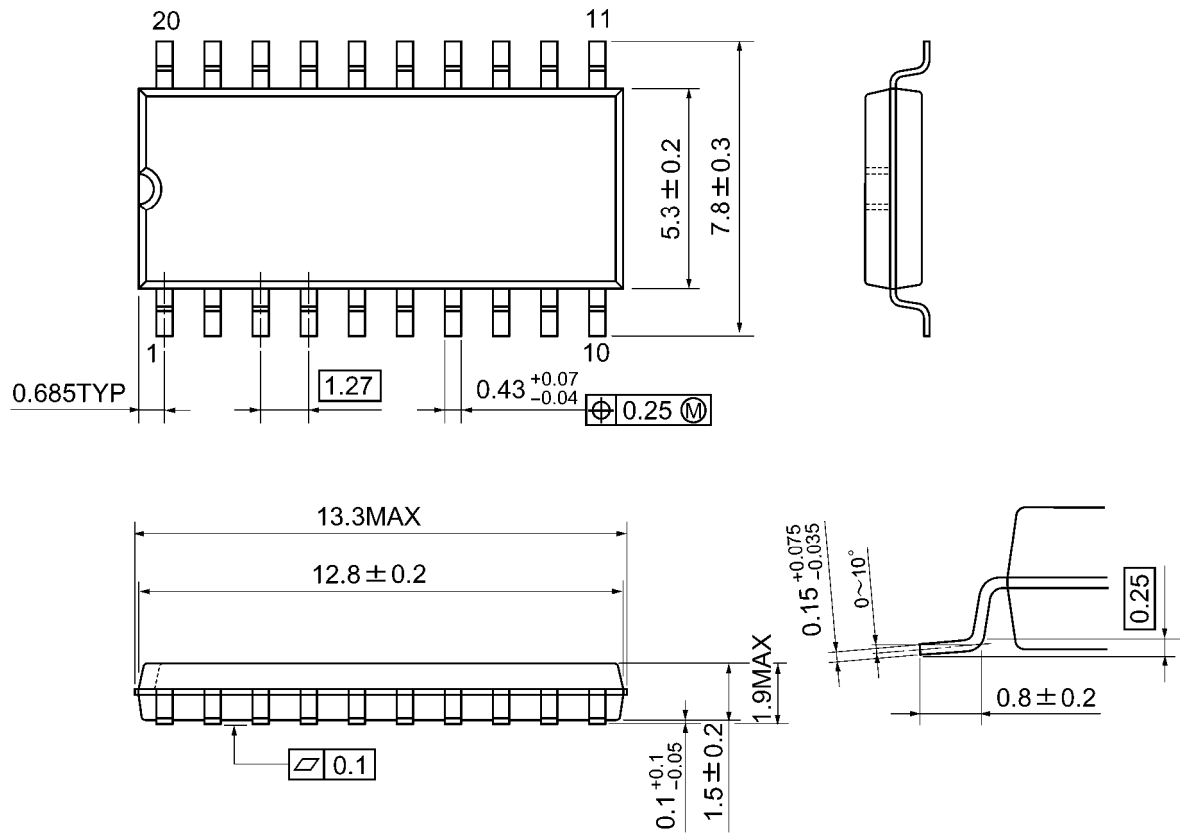
## Noise Characteristics (input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	Ta = 25°C			Unit
			V <sub>CC</sub> (V)	Typ.	Limit	
Quiet output maximum dynamic V <sub>OL</sub>	V <sub>OLP</sub>	C <sub>L</sub> = 50 pF	5.0	0.8	1.0	V
Quiet output minimum dynamic V <sub>OL</sub>	V <sub>OLV</sub>	C <sub>L</sub> = 50 pF	5.0	-0.8	-1.0	V
Minimum high level dynamic input voltage	V <sub>IHD</sub>	C <sub>L</sub> = 50 pF	5.0	—	2.0	V
Maximum low level dynamic input voltage	V <sub>ILD</sub>	C <sub>L</sub> = 50 pF	5.0	—	0.8	V

**Package Dimensions**

SOP20-P-300-1.27A

Unit: mm

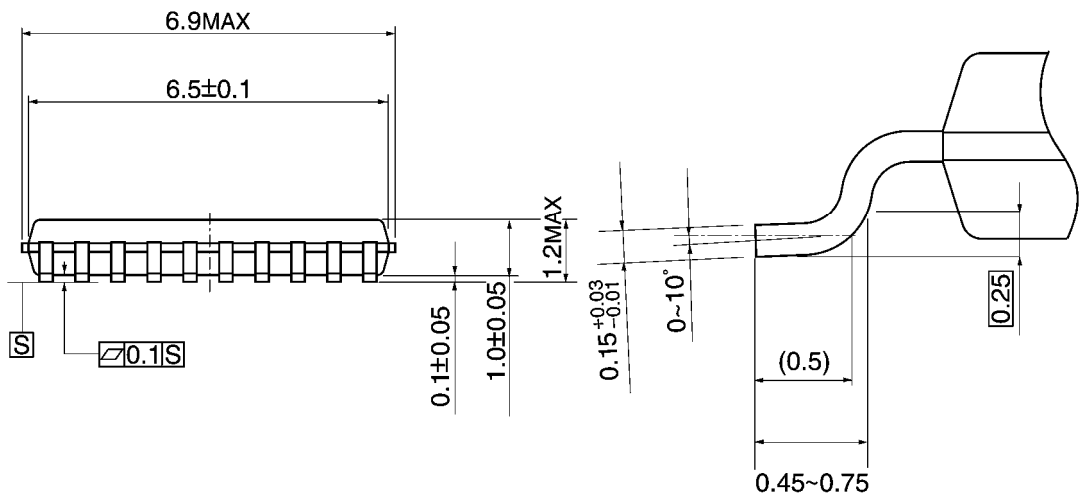
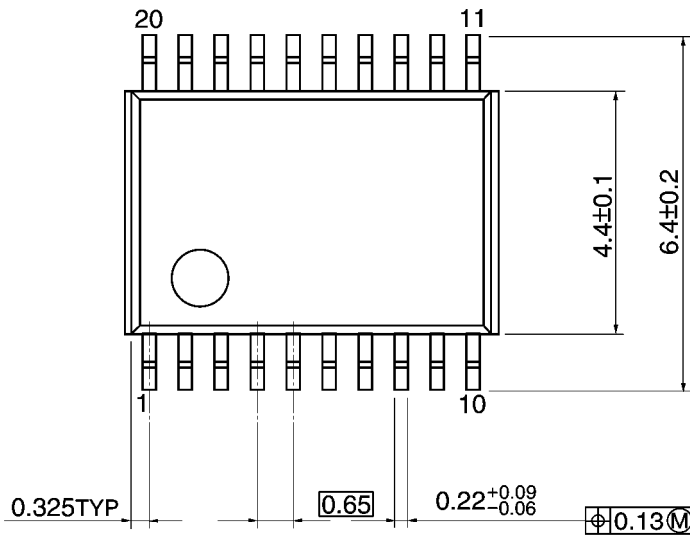


Weight: 0.22 g (typ.)

**Package Dimensions**

TSSOP20-P-0044-0.65A

Unit: mm

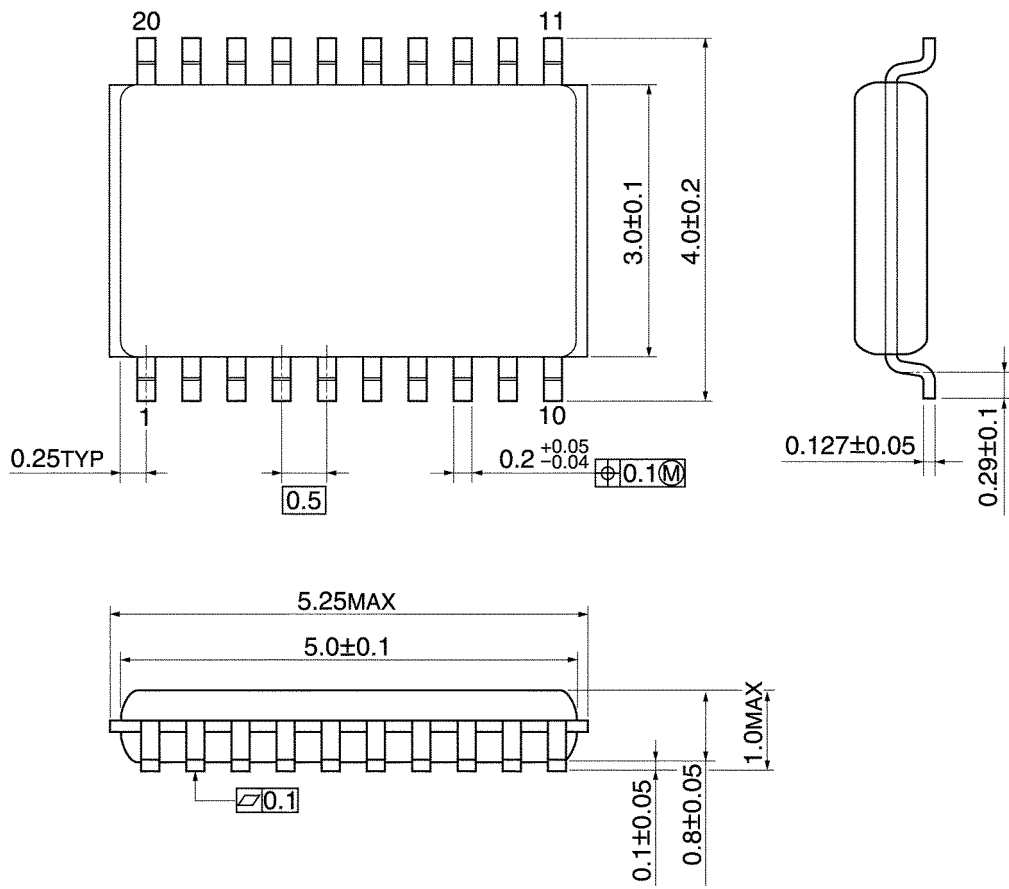


Weight: 0.08 g (typ.)

**Package Dimensions**

VSSOP20-P-0030-0.50

Unit: mm



Weight: 0.03 g (typ.)

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