

# 74VHC240FT, 74VHC244FT

## 1. Functional Description

- Octal Bus Buffer

74VHC240FT: INVERTED, 3-STATE OUTPUTS

74VHC244FT: NON-INVERTED, 3-STATE OUTPUTS

## 2. General

The 74VHC240FT and 74VHC244FT 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 74VHC240FT is an inverting 3-state buffer having two active-low output enables. The 74VHC244FT is a non-inverting 3-state buffer, and has two active-low output enables.

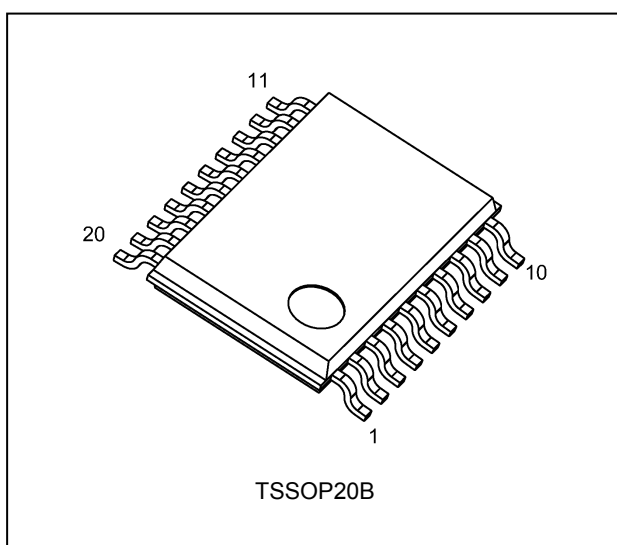
These devices are designed to be used with 3-state memory address drivers, etc.

An input protection circuit ensures that 0 to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

## 3. Features

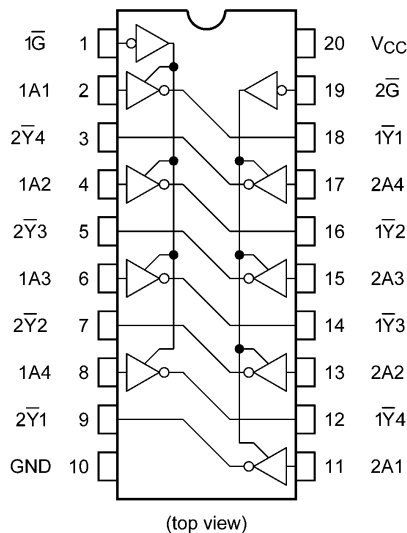
- (1) High speed:  $t_{pd} = 3.9 \text{ ns}$  (typ.) at  $V_{CC} = 5 \text{ V}$
- (2) Low power dissipation:  $I_{CC} = 4 \mu\text{A}$  (max) at  $T_a = 25^\circ\text{C}$
- (3) High noise immunity:  $V_{NIH} = V_{NIL} = 28 \% V_{CC}$  (min)
- (4) Power down protection is provided on all inputs.
- (5) Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$
- (6) Wide operating voltage range:  $V_{CC(opr)} = 2 \text{ V to } 5.5 \text{ V}$
- (7) Low noise:  $V_{OLP} = 0.8 \text{ V}$  (max)
- (8) Pin and function compatible with the 74 serie (74AC/HC/AHC/LV etc.) 240 or 244 type.

## 4. Packaging

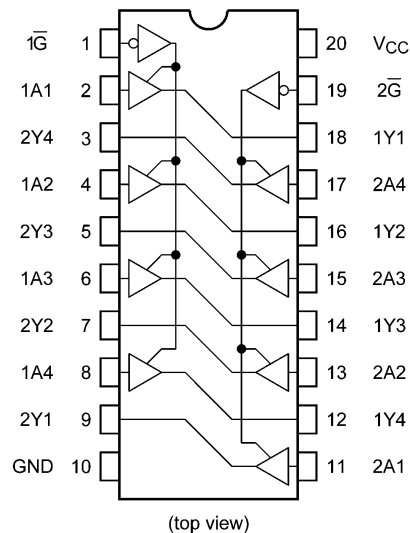


## 5. Pin Assignment

74VHC240FT

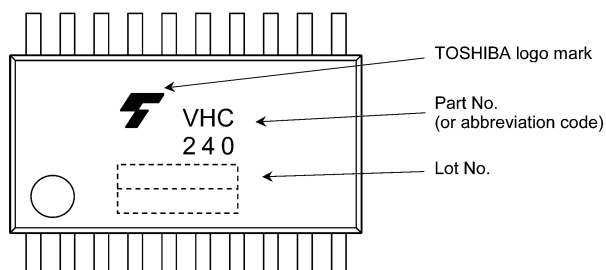


74VHC244FT

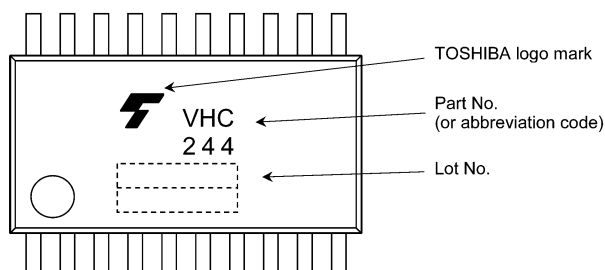


## 6. Marking

74VHC240FT

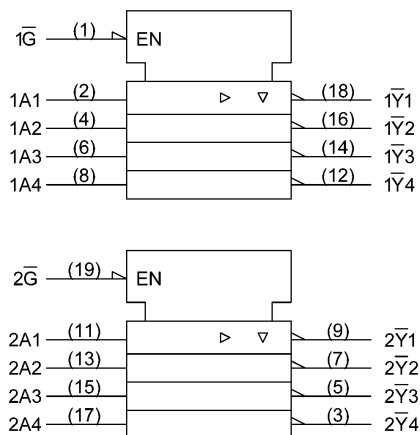


74VHC244FT

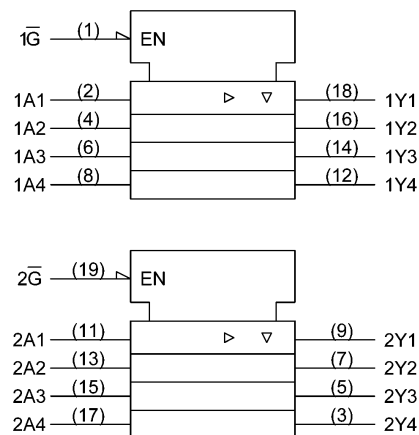


## 7. IEC Logic Symbol

74VHC240FT



74VHC244FT



## 8. Truth Table

Input $\bar{G}$	Input $A_n$	Output $Y_n$	Output $\bar{Y}_n$
L	L	L	H
L	H	H	L
H	X	Z	Z

X: Don't care

Z: High impedance

$Y_n$ : 74VHC244FT

$\bar{Y}_n$ : 74VHC240FT

## 9. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	-0.5 to 7.0	V
Input voltage	$V_{IN}$	-0.5 to 7.0	
Output voltage	$V_{OUT}$	-0.5 to $V_{CC} + 0.5$	
Input diode current	$I_{IK}$	-20	mA
Output diode current	$I_{OK}$	$\pm 20$	
Output current	$I_{OUT}$	$\pm 25$	
$V_{CC}$ /ground current	$I_{CC}$	$\pm 75$	
Power dissipation	$P_D$	180	mW
Storage temperature	$T_{stg}$	-65 to 150	°C

Note: 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).

## 10. Operating Ranges (Note)

Characteristics	Symbol	Test Condition	Rating	Unit
Supply voltage	$V_{CC}$		2.0 to 5.5	V
Input voltage	$V_{IN}$		0 to 5.5	
Output voltage	$V_{OUT}$		0 to $V_{CC}$	
Operating temperature	$T_{opr}$		-40 to 85	°C
Input rise and fall times	dt/dv	$V_{CC} = 3.3 \pm 0.3$ V	0 to 100	ns/V
		$V_{CC} = 5 \pm 0.5$ V	0 to 20	

Note: The operating ranges must be maintained to ensure the normal operation of the device.

Unused inputs and bus inputs must be tied to either  $V_{CC}$  or GND.

## 11. Electrical Characteristics

### 11.1. DC Characteristics (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$ )

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Min	Typ.	Max	Unit
High-level input voltage	$V_{IH}$	—	2.0	1.50	—	—	V
			3.0 to 5.5	$V_{CC} \times 0.7$	—	—	
Low-level input voltage	$V_{IL}$	—	2.0	—	—	0.50	
			3.0 to 5.5	—	—	$V_{CC} \times 0.3$	
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -50\text{ }\mu\text{A}$	2.0	1.9	2.0	
				3.0	2.9	3.0	
				4.5	4.4	4.5	
			$I_{OH} = -4\text{ mA}$	3.0	2.58	—	
			$I_{OH} = -8\text{ mA}$	4.5	3.94	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 50\text{ }\mu\text{A}$	2.0	—	—	μA
				3.0	—	—	
				4.5	—	—	
			$I_{OL} = 4\text{ mA}$	3.0	—	—	
			$I_{OL} = 8\text{ mA}$	4.5	—	—	
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{out} = V_{CC} \text{ or GND}$	5.5	—	—	$\pm 0.25$	
Input leakage current	$I_{IN}$	$V_{IN} = 5.5\text{ V or GND}$	0 to 5.5	—	—	$\pm 0.1$	μA
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC} \text{ or GND}$	5.5	—	—	4.0	

### 11.2. DC Characteristics (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^{\circ}\text{C}$ )

Characteristics	Symbol	Test Condition		V <sub>CC</sub> (V)	Min	Max	Unit
High-level input voltage	V <sub>IH</sub>	—		2.0	1.50	—	V
				3.0 to 5.5	V <sub>CC</sub> x 0.7	—	
Low-level input voltage	V <sub>IL</sub>	—		2.0	—	0.50	
				3.0 to 5.5	—	V <sub>CC</sub> x 0.3	
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	2.0	1.9	—	
				3.0	2.9	—	
				4.5	4.4	—	
			I <sub>OH</sub> = -4 mA	3.0	2.48	—	
				I <sub>OH</sub> = -8 mA	4.5	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>OH</sub> = 50 μA	2.0	—	0.1	
				3.0	—	0.1	
				4.5	—	0.1	
			I <sub>OL</sub> = 4 mA	3.0	—	0.44	
			I <sub>OL</sub> = 8 mA	4.5	—	0.44	
3-state output OFF-state leakage 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	—	±2.50	μA
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V or GND		0 to 5.5	—	±1.0	
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		5.5	—	40.0	

**11.3. AC Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^{\circ}\text{C}$ , Input:  $t_r = t_f = 3\text{ ns}$ )**

Characteristics	Part Number	Symbol	Note	Test Condition	$V_{CC}$ (V)	$C_L$ (pF)	Min	Typ.	Max	Unit
Propagation delay time	74VHC240FT	$t_{PLH}, t_{PHL}$		—	$3.3 \pm 0.3$	15	—	5.3	7.5	ns
						50	—	7.8	11.0	
					$5.0 \pm 0.5$	15	—	3.6	5.5	
						50	—	5.1	7.5	
	74VHC244FT	$t_{PLH}, t_{PHL}$		—	$3.3 \pm 0.3$	15	—	5.8	8.4	
						50	—	8.3	11.9	
					$5.0 \pm 0.5$	15	—	3.9	5.5	
						50	—	5.4	7.5	
3-state output enable time		$t_{PZL}, t_{PZH}$		$R_L = 1\text{ k}\Omega$	$3.3 \pm 0.3$	15	—	6.6	10.6	
						50	—	9.1	14.1	
					$5.0 \pm 0.5$	15	—	4.7	7.3	
						50	—	6.2	9.3	
3-state output disable time		$t_{PLZ}, t_{PHZ}$		$R_L = 1\text{ k}\Omega$	$3.3 \pm 0.3$	50	—	10.3	14.0	
					$5.0 \pm 0.5$	50	—	6.7	9.2	
Output skew		$t_{osLH}, t_{osHL}$	(Note 1)	—	$3.3 \pm 0.3$	50	—	—	1.5	pF
					$5.0 \pm 0.5$	50	—	—	1.0	
Input capacitance		$C_{IN}$		—			4	—	10	
Output capacitance		$C_{OUT}$		—			6	—	—	
Power dissipation capacitance	74VHC240FT	$C_{PD}$	(Note 2)	—			17	—	—	
	74VHC244FT						19	—	—	

Note 1: Parameter guaranteed by design. ( $t_{osLH} = |t_{PLHm} - t_{PLHn}|$ ,  $t_{osHL} = |t_{PHLm} - t_{PHLn}|$ )

Note 2:  $C_{PD}$  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.

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

# 11.4. AC Characteristics

(Unless otherwise specified,  $T_a = -40$  to  $85\text{ }^{\circ}\text{C}$ , Input:  $t_r = t_f = 3\text{ ns}$ )

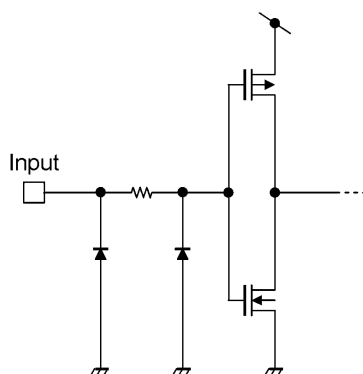
Characteristics	Part Number	Symbol	Note	Test Condition	$V_{CC}$ (V)	$C_L$ (pF)	Min	Max	Unit
Propagation delay time	74VHC240FT	$t_{PLH}, t_{PHL}$		—	$3.3 \pm 0.3$	15	1.0	9.0	ns
						50	1.0	12.5	
					$5.0 \pm 0.5$	15	1.0	6.5	
						50	1.0	8.5	
	74VHC244FT	$t_{PLH}, t_{PHL}$		—	$3.3 \pm 0.3$	15	1.0	10.0	
						50	1.0	13.5	
					$5.0 \pm 0.5$	15	1.0	6.5	
						50	1.0	8.5	
3-state output enable time		$t_{PZL}, t_{PZH}$		$R_L = 1\text{ k}\Omega$	$3.3 \pm 0.3$	15	1.0	12.5	
						50	1.0	16.0	
					$5.0 \pm 0.5$	15	1.0	8.5	
						50	1.0	10.5	
3-state output disable time		$t_{PLZ}, t_{PHZ}$		$R_L = 1\text{ k}\Omega$	$3.3 \pm 0.3$	50	1.0	16.0	
					$5.0 \pm 0.5$	50	1.0	10.5	
Output skew		$t_{osLH}, t_{osHL}$	(Note 1)	—	$3.3 \pm 0.3$	50	—	1.5	
					$5.0 \pm 0.5$	50	—	1.0	
Input capacitance		$C_{IN}$		—			—	10	pF

Note 1: Parameter guaranteed by design. ( $t_{osLH} = |t_{PLHm} - t_{PLHn}|$ ,  $t_{osHL} = |t_{PHLm} - t_{PHLn}|$ )

# 11.5. Noise Characteristics (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$ , Input: $t_r = t_f = 3\text{ ns}$ )

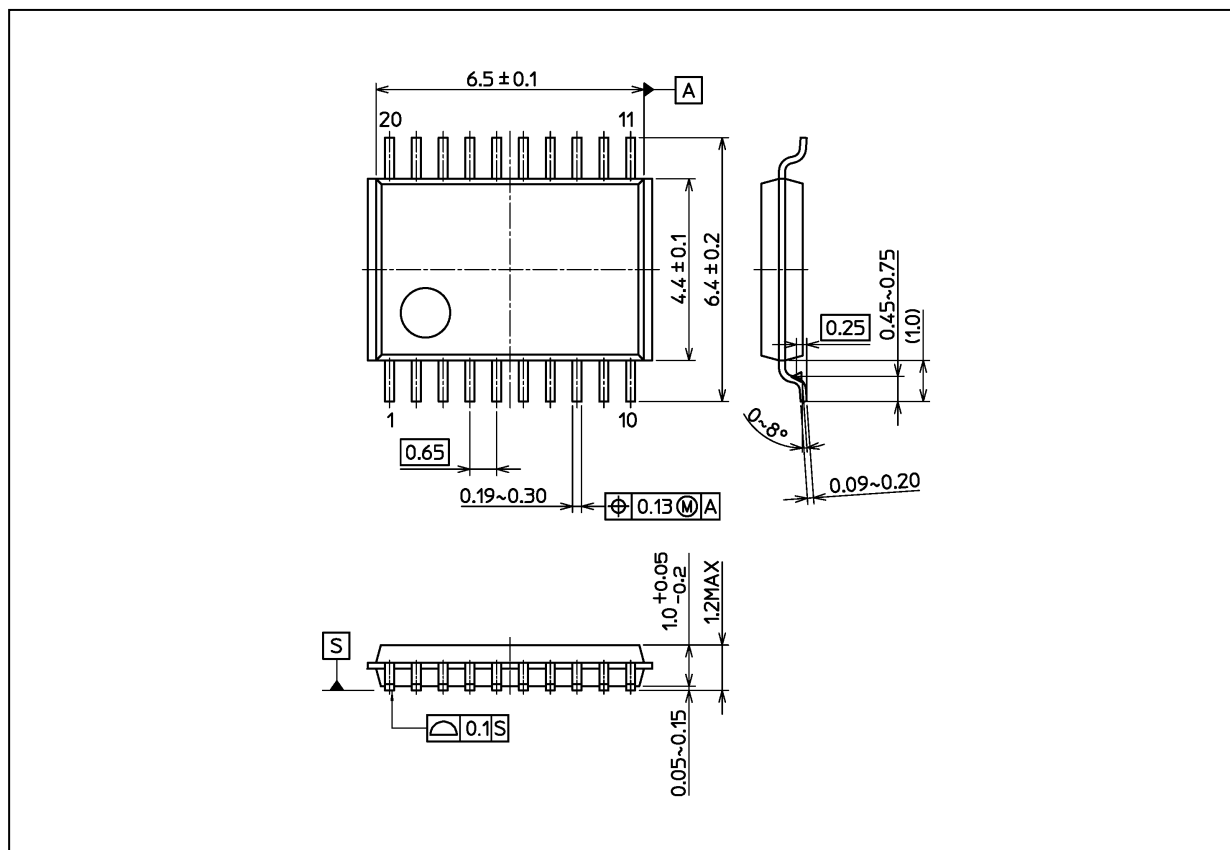
Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Typ.	Limit	Unit
Quiet output maximum dynamic $V_{OL}$	$V_{OLP}$	$C_L = 50\text{ pF}$	5.0	0.5	0.8	V
Quiet output minimum dynamic $V_{OL}$	$V_{OLV}$	$C_L = 50\text{ pF}$	5.0	-0.5	-0.8	
Minimum high-level dynamic input voltage	$V_{IHD}$	$C_L = 50\text{ pF}$	5.0	—	3.5	
Maximum low-level dynamic input voltage	$V_{ILD}$	$C_L = 50\text{ pF}$	5.0	—	1.5	

# 11.6. Internal Equivalent Circuit



## Package Dimensions

Unit: mm



Weight: 0.071 g (typ.)

Package Name(s)
Nickname: TSSOP20B

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