

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 C²MOS 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.

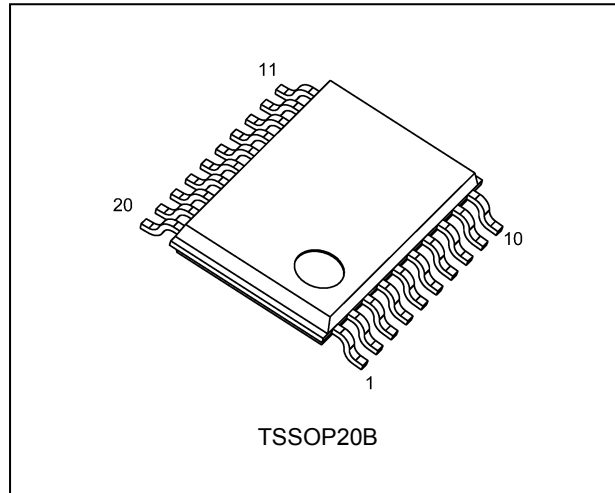
An input protection circuit ensures that 0 to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input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

3. Features

- (1) AEC-Q100 (Rev. H) (Note 1)
- (2) Wide operating temperature range: $T_{opr} = -40$ to 125 °C
- (3) High speed: $t_{pd} = 3.9$ ns (typ.) at $V_{CC} = 5$ V
- (4) Low power dissipation: $I_{CC} = 4.0$ μ A (max) at $T_a = 25$ °C
- (5) High noise immunity: $V_{NIH} = V_{NIL} = 28$ % V_{CC} (min)
- (6) Power down protection is provided on all inputs.
- (7) Balanced propagation delays: $t_{PLH} \approx t_{PHL}$
- (8) Wide operating voltage range: $V_{CC(opr)} = 2.0$ V to 5.5 V
- (9) Low noise: $V_{OLP} = 0.8$ V (max)
- (10) Pin and function compatible with the 74 series (AC/HC/AHC/LV etc.) 240 or 244 type.

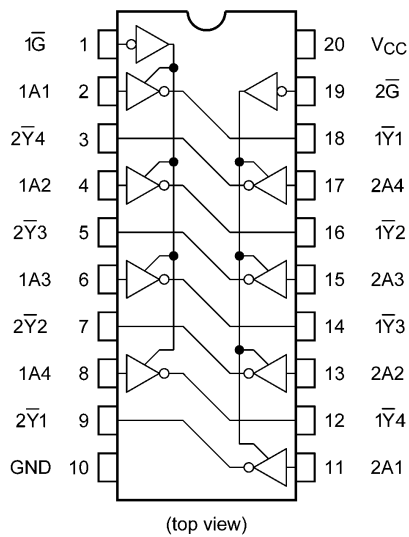
Note 1: This device is compliant with the reliability requirements of AEC-Q100. For details, contact your Toshiba sales representative.

4. Packaging

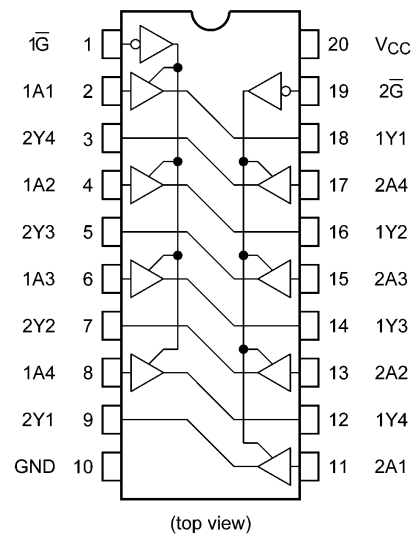


5. Pin Assignment

74VHC240FT

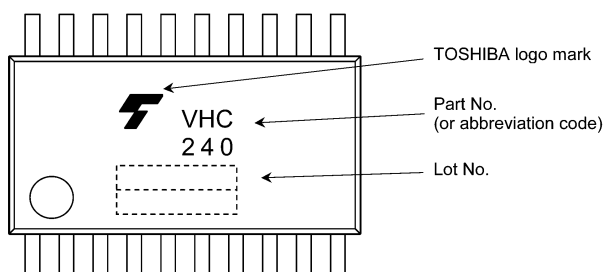


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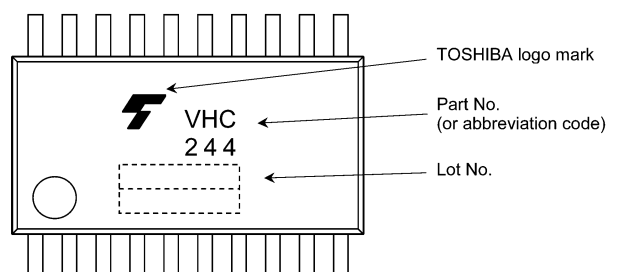


6. Marking

74VHC240FT

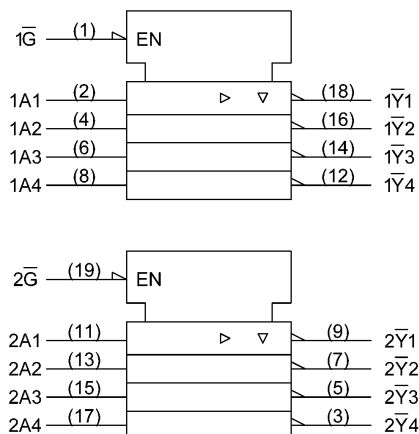


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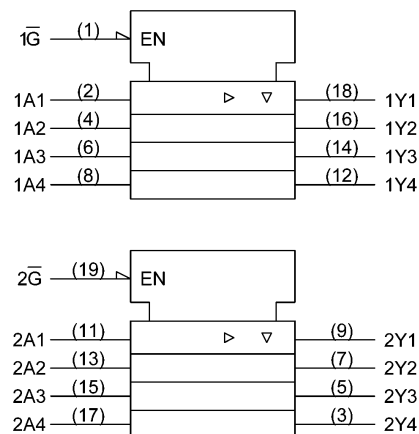


7. IEC Logic Symbol

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	Note	Rating	Unit
Supply voltage	V_{CC}		-0.5 to 7.0	V
Input voltage	V_{IN}		-0.5 to 7.0	V
Output voltage	V_{OUT}		-0.5 to $V_{CC} + 0.5$	V
Input diode current	I_{IK}		-20	mA
Output diode current	I_{OK}		± 20	mA
Output current	I_{OUT}		± 25	mA
V_{CC} /ground current	I_{CC}		± 75	mA
Power dissipation	P_D	(Note 1)	180	mW
Storage temperature	T_{stg}		-65 to 150	$^{\circ}C$

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).

Note 1: 180 mW in the range of $T_a = -40$ to $85^{\circ}C$. From $T_a = 85$ to $125^{\circ}C$ a derating factor of -3.25 mW/ $^{\circ}C$ shall be applied until 50 mW.

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	V
Output voltage	V_{OUT}		0 to V_{CC}	V
Operating temperature	T_{opr}		-40 to 125	°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 must be tied to either V_{CC} or GND.

11. Electrical Characteristics

11.1. DC Characteristics (Unless otherwise specified, $T_a = 25$ °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	V	
			3.0 to 5.5	—	—	$V_{CC} \times 0.3$		
High-level output voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -50$ μ A	2.0	1.9	2.0	—	V
				3.0	2.9	3.0	—	
				4.5	4.4	4.5	—	
			$I_{OH} = -4$ mA	3.0	2.58	—	—	
			$I_{OH} = -8$ mA	4.5	3.94	—	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 50$ μ A	2.0	—	0.0	0.1	V
				3.0	—	0.0	0.1	
				4.5	—	0.0	0.1	
			$I_{OL} = 4$ mA	3.0	—	—	0.36	
				4.5	—	—	0.36	
3-state output OFF-state leakage current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = V_{CC}$ or GND	5.5	—	—	± 0.25	μ A	
Input leakage current	I_{IN}	$V_{IN} = 5.5$ V or GND	0 to 5.5	—	—	± 0.1	μ A	
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}$ or GND	5.5	—	—	4.0	μ A	

11.2. DC Characteristics (Unless otherwise specified, $T_a = -40$ to 85 °C)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	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	V	
			3.0 to 5.5	—	$V_{CC} \times 0.3$		
High-level output voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -50 \mu A$	2.0	1.9	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			$I_{OH} = -4$ mA	3.0	2.48	—	
				4.5	3.80	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 50 \mu A$	2.0	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
			$I_{OL} = 4$ mA	3.0	—	0.44	
				4.5	—	0.44	
3-state output OFF-state leakage current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = V_{CC}$ or GND	5.5	—	± 2.50	μA	
Input leakage current	I_{IN}	$V_{IN} = 5.5$ V or GND	0 to 5.5	—	± 1.0	μA	
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}$ or GND	5.5	—	40.0	μA	

11.3. DC Characteristics (Unless otherwise specified, $T_a = -40$ to 125 °C)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	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	V	
			3.0 to 5.5	—	$V_{CC} \times 0.3$		
High-level output voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -50 \mu A$	2.0	1.9	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			$I_{OH} = -4$ mA	3.0	2.40	—	
				4.5	3.70	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 50 \mu A$	2.0	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
			$I_{OL} = 4$ mA	3.0	—	0.55	
				4.5	—	0.55	
3-state output OFF-state leakage current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = V_{CC}$ or GND	5.5	—	± 10.0	μA	
Input leakage current	I_{IN}	$V_{IN} = 5.5$ V or GND	0 to 5.5	—	± 2.0	μA	
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}$ or GND	5.5	—	80.0	μA	

11.4. 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 ± 0.3	15	—	5.3	7.5	ns
						50	—	7.8	11.0	
					5.0 ± 0.5	15	—	3.6	5.5	
						50	—	5.1	7.5	
Propagation delay time	74VHC244FT	t_{PLH}, t_{PHL}		—	3.3 ± 0.3	15	—	5.8	8.4	ns
						50	—	8.3	11.9	
					5.0 ± 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 ± 0.3	15	—	6.6	10.6	ns
						50	—	9.1	14.1	
					5.0 ± 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 ± 0.3	50	—	10.3	14.0	ns
					5.0 ± 0.5	50	—	6.7	9.2	
Output skew		t_{osLH}, t_{osHL}	(Note 1)	—	3.3 ± 0.3	50	—	—	1.5	ns
					5.0 ± 0.5	50	—	—	1.0	
Input capacitance		C_{IN}		—			—	4	10	pF
Output capacitance		C_{OUT}		—			—	6	—	pF
Power dissipation capacitance	74VHC240FT	C_{PD}	(Note 2)	—			—	17	—	pF
	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.

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

11.5. AC Characteristics (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$, 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 ± 0.3	15	1.0	9.0	ns
						50	1.0	12.5	
					5.0 ± 0.5	15	1.0	6.5	
						50	1.0	8.5	
Propagation delay time	74VHC244FT	t_{PLH}, t_{PHL}		—	3.3 ± 0.3	15	1.0	10.0	ns
						50	1.0	13.5	
					5.0 ± 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 ± 0.3	15	1.0	12.5	ns
						50	1.0	16.0	
					5.0 ± 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 ± 0.3	50	1.0	16.0	ns
					5.0 ± 0.5	50	1.0	10.5	
Output skew		t_{osLH}, t_{osHL}	(Note 1)	—	3.3 ± 0.3	50	—	1.5	ns
					5.0 ± 0.5	50	—	1.0	
Input capacitance		C_{IN}		—			—	10	pF

Note 1: Parameter guaranteed by design. ($t_{osLH} = |t_{PLHM} - t_{PLHN}|$, $t_{osHL} = |t_{PHLM} - t_{PHLN}|$)

11.6. AC Characteristics
 (Unless otherwise specified, $T_a = -40$ to 125 °C, Input: $t_r = t_f = 3$ ns)

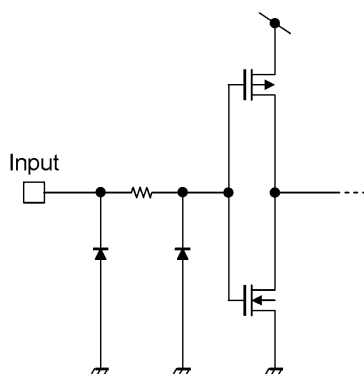
Characteristics	Part Number	Symbol	Note	Test Condition	V_{CC} (V)	C_L (pF)	Min	Max	Unit
Propagation delay time	74VHC240FT	t_{PLH}, t_{PHL}		—	3.3 ± 0.3	15	1.0	10.5	ns
						50	1.0	14.0	
					5.0 ± 0.5	15	1.0	7.5	
						50	1.0	9.5	
Propagation delay time	74VHC244FT	t_{PLH}, t_{PHL}		—	3.3 ± 0.3	15	1.0	11.5	ns
						50	1.0	15.0	
					5.0 ± 0.5	15	1.0	7.5	
						50	1.0	9.5	
3-state output enable time		t_{PZL}, t_{PZH}		$R_L = 1$ k Ω	3.3 ± 0.3	15	1.0	14.0	ns
						50	1.0	17.5	
					5.0 ± 0.5	15	1.0	10.0	
						50	1.0	12.0	
3-state output disable time		t_{PLZ}, t_{PHZ}		$R_L = 1$ k Ω	3.3 ± 0.3	50	1.0	17.5	ns
					5.0 ± 0.5	50	1.0	11.5	
Output skew		t_{osLH}, t_{osHL}	(Note 1)	—	3.3 ± 0.3	50	—	1.5	ns
					5.0 ± 0.5	50	—	1.0	
Input capacitance		C_{IN}		—			—	10	pF

Note 1: Parameter guaranteed by design. ($t_{osLH} = |t_{PLHM} - t_{PLHN}|$, $t_{osHL} = |t_{PHLM} - t_{PHLN}|$)

11.7. Noise Characteristics (Unless otherwise specified, $T_a = 25$ °C, Input: $t_r = t_f = 3$ ns)

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

11.8. Internal Equivalent Circuit



Package Dimensions

Unit: mm



Weight: 0.071 g (typ.)

Package Name(s)
Nickname: TSSOP20B

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