CMOS Digital Integrated Circuits Silicon Monolithic

74VHCT240AFT,74VHCT244AFT

1. Functional Description

- Octal Bus Buffer

74VHCT240AFT: INVERTED, 3-STATE OUTPUTS
74VHCT244AFT: NON-INVERTED, 3-STATE OUTPUTS

2. General

The 74VHCT240AFT and 74VHCT244AFT are advanced high speed CMOS OCTAL BUS BUFFERs fabricated with silicon gate C^2MOS technology. They achieve the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.
The 74VHCT240AFT is an inverting 3-state buffer having two active-low output enables. The 74VHCT244AFT 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

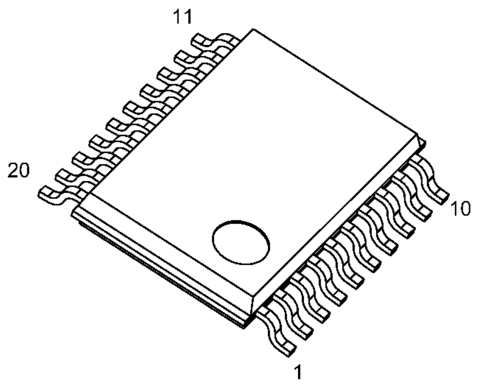
3. Features

(1) AEC-Q100 (Rev. H) (Note 1)
(2) Wide operating temperature range: T_{opr} = -40 to 125 °C
(3) High speed: Propagation delay time = 6.1 ns (typ.) at V_{CC} = 5.0 V
(4) Quiescent supply current: I_{CC} = 4.0 μA (max) at T_a = 25 °C
(5) Compatible with TTL input: V_{IL} = 0.8 V (max)
V_{IH} = 2.0 V (min)
(6) Power down protection is provided on all inputs and outputs.
(7) Balanced propagation delays: $t_{PLH} \approx t_{PHL}$
(8) Low noise: V_{OLP} = 1.0 V (max)
(9) Pin and function compatible with the 74 series (ACT/HCT/AHCT etc.) 240/244 type.

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

Start of commercial production
2013-01

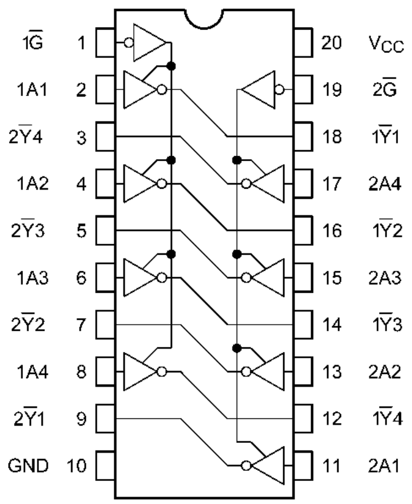
4. Packaging



TSSOP20B

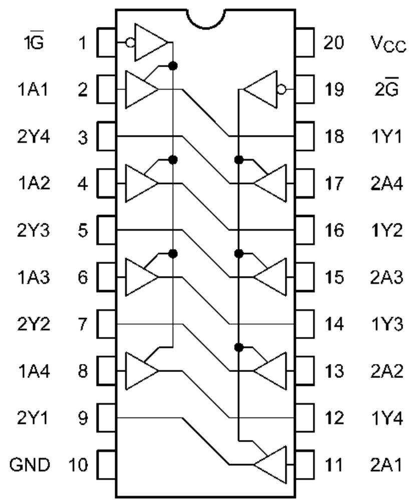
5. Pin Assignment

74VHCT240AFT



(top view)

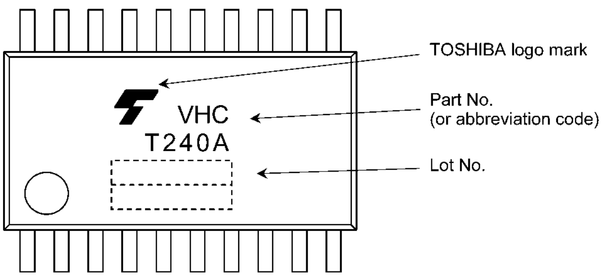
74VHCT244AFT



(top view)

6. Marking

74VHCT240AFT



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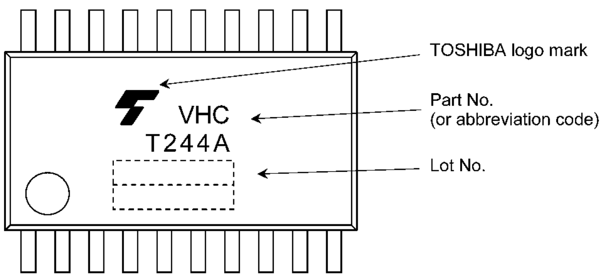
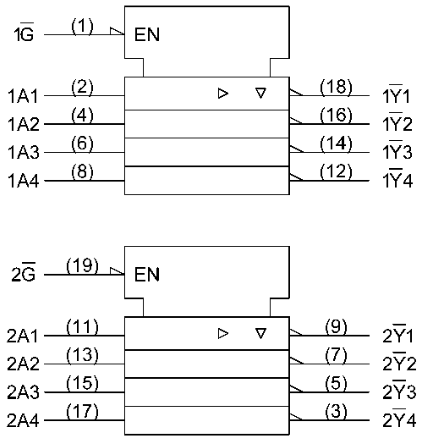
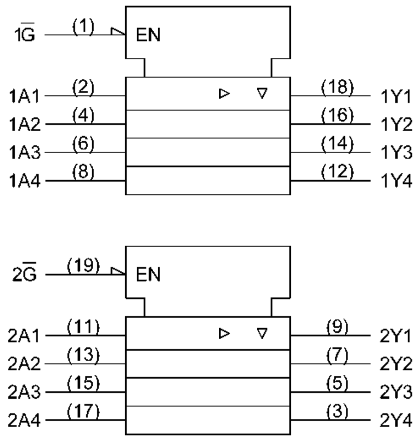


7. IEC Logic Symbol

74VHCT240AFT



74VHCT244AFT



8. Truth Table

Input $\overline{G}$	Input An	Output Yn	Output $\overline{Yn}$
L	L	L	H
L	H	H	L
H	X	Z	Z

X: Don't care
Z: High impedance
Yn: 74VHCT244AFT
$\overline{Yn}$: 74VHCT240AFT

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}	(Note 1)	-0.5 to 7.0	V
		(Note 2)	-0.5 to V_{CC} + 0.5	
Input diode current	I_{IK}		-20	mA
Output diode current	I_{OK}	(Note 3)	±20	mA
Output current	I_{OUT}		±25	mA
V_{CC}/ground current	I_{CC}		±75	mA
Power dissipation	P_D	(Note 4)	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).

Note 1: Output in off-state.

Note 2: High (H) or Low (L) state. I_{OUT} absolute maximum rating must be observed.

Note 3: V_{OUT} < GND, V_{OUT} > VCC

Note 4: 180 mW in the range of T_a = -40 to 85 °C. From T_a = 85 to 125 °C a derating factor of -3.25 mW/°C shall be applied until 50 mW.

10. Operating Ranges (Note)

Characteristics	Symbol	Note	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}	(Note 1)	0 to 5.5	V
		(Note 2)	0 to V_{CC}	
Operating temperature	T_{opr}		-40 to 125	°C
Input rise and fall times	dt/dv		0 to 20	ns/V

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.

Note 1: Output in OFF state.

Note 2: High (H) or Low (L) state.

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}	—		4.5 to 5.5	2.0	—	—	V
Low-level input voltage	V_{IL}	—		4.5 to 5.5	—	—	0.8	V
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = -50 μA	4.5	4.4	4.5	—	V
			I_{OH} = -8 mA	4.5	3.94	—	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA	4.5	—	0.0	0.1	V
			I_{OL} = 8 mA	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	μA
Input leakage current	I_{IN}	V_{IN} = 5.5 V or GND		0 to 5.5	—	—	±0.1	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		5.5	—	—	4.0	μA
	I_{CCT}	Per input :V_{IN} = 3.4V Other input:V_{CC} or GND		5.5	—	—	1.35	mA
Output leakage current (Power-OFF)	I_{OPD}	V_{OUT} = 5.5 V		0	—	—	0.5	μA

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}	—		4.5 to 5.5	2.0	—	V
Low-level input voltage	V_{IL}	—		4.5 to 5.5	—	0.8	V
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = -50 μA	4.5	4.4	—	V
			I_{OH} = -8 mA	4.5	3.80	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA	4.5	—	0.1	V
			I_{OL} = 8 mA	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
Quiescent supply current	I_{CCT}	Per input: V_{IN} = 3.4 V Other input: V_{CC} or GND		5.5	—	1.50	mA
Output leakage current (Power-OFF)	I_{OPD}	V_{OUT} = 5.5 V		0	—	5.0	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}	—		4.5 to 5.5	2.0	—	V
Low-level input voltage	V_{IL}	—		4.5 to 5.5	—	0.8	V
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = -50 μA	4.5	4.4	—	V
			I_{OH} = -8 mA	4.5	3.70	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA	4.5	—	0.1	V
			I_{OL} = 8 mA	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
Quiescent supply current	I_{CCT}	Per input: V_{IN} = 3.4 V Other input: V_{CC} or GND		5.5	—	1.50	mA
Output leakage current (Power-OFF)	I_{OPD}	V_{OUT} = 5.5 V		0	—	20.0	μA

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

Characteristics	Part Number	Symbol	Note	Test Condition	V_{CC} (V)	C_L (pF)	Min	Typ.	Max	Unit
Propagation delay time	74VHCT240AFT	t_{PLH},t_{PHL}		—	5.0 ± 0.5	15	—	5.6	7.8	ns
						50	—	6.1	8.8	
	74VHCT244AFT	t_{PLH},t_{PHL}		—	5.0 ± 0.5	15	—	5.4	7.4	ns
						50	—	5.9	8.4	
3-state output enable time		t_{PZL},t_{PZH}		R_L = 1 kΩ	5.0 ± 0.5	15	—	7.7	10.4	ns
						50	—	8.2	11.4	
3-state output disable time		t_{PLZ},t_{PHZ}		R_L = 1 kΩ	5.0 ± 0.5	50	—	8.8	11.4	ns
Output skew		t_{osLH},t_{osHL}	(Note 1)	—	5.0 ± 0.5	50	—	—	1.0	ns
Input capacitance		C_{IN}		—			—	4	10	pF
Output capacitance		C_{OUT}		—			—	9	—	pF
Power dissipation capacitance	74VHCT240AFT	C_{PD}	(Note 2)	—			—	19	—	pF
	74VHCT244AFT	C_{PD}	(Note 2)	—			—	18	—	

Note 1: Parameter guaranteed by design. (t_{osLH} = $|t_{PLH}m - t_{PLH}n|$, t_{osHL} = $|t_{PHL}m - t_{PHL}n|$)

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.

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

11.5. AC Characteristics (Unless otherwise specified, T_a = -40 to 85 °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	74VHCT240AFT	t_{PLH},t_{PHL}		—	5.0 ± 0.5	15	1.0	9.0	ns
						50	1.0	10.0	
	74VHCT244AFT	t_{PLH},t_{PHL}		—	5.0 ± 0.5	15	1.0	8.5	ns
						50	1.0	9.5	
3-state output enable time		t_{PZL},t_{PZH}		R_L = 1 kΩ	5.0 ± 0.5	15	1.0	12.0	ns
						50	1.0	13.0	
3-state output disable time		t_{PLZ},t_{PHZ}		R_L = 1 kΩ	5.0 ± 0.5	50	1.0	13.0	ns
Output skew		t_{osLH},t_{osHL}	(Note 1)	—	5.0 ± 0.5	50	—	1.0	ns
Input capacitance		C_{IN}		—			—	10	pF

Note 1: Parameter guaranteed by design. (t_{osLH} = $|t_{PLH}m - t_{PLH}n|$, t_{osHL} = $|t_{PHL}m - t_{PHL}n|$)

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	74VHCT240AFT	t_{PLH},t_{PHL}		—	5.0 ± 0.5	15	1.0	10.0	ns
						50	1.0	11.0	
Propagation delay time	74VHCT244AFT	t_{PLH},t_{PHL}		—	5.0 ± 0.5	15	1.0	9.5	ns
						50	1.0	10.5	
3-state output enable time		t_{PZL},t_{PZH}		R_L = 1 kΩ	5.0 ± 0.5	15	1.0	13.0	ns
						50	1.0	14.5	
3-state output disable time		t_{PLZ},t_{PHZ}		R_L = 1 kΩ	5.0 ± 0.5	50	1.0	14.5	ns
Output skew		t_{osLH},t_{osHL}	(Note 1)	—	5.0 ± 0.5	50	—	1.0	ns
Input capacitance		C_{IN}		—			—	10	pF

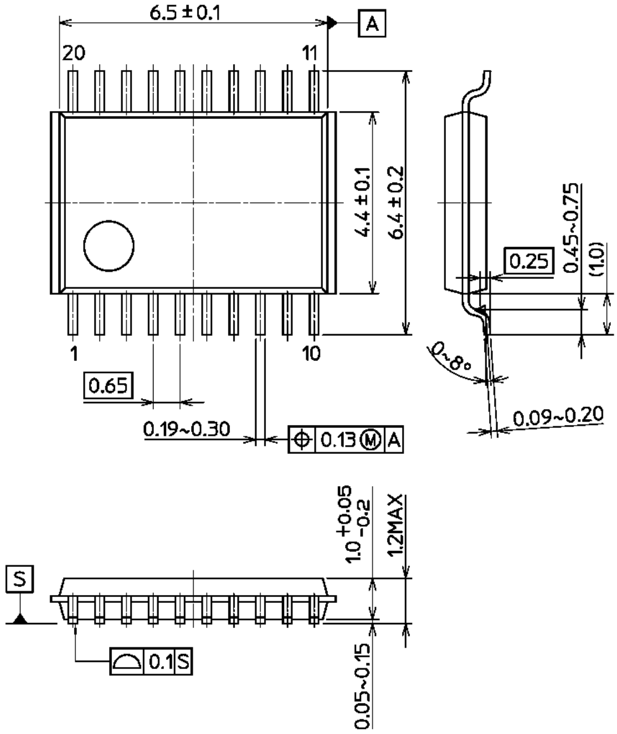
Note 1: Parameter guaranteed by design. (t_{osLH} = $|t_{PLH}m - t_{PLH}n|$, t_{osHL} = $|t_{PHL}m - t_{PHL}n|$)

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	0.8	1.0	V
Quiet output minimum dynamic V_{OL}	V_{OLV}	C_L = 50 pF	5.0	-0.8	-1.0	
Minimum high-level dynamic input voltage	V_{IHD}	C_L = 50 pF	5.0	—	2.0	
Maximum low-level dynamic input voltage	V_{ILD}	C_L = 50 pF	5.0	—	0.8	

Package Dimensions

Unit: mm



Weight: 0.071 g (typ.)

Package Name(s)
Nickname: TSSOP20B

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