CMOS Digital Integrated Circuits   Silicon Monolithic

74VHCT540AFT,74VHCT541AFT

1. Functional Description

- Octal Bus Buffer

74VHCT540AFT: INVERTED, 3-STATE OUTPUTS
74VHCT541AFT: NON-INVERTED, 3-STATE OUTPUTS

2. General

The 74VHCT540AFT and 74VHCT541AFT 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 74VHCT540AFT is an inverting type and, the 74VHCT541AFT is a non-inverting type.

When either $\overline{G}1$ or $\overline{G}2$ are high, the terminal outputs are in the high-impedance state.

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

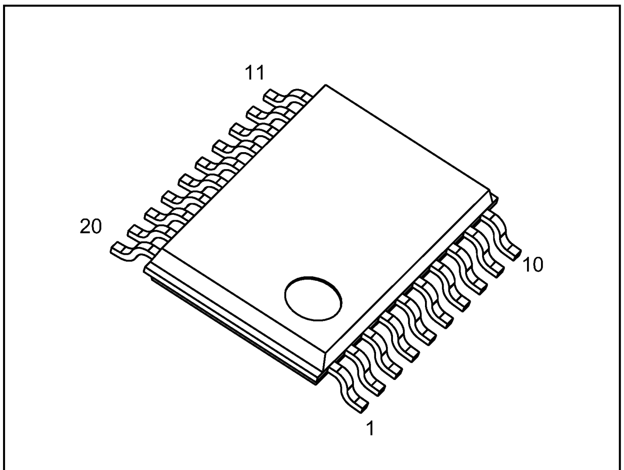
3. Features

(1) AEC-Q100 (Rev. H) (Note 1)
(2) Wide operating temperature range: T_{opr} = -40 to 125 °C
(3) High speed: Propagation delay time = 5.4 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} = 1.5 V (max)
(9) Pin and function compatible with the 74 series (ACT/HCT/AHCT etc.) 540/541 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

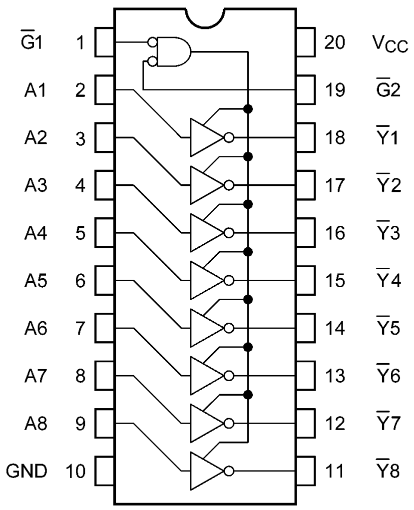
4. Packaging



TSSOP20B

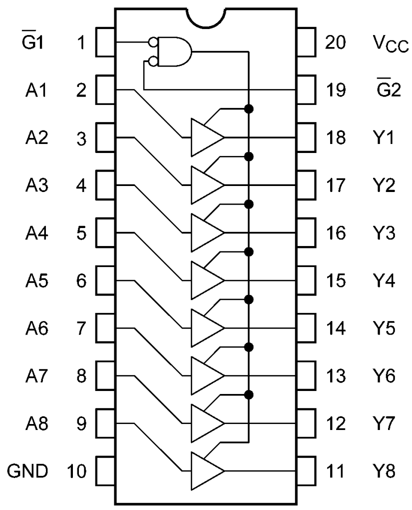
5. Pin Assignment

74VHCT540AFT



(top view)

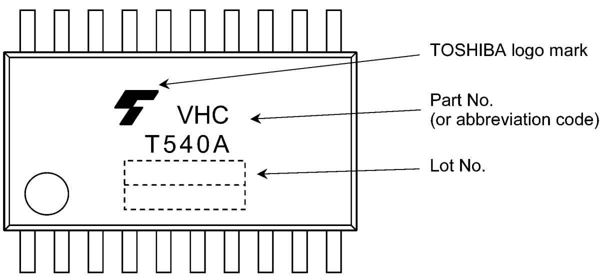
74VHCT541AFT



(top view)

6. Marking

74VHCT540AFT



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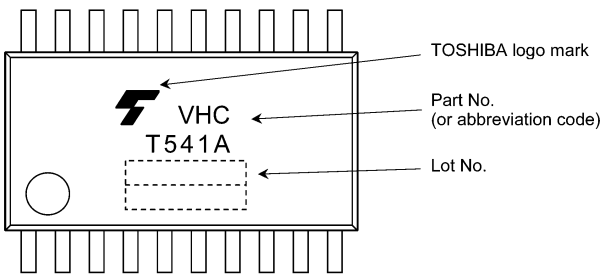
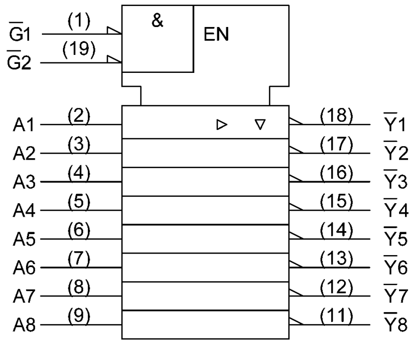


7. IEC Logic Symbol

74VHCT540AFT



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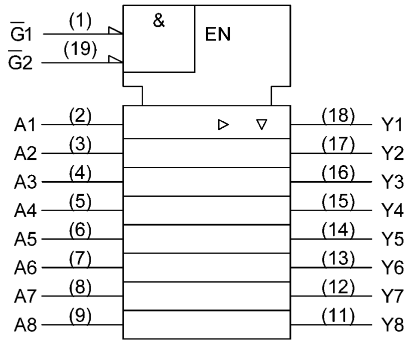


8. Truth Table

Input $\overline{G1}$	Input $\overline{G2}$	Input An	Output Yn	Output $\overline{Yn}$
H	X	X	Z	Z
X	H	X	Z	Z
L	L	H	H	L
L	L	L	L	H

X: Don't care
Z: High impedance
Yn: 74VHCT541AFT
$\overline{Yn}$: 74VHCT540AFT

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	
Output voltage	V_{OUT}	(Note1)	-0.5 to 7.0	
		(Note2)	-0.5 to V_{CC} + 0.5	
Input diode current	I_{IK}		-20	mA
Output diode current	I_{OK}	(Note3)	±20	
Output current	I_{OUT}		±25	
V_{CC}/ground current	I_{CC}		±75	
Power dissipation	P_D	(Note4)	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).

Note1: Output in OFF state.

Note2: High (H) or Low (L) state. I_{OUT} absolute maximum rating must be observed.

Note3: V_{OUT} < GND, V_{OUT} > V_{CC}

Note4: 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	
Output voltage	V_{OUT}	(Note1)	0 to 5.5	
		(Note2)	0 to V_{CC}	
Operating temperature	T_{opr}		-40 to 125	℃
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.

Note1: Output in OFF state.

Note2: High (H) or Low (L) state.

11. Electrical Characteristics

11.1. DC Characteristics (Unless otherwise specified, T_a = 25 ℃)

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} = 3.4 V 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 ℃)

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} = 50μA	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
	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	74VHCT540AFT	t_{PLH},t_{PHL}		—	5.0 ± 0.5	15	—	5.4	7.4	ns
						50	—	5.9	8.4	
	74VHCT541AFT	t_{PLH},t_{PHL}		—	5.0 ± 0.5	15	—	5.0	6.9	ns
						50	—	5.5	7.9	
3-state output enable time		t_{PZL},t_{PZH}		R_L = 1 kΩ	5.0 ± 0.5	15	—	8.3	11.3	ns
						50	—	8.8	12.3	
3-state output disable time		t_{PLZ},t_{PHZ}		R_L = 1 kΩ	5.0 ± 0.5	50	—	9.4	11.9	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		C_{PD}	(Note 2)	—			—	19	—	pF

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.

$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/8$ (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	74VHCT540AFT	t_{PLH},t_{PHL}		—	5.0 ± 0.5	15	1.0	8.5	ns
						50	1.0	9.5	
	74VHCT541AFT	t_{PLH},t_{PHL}		—	5.0 ± 0.5	15	1.0	8.0	ns
						50	1.0	9.0	
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	14.0	
3-state output disable time		t_{PLZ},t_{PHZ}		R_L = 1 kΩ	5.0 ± 0.5	50	1.0	13.5	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} = $|t_{PLHm}-t_{PLHn}|$, 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	74VHCT540AFT	t_{PLH},t_{PHL}		—	5.0 ± 0.5	15	1.0	9.5	ns
						50	1.0	10.5	
	74VHCT541AFT	t_{PLH},t_{PHL}		—	5.0 ± 0.5	15	1.0	9.0	ns
						50	1.0	10.0	
3-state output enable time		t_{PZL},t_{PZH}		R_L = 1 kΩ	5.0 ± 0.5	15	1.0	14.5	ns
						50	1.0	15.5	
3-state output disable time		t_{PLZ},t_{PHZ}		R_L = 1 kΩ	5.0 ± 0.5	50	1.0	15.0	ns
Output skew		t_{osLH},t_{osHL}	(Note 1)	—	5.0 ± 0.5	50	—	1.0	ns
Input capacitance		C_{IN}		—			—	10	pF

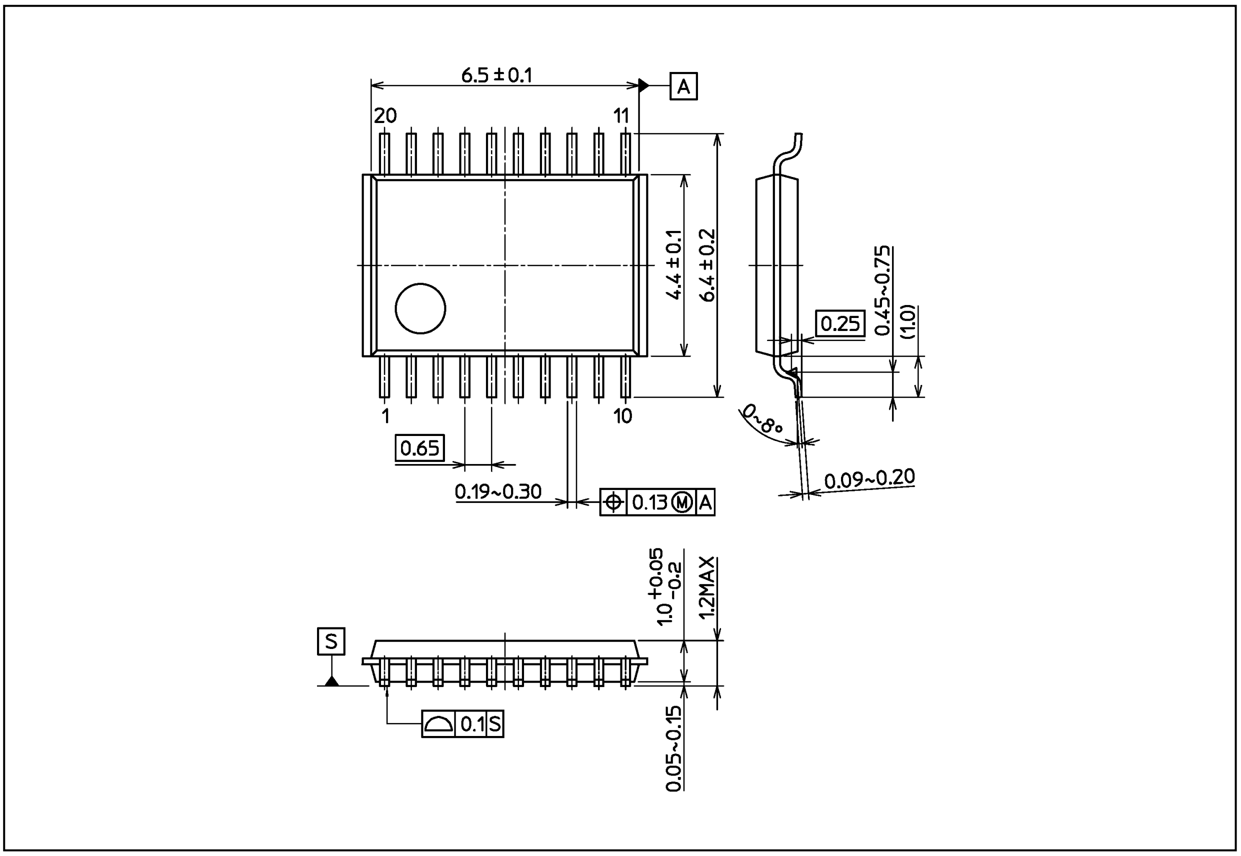
Note 1: Parameter guaranteed by design. (t_{osLH} = |t_{PLH}m-t_{PLH}n|, t_{osHL} = |t_{PHL}m-t_{PHL}n|)

11.7. 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	1.1	1.5	V
Quiet output minimum dynamic V_{OL}	V_{OLV}	C_L = 50 pF	5.0	-1.1	-1.5	
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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