CMOS Digital Integrated Circuits Silicon Monolithic

# 74VHCT125AFT,74VHCT126AFT

#### 1. Functional Description

Quad Bus Buffer, Non-Inverted 3-State Outputs
 74VHCT125AFT:QUAD BUS BUFFER
 74VHCT126AFT:QUAD BUS BUFFER

#### 2. General

The 74VHCT125AFT and 74VHCT126AFT are high speed CMOS QUAD 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 74VHCT125AFT requires the 3-state control input  $\overline{G}$  to be set high to place the output into the high impedance state, whereas the 74VHCT126AFT requires the control input G to be set low to place the output into high impedance.

The input voltage are compatible with TTL output voltage.

This device 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. There 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 = 3.8 ns (typ.) at  $V_{CC} = 5.0 \text{ V}$
- (4) Quiescent supply current:  $I_{CC} = 4.0 \mu A \text{ (max)}$  at  $T_a = 25 \text{ °C}$
- (5) Compatible with TTL input:  $V_{IL} = 0.8 \text{ V(max)}$

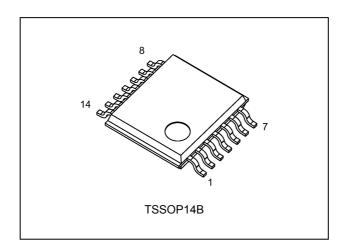
$$V_{IH} = 2.0 \text{ V(min)}$$

- (6) Power down protection is provided on all inputs and outputs.
- (7) Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$
- (8) Low noise:  $V_{OLP} = 0.8 \text{ V (max)}$
- (9) Pin and function compatible with the 74 series

(ACT/HCT/AHCT etc.) 125/126 type.

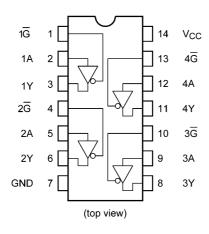
Note 1: This device is compliant with the reliability requirements of AEC-Q100. For details, contact your Toshiba sales representative.

## 4. Packaging

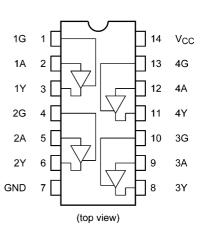


## 5. Pin Assignment

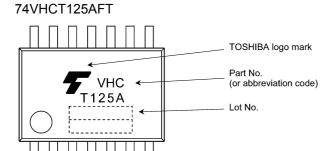
#### 74VHCT125AFT



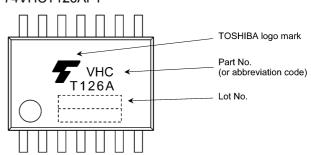
#### 74VHCT126AFT



## 6. Marking



#### 74VHCT126AFT



## 7. IEC Logic Symbol

74VHCT125AFT

1G (1) F	ΞN	D	▽ -	(3) 1Y
2G (4) P				(6) 2Y
3G (10) A 3A (9)				(8)3Y
4G (13) A 4A (12)				(11) 4Y

74VHCT126AFT

1G (1) 1A (2) 2G (4) 2A (5) 3G (10)	EN	Þ	∇	(3) 1Y (6) 2Y (8) 3Y
2G (F)				<del>(6)</del> 2Y
2A (10)				
3A (9)				<del>(8)</del> 3Y
4G (13)				(11)
4A (12)				<del>(11)</del> 4Y



#### 8. Truth Table

Input G (74VHCT125AFT)	Input G (74VHCT126AFT)	· I Inniit Δ I	
Н	L	X	Z
L	Н	L	L
L	Н	Н	Н

X: Don't care

Z: High impedance

#### 9. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V <sub>CC</sub>		-0.5 to 7.0	V
Input voltage	V <sub>IN</sub>		-0.5 to 7.0	V
Output voltage	V <sub>OUT</sub>	(Note 1)	-0.5 to 7.0	V
		(Note 2)	-0.5 to V <sub>CC</sub> + 0.5	
Input diode current	I <sub>IK</sub>		-20	mA
Output diode current	I <sub>OK</sub>	(Note 3)	±20	mA
Output current	I <sub>OUT</sub>		±25	mA
V <sub>CC</sub> /ground current	I <sub>CC</sub>		±50	mA
Power dissipation	P <sub>D</sub>	(Note 4)	180	mW
Storage temperature	T <sub>stg</sub>		-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<sub>OUT</sub> absolute maximum rating must be observed.

Note 3:  $V_{OUT} < GND$ ,  $V_{OUT} > V_{CC}$ 

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 <sub>CC</sub>		4.5 to 5.5	V
Input voltage	V <sub>IN</sub>		0 to 5.5	V
Output voltage	V <sub>OUT</sub>	(Note 1)	0 to 5.5	V
		(Note 2)	0 to V <sub>CC</sub>	
Operating temperature	T <sub>opr</sub>		-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 <sub>CC</sub> (V)	Min	Тур.	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 <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -50 μA	4.5	4.4	4.5	_	V
			I <sub>OH</sub> = -8 mA	4.5	3.94	_	_	
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	0.1	V
			I <sub>OL</sub> = 8 mA	4.5	_	_	0.36	
3-state output OFF-state leakage current	I <sub>OZ</sub>	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{OUT} = V_{CC} \text{ or GND}$		5.5	_	_	±0.25	μА
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V or GND		0 to 5.5	_	_	±0.1	μΑ
Quiescent supply	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	,	5.5	_	_	4.0	μΑ
current	I <sub>CCT</sub>	Per input: V <sub>IN</sub> = 3.4 V Other input: V <sub>CC</sub> or GND	5.5	_	_	1.35	mA	
Output leakage current (Power-OFF)	I <sub>OPD</sub>	V <sub>OUT</sub> = 5.5 V		0			0.5	μА

## 11.2. DC Characteristics (Unless otherwise specified, T<sub>a</sub> = -40 to 85 °C)

Characteristics	Symbol	Test Condition		V <sub>CC</sub> (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 <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -50 μA	4.5	4.4		V
			$I_{OH}$ = -8 mA	4.5	3.80	_	
Low-level output voltage	$V_{OL}$	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	$I_{OL}$ = $50\mu$ A	4.5	_	0.1	V
			I <sub>OL</sub> = 8 mA	4.5	_	0.44	
3-state output OFF-state leakage current	I <sub>OZ</sub>	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{OUT} = V_{CC} \text{ or GND}$		5.5	_	±2.50	μА
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V or GND		0 to 5.5	_	±1.0	μΑ
Quiescent supply current	Icc	V <sub>IN</sub> = V <sub>CC</sub> or GND		5.5	_	40.0	μА
Quiescent supply current	I <sub>CCT</sub>	Per input: V <sub>IN</sub> = 3.4 V Other input: V <sub>CC</sub> or GND		5.5	_	1.50	mA
Output leakage current (Power-OFF)	I <sub>OPD</sub>	V <sub>OUT</sub> = 5.5 V		0	_	5.0	μА

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

Characteristics	Symbol	Test Condition	Test Condition		Min	Max	Unit
High-level input voltage	$V_{IH}$	_		4.5 to 5.5	2.0	_	V
Low-level input voltage	V <sub>IL</sub>	_		4.5 to 5.5	_	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	4.4	_	٧
			I <sub>OH</sub> = -8 mA	4.5	3.70	_	
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	_	0.1	V
			I <sub>OL</sub> = 8 mA	4.5	_	0.55	
3-state output OFF-state leakage current	I <sub>OZ</sub>	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{OUT} = V_{CC} \text{ or GND}$		5.5	_	±10.0	μА
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V or GND		0 to 5.5	_	±2.0	μА
Quiescent supply	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		5.5	_	80.0	μА
current	I <sub>CCT</sub>	Per input: V <sub>IN</sub> = 3.4 V Other input: V <sub>CC</sub> or GND		5.5	_	1.50	mA
Output leakage current (Power-OFF)	I <sub>OPD</sub>	V <sub>OUT</sub> = 5.5 V		0	_	20.0	μА



## 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 <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Тур.	Max	Unit
Propagation delay time		t <sub>PLH</sub> ,t <sub>PHL</sub>		_	$5.0 \pm 0.5$	15	_	3.8	5.5	ns
						50		5.3	7.5	
3-state output enable time		$t_{PZL}, t_{PZH}$		$R_L = 1 k\Omega$	$5.0 \pm 0.5$	15		3.6	5.1	ns
						50	_	5.1	7.1	
3-state output disable time		$t_{PLZ}, t_{PHZ}$		$R_L = 1 k\Omega$	5.0 ± 0.5	50		6.1	8.8	ns
Output skew		t <sub>osLH</sub> ,t <sub>osHL</sub>	(Note 1)	_	$5.0 \pm 0.5$	50		_	1.0	ns
Input capacitance		C <sub>IN</sub>		_				4	10	pF
Output capacitance		C <sub>OUT</sub>					_	6		pF
Power dissipation	74VHCT125AFT	C <sub>PD</sub>	(Note 2)	_				14		pF
capacitance	74VHCT126AFT						_	15		

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.

 $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/4$  (per gate)

# 11.5. AC Characteristics (Unless otherwise specified, $T_a = -40$ to 85 °C, Input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Note	Test Condition	V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Max	Unit
Propagation delay time	t <sub>PLH</sub> ,t <sub>PHL</sub>		_	$5.0 \pm 0.5$	15	1.0	6.5	ns
					50	1.0	8.5	
3-state output enable time	t <sub>PZL</sub> ,t <sub>PZH</sub>		$R_L = 1 k\Omega$	5.0 ± 0.5	15	1.0	6.0	ns
					50	1.0	8.0	
3-state output disable time	t <sub>PLZ</sub> ,t <sub>PHZ</sub>		$R_L = 1 k\Omega$	$5.0 \pm 0.5$	50	1.0	10.0	ns
Output skew	t <sub>osLH</sub> ,t <sub>osHL</sub>	(Note 1)	_	5.0 ± 0.5	50	_	1.0	ns
Input capacitance	C <sub>IN</sub>		_		,		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	Symbol	Note	Test Condition	V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Max	Unit
Propagation delay time	t <sub>PLH</sub> ,t <sub>PHL</sub>		_	$5.0\pm0.5$	15	1.0	7.0	ns
					50	1.0	9.5	
3-state output enable time	t <sub>PZL</sub> ,t <sub>PZH</sub>		$R_L = 1 k\Omega$	$5.0\pm0.5$	15	1.0	6.5	ns
					50	1.0	9.0	
3-state output disable time	$t_{PLZ}, t_{PHZ}$		$R_L = 1 k\Omega$	$5.0 \pm 0.5$	50	1.0	11.0	ns
Output skew	t <sub>osLH</sub> ,t <sub>osHL</sub>	(Note 1)	_	$5.0 \pm 0.5$	50	_	1.0	ns
Input capacitance	C <sub>IN</sub>		_		·	_	10	pF

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

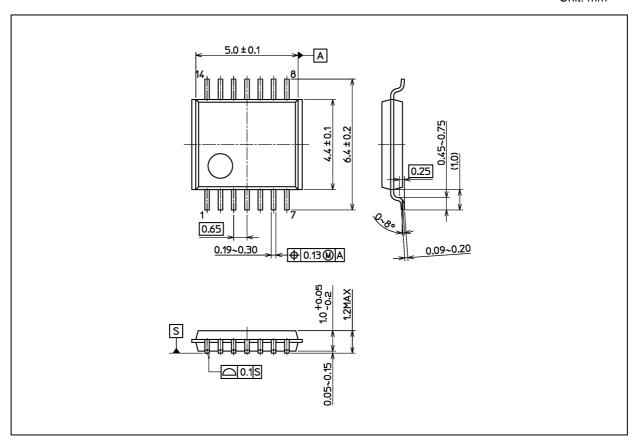
### 11.7. Noise Characteristics (Unless otherwise specified, $T_a = 25$ °C, Input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Тур.	Limit	Unit
Quiet output maximum dynamic V <sub>OL</sub>	V <sub>OLP</sub>	C <sub>L</sub> = 50 pF	5.0	0.5	0.8	V
Quiet output minimum dynamic V <sub>OL</sub>	V <sub>OLV</sub>	C <sub>L</sub> = 50 pF	5.0	-0.5	-0.8	
Minimum high-level dynamic input voltage	V <sub>IHD</sub>	C <sub>L</sub> = 50 pF	5.0		2.0	
Maximum low-level dynamic input voltage	$V_{ILD}$	C <sub>L</sub> = 50 pF	5.0	_	0.8	



## **Package Dimensions**

Unit: mm



Weight: 0.054 g (typ.)

	Package Name(s)
Nic	kname: TSSOP14B



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