

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC74VHCT245AF, TC74VHCT245AFK

## Octal Bus Transceiver

The TC74VHCT245A is an advanced high speed CMOS OCTAL BUS TRANSCEIVER fabricated with silicon gate C<sup>2</sup>MOS technology. It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

It is intended for two-way asynchronous communication between data busses. The direction of data transmission is determined by the level of the DIR input.

The enable input ( $\bar{G}$ ) can be used to disable the device so that the busses are effectively isolated.

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.

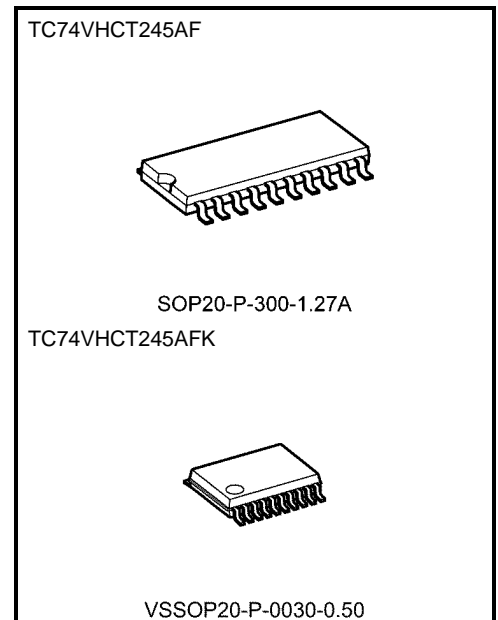
Input protection and output circuit ensure that 0 to 5.5 V can be applied to the input and output (Note) pins without regard to the supply voltage. These structure prevents device destruction due to mismatched supply and input/output voltages such as battery back up, hot board insertion, etc.

Note: Output in off-state

### Features (Note)

- High speed:  $t_{pd} = 4.9 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 4 \text{ }\mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- Compatible with TTL inputs:  $V_{IL} = 0.8 \text{ V (max)}$   
 $V_{IH} = 2.0 \text{ V (min)}$
- Power down protection is provided on all inputs and outputs
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Low noise:  $V_{OLP} = 1.5 \text{ V (max)}$
- Pin and function compatible with the 74 series (74AC/HC/F/ALS/LS etc.) 245 type.

Note: Do not apply a signal to any bus terminal when it is in the output mode. Damage may result.  
All floating (high impedance) bus terminals must have their input levels fixed by means of pull up or pull down resistors.



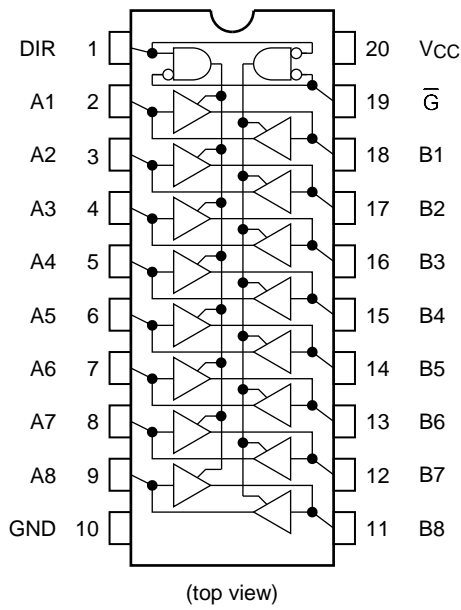
Weight

SOP20-P-300-1.27A: 0.22 g (typ.)

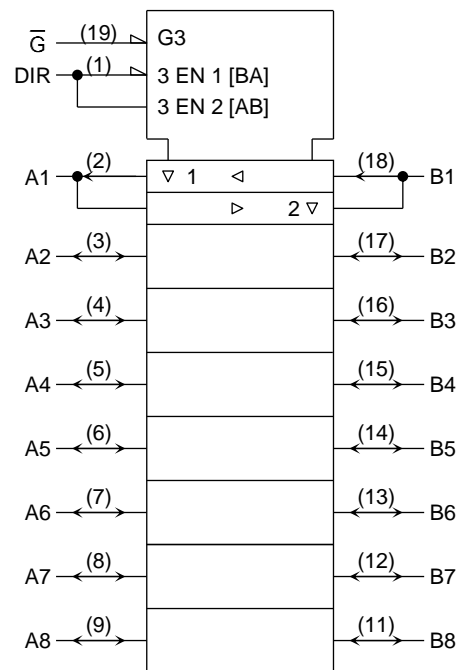
VSSOP20-P-0030-0.50: 0.03 g (typ.)

Start of commercial production  
1995-12

### Pin Assignment



### IEC Logic Symbol



### Truth Table

Inputs		Function		Output
$\bar{G}$	DIR	A Bus	B Bus	
L	L	Output	Input	A = B
L	H	Input	Output	B = A
H	X	Z		Z

X: Don't care

Z: High impedance

### Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V <sub>CC</sub>	-0.5 to 7.0	V
DC input voltage (DIR, $\bar{G}$ )	V <sub>IN</sub>	-0.5 to 7.0	V
DC bus I/O voltage	V <sub>I/O</sub>	-0.5 to 7.0 (Note 2)	V
		-0.5 to V <sub>CC</sub> + 0.5 (Note 3)	
Input diode current	I <sub>IK</sub>	-20	mA
Output diode current	I <sub>OK</sub>	±20 (Note 4)	mA
DC output current	I <sub>OUT</sub>	±25	mA
DC V <sub>CC</sub> /ground current	I <sub>CC</sub>	±75	mA
Power dissipation	P <sub>D</sub>	180	mW
Storage temperature	T <sub>stg</sub>	-65 to 150	°C

Note 1: 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 2: Output in off-state

Note 3: High or low state. I<sub>OUT</sub> absolute maximum rating must be observed.

Note 4: V<sub>OUT</sub> < GND, V<sub>OUT</sub> > V<sub>CC</sub>

### Operating Ranges (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage	V <sub>CC</sub>	4.5 to 5.5	V
Input voltage (DIR, $\bar{G}$ )	V <sub>IN</sub>	0 to 5.5	V
Bus I/O voltage	V <sub>I/O</sub>	0 to 5.5 (Note 2)	V
		0 to V <sub>CC</sub> (Note 3)	
Operating temperature	T <sub>opr</sub>	-40 to 85	°C
Input rise and fall time	dt/dv	0 to 20	ns/V

Note 1: The operating ranges are required to ensure the normal operation of the device. Unused inputs and bus inputs must be tied to either V<sub>CC</sub> or GND. Please connect both bus inputs and the bus outputs with V<sub>CC</sub> or GND when the I/O of the bus terminal changes by the function. In this case, please note that the output is not short-circuited.

Note 2: Output in off-state

Note 3: High or low state

### Electrical Characteristics

#### DC Characteristics

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
				VCC (V)	Min	Typ.	Max	Min		Max
High-level input voltage	V <sub>IH</sub>	—		4.5 to 5.5	2.0	—	—	2.0	—	V
Low-level input voltage	V <sub>IL</sub>	—		4.5 to 5.5	—	—	0.8	—	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	—	4.4	—	V
			I <sub>OH</sub> = -8 mA	4.5	3.94	—	—	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>OL</sub> = 50 μA	4.5	—	0.0	0.1	—	0.1	V
			I <sub>OL</sub> = 8 mA	4.5	—	—	0.36	—	0.44	
3-state output off-state 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	—	—	±0.25	—	±2.50	μA
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V or GND		0 to 5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		5.5	—	—	4.0	—	40.0	μA
	I <sub>CC(T)</sub>	Per input: V <sub>IN</sub> = 3.4 V Other input: V <sub>CC</sub> or GND		5.5	—	—	1.35	—	1.50	mA
Output leakage current (Power-OFF)	I <sub>OPD</sub>	V <sub>OUT</sub> = 5.5 V		0	—	—	0.5	—	5.0	μA

#### AC Characteristics (input: tr = tf = 3 ns)

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit		
				VCC (V)	C <sub>L</sub> (pF)	Min	Typ.	Max		Min	Max
Propagation delay time	t <sub>pLH</sub>	—		5.0 ± 0.5	15	—	4.9	7.7	1.0	8.5	ns
	t <sub>pHL</sub>	50	—		5.4	8.7	1.0	9.5			
3-state output enable time	t <sub>pZL</sub>	R <sub>L</sub> = 1 kΩ	5.0 ± 0.5	15	—	9.4	13.8	1.0	15.0	ns	
	t <sub>pZH</sub>			50	—	9.9	14.8	1.0	16.0		
3-state output disable time	t <sub>pLZ</sub> t <sub>pHZ</sub>	R <sub>L</sub> = 1 kΩ	5.0 ± 0.5	50	—	10.1	15.4	1.0	16.5	ns	
Output to output skew	t <sub>osLH</sub> t <sub>osHL</sub>	(Note 1)		5.0 ± 0.5	50	—	—	1.0	—	1.0	ns
Input capacitance	C <sub>IN</sub>	DIR, $\bar{G}$		—	—	4	10	—	10	pF	
Bus input capacitance	C <sub>I/O</sub>	A <sub>n</sub> , B <sub>n</sub>		—	—	13	—	—	—	pF	
Power dissipation capacitance	CPD	(Note 2)		—	—	16	—	—	—	pF	

Note 1: Parameter guaranteed by design.

$$t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|$$

Note 2: CPD 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:

$$I_{CC(opr)} = CPD \cdot V_{CC} \cdot f_{IN} + I_{CC}/8 \text{ (per bit)}$$

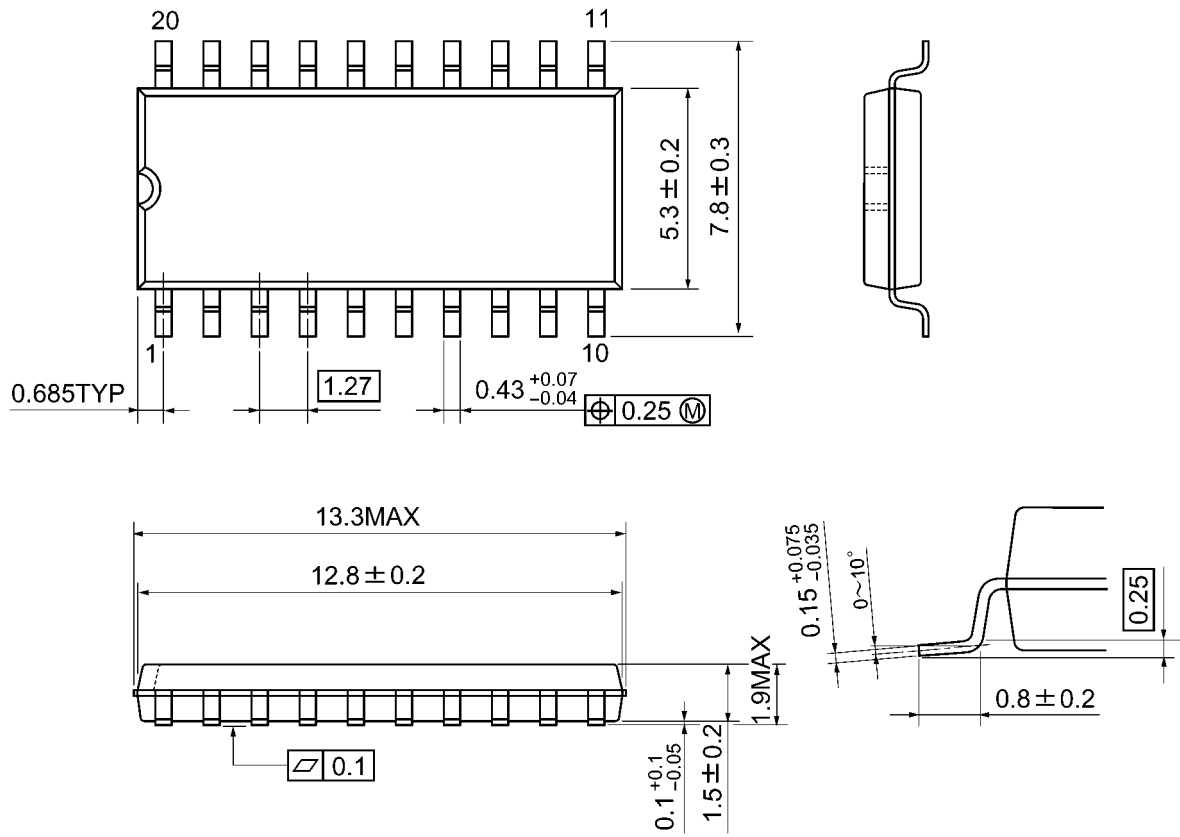
### Noise Characteristics (input: $t_r = t_f = 3 \text{ ns}$ )

Characteristics	Symbol	Test Condition	Ta = 25°C			Unit
			V <sub>CC</sub> (V)	Typ.	Limit	
Quiet output maximum dynamic V <sub>OL</sub>	V <sub>OLP</sub>	C <sub>L</sub> = 50 pF	5.0	1.1	1.5	V
Quiet output minimum dynamic V <sub>OL</sub>	V <sub>OLV</sub>	C <sub>L</sub> = 50 pF	5.0	-1.1	-1.5	V
Minimum high level dynamic input voltage	V <sub>IHD</sub>	C <sub>L</sub> = 50 pF	5.0	—	2.0	V
Maximum low level dynamic input voltage	V <sub>ILD</sub>	C <sub>L</sub> = 50 pF	5.0	—	0.8	V

### Package Dimensions

SOP20-P-300-1.27A

Unit: mm

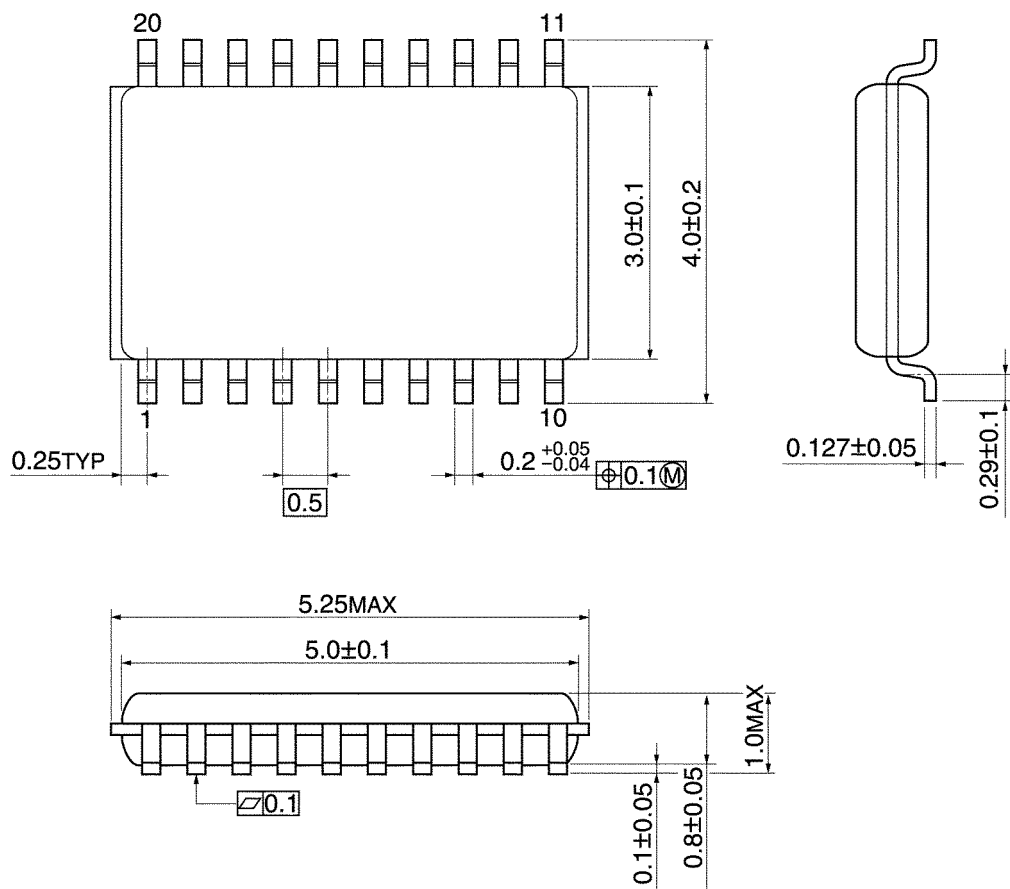


Weight: 0.22 g (typ.)

### Package Dimensions

VSSOP20-P-0030-0.50

Unit: mm



Weight: 0.03 g (typ.)

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