TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC74VHC245F,TC74VHC245FT,TC74VHC245FK

#### Octal Bus Transceiver

The TC74VHC245 is an advanced high speed CMOS OCTAL BUS TRANSCEIVER fabricated with silicon gate  $C^2MOS$  technology.

It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

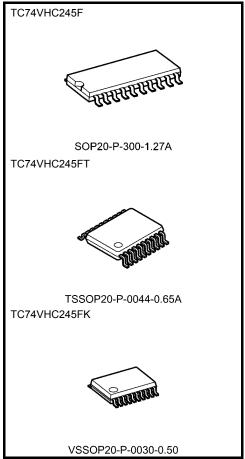
It is intended for two-way asynchronous communication between data busses. The direction of data transmission is determined by the level of the DIR input.

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

All inputs are equipped with protection circuits against static discharge.

## Features (Note 1) (Note 2) (Note 3)

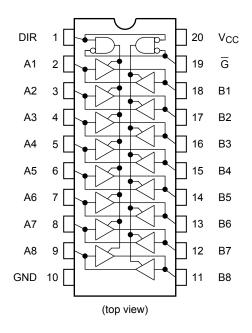
- High speed:  $t_{pd} = 4.0 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 4 \mu A \text{ (max)}$  at  $T_{a} = 25 \text{°C}$
- High noise immunity: V<sub>NIH</sub> = V<sub>NIL</sub> = 28% V<sub>CC</sub> (min)
- Balanced propagation delays:  $t_{pLH} \simeq t_{pHL}$
- Wide operating voltage range: VCC (opr) = 2 V to 5.5 V
- Low noise: VOLP = 1.0 V (max)
- Pin and function compatible with 74ALS245
  - Note 1: Do not apply a signal to any bus terminal when it is in the output mode. Damage may result.
  - Note 2: All floating (high impedance) bus terminals must have their input levels fixed by means of pull up or pull down resistors.
  - Note 3: A parasitic diode is formed between the bus and V<sub>CC</sub> terminals. Therefore bus terminal can not be used to interface 5 V to 3 V systems directly.



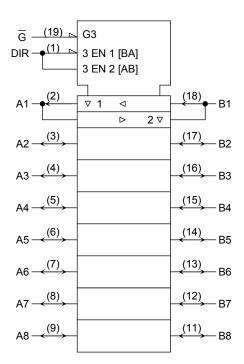
Weight

SOP20-P-300-1.27A : 0.22 g (typ.) TSSOP20-P-0044-0.65A : 0.08 g (typ.) VSSOP20-P-0030-0.50 : 0.03 g (typ.)

## **Pin Assignment**



## **IEC Logic Symbol**



### **Truth Table**

Inputs		Fun	Output		
G	DIR	A Bus	Output		
L	L	Output	Input	A = B	
L	Н	Input	B = A		
Н	Χ	2	Z		

X: Don't care

Z: High impedance

## **Absolute Maximum Ratings (Note)**

Characteristics	Symbol	Rating	Unit
Supply voltage range	V <sub>CC</sub>	−0.5 to 7.0	V
DC input voltage (DIR, $\overline{G}$ )	V <sub>IN</sub>	-0.5 to 7.0	V
DC bus I/O voltage	V <sub>I/O</sub>	-0.5 to V <sub>CC</sub> + 0.5	V
Input diode current	lık	-20	mA
Output diode current	lok	±20	mA
DC output current	lout	±25	mA
DC V <sub>CC</sub> /ground current	Icc	±75	mA
Power dissipation	PD	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).



## **Operating Ranges (Note)**

Characteristics	Symbol	Rating	Unit	
Supply voltage	V <sub>CC</sub>	2.0 to 5.5	V	
Input voltage (DIR, $\overline{\overline{G}}$ )	V <sub>IN</sub>	0 to 5.5	V	
Bus I/O voltage	V <sub>I/O</sub>	0 to V <sub>CC</sub>	V	
Operating temperature	T <sub>opr</sub>	−40 to 85	°C	
Input rise and fall time	dt/dv	0 to 100 (V <sub>CC</sub> = 3.3 ± 0.3 V)	ns/V	
input rise and rail time	ui/uv	0 to 20 (V <sub>CC</sub> = 5 ± 0.5 V)	IIS/V	

Note:

The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs and bus inputs must be tied to either  $V_{CC}$  or GND. Please connect both bus inputs and the bus outputs with  $V_{CC}$  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.

### **Electrical Characteristics**

#### **DC Characteristics**

Characteristics	Symbol	Test Condition  V <sub>CC</sub> (V)		Ta = 25°C			Ta = -40 to 85°C		Unit	
Characteristics	Cymbol				Min	Тур.	Max	Min	Max	Onit
High-level input voltage	V <sub>IH</sub>	_		2.0 3.0 to 5.5	1.50 V <sub>CC</sub> × 0.7	1 1		1.50 V <sub>CC</sub> × 0.7	1 1	V
Low-level input voltage	V <sub>IL</sub>	_		2.0 3.0 to 5.5	_ _	1 1	0.50 V <sub>CC</sub> × 0.3	_ _	0.50 V <sub>CC</sub> × 0.3	V
High-level output	V <sub>ОН</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -50 μA	2.0 3.0 4.5	1.9 2.9 4.4	2.0 3.0 4.5	_ _ _	1.9 2.9 4.4		V
Voltage			$I_{OH} = -4 \text{ mA}$ $I_{OH} = -8 \text{ mA}$	3.0 4.5	2.58 3.94	_ _	_ _	2.48 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	2.0 3.0 4.5	_ _ _	0.0 0.0 0.0	0.1 0.1 0.1	_ _ _	0.1 0.1 0.1	
			I <sub>OL</sub> = 4 mA I <sub>OL</sub> = 8 mA	3.0 4.5	_ _	1 1	0.36 0.36	_ _	0.44 0.44	
3-state output off-state current	l <sub>OZ</sub>	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = V_{CC}$ or GND		5.5	_	_	±0.25	_	±2.50	μΑ
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V or GND		0 to 5.5	_	_	±0.1	_	±1.0	μΑ
Quiescent supply current	Icc	V <sub>IN</sub> = V <sub>CC</sub> or GND		5.5	_	_	4.0	_	40.0	μΑ

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

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = −40 to 85°C		Unit	
	- <b>,</b>		V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Тур.	Max	Min	Max	
		_	3.3 ± 0.3	15	_	5.8	8.4	1.0	10.0	
Propagation delay	$t_{pLH}$		3.3 ± 0.3	50	_	8.3	11.9	1.0	13.5	ns
time	$t_{pHL}$		50.05	15	_	4.0	5.5	1.0	6.5	
			5.0 ± 0.5	50	_	5.5	7.5	1.0	8.5	
	t <sub>pZL</sub>	R <sub>L</sub> = 1 kΩ	3.3 ± 0.3	15	_	8.5	13.2	1.0	15.5	ns
3-state output enable				50	_	11.0	16.7	1.0	19.0	
time			$5.0 \pm 0.5$	15	_	5.8	8.5	1.0	10.0	
				50	_	7.3	10.6	1.0	12.0	
3-state output disable	t <sub>pLZ</sub>	R <sub>L</sub> = 1 kΩ	$3.3 \pm 0.3$	50	_	11.5	15.8	1.0	18.0	ns
time	t <sub>pHZ</sub>		$5.0 \pm 0.5$	50	_	7.0	9.7	1.0	11.0	115
Output to output skew	t <sub>osLH</sub>	(Nata 4)	$3.3 \pm 0.3$	50	_	_	1.5	_	1.5	ns
Output to output skew	t <sub>osHL</sub>	(Note 1)	$5.0 \pm 0.5$	50	_	_	1.0	_	1.0	115
Input capacitance	C <sub>IN</sub>	DIR, G			_	4	10	_	10	pF
Bus input capacitance	C <sub>I/O</sub>	A <sub>n</sub> , Bn			_	8	_	_	_	pF
Power dissipation capacitance	C <sub>PD</sub>			(Note 2)	_	21	_	_	_	pF

Note 1: Parameter guaranteed by design.

 $t_{OSLH} = |t_{PLHm} - t_{PLHn}|, t_{OSHL} = |t_{PHLm} - t_{PHLn}|$ 

Note 2: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

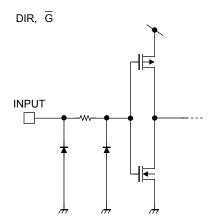
Average operating current can be obtained by the equation:

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

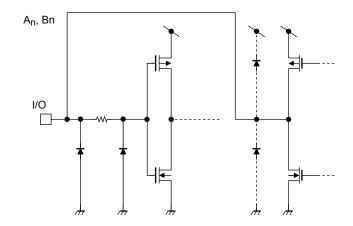
## Noise Characteristics (input: $t_r = t_f = 3 \text{ ns}$ ) (Note)

Characteristics	Symbol	Test Condition		Ta =	Ta = 25°C	
Characteristics	Symbol		V <sub>CC</sub> (V)	Тур.	Max	Unit
Quiet output maximum dynamic V <sub>OL</sub>	V <sub>OLP</sub>	C <sub>L</sub> = 50 pF	5.0	0.7	1.0	V
Quiet output minimum dynamic V <sub>OL</sub>	V <sub>OLV</sub>	C <sub>L</sub> = 50 pF	5.0	-0.7	-1.0	٧
Minimum high level dynamic input voltage	$V_{IHD}$	C <sub>L</sub> = 50 pF	5.0	1	3.5	>
Maximum low level dynamic input voltage	$V_{ILD}$	C <sub>L</sub> = 50 pF	5.0	_	1.5	V

# **Input Equivalent Circuit**



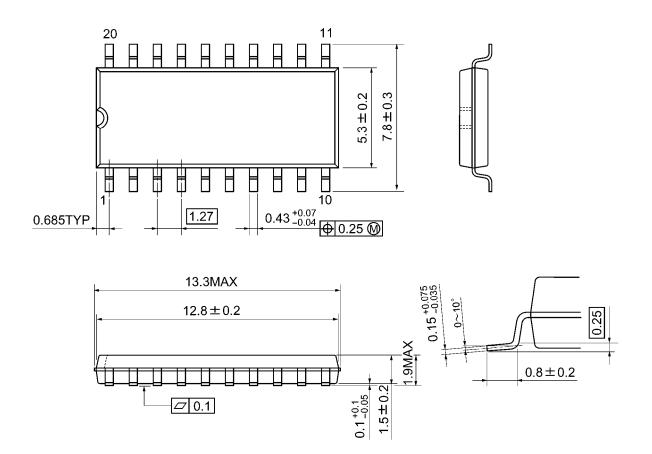
# **Bus Terminal Equivalent Circuit**



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# **Package Dimensions**

SOP20-P-300-1.27A Unit: mm

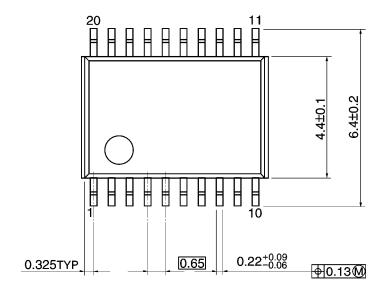


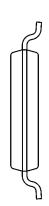
Weight: 0.22 g (typ.)

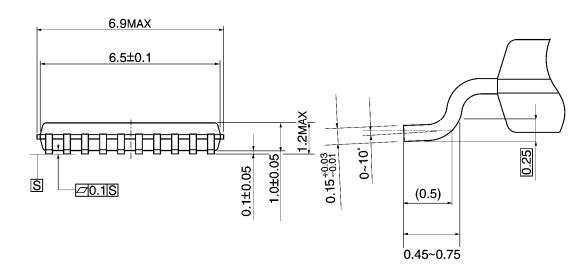
# **Package Dimensions**

TSSOP20-P-0044-0.65A

Unit: mm



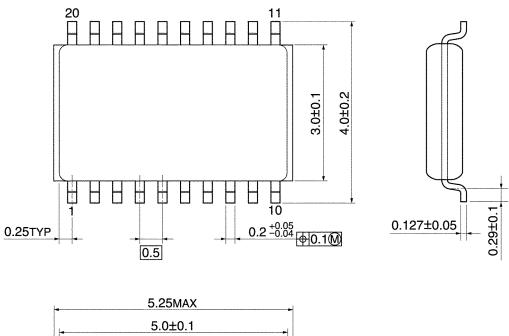


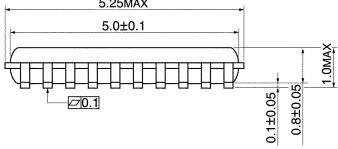


Weight: 0.08 g (typ.)

# **Package Dimensions**

VSSOP20-P-0030-0.50 Unit: mm





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Weight: 0.03 g (typ.)

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