

# 74HC245D

## 1. Functional Description

- Octal Bus Transceiver

## 2. General

The 74HC245D is high speed CMOS OCTAL BUS TRANSCEIVERS fabricated with silicon gate C<sup>2</sup>MOS technology.

They achieve the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

They are 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.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

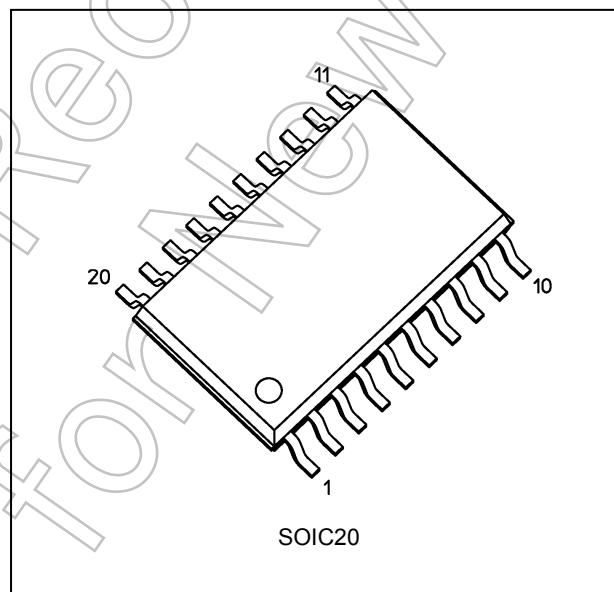
## 3. Features (Note)

- (1) High speed:  $t_{pd} = 10$  ns (typ.) at  $V_{CC} = 6.0$  V
- (2) Low power dissipation:  $I_{CC} = 4.0$   $\mu$ A (max) at  $T_a = 25$  °C
- (3) Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$
- (4) Wide operating voltage range:  $V_{CC(opr)} = 2.0$  V to 6.0 V

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.

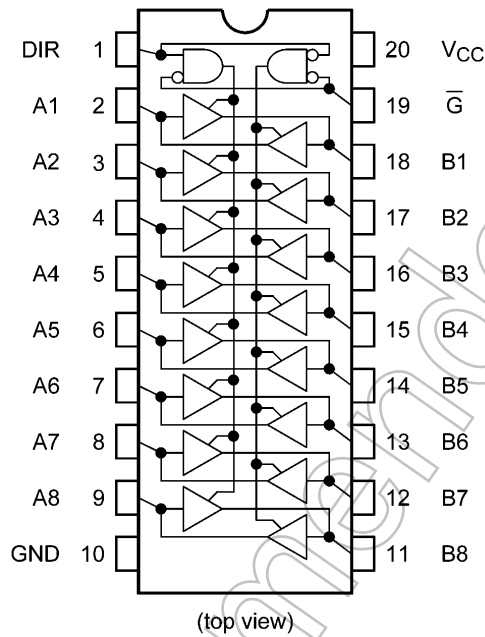
## 4. Packaging



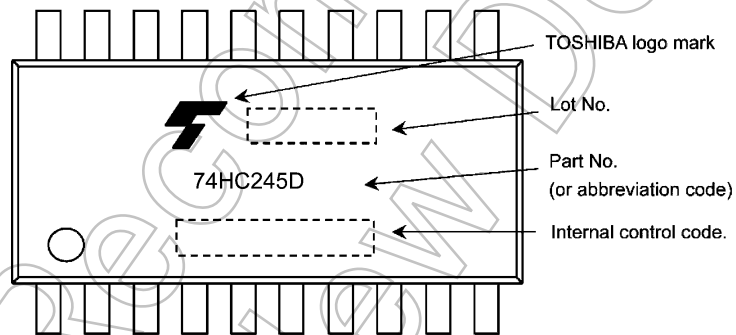
Start of commercial production

2016-04

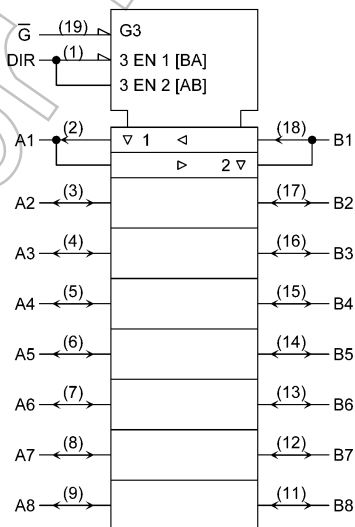
**5. Pin Assignment**



**6. Marking**



**7. IEC Logic Symbol**



## 8. Truth Table

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

X: Don't care (L or H)

Z: High impedance

## 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 $V_{CC} + 0.5$	V
Output voltage	$V_{OUT}$		-0.5 to $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$		$\pm 20$	mA
Output diode current	$I_{OK}$		$\pm 20$	mA
Output current	$I_{OUT}$		$\pm 35$	mA
$V_{CC}$ /ground current	$I_{CC}$		$\pm 75$	mA
Power dissipation	$P_D$	(Note 1)	500	mW
Storage temperature	$T_{stg}$		-65 to 150	$^{\circ}\text{C}$

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:  $P_D$  derates linearly with  $-8 \text{ mW}/^{\circ}\text{C}$  above  $85 \text{ }^{\circ}\text{C}$

## 10. Operating Ranges (Note)

Characteristics	Symbol	Test Condition	Rating	Unit
Supply voltage	$V_{CC}$	—	2.0 to 6.0	V
Input voltage	$V_{IN}$	—	0 to $V_{CC}$	V
Output voltage	$V_{OUT}$	—	0 to $V_{CC}$	V
Operating temperature	$T_{opr}$	—	-40 to 125	$^{\circ}\text{C}$
Input rise and fall times	$t_r, t_f$	—	0 to 50	$\mu\text{s}$

Note: The operating ranges are required 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.

**11. Electrical Characteristics**

**11.1. DC Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^\circ\text{C}$ )**

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Min	Typ.	Max	Unit	
High-level input voltage	$V_{IH}$	—	2.0	1.50	—	—	V	
			4.5	3.15	—	—		
			6.0	4.20	—	—		
Low-level input voltage	$V_{IL}$	—	2.0	—	—	0.50	V	
			4.5	—	—	1.35		
			6.0	—	—	1.80		
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	2.0	1.9	2.0	—	V
				4.5	4.4	4.5	—	
			6.0	5.9	6.0	—		
			$I_{OH} = -6\text{ mA}$	4.5	4.18	4.31	—	
			$I_{OH} = -7.8\text{ mA}$	6.0	5.68	5.80	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 20\text{ }\mu\text{A}$	2.0	—	0.0	0.1	V
				4.5	—	0.0	0.1	
				6.0	—	0.0	0.1	
			$I_{OL} = 6\text{ mA}$	4.5	—	0.17	0.26	
			$I_{OL} = 7.8\text{ mA}$	6.0	—	0.18	0.26	
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = V_{CC}$ or GND	6.0	—	—	$\pm 0.5$	$\mu\text{A}$	
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND	6.0	—	—	$\pm 0.1$	$\mu\text{A}$	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	6.0	—	—	4.0	$\mu\text{A}$	

**11.2. DC Characteristics (Unless otherwise specified,  $T_a = -40$  to  $85\text{ }^\circ\text{C}$ )**

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Min	Max	Unit	
High-level input voltage	$V_{IH}$	—	2.0	1.50	—	V	
			4.5	3.15	—		
			6.0	4.20	—		
Low-level input voltage	$V_{IL}$	—	2.0	—	0.50	V	
			4.5	—	1.35		
			6.0	—	1.80		
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -20\text{ }\mu\text{A}$	2.0	1.9	—	V
				4.5	4.4	—	
			6.0	5.9	—		
			$I_{OH} = -6\text{ mA}$	4.5	4.13	—	
			$I_{OH} = -7.8\text{ mA}$	6.0	5.63	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 20\text{ }\mu\text{A}$	2.0	—	0.1	V
				4.5	—	0.1	
				6.0	—	0.1	
			$I_{OL} = 6\text{ mA}$	4.5	—	0.33	
			$I_{OL} = 7.8\text{ mA}$	6.0	—	0.33	
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = V_{CC}$ or GND	6.0	—	$\pm 5.0$	$\mu\text{A}$	
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND	6.0	—	$\pm 1.0$	$\mu\text{A}$	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	6.0	—	40.0	$\mu\text{A}$	

**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	$V_{IH}$	—	2.0	1.50	—	V	
			4.5	3.15	—		
			6.0	4.20	—		
Low-level input voltage	$V_{IL}$	—	2.0	—	0.50	V	
			4.5	—	1.35		
			6.0	—	1.80		
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -20 \mu A$	2.0	1.9	—	V
				4.5	4.4	—	
			$I_{OH} = -6$ mA	4.5	3.7	—	
				6.0	5.2	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 20 \mu A$	2.0	—	0.1	V
				4.5	—	0.1	
				6.0	—	0.1	
			$I_{OL} = 6$ mA	4.5	—	0.4	
				6.0	—	0.4	
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = V_{CC}$ or GND	6.0	—	$\pm 10.0$	$\mu A$	
Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND	6.0	—	$\pm 1.0$	$\mu A$	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	6.0	—	160.0	$\mu A$	

**11.4. AC Characteristics (Unless otherwise specified,  $T_a = 25$  °C, Input:  $t_r = t_f = 6$  ns)**

Characteristics	Symbol	Note	Test Condition	$C_L$ (pF)	$V_{CC}$ (V)	Min	Typ.	Max	Unit
Output transition time	$t_{TLH}, t_{THL}$	—	—	50	2.0	—	52	60	ns
					4.5	—	7	12	
					6.0	—	6	10	
Propagation delay time	$t_{PLH}, t_{PHL}$	—	—	50	2.0	—	33	90	ns
					4.5	—	12	18	
					6.0	—	10	15	
				150	2.0	—	48	120	
					4.5	—	16	24	
					6.0	—	14	20	
3-state output enable time	$t_{PZL}, t_{PZH}$	—	$R_L = 1$ k $\Omega$	50	2.0	—	48	150	ns
					4.5	—	16	30	
					6.0	—	14	26	
				150	2.0	—	63	180	
					4.5	—	21	36	
					6.0	—	18	31	
3-state output disable time	$t_{PLZ}, t_{PHZ}$	—	$R_L = 1$ k $\Omega$	50	2.0	—	37	150	ns
					4.5	—	17	30	
					6.0	—	15	26	
Input capacitance	$C_{IN}$	—	DIR, $\bar{G}$	—	—	3	—	pF	
Power dissipation capacitance	$C_{PD}$	(Note 1)	—	—	—	12	—	pF	

Note 1:  $C_{PD}$  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.

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

**11.5. AC Characteristics**  
 (Unless otherwise specified,  $T_a = -40$  to  $85$  °C, Input:  $t_r = t_f = 6$  ns)

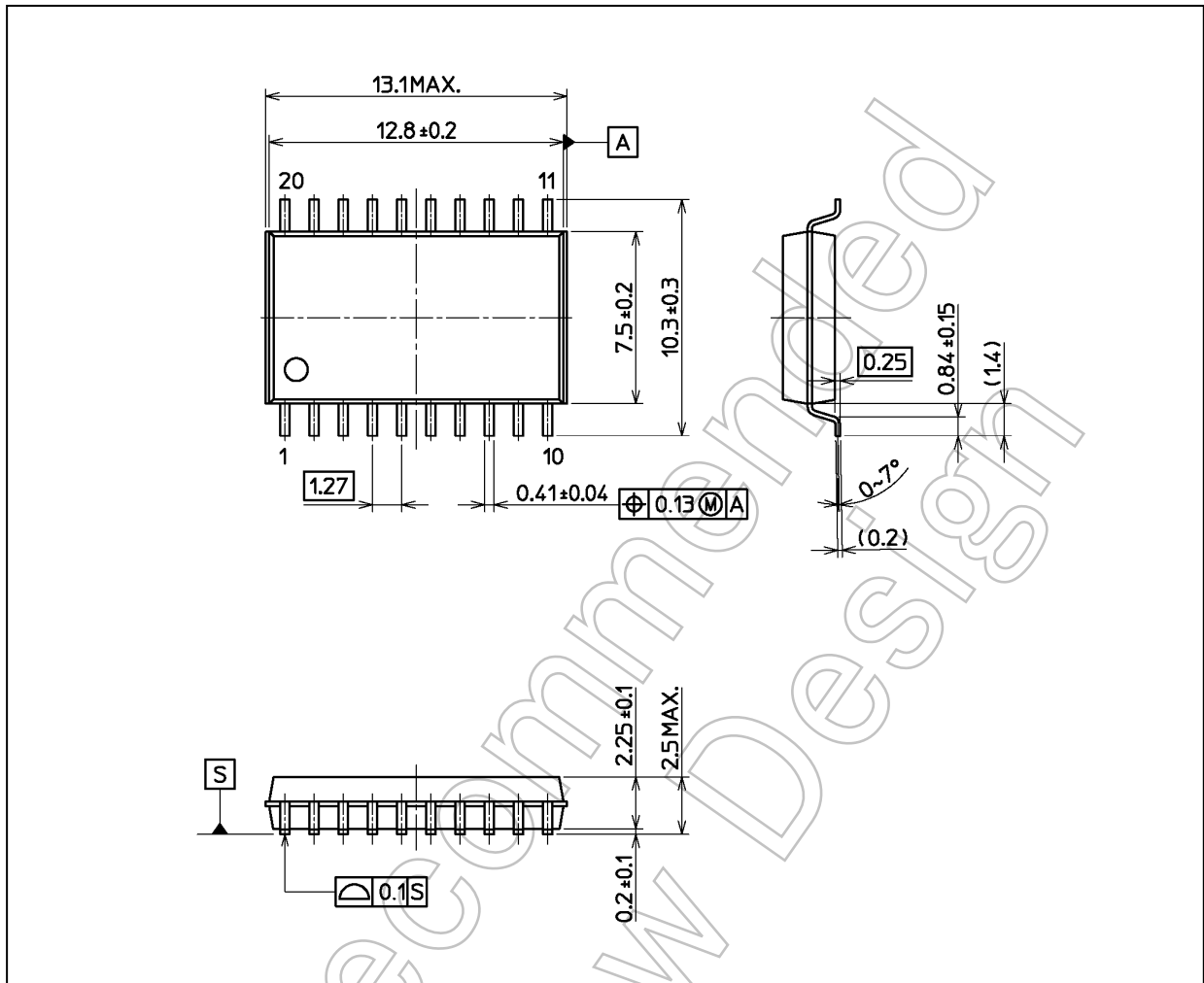
Characteristics	Symbol	Test Condition	$C_L$ (pF)	$V_{CC}$ (V)	Min	Max	Unit
Output transition time	$t_{TLH}, t_{THL}$	—	50	2.0	—	75	ns
				4.5	—	15	
				6.0	—	13	
Propagation delay time	$t_{PLH}, t_{PHL}$	—	50	2.0	—	115	ns
				4.5	—	23	
				6.0	—	20	
			150	2.0	—	150	
				4.5	—	30	
				6.0	—	26	
3-state output enable time	$t_{PZL}, t_{PZH}$	$R_L = 1\text{ k}\Omega$	50	2.0	—	190	ns
				4.5	—	38	
				6.0	—	32	
			150	2.0	—	225	
				4.5	—	45	
				6.0	—	38	
3-state output disable time	$t_{PLZ}, t_{PHZ}$	$R_L = 1\text{ k}\Omega$	50	2.0	—	190	ns
				4.5	—	38	
				6.0	—	32	

**11.6. AC Characteristics**  
 (Unless otherwise specified,  $T_a = -40$  to  $125$  °C, Input:  $t_r = t_f = 6$  ns)

Characteristics	Symbol	Test Condition	$C_L$ (pF)	$V_{CC}$ (V)	Min	Max	Unit
Output transition time	$t_{TLH}, t_{THL}$	—	50	2.0	—	90	ns
				4.5	—	18	
				6.0	—	15	
Propagation delay time	$t_{PLH}, t_{PHL}$	—	50	2.0	—	135	ns
				4.5	—	27	
				6.0	—	23	
			150	2.0	—	180	
				4.5	—	36	
				6.0	—	31	
3-state output enable time	$t_{PZL}, t_{PZH}$	$R_L = 1\text{ k}\Omega$	50	2.0	—	225	ns
				4.5	—	45	
				6.0	—	38	
			150	2.0	—	270	
				4.5	—	54	
				6.0	—	46	
3-state output disable time	$t_{PLZ}, t_{PHZ}$	$R_L = 1\text{ k}\Omega$	50	2.0	—	225	ns
				4.5	—	45	
				6.0	—	38	

Package Dimensions

Unit: mm



Weight: 0.51 g (typ.)

Package Name(s)
Nickname: SOIC20

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