

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC74LVXC3245FS

## Dual Supply Octal Configurable Voltage Interface Bus Transceiver

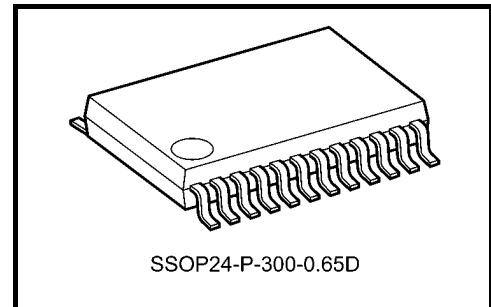
The TC74LVXC3245FS is a dual supply, advanced high-speed CMOS octal configurable voltage interface bus transceiver fabricated with silicon gate CMOS technology.

Designed for use as an interface between a 3.3 V bus and a 3.3V to 5 V bus in mixed 3.3 V/5 V supply systems' it achieves high-speed operation while maintaining the CMOS low power dissipation.

It is intended for 2 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. The A-port interfaces with the 3.3-V bus, the B-port with the 3.3V to 5V bus. This device will allow the  $V_{CCB}$  voltage source pin and I/O pins on the B port to float when  $\overline{G}$  is "H".

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



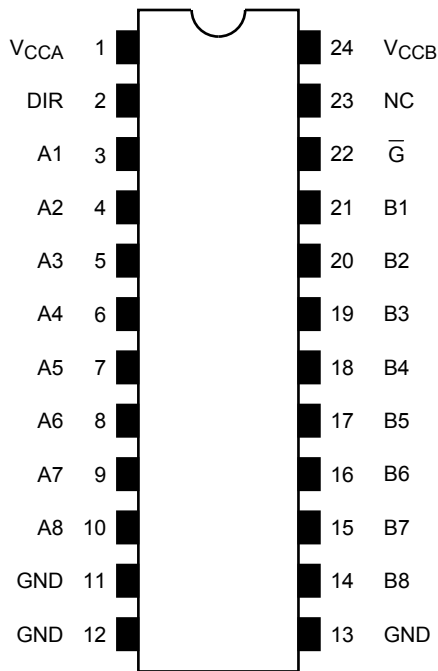
Weight: 0.14 g (typ.)

### Features

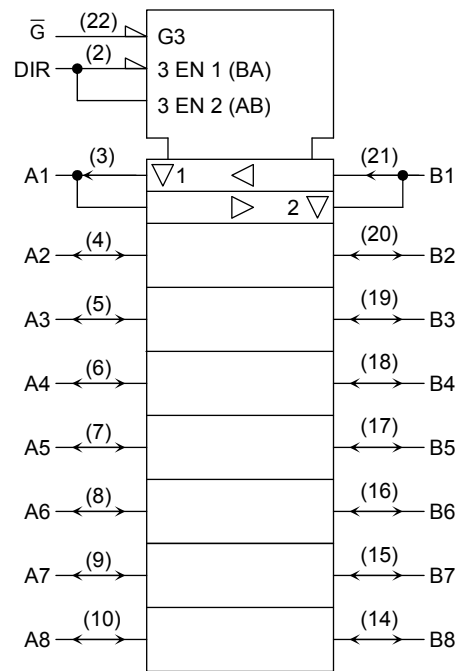
- Bi-directional interface between 3 V and 5 V buses
- High-speed:  $t_{pd} = 8.5 \text{ ns (max)}$   
( $V_{CCA} = 3.3 \text{ V}$ ,  $V_{CCB} = 5.0 \text{ V}$ )
- Low power dissipation:  $I_{CC} = 8 \mu\text{A (max)}$  ( $T_a = 25^\circ\text{C}$ )
- Symmetrical output impedance:  $I_{OUTA} = \pm 24 \text{ mA (min)}$   
 $I_{OUTB} = \pm 24 \text{ mA (min)}$   
( $V_{CCA} = V_{CCB} = 3.0 \text{ V}$ )
- Low noise:  $V_{OLP} = 1.5 \text{ V (max)}$
- Flexible  $V_{CCB}$  operating range
- Allows B port and  $V_{CCB}$  to float simultaneously when  $\overline{G}$  is "H"
- Package: SSOP (shrink small outline package)

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

## Pin Assignment (top view)



## IEC Logic Symbol



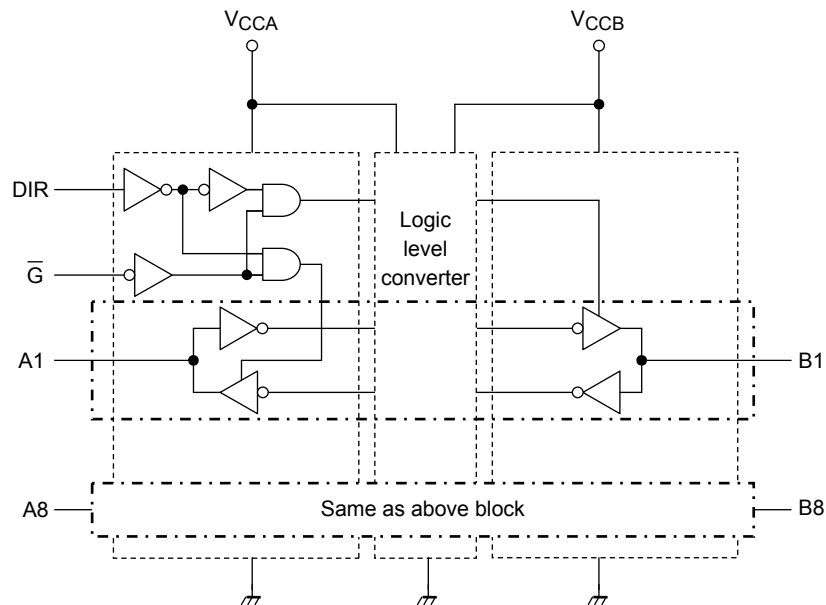
## Truth Table

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

X: Don't care

Z: High impedance

**Block Diagram**



**Absolute Maximum Ratings (Note 1)**

Characteristics	Symbol	Rating	Unit
Supply voltage range (Note 2)	$V_{CCA}$	-0.5 to 7.0	V
	$V_{CCB}$	-0.5 to 7.0	
DC input voltage ( $DIR, \bar{G}$ )	$V_{IN}$	-0.5 to $V_{CCA} + 0.5$	V
DC bus I/O voltage	$V_{IOA}$	-0.5 to $V_{CCA} + 0.5$	V
	$V_{IOB}$	-0.5 to $V_{CCB} + 0.5$	
Input diode current	$I_{IK}$	$\pm 20$	mA
Output diode current	$I_{I/OK}$	$\pm 50$	mA
DC output current	$I_{OUTA}$	$\pm 50$	mA
	$I_{OUTB}$	$\pm 50$	
DC $V_{CC}$ /ground current	$I_{CCA}$	$\pm 200$	mA
	$I_{CCB}$	$\pm 200$	
Power dissipation	$P_D$	180	mW
Storage temperature	$T_{stg}$	-65 to 150	$^{\circ}C$

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:  $V_{CCB} > V_{CCA}$

Don't supply a voltage to  $V_{CCB}$  terminal when  $V_{CCA}$  is in the OFF state.

## Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CCA}$	2.7 to 3.6	V
	$V_{CCB}$	3.0 to 5.5	
Input voltage (DIR, $\bar{G}$ )	$V_{IN}$	0 to $V_{CCA}$	V
Bus I/O voltage	$V_{I/OA}$	0 to $V_{CCA}$	V
	$V_{I/OB}$	0 to $V_{CCB}$	
Operating temperature	$T_{opr}$	-40 to 85	°C
Input rise and fall time	dt/dv	0 to 8 ( $V_{CCA} = 2.7$ to $3.6$ V)	ns/V
		0 to 8 ( $V_{CCB} = 3.0$ to $5.5$ V)	

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.

## Electrical Characteristics

### DC Characteristics

Characteristics	Sym- bol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit			
			V <sub>CCA</sub> (V)	V <sub>CCB</sub> (V)	Min	Typ.	Max		Min	Max	
Input voltage (V <sub>CCA</sub> )	H-level V <sub>IHA</sub>	DIR, $\bar{G}$ , An	2.7	3.0	2.0	—	—	2.0	—	V	
			3.0	3.6	2.0	—	—	2.0	—		
			3.6	5.5	2.0	—	—	2.0	—		
	L-level V <sub>ILA</sub>	DIR, $\bar{G}$ , An	2.7	3.0	—	—	0.8	—	0.8		
			3.0	3.6	—	—	0.8	—	0.8		
			3.6	5.5	—	—	0.8	—	0.8		
Input voltage (V <sub>CCB</sub> )	H-level V <sub>IHB</sub>	Bn	2.7	3.0	2.0	—	—	2.0	—	V	
			3.0	3.6	2.0	—	—	2.0	—		
			3.6	5.5	3.85	—	—	3.85	—		
	L-level V <sub>ILB</sub>	Bn	2.7	3.0	—	—	0.8	—	0.8		
			3.0	3.6	—	—	0.8	—	0.8		
			3.6	5.5	—	—	1.65	—	1.65		
Output voltage (V <sub>CCA</sub> )	H-level V <sub>OHA</sub>	V <sub>INA</sub> = V <sub>IHA</sub> or V <sub>ILA</sub> V <sub>INB</sub> = V <sub>IHB</sub> or V <sub>ILB</sub>	I <sub>OH</sub> = -100 μA	3.0	3.0	2.9	3.0	—	2.9	—	V
			I <sub>OH</sub> = -12 mA	3.0	3.0	2.56	—	—	2.46	—	
			I <sub>OH</sub> = -24 mA	3.0	3.0	2.35	—	—	2.25	—	
			I <sub>OH</sub> = -12 mA	2.7	3.0	2.3	—	—	2.2	—	
			I <sub>OH</sub> = -24 mA	2.7	4.5	2.1	—	—	2.0	—	
	L-level V <sub>OLA</sub>		I <sub>OL</sub> = 100 μA	3.0	3.0	—	0.0	0.1	—	0.1	
			I <sub>OL</sub> = 24 mA	3.0	3.0	—	—	0.36	—	0.44	
			I <sub>OL</sub> = 12 mA	2.7	3.0	—	—	0.36	—	0.44	
			I <sub>OL</sub> = 24 mA	2.7	4.5	—	—	0.42	—	0.5	

## DC Characteristics (continued)

Characteristics		Sym- bol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit		
					V <sub>CCA</sub> (V)	V <sub>CCB</sub> (V)	Min	Typ.	Max		Min	Max
Output voltage (V <sub>CCB</sub> )	H-level	V <sub>OHB</sub>	V <sub>INA</sub> = V <sub>IHA</sub> or V <sub>ILA</sub> V <sub>INB</sub> = V <sub>IHB</sub> or V <sub>ILB</sub>	I <sub>OH</sub> = -100 μA	3.0	3.0	2.9	3.0	—	2.9	—	V
				I <sub>OH</sub> = -12 mA	3.0	3.0	2.56	—	—	2.46	—	
				I <sub>OH</sub> = -24 mA	3.0	3.0	2.35	—	—	2.25	—	
				I <sub>OH</sub> = -24 mA	3.0	4.5	3.86	—	—	3.76	—	
	L-level	V <sub>OLB</sub>		I <sub>OL</sub> = 100 μA	3.0	3.0	—	0.0	0.1	—	0.1	
				I <sub>OL</sub> = 24 mA	3.0	3.0	—	—	0.36	—	0.44	
				I <sub>OL</sub> = 24 mA	3.0	4.5	—	—	0.36	—	0.44	
3-state output Off-state current	I <sub>OZA</sub>	V <sub>INA</sub> = V <sub>IHA</sub> or V <sub>ILA</sub> V <sub>INB</sub> = V <sub>IHB</sub> or V <sub>ILB</sub>	3.6	3.6	—	—	±0.5	—	±5.0	μA		
			3.6	5.5	—	—	±0.5	—	±5.0			
I <sub>OZB</sub>	V <sub>I/OA</sub> = V <sub>CCA</sub> or GND V <sub>I/OB</sub> = V <sub>CCB</sub> or GND	3.6	3.6	—	—	±0.5	—	±5.0				
		3.6	5.5	—	—	±0.5	—	±5.0				
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> (DIR, $\overline{G}$ ) = V <sub>CCA</sub> or GND	3.6	3.6	—	—	±0.1	—	±1.0	μA		
			3.6	5.5	—	—	±0.1	—	±1.0			
Quiescent supply current	I <sub>CCT</sub>	PER INPUT: V <sub>INA</sub> = V <sub>CCA</sub> - 0.6 V V <sub>INA</sub> = V <sub>CCB</sub> - 0.6 V	3.6	3.6	—	—	0.35	—	0.5	mA		
	I <sub>CCA1</sub>	A <sub>n</sub> = V <sub>CCA</sub> or GND B <sub>n</sub> = Open, $\overline{G}$ = V <sub>CCA</sub> DIR = V <sub>CCA</sub> , V <sub>CCB</sub> = Open	3.6	Open	—	—	5	—	50	μA		
	I <sub>CCA2</sub>	V <sub>INA</sub> = V <sub>IHA</sub> or V <sub>ILA</sub> V <sub>INB</sub> = V <sub>IHB</sub> or V <sub>ILB</sub>	3.6	3.6	—	—	5	—	50			
			3.6	5.5	—	—	5	—	50			
	I <sub>CCB</sub>	V <sub>INA</sub> = V <sub>IHA</sub> or V <sub>ILA</sub> V <sub>INB</sub> = V <sub>IHB</sub> or V <sub>ILB</sub>	3.6	3.6	—	—	5	—	50			
3.6			5.5	—	—	8	—	80				

## AC Characteristics (input: $t_r = t_f = 3 \text{ ns}$ , $C_L = 50 \text{ pF}$ , $R_L = 500 \Omega$ )

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit			
			V <sub>CCA</sub> (V)	V <sub>CCB</sub> (V)	Min	Typ.	Max		Min	Max	
Propagation delay time (An → Bn)	t <sub>pLH</sub>	Input: An Output: Bn (DIR = "H")	2.7 to 3.6	5.0 ± 0.5	—	5.7	8.0	1.0	8.5	ns	
	t <sub>pHL</sub>			3.3 ± 0.3	—	6.2	8.5	1.0	9.0		
3-state output enable time ( $\bar{G}$ → Bn)	t <sub>pZL</sub>			5.0 ± 0.5	—	6.5	9.5	1.0	10.0	ns	
	t <sub>pZH</sub>			3.3 ± 0.3	—	7.4	10.5	1.0	11.5		
3-state output disable time ( $\bar{G}$ → Bn)	t <sub>pLZ</sub>			5.0 ± 0.5	—	7.3	9.5	1.0	10.0	ns	
	t <sub>pHZ</sub>			3.3 ± 0.3	—	6.6	9.5	1.0	10.0		
Propagation delay time (Bn → An)	t <sub>pLH</sub>	Input: Bn Output: An (DIR = "L")	2.7 to 3.6	5.0 ± 0.5	—	4.6	7.5	1.0	8.0	ns	
	t <sub>pHL</sub>			3.3 ± 0.3	—	5.2	7.5	1.0	8.0		
3-state output enable time ( $\bar{G}$ → An)	t <sub>pZL</sub>			5.0 ± 0.5	—	7.0	10.5	1.0	11.5	ns	
	t <sub>pZH</sub>			3.3 ± 0.3	—	7.0	10.5	1.0	11.5		
3-state output disable time ( $\bar{G}$ → An)	t <sub>pLZ</sub>			5.0 ± 0.5	—	6.1	9.5	1.0	10.0	ns	
	t <sub>pHZ</sub>			3.3 ± 0.3	—	6.0	9.5	1.0	10.0		
Output to output skew	t <sub>osLH</sub>	(Note 1)	2.7 to 3.6	5.0 ± 0.5	—	—	1.5	—	1.5	ns	
	t <sub>osHL</sub>			3.3 ± 0.3	—	—	1.5	—	1.5		
Input capacitance	C <sub>INA</sub>	DIR, $\bar{G}$	3.3 ± 0.3	5.0 ± 0.5	—	5	10	—	10	pF	
Bus input capacitance	C <sub>I/O</sub>	An, Bn			—	8	—	—	—	—	pF
Power dissipation capacitance (Note 2)	C <sub>PD</sub>	A → B (DIR = "H")			—	4	—	—	—	—	pF
		B → A (DIR = "L")			—	38	—	—	—	—	
	C <sub>PDB</sub>	A → B (DIR = "H")	—	88	—	—	—	—			
		B → A (DIR = "L")	—	7	—	—	—	—			

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:

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

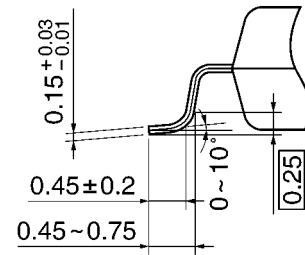
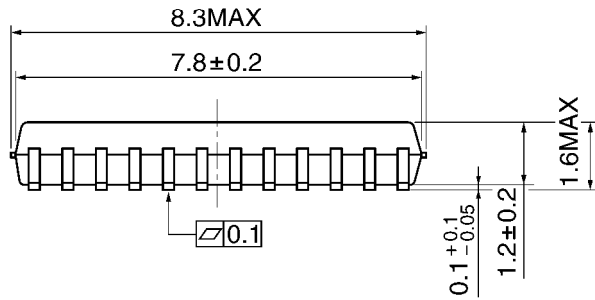
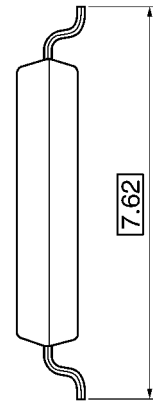
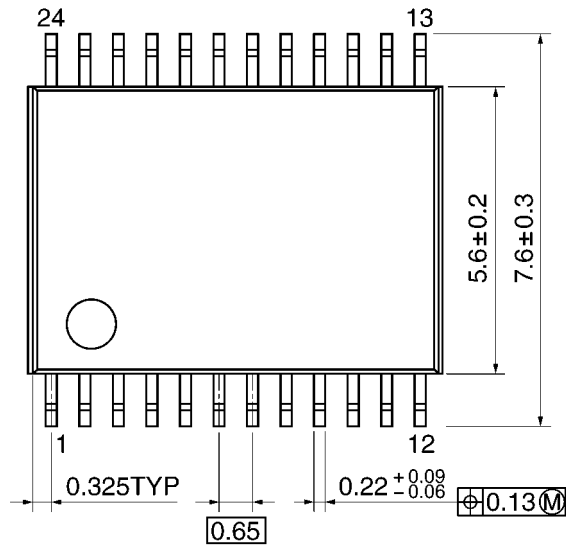
## Noise Characteristics (Ta = 25°C, input: tr = tf = 3 ns, CL = 50 pF, RL = 500 Ω)

Characteristics	Symbol	Test Condition	Test Condition		Typ.	Limit	Unit	
			VCCA (V)	VCCB (V)				
Quiet output maximum dynamic	VOL (A)	VOLPA	Input: Bn Output: An (DIR = "L")	3.3	3.3	—	0.9	V
				3.3	5.0	—	0.9	
Quiet output minimum dynamic	VOL (A)	VOLVA	(DIR = "L")	3.3	3.3	—	-0.9	
				3.3	5.0	—	-0.9	
Quiet output maximum dynamic	VOL (B)	VOLPB	Input: An Output: Bn (DIR = "H")	3.3	3.3	—	0.8	
				3.3	5.0	—	1.5	
Quiet output minimum dynamic	VOL (B)	VOLVB	(DIR = "H")	3.3	3.3	—	-0.8	
				3.3	5.0	—	-1.2	
Minimum high level dynamic input voltage	VIH (A)	VIHDA	Input: An	3.3	3.3	—	2.0	V
				3.3	5.0	—	2.0	
Maximum low level dynamic input Voltage	VIL (A)	VILDA	Input: An	3.3	3.3	—	0.8	V
				3.3	5.0	—	0.8	
Minimum high level dynamic input voltage	VIH (B)	VIHDB	Input: Bn	3.3	3.3	2.0	—	V
				3.3	5.0	3.5	—	
Maximum low level dynamic input voltage	VIL (B)	VILDB	Input: Bn	3.3	3.3	0.8	—	V
				3.3	5.0	1.5	—	

**Package Dimensions**

SSOP24-P-300-0.65D

Unit: mm



Weight: 0.14 g (typ.)

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