TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC74VCX163245FT

#### 16-Bit Dual Supply Bus Transceiver

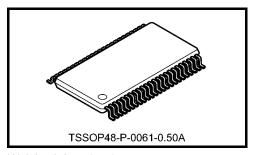
The TC74VCX163245FT is a dual supply, advanced high-speed CMOS 16-bit dual supply voltage interface bus transceiver fabricated with silicon gate CMOS technology.

It is also designed with over voltage tolerant inputs and outputs up to 3.6  $\rm V.$ 

Designed for use as an interface between a 1.8-V or 2.5-V bus and a 2.5-V or 3.6-V bus in mixed 1.8-V or 2.5-V/2.5-V or 3.6-V supply systems.

The B-port interfaces with the 1.8-V or 2.5-V bus, the A-port with the 2.5-V or 3.6-V bus.

The direction of data transmission is determined by the level of the DIR input. The enable input  $(\overline{OE})$  can be used to disable the device so that the buses are effectively isolated.



Weight: 0.25 g (typ.)

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

#### Features (Note)

- Bidirectional interface between 1.8-V and 2.5 V, 1.8-V and 3.6-V or 2.5 V and 3.6-V buses
- High-speed operation:  $t_{pd}$  = 7.0 ns (max) ( $V_{CCB}$  = 1.8 ± 0.15 V,  $V_{CCA}$  = 2.5 ± 0.2 V)

:  $t_{pd}$  = 7.1 ns (max) (V<sub>CCB</sub> = 1.8 ± 0.15 V, V<sub>CCA</sub> = 3.3 ± 0.3 V)

:  $t_{pd}$  = 4.6 ns (max) ( $V_{CCB}$  = 2.5 ± 0.2 V,  $V_{CCA}$  = 3.3 ± 0.3 V)

Output current: I<sub>OH</sub>/I<sub>OL</sub> = ±24 mA (min) (V<sub>CC</sub> = 3.0 V)

 $: I_{OH}/I_{OL} = \pm 18 \text{ mA (min)} (V_{CC} = 2.3 \text{ V})$ 

 $: I_{OH}/I_{OL} = \pm 6 \text{ mA (min)} (V_{CC} = 1.65 \text{ V})$ 

- Latch-up performance: –300 mA
- ESD performance: Machine model ≥ ±200 V

Human body model  $\geq \pm 2000 \text{ V}$ 

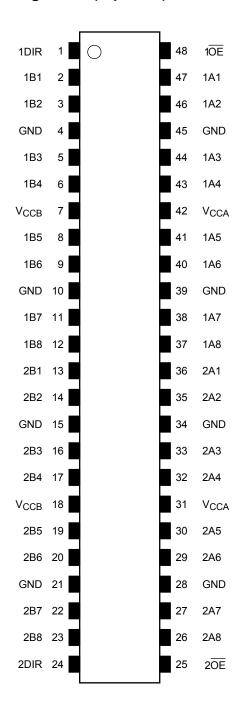
- Package: TSSOP
- 3.6-V tolerant function and power-down protection provided on all inputs and outputs

Note: Do not apply a signal to any bus pins when it is in the output mode. Damage may result.

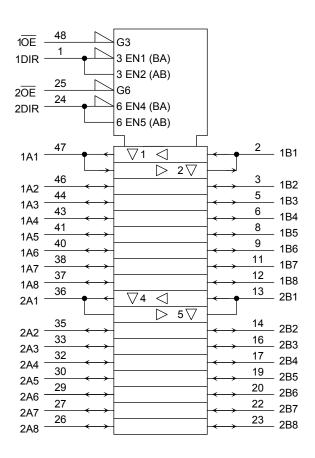
All floating (high impedance) bus pins must have their input level fixed by means of pull-up or pull-down

resistors.

### Pin Assignment (top view)



## **IEC Logic Symbol**



## **Truth Table**

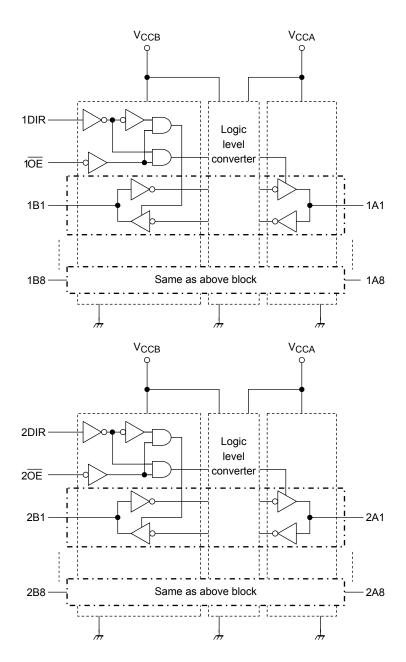
Inp	uts	Fun		
1OE	1DIR	Bus 1A1-1A8	Bus 1B1-1B8	Outputs
L	L	Output	Input	A = B
L	Н	Input	Output	B = A
Н	Х	2	7	Z

Inp	uts	Fun	ction			
2 <del>OE</del>	2DIR	Bus 2A1-2A8	Bus 2B1-2B8	Outputs		
L	L	Output	Input	A = B		
L	Н	Input	Output	B=A		
Н	X	Ž	7	Z		

X: Don't care

Z: High impedance

## **Block Diagram**





#### **Absolute Maximum Ratings (Note 1)**

Characteristics	Symbol	Rating	Unit	
Dower aupply voltage (Note 2)	$V_{CCB}$	-0.5 to 4.6	V	
Power supply voltage (Note 2)	V <sub>CCA</sub>	-0.5 to 4.6	V	
DC input voltage (DIR, $\overline{\text{OE}}$ )	V <sub>IN</sub>	-0.5 to 4.6	V	
		-0.5 to 4.6 (Note 3)		
	V <sub>I/OB</sub>	-0.5 to V <sub>CCB</sub> + 0.5	V	
DC bus I/O voltage		(Note 4)		
De bus 1/O voltage		-0.5 to 4.6 (Note 3)		
	V <sub>I/OA</sub>	-0.5 to V <sub>CCA</sub> + 0.5		
		(Note 4)		
Input diode current	Ι <sub>ΙΚ</sub>	-50	mA	
Output diode current	I <sub>I/OK</sub>	±50 (Note 5)	mA	
DC output ourrent	I <sub>OUTB</sub>	±50	mA	
DC output current	I <sub>OUTA</sub>	±50	IIIA	
DC V <sub>CC</sub> /ground current per supply pin	I <sub>CCB</sub>	±100	mA	
DO v.Co/ground current per supply pin	I <sub>CCA</sub>	±100	IIIA	
Power dissipation	P <sub>D</sub>	400	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.

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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:  $V_{CCA} > V_{CCB}$ Don't use under the condition that  $V_{CCB}$  is 0 V.

Note 3: Output in OFF state

Note 4: High or low state. IOUT absolute maximum rating must be observed.

Note 5:  $V_{OUT} < GND$ ,  $V_{OUT} > V_{CC}$ 



#### **Operating Ranges (Note 1)**

Characteristics	Symbol	Rating	Unit		
Power supply voltage	V <sub>CCB</sub>	1.65 to 2.7	V		
Tower supply voltage	V <sub>CCA</sub>	2.3 to 3.6	•		
Input voltage (DIR, $\overline{OE}$ )	V <sub>IN</sub>	0 to 3.6	٧		
	\/	0 to 3.6 (Note 2)	V		
Bus I/O voltage	V <sub>I/OB</sub>	0 to V <sub>CCB</sub> (Note 3)			
	V <sub>I/OA</sub>	0 to 3.6 (Note 2)	V		
	VI/OA	0 to V <sub>CCA</sub> (Note 3)			
	Іоитв	±18 (Note 4)			
Output current	IOOIB	±6 (Note 5)	mA		
Output current	louza	±24 (Note 6)	ША		
	IOUTA	±18 (Note 7)			
Operating temperature	T <sub>opr</sub>	-40 to 85	°C		
Input rise and fall time	dt/dv	0 to 10 (Note 8)	ns/V		

Note 1: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs and bus inputs must be tied to either VCC or GND. Please connect both bus inputs and the bus outputs with VCC 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
- Note 4:  $V_{CCB} = 2.3 \text{ to } 2.7 \text{ V}$
- Note 5:  $V_{CCB} = 1.65 \text{ to } 1.95 \text{ V}$
- Note 6:  $V_{CCA} = 3.0 \text{ to } 3.6 \text{ V}$
- Note 7:  $V_{CCA} = 2.3 \text{ to } 2.7 \text{ V}$
- Note 8:  $V_{IN} = 0.8$  to 2.0 V,  $V_{CCB} = 2.5$  V,  $V_{CCA} = 3.0$  V



### **Electrical Characteristics**

## DC Characteristics (V<sub>CCB</sub> = 1.8 $\pm$ 0.15 V, V<sub>CCA</sub> = 2.5 $\pm$ 0.2 V)

Characteristics	Symbol	Test Co	ondition	V <sub>CCB</sub> (V)	V <sub>CCA</sub> (V)	Ta = -4	0~85°C	Unit
Characteriotics	Cymbol	1001 01	ondition	VCCB(V)	VCCA(V)	Min	Max	Onit
H-level input voltage	V <sub>IHB</sub>	DIR, $\overline{OE}$ , Bn		1.8 ± 0.15	$2.5\pm0.2$	0.65 × V <sub>CC</sub>		V
	V <sub>IHA</sub>	An	An		$2.5 \pm 0.2$	1.6	_	
L-level input voltage	V <sub>ILB</sub>	DIR, OE, Bn		1.8 ± 0.15	$2.5\pm0.2$		$\begin{array}{c} 0.35 \times \\ V_{CC} \end{array}$	٧
	V <sub>ILA</sub>	An		1.8 ± 0.15	$2.5 \pm 0.2$	_	0.7	
	V <sub>OHB</sub>		I <sub>OHB</sub> = -100 μA	1.8 ± 0.15	$2.5\pm0.2$	V <sub>CCB</sub> - 0.2	_	
H-level output voltage		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OHB</sub> = -6 mA	1.65	$2.5 \pm 0.2$	1.25	_	V
	V <sub>OHA</sub>	VIN - VIH OI VIL	I <sub>OHA</sub> = -100 μA	1.8 ± 0.15	$2.5\pm0.2$	V <sub>CCA</sub> - 0.2		V
	01111		$I_{OHA} = -18 \text{ mA}$	1.8 ± 0.15	2.3	1.7		
	V <sub>OLB</sub>	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OLB} = 100 \mu A$	$1.8 \pm 0.15$	$2.5\pm0.2$	_	0.2	
L-level output voltage	VOLB		I <sub>OLB</sub> = 6 mA	1.65	$2.5\pm0.2$	_	0.3	V
	V <sub>OLA</sub>		$I_{OLA} = 100 \mu A$	1.8 ± 0.15	$2.5 \pm 0.2$	_	0.2	V
	VOLA		$I_{OLA} = 18 \text{ mA}$	$1.8 \pm 0.15$	2.3	_	0.6	
	I <sub>OZB</sub>	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{OUT} = 0 \text{ to } 3.6 \text{ m}$	V	1.8 ± 0.15	$2.5\pm0.2$	_	±10	
3-state output OFF state current	I <sub>OZA</sub>	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{OUT} = 0 \text{ to } 3.6$	V	1.8 ± 0.15	2.5 ± 0.2	_	±10	μΑ
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> (DIR, $\overline{\text{OE}}$ )	= 0 to 3.6 V	1.8 ± 0.15	$2.5 \pm 0.2$	_	±5.0	μΑ
Power-off leakage current	loff	$V_{IN}$ , $V_{OUT} = 0$ to	3.6 V	0	0	_	10	μА
	ICCB	$V_{INA} = V_{CCA}$ or $V_{INB} = V_{CCB}$ or		1.8 ± 0.15	2.5 ± 0.2	_	20	1
Ouissand surgh, surgar	ICCA		$V_{INA} = V_{CCA}$ or GND $V_{INB} = V_{CCB}$ or GND		2.5 ± 0.2	_	20	μА
Quiescent supply current	I <sub>CCB</sub>	V <sub>CCB</sub> < (V <sub>IN</sub> , V <sub>O</sub>	oUT) ≦ 3.6 V	1.8 ± 0.15	$2.5\pm0.2$	_	±20	μА
	ICCA	$V_{CCA} \le (V_{IN}, V_{CC})$	ouT) ≦ 3.6 V	1.8 ± 0.15	$2.5\pm0.2$	_	±20	μΑ
	Ісств	$V_{INB} = V_{CCB} - 0$	0.6 V per input	1.8 ± 0.15	$2.5 \pm 0.2$	_	750	μΑ
	ICCTA	$V_{INA} = V_{CCA} - 0$	0.6 V per input	$1.8 \pm 0.15$	$2.5 \pm 0.2$	_	750	μΑ



## DC Characteristics (V\_{CCB} = 1.8 $\pm$ 0.15 V, V\_{CCA} = 3.3 $\pm$ 0.3 V)

Characteristics	Symbol	Toot C	ondition	V ()()	\/aa. (\/)	Ta = -4	0~85°C	Unit
Characteristics	Symbol	Test O	ondition	V <sub>CCB</sub> (V)	V <sub>CCA</sub> (V)	Min	Max	Offic
H-level input voltage	V <sub>IHB</sub>	DIR, $\overline{OE}$ , Bn		1.8 ± 0.15	$3.3 \pm 0.3$	0.65 × V <sub>CC</sub>	_	V
	V <sub>IHA</sub>	An		1.8 ± 0.15	$3.3 \pm 0.3$	2.0	_	
L-level input voltage	V <sub>ILB</sub>	DIR, $\overline{OE}$ , Bn		1.8 ± 0.15	$3.3\pm0.3$	_	0.35 × V <sub>CC</sub>	V
	V <sub>ILA</sub>	An		$1.8 \pm 0.15$	$3.3 \pm 0.3$	_	0.8	
	V <sub>OHB</sub>		I <sub>OHB</sub> = -100 μA	1.8 ± 0.15	$3.3\pm0.3$	V <sub>CCB</sub> – 0.2	_	
H-level output voltage		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	$I_{OHB} = -6 \text{ mA}$	1.65	$3.3 \pm 0.3$	1.25	_	V
H-level output voltage	V <sub>OHA</sub>	VIN - VIH OI VIL	$I_{OHA} = -100 \mu A$	1.8 ± 0.15	$3.3 \pm 0.3$	V <sub>CCA</sub> - 0.2	_	V
	Orax		$I_{OHA} = -24 \text{ mA}$	1.8 ± 0.15	3.0	2.2	_	
	V <sub>OLB</sub>	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OLB} = 100 \ \mu A$	1.8 ± 0.15	$3.3 \pm 0.3$	_	0.2	
L-level output voltage	VOLB		I <sub>OLB</sub> = 6 mA	1.65	$3.3 \pm 0.3$	_	0.3	V
	V <sub>OLA</sub>		$I_{OLA} = 100 \ \mu A$	$1.8 \pm 0.15$	$3.3 \pm 0.3$	_	0.2	·
	VOLA		I <sub>OLA</sub> = 24 mA	$1.8 \pm 0.15$	3.0	_	0.55	
	I <sub>OZB</sub>	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{OUT} = 0 \text{ to } 3.6$	V	1.8 ± 0.15	$3.3\pm0.3$	_	±10	
3-state output OFF state current	I <sub>OZA</sub>	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{OUT} = 0 \text{ to } 3.6$	V	1.8 ± 0.15	3.3 ± 0.3	_	±10	μА
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> (DIR, $\overline{\text{OE}}$ )	= 0 to 3.6 V	1.8 ± 0.15	$3.3\pm0.3$	_	±5.0	μА
Power-off leakage current	I <sub>OFF</sub>	V <sub>IN</sub> , V <sub>OUT</sub> = 0 to	3.6 V	0	0	_	10	μΑ
	I <sub>CCB</sub>	$V_{INA} = V_{CCA}$ or $V_{INB} = V_{CCB}$ or		1.8 ± 0.15	3.3 ± 0.3	_	20	
	ICCA	$V_{INA} = V_{CCA}$ or $V_{INB} = V_{CCB}$ or		1.8 ± 0.15	3.3 ± 0.3	_	20	μА
Quiescent supply current	ICCB	V <sub>CCB</sub> < (V <sub>IN</sub> , V <sub>C</sub>	<sub>OUT</sub> ) ≦ 3.6 V	1.8 ± 0.15	$3.3 \pm 0.3$	_	±20	^
	ICCA	$V_{CCA} \le (V_{IN}, V_{CC})$	ouT) ≦ 3.6 V	1.8 ± 0.15	$3.3\pm0.3$		±20	μΑ
	Ісств	$V_{INB} = V_{CCB} - 0$	0.6 V per input	1.8 ± 0.15	$3.3 \pm 0.3$	_	750	μΑ
	I <sub>CCTA</sub>	$V_{INA} = V_{CCA} - 0$	0.6 V per input	1.8 ± 0.15	$3.3 \pm 0.3$	_	750	μΑ



## DC Characteristics (V<sub>CCB</sub> = 2.5 $\pm$ 0.2 V, V<sub>CCA</sub> = 3.3 $\pm$ 0.3 V)

Characteristics	Symbol	Toot Co	ondition	V <sub>CCB</sub> (V)	V <sub>CCA</sub> (V)	Ta = -4	0~85°C	Unit
Characteristics	Syllibol	Test O	ondition	ACCB(A)	vCCA(v)	Min	Max	Offic
H-level input voltage	V <sub>IHB</sub>	DIR, $\overline{OE}$ , Bn		$2.5\pm0.2$	$3.3 \pm 0.3$	1.6	_	V
Thever input voltage	VIHA	An		$2.5\pm0.2$	$3.3 \pm 0.3$	2.0		V
L-level input voltage	V <sub>ILB</sub>	DIR, $\overline{OE}$ , Bn		$2.5\pm0.2$	$3.3 \pm 0.3$	_	0.7	V
L-level iliput voltage	V <sub>ILA</sub>	An		$2.5\pm0.2$	$3.3 \pm 0.3$	_	0.8	V
	V <sub>OHB</sub>		I <sub>OHB</sub> = -100 μA	$2.5\pm0.2$	$3.3\pm0.3$	V <sub>CCB</sub> - 0.2		
H-level output voltage		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	$I_{OHB} = -18 \text{ mA}$	2.3	$3.3 \pm 0.3$	1.7		V
Triever output voltage	V <sub>OHA</sub>	VIN - VIH OI VIL	I <sub>OHA</sub> = -100 μA	2.5 ± 0.2	$3.3\pm0.3$	V <sub>CCA</sub> - 0.2	l	V
			$I_{OHA} = -24 \text{ mA}$	$2.5\pm0.2$	3.0	2.2		
	V <sub>OLB</sub>	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OLB} = 100 \mu A$	$2.5\pm0.2$	$3.3\pm0.3$	_	0.2	
L-level output voltage			I <sub>OLB</sub> = 18 mA	2.3	$3.3\pm0.3$	_	0.6	V
	$V_{OLA}$		$I_{OLA} = 100 \mu A$	$2.5\pm0.2$	$3.3\pm0.3$	_	0.2	
	VOLA		I <sub>OLA</sub> = 24 mA	$2.5\pm0.2$	3.0	_	0.55	
	l <sub>OZB</sub>	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to 3.6 V		$2.5\pm0.2$	$3.3 \pm 0.3$	_	±10	
3-state output OFF state current	loza	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>OUT</sub> = 0 to 3.6 V		2.5 ± 0.2	3.3 ± 0.3	_	±10	μА
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> (DIR, $\overline{\text{OE}}$ )	= 0 to 3.6 V	$2.5\pm0.2$	$3.3\pm0.3$	_	±5.0	μΑ
Power-off leakage current	I <sub>OFF</sub>	$V_{IN}$ , $V_{OUT} = 0$ to	3.6 V	0	0	_	10	μΑ
	ICCB	$V_{INA} = V_{CCA}$ or $V_{INB} = V_{CCB}$ or		2.5 ± 0.2	3.3 ± 0.3	_	20	•
	I <sub>CCA</sub>	$V_{INA} = V_{CCA}$ or $V_{INB} = V_{CCB}$ or		2.5 ± 0.2	3.3 ± 0.3	_	20	μА
Quiescent supply current	ICCB	V <sub>CCB</sub> < (V <sub>IN</sub> , V <sub>C</sub>	<sub>UT</sub> ) ≦ 3.6 V	$2.5\pm0.2$	$3.3 \pm 0.3$	_	±20	μА
	ICCA	$V_{CCA} \le (V_{IN}, V_{CC})$	<sub>UT</sub> ) ≦ 3.6 V	$2.5 \pm 0.2$	$3.3\pm0.3$	_	±20	
	Ісств	V <sub>INB</sub> = V <sub>CCB</sub> - 0	.6 V per input	$2.5\pm0.2$	$3.3\pm0.3$	_	750	μА
	I <sub>CCTA</sub>	$V_{INA} = V_{CCA} - 0$	.6 V per input	$2.5\pm0.2$	$3.3 \pm 0.3$	_	750	μА

AC Characteristics (Ta =  $-40 \sim 85$ °C, Input:  $t_r = t_f = 2.0$  ns,  $C_L = 30$  pF,  $R_L = 500$   $\Omega$ )

 $V_{CCB} = 1.8 \pm 0.15$  V,  $V_{CCA} = 2.5 \pm 0.2$  V

Characteristics	Symbol	Test Condition	Min	Max	Unit
Propagation delay time	t <sub>pLH</sub>	Figure 1 Figure 2	0.0	5.8	
$(Bn \rightarrow An)$	t <sub>pHL</sub>	Figure 1, Figure 2	0.8	5.6	
3-state output enable time	t <sub>pZL</sub>	Simon 4 Simon 0	0.8	6.9	ns
$(\overline{OE} \to An)$	t <sub>pZH</sub>	Figure 1, Figure 3	0.0	0.9	113
3-state output disable time	t <sub>pLZ</sub>	Simura 4 Simura 0	0.8	6.4	
$(\overline{OE} \to An)$	t <sub>pHZ</sub>	Figure 1, Figure 3	0.0		
Propagation delay time	t <sub>pLH</sub>	Simura 4 Simura 0	1.5	7.0	
$(An \rightarrow Bn)$	t <sub>pHL</sub>	Figure 1, Figure 2			
3-state output enable time	t <sub>pZL</sub>	Simura 4 Simura 0	1 5	11.0	no
$(\overline{\sf OE} \ \to \sf Bn)$	t <sub>pZH</sub>	Figure 1, Figure 3	1.5	11.0	ns
3-state output disable time	t <sub>pLZ</sub>	F: 4 F: 0		7.0	1
$(\overline{OE} \to Bn)$	t <sub>pHZ</sub>	Figure 1, Figure 3	0.8	7.0	
Outrotte autrotalian	t <sub>osLH</sub>	/Notal		0.5	no
Output to output skew	t <sub>osHL</sub>	(Note)	-	0.5	ns

Note: Parameter guaranteed by design.

 $(t_{OSLH} = |t_{pLHm} - t_{pLHn}|, t_{OSHL} = |t_{pHLm} - t_{pHLn}|)$ 

 $V_{CCB} = 1.8 \pm 0.15$  V,  $V_{CCA} = 3.3 \pm 0.3$  V

Characteristics	Symbol	Test Condition		Max	Unit
Propagation delay time $(Bn \rightarrow An)$	t <sub>pLH</sub>	Figure 1, Figure 2	0.6	5.5	
3-state output enable time ( OE → An)	t <sub>pZL</sub>	Figure 1, Figure 3	0.6	6.9	ns
3-state output disable time ( OE → An)	t <sub>pLZ</sub>	Figure 1, Figure 3	0.6	7.1	
Propagation delay time $(An \rightarrow Bn)$	t <sub>pLH</sub>	Figure 1, Figure 2	1.5	7.1	
3-state output enable time $( \overrightarrow{OE} \rightarrow Bn)$	t <sub>pZL</sub>	Figure 1, Figure 3	1.5	10.3	ns
3-state output disable time $( \overrightarrow{OE} \rightarrow Bn)$	t <sub>pLZ</sub>	Figure 1, Figure 3	0.8	7.1	
Output to output skew	t <sub>osLH</sub>	(Note)	_	0.5	ns

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Note: Parameter guaranteed by design.

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

 $V_{CCB} = 2.5 \pm 0.2$  V,  $V_{CCA} = 3.3 \pm 0.3$  V

Characteristics	Symbol	ol Test Condition		Max	Unit
Propagation delay time	t <sub>pLH</sub>	Figure 1, Figure 2	0.6	4.4	
$(Bn \rightarrow An)$	t <sub>pHL</sub>	rigaro 1, rigaro 2			
3-state output enable time	$t_{pZL}$	Figure 1, Figure 3	0.6	4.8	ns
$(\overline{OE} \to An)$	t <sub>pZH</sub>	rigule 1, rigule 3	0.0	4.0	110
3-state output disable time	t <sub>pLZ</sub>	Figure 4 Figure 2	0.6	4.9	
$(\overline{OE} \to An)$	t <sub>pHZ</sub>	Figure 1, Figure 3			
Propagation delay time	t <sub>pLH</sub>	Figure 4 Figure 0	0.8	4.6	
$(An \rightarrow Bn)$	t <sub>pHL</sub>	Figure 1, Figure 2			
3-state output enable time	t <sub>pZL</sub>	Figure 4 Figure 0	0.8	6.2	ns
$(\overline{\sf OE} \ \to \sf Bn)$	t <sub>pZH</sub>	Figure 1, Figure 3	0.0	0.2	115
3-state output disable time	t <sub>pLZ</sub>	Figure 4 Figure 0	0.8	4.9	
$(\overline{\sf OE} \ \to \sf Bn)$	t <sub>pHZ</sub>	Figure 1, Figure 3	0.0	4.9	
Output to output alcour	t <sub>osLH</sub>	/Notal		0.5	no
Output to output skew	t <sub>osHL</sub>	(Note)		0.5	ns

Note: Parameter guaranteed by design.

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

## Dynamic Switching Characteristics (Ta = 25°C, Input: $t_r = t_f = 2.0$ ns, $C_L = 30$ pF)

Characteristics		Symbol Test Condition				Тур.	Unit
Onaracteristics		Syllibol	rest condition	V <sub>CCB</sub> (V)	V <sub>CCA</sub> (V)	τyp.	Offic
				1.8	2.5	0.25	
Quiet output maximum dynamic V <sub>OL</sub>	$B\toA$			1.8	3.3	0.25	
		V <sub>OLP</sub>	$V_{IH} = V_{CC}, V_{IL} = 0 V$	2.5	3.3	0.6	V
		VOLP	VIH - VCC, VIL - 0 V	1.8	2.5	0.6	v
	$A\toB$			1.8	3.3	0.8	
				2.5	3.3	0.8	
	$B\toA$	V <sub>OLV</sub>	V <sub>IH</sub> = V <sub>CC</sub> , V <sub>IL</sub> = 0 V	1.8	2.5	-0.25	
				1.8	3.3	-0.25	· V
Quiet output minimum				2.5	3.3	-0.6	
dynamic V <sub>OL</sub>	$A \rightarrow B$			1.8	2.5	-0.6	
				1.8	3.3	-0.8	
				2.5	3.3	-0.8	
				1.8	2.5	1.3	
	$B\toA$			1.8	3.3	1.3	V
Quiet output minimum		Voun	V <sub>IH</sub> = V <sub>CC</sub> , V <sub>IL</sub> = 0 V	2.5	3.3	1.7	
dynamic V <sub>OH</sub>	$A\toB$	Vонv		1.8	2.5	1.7	
				1.8	3.3	2.0	
				2.5	3.3	2.0	



## **Capacitive Characteristics (Ta = 25°C)**

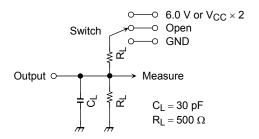
Characteristics		Symbol	Test	Test Test Condition			Тур.	Unit
Characteristics		Symbol	Circuit	rest Condition	V <sub>CCB</sub> (V)	V <sub>CCA</sub> (V)	Typ.	Offic
Input capacitance		C <sub>IN</sub>	_	DIR, OE	2.5	3.3	7	pF
Output capacitance		C <sub>I/O</sub>	_	An, Bn	2.5	3.3	8	pF
		C	_	A ⇒ B (DIR = "H")	2.5	3.3	2	
Power dissipation capacitance (Note		C <sub>PDA</sub>		B ⇒ A (DIR = "L")	2.5	3.3	23	
	(Note)			A ⇒ B (DIR = "H")	2.5	3.3	26	pF
		C <sub>PDB</sub>		B ⇒ A (DIR = "L")	2.5	3.3	2	

Note: 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:

 $I_{CC (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/16 \text{ (per bit)}$ 

#### **AC Test Circuit**



Parameter	Switch		
t <sub>pLH</sub> , t <sub>pHL</sub>	Open		
t <sub>pLZ</sub> , t <sub>pZL</sub>	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		
t <sub>pHZ</sub> , t <sub>pZH</sub>	GND		

Figure 1

#### **AC Waveform**

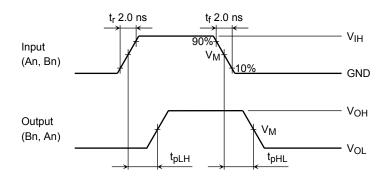


Figure 2  $t_{pLH}$ ,  $t_{pHL}$ 

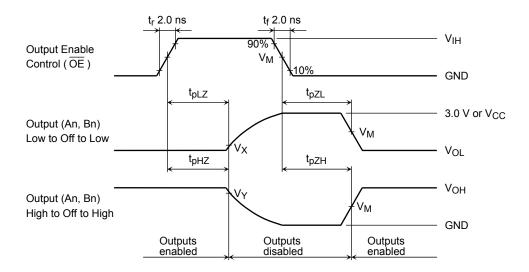
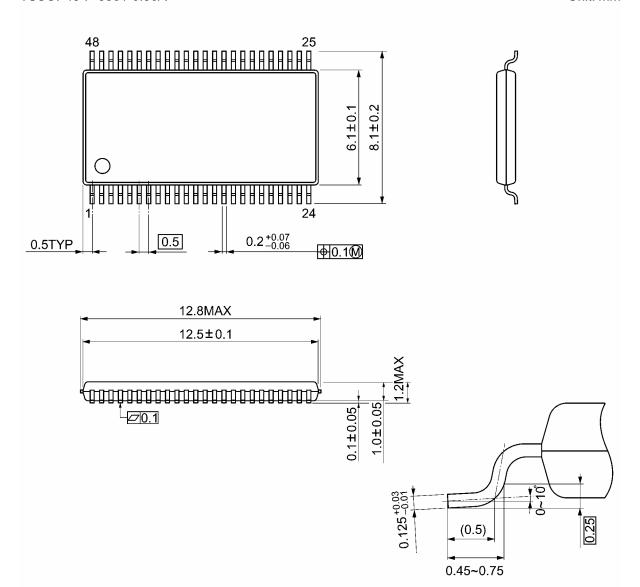


Figure 3  $t_{\text{pLZ}},\,t_{\text{pHZ}},\,t_{\text{pZL}},\,t_{\text{pZH}}$ 

Symbol	Vcc		
Symbol	$3.3\pm0.3~\textrm{V}$	$2.5\pm0.2\textrm{V}$	1.8 ± 0.15 V
V <sub>IH</sub>	2.7 V	V <sub>CC</sub>	V <sub>CC</sub>
V <sub>M</sub>	1.5 V	V <sub>CC</sub> /2	V <sub>CC</sub> /2
VX	V <sub>OL</sub> + 0.3 V	V <sub>OL</sub> + 0.15 V	V <sub>OL</sub> + 0.15 V
VY	V <sub>OH</sub> – 0.3 V	V <sub>OH</sub> – 0.15 V	V <sub>OH</sub> – 0.15 V

### **Package Dimensions**

TSSOP48-P-0061-0.50A Unit: mm



Weight: 0.25 g (typ.)

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20070701-EN

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