TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

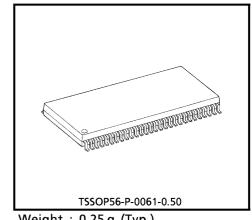
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LOW-VOLTAGE 18-BIT UNIVERSAL BUS TRANSCEIVER WITH 3.6 V TOLERANT INPUTS AND OUTPUTS

The TC74VCXR162601FT is a high performance CMOS 18bit UNIVERSAL BUS TRANSCEIVER. Designed for use in 1.8, 2.5 or 3.3 Volt systems, it achieves high speed operation while maintaining the CMOS low power dissipation.

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

Data flow in each direction is controlled by outputenable (OEAB and OEBA), latch-enable (LEAB and LEBA), and clock (CKAB and CKBA) inputs. The clock can be controlled by the clock-enable (CKENAB and CKENBA) inputs. For A-to-B data flow, the device operates in the transparent mode when LEAB is high. When LEAB is low, the A data is latched if CKAB is held at a high or low logic level. If LEAB is low, the A-bus data is stored in the latch/flip-flop on the low-to-high transition of CKAB.



Weight : 0.25 g (Typ.)

Data flow for B to A is similar to that of A to B but uses OEBA, LEBA, CKBA, and CKENBA. When the \overline{OE} input is high, the outputs are in a high impedance state. This device is designed to be used with 3-state memory address drivers, etc.

The 26- Ω series resistor helps reducing output overshoot and undershoot without external resistor. All inputs are equipped with protection circuits against static discharge.

FEATURES

- **26**- Ω Series Resistors on Outputs.
- Low Voltage Operation : $V_{CC} = 1.8 \sim 3.6V$

High Speed Operation	: $t_{pd} = 3.8 \text{ ns} (\text{max}) \text{ at } V_{CC} = 3.0 \sim 3.6 \text{V}$
	$t_{pd} = 4.6 \text{ ns} (\text{max}) \text{ at } V_{CC} = 2.3 \sim 2.7 \text{ V}$
	$t_{pd} = 9.2 \text{ ns} (max) \text{ at } V_{CC} = 1.8 \text{ V}$
• 3.3 V Tolerant inputs a	and outputs.
 Output Current 	$: I_{OH} / I_{OL} = \pm 12 \text{ mA} (\text{min}) \text{ at } V_{CC} = 3.0 \text{ V}$
	$: I_{OH} / I_{OL} = \pm 8 \text{ mA} (min) \text{ at } V_{CC} = 2.3 \text{ V}$
	:I _{OH} / I _{OL} = ±4 mA (min) at V _{CC} = 1.8 V
Latch-up Performance	: ±300 mA
 ESD Performance 	: Human Body Model > ±2000V
	: Machine Model > ±200 V
 Package 	: TSSOP
	(Thin Shrink Small Outline Package)
Bidirectional interface	between 2.5 V and 3.3 V signals.
Bower Down Protectio	n is provided on all inputs and outputs

Power Down Protection is provided on all inputs and outputs.

Supports live insertion / withdrawal (Note 3)

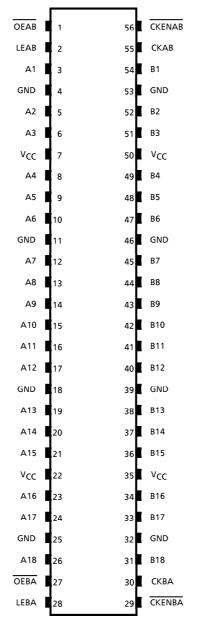
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- (Note 1) : Do not apply a signal to any bus terminal when it is in the output mode. Damage may result.
- (Note 2) : All floating (high impedance) bus terminal must have their input level fixed by means of pull up or pull down resistors.
- (Note 3) : To ensure the high-impedance state during power up or power down, OE should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

PIN ASSIGNMENT



(TOP VIEW)

980910EBA2'

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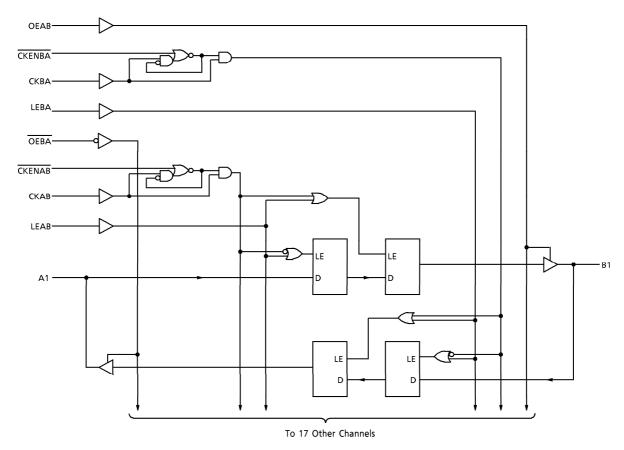
TRUTH TABLE *

	OUTPUTS								
CKENAB	OEAB	LEAB	СКАВ	А	В				
Х	Н	Х	Х	Х	Z				
Х	L	Н	Х	L	L				
Х	L	Н	Х	Н	Н				
Н	L	L	Х	Х	B0**				
Н	L	L	Х	Х	B0**				
L	L	L	ſ	L	L				
L	L	L		Н	Н				
L	L	L	L	Х	B0**				
L	L	L	Н	Х	B0**				

* A-to-B data flow is shown: B-to-A flow is similar but uses OEBA, LEBA, CKBA, and CKENBA.

** Output level before the indicated steady-state input conditions were established, provided that CKAB was low or high before LEAB went low.

SYSTEM DIAGRAM



MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT	
Power Supply Voltage	V _{CC}	-0.5~4.6	V	
DC Input Voltage (OEAB, OEBA, LEAB, LEBA, CKAB, CKBA, CKENAB, CKENBA)	V _{IN}	-0.5~4.6	V	
	Maria	-0.5~4.6 (Note 1)	v	
DC Bus I/O Voltage	VI/O	-0.5~V _{CC} + 0.5 (Note 2)	v	
Input Diode Current	IК	- 50	mA	
Output Diode Current	ΙΟΚ	±50 (Note 3)	mA	
DC Output Current	ΙΟυτ	± 50	mA	
Power Dissipation	PD	400	mW	
DC V _{CC} /Ground Current Per Supply Pin	ICC / IGND	± 100	mA	
Storage Temperature	T _{stg}	- 65~150	°C	

(Note 1) : Off-State

(Note 2) : High or Low State. IOUT absolute maximum rating must be observed.

(Note 3) : $V_{OUT} < GND$, $V_{OUT} > V_{CC}$

RECOMMENDED OPERATING RANGE

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	Vac	1.8~3.6	v
Supply Voltage	Vcc	1.2~3.6 (Note 4)	v
Input Voltage (OEAB, OEBA, LEAB, LEBA, CKAB, CKBA, CKENAB, CKENBA)	VIN	- 0.3~3.6	v
Bus I/O Voltage	Vicio	0~3.6 (Note 5)	v
Bus 170 Voltage	VI/O	0~ V _{CC} (Note 6)	v
		±12 (Note 7)	
Output Current	IOH/IOL	±8 (Note 8)	mA
		±4 (Note 9)	
Operating Temperature	T _{opr}	- 40~85	°C
Input Rise And Fall Time	dt/dv	0~10 (Note 10)	ns / V

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = $-40{\sim}85^\circ\text{C},~2.7~\text{V} < \text{V}_{\text{CC}} \leq 3.6~\text{V})$

PARA	METER	SYMBOL	TEST	CONDITION	V _{CC} (V)	MIN	МАХ	UNIT										
Input	"H" Level	VIH			2.7~3.6	2.0	—	V										
Voltage	"L" Level	VIL			2.7~3.6		0.8	V										
			.,	I _{OH} = −100 μA	2.7~3.6	V _{CC} - 0.2	—											
	"H" Level	∨он	VIN =	$I_{OH} = -6 \text{mA}$	2.7	2.2	—	V										
			VIH or VIL	VIH or VIL	VIH or VIL	VIH or VIL	VIH or VIL	VIH or VIL	V _{IH} or V _{IL}		$I_{OH} = -8 \text{mA}$	3.0	2.4	_				
Output						$I_{OH} = -12 \text{ mA}$	3.0	2.2	_									
Voltage				I _{OL} = 100 μA	2.7~3.6		0.2											
	"L" Level	Ma	V _{IN} = V _{IH} or V _{IL}							VIN =	V _{IN} =	VIN =	VIN =	I _{OL} = 6 mA	2.7		0.4	v
	L Levei	VOL								I _{OL} = 8 mA	3.0		0.55	v				
				I _{OL} = 12 mA	3.0		0.8											
Input Leaka	age Current	^I IN	$V_{IN} = 0 \sim 3.$	6 V	2.7~3.6		± 5.0	μA										
3-State Out Off-State C	urrent	loz	V _{IN} = V _{IH} V _{OUT} = 0~	V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0~3.6 V		_	± 10.0	μΑ										
Power Off Current	Leakage	lOFF	V _{IN} , V _{OUT} = 0~3.6 V		0	_	10.0	μΑ										
Quiescent S	Supply		$V_{IN} = V_{CC}$	or GND	2.7~3.6		20.0											
Current		lcc	$V_{CC} \leq (V_{IN})$	I, V _{OUT}) ≦ 3.6 V	2.7~3.6	_	±20.0	μΑ										
Increase In Input	ICC Per	⊿ICC	V _{IH} = V _{CC}	– 0.6 V	2.7~3.6		750	μΑ										

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = $-40 \sim 85^{\circ}$ C, 2.3 V $\leq V_{CC} < 2.7$ V)

PARA	AMETER	SYMBOL	TEST	CONDITION	V _{CC} (V)	MIN	МАХ	UNIT													
Input	"H" Level	VIH			2.3~2.7	1.6	_	V													
Voltage	"L" Level	VIL			2.3~2.7	_	0.7	V													
				I _{OH} = -100 μA	2.3~2.7	V _{CC} - 0.2	_														
	"H" Level	∨он	VIN = VIH or VIL						V _{IN} = V _{IH} or V _{IL}	$I_{OH} = -4 \text{mA}$	2.3	2.0		V							
Output										VIH or VIL	VIH or VIL	$I_{OH} = -6 \text{mA}$	2.3	1.8	_						
Voltage															$I_{OH} = -8 \text{mA}$	2.3	1.7	_			
			V _{IN} = V _{IH} or V _{IL}						l _{OL} = 100 μA	2.3~2.7	_	0.2									
	"L" Level	VOL																			I _{OL} = 6 mA
					I _{OL} = 8 mA	2.3	_	0.6													
Input Leak	age Current	^I IN	$V_{IN} = 0 \sim 3.$	6V	2.3~2.7	_	± 5.0	μA													
3-State Ou Off-State C		loz		$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{OUT} = 0 \sim 3.6 \text{ V}$			± 10.0	μΑ													
Power Off Current	Leakage	^I OFF	V _{IN} , V _{OUT} = 0~3.6 V		0		10.0	μΑ													
Quiescent Supply		lee	$V_{IN} = V_{CC}$	or GND	2.3~2.7	_	20.0														
Current		lcc	$V_{CC} \leq (V_{IN})$	l, V _{OUT}) ≦ 3.6 V	2.3~2.7	_	±20.0	μΑ													

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = $-40 \sim 85^{\circ}$ C, $1.8 V \leq V_{CC} < 2.3 V$)

PARA	METER	SYMBOL	TEST	CONDITION	V _{CC} (V)	MIN	MAX	UNIT
Input	"H" Level	VIH				0.7 × V _{CC}		V
Voltage	"L" Level	V _{IL}			1.8~2.3	_	0.2 × V _{CC}	V
Quitaut	"H" Level	V _{OH}		I _{OH} = -100 μA	1.8	V _{CC} – 0.2	_	v
Output Voltage		•	V _{IH} or V _{IL}	$I_{OH} = -4 \text{mA}$	1.8	1.4	—	
voltage	"L" Level	Max	V _{IN} =	l _{OL} = 100 μA	1.8	_	0.2	v
	L Levei	V _{OL}	V _{IH} or V _{IL}	I _{OL} = 4 mA	1.8	_	0.3	v
Input Leak	age Current	^I IN	V _{IN} = 0∼3.	6 V	1.8	_	± 5.0	μA
3-State Out Off-State C		loz		$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{OUT} = 0 \sim 3.6 \text{ V}$			± 10.0	μA
Power Off Current	Leakage	loff	V _{IN} , V _{OUT} = 0~3.6 V		0		10.0	μΑ
Quiescent S	Quiescent Supply		$V_{IN} = V_{CC}$	or GND	1.8	_	20.0	<i>μ</i> Δ
Current		lcc	$V_{CC} \leq V_{IN}$	l, V _{OUT}) ≦ 3.6 V	1.8	_	±20.0	μΑ

PARAMETER	SYMBOL	TEST CONDI	ITION	V _{CC} (V)	MIN	MAX	UNIT
Maximum Clock				1.8	100	_	
Frequency	fMAX	(Fig.1, 3)		2.5 ± 0.2	200		MHz
riequency				3.3 ± 0.3	250	_	
Propagation Delay Time	4			1.8	1.5	9.2	
(An, Bn-Bn, An)	tpLH	(Fig.1, 2)		2.5 ±0.2	0.8	4.6	ns
	t _{pHL}			3.3 ±0.3	0.6	3.8	
Propagation Dalay Time	4			1.8	1.5	9.8	
Propagation Delay Time (CKAB, CKBA-Bn, An)	t _{pLH}	(Fig.1, 3)		2.5 ± 0.2	0.8	5.5	ns
(CRAB, CRBA-BII, AII)	^t pHL			3.3 ± 0.3	0.6	4.4	
Proposition Dolou Time	4			1.8	1.5	9.8	
Propagation Delay Time (LEAB, LEBA-Bn, An)	^t pLH	(Fig.1, 4)		2.5 ± 0.2	0.8	5.5	ns
(LEAD, LEDA-BII, AII)	^t pHL			3.3 ± 0.3	0.6	4.4	
Output Frankla Time				1.8	1.5	9.8	
Output Enable Time	^t pZL	(Fig.1, 6)		2.5 ± 0.2	0.8	5.9	ns
(OEAB, OEBA-Bn, An)	^t pZH		3.3 ± 0.3	0.6	4.3		
Output Dischle Time	4			1.8	1.5	8.8	
Output Disable Time (OEAB, OEBA-Bn, An)	^t pLZ	(Fig.1, 6)		2.5 ± 0.2	0.8	4.9	ns
(ОЕАВ, ОЕВА-ВП, АП)	^t pHZ			3.3 ± 0.3	0.6	4.3	
				1.8	4.0		
Minimum Pulse Width	^t w (H)	(Fig.1, 3, 4)		2.5 ± 0.2	1.5		ns
	^t w (L)			3.3 ± 0.3	1.5		
				1.8	2.5		
Minimum Set-up Time	ts	(Fig.1, 3, 4, 5)		2.5 ± 0.2	1.5		ns
	_			3.3 ± 0.3	1.5	_	
				1.8	1.0	_	
Minimum Hold Time	th	(Fig.1, 3, 4, 5)		2.5 ± 0.2	1.0	_	ns
				3.3 ± 0.3	1.0		
				1.8		0.5	
Output to Output Skew	tosLH		(Note 11)	2.5 ± 0.2		0.5	ns
	^t osHL		-	3.3 ± 0.3	_	0.5	

AC characteristics (Ta = $-40 \sim 85^{\circ}$ C, Input t_r = t_f = 2.0 ns, C_L = 30 pF, R_L = 500 Ω)

For $C_L = 50 \text{ pF}$, add approximately 300 ps to the AC maximum specification.

(Note 11) : Parameter guaranteed by design. $(t_{osLH} = |t_{pLHm} - t_{pLHn}|, \ t_{osHL} = |t_{pHLm} - t_{pHLn}|)$

<u>TOSHIBA</u>

PARAMETER	SYMBOL	TEST CONDITIC	DN	V _{CC} (V)	TYP.	UNIT
Quist Output Maximum		$V_{IH} = 1.8 V, V_{IL} = 0 V$	(Note 12)	1.8	0.15	
Quiet Output Maximum Dynamic V _{OL}	VOLP	$V_{IH} = 2.5 V, V_{IL} = 0 V$	(Note 12)	2.5	0.25	V
		$V_{IH} = 3.3 V, V_{IL} = 0 V$	(Note 12)	3.3	0.35	
Quiet Output Minimum		$V_{IH} = 1.8 V, V_{IL} = 0 V$	(Note 12)	1.8	- 0.15	
Dynamic V _{OI}	VOLV	V _{IH} = 2.5 V, V _{IL} = 0 V	(Note 12)	2.5	- 0.25	V
		V _{IH} = 3.3 V, V _{IL} = 0 V	(Note 12)	3.3	- 0.35	
		V _{IH} = 1.8 V, V _{IL} = 0 V	(Note 12)	1.8	1.55	
Quiet Output Minimum Dynamic V _{OH}	VOHV	V _{IH} = 2.5 V, V _{IL} = 0 V	(Note 12)	2.5	2.05	V
		V _{IH} = 3.3 V, V _{IL} = 0 V	(Note 12)	3.3	2.65	

Dynamic switching characteristics (Ta = 25° C, Input t_r = t_f = 2.0 ns, C_L = 30 pF)

(Note 12) : Parameter guaranteed by design.

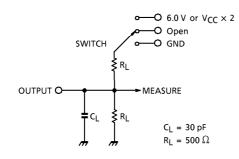
Capacitive characteristics (Ta = 25° C)

PARAMETER	SYMBOL	TEST CONDITION	V _{CC} (V)	TYP.	UNIT
Input Capacitance	C _{IN}		1.8, 2.5, 3.3	6	рF
Bus I/O Capacitance	CI/O		1.8, 2.5, 3.3	7	рF
Power Dissipation Capacitance	C _{PD}	f _{IN} = 10 MHz (Note 13) 1.8, 2.5, 3.3	20	рF

(Note 13) : 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.) = $C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 18$ (per bit)

TEST CIRCUIT

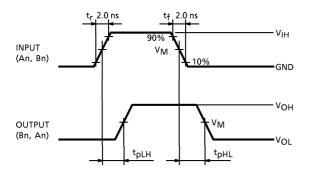
Fig.1



PARAMETER	SWITCH
t _{pLH} , t _{pHL}	Open
t _{pLZ} , t _{pZL}	6.0 V @V _{CC} = 3.3 ± 0.3 V V _{CC} × 2 @V _{CC} = 2.5 ± 0.2 V @V _{CC} = 1.8 V
t _{pHZ} , t _{pZH}	GND

AC WAVEFORM

Fig.2 t_{pLH}, t_{pHL}



SYM		V _{CC}					
31101	BOL	3.3 ± 0.3 V	2.5 ± 0.2 V	1.8 V			
VI	Н	2.7 V	Vcc	Vcc			
V	VI	1.5 V	V _{CC} / 2	V _{CC} / 2			
V	x	V _{OL} + 0.3 V	V _{OL} + 0.15 V	V _{OL} + 0.15 V			
V	Y	V _{OH} – 0.3 V	V _{OH} – 0.15 V	V _{OH} – 0.15 V			

Fig.3 t_{pLH} , t_{pHL} , t_w , t_s , t_h

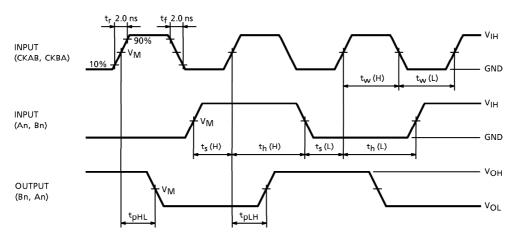


Fig.4 tpLH, tpHL, tw, ts, th

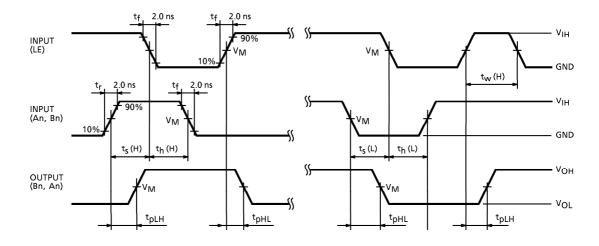


Fig.5 t_s, t_h

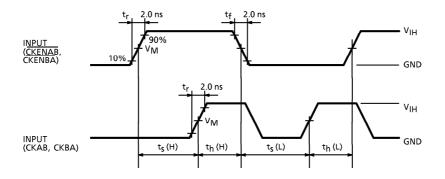
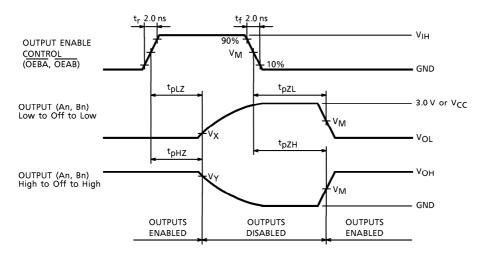
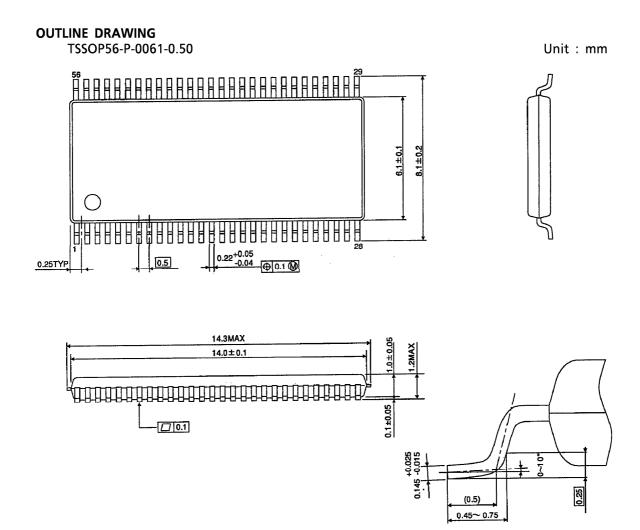


Fig.6 t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}





Weight: 0.25 g (Typ.)

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