

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74VCXR162245FT

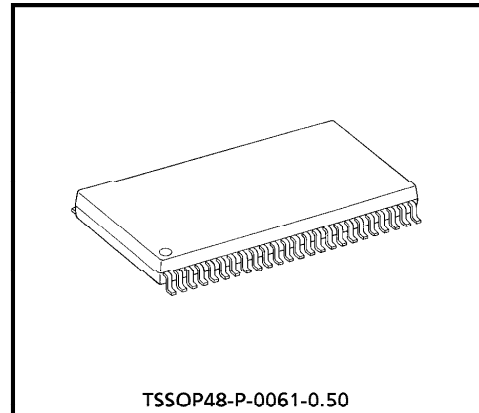
LOW-VOLTAGE 16-BIT BUS TRANSCEIVER WITH 3.6V TOLERANT INPUTS AND OUTPUTS

The TC74VCXR162245FT is a high performance CMOS 16-bit 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 3.6V.

This 16bit bus transceiver is controlled by direction control (DIR) inputs and output enable ($\overline{OE}$) inputs which are common to each byte. It can be used as two 8-bit transceivers or one 16-bit transceiver. The direction of data transmission is determined by the level of the DIR inputs. The $\overline{OE}$ inputs can be used to disable the device so that the busses are effectively isolated.

The 26- Ω series resistor helps reducing output overshoot and undershoot without external resistor.

All inputs are equipped with protection circuits against static discharge.



TSSOP48-P-0061-0.50

Weight : 0.25g (Typ.)

FEATURES

- 26- Ω Series Resistors on all Outputs.
- Low Voltage Operation : $V_{CC} = 1.8 \sim 3.6V$
- High Speed Operation : $t_{pd} = 3.4$ (max.) at $V_{CC} = 3.0 \sim 3.6V$
: $t_{pd} = 4.3$ (max.) at $V_{CC} = 2.3 \sim 2.7V$
: $t_{pd} = 5.7$ (max.) at $V_{CC} = 1.8V$
- 3.6V Tolerant inputs and outputs.
- Output Current : $I_{OH}/I_{OL} = \pm 12mA$ (min.) at $V_{CC} = 3.0V$
: $I_{OH}/I_{OL} = \pm 8mA$ (min.) at $V_{CC} = 2.3V$
: $I_{OH}/I_{OL} = \pm 4mA$ (min.) at $V_{CC} = 1.8V$
- Latch-up Performance : $\pm 300mA$
- ESD Performance : Human Body Model $> \pm 2000V$
: Machine Model $> \pm 200V$
- Package : TSSOP (Thin Shrink Small Outline Package)
- Bidirectional interface between 2.5V and 3.3V signals.
- Power Down Protection is provided on all inputs and outputs

Note 1) Do not apply a signal to any bus terminal when it is in the output mode. Damage may result.
2) All floating (high impedance) bus terminal must have their input level fixed by means of pull up or pull down resistors.

PIN CONNECTION

1DIR	1	48	$\overline{1OE}$
1B1	2	47	1A1
1B2	3	46	1A2
GND	4	45	GND
1B3	5	44	1A3
1B4	6	43	1A4
V_{CC}	7	42	V_{CC}
1B5	8	41	1A5
1B6	9	40	1A6
GND	10	39	GND
1B7	11	38	1A7
1B8	12	37	1A8
2B1	13	36	2A1
2B2	14	35	2A2
GND	15	34	GND
2B3	16	33	2A3
2B4	17	32	2A4
V_{CC}	18	31	V_{CC}
2B5	19	30	2A5
2B6	20	29	2A6
GND	21	28	GND
2B7	22	27	2A7
2B8	23	26	2A8
2DIR	24	25	$\overline{2OE}$

(TOP VIEW)

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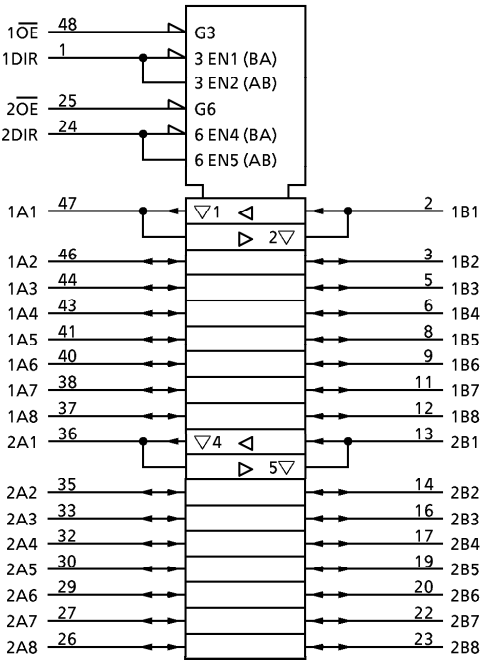
TRUTH TABLE

INPUT		FUNCTION		OUTPUT
1OE	1DIR	BUS 1A1-1A8	BUS 1B1-1B8	
L	L	OUTPUT	INPUT	A = B
L	H	INPUT	OUTPUT	B = A
H	X	High Impedance		Z

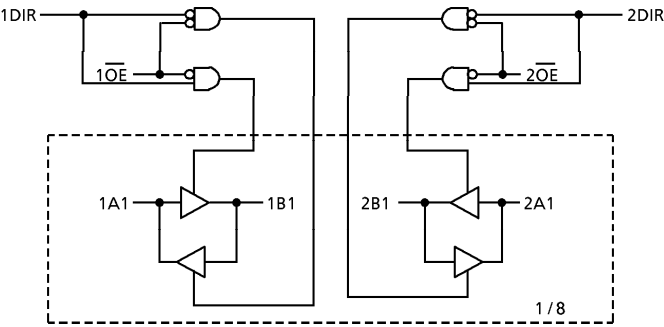
INPUT		FUNCTION		OUTPUT
2OE	2DIR	BUS 2A1-2A8	BUS 2B1-2B8	
L	L	OUTPUT	INPUT	A = B
L	H	INPUT	OUTPUT	B = A
H	X	High Impedance		Z

X : Don't Care
Z : High impedance

IEC LOGIC SYMBOL



SYSTEM DIAGRAM



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MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT
Power Supply Voltage	V_{CC}	- 0.5~4.6	V
DC Input Voltage (DIR, $\overline{OE}$)	V_{IN}	- 0.5~4.6	V
DC Bus I / O Voltage	$V_{I/O}$	- 0.5~4.6 (Note 1)	V
		- 0.5~ $V_{CC} + 0.5$ (Note 2)	
Input Diode Current	I_{IK}	- 50	mA
Output Diode Current	I_{OK}	± 50 (Note 3)	mA
DC Output Current	I_{OUT}	± 50	mA
Power Dissipation	P_D	400	mW
DC V_{CC} / Ground Current Per Supply Pin	I_{CC}/I_{GND}	± 100	mA
Storage Temperature	T_{stg}	- 65~150	°C

(Note 1) Off-State

(Note 2) High or Low State. I_{OUT} absolute maximum rating must be observed.(Note 3) $V_{OUT} < GND$, $V_{OUT} > V_{CC}$

RECOMMENDED OPERATING RANGE

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	1.8~3.6	V
		1.2~3.6 (Note 4)	
Input Voltage (DIR, $\overline{OE}$)	V_{IN}	- 0.3~3.6	V
Bus I / O Voltage	$V_{I/O}$	0~3.6 (Note 5)	V
		0~ V_{CC} (Note 6)	
Output Current	I_{OH}/I_{OL}	± 12 (Note 7)	mA
		± 8 (Note 8)	
		± 4 (Note 9)	
Operating Temperature	T_{opr}	- 40~85	°C
Input Rise And Fall Time	dt/dv	0~10 (Note 10)	ns/V

(Note 4) Data Retention Only

(Note 5) Off-State

(Note 6) High or Low State

(Note 7) $V_{CC} = 3.0 \sim 3.6V$ (Note 8) $V_{CC} = 2.3 \sim 2.7V$ (Note 9) $V_{CC} = 1.8V$ (Note 10) $V_{IN} = 0.8 \sim 2.0V$, $V_{CC} = 3.0V$

ELECTRICAL CHARACTERISTICS

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

PARAMETER		SYMBOL	TEST CONDITION		V _{CC} (V)	MIN.	MAX.	UNIT
Input Voltage	"H" Level	V _{IH}			2.7~3.6	2.0	—	V
	"L" Level	V _{IL}			2.7~3.6	—	0.8	V
Output Voltage	"H" Level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = - 100μA	2.7~3.6	V _{CC} - 0.2	—	V
				I _{OH} = - 6mA	2.7	2.2	—	
				I _{OH} = - 8mA	3.0	2.4	—	
				I _{OH} = - 12mA	3.0	2.2	—	
	"L" Level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100μA	2.7~3.6	—	0.2	V
				I _{OL} = 6mA	2.7	—	0.4	
				I _{OL} = 8mA	3.0	—	0.55	
				I _{OL} = 12mA	3.0	—	0.8	
Input Leakage Current		I _{IN}	V _{IN} = 0~3.6V	2.7~3.6	—	± 5.0	μA	
3-State Output Off-State Current		I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0~3.6V	2.7~3.6	—	± 10.0	μA	
Power Off Leakage Current		I _{OFF}	V _{IN} , V _{OUT} = 0~3.6V	0	—	10.0	μA	
Quiescent Supply Current		I _{CC}	V _{IN} = V _{CC} or GND		2.7~3.6	—	20.0	μA
			V _{CC} ≤ (V _{IN} , V _{OUT}) ≤ 3.6V		2.7~3.6	—	± 20.0	
Increase In I _{CC} Per Input		ΔI _{CC}	V _{IH} = V _{CC} - 0.6V		2.7~3.6	—	750	μA

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = -40~85°C, 2.3V ≤ V_{CC} ≤ 2.7V)

PARAMETER		SYMBOL	TEST CONDITION			MIN.	MAX.	UNIT
					V _{CC} (V)			
Input Voltage	“H” Level	V _{IH}	2.3~2.7			1.6	—	V
	“L” Level	V _{IL}	2.3~2.7			—	0.7	V
Output Voltage	“H” Level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = - 100μA	2.3~2.7	V _{CC} - 0.2	—	V
				I _{OH} = - 4mA	2.3	2.0	—	
				I _{OH} = - 6mA	2.3	1.8	—	
				I _{OH} = - 8mA	2.3	1.7	—	
	“L” Level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100μA	2.3~2.7	—	0.2	V
				I _{OL} = 6mA	2.3	—	0.4	
				I _{OL} = 8mA	2.3	—	0.6	
Input Leakage Current		I _{IN}	V _{IN} = 0~3.6V		2.3~2.7	—	± 5.0	μA
3-State Output Off-State Current		I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0~3.6V		2.3~2.7	—	± 10.0	μA
Power Off Leakage Current		I _{OFF}	V _{IN} , V _{OUT} = 0~3.6V		0	—	10.0	μA
Quiescent Supply Current		I _{CC}	V _{IN} = V _{CC} or GND		2.3~2.7	—	20.0	μA
			V _{CC} ≤ (V _{IN} , V _{OUT}) ≤ 3.6V _{CC}		2.3~2.7	—	± 20.0	

ELECTRICAL CHARACTERISTICSDC characteristics (Ta = -40~85°C, 1.8V ≤ V_{CC} < 2.3V)

PARAMETER		SYMBOL	TEST CONDITION		V _{CC} (V)	MIN.	MAX.	UNIT
Input Voltage	“H” Level	V _{IH}			1.8~2.3	0.7 × V _{CC}	—	V
	“L” Level	V _{IL}			1.8~2.3	—	0.2 × V _{CC}	V
Output Voltage	“H” Level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = - 100μA	1.8	V _{CC} - 0.2	—	V
				I _{OH} = - 4mA	1.8	1.4	—	
	“L” Level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100μA	1.8	—	0.2	V
				I _{OL} = 4mA	1.8	—	0.3	
Input Leakage Current		I _{IN}	V _{IN} = 0~3.6V		1.8	—	± 5.0	μA
3-State Output Off-State Current		I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0~3.6V		1.8	—	± 10.0	μA
Power Off Leakage Current		I _{OFF}	V _{IN} , V _{OUT} = 0~3.6V		0	—	10.0	μA
Quiescent Supply Current		I _{CC}	V _{IN} = V _{CC} or GND		1.8	—	20.0	μA
			V _{CC} ≤ (V _{IN} , V _{OUT}) ≤ 3.6V		1.8	—	± 20.0	

AC characteristics (Ta = -40~85°C, Input t_r = t_f = 2.0ns, C_L = 30pF, R_L = 500Ω)

PARAMETER		SYMBOL	TEST CONDITION		V _{CC} (V)	MIN.	MAX.	UNIT
Propagation Delay Time	t _{pLH} t _{pHL}	(Fig.1, 2)			1.8	1.5	5.7	ns
					2.5 ± 0.2	1.0	4.3	
					3.3 ± 0.3	0.8	3.4	
3-State Output Enable Time	t _{pZL} t _{pZH}	(Fig.1, 3)			1.8	1.5	7.6	ns
					2.5 ± 0.2	1.0	5.7	
					3.3 ± 0.3	0.8	4.2	
3-State Output Disable Time	t _{pLZ} t _{pHZ}	(Fig.1, 3)			1.8	1.5	5.7	ns
					2.5 ± 0.2	1.0	4.8	
					3.3 ± 0.3	0.8	4.1	
Output To Output Skew	t _{osLH} t _{osHL}	(Note 11)			1.8	—	0.5	ns
					2.5 ± 0.2	—	0.5	
					3.3 ± 0.3	—	0.5	

For C_L = 50pF, add approximately 300ps to the AC maximum specification.

(Note 11) Parameter guaranteed by design.

$$(t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|)$$

Dynamic switching characteristics (Ta = 25°C, Input $t_r = t_f = 2.0\text{ns}$, $C_L = 30\text{pF}$)

PARAMETER	SYMBOL	TEST CONDITION		TYP.	UNIT
			V_{CC} (V)		
Quiet Output Maximum Dynamic V_{OL}	V_{OLP}	$V_{IH} = 1.8\text{V}$, $V_{IL} = 0\text{V}$ (Note 12)	1.8	0.15	V
		$V_{IH} = 2.5\text{V}$, $V_{IL} = 0\text{V}$ (Note 12)	2.5	0.25	
		$V_{IH} = 3.3\text{V}$, $V_{IL} = 0\text{V}$ (Note 12)	3.3	0.35	
Quiet Output Minimum Dynamic V_{OL}	V_{OLV}	$V_{IH} = 1.8\text{V}$, $V_{IL} = 0\text{V}$ (Note 12)	1.8	-0.15	V
		$V_{IH} = 2.5\text{V}$, $V_{IL} = 0\text{V}$ (Note 12)	2.5	-0.25	
		$V_{IH} = 3.3\text{V}$, $V_{IL} = 0\text{V}$ (Note 12)	3.3	-0.35	
Quiet Output Minimum Dynamic V_{OH}	V_{OHV}	$V_{IH} = 1.8\text{V}$, $V_{IL} = 0\text{V}$ (Note 12)	1.8	1.55	V
		$V_{IH} = 2.5\text{V}$, $V_{IL} = 0\text{V}$ (Note 12)	2.5	2.05	
		$V_{IH} = 3.3\text{V}$, $V_{IL} = 0\text{V}$ (Note 12)	3.3	2.65	

(Note 12) Parameter guaranteed by design.

Capacitive characteristics (Ta = 25°C)

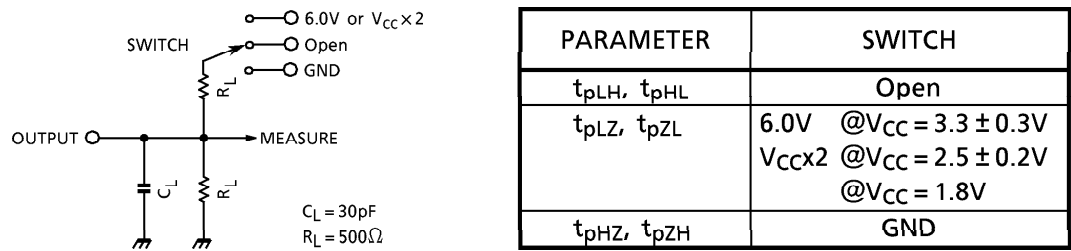
PARAMETER	SYMBOL	TEST CONDITION		TYP.	UNIT
			V_{CC} (V)		
Input Capacitance	C_{IN}	DIR, $\overline{OE}$	1.8, 2.5, 3.3	6	pF
Bus I/O Capacitance	$C_{I/O}$	An, Bn	1.8, 2.5, 3.3	7	pF
Power Dissipation Capacitance	C_{PD}	$f_{IN} = 10\text{MHz}$ (Note 13)	1.8, 2.5, 3.3	20	pF

(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 :

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

Fig.1 Test circuit



AC WAVEFORM

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

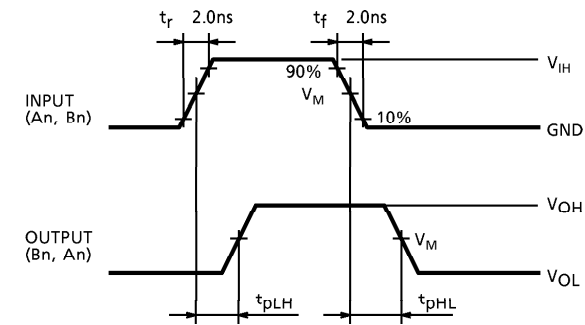
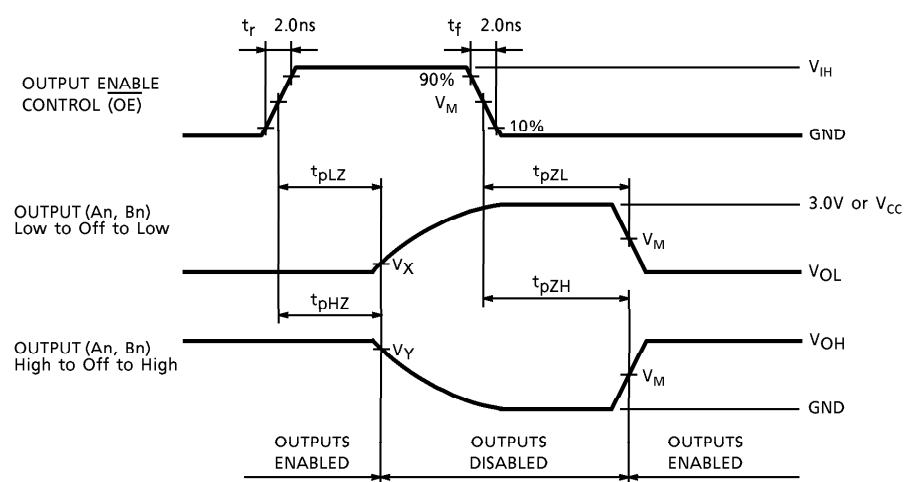


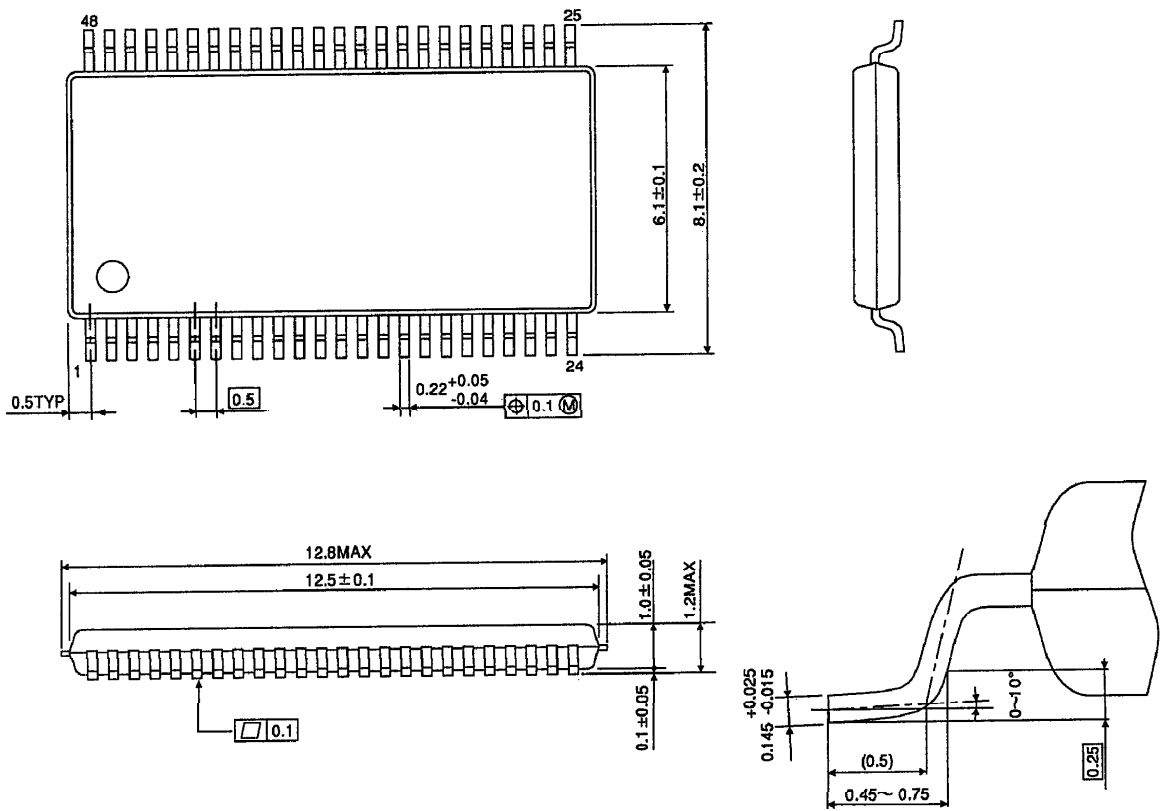
Fig.3 t_{pLZ} , t_{pHZ} , t_{pZL} , t_{pZH}



SYMBOL	V _{CC}		
	3.3 ± 0.3V	2.5 ± 0.2V	1.8V
V _{IH}	2.7V	V _{CC}	V _{CC}
V _M	1.5V	V _{CC} / 2	V _{CC} / 2
V _X	V _{OL} + 0.3V	V _{OL} + 0.15V	V _{OL} + 0.15V
V _Y	V _{OH} - 0.3V	V _{OH} - 0.15V	V _{OH} - 0.15V

OUTLINE DRAWING
TSSOP48-P-0061-0.50

Unit : mm



Weight : 0.25g (Typ.)