

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74VCX86FT

Low-Voltage Quad 2-Input Exclusive OR Gate with 3.6-V Tolerant Inputs and Outputs

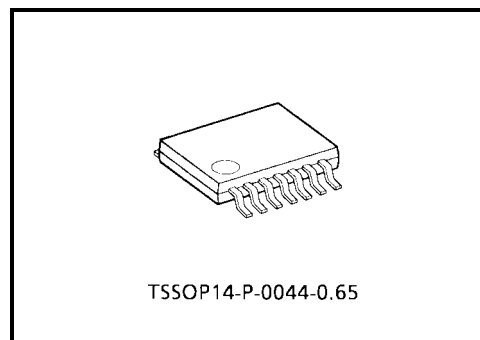
The TC74VCX86FT is a high-performance CMOS exclusive OR gate. Designed for use in 1.8-V, 2.5-V or 3.3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

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

All inputs are equipped with protection circuits against static discharge.

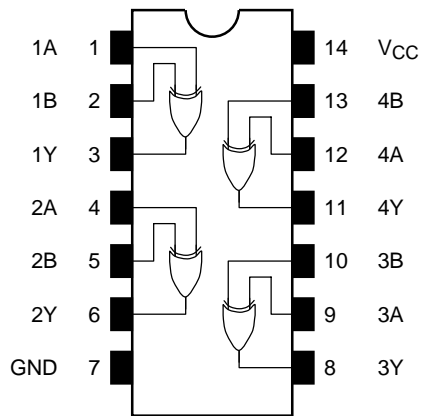
Features

- Low-voltage operation: $V_{CC} = 1.8$ to 3.6 V
- High-speed operation : $t_{pd} = 3.0$ ns (max) ($V_{CC} = 3.0$ to 3.6 V)
: $t_{pd} = 3.9$ ns (max) ($V_{CC} = 2.3$ to 2.7 V)
: $t_{pd} = 7.8$ ns (max) ($V_{CC} = 1.8$ V)
- Output current: $I_{OH}/I_{OL} = \pm 24$ mA (min) ($V_{CC} = 3.0$ V)
: $I_{OH}/I_{OL} = \pm 18$ mA (min) ($V_{CC} = 2.3$ V)
: $I_{OH}/I_{OL} = \pm 6$ mA (min) ($V_{CC} = 1.8$ V)
- Latch-up performance: ± 300 mA
- ESD performance: Machine model $> \pm 200$ V
: Human body model $> \pm 2000$ V
- Package: TSSOP (thin shrink small outline package)
- Power-down protection provided on all inputs and outputs

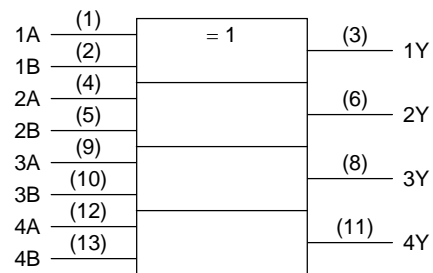


Weight: 0.06g (typ.)

Pin Assignment (top view)



IEC Logic Symbol



Truth Table

A	B	Y
L	L	L
L	H	H
H	L	H
H	H	L

Maximum Ratings

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	-0.5 to 4.6	V
DC input voltage	V_{IN}	-0.5 to 4.6	V
DC output voltage	V_{OUT}	-0.5 to 4.6 (Note 1)	V
		-0.5 to $V_{CC} + 0.5$ (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	180	mW
DC V_{CC} /ground current	I_{CC}/I_{GND}	± 100	mA
Storage temperature	T_{stg}	-65 to 150	$^{\circ}C$

Note 1: $V_{CC} = 0\text{ V}$

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

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	1.8 to 3.6	V
		1.2 to 3.6 (Note 4)	
Input voltage	V_{IN}	-0.3 to 3.6	V
Output voltage	V_{OUT}	0 to 3.6 (Note 5)	V
		0 to V_{CC} (Note 6)	
Output current	I_{OH}/I_{OL}	± 24 (Note 7)	mA
		± 18 (Note 8)	
		± 6 (Note 9)	
Operating temperature	T_{opr}	-40 to 85	$^{\circ}\text{C}$
Input rise and fall time	dt/dv	0 to 10 (Note 10)	ns/V

Note 4: Data retention only

Note 5: $V_{CC} = 0\text{ V}$

Note 6: High or low state

Note 7: $V_{CC} = 3.0\text{ to }3.6\text{ V}$

Note 8: $V_{CC} = 2.3\text{ to }2.7\text{ V}$

Note 9: $V_{CC} = 1.8\text{ V}$

Note 10: $V_{IN} = 0.8\text{ to }2.0\text{ V}$, $V_{CC} = 3.0\text{ V}$

Electrical Characteristics

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

Characteristics		Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit	
Input voltage	"H" level	V_{IH}	—	2.7 to 3.6	2.0	—	V	
	"L" level	V_{IL}	—	2.7 to 3.6	—	0.8		
Output voltage	"H" level	V_{OH}	$V_{IN} = V_{IH}\text{ or }V_{IL}$	$I_{OH} = -100\ \mu\text{A}$	2.7 to 3.6	$V_{CC} - 0.2$	—	V
				$I_{OH} = -12\ \text{mA}$	2.7	2.2	—	
				$I_{OH} = -18\ \text{mA}$	3.0	2.4	—	
				$I_{OH} = -24\ \text{mA}$	3.0	2.2	—	
	"L" level	V_{OL}	$V_{IN} = V_{IH}\text{ or }V_{IL}$	$I_{OL} = 100\ \mu\text{A}$	2.7 to 3.6	—	0.2	
				$I_{OL} = 12\ \text{mA}$	2.7	—	0.4	
				$I_{OL} = 18\ \text{mA}$	3.0	—	0.4	
				$I_{OL} = 24\ \text{mA}$	3.0	—	0.55	
Input leakage current		I_{IN}	$V_{IN} = 0\text{ to }3.6\text{ V}$	2.7 to 3.6	—	± 5.0	μA	
Power off leakage current		I_{OFF}	$V_{IN}, V_{OUT} = 0\text{ to }3.6\text{ V}$	0	—	10.0	μA	
Quiescent supply current		I_{CC}	$V_{IN} = V_{CC}\text{ or GND}$	2.7 to 3.6	—	20.0	μA	
			$V_{CC} \leq V_{IN} \leq 3.6\text{ V}$	2.7 to 3.6	—	± 20.0		
Increase in I_{CC} per input		ΔI_{CC}	$V_{IH} = V_{CC} - 0.6\text{ V}$	2.7 to 3.6	—	750		

DC Characteristics (Ta = -40 to 85°C, 2.3 V ≤ VCC ≤ 2.7 V)

Characteristics		Symbol	Test Condition		VCC (V)	Min	Max	Unit
Input voltage	H-level	V _{IH}	—		2.3 to 2.7	1.6	—	V
	L-level	V _{IL}	—		2.3 to 2.7	—	0.7	
Output voltage	H-level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -100 μA	2.3 to 2.7	V _{CC} - 0.2	—	V
				I _{OH} = -6 mA	2.3	2.0	—	
				I _{OH} = -12 mA	2.3	1.8	—	
	L-level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	2.3 to 2.7	—	0.2	
				I _{OL} = 12 mA	2.3	—	0.4	
				I _{OL} = 18 mA	2.3	—	0.6	
Input leakage current		I _{IN}	V _{IN} = 0 to 3.6 V		2.3 to 2.7	—	±5.0	μA
Power-off leakage current		I _{OFF}	V _{IN} , V _{OUT} = 0 to 3.6 V		0	—	10.0	μA
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND		2.3 to 2.7	—	20.0	μA
			V _{CC} ≤ V _{IN} ≤ 3.6 V		2.3 to 2.7	—	±20.0	

DC Characteristics (Ta = -40 to 85°C, 1.8 V ≤ VCC < 2.3 V)

Characteristics		Symbol	Test Condition		VCC (V)	Min	Max	Unit
Input voltage	H-level	V _{IH}	—		1.8 to 2.3	0.7 × V _{CC}	—	V
	L-level	V _{IL}	—		1.8 to 2.3	—	0.2 × V _{CC}	
Output voltage	H-level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -100 μA	1.8	V _{CC} - 0.2	—	V
				I _{OH} = -6 mA	1.8	1.4	—	
	L-level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	1.8	—	0.2	
				I _{OL} = 6 mA	1.8	—	0.3	
Input leakage current		I _{IN}	V _{IN} = 0 to 3.6 V		1.8	—	±5.0	μA
Power-off leakage current		I _{OFF}	V _{IN} , V _{OUT} = 0 to 3.6 V		0	—	10.0	μA
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND		1.8	—	20.0	μA
			V _{CC} ≤ V _{IN} ≤ 3.6 V		1.8	—	±20.0	

AC Characteristics (Ta = -40 to 85°C, input: tr = tf = 2.0 ns, CL = 30 pF, RL = 500 Ω)

Characteristics	Symbol	Test Condition	VCC (V)	Min	Max	Unit
			1.8	1.0	7.8	ns
2.5 ± 0.2	0.8	3.9				
3.3 ± 0.3	0.6	3.0				

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

Dynamic Switching Characteristics (Ta = 25°C, input: tr = tf = 2.0 ns, CL = 30 pF)

Characteristics	Symbol	Test Condition	VCC (V)	Typ.	Unit
			1.8	0.25	V
2.5	0.6				
3.3	0.8				
Quiet output minimum dynamic VOL	VOLV	VIH = 1.8 V, VIL = 0 V (Note 11)	1.8	-0.25	V
		VIH = 2.5 V, VIL = 0 V (Note 11)	2.5	-0.6	
		VIH = 3.3 V, VIL = 0 V (Note 11)	3.3	-0.8	
Quiet output minimum dynamic VOH	VOHV	VIH = 1.8 V, VIL = 0 V (Note 11)	1.8	1.5	V
		VIH = 2.5 V, VIL = 0 V (Note 11)	2.5	1.9	
		VIH = 3.3 V, VIL = 0 V (Note 11)	3.3	2.2	

Note 11: Parameter guaranteed by design.

Capacitive Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	VCC (V)	Typ.	Unit
			1.8, 2.5, 3.3	6	pF
fIN = 10 MHz (Note 12)	1.8, 2.5, 3.3	20			

Note 12: CPD 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:

$$I_{CC (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/4 \text{ (per gate)}$$

AC Test Circuit

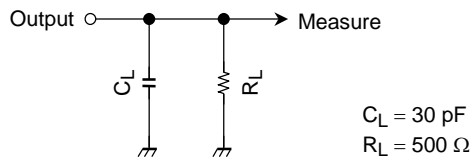
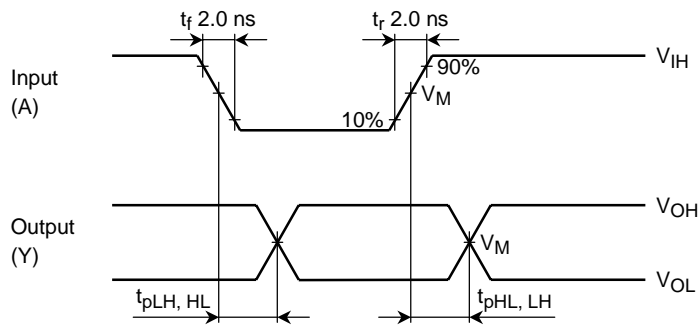


Figure 1

AC Waveform



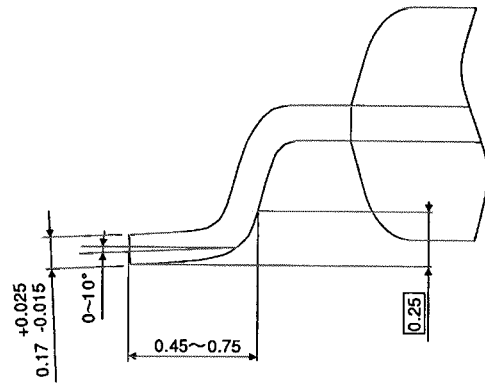
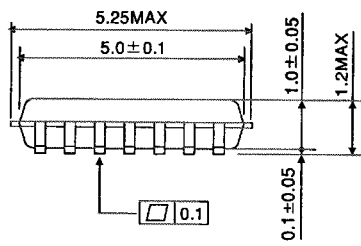
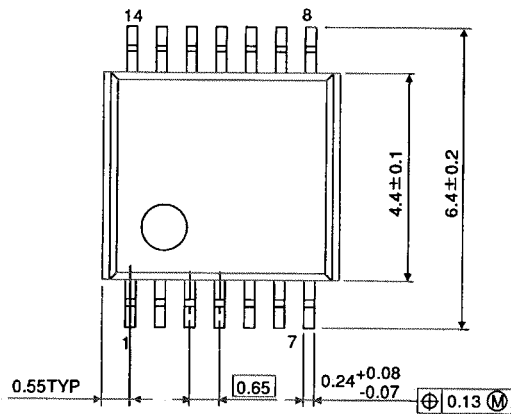
Symbol	V_{CC}		
	$3.3 \pm 0.3 \text{ V}$	$2.5 \pm 0.2 \text{ V}$	1.8 V
V_{IH}	2.7 V	V_{CC}	V_{CC}
V_M	1.5 V	$V_{CC}/2$	$V_{CC}/2$

Figure 2 t_{pLH} , t_{pHL}

Package Dimensions

TSSOP14-P-0044-0.65

Unit : mm



Weight: 0.06g (typ.)

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