

TENTATIVE TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74VCX74FT

LOW-VOLTAGE DUAL D-TYPE FLIP-FLOP WITH 3.6 V TOLERANT INPUTS AND OUTPUTS

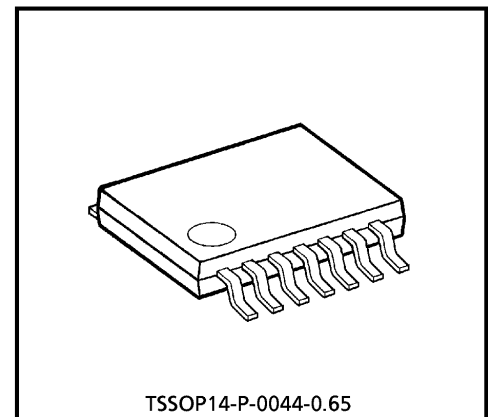
The TC74VCX74FT is a high performance CMOS D-type flip-flop. Designed for use in 1.8, 2.5 or 3.3 Volt systems, it achieves high speed operation while maintaining the CMOS low power dissipation.

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

The signal level applied to the D INPUT is transferred to Q OUTPUT during the positive going transition of the CK pulse.

$\overline{\text{CLR}}$ and $\overline{\text{PR}}$ are independent of the CK and are accomplished by setting the appropriate input low.

All inputs are equipped with protection circuits against static discharge.



Weight : 0.06 g (Typ.)

FEATURES

- Low Voltage Operation : $V_{CC} = 1.8\sim 3.6\text{ V}$
- High Speed Operation : $t_{pd} = \text{TBD (max) at } V_{CC} = 3.0\sim 3.6\text{ V}$
 $t_{pd} = \text{TBD (max) at } V_{CC} = 2.3\sim 2.7\text{ V}$
 $t_{pd} = \text{TBD (max) at } V_{CC} = 1.8\text{ V}$
- Output Current : $I_{OH}/I_{OL} = \pm 24\text{ mA (min) at } V_{CC} = 3.0\text{ V}$
 $I_{OH}/I_{OL} = \pm 18\text{ mA (min) at } V_{CC} = 2.3\text{ V}$
 $I_{OH}/I_{OL} = \pm 6\text{ mA (min) at } V_{CC} = 1.8\text{ V}$
- Latch-up Performance : $\pm 300\text{ mA}$
- ESD Performance : Human body model $> \pm 2000\text{ V}$
Machine model $> \pm 200\text{ V}$
- Package : TSSOP
(Thin Shrink Small Outline Package)
- Power down protection is provided on all inputs and outputs.

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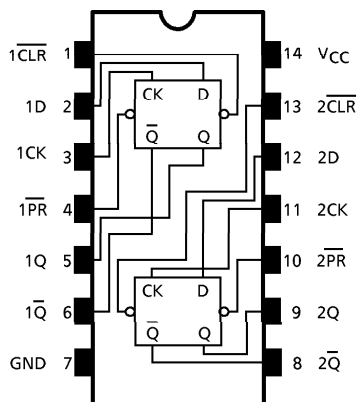
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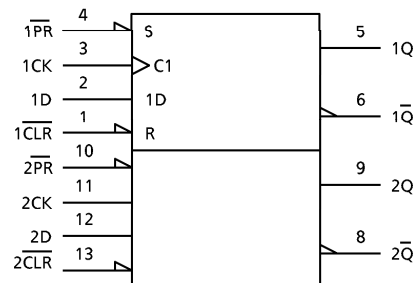
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PIN ASSIGNMENT



IEC LOGIC SYMBOL



TRUTH TABLE

INPUTS				OUTPUTS		FUNCTION
CLR	PR	D	CK	Q	Q̄	
L	H	X	X	L	H	CLEAR
H	L	X	X	H	L	PRESET
L	L	X	X	H	H	—
H	H	L		L	H	—
H	H	H		H	L	—
H	H	X		Q _n	Q̄ _n	NO CHANGE

X : Don't care

MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT
Power Supply Voltage	V _{CC}	-0.5~4.6	V
DC Input Voltage	V _{IN}	-0.5~4.6	V
DC Output Voltage	V _{OUT}	-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	180	mW
DC V _{CC} /Ground Current	I _{CC} /I _{GND}	±100	mA
Storage Temperature	T _{stg}	-65~150	°C

(Note 1) : V_{CC} = 0 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

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	1.8~3.6	V
		1.2~3.6 (Note 4)	
Input Voltage	V_{IN}	-0.3~3.6	V
Output Voltage	V_{OUT}	0~3.6 (Note 5)	V
		0~ V_{CC} (Note 6)	
Output Current	I_{OH}/I_{OL}	± 24 (Note 7)	mA
		± 18 (Note 8)	
		± 6 (Note 9)	
Operating Temperature	T_{opr}	-40~85	°C
Input Rise And Fall Time	dt/dv	0~10 (Note 10)	ns/V

(Note 4) : Data Retention Only

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

(Note 6) : High or Low State

(Note 7) : $V_{CC} = 3.0\sim 3.6\text{ V}$

(Note 8) : $V_{CC} = 2.3\sim 2.7\text{ V}$

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

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

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		
Output Voltage	"H" Level	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -100\ \mu\text{A}$	2.7~3.6	$V_{CC} - 0.2$	—	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}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 100\ \mu\text{A}$	2.7~3.6	—	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}	$V_{IN} = 0\sim 3.6\text{ V}$	2.7~3.6	—	± 5.0	μA	
Power Off Leakage Current		I_{OFF}	$V_{IN}, V_{OUT} = 0\sim 3.6\text{ V}$	0	—	10.0	μA	
Quiescent Supply Current		I_{CC}	$V_{IN} = V_{CC}$ or GND	2.7~3.6	—	20.0	μA	
			$V_{CC} \leq V_{IN} \leq 3.6\text{ V}$	2.7~3.6	—	± 20.0		
Increase In I_{CC} Per Input		ΔI_{CC}	$V_{IH} = V_{CC} - 0.6\text{ V}$	2.7~3.6	—	750	μA	

ELECTRICAL CHARACTERISTICS

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

PARAMETER		SYMBOL	TEST CONDITION		VCC (V)	MIN	MAX	UNIT
Input Voltage	"H" Level	V _{IH}			2.3~2.7	1.6	—	V
	"L" Level	V _{IL}			2.3~2.7	—	0.7	
Output Voltage	"H" Level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -100 μA	2.3~2.7	V _{CC} - 0.2	—	V
				I _{OH} = -6 mA	2.3	2.2	—	
				I _{OH} = -12 mA	2.3	1.8	—	
				I _{OH} = -18 mA	2.3	1.7	—	
	"L" Level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	2.3~2.7	—	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} = 0~3.6 V		2.3~2.7	—	± 5.0	μA
Power Off Leakage Current		I _{OFF}	V _{IN} , V _{OUT} = 0~3.6 V		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} ≤ 3.6 V		2.3~2.7	—	± 20.0	

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

PARAMETER		SYMBOL	TEST CONDITION		VCC (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}	
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} = 0~3.6 V		1.8	—	± 5.0	μA
Power Off Leakage Current		I _{OFF}	V _{IN} , V _{OUT} = 0~3.6 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 = -40~85°C, Input $t_r = t_f = 2.0$ ns, $C_L = 30$ pF, $R_L = 500 \Omega$)

PARAMETER	SYMBOL	TEST CONDITION	VCC (V)	MIN	MAX	UNIT
Maximum Clock Frequency	f_{MAX}	(Fig.1, 2)	1.8	TBD	—	MHz
			2.5 ± 0.2	TBD	—	
			3.3 ± 0.3	TBD	—	
Propagation Delay Time (CK-Q, \bar{Q})	t_{pLH} t_{pHL}	(Fig.1, 2)	1.8	1.0	TBD	ns
			2.5 ± 0.2	0.8	TBD	
			3.3 ± 0.3	0.6	TBD	
Propagation Delay Time (\bar{CLR} , \bar{PR} -Q, \bar{Q})	t_{pLH} t_{pHL}	(Fig.1, 4)	1.8	1.0	TBD	ns
			2.5 ± 0.2	0.8	TBD	
			3.3 ± 0.3	0.6	TBD	
Minimum Pulse Width (CK)	t_w (H) t_w (L)	(Fig.1, 2)	1.8	1.0	—	ns
			2.5 ± 0.2	0.8	—	
			3.3 ± 0.3	0.6	—	
Minimum Pulse Width (CLR, PR)	t_w (L)	(Fig.1, 4)	1.8	TBD	—	ns
			2.5 ± 0.2	TBD	—	
			3.3 ± 0.3	TBD	—	
Minimum Set-up Time	t_s	(Fig.1, 2)	1.8	TBD	—	ns
			2.5 ± 0.2	TBD	—	
			3.3 ± 0.3	TBD	—	
Minimum Hold Time	t_h	(Fig.1, 2)	1.8	TBD	—	ns
			2.5 ± 0.2	TBD	—	
			3.3 ± 0.3	TBD	—	
Minimum Removal Time	t_{rem}	(Fig.1, 3)	1.8	TBD	—	ns
			2.5 ± 0.2	TBD	—	
			3.3 ± 0.3	TBD	—	
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 $C_L = 50$ pF, add approximately 300 ps to the AC maximum specification.

(Note 11) : Parameter guaranteed by design.

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

Dynamic switching characteristics (Ta = 25°C, Input tr = tf = 2.0 ns, CL = 30 pF)

PARAMETER	SYMBOL	TEST CONDITION	VCC (V)	TYP.	UNIT
Quiet Output Maximum Dynamic VOL	VOLP	V _{IH} = 1.8 V, V _{IL} = 0 V (Note 12)	1.8	0.25	V
		V _{IH} = 2.5 V, V _{IL} = 0 V (Note 12)	2.5	0.6	
		V _{IH} = 3.3 V, V _{IL} = 0 V (Note 12)	3.3	0.8	
Quiet Output Minimum Dynamic VOL	VOLV	V _{IH} = 1.8 V, V _{IL} = 0 V (Note 12)	1.8	-0.25	V
		V _{IH} = 2.5 V, V _{IL} = 0 V (Note 12)	2.5	-0.6	
		V _{IH} = 3.3 V, V _{IL} = 0 V (Note 12)	3.3	-0.8	
Quiet Output Minimum Dynamic VOH	VOHV	V _{IH} = 1.8 V, V _{IL} = 0 V (Note 12)	1.8	1.5	V
		V _{IH} = 2.5 V, V _{IL} = 0 V (Note 12)	2.5	1.9	
		V _{IH} = 3.3 V, V _{IL} = 0 V (Note 12)	3.3	2.2	

(Note 12) : Parameter guaranteed by design.

Capacitive characteristics (Ta = 25°C)

PARAMETER	SYMBOL	TEST CONDITION	VCC (V)	TYP.	UNIT
Input Capacitance	C _{IN}		1.8, 2.5, 3.3	6	pF
Power Dissipation Capacitance	C _{PD}	f _{IN} = 10 MHz (Note 13)	1.8, 2.5, 3.3	20	pF

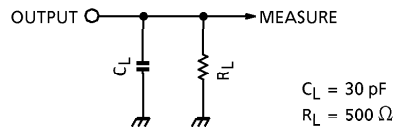
(Note 13) : C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

$$I_{CC(opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 2 \text{ (per F/F)}$$

TEST CIRCUIT

Fig.1



AC WAVEFORM

Fig.2 t_{pLH} , t_{pHL} , t_w , t_s , t_h

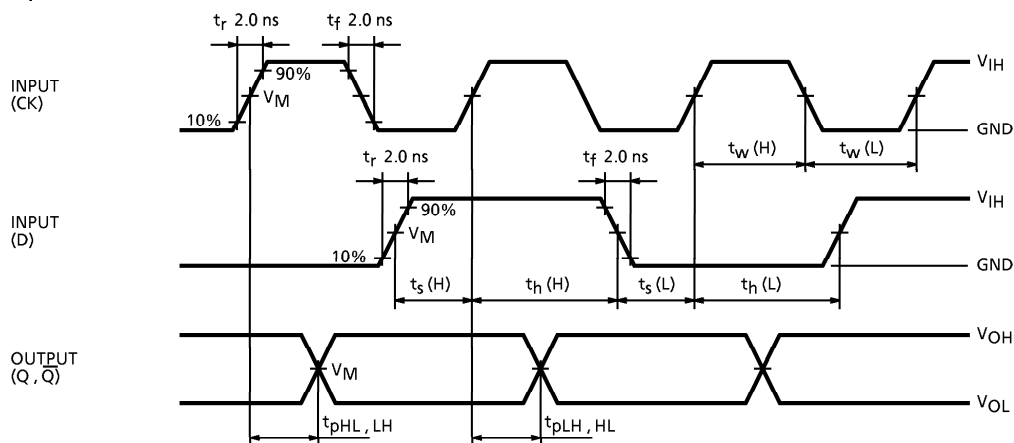


Fig.3 t_{rem}

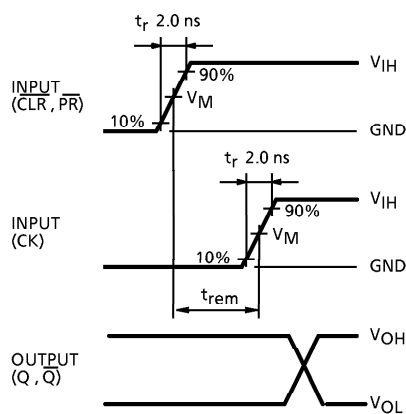
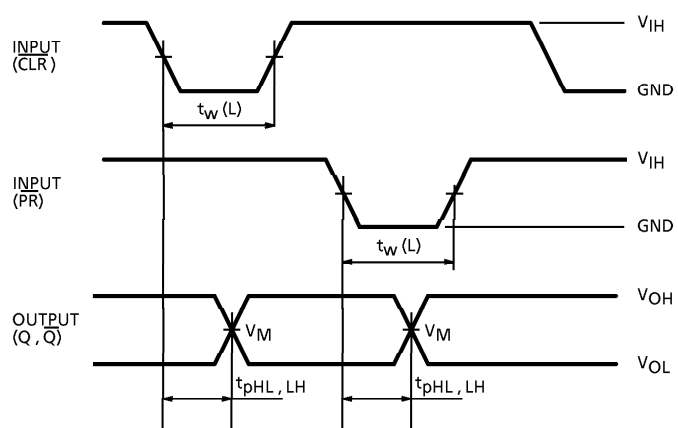


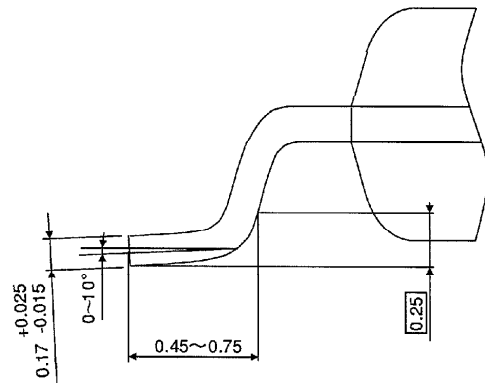
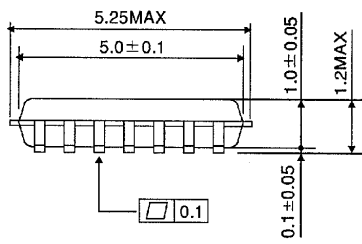
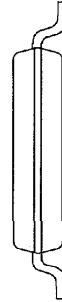
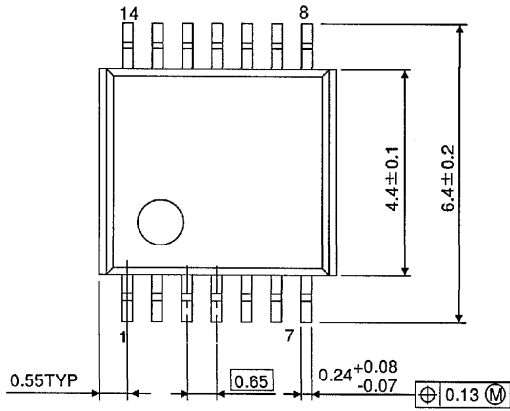
Fig.4 t_{pLH} , t_{pHL}



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	$V_{CC} / 2$	$V_{CC} / 2$

OUTLINE DRAWING
TSSOP14-P-0044-0.65

Unit : mm



Weight : 0.06 g (Typ.)