

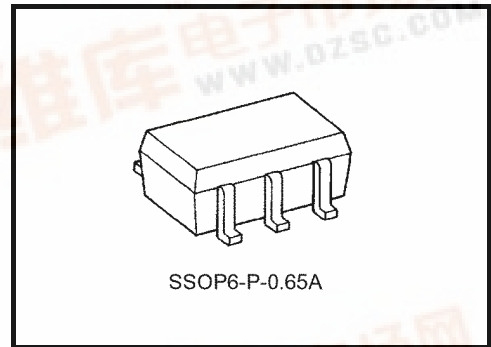
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7PA175FU

D-Type Flip-Flop with Clear

Features

- Operating voltage range: $V_{CC} = 1.8\sim 3.6\text{ V}$
- High-speed operation: $t_{pd} = 3.5\text{ ns (max) at } V_{CC} = 3.0\sim 3.6\text{ V}$
 $t_{pd} = 4.6\text{ ns (max) at } V_{CC} = 2.3\sim 2.7\text{ V}$
 $t_{pd} = 9.2\text{ ns (max) at } V_{CC} = 1.8\text{ V}$
- High-level output current:
 $I_{OH}/I_{OL} = \pm 24\text{ mA (min) at } V_{CC} = 3.0\text{ V}$
 $I_{OH}/I_{OL} = \pm 18\text{ mA (min) at } V_{CC} = 2.3\text{ V}$
 $I_{OH}/I_{OL} = \pm 6\text{ mA (min) at } V_{CC} = 1.8\text{ V}$
- 3.6-V tolerant inputs
- 3.6-V power down protection output



Weight: 0.0068 g (typ.)

Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Value	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	200	mW
DC V_{CC} /ground current	I_{CC}	± 100	mA
Storage temperature	T_{stg}	-65~150	°C

Note: 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.

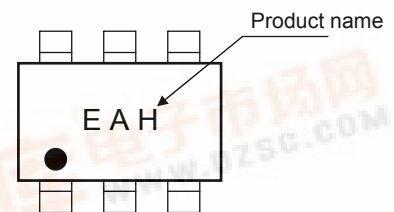
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

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

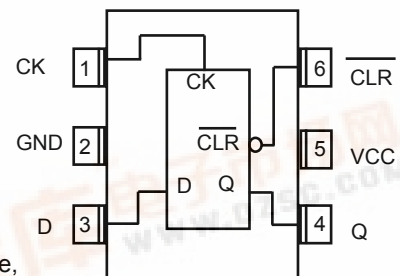
Note 2: High or Low state. The I_{OUT} absolute maximum rating must be adhered to.

Note 3: $V_{OUT} < GND$

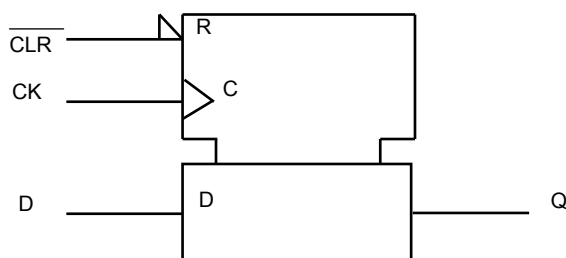
Marking



Pin Assignment (top view)



IEC Logic Symbol



Truth Table

INPUTS			OUTPUT	FUNCTION
CLR	D	CK	Q	
L	X	X	L	CLEAR
H	L		L	—
H	H		H	—
H	X		Qn	NO CHANGE

X: Don't care

Operating Ranges

Characteristics	Symbol	Value	Unit
Power 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	d_t/d_v	0~10 (Note 10)	ns/V

Note 4: Data retention only

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

Note 6: High or Low state

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

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

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

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

DC Electrical Characteristics (Ta = -40~85°C, 2.7 V < VCC ≤ 3.6 V)

Characteristics	Symbol	Test Condition		Min	Max	Unit	
			VCC (V)				
High-Level Input Voltage	V _{IH}	—		2.7~3.6	2.0	V	
Low-Level Input Voltage	V _{IL}	—		2.7~3.6	—		
High-Level Output Voltage	V _{OH}	V _{IN} = V _{IH}	I _{OH} = -100 μA	2.7~3.6	V _{CC} - 0.2	V	
			I _{OH} = -12 mA	2.7	2.2		
			I _{OH} = -18 mA	3.0	2.4		
			I _{OH} = -24 mA	3.0	2.2		
Low-Level Output Voltage	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	2.7~3.6	—	V	
			I _{OL} = 12 mA	2.7	—		
			I _{OL} = 18 mA	3.0	—		
			I _{OL} = 24 mA	3.0	—		
Input Leakage Current	I _{IN}	V _{IN} = 0~3.6 V		2.7~3.6	—	±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		2.7~3.6	—	20.0	μA
		V _{CC} ≤ (V _{IN} , V _{OUT}) ≤ 3.6 V		2.7~3.6	—	±20.0	
Increase in I _{CC} per Input	ΔI _{CC}	V _{IH} = V _{CC} - 0.6 V		2.7~3.6	—	750	

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

Characteristics	Symbol	Test Condition		Min	Max	Unit	
			VCC (V)				
High-Level Input Voltage	V _{IH}	—		2.3~2.7	1.6	V	
Low-Level Input Voltage	V _{IL}	—		2.3~2.7	—		
High-Level Output Voltage	V _{OH}	V _{IN} = V _{IH}	I _{OH} = -100 μA	2.3~2.7	V _{CC} - 0.2	V	
			I _{OH} = -6 mA	2.3	2.0		
			I _{OH} = -12 mA	2.3	1.8		
			I _{OH} = -18 mA	2.3	1.7		
Low-Level Output Voltage	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	2.3~2.7	—	V	
			I _{OL} = 12 mA	2.3	—		
			I _{OL} = 18 mA	2.3	—		
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} , V _{OUT}) ≤ 3.6 V		2.3~2.7	—	±20.0	

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

Characteristics	Symbol	Test Condition		VCC (V)	Min	Max	Unit
High-Level Input Voltage	V _{IH}	—		1.8~2.3	0.7 × V _{CC}	—	V
Low-Level Input Voltage	V _{IL}	—		1.8~2.3	—	0.2 × V _{CC}	
High-Level Output Voltage	V _{OH}	V _{IN} = V _{IH}	I _{OH} = -100 μA	1.8	V _{CC} - 0.2	—	V
			I _{OH} = -6 mA	1.8	1.4	—	
Low-Level Output Voltage	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} , V _{OUT}) ≤ 3.6 V		1.8	—	±20.0	

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

Characteristics	Symbol	Test Condition		VCC (V)	Min	Max	Unit
Maximum Clock Frequency	f _{max}			1.8	100	—	MHz
				2.5 ± 0.2	200	—	
				3.3 ± 0.3	250	—	
Propagation Delay Time (CK-Q)	t _{pLH} t _{pHL}	(Figure 1 and 2)		1.8	1.0	9.2	ns
				2.5 ± 0.2	0.8	4.6	
				3.3 ± 0.3	0.6	3.5	
Propagation Delay Time (CLR-Q)	t _{pHL}	(Figure 1 and 3)		1.8	1.0	9.2	ns
				2.5 ± 0.2	0.8	4.6	
				3.3 ± 0.3	0.6	3.5	
Minimum Set-up Time	t _s	(Figure 1 and 2)		1.8	3.0	—	ns
				2.5 ± 0.2	1.5	—	
				3.3 ± 0.3	1.5	—	
Minimum Hold time	t _h	(Figure 1 and 2)		1.8	3.0	—	ns
				2.5 ± 0.2	1.7	—	
				3.3 ± 0.3	1.7	—	
Minimum Pulse Width (CK)	t _{w(H)} t _{w(L)}	(Figure 1 and 2)		1.8	4.0	—	ns
				2.5 ± 0.2	2.3	—	
				3.3 ± 0.3	2.3	—	
Minimum Pulse Width (CLR)	t _{w(L)}	(Figure 1 and 3)		1.8	4.0	—	ns
				2.5 ± 0.2	2.3	—	
				3.3 ± 0.3	2.3	—	
Minimum Removal Time	t _{rem}	(Figure 1 and 3)		1.8	3.1	—	ns
				2.5 ± 0.2	2.0	—	
				3.3 ± 0.3	1.5	—	

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

Capacitive Characteristics (Ta = 25°C)

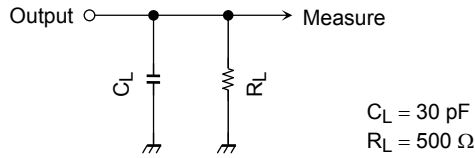
Characteristics	Symbol	Test Condition	V _{CC} (V)	TYP.	Unit
Input Capacitance	C _{IN}	—	1.8, 2.5, 3.3	2.4	pF
Power Dissipation Capacitance	C _{PD}	f _{IN} = 10 MHz (Note 11)	1.8, 2.5, 3.3	11	pF

Note11: 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:

$$I_{CC (opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

Figure 1 Test Circuit



AC Waveforms

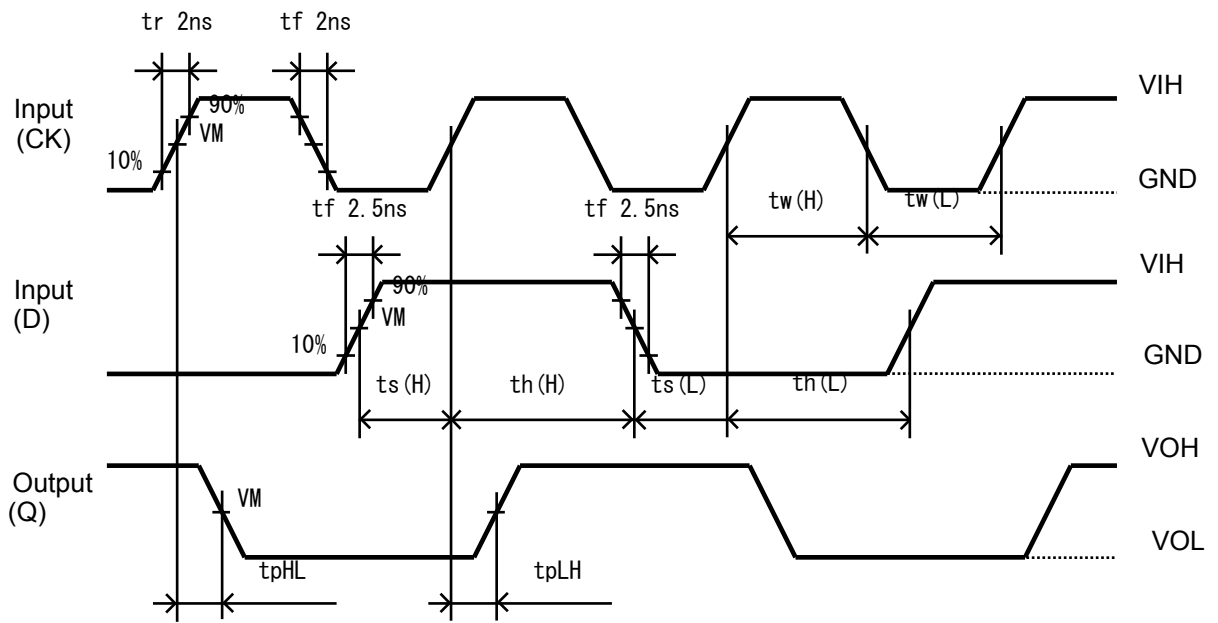


Figure 2 t_{pLH} , t_{pHL}

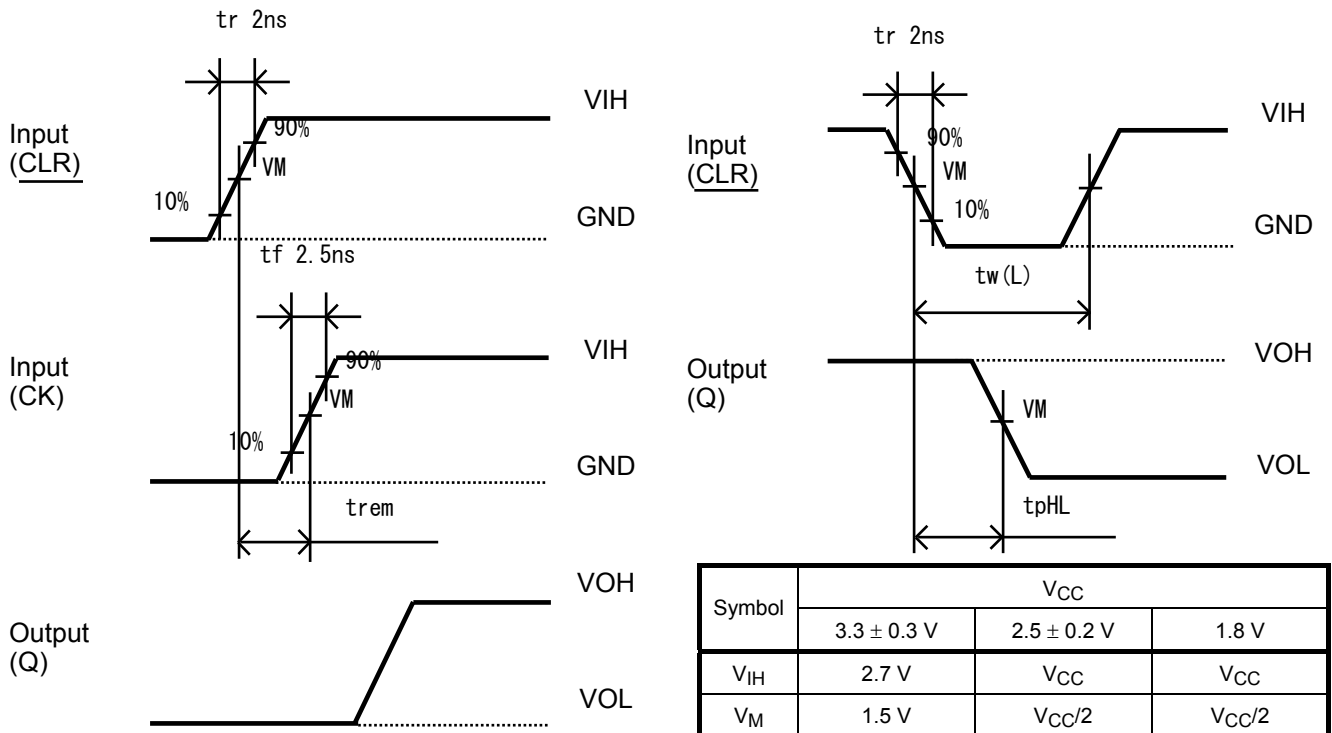
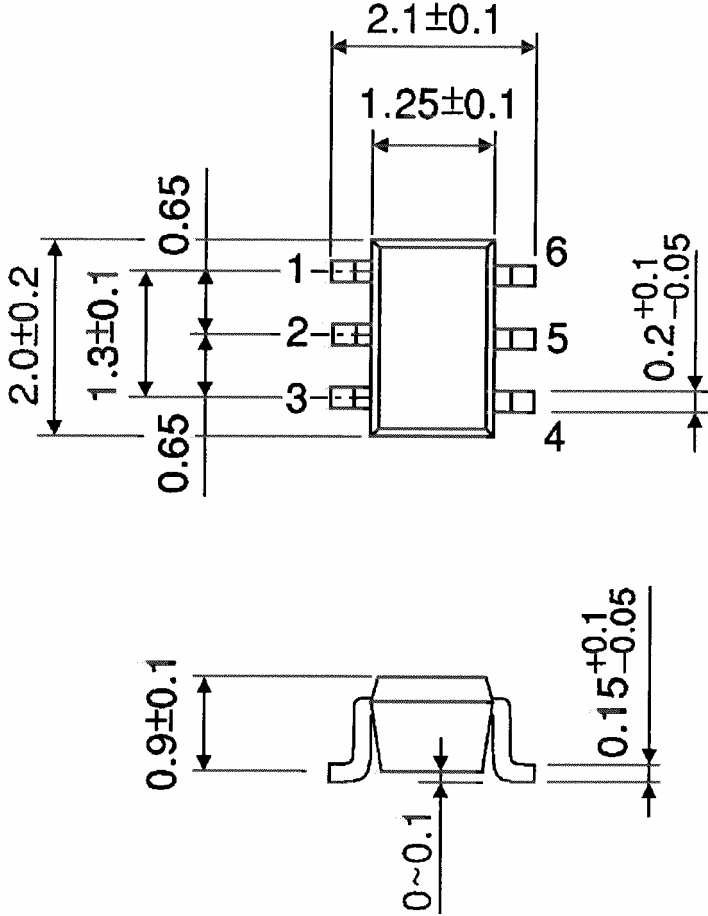


Figure 3 t_{rem} , t_{pHL} , $t_w(L)$

Package Dimensions

SSOP6-P-0.65A

Unit: mm



Weight: 0.0068 g (typ.)

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20070701-EN GENERAL

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