

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC4027BP, TC4027BF

TC4027B Dual J-K Master-Slave Flip Flop

TC4027B is J-K master-slave flip-flop having RESET and SET functions.

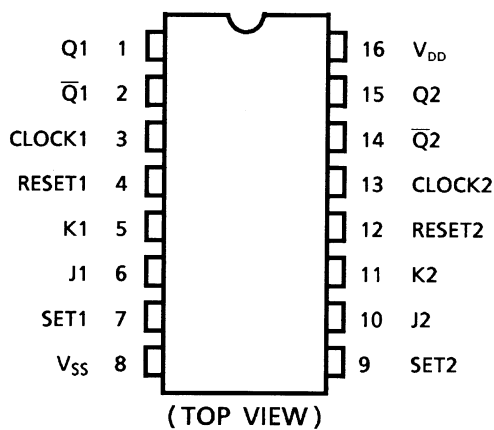
In the case of J-K made, when the clock input is given with both RESET and SET at "L", the output changes at rising edge of the clock according to the states of J and K.

When SET input is placed at "H", and RESET input is placed at "L", outputs become $Q = "H"$, and $\bar{Q} = "L"$.

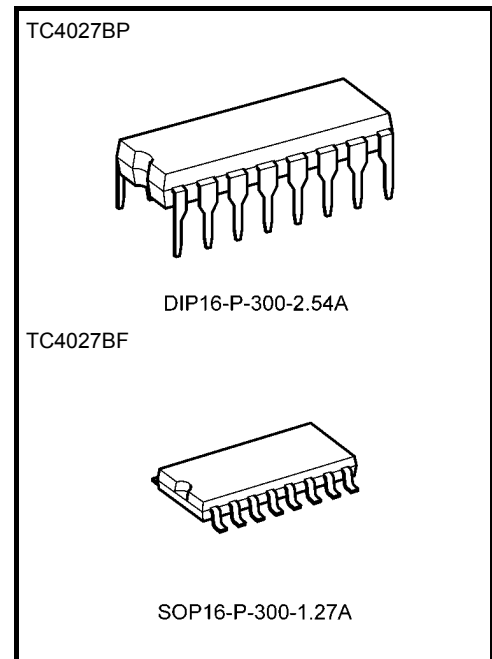
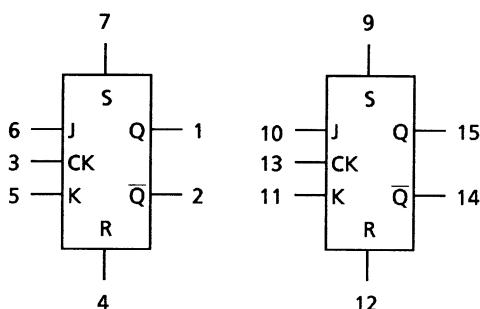
When RESET input is placed at "H", and SET input is placed at "L", outputs become $Q = "L"$, and $\bar{Q} = "H"$.

When both of RESET input and SET input are at "H", outputs become $Q = "H"$ and $\bar{Q} = "H"$.

Pin Assignment



Block Diagram



Weight

DIP16-P-300-2.54A : 1.00 g (typ.)

SOP16-P-300-1.27A : 0.18 g (typ.)

Truth Table

Inputs					Outputs	
RESET	SET	J	K	CLOCK Δ	Q_{n+1}	$\bar{Q}_{n+1}$
L	H	*	*	*	H	L
H	L	*	*	*	L	H
H	H	*	*	*	H	H
L	L	L	L	$\uparrow$	Q_n^*	Q_n^*
L	L	L	H	$\uparrow$	L	H
L	L	H	L	$\uparrow$	H	L
L	L	H	H	$\uparrow$	$\bar{Q}_n^{**}$	Q_n^{**}
L	L	*	*	$\downarrow$	Q_n^*	$\bar{Q}_n^*$

*: Don't care

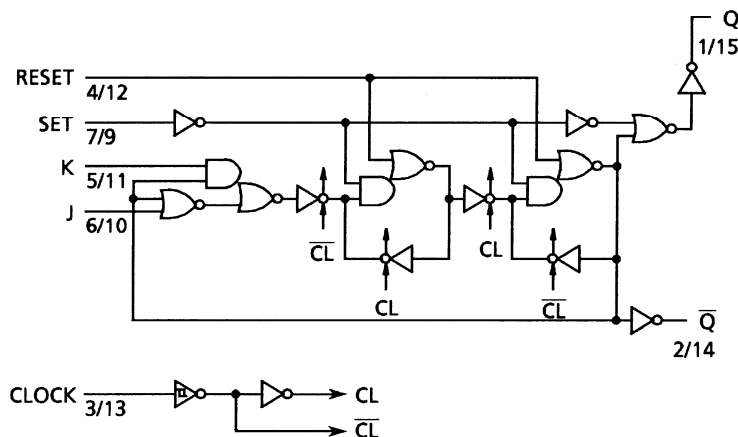
Δ : Level change

*: No change

** : Change

Logic Diagram

1/2 TC4027B



Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
DC supply voltage	V_{DD}	$V_{SS} - 0.5$ to $V_{SS} + 20$	V
Input voltage	V_{IN}	$V_{SS} - 0.5$ to $V_{DD} + 0.5$	V
Output voltage	V_{OUT}	$V_{SS} - 0.5$ to $V_{DD} + 0.5$	V
DC input current	I_{IN}	± 10	mA
Power dissipation	P_D	300 (DIP)/180 (SOIC)	mW
Operating temperature range	T_{opr}	-40 to 85	$^{\circ}\text{C}$
Storage temperature range	T_{stg}	-65 to 150	$^{\circ}\text{C}$

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

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).

Operating Ranges ($V_{SS} = 0$ V) (Note)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
DC supply voltage	V_{DD}	—	3	—	18	V
Input voltage	V_{IN}	—	0	—	V_{DD}	V

Note: The operating ranges must be maintained to ensure the normal operation of the device.

Unused inputs must be tied to either V_{DD} or V_{SS} .

Static Electrical Characteristics ($V_{SS} = 0$ V)

Characteristics	Sym- bol	Test Condition	V_{DD} (V)	-40°C		25°C			85°C		Unit
				Min	Max	Min	Typ.	Max	Min	Max	
High-level output voltage	V_{OH}	$ I_{OUT} < 1 \mu A$ $V_{IN} = V_{SS}, V_{DD}$	5	4.95	—	4.95	5.00	—	4.95	—	V
			10	9.95	—	9.95	10.00	—	9.95	—	
			15	14.95	—	14.95	15.00	—	14.95	—	
Low-level output voltage	V_{OL}	$ I_{OUT} < 1 \mu A$ $V_{IN} = V_{SS}, V_{DD}$	5	—	0.05	—	0.00	0.05	—	0.05	V
			10	—	0.05	—	0.00	0.05	—	0.05	
			15	—	0.05	—	0.00	0.05	—	0.05	
Output high current	I_{OH}	$V_{OH} = 4.6$ V	5	-0.61	—	-0.51	-1.0	—	-0.42	—	mA
		$V_{OH} = 2.5$ V	5	-2.50	—	-2.10	-4.0	—	-1.70	—	
		$V_{OH} = 9.5$ V	10	-1.50	—	-1.30	-2.2	—	-1.10	—	
		$V_{OH} = 13.5$ V	15	-4.00	—	-3.40	-9.0	—	-2.80	—	
		$V_{IN} = V_{SS}, V_{DD}$									
Output low current	I_{OL}	$V_{OL} = 0.4$ V	5	0.61	—	0.51	1.2	—	0.42	—	mA
		$V_{OL} = 0.5$ V	10	1.50	—	1.30	3.2	—	1.10	—	
		$V_{OL} = 1.5$ V	15	4.00	—	3.40	12.0	—	2.80	—	
		$V_{IN} = V_{SS}, V_{DD}$									
Input high voltage	V_{IH}	$V_{OUT} = 0.5$ V, 4.5 V	5	3.5	—	3.5	2.75	—	3.5	—	V
		$V_{OUT} = 1.0$ V, 9.0 V	10	7.0	—	7.0	5.50	—	7.0	—	
		$V_{OUT} = 1.5$ V, 13.5 V	15	11.0	—	11.0	8.25	—	11.0	—	
		$ I_{OUT} < 1 \mu A$									
Input low voltage	V_{IL}	$V_{OUT} = 0.5$ V, 4.5 V	5	—	1.5	—	2.25	1.5	—	1.5	V
		$V_{OUT} = 1.0$ V, 9.0 V	10	—	3.0	—	4.50	3.0	—	3.0	
		$V_{OUT} = 1.5$ V, 13.5 V	15	—	4.0	—	6.75	4.0	—	4.0	
		$ I_{OUT} < 1 \mu A$									
Input current	"H" level	I_{IH}	$V_{IH} = 18$ V	18	—	0.1	—	10^{-5}	0.1	—	μA
	"L" level	I_{IL}	$V_{IL} = 0$ V	18	—	-0.1	—	-10^{-5}	-0.1	—	
Quiescent supply current	I_{DD}	$V_{IN} = V_{SS}, V_{DD}$ (Note)	5	—	1	—	0.002	1	—	30	μA
			10	—	2	—	0.004	2	—	60	
			15	—	4	—	0.008	4	—	120	

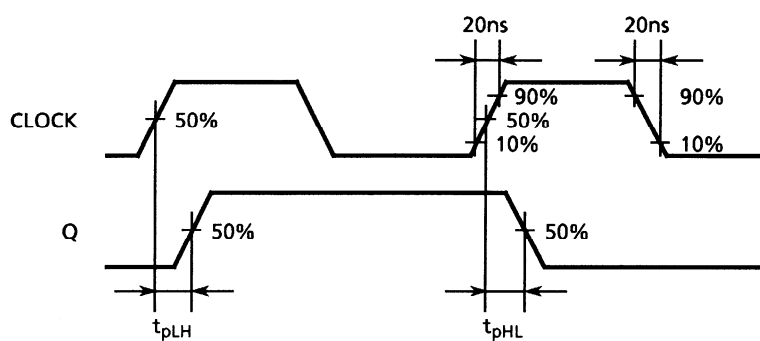
Note: All valid input combinations.

Dynamic Electrical Characteristics (Ta = 25°C, V_{SS} = 0 V, C_L = 50 pF)

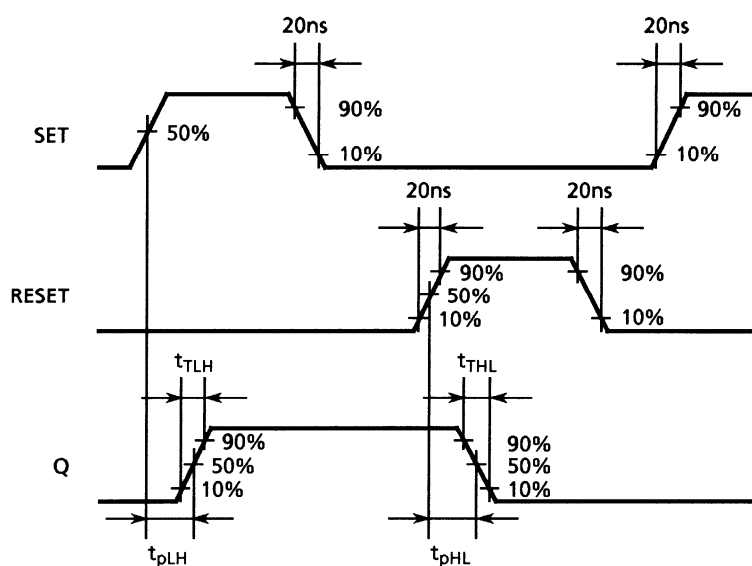
Characteristics	Symbol	Test Condition	V _{DD} (V)	Min	Typ.	Max	Unit
Output transition time (low to high)	t _{TLH}	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Output transition time (high to low)	t _{THL}	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Propagation delay time (CLOCK-Q, $\bar{Q}$)	t _{pLH} t _{pHL}	—	5	—	150	300	ns
			10	—	75	130	
			15	—	60	90	
Propagation delay time (SET, RESET-Q, $\bar{Q}$)	t _{pLH} t _{pHL}	—	5	—	120	300	ns
			10	—	60	130	
			15	—	45	90	
Max clock frequency	f _{CL}	—	5	3.5	8	—	MHz
			10	8.0	16	—	
			15	12.0	20	—	
Max clock input rise time Max clock input fall time	t _{rCL} t _{rCL}	—	5	No limit			μs
			10				
			15				
Min pulse width (SET, RESET)	t _w	—	5	—	60	180	ns
			10	—	35	80	
			15	—	25	50	
Min clock pulse width	t _w	—	5	—	60	140	ns
			10	—	35	60	
			15	—	25	40	
Min set-up time (J, K-CLOCK)	t _{su}	—	5	—	30	140	ns
			10	—	10	50	
			15	—	5	35	
Min hold time (J, K-CLOCK)	t _H	—	5	—	—	140	ns
			10	—	—	50	
			15	—	—	35	
Min removal time (SET, RESET-CLOCK)	t _{rem}	—	5	—	—	40	ns
			10	—	—	20	
			15	—	—	15	
Input capacitance	C _{IN}	—		—	5	7.5	pF

Waveforms for Measurement of Dynamic Characteristics

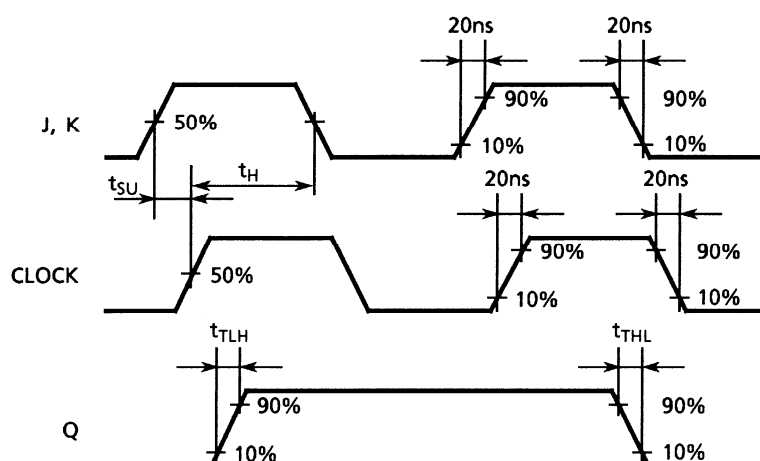
Waveform 1



Waveform 2



Waveform 3



Package Dimensions

DIP16-P-300-2.54A

Unit : mm



Weight: 1.00 g (typ.)

Package Dimensions

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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