TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC4027BP, TC4027BF, TC4027BFN

TC4027B DUAL J – K MASTER – SLAVE FLIP FLOP

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

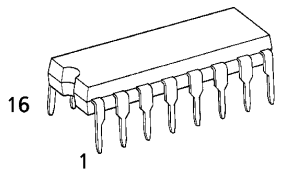
In the case of J-K made, when the clock input is given with both RESET and SET at "L", the output changes at rising edge of the clock according to the states of J and K.

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

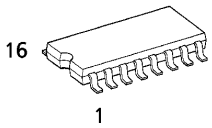
When RESET input is placed at "H", and SET input is placed at "L", outputs become Q="L", and $\overline{Q}$="H".

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

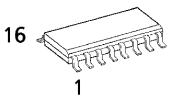
(Note) The JEDEC SOP (FN) is not available in Japan.



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



F (SOP16-P-300-1.27)
Weight : 0.18g (Typ.)

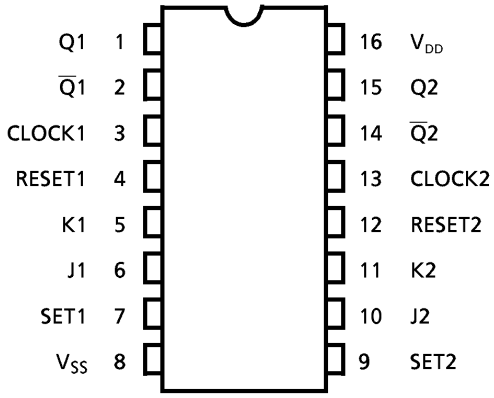


FN (SOL16-P-150-1.27)
Weight : 0.13g (Typ.)

MAXIMUM RATINGS

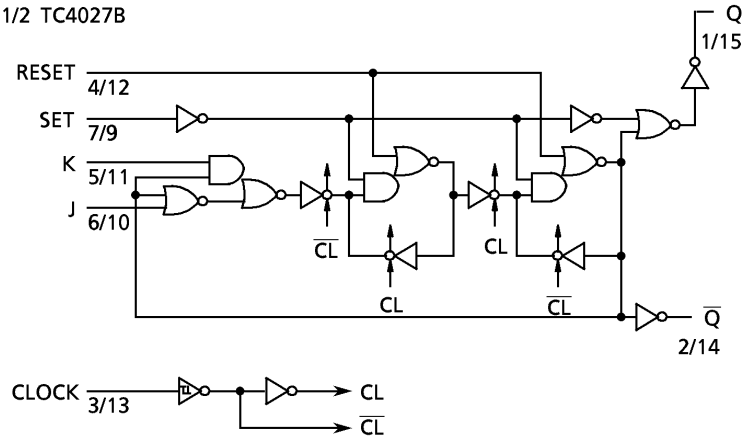
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Supply Voltage	V_{DD}	$V_{SS}-0.5 \sim V_{SS}+20$	V
Input Voltage	V_{IN}	$V_{SS}-0.5 \sim V_{DD}+0.5$	V
Output Voltage	V_{OUT}	$V_{SS}-0.5 \sim V_{DD}+0.5$	V
DC Input Current	I_{IN}	± 10	mA
Power Dissipation	P_D	300 (DIP) / 180 (SOIC)	mW
Operating Temperature Range	T_{opr}	– 40~85	°C
Storage Temperature Range	T_{stg}	– 65~150	°C

PIN ASSIGNMENT

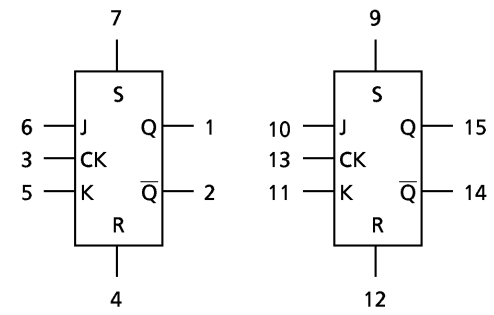


(TOP VIEW)

LOGIC DIAGRAM



BLOCK DIAGRAM



TRUTH TABLE

INPUTS					OUTPUTS	
RESET	SET	J	K	CLOCK △	Q_{n+1}	$\overline{Q}_{n+1}$
L	H	*	*	*	H	L
H	L	*	*	*	L	H
H	H	*	*	*	H	H
L	L	L	L	↑	Q_{n*}	Q_{n*}
L	L	L	H	↑	L	H
L	L	H	L	↑	H	L
L	L	H	H	↑	$\overline{Q}_{n**}$	Q_{n**}
L	L	*	*	↓	Q_{n*}	$\overline{Q}_{n*}$

* : Don't Care
△ : Level Change
* : No Change
** : Change

RECOMMENDED OPERATING CONDITIONS (V_{SS} = 0V)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
DC Supply Voltage	V_{DD}		3	—	18	V
Input Voltage	V_{IN}		0	—	V_{DD}	V

STATIC ELECTRICAL CHARACTERISTICS (V_{SS} = 0V)

CHARACTERISTIC	SYMBOL	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 10 15	4.95 9.95 14.95	— — —	4.95 9.95 14.95	5.00 10.00 15.00	— — —	4.95 9.95 14.95	— — —	V
Low-Level Output Voltage	V_{OL}	$\|I_{OUT}\| < 1\mu A$ $V_{IN} = V_{SS}, V_{DD}$	5 10 15	— — —	0.05 0.05 0.05	— — —	0.00 0.00 0.00	0.05 0.05 0.05	— — —	0.05 0.05 0.05	V
Output High Current	I_{OH}	V_{OH} = 4.6V V_{OH} = 2.5V V_{OH} = 9.5V V_{OH} = 13.5V $V_{IN} = V_{SS}, V_{DD}$	5 5 10 15	−0.61 −2.50 −1.50 −4.00	— — — —	−0.51 −2.10 −1.30 −3.40	−1.0 −4.0 −2.2 −9.0	— — — —	−0.42 −1.70 −1.10 −2.80	— — — —	mA
Output Low Current	I_{OL}	V_{OL} = 0.4V V_{OL} = 0.5V V_{OL} = 1.5V $V_{IN} = V_{SS}, V_{DD}$	5 10 15	0.61 1.50 4.00	— — —	0.51 1.30 3.40	1.2 3.2 12.0	— — —	0.42 1.10 2.80	— — —	
Input High Voltage	V_{IH}	V_{OUT} = 0.5V, 4.5V V_{OUT} = 1.0V, 9.0V V_{OUT} = 1.5V, 13.5V $\|I_{OUT}\| < 1\mu A$	5 10 15	3.5 7.0 11.0	— — —	3.5 7.0 11.0	2.75 5.50 8.25	— — —	3.5 7.0 11.0	— — —	V
Input Low Voltage	V_{IL}	V_{OUT} = 0.5V, 4.5V V_{OUT} = 1.0V, 9.0V V_{OUT} = 1.5V, 13.5V $\|I_{OUT}\| < 1\mu A$	5 10 15	— — —	1.5 3.0 4.0	— — —	2.25 4.50 6.75	1.5 3.0 4.0	— — —	1.5 3.0 4.0	
Input Current "H" Level	I_{IH}	V_{IH} = 18V	18	—	0.1	—	10^{-5}	0.1	—	1.0	μA
Input Current "L" Level	I_{IL}	V_{IL} = 0V	18	—	−0.1	—	-10^{-5}	−0.1	—	−1.0	
Quiescent Supply Current	I_{DD}	$V_{IN} = V_{SS}, V_{DD}$*	5 10 15	— — —	1 2 4	— — —	0.002 0.004 0.008	1 2 4	— — —	30 60 120	

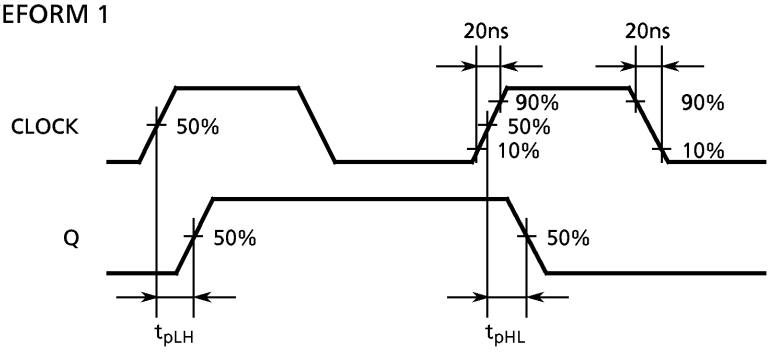
* All valid input combinations.

DYNAMIC ELECTRICAL CHARACTERISTICS (Ta = 25°C, Vss = 0V, C_L = 50pF)

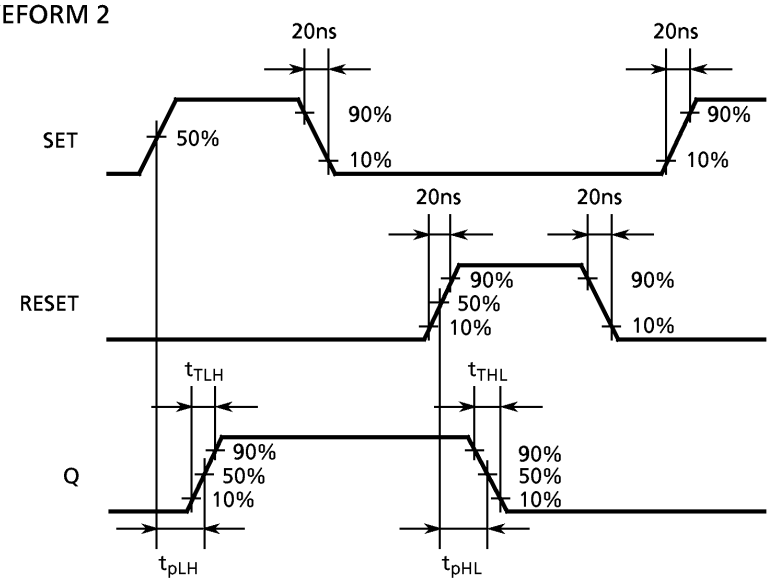
CHARACTERISTIC	SYMBOL	TEST CONDITION	V_{DD}(V)	MIN.	TYP.	MAX.	UNIT
Output Transition Time (Low to High)	t_{TLH}		5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Output Transition Time (High to Low)	t_{THL}		5	—	70	200	
			10	—	35	100	
			15	—	30	80	
Propagation Delay Time (CLOCK - Q, $\overline{Q}$)	t_{pLH} t_{pHL}		5	—	150	300	
			10	—	75	130	
			15	—	60	90	
Propagation Delay Time (SET, RESET - Q, $\overline{Q}$)	t_{pLH} t_{pHL}		5	—	120	300	
			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_{fCL}		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	
			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	
			10	—	—	50	
			15	—	—	35	
Min. Removal Time (SET, RESET - CLOCK)	t_{rem}		5	—	—	40	
			10	—	—	20	
			15	—	—	15	
Input Capacitance	C_{IN}			—	5	7.5	pF

WAVEFORMS FOR MEASUREMENT OF DYNAMIC CHARACTERISTICS

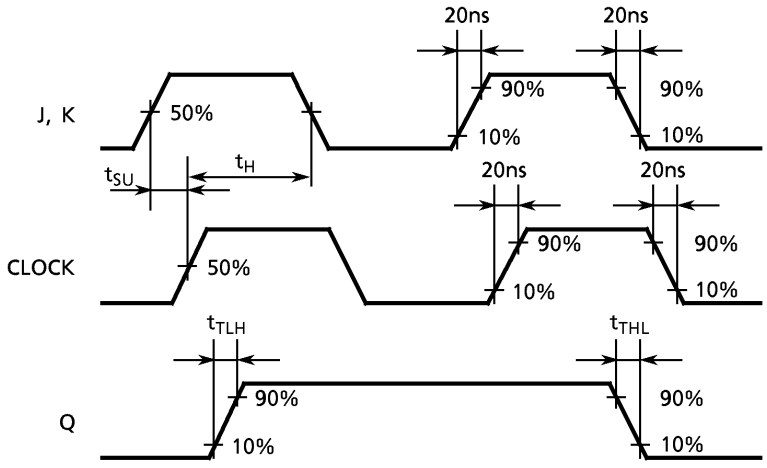
WAVEFORM 1



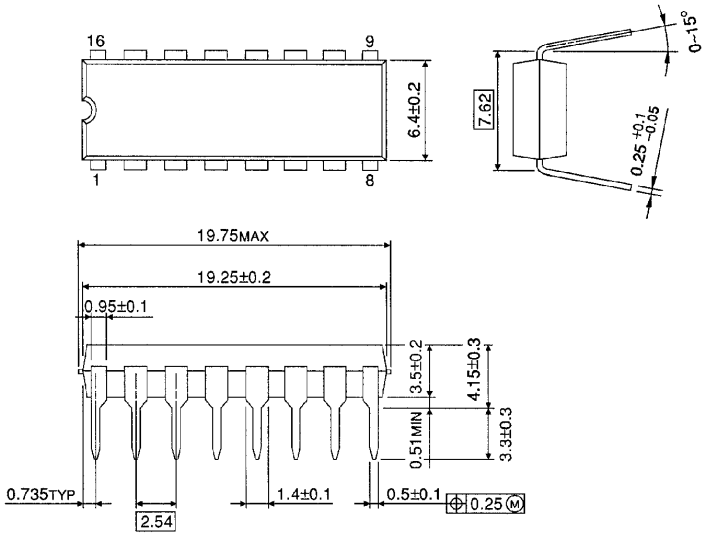
WAVEFORM 2



WAVEFORM 3

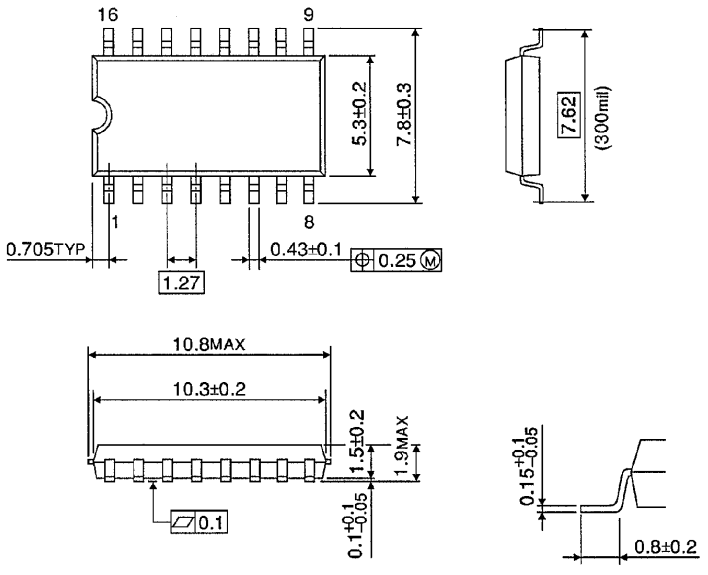


DIP 16PIN PACKAGE DIMENSIONS (DIP16-P-300-2.54A) Unit in mm



Weight : 1.00g (Typ.)

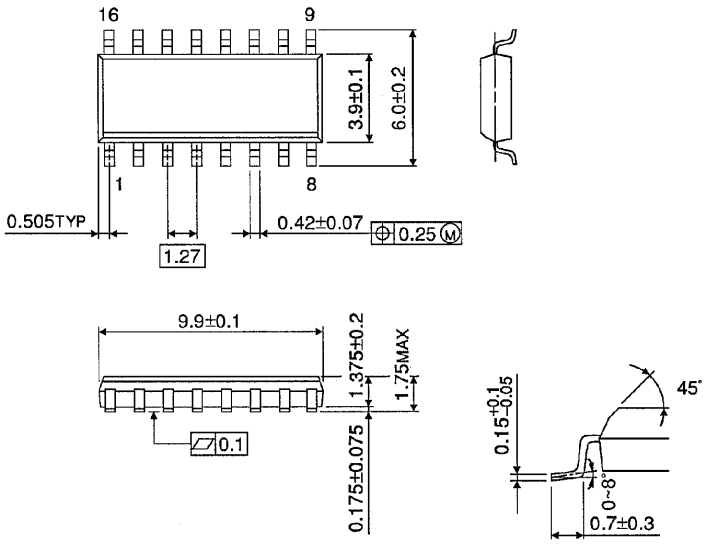
SOP 16PIN (200mil BODY) PACKAGE DIMENSIONS (SOP16-P-300-1.27) Unit in mm



Weight : 0.18g (Typ.)

SOP 16PIN (150mil BODY) PACKAGE DIMENSIONS (SOL16-P-150 -1.27) Unit in mm

(Note) This package is not available in Japan.



Weight : 0.13g (Typ.)

RESTRICTIONS ON PRODUCT USE

000707EBA

- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk.
- The products described in this document are subject to the foreign exchange and foreign trade laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.