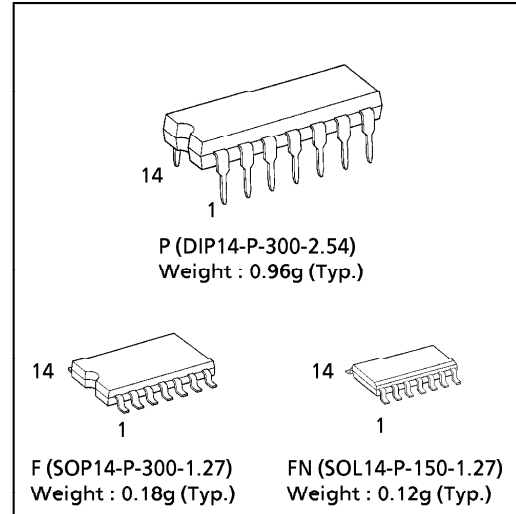


# TC4013BP, TC4013BF, TC4013BFN

## TC4013B DUAL D-TYPE FLIP-FLOP

TC4013B contains two independent circuits of D type flip-flop. The input level applied to DATA input are transferred to Q and  $\bar{Q}$  output by rising edge of the clock pulse. 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".

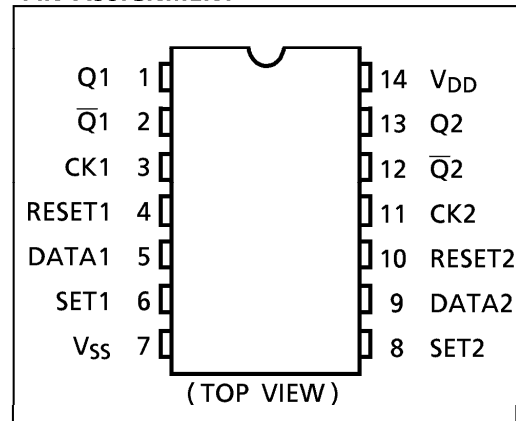
(Note) The JEDEC SOP (FN) is not available in Japan.



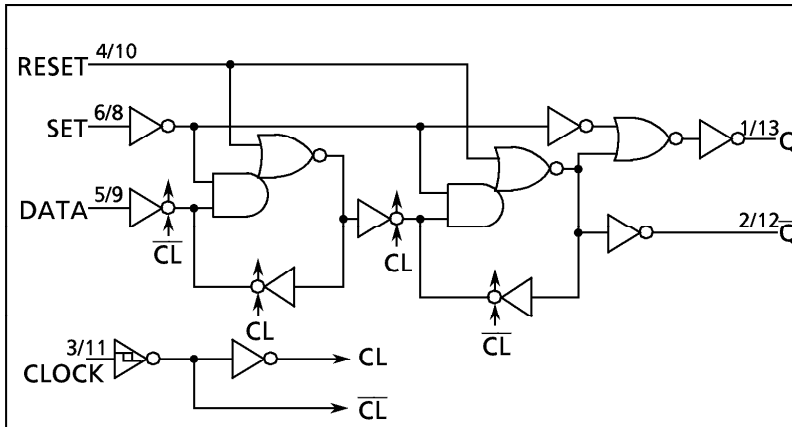
### MAXIMUM RATINGS

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	$I_{IN}$	$\pm 10$	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

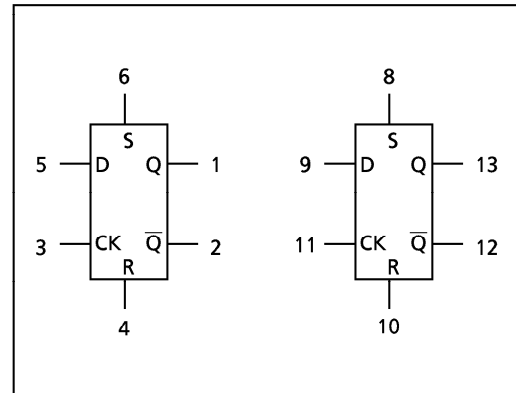
### PIN ASSIGNMENT



### LOGIC DIAGRAM






### BLOCK DIAGRAM



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**TRUTH TABLE**

INPUTS				OUTPUTS	
RESET	SET	DATA	CK $\Delta$	Q <sub>n+1</sub>	$\overline{Q}_{n+1}$
L	H	*	*	H	L
H	L	*	*	L	H
H	H	*	*	H	H
L	L	L		L	H
L	L	H		H	L
L	L	*		Q <sub>n</sub> $\cdot$	$\overline{Q}_n\cdot$

\* : Don't Care  
 $\Delta$  : Level Change  
 $\cdot$  : No Change

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- 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.

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

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

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

CHARACTERISTIC	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	$I_{OH}$	$V_{OH} = 4.6V$ $V_{OH} = 2.5V$ $V_{OH} = 9.5V$ $V_{OH} = 13.5V$ $V_{IN} = V_{SS}, V_{DD}$	5	-0.61	—	-0.51	-1.0	—	-0.42	—	mA	
			5	-2.50	—	-2.10	-4.0	—	-1.70	—		
			10	-1.50	—	-1.30	-2.2	—	-1.10	—		
			15	-4.00	—	-3.40	-9.0	—	-2.80	—		
Output Low Current	$I_{OL}$	$V_{OL} = 0.4V$ $V_{OL} = 0.5V$ $V_{OL} = 1.5V$ $V_{IN} = V_{SS}, V_{DD}$	5	0.61	—	0.51	1.2	—	0.42	—	mA	
			10	1.50	—	1.30	3.2	—	1.10	—		
			15	4.00	—	3.40	12.0	—	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	3.5	—	3.5	2.75	—	3.50	—	V	
			10	7.0	—	7.0	5.50	—	7.00	—		
			15	11.0	—	11.0	8.25	—	11.00	—		
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	—	1.5	—	2.25	1.5	—	1.5	V	
			10	—	3.0	—	4.50	3.0	—	3.0		
			15	—	4.0	—	6.75	4.0	—	4.0		
Input Current	"H" Level	$I_{IH}$	$V_{IH} = 18V$	18	—	0.1	—	$10^{-5}$	0.1	—	1.0	μA
	"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	—	1	—	0.002	1	—	30	μA	
			10	—	2	—	0.004	2	—	60		
			15	—	4	—	0.008	4	—	120		

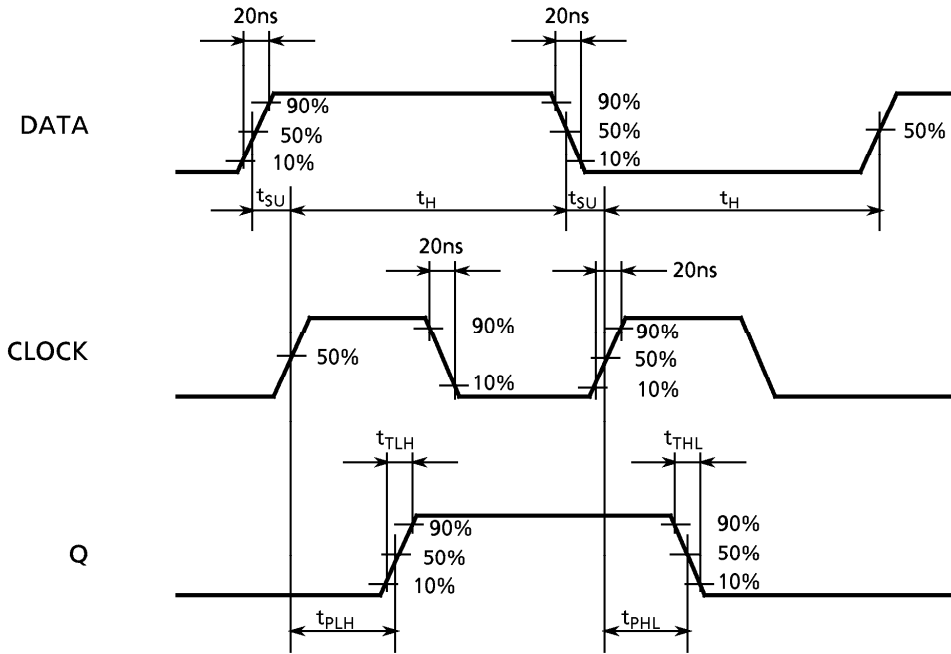
\* All valid input combinations.

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

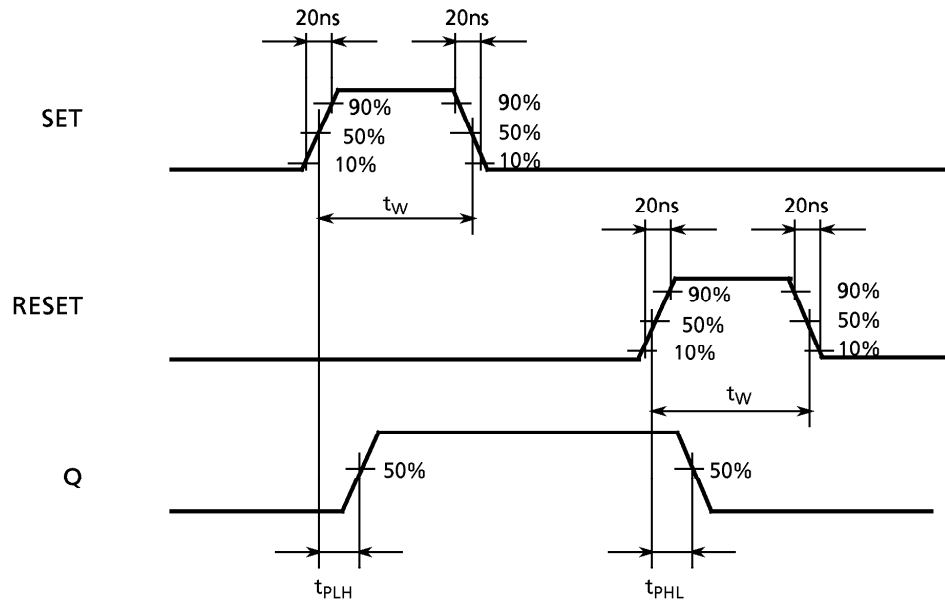
CHARACTERISTIC	SYMBOL	TEST CONDITION	V <sub>DD</sub> (V)	MIN.	TYP.	MAX.	UNIT
Output Transition Time (Low to High)	t <sub>TLH</sub>		5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Output Transition Time (High to Low)	t <sub>THL</sub>		5	—	70	200	
			10	—	35	100	
			15	—	30	80	
Propagation Delay Time (CK - Q, $\bar{Q}$ )	t <sub>pLH</sub> t <sub>pHL</sub>		5	—	130	300	
			10	—	65	130	
			15	—	50	90	
Propagation Delay Time (SET, RESET - Q, $\bar{Q}$ )	t <sub>pLH</sub>		5	—	110	300	
			10	—	50	130	
			15	—	40	90	
Propagation Delay Time (SET, RESET - Q, $\bar{Q}$ )	t <sub>pHL</sub>		5	—	110	300	
			10	—	50	130	
			15	—	40	90	
Max. Clock Frequency	f <sub>CL</sub>		5	3.5	8	—	MHz
			10	8.0	16	—	
			15	12.0	20	—	
Max. Clock Input Rise Time Max. Clock Input Fall Time	t <sub>rCL</sub> t <sub>fCL</sub>		5	No Limit			μs
			10				
			15				
Min. Pulse Width (SET, RESET)	t <sub>w</sub>		5	—	60	180	ns
			10	—	30	80	
			15	—	25	50	
Min. Clock Pulse Width	t <sub>w</sub>		5	—	60	140	
			10	—	30	60	
			15	—	25	40	
Min. Set-up Time (DATA - CK)	t <sub>su</sub>		5	—	—	40	ns
			10	—	—	20	
			15	—	—	15	
Min. Hold Time (DATA - CK)	t <sub>H</sub>		5	—	20	40	
			10	—	10	20	
			15	—	6	15	
Min. Removal Time (SET, RESET - CK)	t <sub>rem</sub>		5	—	—	40	
			10	—	—	20	
			15	—	—	15	
Input Capacitance	C <sub>IN</sub>			—	5	7.5	pF

WAVEFORM FOR MEASUREMENT OF DYNAMIC CHARACTERISTICS

WAVEFORM 1

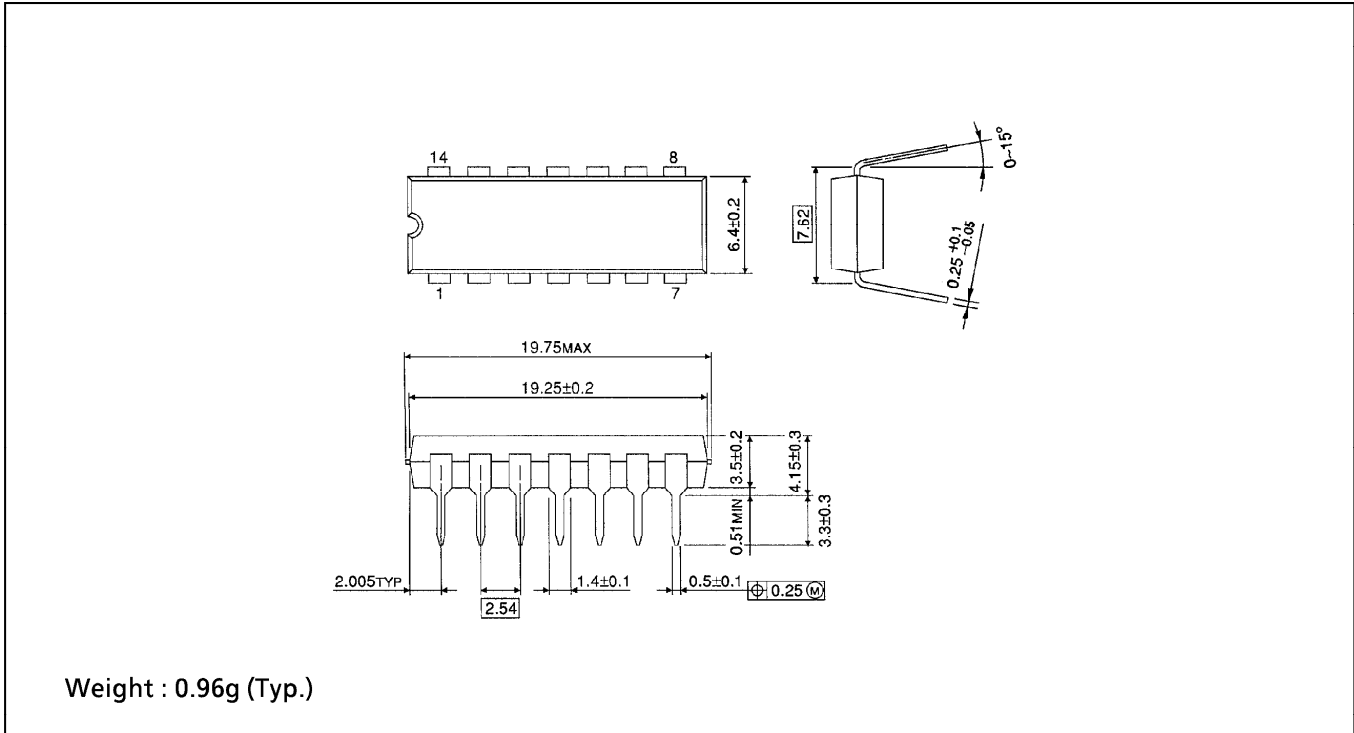


WAVEFORM 2



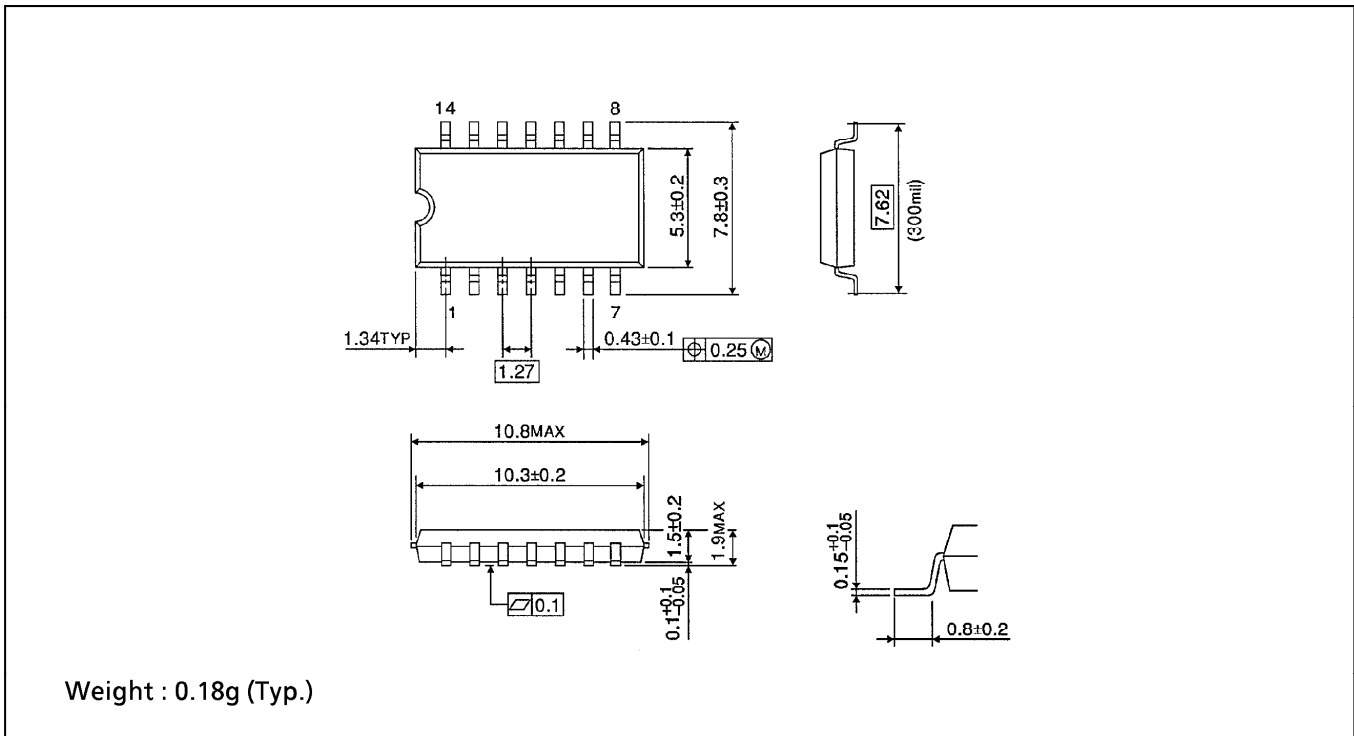
**DIP 14PIN OUTLINE DRAWING (DIP14-P-300-2.54)**

Unit in mm



**SOP 14PIN (200mil BODY) OUTLINE DRAWING (SOP14-P-300-1.27)**

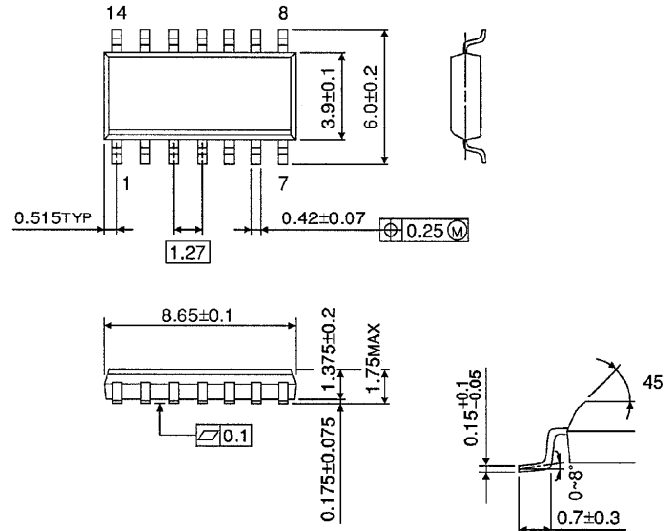
Unit in mm



**SOP 14PIN (150mil BODY) OUTLINE DRAWING (SOL14-P-150-1.27)**

Unit in mm

(Note) This package is not available in Japan.



Weight : 0.12g (Typ.)