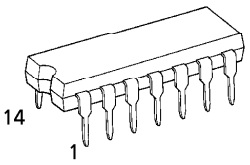
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC4013BP, TC4013BF, TC4013BFN

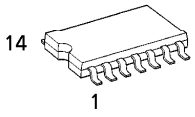
TC4013B DUAL D – TYPE FLIP – FLOP

TC4013B contains two independent circuits of D type flip-flop. The input level applied to DATA input are transferred to Q and $\overline{Q}$ 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 $\overline{Q}$ = "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".

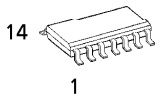
(Note) The JEDEC SOP (FN) is not available in Japan.



P (DIP14-P-300-2.54)
Weight : 0.96g (Typ.)



F (SOP14-P-300-1.27)
Weight : 0.18g (Typ.)

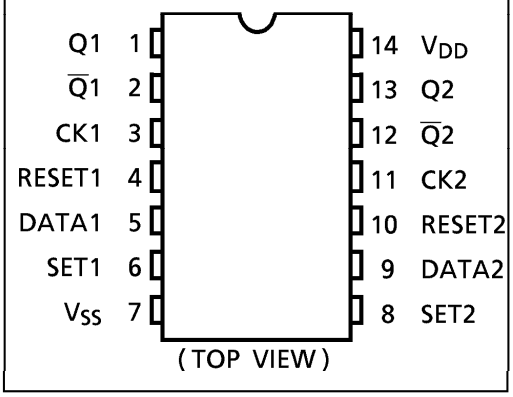


FN (SOL14-P-150-1.27)
Weight : 0.12g (Typ.)

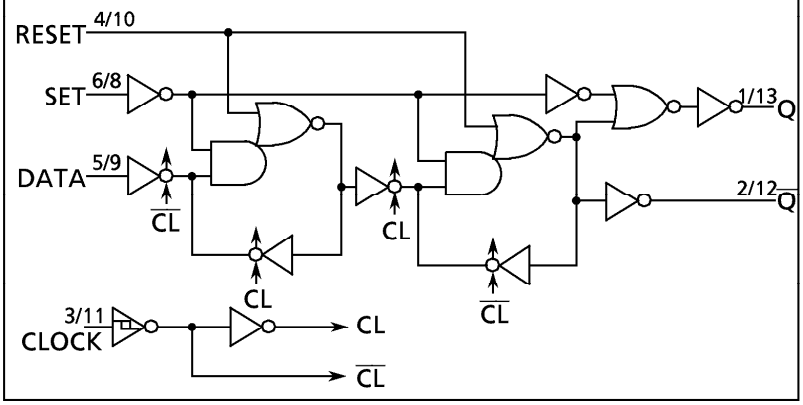
MAXIMUM RATINGS

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

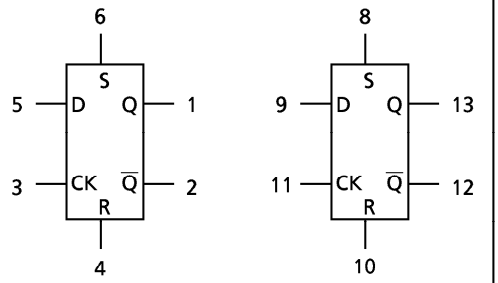
PIN ASSIGNMENT



LOGIC DIAGRAM



BLOCK DIAGRAM



961001EBA2

TRUTH TABLE

INPUTS				OUTPUTS	
RESET	SET	DATA	CK△	Qn + 1	$\overline{Q}$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	*	↓	Qn.	$\overline{Q}$n.

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

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	SYMBOL	TEST CONDITION	V_{DD} (V)	−40°C MIN.	−40°C MAX.	25°C MIN.	25°C TYP.	25°C MAX.	85°C MIN.	85°C MAX.	UNIT
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	
			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	5	−0.61	—	−0.51	−1.0	—	−0.42	—	mA
		V_{OH} = 2.5V	5	−2.50	—	−2.10	−4.0	—	−1.70	—	
		V_{OH} = 9.5V	10	−1.50	—	−1.30	−2.2	—	−1.10	—	
		V_{OH} = 13.5V	15	−4.00	—	−3.40	−9.0	—	−2.80	—	
		$V_{IN} = V_{SS}, V_{DD}$									
Output Low Current	I_{OL}	V_{OL} = 0.4V	5	0.61	—	0.51	1.2	—	0.42	—	
		V_{OL} = 0.5V	10	1.50	—	1.30	3.2	—	1.10	—	
		V_{OL} = 1.5V	15	4.00	—	3.40	12.0	—	2.80	—	
		$V_{IN} = V_{SS}, V_{DD}$									
Input High Voltage	V_{IH}	V_{OUT} = 0.5V, 4.5V	5	3.5	—	3.5	2.75	—	3.50	—	V
		V_{OUT} = 1.0V, 9.0V	10	7.0	—	7.0	5.50	—	7.00	—	
		V_{OUT} = 1.5V, 13.5V	15	11.0	—	11.0	8.25	—	11.00	—	
		$\|I_{OUT}\| < 1\mu A$									
Input Low Voltage	V_{IL}	V_{OUT} = 0.5V, 4.5V	5	—	1.5	—	2.25	1.5	—	1.5	
		V_{OUT} = 1.0V, 9.0V	10	—	3.0	—	4.50	3.0	—	3.0	
		V_{OUT} = 1.5V, 13.5V	15	—	4.0	—	6.75	4.0	—	4.0	
		$\|I_{OUT}\| < 1\mu A$									
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	—	1	—	0.002	1	—	30	
			10	—	2	—	0.004	2	—	60	
			15	—	4	—	0.008	4	—	120	

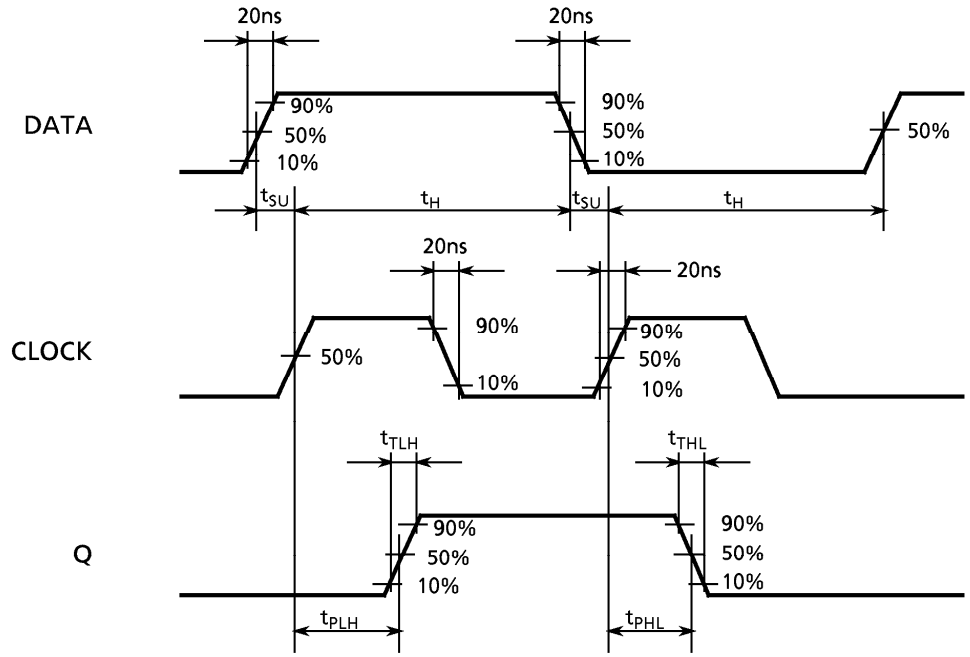
* All valid input combinations.

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

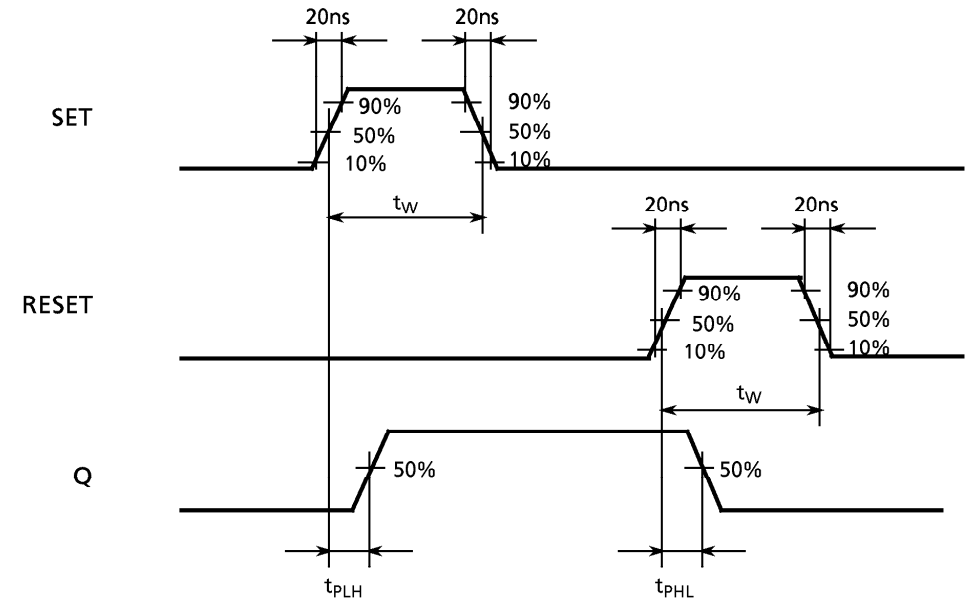
CHARACTERISTIC	SYMBOL	TEST CONDITION V_{DD}(V)	MIN.	TYP.	MAX.	UNIT
Output Transition Time (Low to High)	t_{TLH}	5	—	70	200	ns
		10	—	35	100	
		15	—	30	80	
Output Transition Time (High to Low)	t_{THL}	5	—	70	200	
		10	—	35	100	
		15	—	30	80	
Propagation Delay Time (CK - Q, $\overline{Q}$)	t_{pLH} t_{pHL}	5	—	130	300	
		10	—	65	130	
		15	—	50	90	
Propagation Delay Time (SET, RESET - Q, $\overline{Q}$)	t_{pLH}	5	—	110	300	
		10	—	50	130	
		15	—	40	90	
Propagation Delay Time (SET, RESET - Q, $\overline{Q}$)	t_{pHL}	5	—	110	300	
		10	—	50	130	
		15	—	40	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	—	30	80	
		15	—	25	50	
Min. Clock Pulse Width	t_W	5	—	60	140	
		10	—	30	60	
		15	—	25	40	
Min. Set-up Time (DATA - CK)	t_{su}	5	—	—	40	ns
		10	—	—	20	
		15	—	—	15	
Min. Hold Time (DATA - CK)	t_H	5	—	20	40	
		10	—	10	20	
		15	—	6	15	
Min. Removal Time (SET, RESET - CK)	t_{rem}	5	—	—	40	
		10	—	—	20	
		15	—	—	15	
Input Capacitance	C_{IN}		—	5	7.5	pF

WAVEFORM FOR MEASUREMENT OF DYNAMIC CHARACTERISTICS

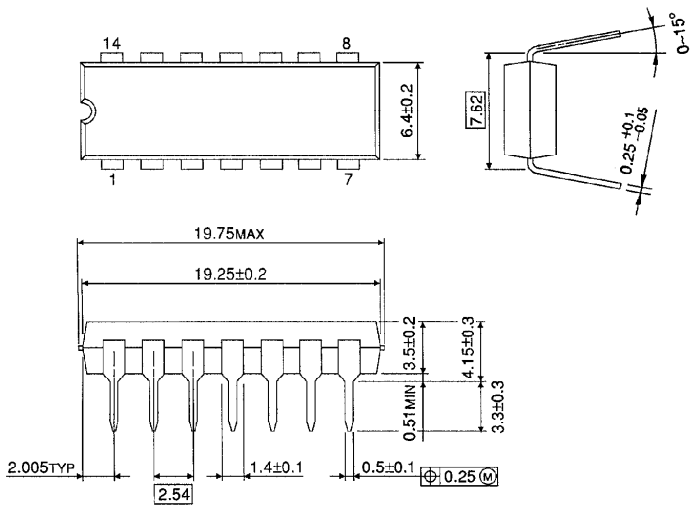
WAVEFORM 1



WAVEFORM 2

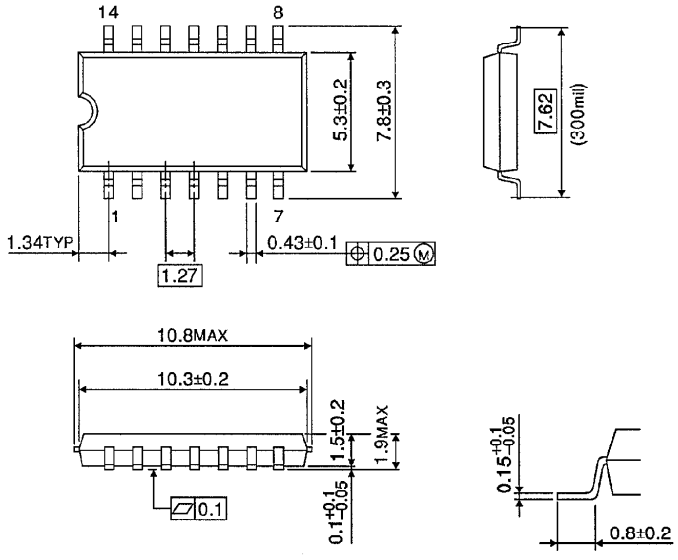


DIP 14PIN OUTLINE DRAWING (DIP14-P-300-2.54) Unit in mm



Weight : 0.96g (Typ.)

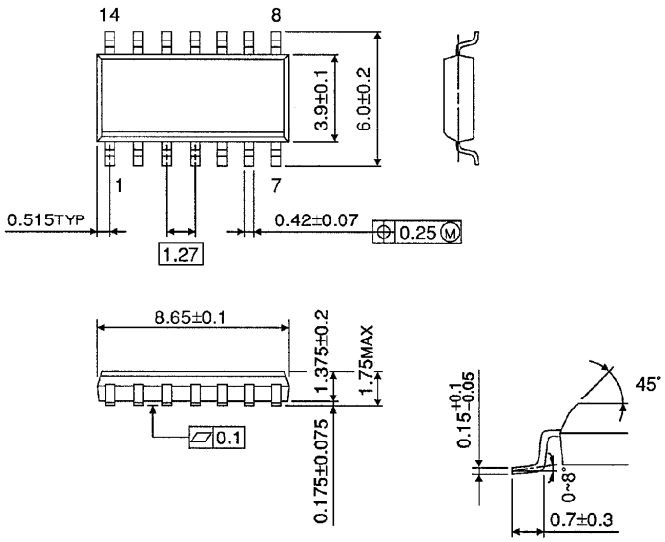
SOP 14PIN (200mil BODY) OUTLINE DRAWING (SOP14-P-300-1.27) Unit in mm



Weight : 0.18g (Typ.)

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.)