

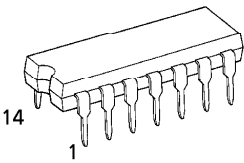
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC4013BP, TC4013BF, TC4013BFN

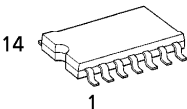
TC4013B DUAL D-TYPE FLIP-FLOP

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”.

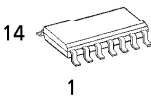
(Note) The JEDEC SOP (FN) is not available in Japan.



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



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

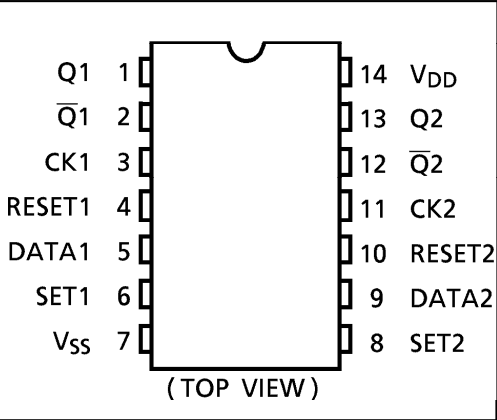


FN (SOL14-P-150-1.27)
Weight : 0.12g (Typ.)

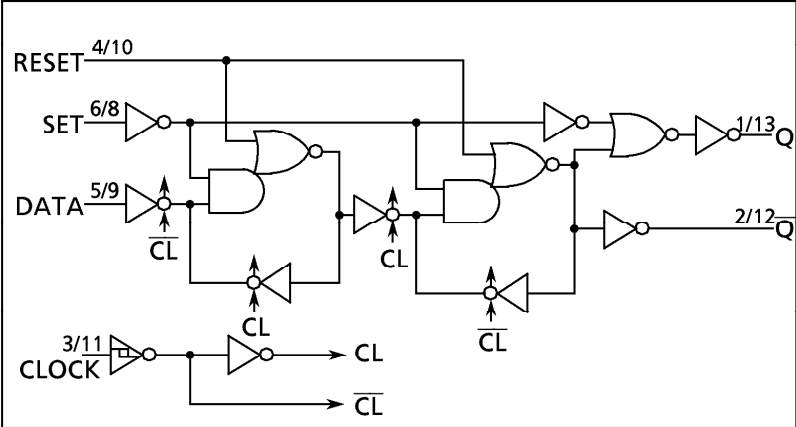
MAXIMUM RATINGS

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}	$-40 \sim 85$	$^{\circ}\text{C}$
Storage Temperature Range	T_{stg}	$-65 \sim 150$	$^{\circ}\text{C}$

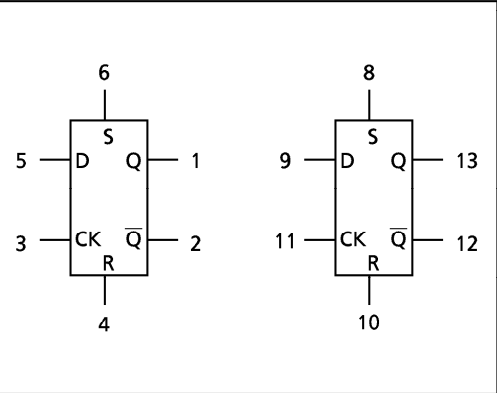
PIN ASSIGNMENT



LOGIC DIAGRAM






BLOCK DIAGRAM



961001EBA2

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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	*		$Qn \cdot$	$\overline{Q}n \cdot$

* : Don't Care

△ : Level Change

· : No Change

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● 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}	$V_{OH} = 4.6V$	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	—	mA
		$V_{OL} = 0.5V$	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
		$V_{OUT} = 1.0V, 9.0V$	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	—	μA
	"L" Level	I_{IL}	$V_{IL} = 0V$	18	—	-0.1	—	-10^{-5}	-0.1	—	
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	

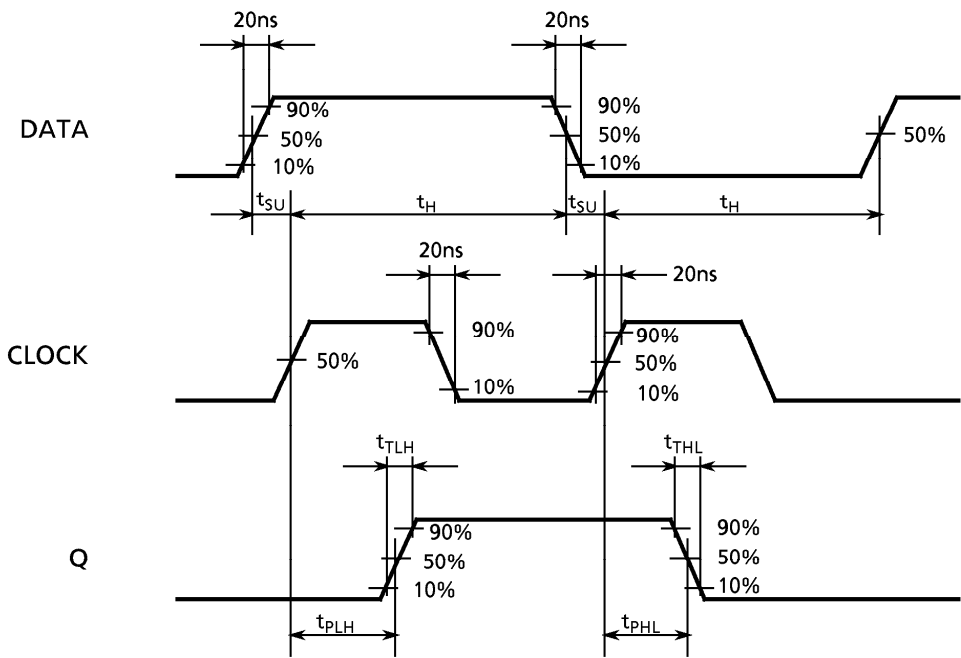
* All valid input combinations.

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

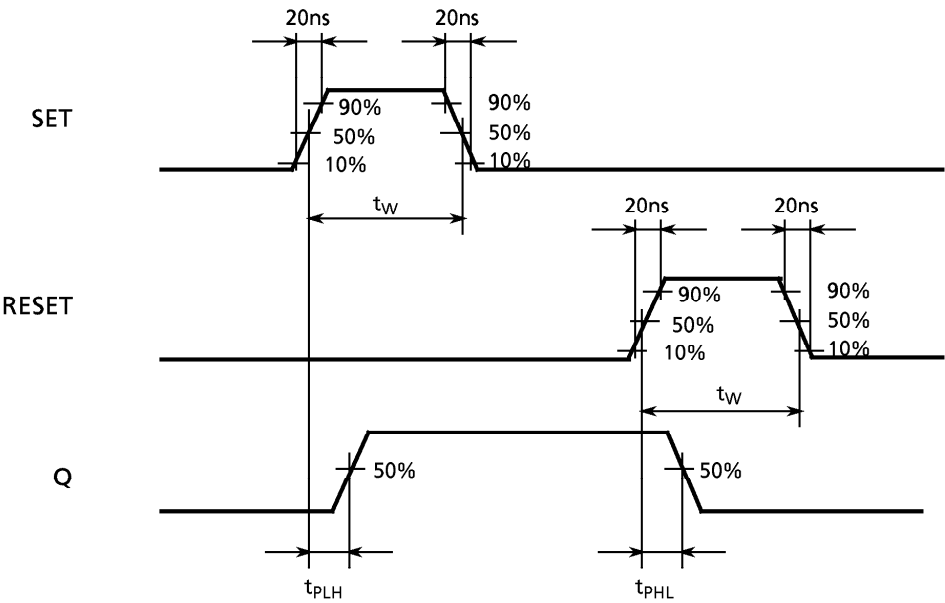
CHARACTERISTIC	SYMBOL	TEST CONDITION	V _{DD} (V)	MIN.	TYP.	MAX.	UNIT
Output Transition Time (Low to High)	t _{TLH}		5 10 15	— — —	70 35 30	200 100 80	ns
Output Transition Time (High to Low)	t _{THL}		5 10 15	— — —	70 35 30	200 100 80	
Propagation Delay Time (CK - Q, \overline{Q})	t _{pLH} t _{pHL}		5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

WAVEFORM FOR MEASUREMENT OF DYNAMIC CHARACTERISTICS

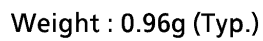
WAVEFORM 1



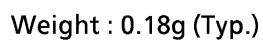
WAVEFORM 2



Unit in mm



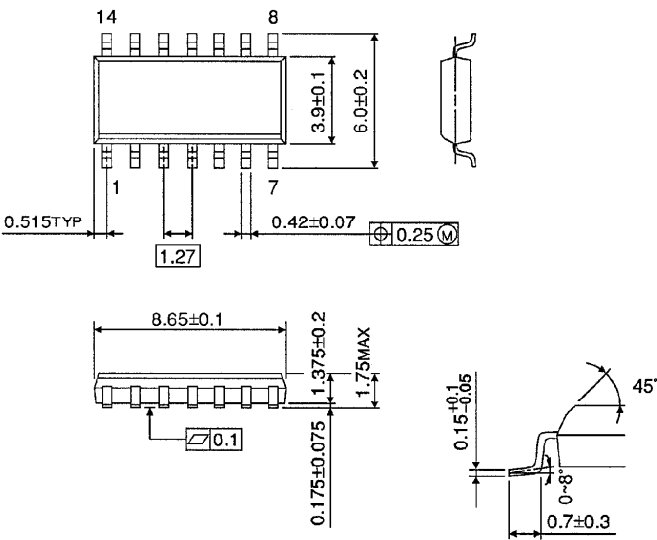
Unit in mm



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.)