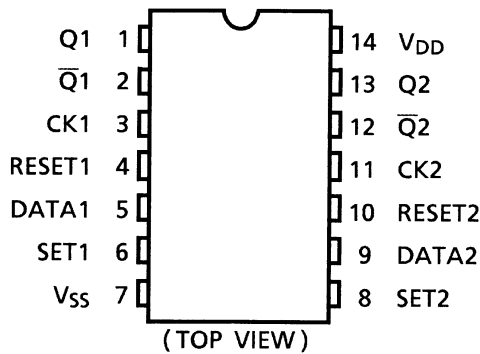


TC4013BP, TC4013BF

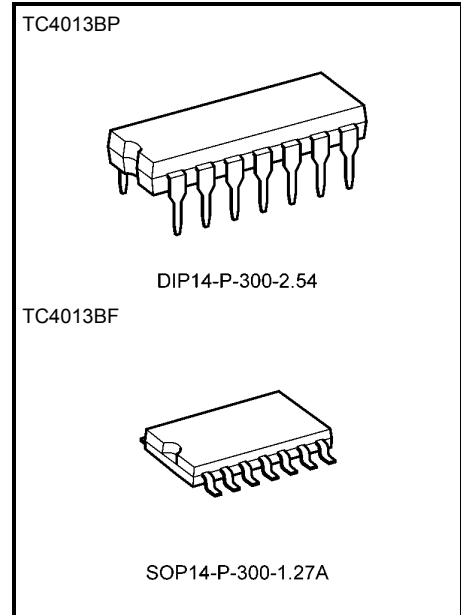
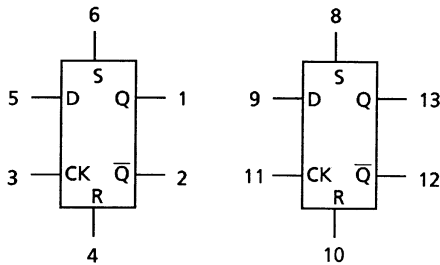
TC4013B Dual D-Type Flip Flop

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".

Pin Assignment



Block Diagram



Weight	
DIP14-P-300-2.54	: 0.96 g (typ.)
SOP14-P-300-1.27A	: 0.18 g (typ.)

Truth Table

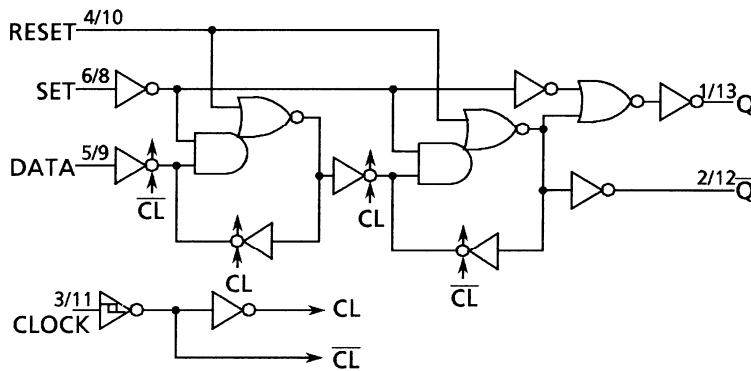
Inputs				Outputs	
RESET	SET	DATA	CK Δ	Q _{n+1}	\overline{Q}_{n+1}
L	H	*	*	H	L
H	L	*	*	L	H
H	H	*	*	H	H
L	L	L	\uparrow	L	H
L	L	H	\uparrow	H	L
L	L	*	\downarrow	Q _n '	\overline{Q}_n '

*: Don't care

Δ : Level change

\cdot : No change

Logic Diagram



Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
DC supply voltage	V _{DD}	V _{SS} - 0.5~V _{SS} + 20	V
Input voltage	V _{IN}	V _{SS} - 0.5~V _{DD} + 0.5	V
Output voltage	V _{OUT}	V _{SS} - 0.5~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

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 ($V_{SS} = 0\text{ V}$) (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 ($V_{SS} = 0\text{ V}$)

Characteristics	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\text{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\text{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}	$V_{OH} = 4.6\text{ V}$ $V_{OH} = 2.5\text{ V}$ $V_{OH} = 9.5\text{ V}$ $V_{OH} = 13.5\text{ V}$ $V_{IN} = V_{SS}, V_{DD}$	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}	$V_{OL} = 0.4\text{ V}$ $V_{OL} = 0.5\text{ V}$ $V_{OL} = 1.5\text{ V}$ $V_{IN} = V_{SS}, V_{DD}$	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}	$V_{OUT} = 0.5\text{ V}, 4.5\text{ V}$ $V_{OUT} = 1.0\text{ V}, 9.0\text{ V}$ $V_{OUT} = 1.5\text{ V}, 13.5\text{ V}$ $ I_{OUT} < 1\ \mu\text{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}	$V_{OUT} = 0.5\text{ V}, 4.5\text{ V}$ $V_{OUT} = 1.0\text{ V}, 9.0\text{ V}$ $V_{OUT} = 1.5\text{ V}, 13.5\text{ V}$ $ I_{OUT} < 1\ \mu\text{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}	$V_{IH} = 18\text{ V}$	18	—	0.1	—	10^{-5}	0.1	—	1.0	μA
	"L" level	I_{IL}	$V_{IL} = 0\text{ V}$	18	—	-0.1	—	-10^{-5}	-0.1	—	-1.0	
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		

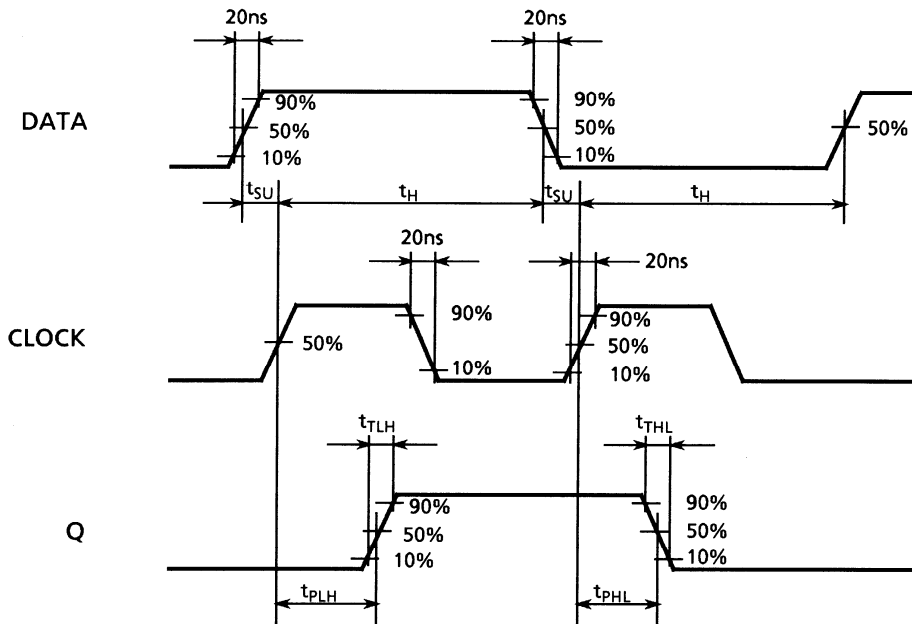
Note: All valid input combinations.

Dynamic Electrical Characteristics (Ta = 25°C, VSS = 0 V, CL = 50 pF)

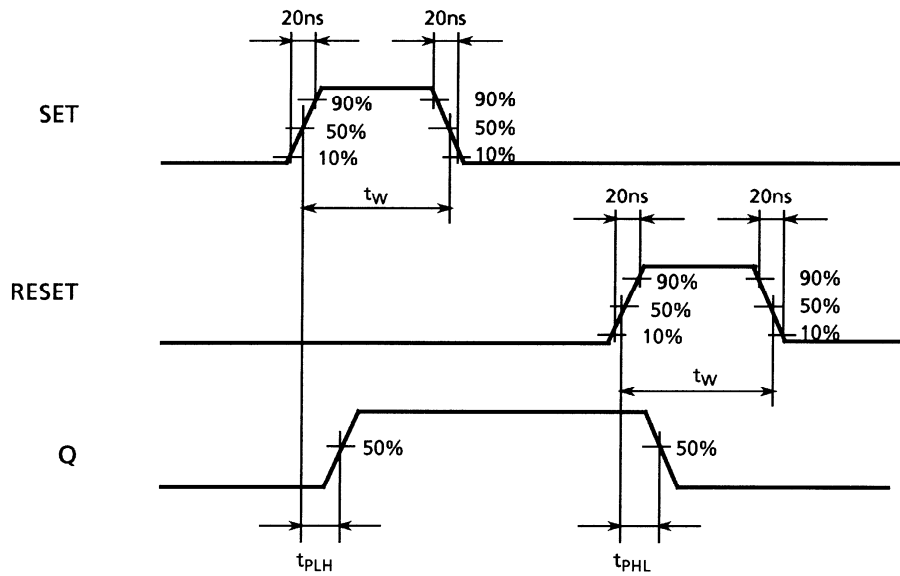
Characteristics	Symbol	Test Condition	VDD (V)	Min	Typ.	Max	Unit
Output transition time (low to high)	t _{TLH}	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Output transition time (high to low)	t _{THL}	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Propagation delay time (CK-Q, \bar{Q})	t _{pLH} t _{pHL}	—	5	—	130	300	ns
			10	—	65	130	
			15	—	50	90	
Propagation delay time (SET, RESET-Q, \bar{Q})	t _{pLH}	—	5	—	110	300	ns
			10	—	50	130	
			15	—	40	90	
Propagation delay time (SET, RESET-Q, \bar{Q})	t _{pHL}	—	5	—	110	300	ns
			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 _{rCL}	—	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	ns
			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	ns
			10	—	10	20	
			15	—	6	15	
Min removal time (SET, RESET-CK)	t _{rem}	—	5	—	—	40	ns
			10	—	—	20	
			15	—	—	15	
Input capacitance	C _{IN}	—	—	5	7.5	pF	

Waveform for Measurement of Dynamic Characteristics

Waveform 1



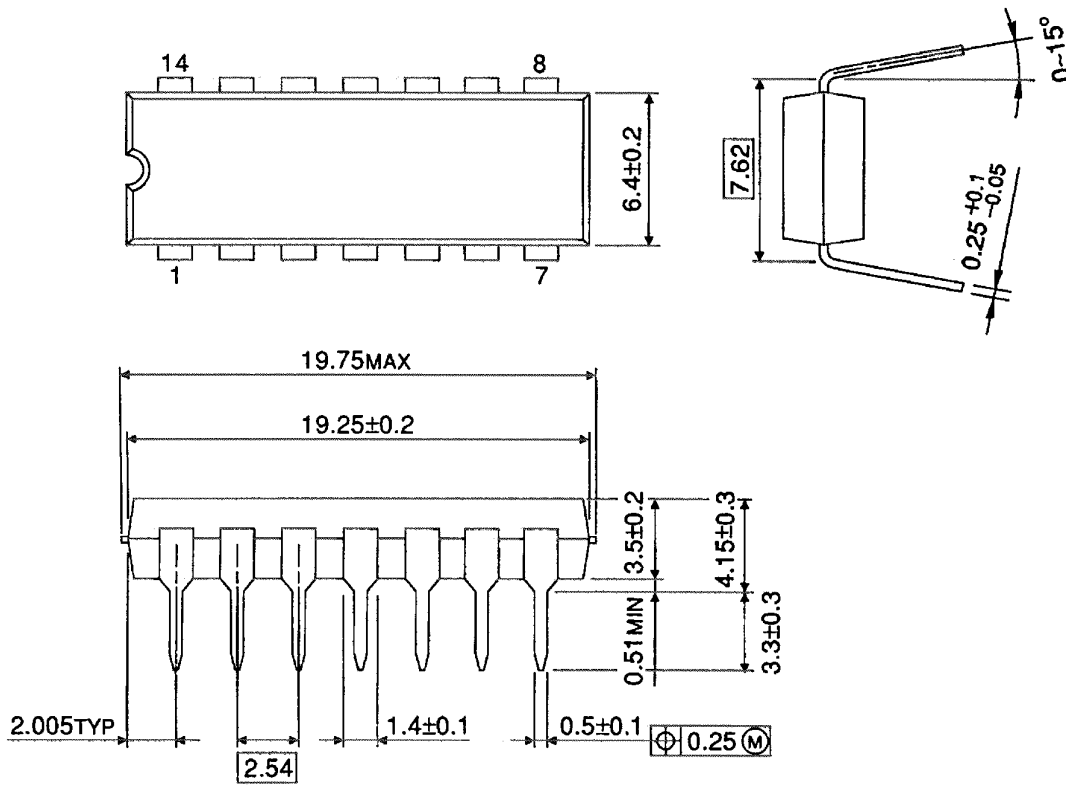
Waveform 2



Package Dimensions

DIP14-P-300-2.54

Unit : mm

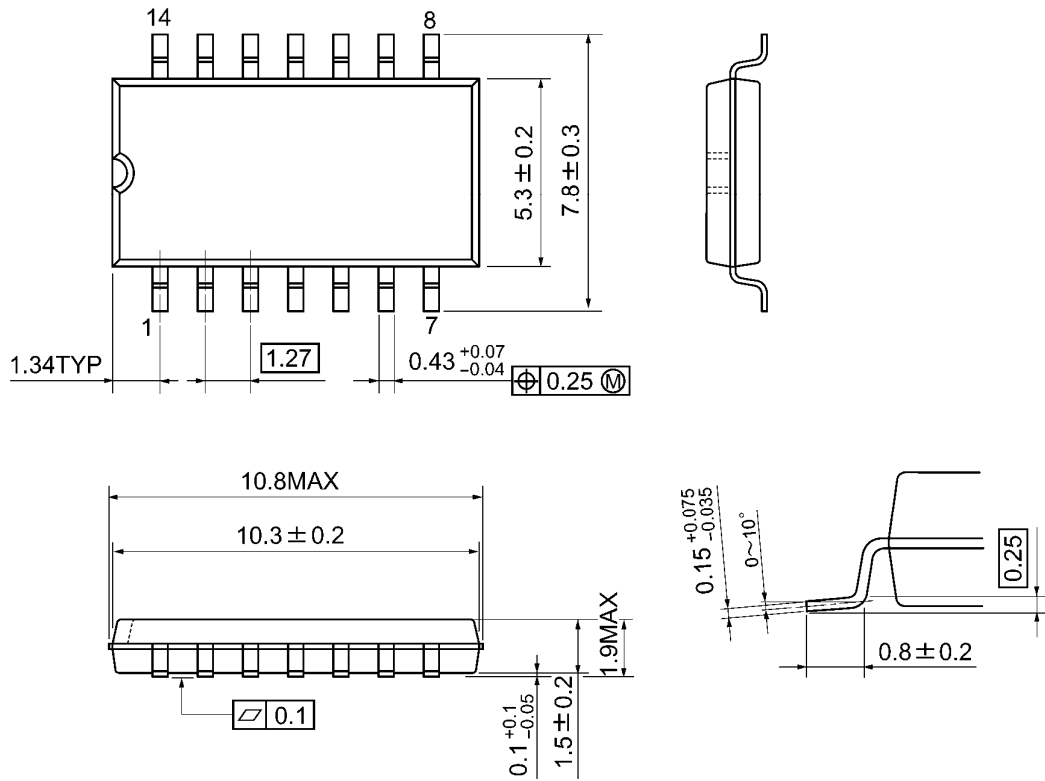


Weight: 0.96 g (typ.)

Package Dimensions

SOP14-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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