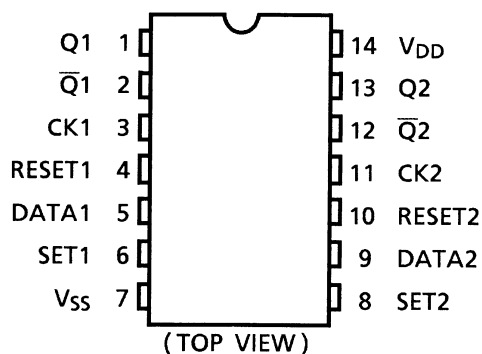


# TC4013BP, TC4013BF, TC4013BFN

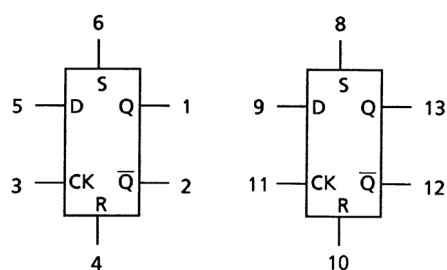
## TC4013B Dual D-Type Flip Flop

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".

### Pin Assignment

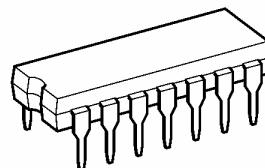


### Block Diagram



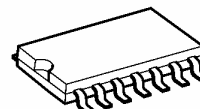
Note: xxxFN (JEDEC SOP) is not available in Japan.

TC4013BP

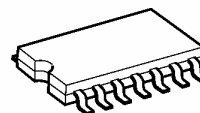


DIP14-P-300-2.54

TC4013BF

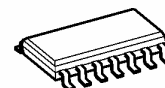


SOP14-P-300-1.27A



SOP14-P-300-1.27

TC4013BFN



SOL14-P-150-1.27

### Weight

DIP14-P-300-2.54	: 0.96 g (typ.)
SOP14-P-300-1.27A	: 0.18 g (typ.)
SOP14-P-300-1.27	: 0.18 g (typ.)
SOL14-P-150-1.27	: 0.12 g (typ.)

## Truth Table

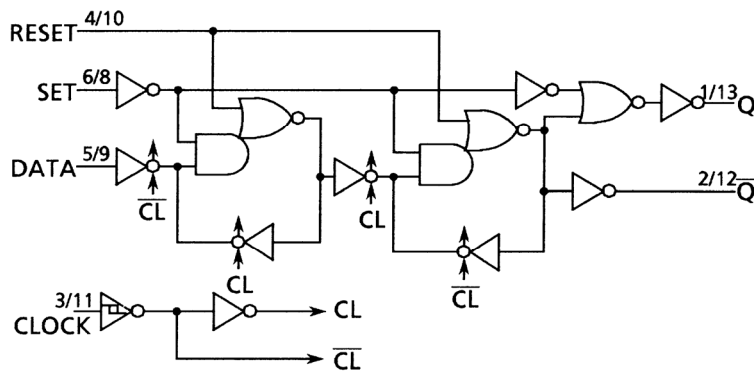
Inputs				Outputs	
RESET	SET	DATA	CK $\Delta$	Q <sub>n+1</sub>	$\overline{Q}_{n+1}$
L	H	*	*	H	L
H	L	*	*	L	H
H	H	*	*	H	H
L	L	L	$\uparrow$	L	H
L	L	H	$\uparrow$	H	L
L	L	*	$\downarrow$	Q <sub>n</sub>	$\overline{Q}_n$

\*: Don't care

$\Delta$ : 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	$I_{IN}$	$\pm 10$	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

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

**Recommended Operating Conditions ( $V_{SS} = 0$  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 recommended operating conditions are required to ensure the normal operation of the device.  
Unused inputs must be tied to either VCC or GND.

**Static Electrical Characteristics ( $V_{SS} = 0$  V)**

Characteristics	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	$I_{OH}$	$V_{OH} = 4.6$ V	5	-0.61	—	-0.51	-1.0	—	-0.42	—	mA
		$V_{OH} = 2.5$ V	5	-2.50	—	-2.10	-4.0	—	-1.70	—	
		$V_{OH} = 9.5$ V	10	-1.50	—	-1.30	-2.2	—	-1.10	—	
		$V_{OH} = 13.5$ V	15	-4.00	—	-3.40	-9.0	—	-2.80	—	
		$V_{IN} = V_{SS}, V_{DD}$									
Output low current	$I_{OL}$	$V_{OL} = 0.4$ V	5	0.61	—	0.51	1.2	—	0.42	—	mA
		$V_{OL} = 0.5$ V	10	1.50	—	1.30	3.2	—	1.10	—	
		$V_{OL} = 1.5$ V	15	4.00	—	3.40	12.0	—	2.80	—	
		$V_{IN} = V_{SS}, V_{DD}$									
Input high voltage	$V_{IH}$	$V_{OUT} = 0.5$ V, 4.5 V	5	3.5	—	3.5	2.75	—	3.50	—	V
		$V_{OUT} = 1.0$ V, 9.0 V	10	7.0	—	7.0	5.50	—	7.00	—	
		$V_{OUT} = 1.5$ V, 13.5 V	15	11.0	—	11.0	8.25	—	11.00	—	
		$ I_{OUT}  < 1 \mu A$									
Input low voltage	$V_{IL}$	$V_{OUT} = 0.5$ V, 4.5 V	5	—	1.5	—	2.25	1.5	—	1.5	V
		$V_{OUT} = 1.0$ V, 9.0 V	10	—	3.0	—	4.50	3.0	—	3.0	
		$V_{OUT} = 1.5$ V, 13.5 V	15	—	4.0	—	6.75	4.0	—	4.0	
		$ I_{OUT}  < 1 \mu A$									
Input current	"H" level	$I_{IH}$	$V_{IH} = 18$ V	18	—	0.1	—	$10^{-5}$	0.1	—	$\mu A$
	"L" level	$I_{IL}$	$V_{IL} = 0$ V	18	—	-0.1	—	$-10^{-5}$	-0.1	—	
Quiescent supply current	$I_{DD}$	$V_{IN} = V_{SS}, V_{DD}$ (Note)	5	—	1	—	0.002	1	—	30	$\mu A$
			10	—	2	—	0.004	2	—	60	
			15	—	4	—	0.008	4	—	120	

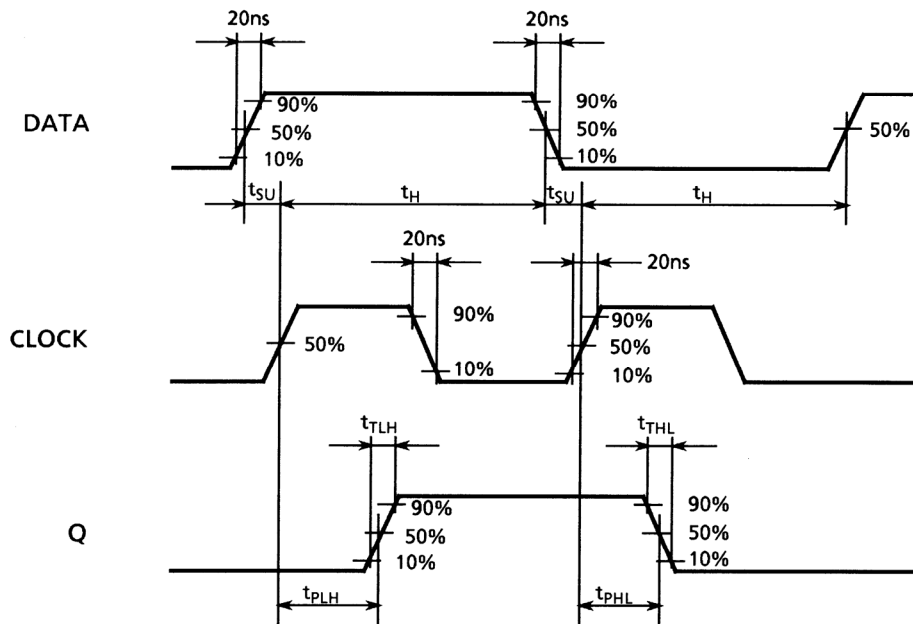
Note: All valid input combinations.

Dynamic Electrical Characteristics (Ta = 25°C, V<sub>SS</sub> = 0 V, C<sub>L</sub> = 50 pF)

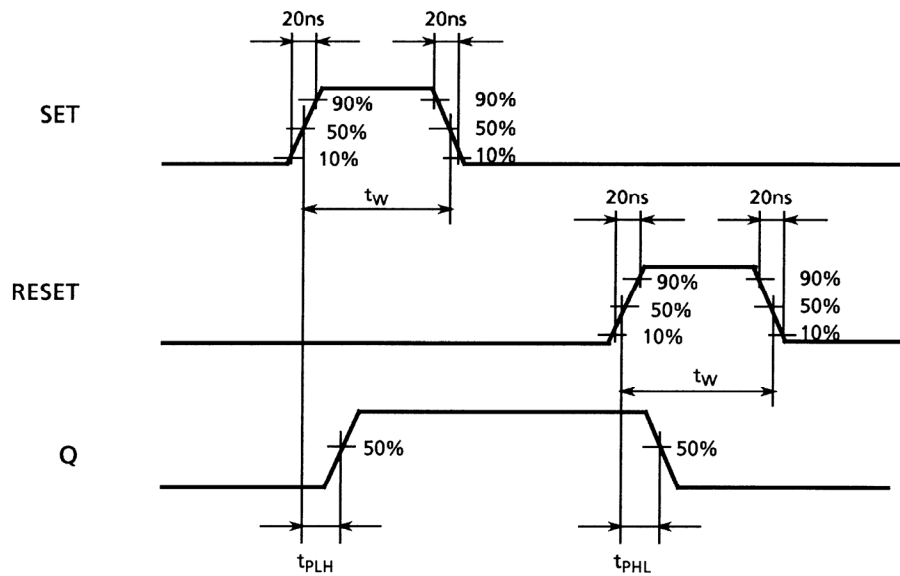
Characteristics	Symbol	Test Condition		Min	Typ.	Max	Unit
			V <sub>DD</sub> (V)				
Output transition time (low to high)	t <sub>TLH</sub>	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Output transition time (high to low)	t <sub>THL</sub>	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Propagation delay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

## Waveform for Measurement of Dynamic Characteristics

Waveform 1



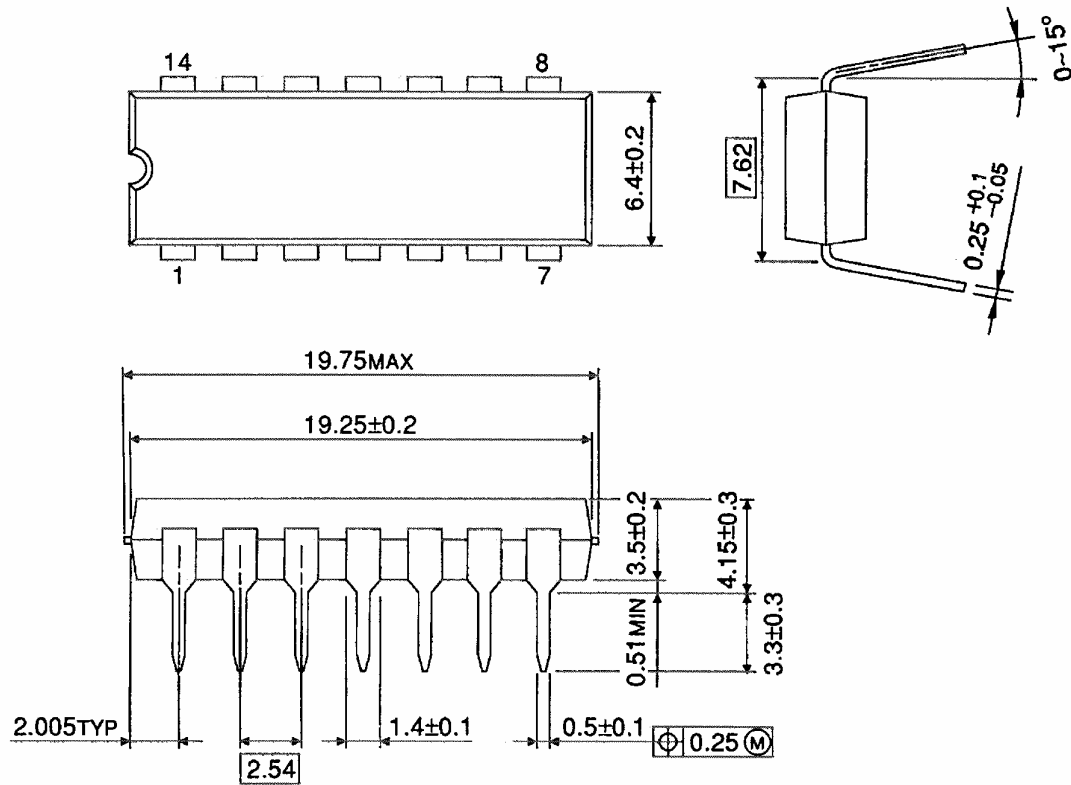
Waveform 2



## Package Dimensions

DIP14-P-300-2.54

Unit : mm

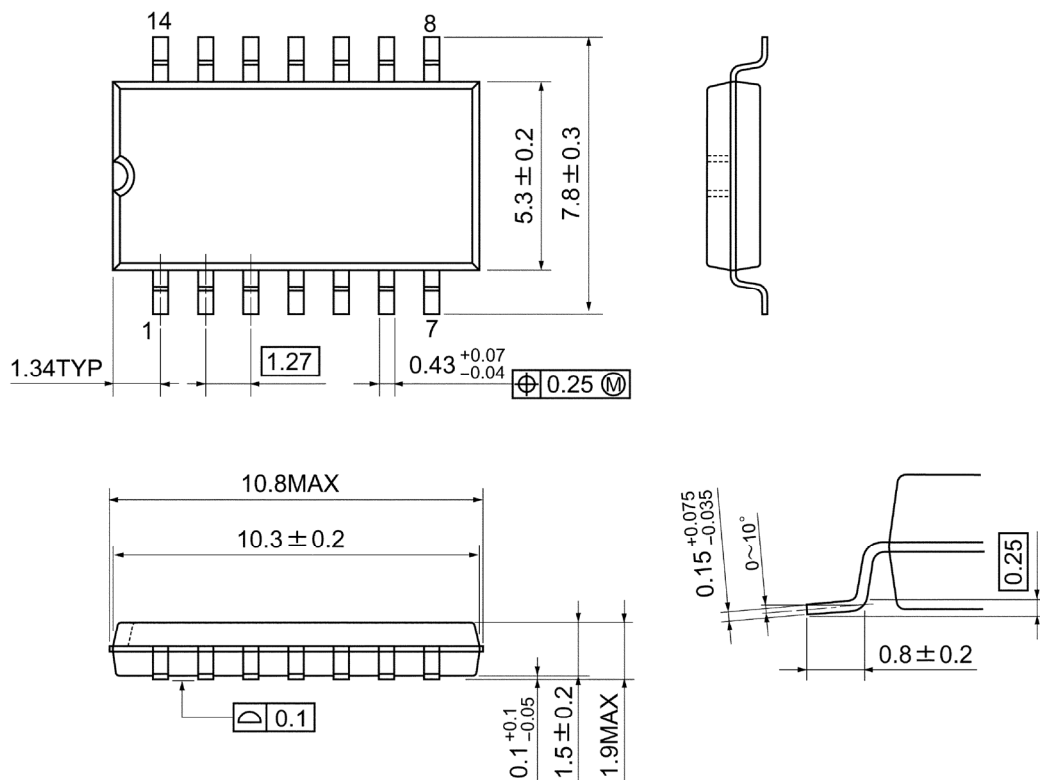


Weight: 0.96 g (typ.)

## Package Dimensions

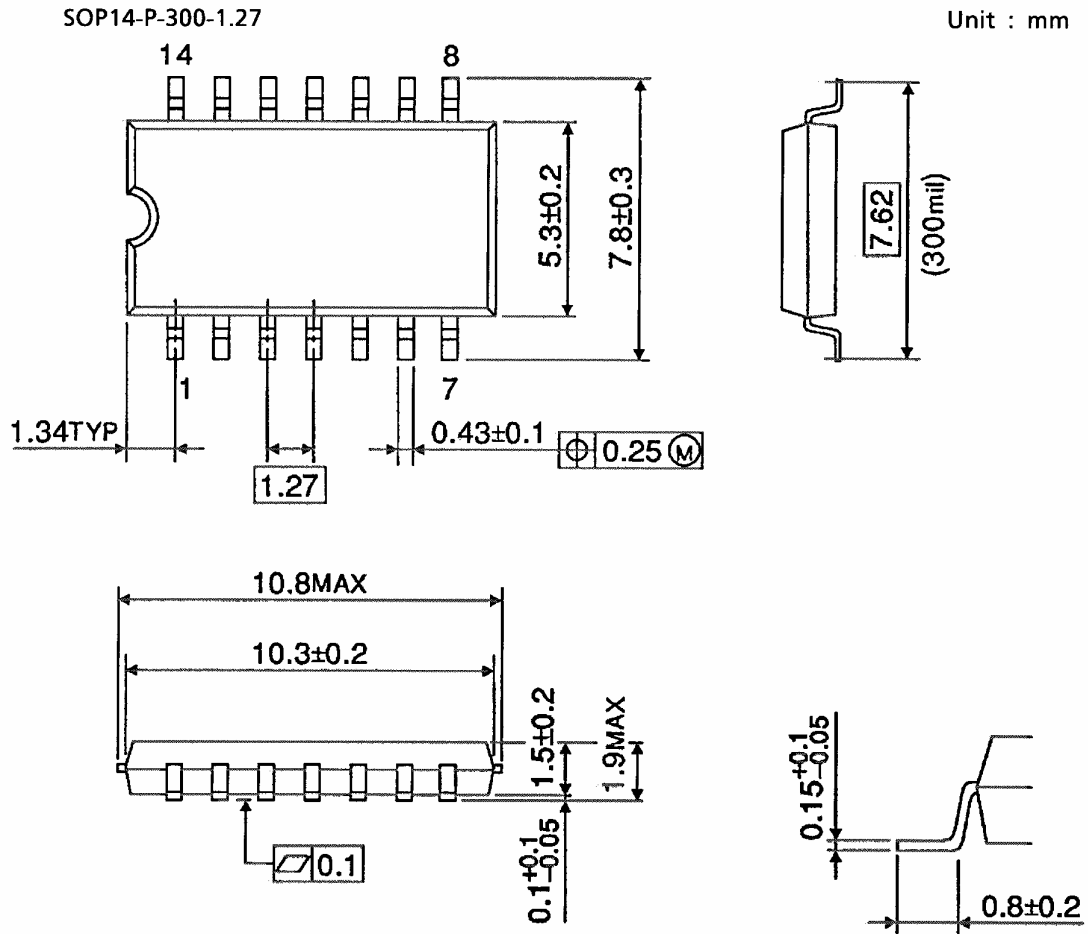
SOP14-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

## Package Dimensions



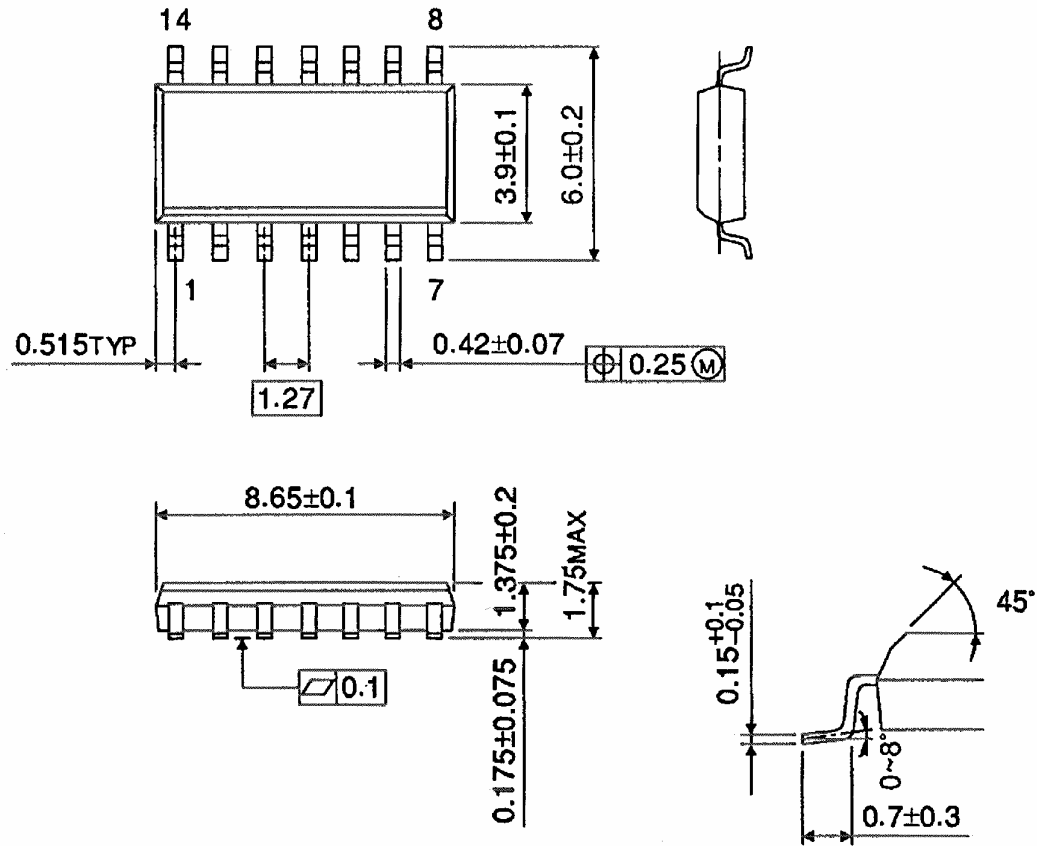
Weight: 0.18 g (typ.)



## Package Dimensions (Note)

SOL14-P-150-1.27

Unit : mm



Note: This package is not available in Japan.

Weight: 0.12 g (typ.)

**Note: Lead (Pb)-Free Packages****DIP14-P-300-2.54 SOP14-P-300-1.27A SOL14-P-150-1.27****RESTRICTIONS ON PRODUCT USE**

060116EBA

- The information contained herein is subject to change without notice. 021023\_D
- 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. 021023\_A
- 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. 021023\_B
- The products described in this document shall not be used or embedded to any downstream products of which manufacture, use and/or sale are prohibited under any applicable laws and regulations. 060106\_Q
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of TOSHIBA or others. 021023\_C
- The products described in this document are subject to the foreign exchange and foreign trade laws. 021023\_E