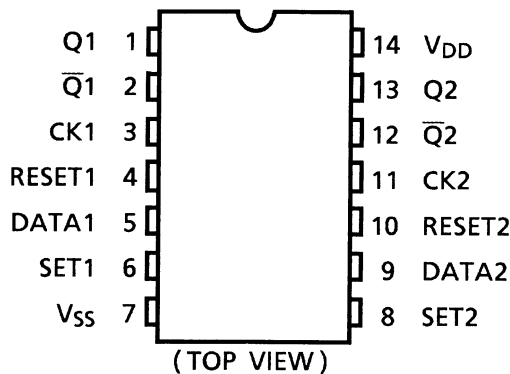


TC4013BP, TC4013BF, TC4013BFN

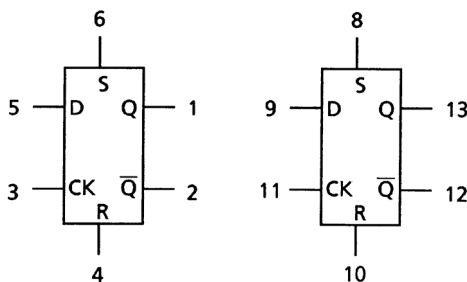
TC4013B Dual D-Type Flip Flop

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

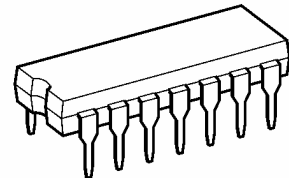


Block Diagram



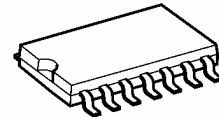
Note: xxxFN (JEDEC SOP) is not available in Japan.

TC4013BP

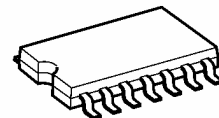


DIP14-P-300-2.54

TC4013BF

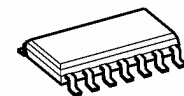


SOP14-P-300-1.27A



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

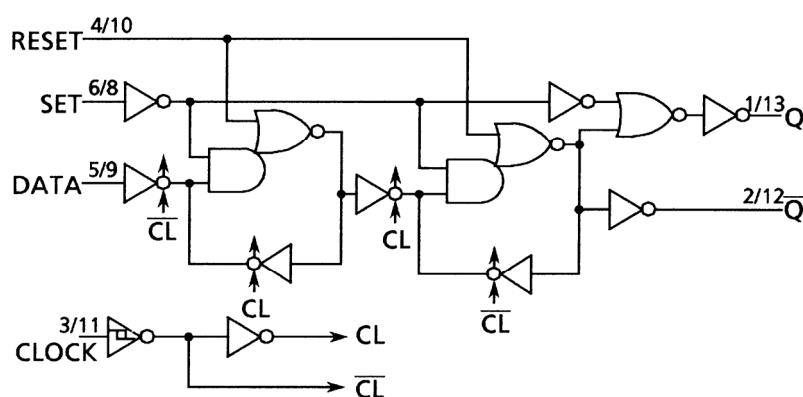
Inputs				Outputs	
RESET	SET	DATA	CK Δ	Q _{n+1}	$\overline{Q}_{n+1}$
L	H	*	*	H	L
H	L	*	*	L	H
H	H	*	*	H	H
L	L	L	$\uparrow$	L	H
L	L	H	$\uparrow$	H	L
L	L	*	$\downarrow$	Q _n	$\overline{Q}_n$

*: 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.

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	—	μA
	"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	μA
			10	—	2	—	0.004	2	—	60	
			15	—	4	—	0.008	4	—	120	

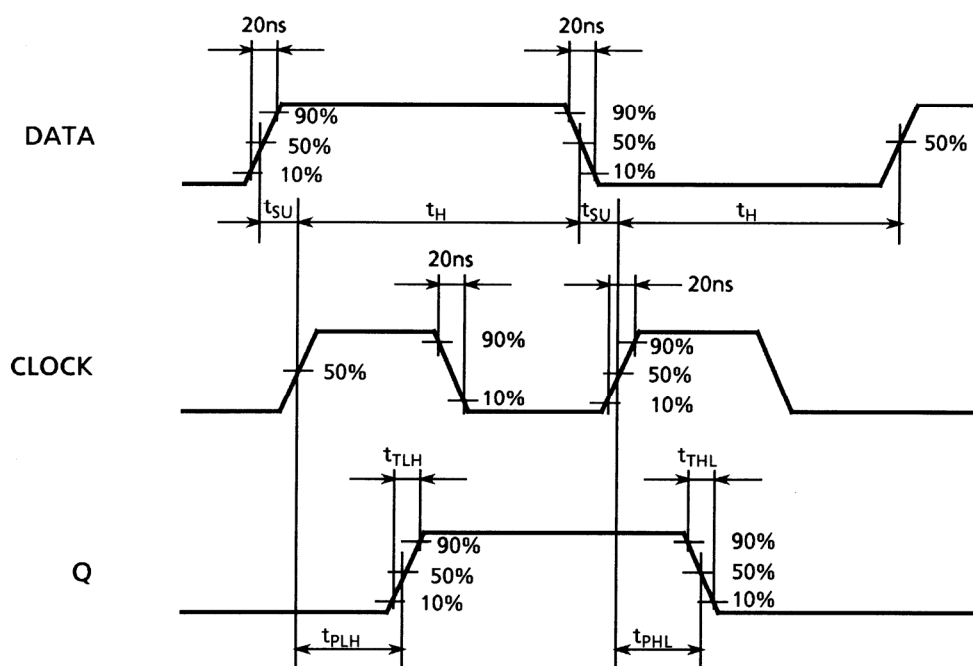
Note: All valid input combinations.

Dynamic Electrical Characteristics (Ta = 25°C, V_{SS} = 0 V, C_L = 50 pF)

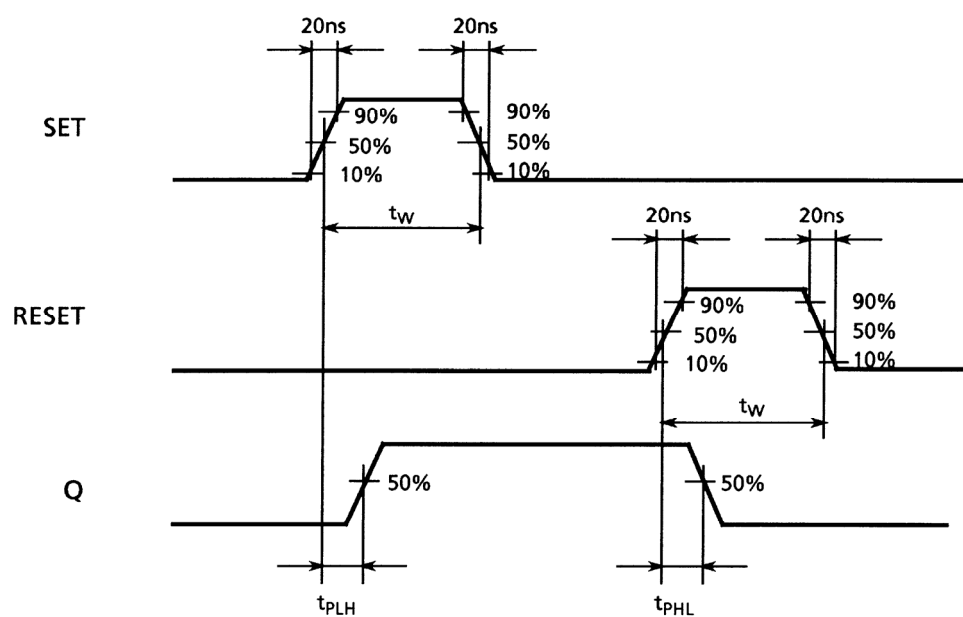
Characteristics	Symbol	Test Condition	V _{DD} (V)	Min	Typ.	Max	Unit
Output transition time (low to high)	t _{TLH}	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Output transition time (high to low)	t _{THL}	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Propagation delay time (CK-Q, $\bar{Q}$)	t _{pLH} 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 _{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	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



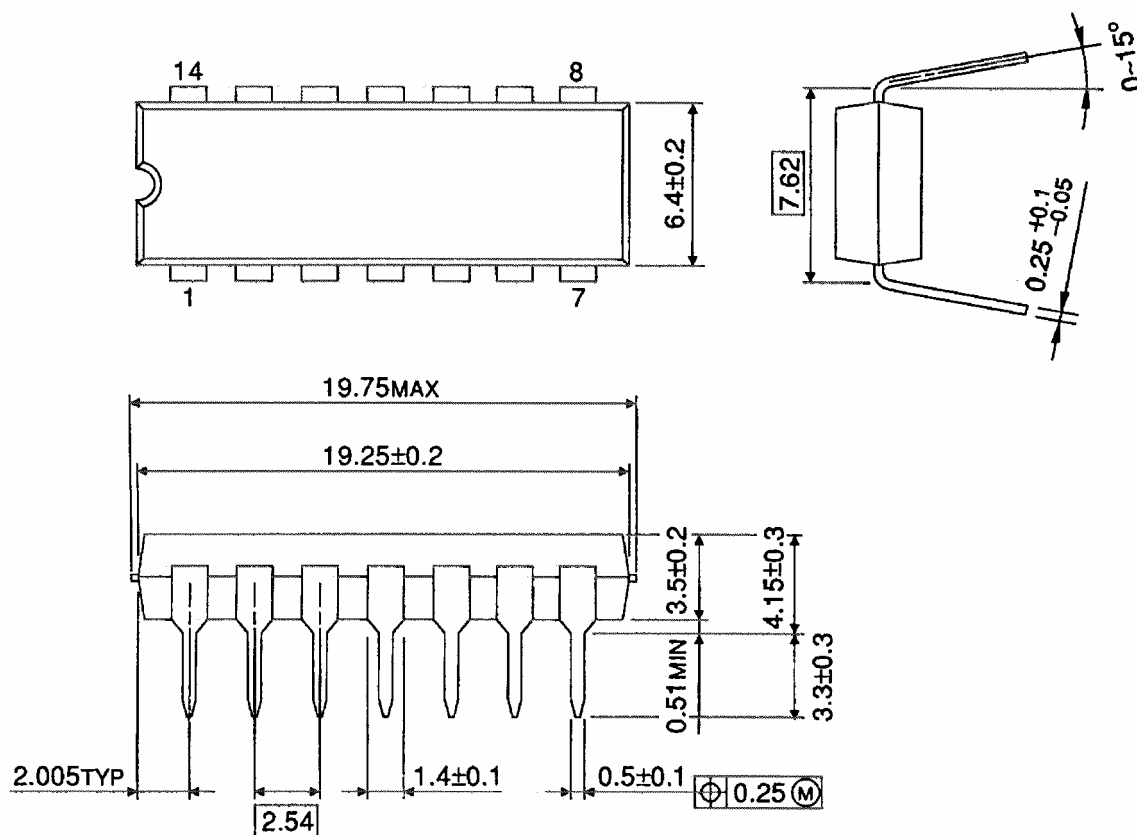
Waveform 2



Package Dimensions

DIP14-P-300-2.54

Unit : mm

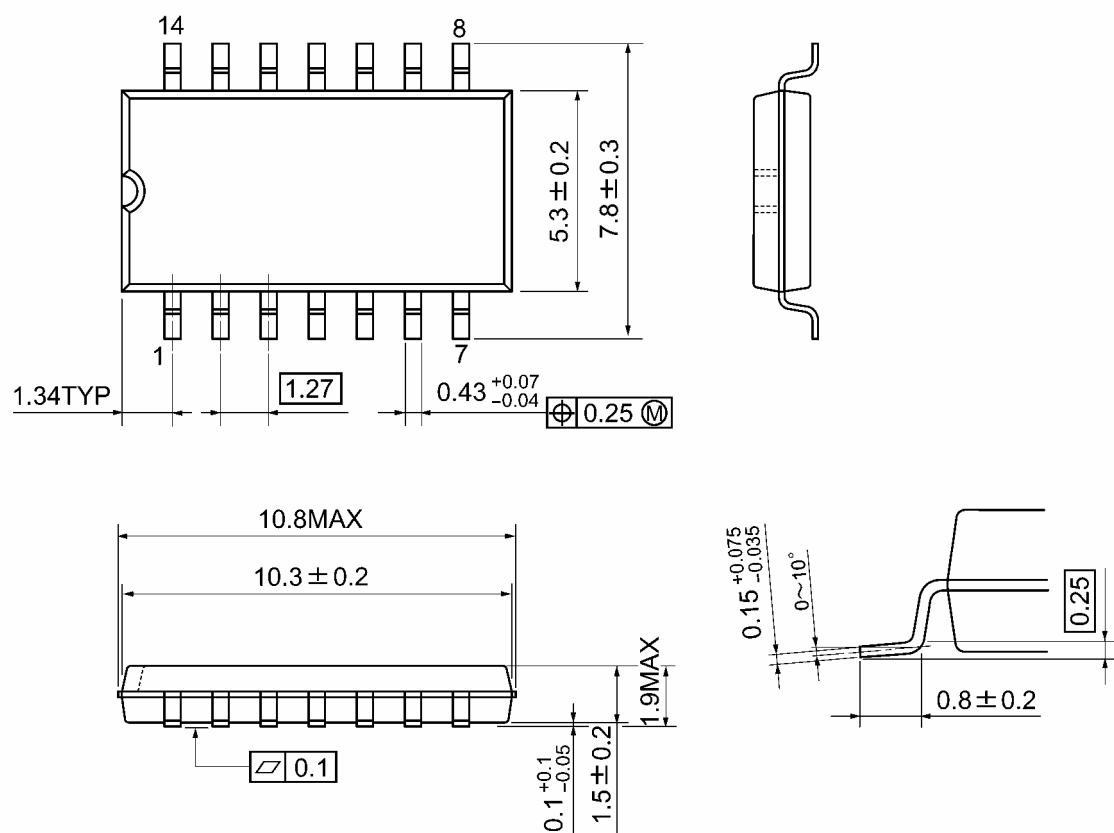


Weight: 0.96 g (typ.)

Package Dimensions

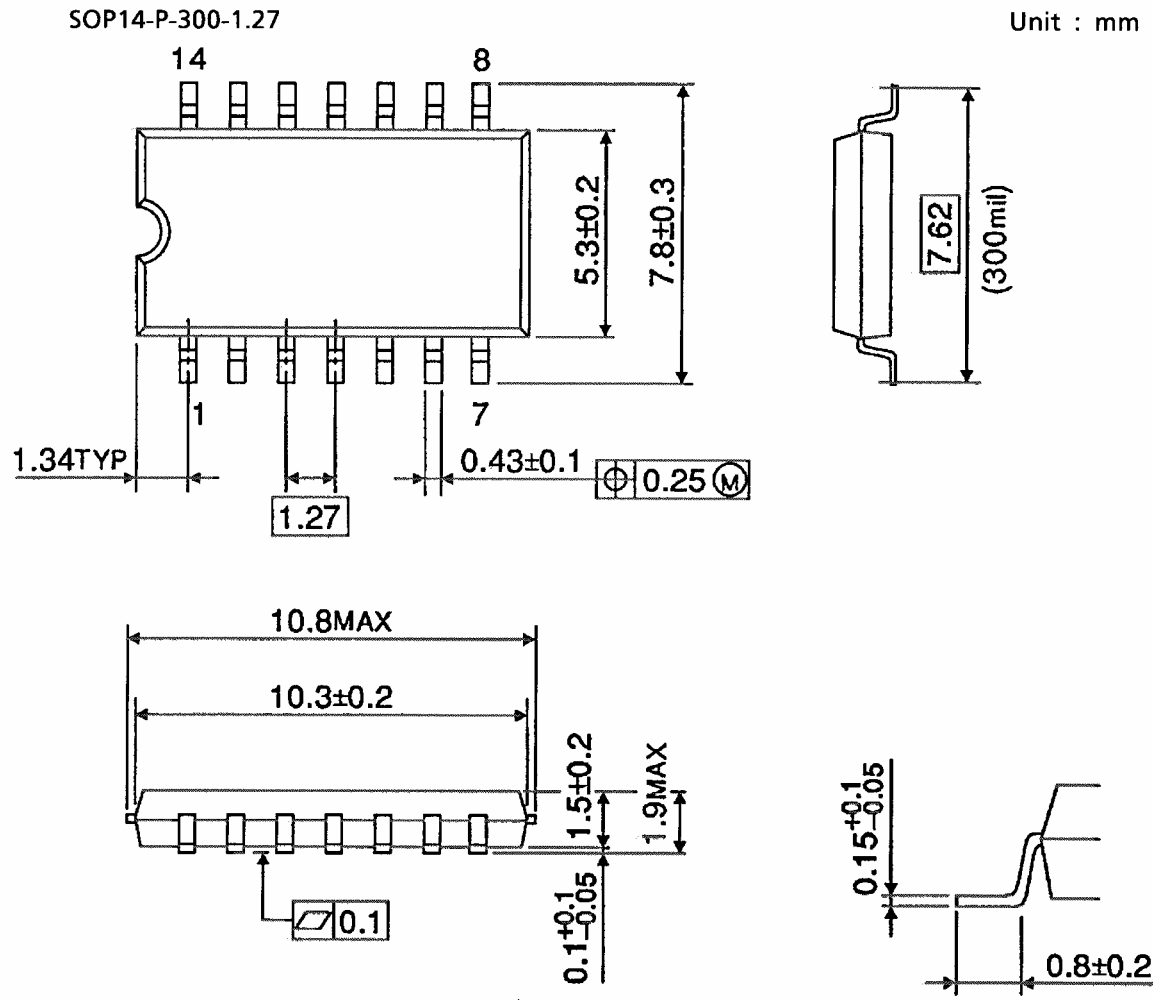
SOP14-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

Package Dimensions

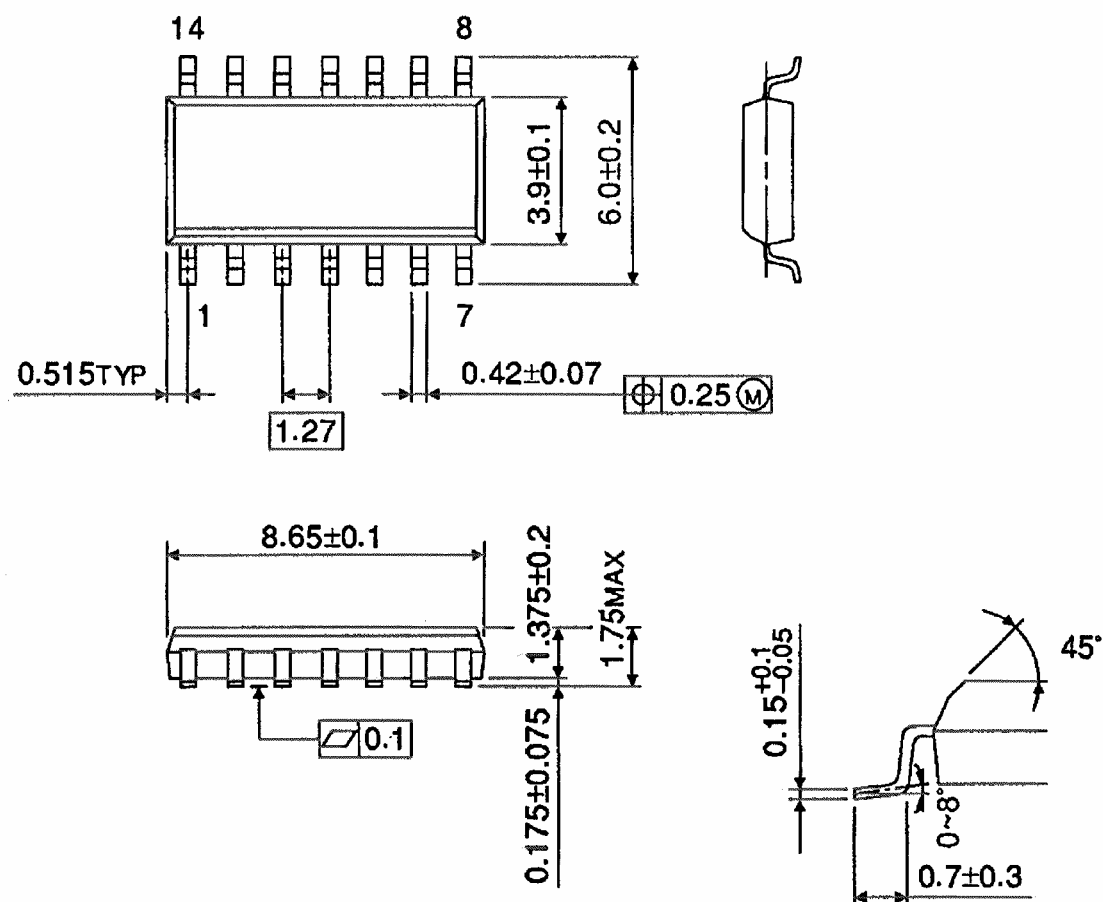


Weight: 0.18 g (typ.)

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**

20070701-EN

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