

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

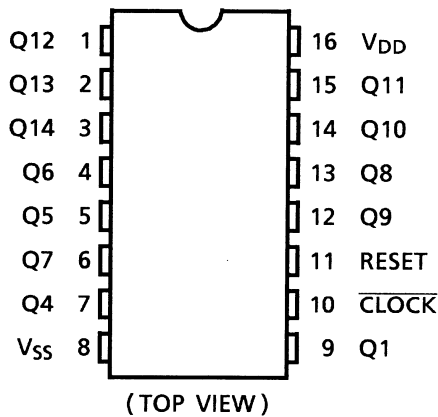
# TC4020BP, TC4020BF, TC4020BFN

## TC4020B 14 Stage Ripple-Carry Binary Counter/Dividers

TC4020B is 14 stage ripple carry binary counter having asynchronous clear function. The counter advances its counting stage by falling edge of  $\overline{\text{CLOCK}}$  input. When RESET input is placed "H", all the circuits are reset regardless of  $\overline{\text{CLOCK}}$  input making all the outputs (Q1, Q4~Q14) to be "L".

This is most suitable for frequency dividers, control circuits and timing circuits.

### Pin Assignment



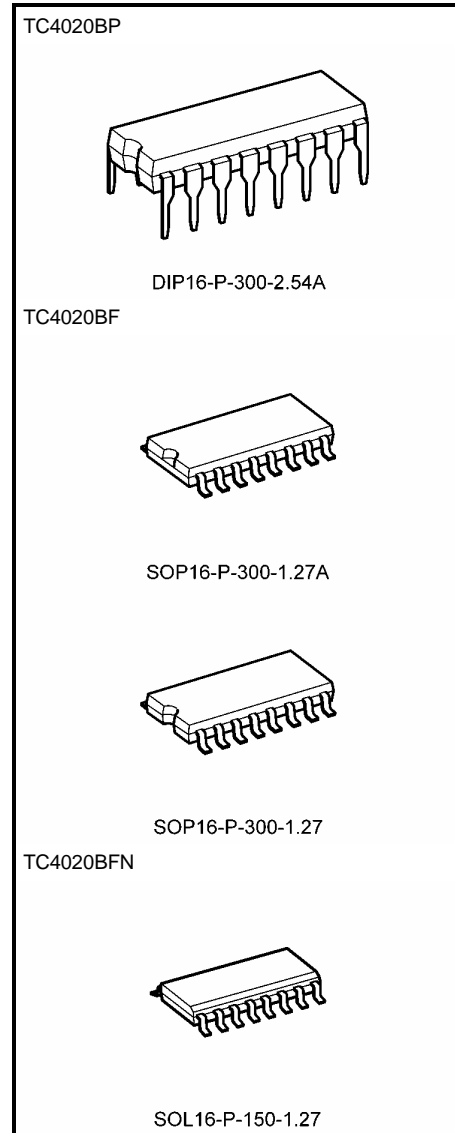
### Truth Table

CLOCK $\Delta$	RESET	Output State
*	H	All Outputs = "L"
$\uparrow$	L	No Change
$\downarrow$	L	Advance to Next State

$\Delta$ : Level change

\*: Don't care

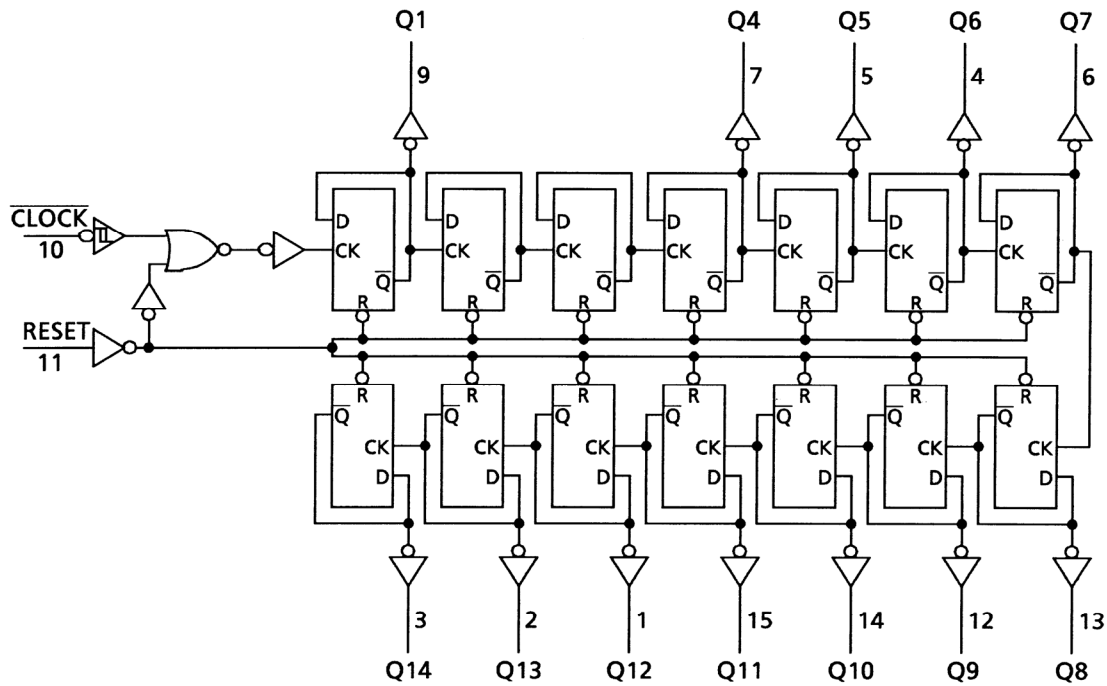
Note: xxxFN (JEDEC SOP) is not available in Japan.



Weight

DIP16-P-300-2.54A	: 1.00 g (typ.)
SOP16-P-300-1.27A	: 0.18 g (typ.)
SOP16-P-300-1.27	: 0.18 g (typ.)
SOL16-P-150-1.27	: 0.13 g (typ.)

## 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<sub>SS</sub> = 0 V)**

Characteristics	Symbol	Test Condition	V <sub>DD</sub> (V)	-40°C		25°C			85°C		Unit	
				Min	Max	Min	Typ.	Max	Min	Max		
High-level output voltage	V <sub>OH</sub>	I <sub>OUT</sub>   < 1 μA V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>	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 <sub>OL</sub>	I <sub>OUT</sub>   < 1 μA V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>	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 <sub>OH</sub>	V <sub>OH</sub> = 4.6 V	5	-0.61	—	-0.51	-1.0	—	-0.42	—	mA	
		V <sub>OH</sub> = 2.5 V	5	-2.50	—	-2.10	-4.0	—	-1.70	—		
		V <sub>OH</sub> = 9.5 V	10	-1.50	—	-1.30	-2.2	—	-1.10	—		
		V <sub>OH</sub> = 13.5 V	15	-4.00	—	-3.40	-9.0	—	-2.80	—		
		V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>										
Output low current	I <sub>OL</sub>	V <sub>OL</sub> = 0.4 V	5	0.61	—	0.51	1.2	—	0.42	—	mA	
		V <sub>OL</sub> = 0.5 V	10	1.50	—	1.30	3.2	—	1.10	—		
		V <sub>OL</sub> = 1.5 V	15	4.00	—	3.40	12.0	—	2.80	—		
		V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>										
Input high voltage	V <sub>IH</sub>	V <sub>OUT</sub> = 0.5 V, 4.5 V	5	3.5	—	3.5	2.75	—	3.5	—	V	
		V <sub>OUT</sub> = 1.0 V, 9.0 V	10	7.0	—	7.0	5.50	—	7.0	—		
		V <sub>OUT</sub> = 1.5 V, 13.5 V	15	11.0	—	11.0	8.25	—	11.0	—		
		I <sub>OUT</sub>   < 1 μA										
Input low voltage	V <sub>IL</sub>	V <sub>OUT</sub> = 0.5 V, 4.5 V	5	—	1.5	—	2.25	1.5	—	1.5	V	
		V <sub>OUT</sub> = 1.0 V, 9.0 V	10	—	3.0	—	4.50	3.0	—	3.0		
		V <sub>OUT</sub> = 1.5 V, 13.5 V	15	—	4.0	—	6.75	4.0	—	4.0		
		I <sub>OUT</sub>   < 1 μA										
Input current	"H" level	I <sub>IH</sub>	V <sub>IH</sub> = 18 V	18	—	0.1	—	10 <sup>-5</sup>	0.1	—	1.0	μA
	"L" level	I <sub>IL</sub>	V <sub>IL</sub> = 0 V	18	—	-0.1	—	-10 <sup>-5</sup>	-0.1	—	-1.0	
Quiescent supply current	I <sub>DD</sub>	V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub> (Note)	5	—	5	—	0.005	5	—	150	μA	
			10	—	10	—	0.010	10	—	300		
			15	—	20	—	0.015	20	—	600		

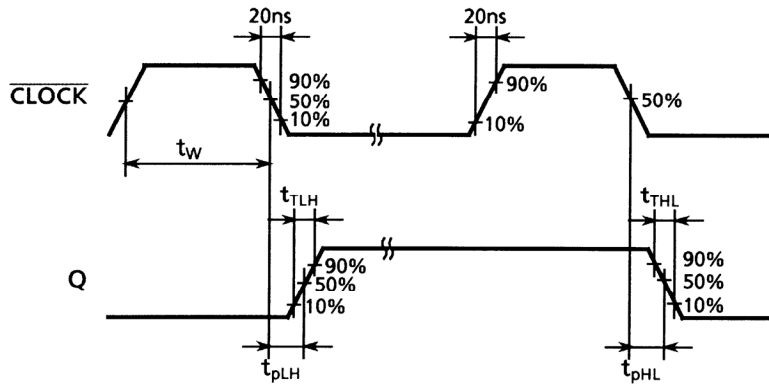
Note: All valid input combinations.

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

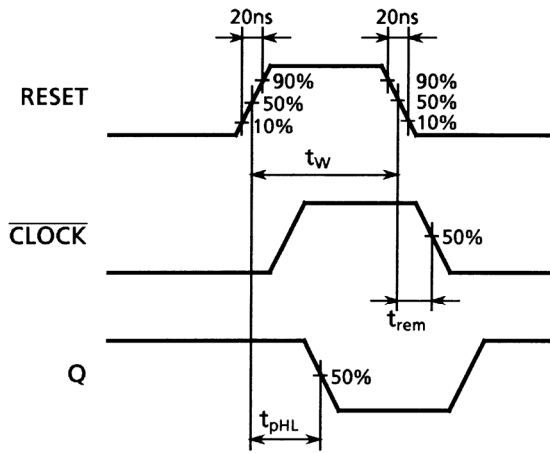
Characteristics	Symbol	Test Condition	VDD (V)	Min	Typ.	Max	Unit
Output transition time (low to high)	t <sub>TLH</sub>	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Output transition time (high to low)	t <sub>THL</sub>	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Propagation delay time ( $\overline{\text{CLOCK}}$ -Q1)	t <sub>pLH</sub>	—	5	—	160	360	ns
			10	—	80	160	
			15	—	65	130	
Propagation delay time ( $\overline{\text{CLOCK}}$ -Q1)	t <sub>pHL</sub>	—	5	—	160	360	ns
			10	—	80	160	
			15	—	65	130	
Propagation delay time ( $\overline{\text{CLOCK}}$ -Q14)	t <sub>pLH</sub>	—	5	—	1000	2000	ns
			10	—	500	1000	
			15	—	400	800	
Propagation delay time ( $\overline{\text{CLOCK}}$ -Q14)	t <sub>pHL</sub>	—	5	—	1000	2000	ns
			10	—	500	1000	
			15	—	400	800	
Propagation delay time (RESET-Q)	t <sub>pHL</sub>	—	5	—	150	280	ns
			10	—	70	120	
			15	—	50	100	
Max clock frequency	f <sub>CL</sub>	—	5	3.5	10	—	MHz
			10	8.0	20	—	
			15	12.0	25	—	
Min clock pulse width (RESET)	t <sub>w</sub>	—	5	—	50	140	ns
			10	—	20	60	
			15	—	15	40	
Min pulse width	t <sub>w</sub>	—	5	—	100	200	ns
			10	—	40	80	
			15	—	30	60	
Min removal time (RESET- $\overline{\text{CLOCK}}$ )	t <sub>rem</sub>	—	5	—	—	350	ns
			10	—	—	150	
			15	—	—	100	
Max clock input rise time Max clock input fall time	t <sub>rCL</sub> t <sub>fCL</sub>	—	5	No limit			μs
			10				
			15				
Input capacitance	C <sub>IN</sub>	—	—	5	7.5	pF	

**Operating Supply Current Test Circuit**

**Waveform 1**



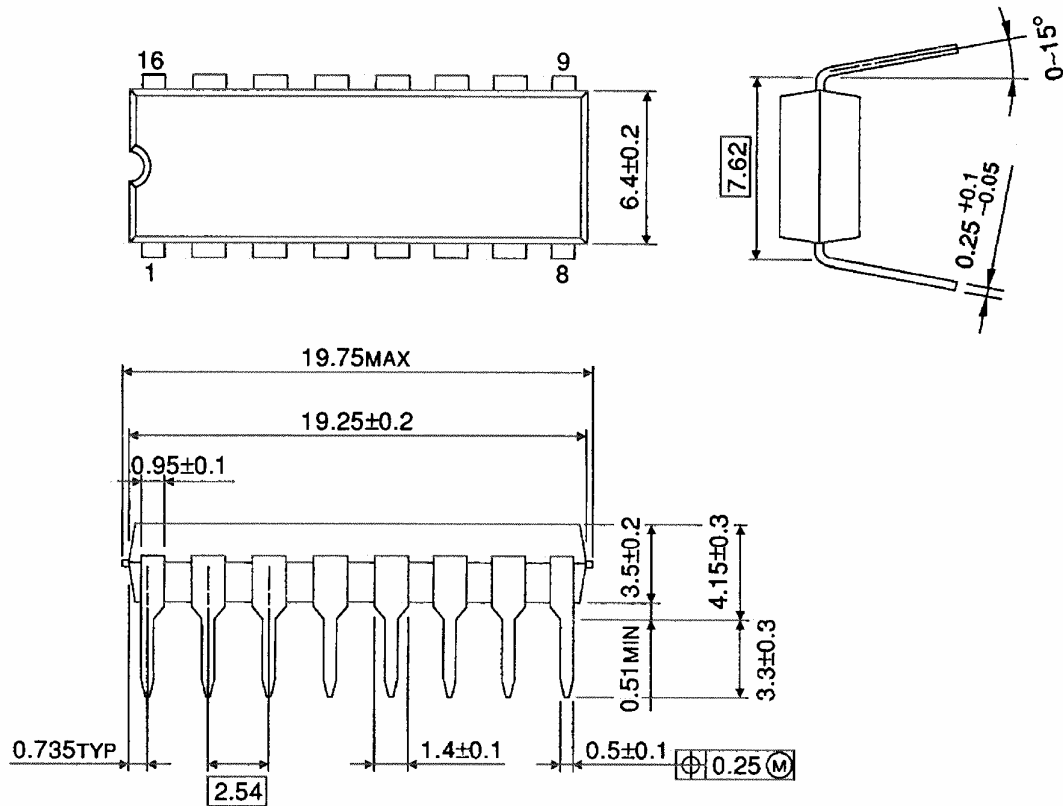
**Waveform 2**



## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

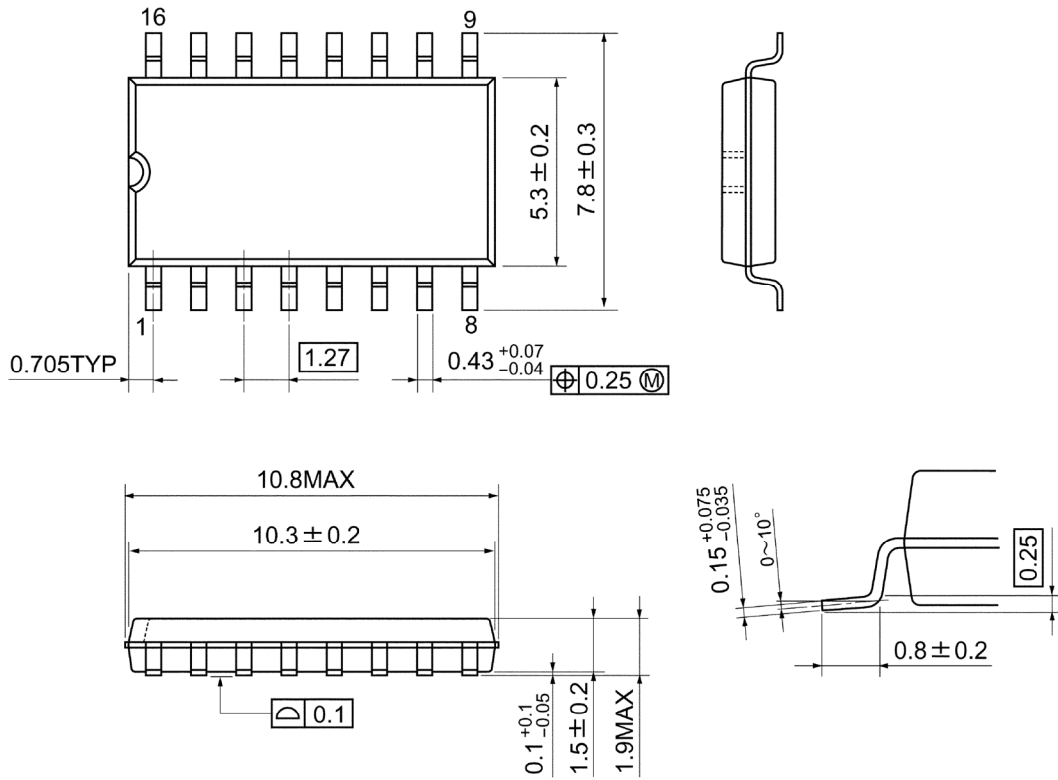


Weight: 1.00 g (typ.)

## Package Dimensions

SOP16-P-300-1.27A

Unit: mm

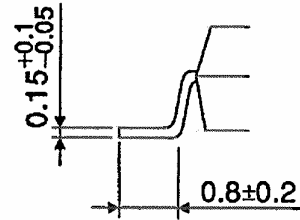
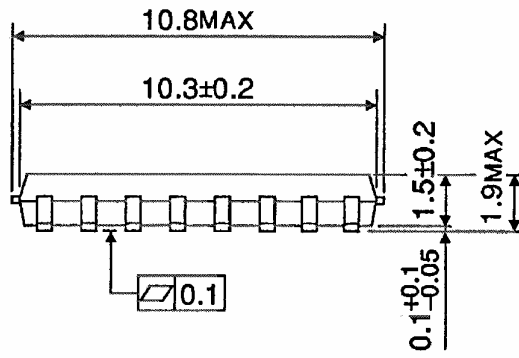
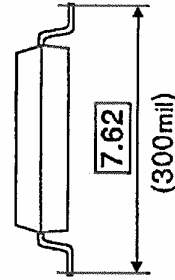
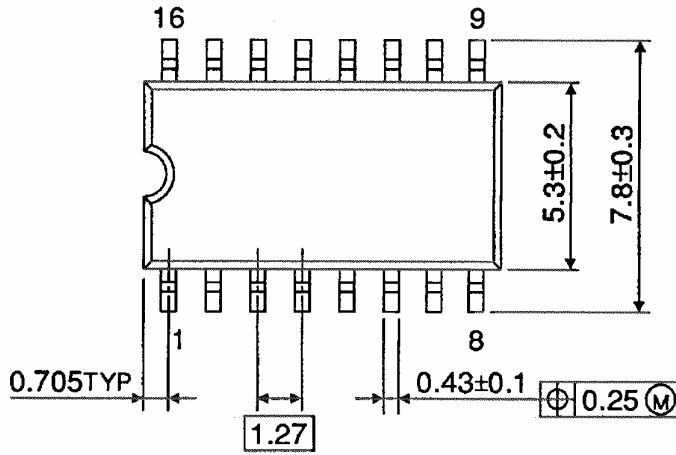


Weight: 0.18 g (typ.)

**Package Dimensions**

SOP16-P-300-1.27

Unit : mm



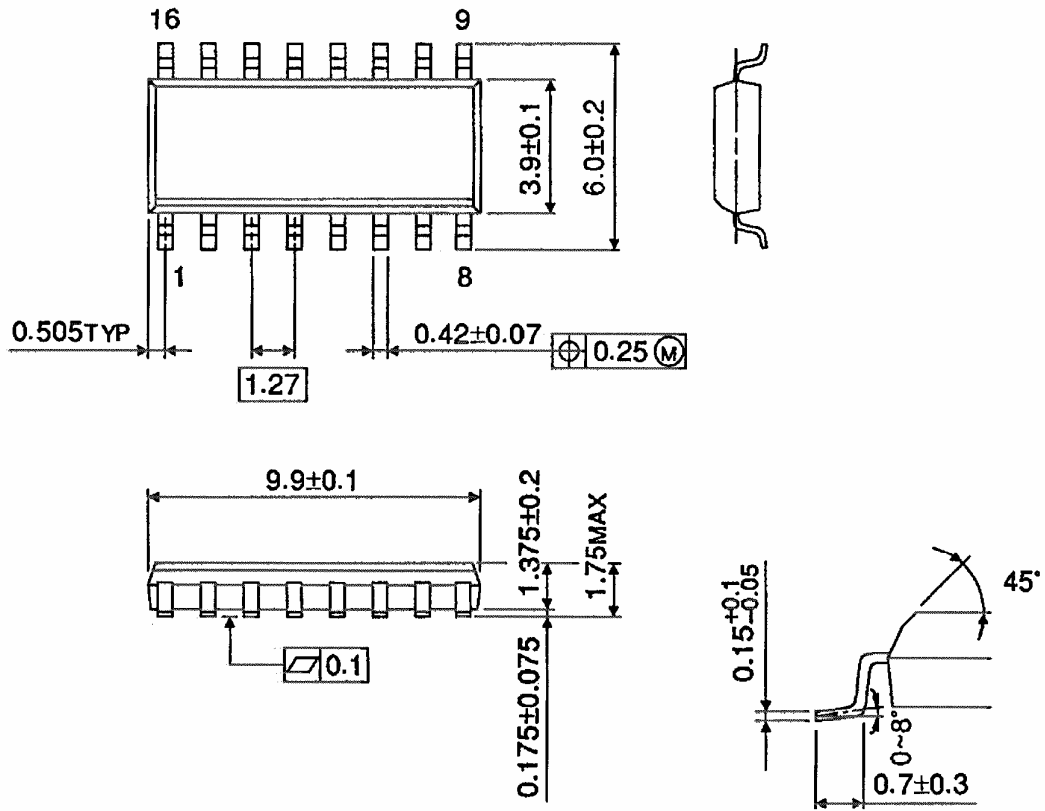
Weight: 0.18 g (typ.)



## Package Dimensions (Note)

SOL16-P-150-1.27

Unit : mm



Note: This package is not available in Japan.

Weight: 0.13 g (typ.)

**Note: Lead (Pb)-Free Packages****DIP16-P-300-2.54A SOP16-P-300-1.27A SOL16-P-150-1.27****RESTRICTIONS ON PRODUCT USE**

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