

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC74HC4020AP, TC74HC4020AF, TC74HC4020AFN TC74HC4040AP, TC74HC4040AF, TC74HC4040AFN

TC74HC4020AP/AF/AFN 14-Stage Binary Counter

TC74HC4040AP/AF/AFN 12-Stage Binary Counter

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

The TC74HC4020A/TC74HC4040A are high speed CMOS BINARY COUNTER/DIVIDERS fabricated with silicon gate C<sup>2</sup>MOS technology.

They achieve the high speed operation similar to equivalent LSTTL while maintaining the CMOS dissipation.

The TC74HC4020A is a 14-STAGE BINARY COUNTER, and the TC74HC4040A is a 12-STAGE BINARY COUNTER.

Setting CLR to high resets the counter to low.

A negative transition on the CK input brings one increment into the counter.

The TC74HC4020A provides 12 divided outputs: 1<sup>st</sup> stage and stage 4 thru stage 14. At Q14, a 1/16384 divided frequency will be output.

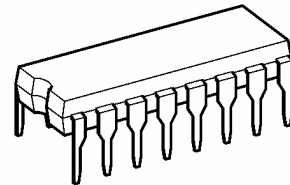
The TC74HC4040A provides all divided output stages, and at Q12, a 1/4096 divided frequency will be output.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

### Features

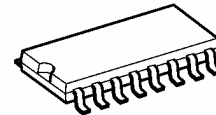
- High speed:  $f_{max} = 73$  MHz (typ.) at  $V_{CC} = 5$  V
- Low power dissipation:  $I_{CC} = 4$   $\mu$ A (max) at  $T_a = 25^\circ$ C
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\%$   $V_{CC}$  (min)
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 4$  mA (min)
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC}$  (opr) = 2~6 V
- Pin and function compatible with 4020B/4040B

TC74HC4020AP, TC74HC4040AP

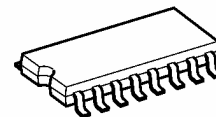


DIP16-P-300-2.54A

TC74HC4020AF, TC74HC4040AF

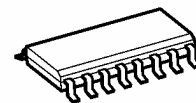


SOP16-P-300-1.27A



SOP16-P-300-1.27

TC74HC4020AFN, TC74HC4040AFN



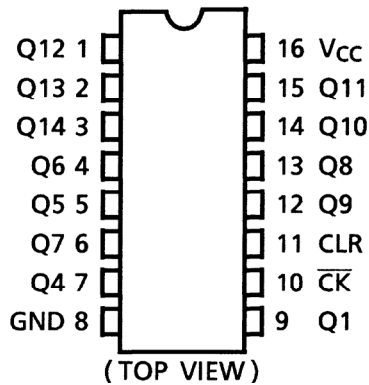
SOL16-P-150-1.27

Weight

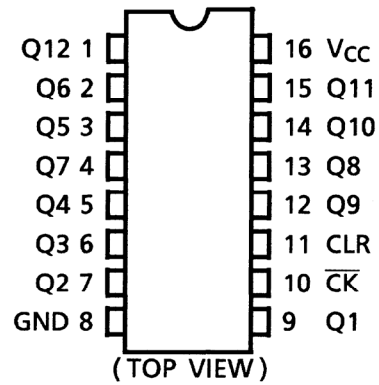
DIP16-P-300-2.54A	: 1.00 g (typ.)
SOP16-P-300-1.27A	: 0.18 g (typ.)
SOP16-P-300-1.27	: 0.18 g (typ.)
SOL16-P-150-1.27	: 0.13 g (typ.)

## Pin Assignment

TC74HC4020A

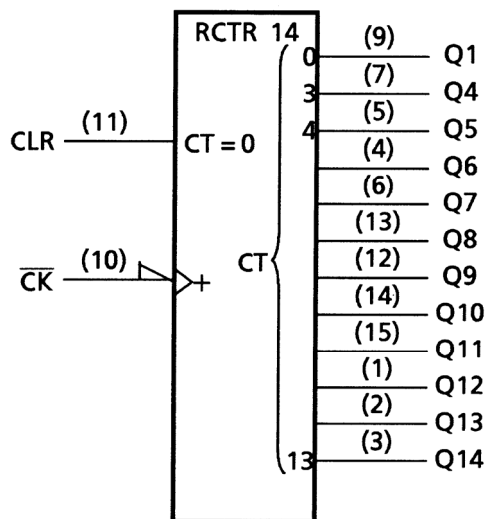


TC74HC4040A

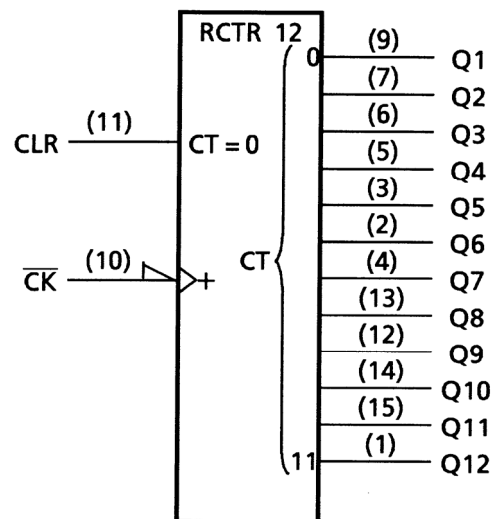


## IEC Logic Symbol

TC74HC4020A



TC74HC4040A



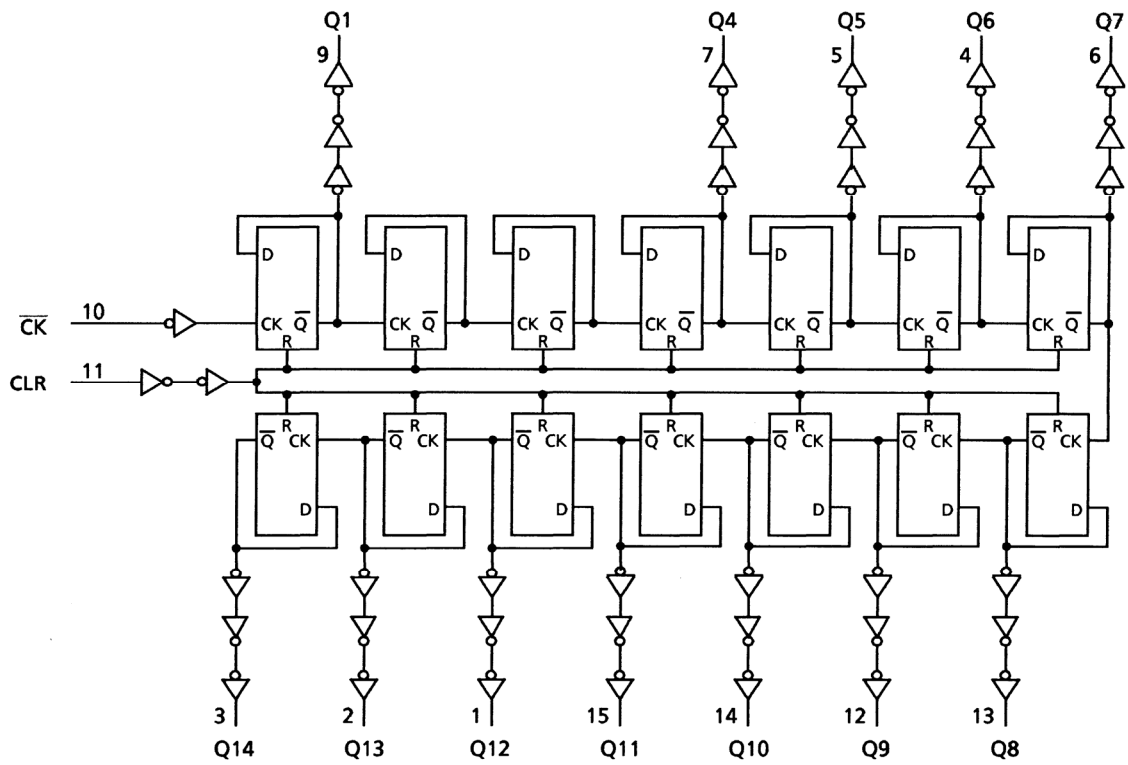
## Truth Table

$\overline{CK}$	CLR	Output State
X	H	All Output = "L"
$\uparrow$	L	No Change
$\downarrow$	L	Advance to Next State

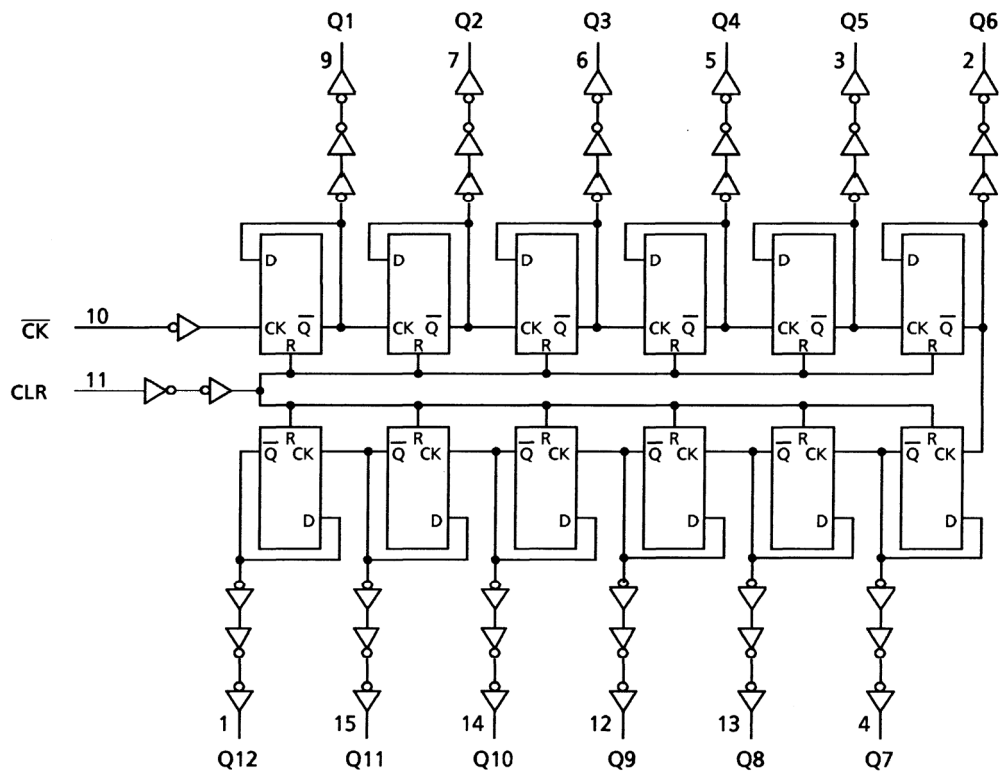
X: Don't care

## System Diagram

### TC74HC4020A



### TC74HC4040A



## Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-0.5~7	V
DC input voltage	$V_{IN}$	-0.5~ $V_{CC} + 0.5$	V
DC output voltage	$V_{OUT}$	-0.5~ $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$	$\pm 20$	mA
Output diode current	$I_{OK}$	$\pm 20$	mA
DC output current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 50$	mA
Power dissipation	$P_D$	500 (DIP) (Note 2)/180 (SOP)	mW
Storage temperature	$T_{stg}$	-65~150	°C

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Note 2: 500 mW in the range of  $T_a = -40$  to  $65^\circ\text{C}$ . From  $T_a = 65$  to  $85^\circ\text{C}$  a derating factor of  $-10$  mW/°C shall be applied until 300 mW.

## Recommended Operating Conditions (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	2~6	V
Input voltage	$V_{IN}$	0~ $V_{CC}$	V
Output voltage	$V_{OUT}$	0~ $V_{CC}$	V
Operating temperature	$T_{opr}$	-40~85	°C
Input rise and fall time	$t_r, t_f$	0~1000 ( $V_{CC} = 2.0$ V) 0~500 ( $V_{CC} = 4.5$ V) 0~400 ( $V_{CC} = 6.0$ V)	ns

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.

## Electrical Characteristics

### DC Characteristics

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40~85°C		Unit	
				V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
High-level input voltage	V <sub>IH</sub>	—		2.0	1.50	—	—	1.50	—	V
				4.5	3.15	—	—	3.15	—	
				6.0	4.20	—	—	4.20	—	
Low-level input voltage	V <sub>IL</sub>	—		2.0	—	—	0.50	—	0.50	V
				4.5	—	—	1.35	—	1.35	
				6.0	—	—	1.80	—	1.80	
High-level output voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -20 μA	2.0	1.9	2.0	—	1.9	—	V
				4.5	4.4	4.5	—	4.4	—	
				6.0	5.9	6.0	—	5.9	—	
			I <sub>OH</sub> = -4 mA	4.5	4.18	4.31	—	4.13	—	
				6.0	5.68	5.80	—	5.63	—	
				I <sub>OH</sub> = -5.2 mA	4.5	—	—	—	—	
Low-level output voltage	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 20 μA	2.0	—	0.0	0.1	—	0.1	V
				4.5	—	0.0	0.1	—	0.1	
				6.0	—	0.0	0.1	—	0.1	
			I <sub>OL</sub> = 4 mA	4.5	—	0.17	0.26	—	0.33	
				6.0	—	0.18	0.26	—	0.33	
				I <sub>OL</sub> = 5.2 mA	4.5	—	—	—	—	
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		6.0	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		6.0	—	—	4.0	—	40.0	μA

### Timing Requirements (input: t<sub>r</sub> = t<sub>f</sub> = 6 ns)

Characteristics	Symbol	Test Condition		Ta = 25°C		Ta = -40~85°C	Unit	
				V <sub>CC</sub> (V)	Typ.	Limit		Limit
Minimum pulse width (CK)	t <sub>W</sub> (L) t <sub>W</sub> (H)	—		2.0	—	75	95	ns
				4.5	—	15	19	
				6.0	—	13	16	
Minimum pulse width (CLR)	t <sub>W</sub> (H)	—		2.0	—	75	95	ns
				4.5	—	15	19	
				6.0	—	13	16	
Minimum removal time	t <sub>rem</sub>	—		2.0	—	25	30	ns
				4.5	—	5	6	
				6.0	—	5	5	
Clock frequency	f	—		2.0	—	6	5	MHz
				4.5	—	30	24	
				6.0	—	35	28	

### AC Characteristics ( $C_L = 15 \text{ pF}$ , $V_{CC} = 5 \text{ V}$ , $T_a = 25^\circ\text{C}$ , input: $t_r = t_f = 6 \text{ ns}$ )

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output transition time	$t_{TLH}$ $t_{THL}$	—	—	4	8	ns
Propagation delay time ( $\overline{\text{CK}} - Q1$ )	$t_{pLH}$ $t_{pHL}$	—	—	16	24	ns
Propagation delay time ( $Q_n - Q_{n+1}$ )	$\Delta t_{pd}$	—	—	5	14	ns
Propagation delay time (CLR)	$t_{pHL}$	—	—	14	24	ns
Maximum clock frequency	$f_{max}$	—	33	73	—	MHz

### AC Characteristics ( $C_L = 50 \text{ pF}$ , input: $t_r = t_f = 6 \text{ ns}$ )

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	$T_a = 25^\circ\text{C}$			$T_a = -40 \sim 85^\circ\text{C}$		Unit
				Min	Typ.	Max	Min	Max	
Output transition time	$t_{TLH}$ $t_{THL}$	—	2.0	—	30	75	—	95	ns
			4.5	—	8	15	—	19	
			6.0	—	7	13	—	16	
Propagation delay time ( $\overline{\text{CK}} - Q1$ )	$t_{pLH}$ $t_{pHL}$	—	2.0	—	70	145	—	180	ns
			4.5	—	20	29	—	36	
			6.0	—	17	25	—	31	
Propagation delay time ( $Q_n - Q_{n+1}$ )	$\Delta t_{pd}$	—	2.0	—	20	75	—	95	ns
			4.5	—	6	15	—	19	
			6.0	—	4	13	—	16	
Propagation delay time (CLR)	$t_{pHL}$	—	2.0	—	55	140	—	175	ns
			4.5	—	17	28	—	35	
			6.0	—	14	24	—	30	
Maximum clock frequency	$f_{max}$	—	2.0	6	17	—	5	—	MHz
			4.5	30	66	—	24	—	
			6.0	35	78	—	28	—	
Input capacitance	$C_{IN}$	—	—	5	10	—	10	pF	
Power dissipation capacitance	CPD (Note)	TC74HC4020A	—	27	—	—	—	pF	
		TC74HC4040A	—	37	—	—	—		

Note:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

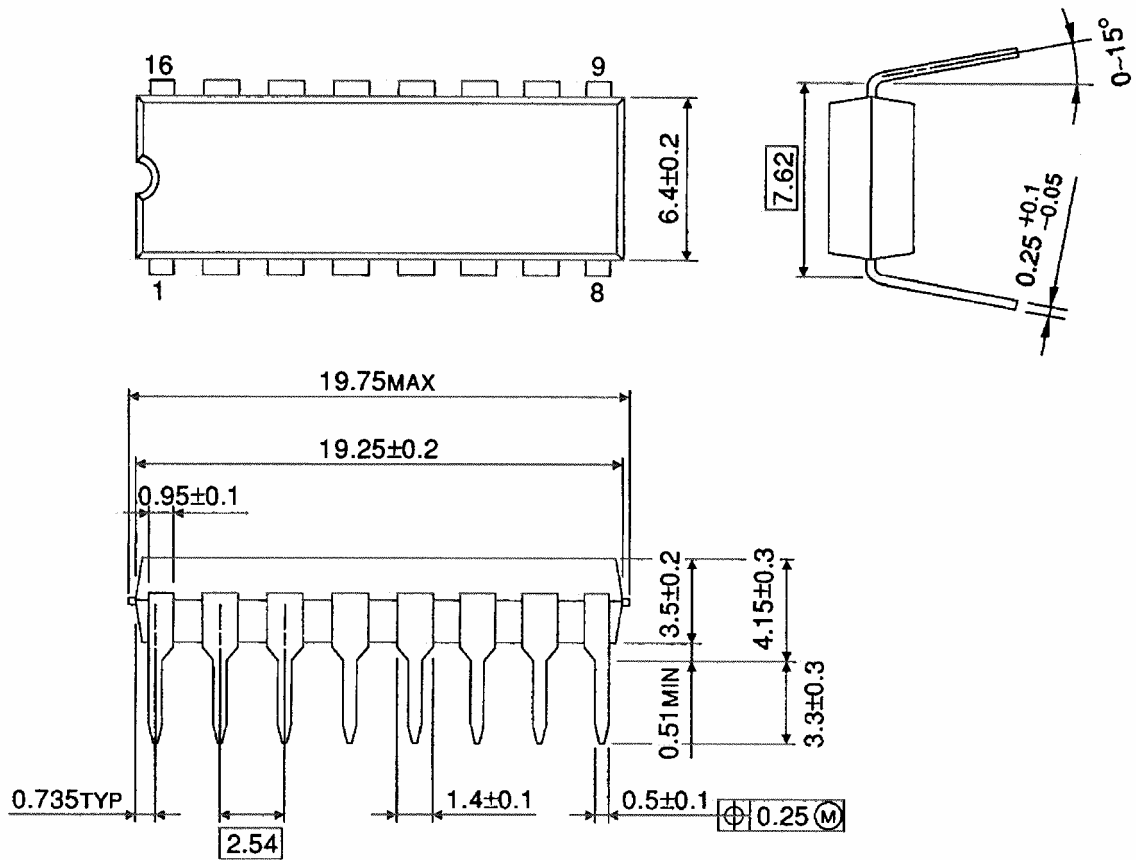
Average operating current can be obtained by the equation:

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

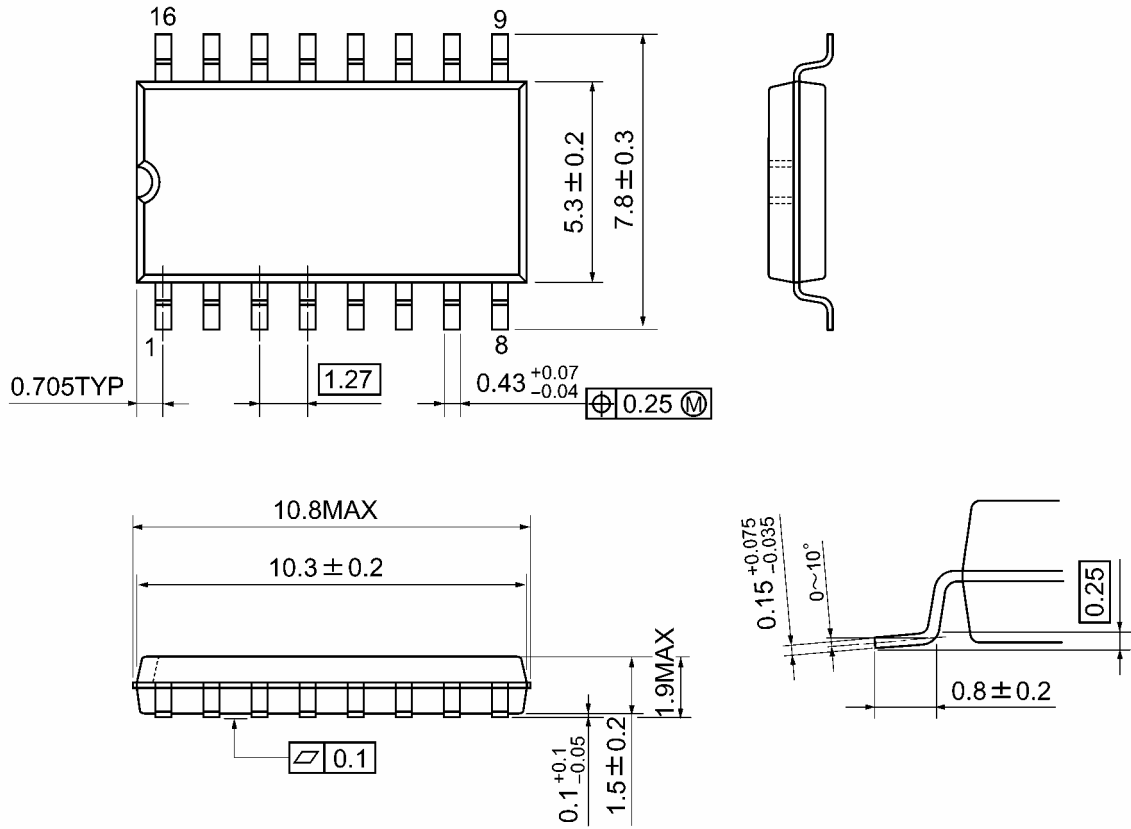


Weight: 1.00 g (typ.)

**Package Dimensions**

SOP16-P-300-1.27A

Unit: mm



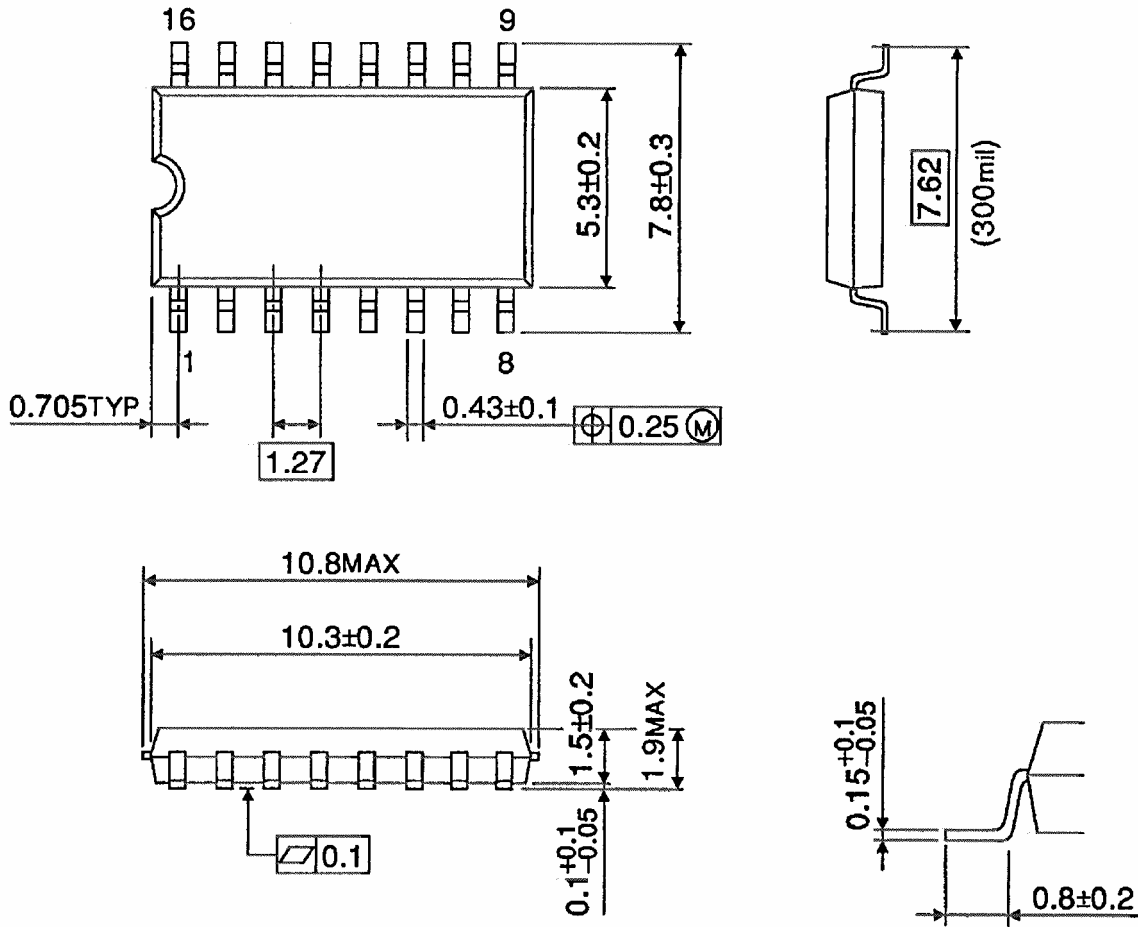
Weight: 0.18 g (typ.)



**Package Dimensions**

SOP16-P-300-1.27

Unit : mm

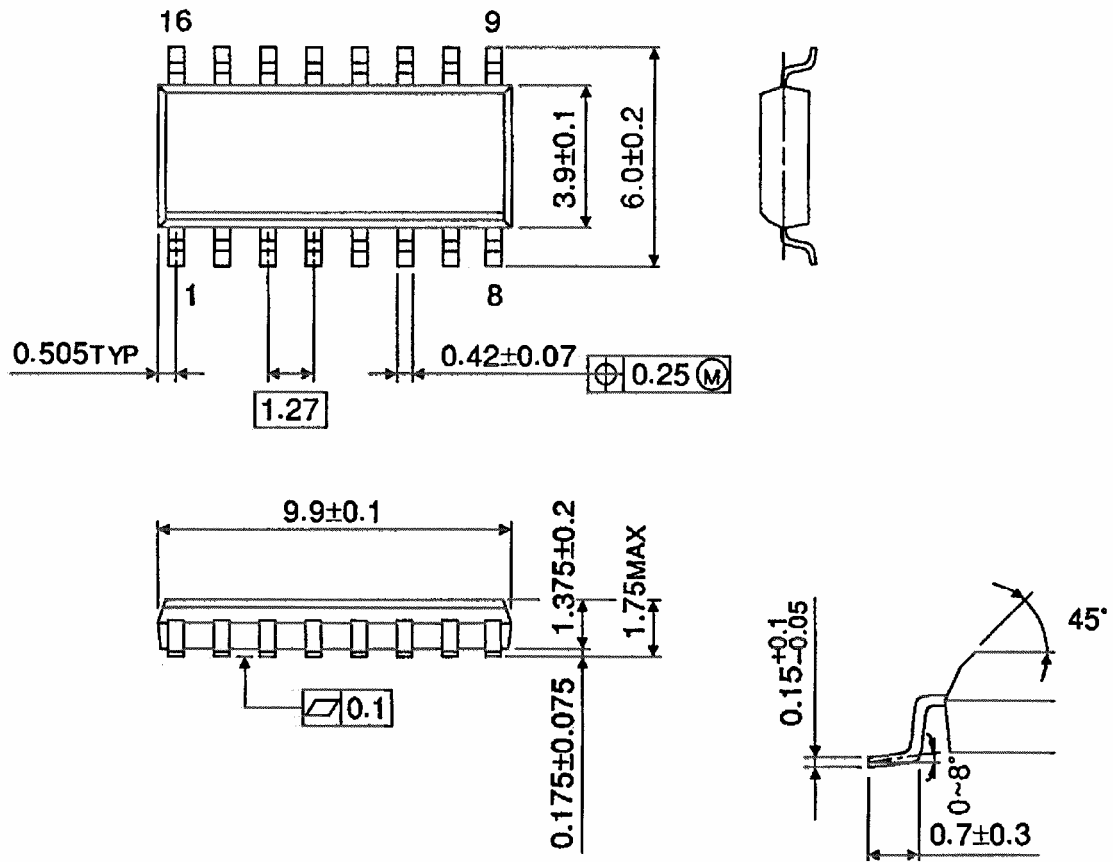


Weight: 0.18 g (typ.)

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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