

# TC74HC4060AP, TC74HC4060AF

## 14-Stage Binary Counter/Oscillator

The TC74HC4060A is a high speed CMOS 14-STAGE BINARY COUNTER fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

The oscillator configuration allows designs using either RC or crystal oscillator circuits, or an external clock may be used.

The clear input resets the counter to a low level on all outputs and disables the oscillator.

A high CLR accomplishes this reset function.

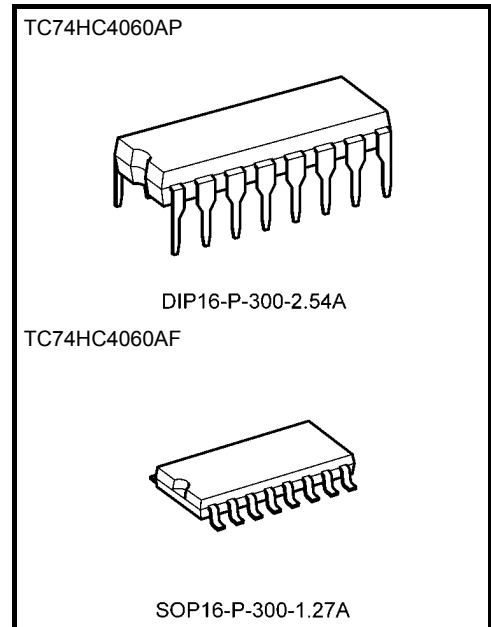
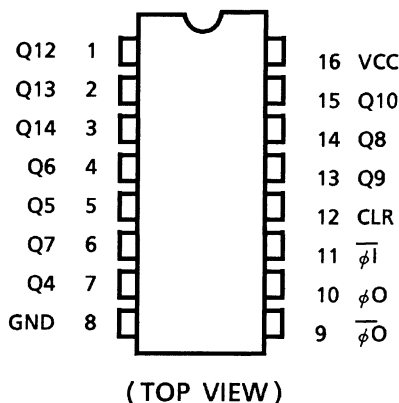
A negative transition on the clock input ( $\overline{\phi}$ ) increments the counter. Ten levels of divided output are provided: 4 stage thru 10 stage and 12 stage thru 14 stage. At the last stage (Q14), a 1/16384 divided frequency is obtained.

The  $\overline{\phi}$  I input and CLR input are equipped with protection circuits against static discharge or transient excess voltage.

### Features

- High speed:  $f_{max} = 58$  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 to 6 V
- Oscillator configuration: RC or crystal oscillator
- Pin and function compatible with 4060B

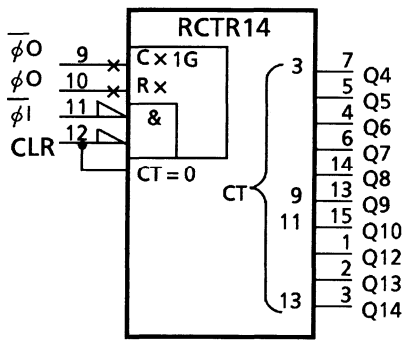
### Pin Assignment



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

Start of commercial production  
1987-11

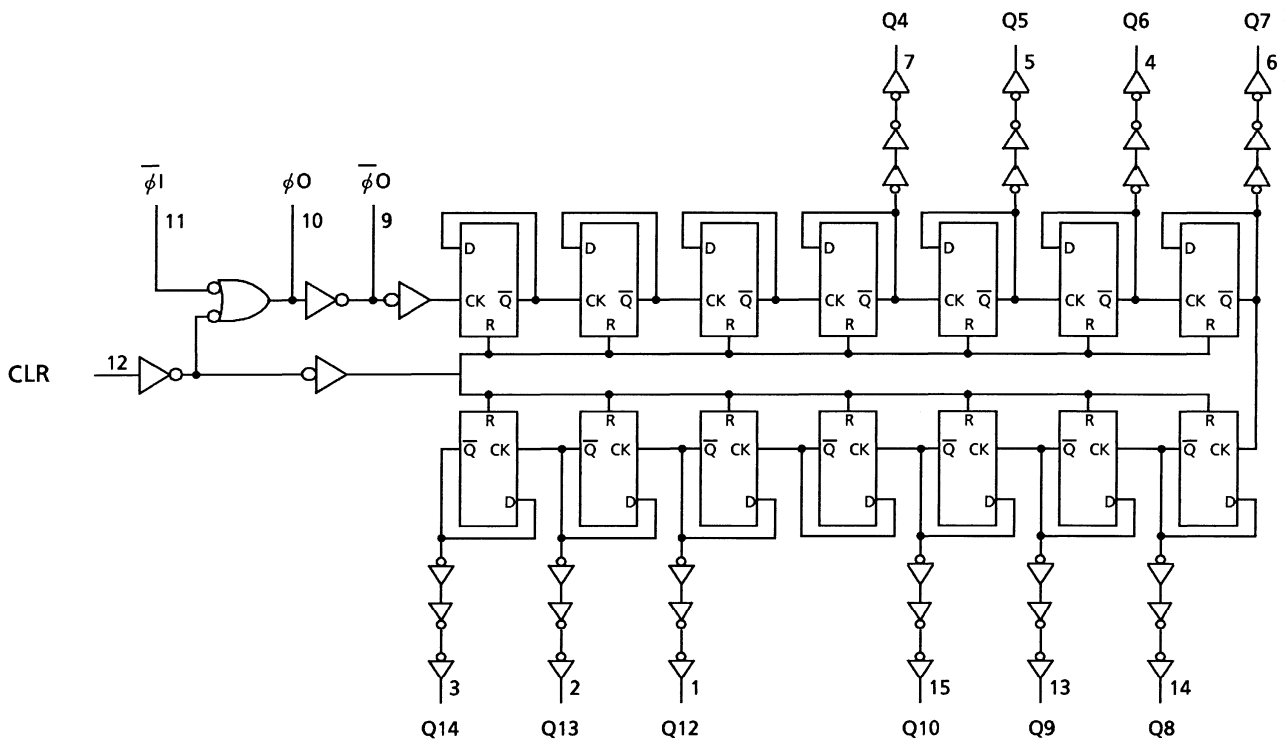
## IEC Logic Symbol



## Truth Table

Inputs		Function
$\bar{\phi}I$	CLR	
X	H	Counter is reset to zero state. $\phi O$ output goes to high level. $\bar{\phi}O$ output goes to low level.
$\downarrow$	L	Count up one step.
$\uparrow$	L	No Change

## System Diagram



## Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-0.5 to 7	V
DC input voltage	$V_{IN}$	-0.5 to $V_{CC} + 0.5$	V
DC output voltage	$V_{OUT}$	-0.5 to $V_{CC} + 0.5$	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 to 150	$^{\circ}C$

Note 1: 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).

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

## Operating Range (Note)

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

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either  $V_{CC}$  or GND.

## Electrical Characteristics

### DC Characteristics

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 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 (Qn)	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	—	
			I <sub>OH</sub> = -4 mA	4.5	4.18	4.31	—	4.13	—	
				6.0	5.68	5.80	—	5.63	—	
High-level output voltage (φO, φ̄O)	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	1.8	2.0	—	1.8	—	V
				4.5	4.0	4.5	—	4.0	—	
				6.0	5.5	5.9	—	5.5	—	
Low-level output voltage (Qn)	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	
			I <sub>OL</sub> = 4 mA	4.5	—	0.17	0.26	—	0.33	
				6.0	—	0.18	0.26	—	0.33	
Low-level output voltage (φO, φ̄O)	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	0.2	—	0.2	V
				4.5	—	0.0	0.5	—	0.5	
				6.0	—	0.1	0.5	—	0.5	
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:  $t_r = t_f = 6 \text{ ns}$ )**

Characteristics	Symbol	Test Condition	Ta = 25°C		Ta = -40 to 85°C	Unit	
			V <sub>CC</sub> (V)	Typ.	Limit		
Minimum pulse width ( $\bar{\phi}$ )	$t_W$ (L) $t_W$ (H)	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum pulse time (CLR)	$t_W$ (H)	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum removal time	$t_{rem}$	—	2.0	—	100	125	ns
			4.5	—	20	25	
			6.0	—	17	21	
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	$t_{TLH}$	—	—	4	8	ns
	$t_{THL}$					
Propagation delay time ( $\bar{\phi}$ - Q <sub>4</sub> )	$t_{pLH}$	—	—	36	53	ns
	$t_{pHL}$					
Propagation delay time difference (Q <sub>n</sub> - Q <sub>n + 1</sub> )	$\Delta t_{pd}$	$C_L = 15 \text{ pF}$ (Q <sub>n</sub> , Q <sub>n + 1</sub> )	—	6	14	ns
Propagation delay time (CLR)	$t_{pHL}$	—	—	19	34	ns
Maximum clock frequency	$f_{max}$	—	33	58	—	MHz

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

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit	
			VCC (V)	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 ( $\bar{\phi}1$ -Q4)	$t_{pLH}$ $t_{pHL}$	—	2.0	—	170	300	—	375	ns
			4.5	—	41	60	—	75	
			6.0	—	30	51	—	64	
Propagation delay time difference (Qn-Qn + 1)	$\Delta t_{pd}$	$C_L = 50 \text{ pF}$ (Qn, Qn + 1)	2.0	—	32	75	—	95	ns
			4.5	—	7	15	—	19	
			6.0	—	5	13	—	16	
Propagation delay time (CLR)	$t_{pHL}$	—	2.0	—	85	195	—	245	ns
			4.5	—	23	39	—	49	
			6.0	—	17	33	—	42	
Maximum clock frequency	$f_{max}$	—	2.0	6	12	—	5	—	MHz
			4.5	30	50	—	24	—	
			6.0	35	65	—	28	—	
Input capacitance	$C_{IN}$	—	—	5	10	—	10	pF	
Power dissipation capacitance	$C_{PD}$	(Note)	—	27	—	—	—	pF	

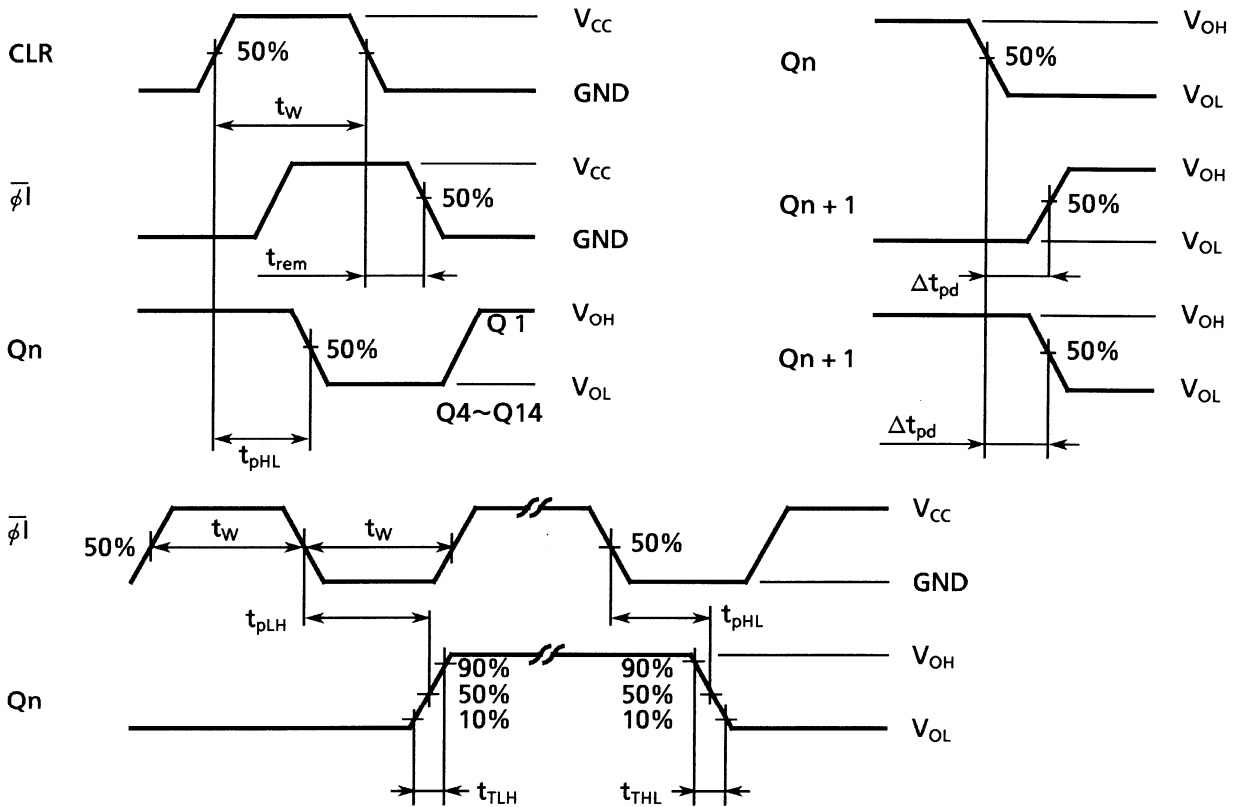
Note:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

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

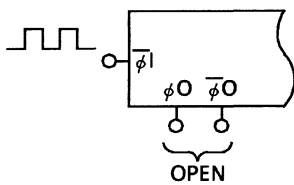
When CR or Crystal oscillation circuit is adopted, the dynamic power dissipation will be greater than the above calculation, because these oscillation circuits spend much supply current.

**Switching Characteristics Test Waveform**

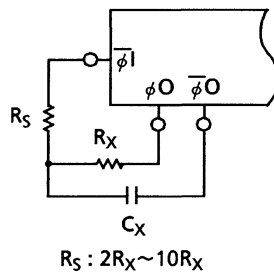


**Typical Clock Drive Circuits**

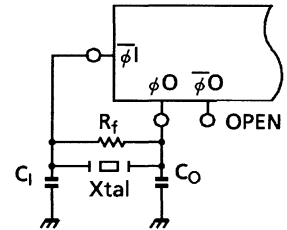
**External Clock Drive**



**Typical RC Circuit**



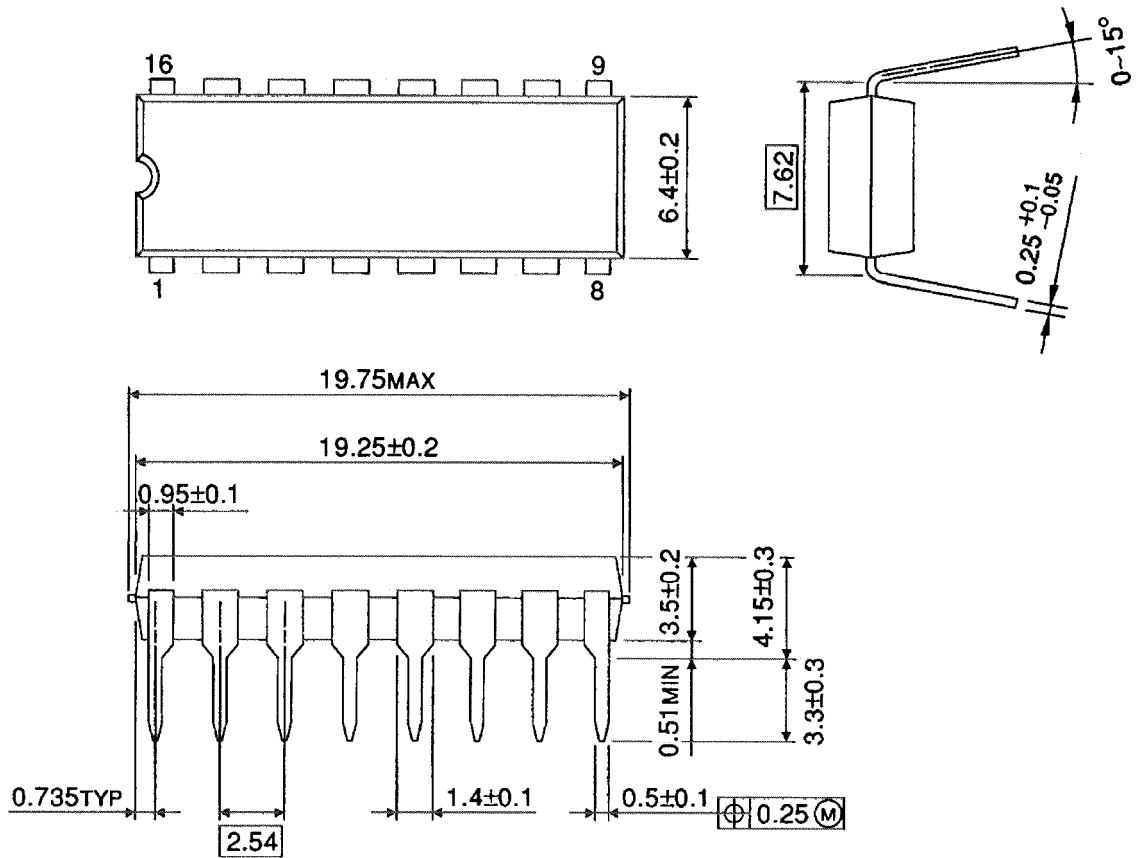
**Typical Crystal Circuit**



## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

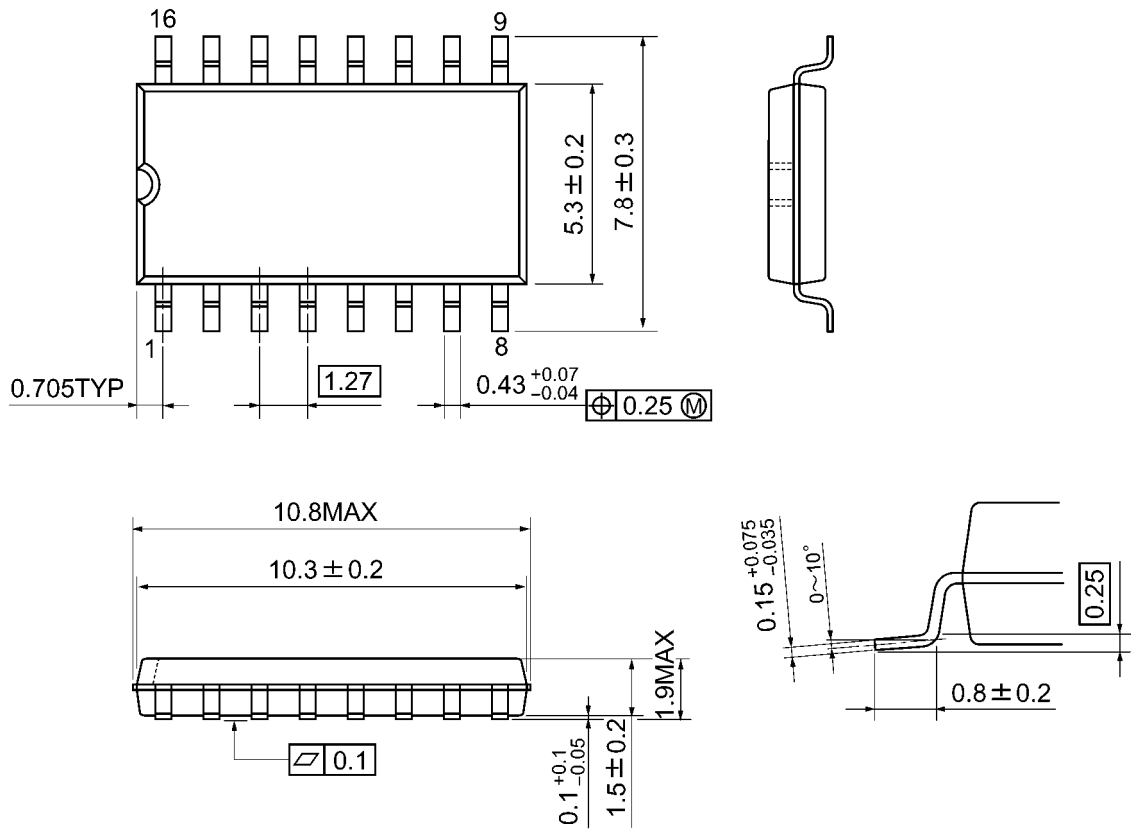


Weight: 1.00 g (typ.)

**Package Dimensions**

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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