

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) The JEDEC SOP (FN) is not available in Japan.

The TC74HC4020A / TC74HC4040A are high speed CMOS BINARY COUNTER / DIVIDERS fabricated with silicon gate C²MOS 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.

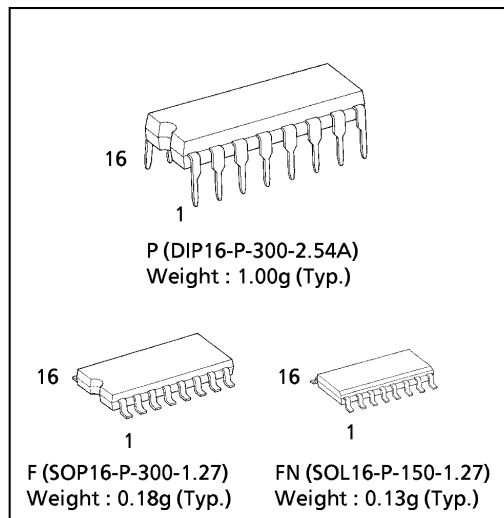
The TC74HC4020A provides 12 divided outputs : 1'st stage and atage 4 thru stage 14. At Q14, a 1 / 16384 divided frequency will be output.

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..... $f_{MAX} = 73\text{MHz}$ (typ.) at $V_{CC} = 5\text{V}$
- Low Power Dissipation..... $I_{CC} = 4\mu\text{A}$ (Max.) at $T_a = 25^\circ\text{C}$
- High Noise Immunity..... $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (Min.)
- Output Drive Capability..... 10 LSTTL Loads
- Symmetrical Output Impedance... $|I_{OH}| = I_{OL} = 4\text{mA}$ (Min.)
- Balanced Propagation Delays..... $t_{pLH} \approx t_{pHL}$
- Wide Operating Voltage Range... V_{CC} (opr.) = 2V ~ 6V
- Pin and Function Compatible with 4020B / 4040B

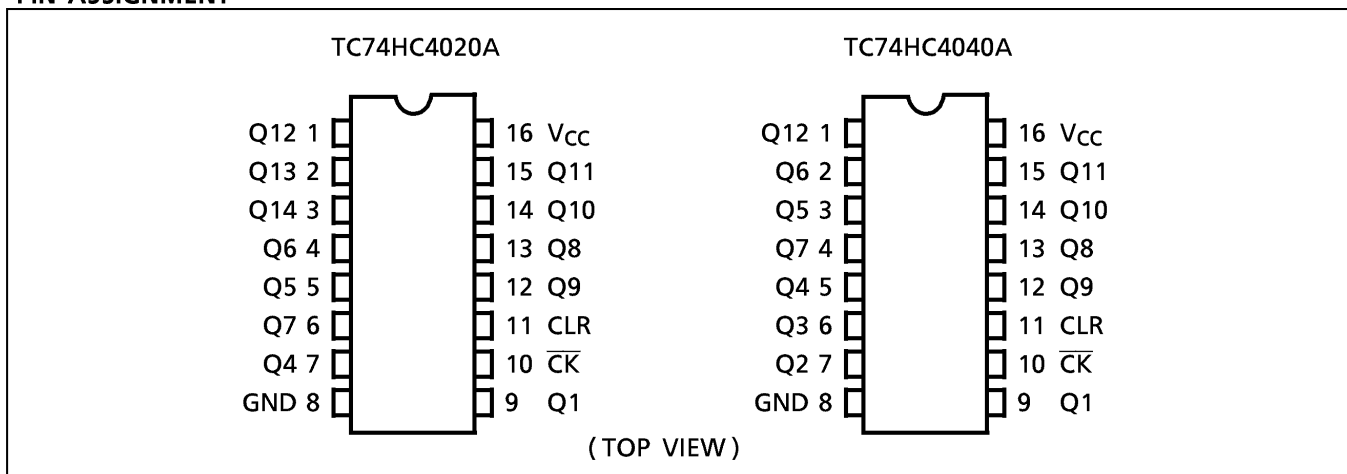


TRUTH TABLE

$\overline{\text{CK}}$	CLR	OUTPUT STATE
X	H	ALL OUTPUTS = "L"
	L	NO CHANGE
	L	ADVANCE TO NEXT STATE

X : Don't Care

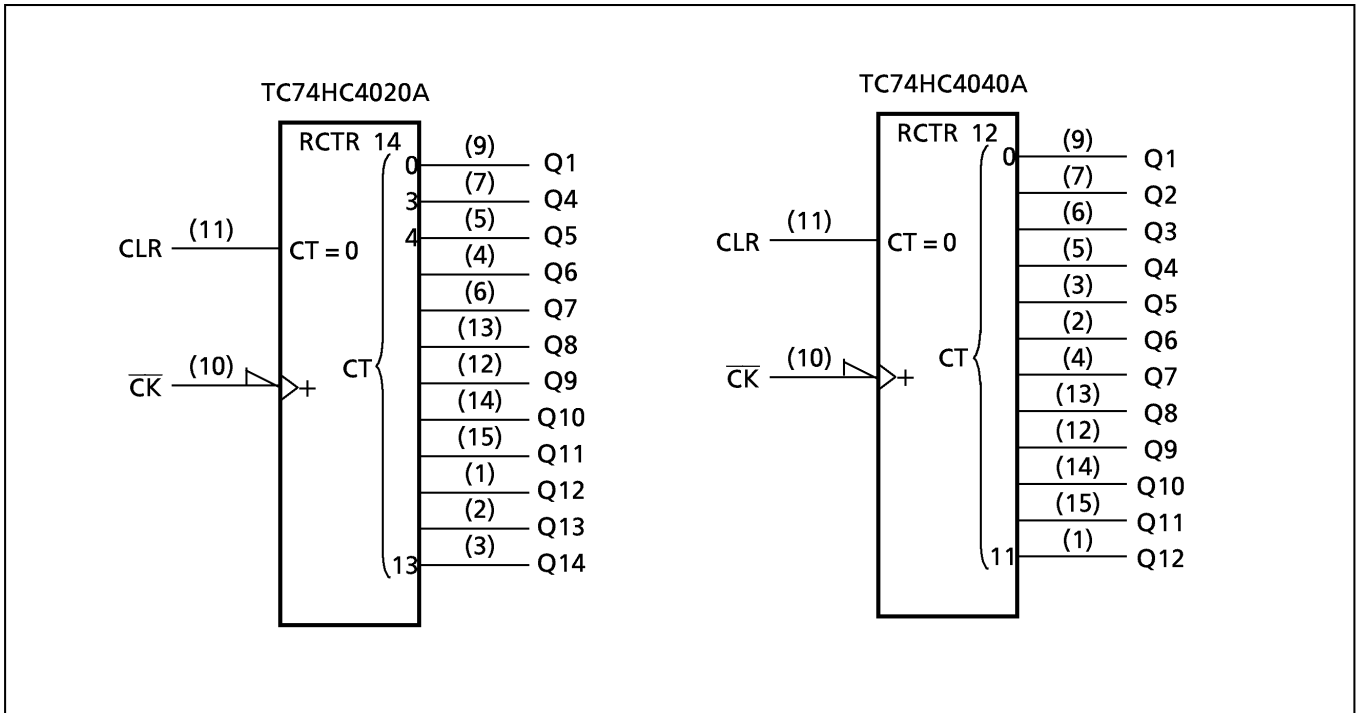
PIN ASSIGNMENT



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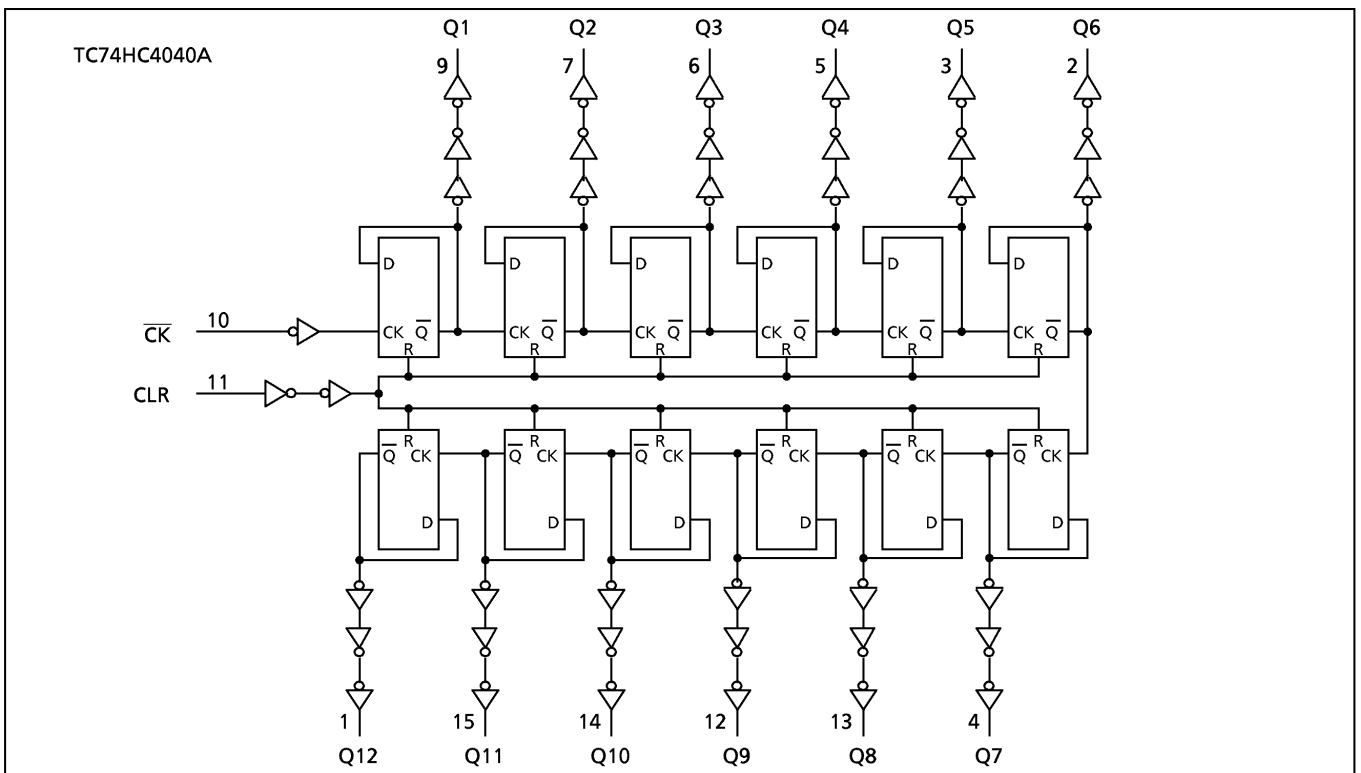
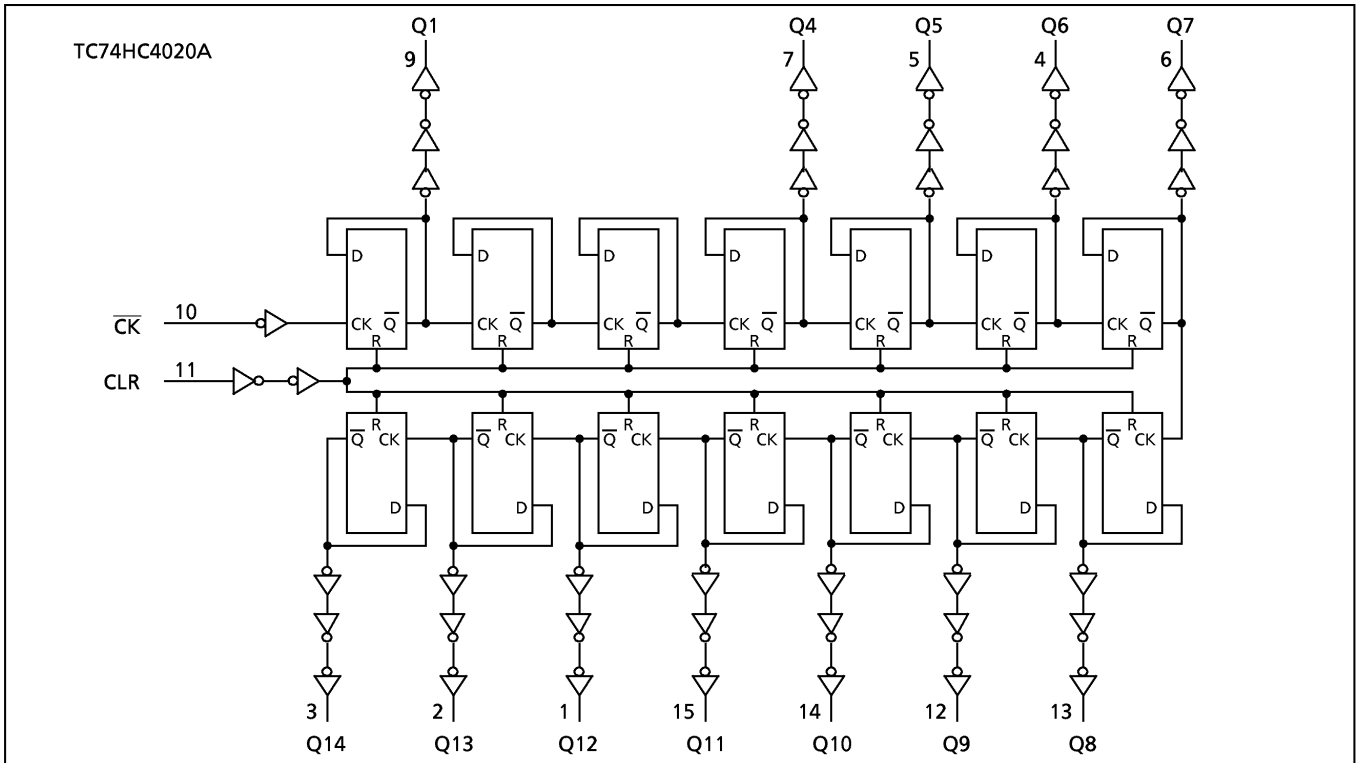
IEC LOGIC SYMBOL



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SYSTEM DIAGRAM



ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	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}	± 20	mA
Output Diode Current	I_{OK}	± 20	mA
DC Output Current	I_{OUT}	± 25	mA
DC V_{CC} /Ground Current	I_{CC}	± 50	mA
Power Dissipation	P_D	500 (DIP)* / 180 (SOP)	mW
Storage Temperature	T_{stg}	-65~150	°C

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

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	VALUE	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 ($V_{CC} = 2.0\text{V}$) 0~500 ($V_{CC} = 4.5\text{V}$) 0~400 ($V_{CC} = 6.0\text{V}$)	ns

DC ELECTRICAL CHARACTERISTICS

PARAMETER	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.					
High - Level Input Voltage	V_{IH}		2.0	1.50	—	—	1.50	—	V				
			4.5	3.15	—	—	3.15	—					
			6.0	4.20	—	—	4.20	—					
Low - Level Input Voltage	V_{IL}		2.0	—	—	0.50	—	0.50	V				
			4.5	—	—	1.35	—	1.35					
			6.0	—	—	1.80	—	1.80					
High - Level Output Voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -20\mu\text{A}$	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	—				
Low - Level Output Voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 20\mu\text{A}$	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				
Input Leakage Current	I_{IN}	$V_{IN} = V_{CC}$ or GND	6.0	—	—	± 0.1	—	± 1.0	μA				
				Quiescent Supply Current	I_{CC}	$V_{IN} = V_{CC}$ or GND	6.0	—		—	4.0	—	40.0

TIMING REQUIREMENTS (Input $t_r = t_f = 6\text{ns}$)

PARAMETER	SYMBOL	TEST CONDITION	Ta = 25°C			Ta = -40~85°C	UNIT
			V _{CC} (V)	TYP.	LIMIT	LIMIT	
Minimum Pulse Width ($\overline{\text{CK}}$)	$t_{W(L)}$ $t_{W(H)}$		2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Pulse Width (CLR)	$t_{W(H)}$		2.0	—	75	95	
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Removal Time	t_{rem}		2.0	—	25	30	
			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 ELECTRICAL CHARACTERISTICS (C_L = 15pF, V_{CC} = 5V, Ta = 25°C, Input $t_r = t_f = 6\text{ns}$)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Transition Time	t_{TLH}		—	4	8	ns
	t_{THL}					
Propagation Delay Time ($\overline{\text{CK}} - Q1$)	t_{pLH}		—	16	24	
	t_{pHL}					
Propagation Delay Time (Qn - Qn + 1)	Δt_{pd}		—	5	14	
Propagation Delay Time (CLR)	t_{pHL}		—	14	24	
Maximum Clock Frequency	f _{MAX}		33	73	—	MHz

AC ELECTRICAL CHARACTERISTICS ($C_L = 50\text{pF}$, Input $t_r = t_f = 6\text{ns}$)

PARAMETER	SYMBOL	TEST CONDITION	Ta = 25°C			Ta = -40~85°C		UNIT	
			V _{CC} (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 ($\overline{CK}-Q1$)	t_{pLH} t_{pHL}		2.0	—	70	145	—	180	
			4.5	—	20	29	—	36	
			6.0	—	17	25	—	31	
Propagation Delay Time ($Qn-Q+1$)	Δt_{pd}		2.0	—	20	75	—	95	
			4.5	—	6	15	—	19	
			6.0	—	4	13	—	16	
Propagation Delay Time (CLR)	t_{pHL}		2.0	—	55	140	—	175	
			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	$C_{PD} (1)$	TC74HC4020A	—	27	—	—	—		
		TC74HC4040A	—	37	—	—	—		

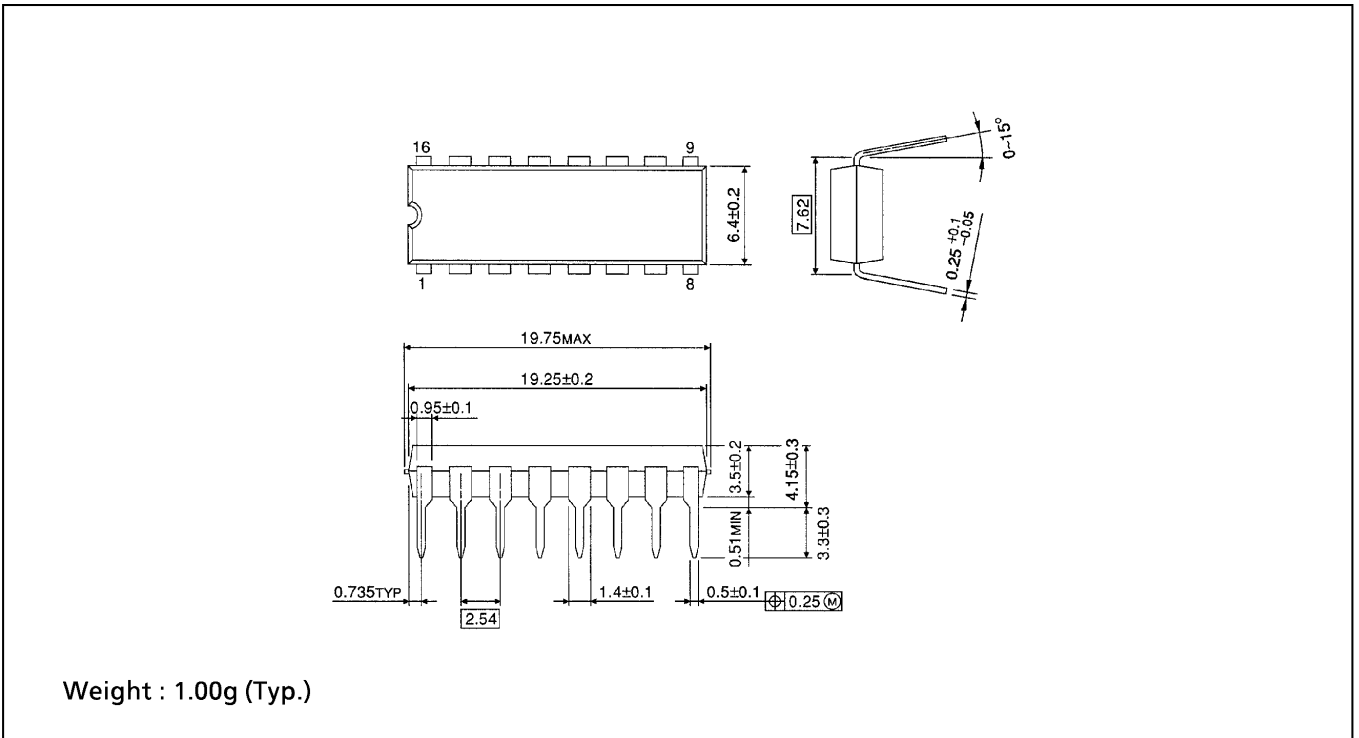
Note (1) C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

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

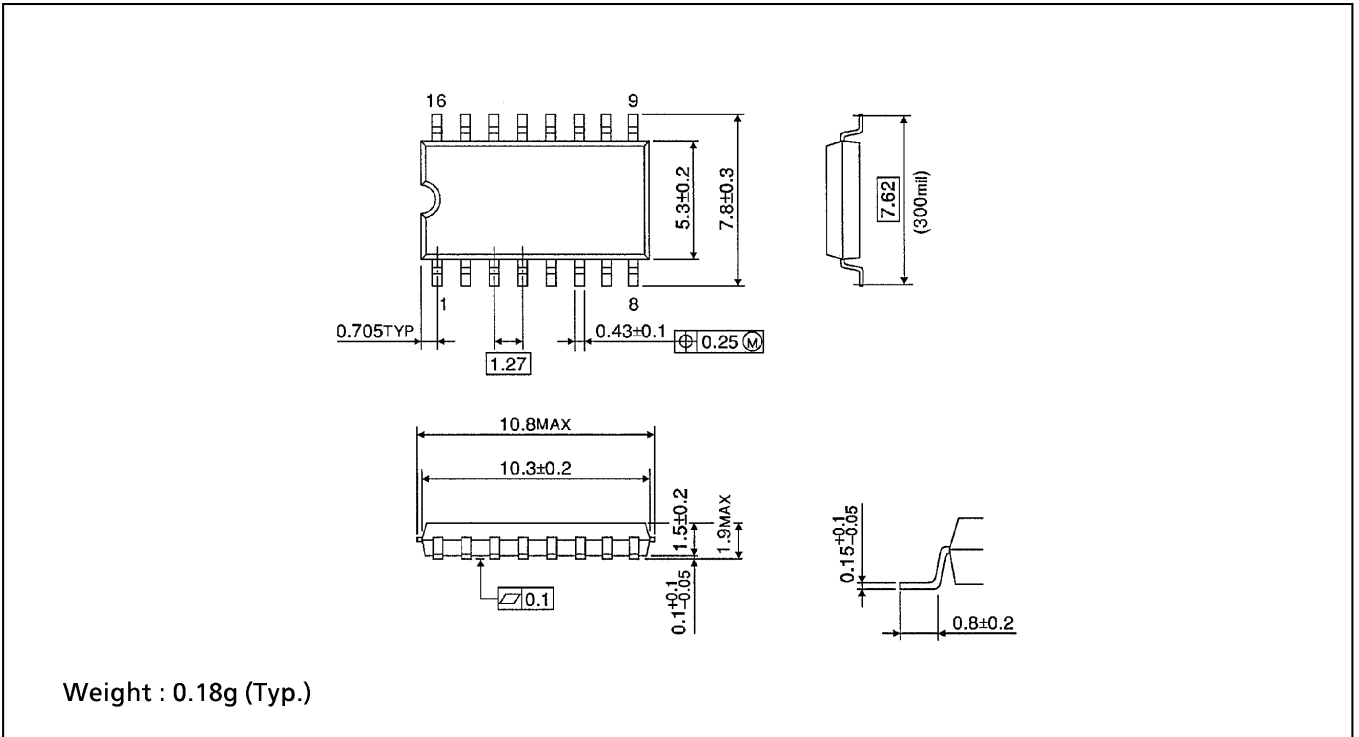
DIP 16PIN OUTLINE DRAWING (DIP16-P-300-2.54A)

Unit in mm



SOP 16PIN (200mil BODY) OUTLINE DRAWING (SOP16-P-300-1.27)

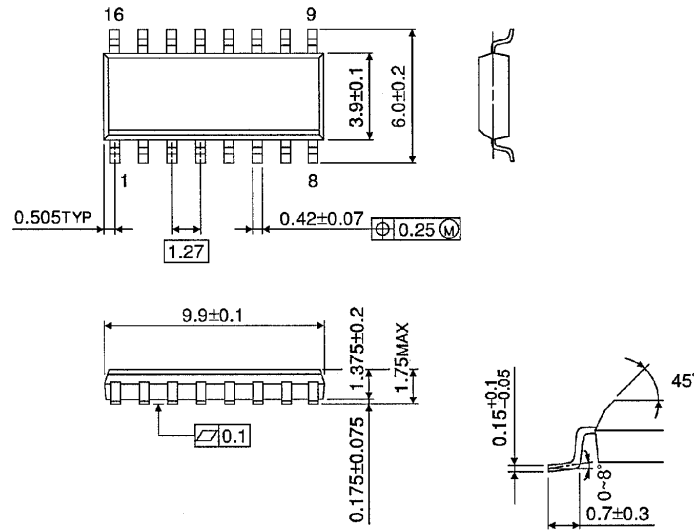
Unit in mm



SOP 16PIN (150mil BODY) OUTLINE DRAWING (SOL16-P-150 -1.27)

Unit in mm

(Note) This package is not available in Japan.



Weight : 0.13g (Typ.)