

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 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.

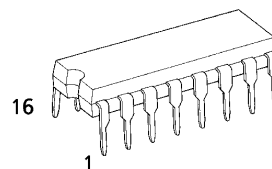
The TC74HC4020A provides 12 divided outputs : 1'st stage and stage 4 thru stage 14. At Q14, a 1 / 16384 divided frequency will be output.

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

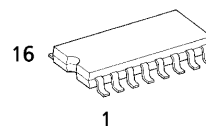
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

**FEATURES :**

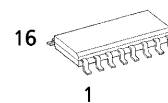
- High Speed..... $f_{MAX} = 73\text{MHz}$  (typ.)  
at  $V_{CC} = 5\text{V}$
- Low Power Dissipation..... $I_{CC} = 4\mu\text{A}$ (Max.) at  $T_a = 25^\circ\text{C}$
- High Noise Immunity..... $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (Min.)
- Output Drive Capability.....10 LSTTL Loads
- Symmetrical Output 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



P (DIP16-P-300-2.54A)  
Weight : 1.00g (Typ.)



F (SOP16-P-300-1.27)  
Weight : 0.18g (Typ.)

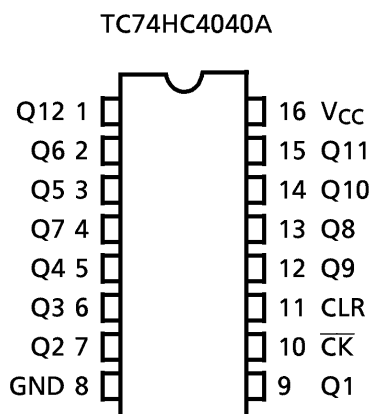
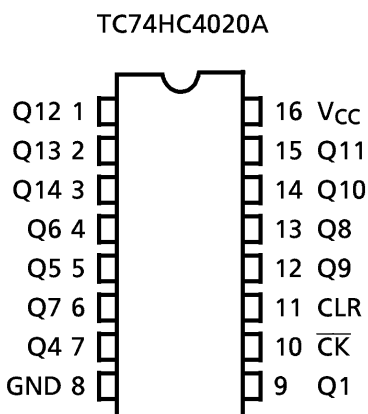


FN (SOL16-P-150-1.27)  
Weight : 0.13g (Typ.)

**TRUTH TABLE**

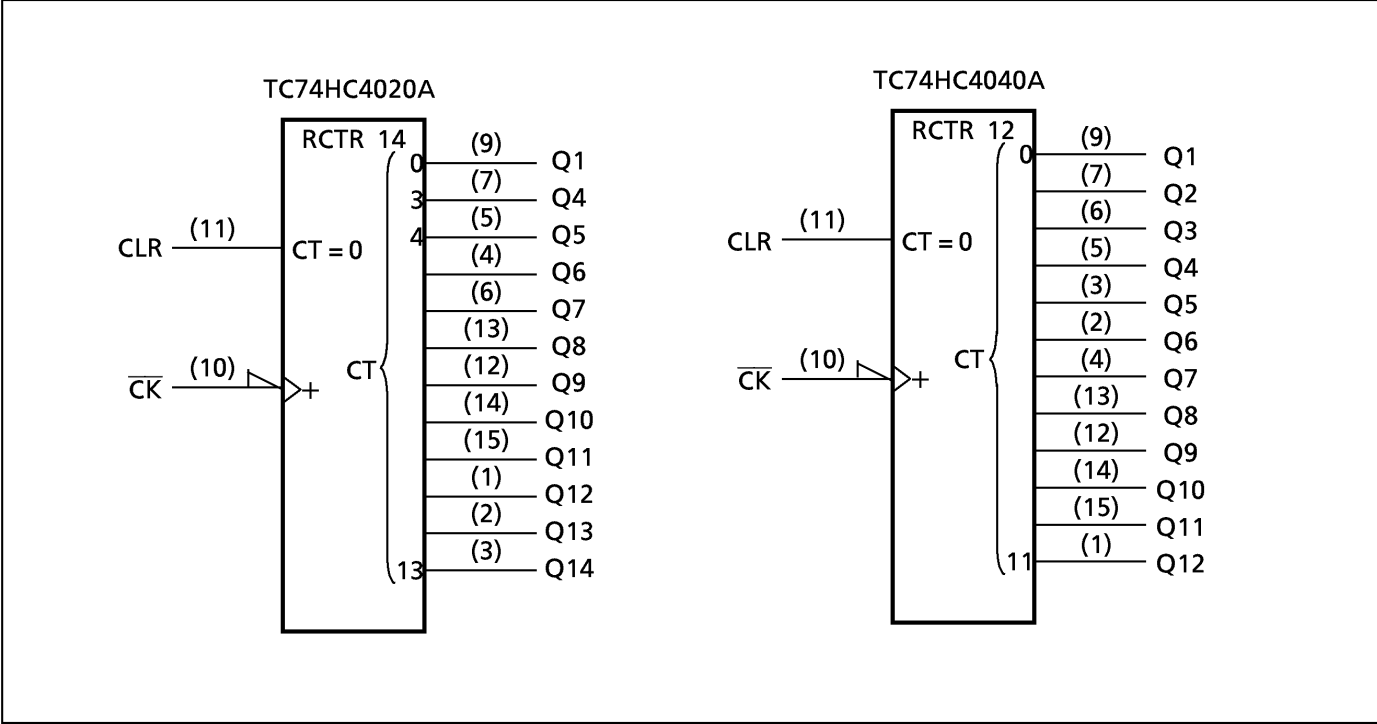
| $\overline{\text{CK}}$ | CLR | OUTPUT STATE          |
|------------------------|-----|-----------------------|
| X                      | H   | ALL OUTPUTS = "L"     |
|                        | L   | NO CHANGE             |
|                        | L   | ADVANCE TO NEXT STATE |

X : Don't Care

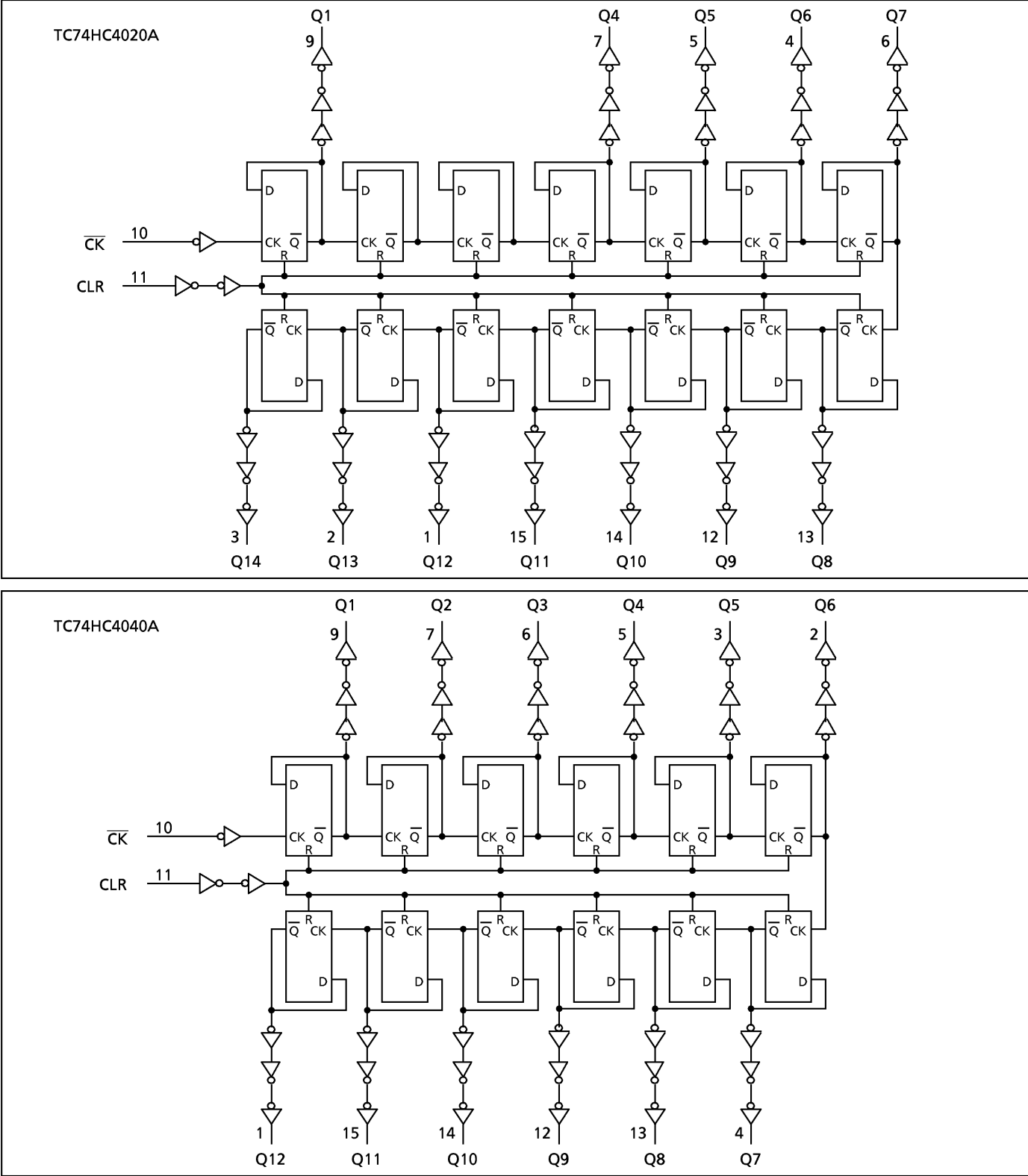
**PIN ASSIGNMENT**

(TOP VIEW)

IEC LOGIC SYMBOL



SYSTEM DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| PARAMETER                   | SYMBOL    | VALUE                    | UNIT |
|-----------------------------|-----------|--------------------------|------|
| Supply Voltage Range        | $V_{CC}$  | $-0.5 \sim 7$            | V    |
| DC Input Voltage            | $V_{IN}$  | $-0.5 \sim V_{CC} + 0.5$ | V    |
| DC Output Voltage           | $V_{OUT}$ | $-0.5 \sim V_{CC} + 0.5$ | 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)* / 180 (SOP)   | mW   |
| Storage Temperature         | $T_{stg}$ | $-65 \sim 150$           | °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  $85^\circ\text{C}$  a derating factor of  $-10\text{mW}/^\circ\text{C}$  shall be applied until 300mW.

## RECOMMENDED OPERATING CONDITIONS

| PARAMETER                | SYMBOL     | VALUE                                                                                                              | UNIT |
|--------------------------|------------|--------------------------------------------------------------------------------------------------------------------|------|
| Supply Voltage           | $V_{CC}$   | $2 \sim 6$                                                                                                         | V    |
| Input Voltage            | $V_{IN}$   | $0 \sim V_{CC}$                                                                                                    | V    |
| Output Voltage           | $V_{OUT}$  | $0 \sim V_{CC}$                                                                                                    | V    |
| Operating Temperature    | $T_{opr}$  | $-40 \sim 85$                                                                                                      | °C   |
| Input Rise and Fall Time | $t_r, t_f$ | $0 \sim 1000 (V_{CC} = 2.0\text{V})$<br>$0 \sim 500 (V_{CC} = 4.5\text{V})$<br>$0 \sim 400 (V_{CC} = 6.0\text{V})$ | ns   |

## DC ELECTRICAL CHARACTERISTICS

| PARAMETER                   | SYMBOL   | TEST CONDITION                           | $V_{CC}$<br>(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<br>4.5<br>6.0          | 1.50<br>3.15<br>4.20     | —<br>—<br>—       | —<br>—<br>—          | 1.50<br>3.15<br>4.20              | —<br>—<br>—          | V             |
| Low - Level Input Voltage   | $V_{IL}$ |                                          | 2.0<br>4.5<br>6.0          | —<br>—<br>—              | —<br>—<br>—       | 0.50<br>1.35<br>1.80 | —<br>—<br>—                       | 0.50<br>1.35<br>1.80 | V             |
| High - Level Output Voltage | $V_{OH}$ | $V_{IN} = V_{IH} \text{ or } V_{IL}$     | $I_{OH} = -20\mu\text{A}$  | 2.0<br>4.5<br>6.0        | 1.9<br>4.4<br>5.9 | 2.0<br>4.5<br>6.0    | —<br>—<br>—                       | 1.9<br>4.4<br>5.9    | V             |
|                             |          |                                          | $I_{OH} = -4 \text{ mA}$   | 4.5<br>6.0               | 4.18<br>5.68      | 4.31<br>5.80         | —<br>—                            | 4.13<br>5.63         |               |
|                             |          |                                          | $I_{OH} = -5.2 \text{ mA}$ | 6.0                      | 5.68              | —                    | —                                 | —                    |               |
| Low - Level Output Voltage  | $V_{OL}$ | $V_{IN} = V_{IH} \text{ or } V_{IL}$     | $I_{OL} = 20\mu\text{A}$   | 2.0<br>4.5<br>6.0        | —<br>—<br>—       | 0.0<br>0.0<br>0.0    | 0.1<br>0.1<br>0.1                 | —<br>—<br>—          | V             |
|                             |          |                                          | $I_{OL} = 4 \text{ mA}$    | 4.5<br>6.0               | —<br>—            | 0.17<br>0.18         | 0.26<br>0.26                      | —<br>—               |               |
|                             |          |                                          | $I_{OL} = 5.2 \text{ mA}$  | 6.0                      | —                 | —                    | —                                 | 0.33<br>0.33         |               |
| Input Leakage Current       | $I_{IN}$ | $V_{IN} = V_{CC} \text{ or } \text{GND}$ | 6.0                        | —                        | —                 | $\pm 0.1$            | —                                 | $\pm 1.0$            | $\mu\text{A}$ |
| Quiescent Supply Current    | $I_{CC}$ | $V_{IN} = V_{CC} \text{ or } \text{GND}$ | 6.0                        | —                        | —                 | 4.0                  | —                                 | 40.0                 | $\mu\text{A}$ |

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

| PARAMETER                                         | SYMBOL                   | TEST CONDITION | $V_{CC}(\text{V})$ | $T_a = 25^\circ\text{C}$ |       | $T_a = -40\sim 85^\circ\text{C}$ | UNIT |
|---------------------------------------------------|--------------------------|----------------|--------------------|--------------------------|-------|----------------------------------|------|
|                                                   |                          |                |                    | TYP.                     | LIMIT | LIMIT                            |      |
| Minimum Pulse Width<br>( $\overline{\text{CK}}$ ) | $t_{W(L)}$<br>$t_{W(H)}$ |                | 2.0                | —                        | 75    | 95                               | ns   |
|                                                   |                          |                | 4.5                | —                        | 15    | 19                               |      |
|                                                   |                          |                | 6.0                | —                        | 13    | 16                               |      |
| Minimum Pulse Width<br>( CLR )                    | $t_{W(H)}$               |                | 2.0                | —                        | 75    | 95                               |      |
|                                                   |                          |                | 4.5                | —                        | 15    | 19                               |      |
|                                                   |                          |                | 6.0                | —                        | 13    | 16                               |      |
| Minimum Removal Time                              | $t_{\text{rem}}$         |                | 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 (  $C_L = 15\text{pF}$ ,  $V_{CC} = 5\text{V}$ ,  $T_a = 25^\circ\text{C}$ , Input  $t_r = t_f = 6\text{ns}$  )

| PARAMETER                                        | SYMBOL                 | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|--------------------------------------------------|------------------------|----------------|------|------|------|------|
| Output Transition Time                           | $t_{TLH}$<br>$t_{THL}$ |                | —    | 4    | 8    | ns   |
| Propagation Delay Time<br>( $\overline{CK}-Q1$ ) | $t_{pLH}$<br>$t_{pHL}$ |                | —    | 16   | 24   |      |
| Propagation Delay Time<br>( $Qn-Qn+1$ )          | $\Delta t_{pd}$        |                | —    | 5    | 14   |      |
| Propagation Delay Time<br>( 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 <sub>CC</sub> (V) | MIN. | TYP. | MAX.          | MIN. | MAX. |
| Output Transition Time                           | $t_{TLH}$<br>$t_{THL}$ |                | 2.0                 | —    | 30   | 75            | —    | 95   |
|                                                  |                        |                | 4.5                 | —    | 8    | 15            | —    | 19   |
|                                                  |                        |                | 6.0                 | —    | 7    | 13            | —    | 16   |
| Propagation Delay Time<br>( $\overline{CK}-Q1$ ) | $t_{pLH}$<br>$t_{pHL}$ |                | 2.0                 | —    | 70   | 145           | —    | 180  |
|                                                  |                        |                | 4.5                 | —    | 20   | 29            | —    | 36   |
|                                                  |                        |                | 6.0                 | —    | 17   | 25            | —    | 31   |
| Propagation Delay Time<br>( $Qn-Q+1$ )           | $\Delta t_{pd}$        |                | 2.0                 | —    | 20   | 75            | —    | 95   |
|                                                  |                        |                | 4.5                 | —    | 6    | 15            | —    | 19   |
|                                                  |                        |                | 6.0                 | —    | 4    | 13            | —    | 16   |
| Propagation Delay Time<br>(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    | —    |
|                                                  |                        |                | 4.5                 | 30   | 66   | —             | 24   | —    |
|                                                  |                        |                | 6.0                 | 35   | 78   | —             | 28   | —    |
| Input Capacitance                                | $C_{IN}$               |                |                     | —    | 5    | 10            | —    | 10   |
| Power Dissipation Capacitance                    | $C_{PD}$ (1)           | TC74HC4020A    |                     | —    | 27   | —             | —    | —    |
|                                                  |                        | TC74HC4040A    |                     | —    | 37   | —             | —    | —    |

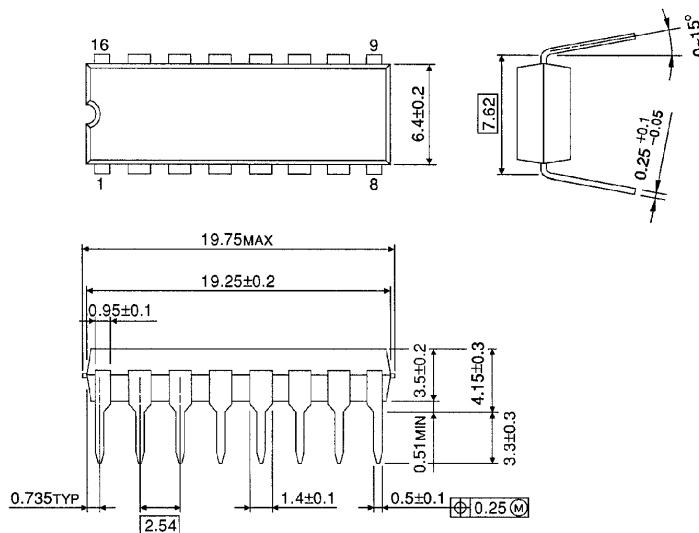
Note (1)  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

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 PACKAGE DIMENSIONS (DIP16-P-300-2.54A)

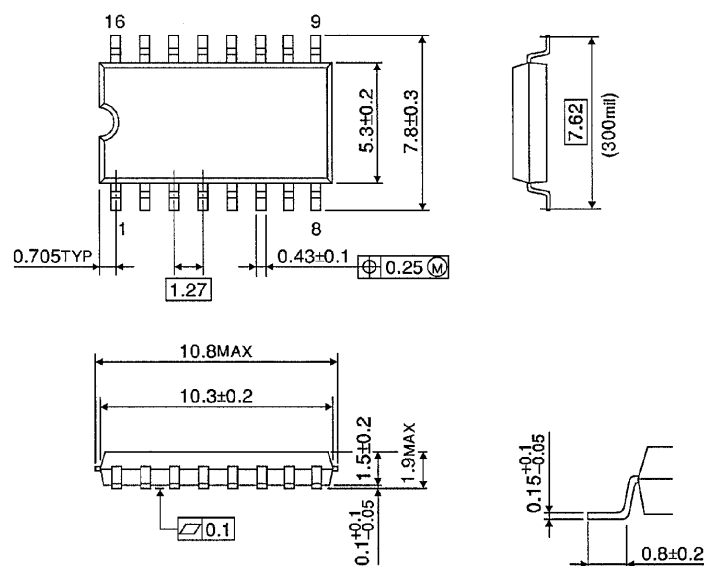
Unit in mm



Weight : 1.00g (Typ.)

## SOP 16PIN (200mil BODY) PACKAGE DIMENSIONS (SOP16-P-300-1.27)

Unit in mm

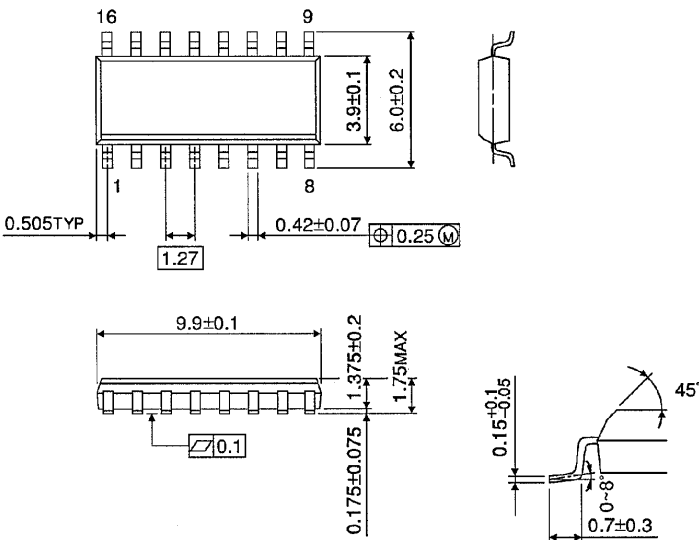


Weight : 0.18g (Typ.)

SOP 16PIN (150mil BODY) PACKAGE DIMENSIONS (SOL16-P-150 -1.27)

Unit in mm

(Note) This package is not available in Japan.



Weight : 0.13g (Typ.)



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000707EBA

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