

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

# TC74HC7292AP, TC74HC7292AF

## PROGRAMMABLE DIVIDER / TIMER

The TC74HC7292A is a high speed CMOS PROGRAMMABLE DIVIDER / TIMER 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 TC74HC7292A can divide from 2<sup>2</sup> to 2<sup>31</sup>.

CK1 and CK2 are clock inputs, either one may be used for clock gating.

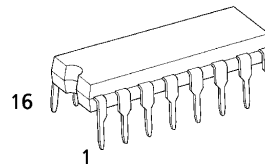
It features an active-low clear input to initialize the state of all flip-flops.

To facilitate incoming inspection, test points are provided. (TP1, TP2 and TP3)

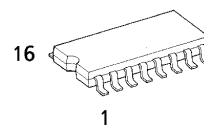
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

### FEATURES:

- High Speed.....  $f_{MAX} = 70\text{MHz}(\text{typ.})$   
at  $V_{CC} = 5\text{V}$
- Low Power Dissipation.....  $I_{CC} = 4\mu\text{A}(\text{Max.})$  at  $T_a = 25^\circ\text{C}$
- High Noise Immunity.....  $V_{NIH} = V_{NIL} = 28\% V_{CC} (\text{Min.})$
- Output Drive Capability..... 10 LSTTL Loads
- Symmetrical Output Impedance...  $|I_{OH}| = I_{OL} = 4\text{mA}(\text{Min.})$
- Balanced Propagation Delays.....  $t_{pLH} \approx t_{pHL}$
- Wide Operating Voltage Range...  $V_{CC} (\text{opr.}) = 2\text{V} \sim 6\text{V}$
- Pin and Function Compatible with 74LS292

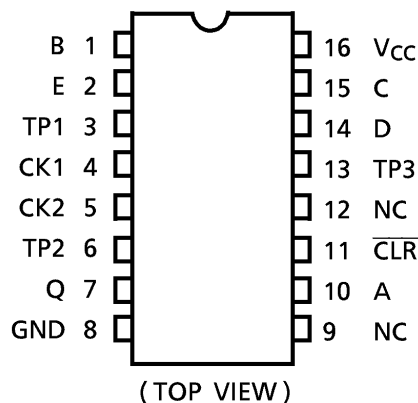


P (DIP16-P-300-2.54A)  
Weight : 1.00g (Typ.)

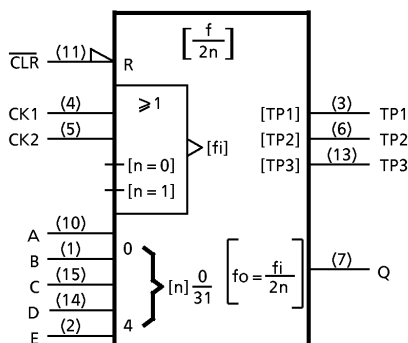


F (SOP16-P-300-1.27)  
Weight : 0.18g (Typ.)

### PIN ASSIGNMENT



### IEC LOGIC SYMBOL



980508EBA2

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**TRUTH TABLE**

| CLR | CK1 | CK2 | Q OUTPUT MODE |
|-----|-----|-----|---------------|
| L   | X   | X   | Cleared to L  |
| H   |     | L   | UP Count      |
| H   | L   |     |               |
| H   | H   | X   | NO Change     |
| H   | X   | H   |               |

| PROGRAMMING INPUTS |   |   |   |   | FREQUENCY DIVISION |               |                |         |                 |         |                 |            |
|--------------------|---|---|---|---|--------------------|---------------|----------------|---------|-----------------|---------|-----------------|------------|
|                    |   |   |   |   | Q                  |               | TP1            |         | TP2             |         | TP3             |            |
| E                  | D | C | B | A | BINARY             | DECIMAL       | BINARY         | DECIMAL | BINARY          | DECIMAL | BINARY          | DECIMAL    |
| L                  | L | L | L | L | Inhibit            | Inhibit       | Inhibit        | Inhibit | Inhibit         | Inhibit | Inhibit         | Inhibit    |
| L                  | L | L | L | H | Inhibit            | Inhibit       | Inhibit        | Inhibit | Inhibit         | Inhibit | Inhibit         | Inhibit    |
| L                  | L | L | H | L | 2 <sup>2</sup>     | 4             | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>24</sup> | 16,777,216 |
| L                  | L | L | H | H | 2 <sup>3</sup>     | 8             | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>24</sup> | 16,777,216 |
| L                  | L | H | L | L | 2 <sup>4</sup>     | 16            | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>24</sup> | 16,777,216 |
| L                  | L | H | L | H | 2 <sup>5</sup>     | 32            | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>24</sup> | 16,777,216 |
| L                  | L | H | H | L | 2 <sup>6</sup>     | 64            | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>24</sup> | 16,777,216 |
| L                  | L | H | H | H | 2 <sup>7</sup>     | 128           | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>24</sup> | 16,777,216 |
| L                  | H | L | L | L | 2 <sup>8</sup>     | 256           | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>2</sup>  | 4          |
| L                  | H | L | L | H | 2 <sup>9</sup>     | 512           | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>2</sup>  | 4          |
| L                  | H | L | H | L | 2 <sup>10</sup>    | 1,024         | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>4</sup>  | 16         |
| L                  | H | L | H | H | 2 <sup>11</sup>    | 2,048         | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>4</sup>  | 16         |
| L                  | H | H | L | L | 2 <sup>12</sup>    | 4,096         | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>6</sup>  | 64         |
| L                  | H | H | L | H | 2 <sup>13</sup>    | 8,192         | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>6</sup>  | 64         |
| L                  | H | H | H | L | 2 <sup>14</sup>    | 16,384        | 2 <sup>9</sup> | 512     | Disabled Low    |         | 2 <sup>8</sup>  | 256        |
| L                  | H | H | H | H | 2 <sup>15</sup>    | 32,768        | 2 <sup>9</sup> | 512     | Disabled Low    |         | 2 <sup>8</sup>  | 256        |
| H                  | L | L | L | L | 2 <sup>16</sup>    | 65,536        | 2 <sup>9</sup> | 512     | 2 <sup>3</sup>  | 8       | 2 <sup>10</sup> | 1,024      |
| H                  | L | L | L | H | 2 <sup>17</sup>    | 131,072       | 2 <sup>9</sup> | 512     | 2 <sup>3</sup>  | 8       | 2 <sup>10</sup> | 1,024      |
| H                  | L | L | H | L | 2 <sup>18</sup>    | 262,144       | 2 <sup>9</sup> | 512     | 2 <sup>5</sup>  | 32      | 2 <sup>12</sup> | 4,096      |
| H                  | L | L | H | H | 2 <sup>19</sup>    | 524,288       | 2 <sup>9</sup> | 512     | 2 <sup>5</sup>  | 32      | 2 <sup>12</sup> | 4,096      |
| H                  | L | H | L | L | 2 <sup>20</sup>    | 1,048,576     | 2 <sup>9</sup> | 512     | 2 <sup>7</sup>  | 128     | 2 <sup>14</sup> | 16,384     |
| H                  | L | H | L | H | 2 <sup>21</sup>    | 2,097,152     | 2 <sup>9</sup> | 512     | 2 <sup>7</sup>  | 128     | 2 <sup>14</sup> | 16,384     |
| H                  | L | H | H | L | 2 <sup>22</sup>    | 4,194,304     | Disabled Low   |         | 2 <sup>9</sup>  | 512     | 2 <sup>16</sup> | 65,536     |
| H                  | L | H | H | H | 2 <sup>23</sup>    | 8,388,608     | Disabled Low   |         | 2 <sup>9</sup>  | 512     | 2 <sup>16</sup> | 65,536     |
| H                  | H | L | L | L | 2 <sup>24</sup>    | 16,777,216    | 2 <sup>3</sup> | 8       | 2 <sup>11</sup> | 2,048   | 2 <sup>18</sup> | 262,144    |
| H                  | H | L | L | H | 2 <sup>25</sup>    | 33,554,432    | 2 <sup>3</sup> | 8       | 2 <sup>11</sup> | 2,048   | 2 <sup>18</sup> | 262,144    |
| H                  | H | L | H | L | 2 <sup>26</sup>    | 67,108,864    | 2 <sup>5</sup> | 32      | 2 <sup>13</sup> | 8,192   | 2 <sup>20</sup> | 1,048,576  |
| H                  | H | L | H | H | 2 <sup>27</sup>    | 134,217,728   | 2 <sup>5</sup> | 32      | 2 <sup>13</sup> | 8,192   | 2 <sup>20</sup> | 1,048,576  |
| H                  | H | H | L | L | 2 <sup>28</sup>    | 268,435,456   | 2 <sup>7</sup> | 128     | 2 <sup>15</sup> | 32,768  | 2 <sup>22</sup> | 4,194,304  |
| H                  | H | H | L | H | 2 <sup>29</sup>    | 536,870,912   | 2 <sup>7</sup> | 128     | 2 <sup>15</sup> | 32,768  | 2 <sup>22</sup> | 4,194,304  |
| H                  | H | H | H | L | 2 <sup>30</sup>    | 1,073,741,824 | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>24</sup> | 16,777,216 |
| H                  | H | H | H | H | 2 <sup>31</sup>    | 2,147,483,648 | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>24</sup> | 16,777,216 |

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## 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  $85^{\circ}\text{C}$  a derating factor of  $-10\text{mW}/^{\circ}\text{C}$  shall be applied until 300mW.

## RECOMMENDED OPERATING CONDITIONS

| PARAMETER                | SYMBOL     | VALUE   | UNIT |
|--------------------------|------------|---|------|
| Supply Voltage           | $V_{CC}$   | 2~6   | 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 ( $V_{CC} = 2.0\text{V}$ )<br>0~500 ( $V_{CC} = 4.5\text{V}$ )<br>0~400 ( $V_{CC} = 6.0\text{V}$ ) | 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<br>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<br>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<br>Output Voltage<br>(Q) | $V_{OH}$ | $V_{IN} = V_{IH}$<br>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  | —             |   |
|                                       |          |                                  | $I_{OH} = -4\text{ mA}$<br>$I_{OH} = -5.2\text{ mA}$ | 4.5                        | 4.18 | 4.31 | —                                   | 4.13 | —             |   |
|                                       |          |                                  |  | 6.0                        | 5.68 | 5.80 | —                                   | 5.63 | —             |   |
|                                       |          |                                  |  | 6.0                        | —    | —    | —                                   | —    | —             |   |
| Low - Level<br>Output Voltage<br>(Q)  | $V_{OL}$ | $V_{IN} = V_{IH}$<br>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           |   |
|                                       |          |                                  | $I_{OL} = 4\text{ mA}$<br>$I_{OL} = 5.2\text{ mA}$   | 4.5                        | —    | 0.17 | 0.26                                | —    | 0.33          |   |
|                                       |          |                                  |  | 6.0                        | —    | 0.18 | 0.26                                | —    | 0.33          |   |
|                                       |          |                                  |  | 6.0                        | —    | —    | —                                   | —    | —             |   |
| Input Leakage Current                 | $I_{IN}$ | $V_{IN} = V_{CC}$ or GND         | 6.0  | —                          | —    | ±0.1 | —                                   | ±1.0 | $\mu\text{A}$ |   |
| 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 | $V_{CC}$ (V) | Ta = 25°C |       | Ta = -40~85°C | UNIT |
|-----------------------------|--------------------------|----------------|--------------|-----------|-------|---------------|------|
|                             |                          |                |              | TYP.      | LIMIT | LIMIT         |      |
| Minimum Pulse Width<br>(CK) | $t_{W(L)}$<br>$t_{W(H)}$ |                | 2.0          | —         | 75    | 95            | ns   |
|                             |                          |                | 4.5          | —         | 15    | 19            |      |
|                             |                          |                | 6.0          | —         | 13    | 16            |      |
| Minimum Hold Time<br>(CLR)  | $t_{W(L)}$               |                | 2.0          | —         | 175   | 220           |      |
|                             |                          |                | 4.5          | —         | 35    | 44            |      |
|                             |                          |                | 6.0          | —         | 30    | 37            |      |
| Minimum Removal Time        | $t_{rem}$                |                | 2.0          | —         | 5     | 5             |      |
|                             |                          |                | 4.5          | —         | 5     | 5             |      |
|                             |                          |                | 6.0          | —         | 5     | 5             |      |
| Clock Frequency             | f                        |                | 2.0          | —         | 5     | 4             | MHz  |
|                             |                          |                | 4.5          | —         | 27    | 22            |      |
|                             |                          |                | 6.0          | —         | 32    | 26            |      |

AC ELECTRICAL CHARACTERISTICS ( $C_L = 15\text{pF}$ ,  $V_{CC} = 5\text{V}$ , Ta = 25°C, Input  $t_r = t_f = 6\text{ns}$ )

| PARAMETER   | SYMBOL    | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|-----------|----------------|------|------|------|------|
| Output Transition Time<br>(Q)                           | $t_{TLH}$ |                | —    | 4    | 8    | ns   |
|   | $t_{THL}$ |                |      |      |      |      |
| Output Transition Time<br>(TP)                          | $t_{TLH}$ |                | —    | 25   | 44   |      |
|   | $t_{THL}$ |                |      |      |      |      |
| Propagation Delay Time<br>(CK-Q)                        | $t_{pLH}$ |                | —    | 42   | 75   |      |
|   | $t_{pHL}$ |                |      |      |      |      |
| Propagation Delay Time<br>( $\overline{\text{CLR}}$ -Q) | $t_{pHL}$ |                | —    | 36   | 62   |      |
| Maximum Clock Frequency                                 | $f_{MAX}$ |                | 30   | 70   | —    | MHz  |

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

| PARAMETER   | SYMBOL                 | TEST CONDITION | $V_{CC}$ (V) | Ta = 25°C |      |      | Ta = -40~85°C |      | UNIT |
|---|------------------------|----------------|--------------|-----------|------|------|---------------|------|------|
|   |                        |                |              | MIN.      | TYP. | MAX. | MIN.          | MAX. |      |
| Output Transition Time<br>(Q)                           | $t_{TLH}$<br>$t_{THL}$ |                | 2.0          | —         | 27   | 75   | —             | 95   | ns   |
|   |                        |                | 4.5          | —         | 9    | 15   | —             | 19   |      |
|   |                        |                | 6.0          | —         | 8    | 13   | —             | 16   |      |
| Output Transition Time<br>(TP)                          | $t_{TLH}$<br>$t_{THL}$ |                | 2.0          | —         | 90   | 250  | —             | 315  |      |
|   |                        |                | 4.5          | —         | 30   | 50   | —             | 63   |      |
|   |                        |                | 6.0          | —         | 25   | 43   | —             | 54   |      |
| Propagation Delay Time<br>(CK-Q)                        | $t_{pLH}$<br>$t_{pHL}$ |                | 2.0          | —         | 150  | 425  | —             | 530  |      |
|   |                        |                | 4.5          | —         | 48   | 85   | —             | 106  |      |
|   |                        |                | 6.0          | —         | 41   | 72   | —             | 90   |      |
| Propagation Delay Time<br>( $\overline{\text{CLR}}$ -Q) | $t_{pHL}$              |                | 2.0          | —         | 130  | 350  | —             | 440  |      |
|   |                        |                | 4.5          | —         | 42   | 70   | —             | 88   |      |
|   |                        |                | 6.0          | —         | 36   | 60   | —             | 75   |      |
| Maximum Clock Frequency                                 | $f_{MAX}$              |                | 2.0          | 5         | 20   | —    | 4             | —    | MHz  |
|   |                        |                | 4.5          | 27        | 64   | —    | 22            | —    |      |
|   |                        |                | 6.0          | 32        | 75   | —    | 26            | —    |      |
| Input Capacitance                                       | $C_{IN}$               |                |              | —         | 5    | 10   | —             | 10   | pF   |
| Power Dissipation Capacitance                           | $C_{PD}$               | Note (1)       |              | —         | 22   | —    | —             | —    |      |

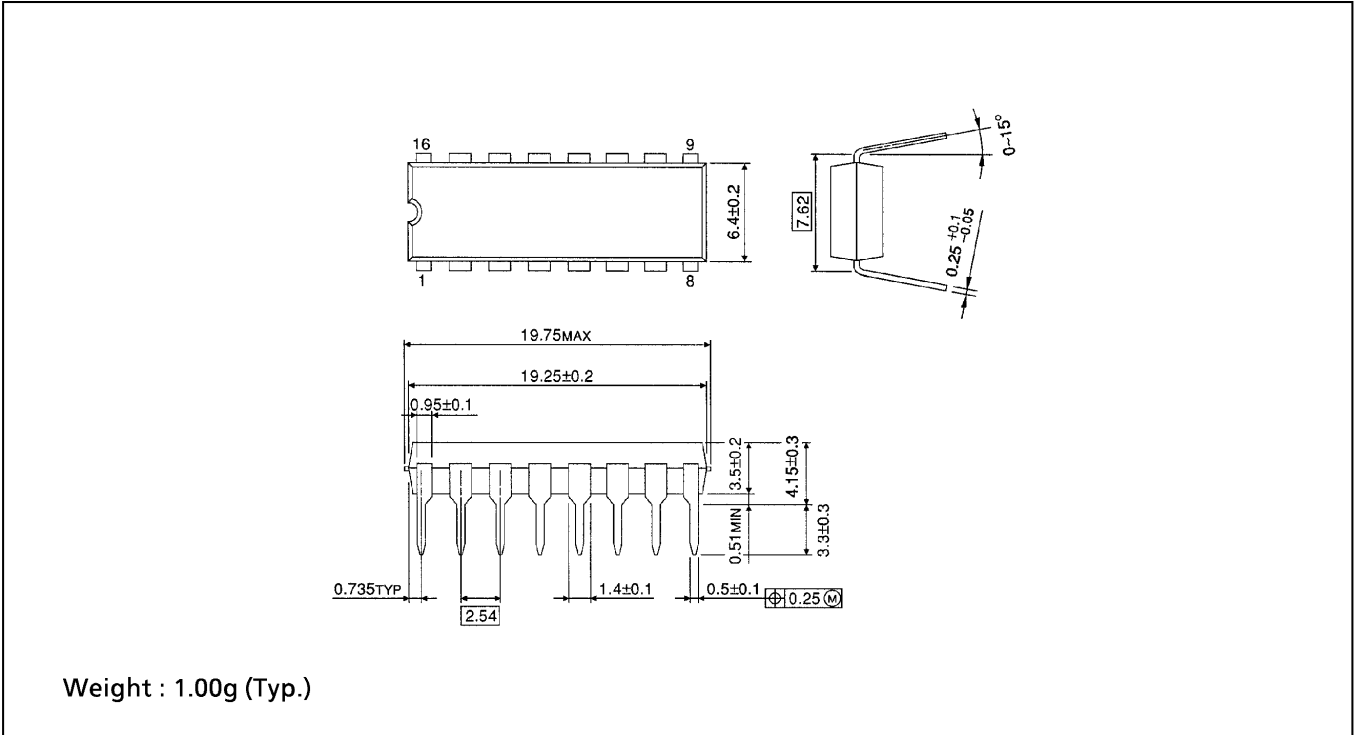
Note (1)  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

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

