

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.

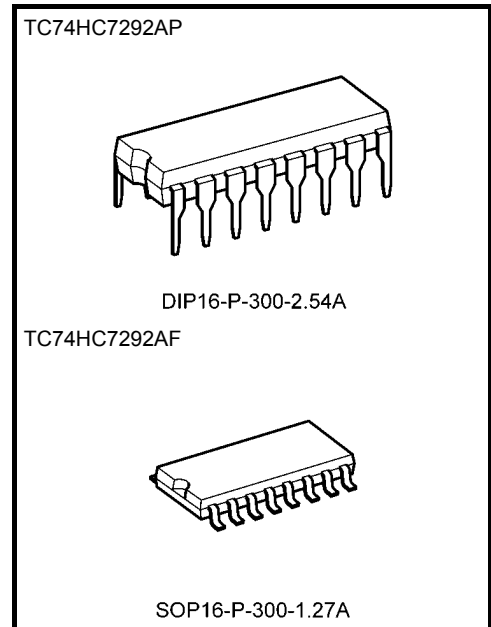
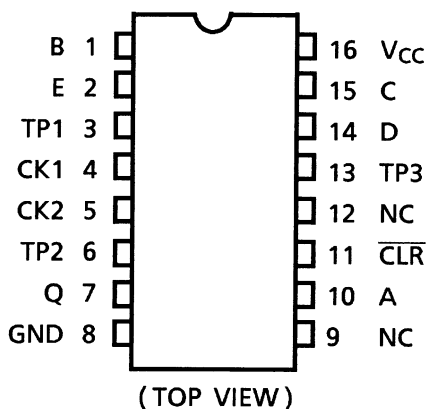
To facilitate incoming inspection, test points are provided. (TP1, TP2 and TP3)

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

### Features

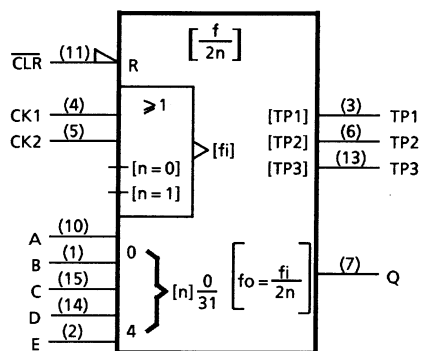
- High speed:  $f_{max} = 70 \text{ MHz (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 4 \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (min)}$
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 4 \text{ mA (min)}$
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC} \text{ (opr)} = 2 \text{ to } 6 \text{ V}$
- Pin and function compatible with 74LS292

### Pin Assignment



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

## IEC Logic Symbol

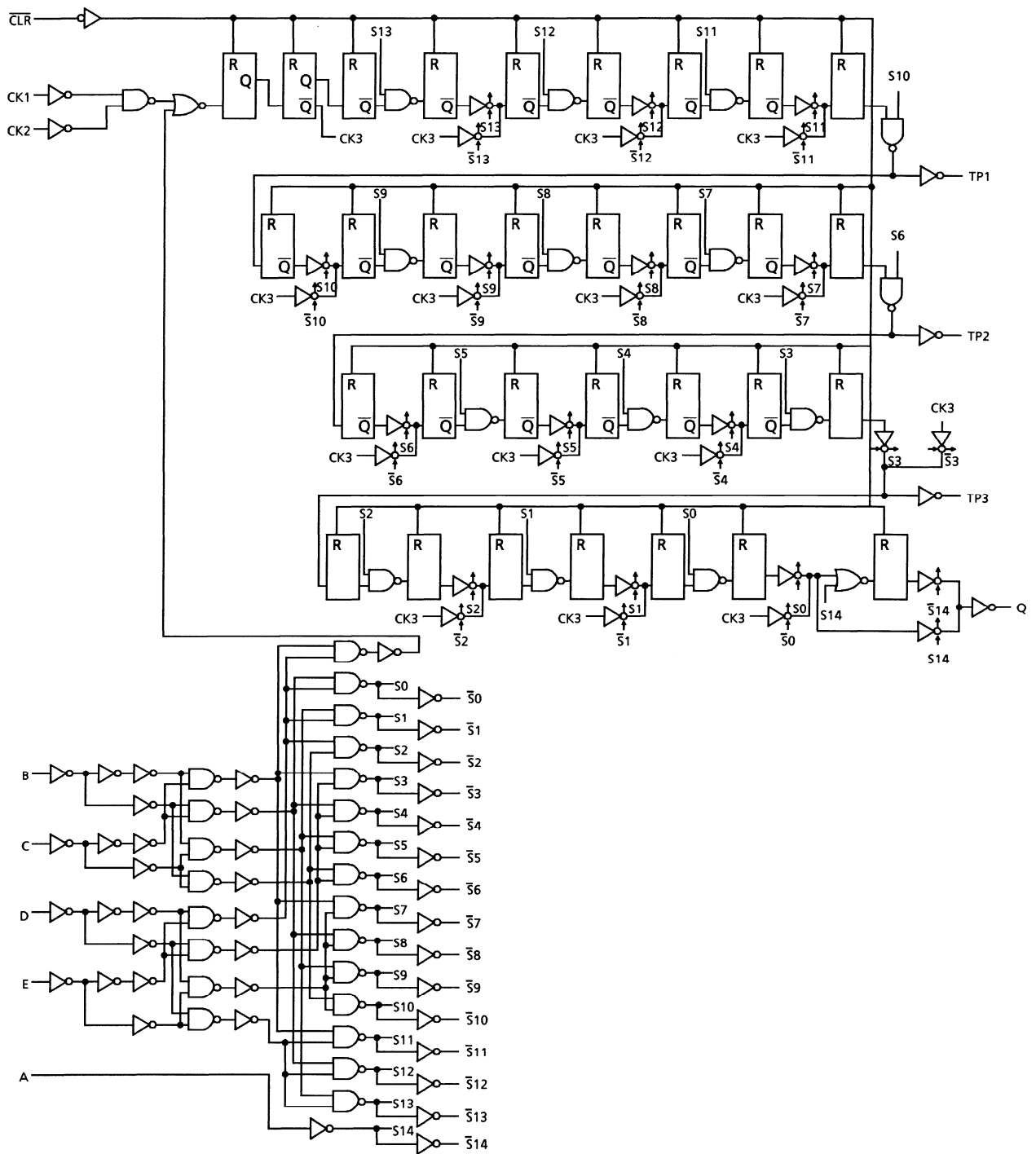


## Truth Table

| $\overline{\text{CLR}}$ | CK1        | CK2        | Q Output Mode |
|-------------------------|------------|------------|---------------|
| L                       | X          | X          | Cleared to L  |
| H                       | $\uparrow$ | L          | Up Count      |
| H                       | L          | $\uparrow$ |               |
| 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 |

## 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                   | $^{\circ}\text{C}$ |

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  $65^{\circ}\text{C}$ . From  $T_a = 65$  to  $85^{\circ}\text{C}$  a derating factor of  $-10$  mW/ $^{\circ}\text{C}$  shall be applied until 300 mW.

## Operating Ranges (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   | $^{\circ}\text{C}$ |
| Input rise and fall time | $t_r, t_f$ | 0 to 1000 ( $V_{CC} = 2.0$ V)<br>0 to 500 ( $V_{CC} = 4.5$ V)<br>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 VCC 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 (Q) | 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  | 4.18 | 4.31             | —    | 4.13 |     |
| Low-level output voltage (Q)  | 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  | —    | 0.17             | 0.26 | —    |     |
| 6.0                           | —               | 0.18   | 0.26                     | —                         | 0.33 |      |                  |      |      |     |
| 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 to 85°C | Unit |       |
|---------------------------|--|----------------|--|---------------------|------|------------------|------|-------|
|                           |  |                |  | V <sub>CC</sub> (V) | Typ. | Limit            |      | Limit |
| Minimum pulse width (CK)  | t <sub>W</sub> (L)<br>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> (L)                       | —              |  | 2.0                 | —    | 175              | 220  | ns    |
|                           |  |                |  | 4.5                 | —    | 35               | 44   |       |
|                           |  |                |  | 6.0                 | —    | 30               | 37   |       |
| Minimum removal time      | t <sub>rem</sub>                         | —              |  | 2.0                 | —    | 5                | 5    | ns    |
|                           |  |                |  | 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 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 (Q)                                    | $t_{TLH}$<br>$t_{THL}$ | —              | —   | 4    | 8   | ns   |
| Output transition time (TP)                                   | $t_{TLH}$<br>$t_{THL}$ | —              | —   | 25   | 44  | ns   |
| Propagation delay time (CK-Q)                                 | $t_{pLH}$<br>$t_{pHL}$ | —              | —   | 42   | 75  | ns   |
| Propagation delay time ( $\overline{\text{CLR}} - \text{Q}$ ) | $t_{pHL}$              | —              | —   | 36   | 62  | ns   |
| Maximum clock frequency                                       | $f_{\text{max}}$       | —              | 30  | 70   | —   | MHz  |

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

| Characteristics   | Symbol                 | Test Condition | $T_a = 25^\circ\text{C}$ |     |      | $T_a = -40 \text{ to } 85^\circ\text{C}$ |     | Unit |     |
|---|------------------------|----------------|--------------------------|-----|------|--|-----|------|-----|
|   |                        |                | $V_{CC}$ (V)             | Min | Typ. | Max                                      | Min |      | Max |
| Output transition time (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 (TP)                                   | $t_{TLH}$<br>$t_{THL}$ | —              | 2.0                      | —   | 90   | 250                                      | —   | 315  | ns  |
|   |                        |                | 4.5                      | —   | 30   | 50                                       | —   | 63   |     |
|   |                        |                | 6.0                      | —   | 25   | 43                                       | —   | 54   |     |
| Propagation delay time (CK-Q)                                 | $t_{pLH}$<br>$t_{pHL}$ | —              | 2.0                      | —   | 150  | 425                                      | —   | 530  | ns  |
|   |                        |                | 4.5                      | —   | 48   | 85                                       | —   | 106  |     |
|   |                        |                | 6.0                      | —   | 41   | 72                                       | —   | 90   |     |
| Propagation delay time ( $\overline{\text{CLR}} - \text{Q}$ ) | $t_{pHL}$              | —              | 2.0                      | —   | 130  | 350                                      | —   | 440  | ns  |
|   |                        |                | 4.5                      | —   | 42   | 70                                       | —   | 88   |     |
|   |                        |                | 6.0                      | —   | 36   | 60                                       | —   | 75   |     |
| Maximum clock frequency                                       | $f_{\text{max}}$       | —              | 2.0                      | 5   | 20   | —  | 4   | —    | MHz |
|   |                        |                | 4.5                      | 27  | 64   | —  | 22  | —    |     |
|   |                        |                | 6.0                      | 32  | 75   | —  | 26  | —    |     |
| Input capacitance   | $C_{\text{IN}}$        | —              | —                        | 5   | 10   | —  | 10  | pF   |     |
| Power dissipation capacitance                                 | $C_{\text{PD}}$        | (Note)         | —                        | 22  | —    | —  | —   | pF   |     |

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

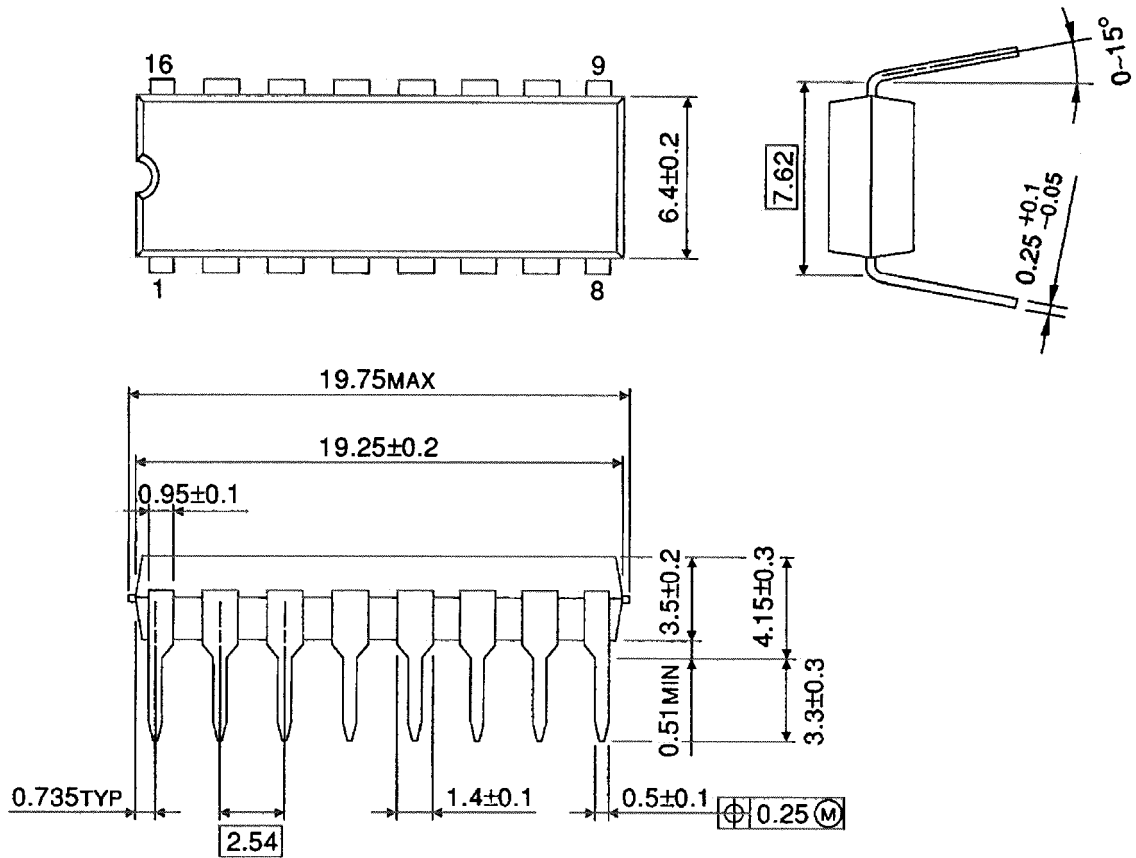
Average operating current can be obtained by the equation:

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

## Package Dimensions

DIP16-P-300-2.54A

Unit : mm



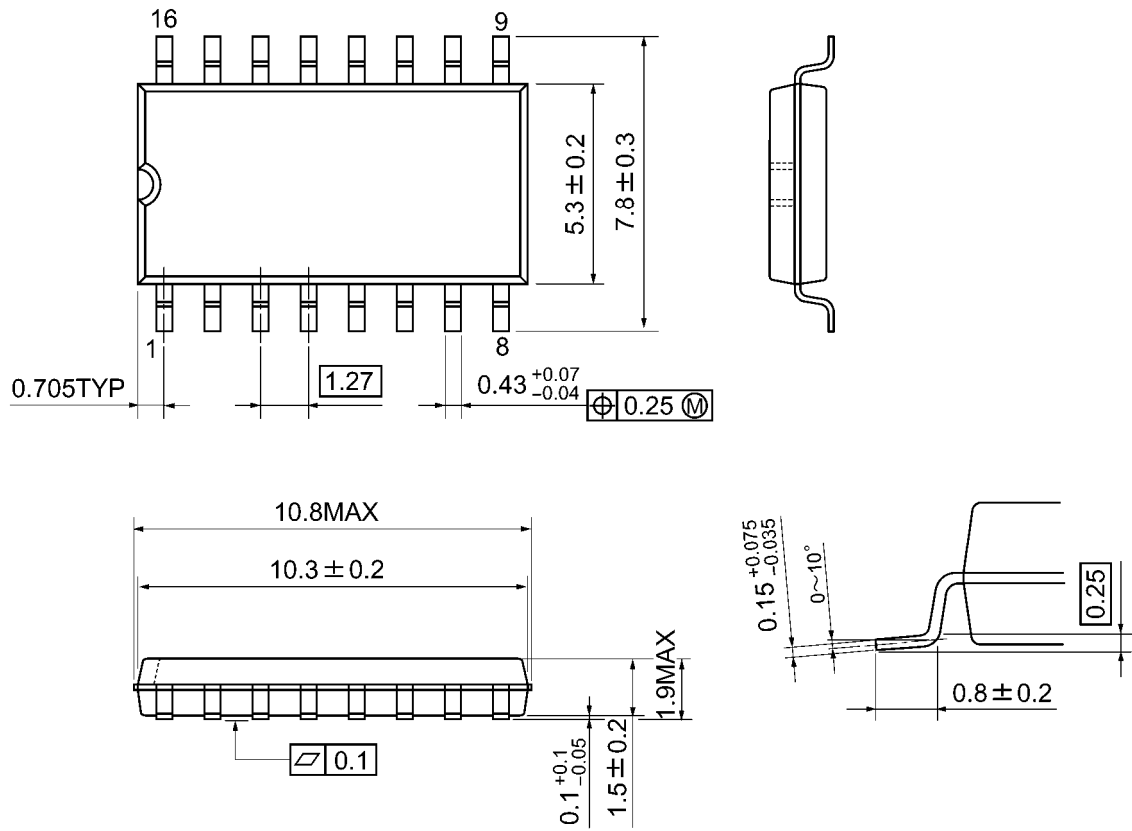
Weight: 1.00 g (typ.)



## Package Dimensions

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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