

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74HC4511AP, TC74HC4511AF

BCD - TO - 7 SEGMENT LATCH / DECODER / DRIVER

The TC74HC4511A is a high speed CMOS BCD-TO-7 SEGMENT LATCH / DECODER / DRIVER fabricated with silicon gate C²MOS technology.

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

The segment output driver, which is of CMOS construction, has a large I_{OH} capability which permits the device to drive cathode common LED directly.

When lamp test (LT) is held low, all segment outputs will go high, and when the blanking input (BI) is held low and LT is held high, all segment outputs will go low. These functions are independent of other inputs and used to test the display.

BI is used to pulse - modulate the brightness of the display.

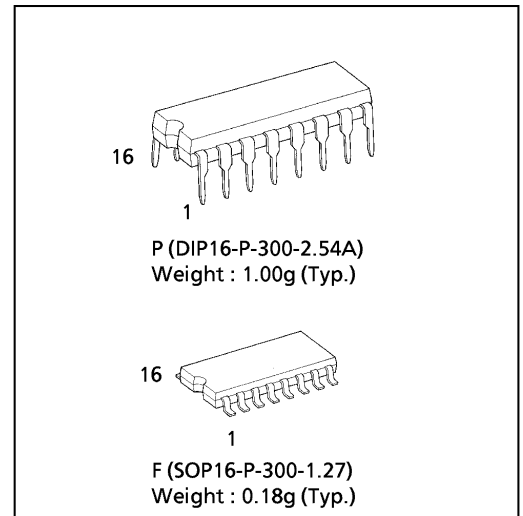
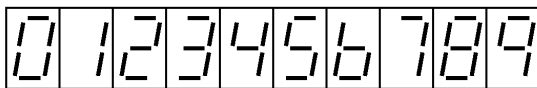
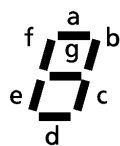
When error code (over 10) is applied to BCD inputs, all segment outputs will go to low (turn off).

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

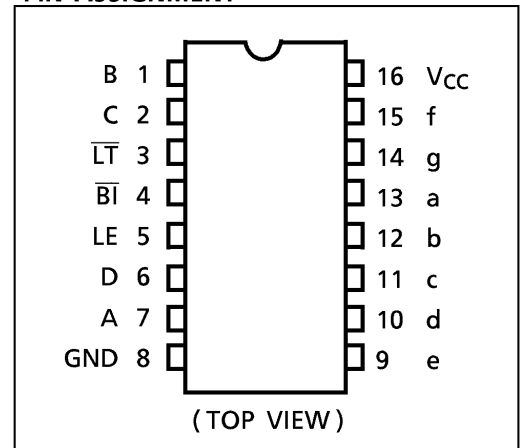
FEATURES :

- High Speed.....t_{pd} = 28ns(typ.) at V_{CC} = 5V
- Low Power Dissipation.....I_{CC} = 4μA(Max.) at Ta = 25°C
- High Noise Immunity.....V_{NIH} = V_{NIL} = 28% V_{CC} (Min.)
- Output Drive Capability.....10 LSTTL Loads
- Symmetrical Output Impedance...|I_{OH}| = 20mA
- Wide Operating Voltage Range...V_{CC} (opr.) = 2V~6V
- Pin and Function Compatible with TC4511B

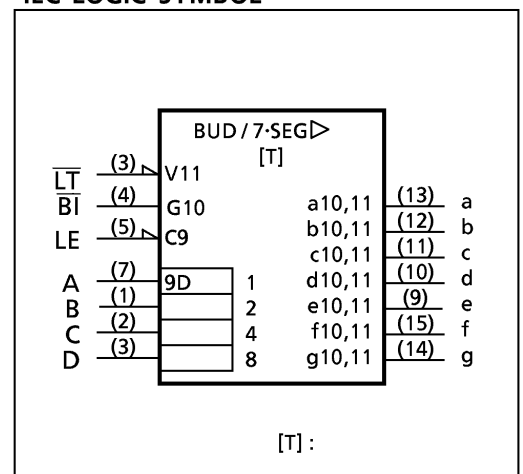
DISPLAY MODE



PIN ASSIGNMENT



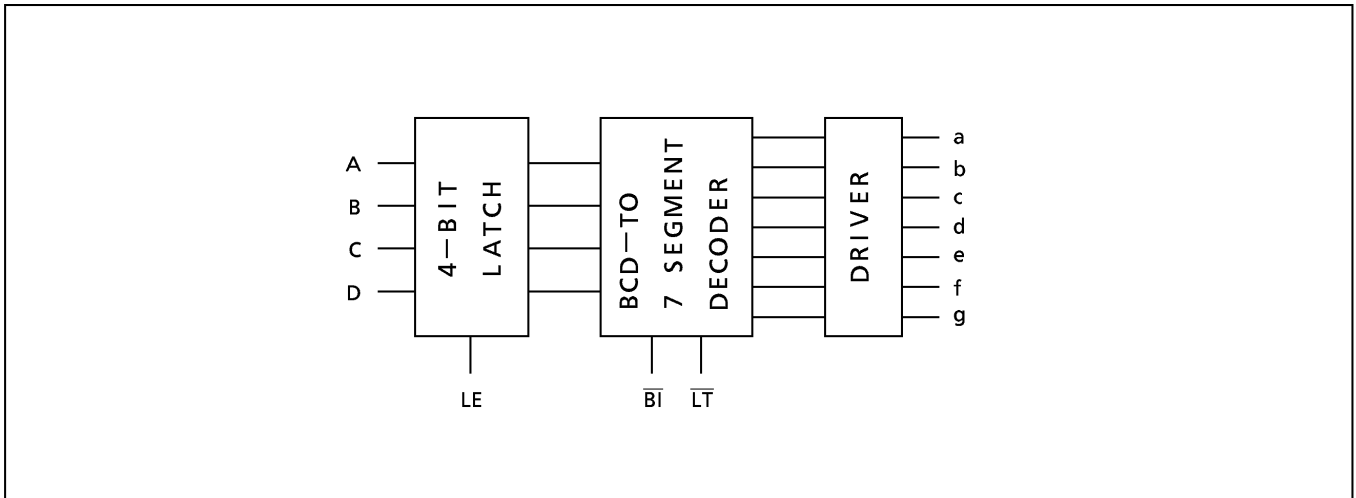
IEC LOGIC SYMBOL



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BLOCK DIAGRAM



TRUTH TABLE

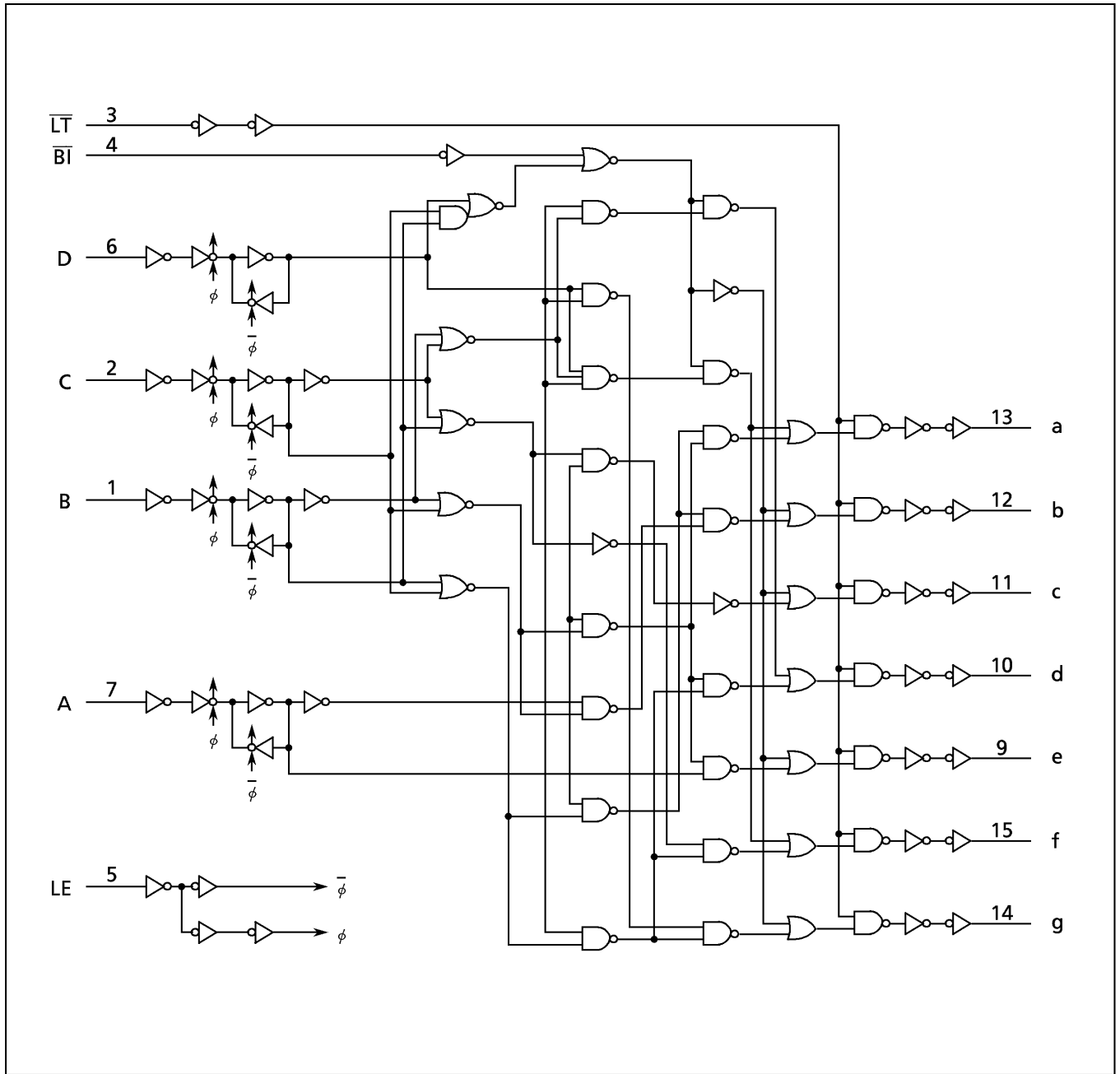
| INPUTS | | | | | | | OUTPUTS | | | | | | | DISPLAY MODE |
|--------|----|----|---|---|---|---|--|---|---|---|---|---|---|--------------|
| LE | BI | LT | D | C | B | A | a | b | c | d | e | f | g | |
| ※ | ※ | L | ※ | ※ | ※ | ※ | H | H | H | H | H | H | H | 8 |
| ※ | L | H | ※ | ※ | ※ | ※ | L | L | L | L | L | L | L | BLANK |
| L | H | H | L | L | L | L | H | H | H | H | H | H | L | 0 |
| L | H | H | L | L | L | H | L | H | H | L | L | L | L | 1 |
| L | H | H | L | L | H | L | H | H | L | H | H | L | H | 2 |
| L | H | H | L | L | H | H | H | H | H | H | L | L | H | 3 |
| L | H | H | L | H | L | L | L | H | H | L | L | H | H | 4 |
| L | H | H | L | H | L | H | H | L | H | H | L | H | H | 5 |
| L | H | H | L | H | H | L | L | L | H | H | H | H | H | 6 |
| L | H | H | L | H | H | H | H | H | H | L | L | L | L | 7 |
| L | H | H | H | L | L | L | H | H | H | H | H | H | H | 8 |
| L | H | H | H | L | L | H | H | H | H | L | L | H | H | 9 |
| L | H | H | H | L | H | ※ | L | L | L | L | L | L | L | BLANK |
| L | H | H | H | H | ※ | ※ | L | L | L | L | L | L | L | BLANK |
| H | H | H | ※ | ※ | ※ | ※ | Hold the stage at the leading edge of LE | | | | | | | |

※ Don't Care

980508EBA2'

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LOGIC 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 (Sinc) / -35 (Source) | mA |
| DC V_{CC} /Ground Current | I_{CC} | +150 (I_{CC}) / -50 (I_{GND}) | 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} | $V_{IN} = V_{IH} \text{ or } V_{IL}$ | $I_{OH} = -20\mu\text{A}$ | 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 | — | |
| | | | | 4.5 | 4.18 | 4.31 | — | 4.13 | — | |
| Low - Level Output Voltage | V_{OL} | $V_{IN} = V_{IH} \text{ or } V_{IL}$ | $I_{OH} = -6 \text{ mA}$ | 4.5 | 3.20 | 3.80 | — | 2.90 | — | V |
| | | | | 4.5 | 3.20 | 3.80 | — | 2.90 | — | |
| | | | | 6.0 | 5.68 | 5.80 | — | 5.63 | — | |
| | | | | 6.0 | — | — | — | — | — | |
| Low - Level Output Voltage | V_{OL} | $V_{IN} = V_{IH} \text{ or } V_{IL}$ | $I_{OL} = 20\mu\text{A}$ | 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 | |
| Low - Level Output Voltage | V_{OL} | $V_{IN} = V_{IH} \text{ or } V_{IL}$ | $I_{OL} = 4 \text{ mA}$ $I_{OL} = 5.2\text{mA}$ | 4.5 | — | 0.17 | 0.26 | — | 0.33 | V |
| | | | | 4.5 | — | 0.17 | 0.26 | — | 0.33 | |
| | | | | 6.0 | — | 0.18 | 0.26 | — | 0.33 | |
| Input Leakage Current | I_{IN} | $V_{IN} = V_{CC} \text{ or } \text{GND}$ | 6.0 | — | — | ± 0.1 | — | ± 1.0 | μA | |
| Quiescent Supply Current | I_{CC} | $V_{IN} = V_{CC} \text{ or } \text{GND}$ | 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 (LE) | $t_{W(L)}$ | | 2.0 | — | 75 | 95 | ns |
| | | | 4.5 | — | 15 | 19 | |
| | | | 6.0 | — | 13 | 16 | |
| Minimum Set-up Time | t_s | | 2.0 | — | 75 | 95 | |
| | | | 4.5 | — | 15 | 19 | |
| | | | 6.0 | — | 13 | 16 | |
| Minimum Hold Time | t_h | | 2.0 | — | 0 | 0 | |
| | | | 4.5 | — | 0 | 0 | |
| | | | 6.0 | — | 0 | 0 | |

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 |
| Output Transition Time | t_{THL} | | — | 4 | 8 | |
| Propagation Delay Time (BCD—Segment) | t_{pLH} | | — | 28 | 45 | |
| | t_{pHL} | | — | 18 | 31 | |
| Propagation Delay Time ($\overline{\text{BI}}$ —Segment) | t_{pLH} | | — | 12 | 21 | |
| | t_{pHL} | | — | 26 | 44 | |

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

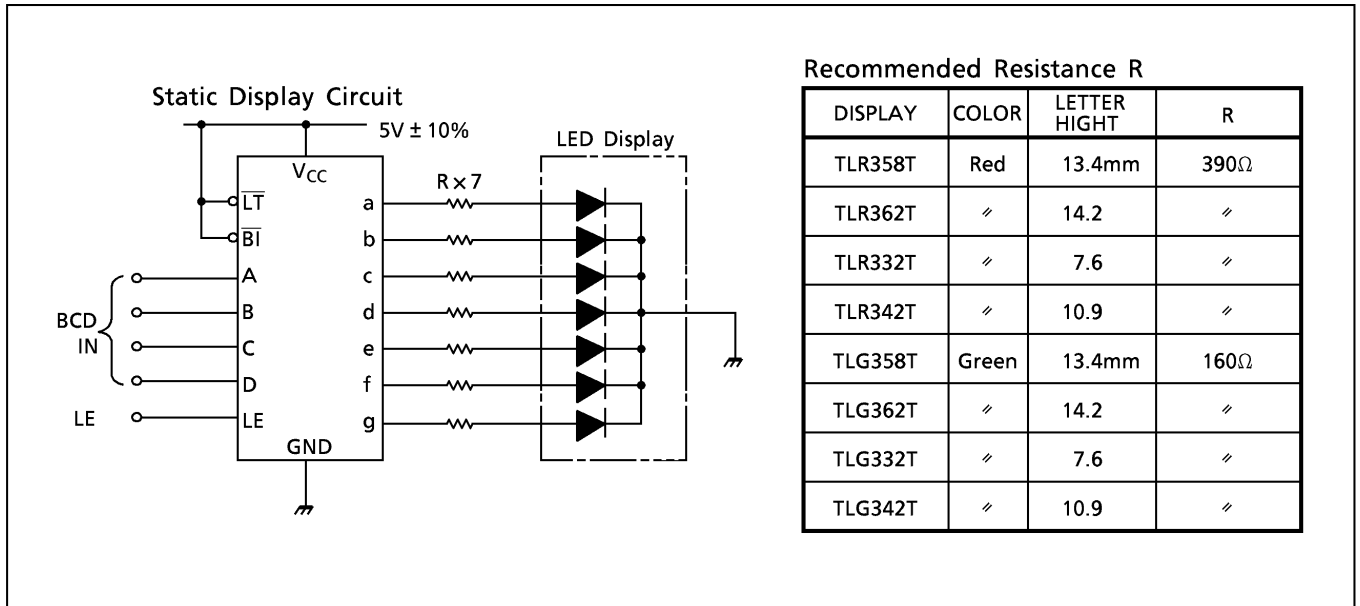
| PARAMETER | SYMBOL | TEST CONDITION | Ta = 25°C | | | Ta = -40~85°C | | UNIT | |
|--|------------------------|----------------|---------------------|------|------|---------------|------|------|------|
| | | | V _{CC} (V) | MIN. | TYP. | MAX. | MIN. | | MAX. |
| Output Transition Time Low to High | t_{TLH} | | 2.0 | — | 25 | 60 | — | 75 | ns |
| | | | 4.5 | — | 7 | 12 | — | 15 | |
| | | | 6.0 | — | 6 | 11 | — | 13 | |
| Output Transition Time High to Low | t_{THL} | | 2.0 | — | 30 | 75 | — | 95 | |
| | | | 4.5 | — | 8 | 15 | — | 19 | |
| | | | 6.0 | — | 7 | 13 | — | 16 | |
| Propagation Delay Time (BCD—Segment) | t_{pLH} t_{pHL} | | 2.0 | — | 125 | 255 | — | 320 | |
| | | | 4.5 | — | 33 | 51 | — | 64 | |
| | | | 6.0 | — | 23 | 43 | — | 54 | |
| Propagation Delay Time ($\overline{\text{BI}}$ —Segment) | t_{pLH} t_{pHL} | | 2.0 | — | 70 | 175 | — | 220 | |
| | | | 4.5 | — | 22 | 35 | — | 44 | |
| | | | 6.0 | — | 17 | 30 | — | 37 | |
| Propagation Delay Time ($\overline{\text{LT}}$ —Segment) | t_{pLH} t_{pHL} | | 2.0 | — | 60 | 120 | — | 150 | |
| | | | 4.5 | — | 15 | 24 | — | 30 | |
| | | | 6.0 | — | 12 | 20 | — | 26 | |
| Propagation Delay Time (LE—Segment) | t_{pLH} t_{pHL} | | 2.0 | — | 95 | 240 | — | 300 | |
| | | | 4.5 | — | 32 | 48 | — | 60 | |
| | | | 6.0 | — | 23 | 41 | — | 51 | |
| Input Capacitance | C_{IN} | | — | 5 | 10 | — | 10 | pF | |
| Power Dissipation Capacitance | C_{PD} (1) | (Note 1) | — | 95 | — | — | — | | |

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 :

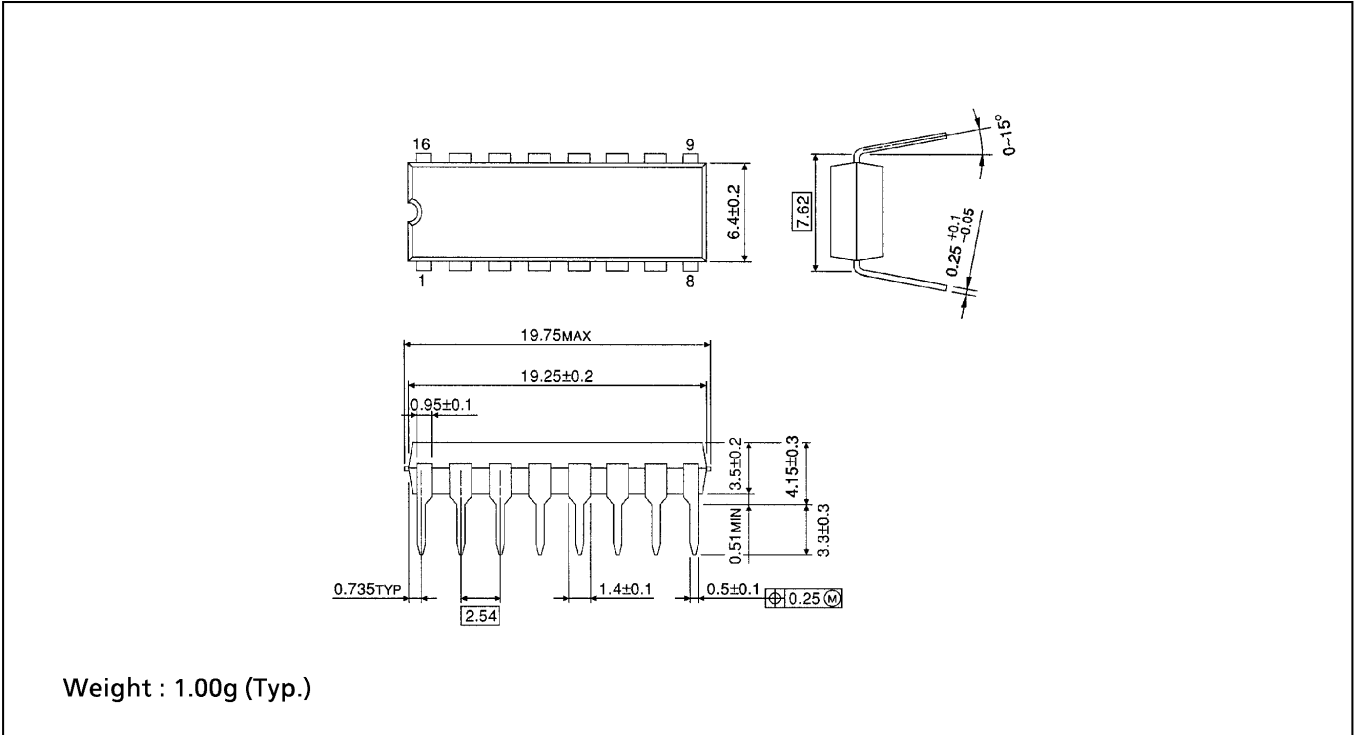
$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

APPLICATION CIRCUIT



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

