

TC74HC592AP, TC74HC592AF

8 Bit Binary Counter with Input Register

The TC74HC592A is high speed CMOS 8-BIT REGISTER COUNTER fabricated with silicon gate C²MOS technology.

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

The internal counter counts at positive edge of Counter Clock (CCK) when Counter Clock Enable ($\overline{\text{CCKEN}}$) is held "L" level. If Counter clear ($\overline{\text{CCLR}}$) is held "L", the internal counter is cleared asynchronously to clock.

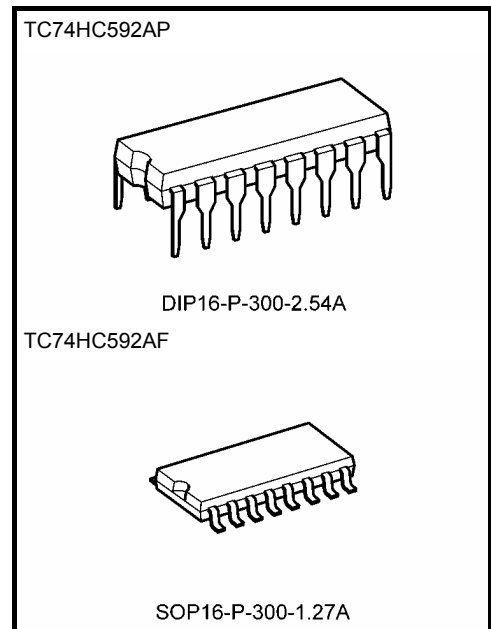
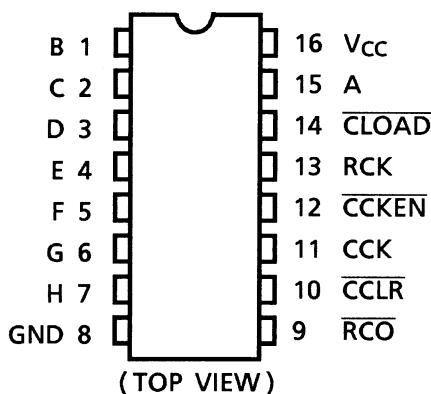
Input A to H are loaded to register at positive edge of Register Clock (RCK), and the register outputs are loaded to Counter when Counter Load ($\overline{\text{CLOAD}}$) is held "L" level.

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

Features

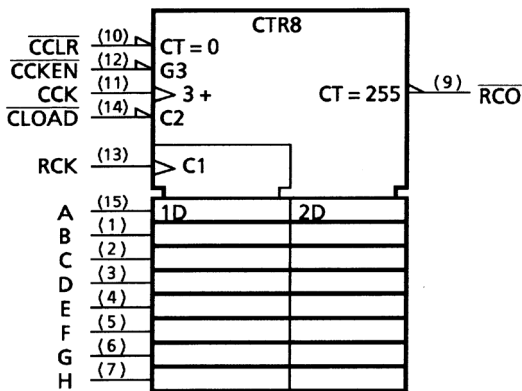
- High speed: $f_{\text{max}} = 35 \text{ MHz}$ (typ.) at $V_{\text{CC}} = 5 \text{ V}$
- Low power dissipation: $I_{\text{CC}} = 4 \mu\text{A}$ (max) at $T_a = 25^\circ\text{C}$
- High noise immunity: $V_{\text{NIH}} = V_{\text{NIL}} = 28\% V_{\text{CC}}$ (min)
- Output drive capability: 10 LSTTL loads for QA to QH
- Symmetrical output impedance: $|I_{\text{OH}}| = I_{\text{OL}} = 4 \text{ mA}$ (min)
- Balanced propagation delays: $t_{\text{pLH}} \approx t_{\text{pHL}}$
- Wide operating voltage range: $V_{\text{CC}} (\text{opr}) = 2 \text{ to } 6 \text{ V}$
- Pin and function compatible with 74LS592

Pin Assignment

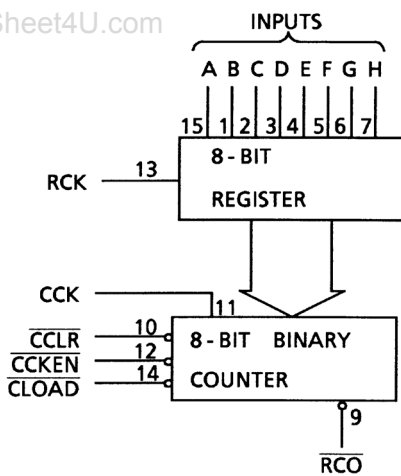


| | |
|-------------------|-----------------|
| Weight | |
| DIP16-P-300-2.54A | : 1.00 g (typ.) |
| SOP16-P-300-1.27A | : 0.18 g (typ.) |

IEC Logic Symbol



Block Diagram



Truth Table

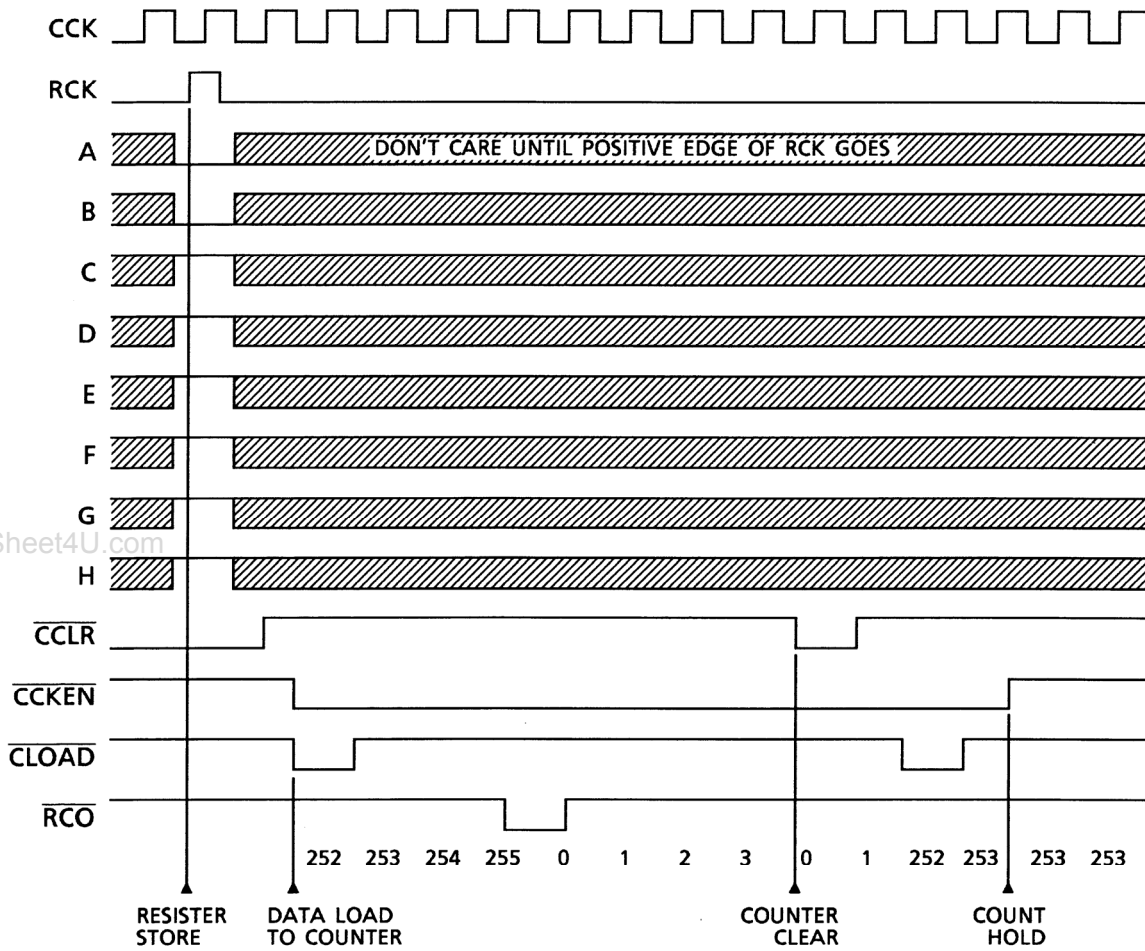
| Inputs | | | | | Function |
|--------------|---------------------------|--------------------------|---------------------------|--------------|---|
| RCK | $\overline{\text{CLOAD}}$ | $\overline{\text{CCLR}}$ | $\overline{\text{CCKEN}}$ | CCK | |
| X | L | H | X | X | Register Data is Loaded into Counter |
| X | H | L | X | X | Counter Clear |
| \uparrow | H | H | X | X | The Data of a Thru H Inputs is Stored into Register |
| \downarrow | H | H | X | X | Register State is not Changed |
| X | H | H | L | \uparrow | Counter Advances the Count |
| X | H | H | L | \downarrow | No Count |
| X | H | H | H | X | No Count |

X: Don't care

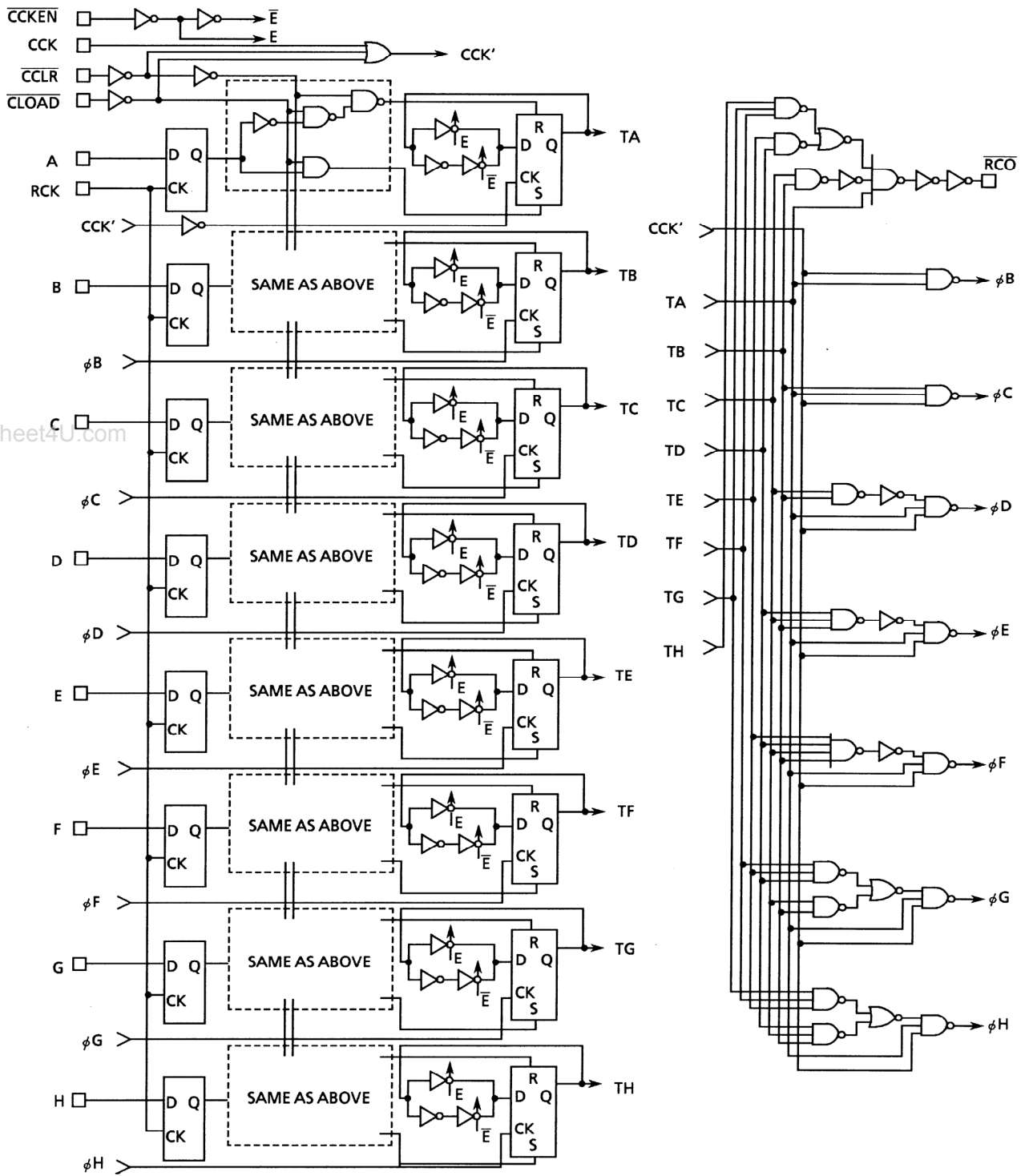
$$\overline{\text{RCO}} = \text{QA}' \cdot \text{QB}' \cdot \text{QC}' \cdot \text{QD}' \cdot \text{QE}' \cdot \text{QF}' \cdot \text{QG}' \cdot \text{QH}'$$

(QA' to QH': internal outputs of the counter)

Timing Chart



System Diagram



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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} | ± 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) (Note 2)/180 (SOP) | mW |
| Storage temperature | T_{stg} | -65 to 150 | $^{\circ}C$ |

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 $65^{\circ}C$. From $T_a = 65$ to $85^{\circ}C$ a derating factor of -10 mW/ $^{\circ}C$ 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 | $^{\circ}C$ |
| Input rise and fall time | t_r, t_f | 0 to 1000 ($V_{CC} = 2.0$ V) 0 to 500 ($V_{CC} = 4.5$ V) 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 _{CC} (V) | 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 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 _{OH} = -4 mA | 4.5 | 4.18 | 4.31 | — | 4.13 | — | |
| | | | | 6.0 | 5.68 | 5.80 | — | 5.63 | — | |
| | | | | I _{OH} = -5.2 mA | 4.5 | — | — | — | — | |
| Low-level output voltage | V _{OL} | V _{IN} = V _{IH} or V _{IL} | I _{OL} = 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 _{OL} = 4 mA | 4.5 | — | 0.17 | 0.26 | — | 0.33 | |
| | | | | 6.0 | — | 0.18 | 0.26 | — | 0.33 | |
| | | | | I _{OL} = 5.2 mA | 4.5 | — | — | — | — | |
| 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 | μA |

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Timing Requirements (input: $t_r = t_f = 6 \text{ ns}$)

| Characteristics | Symbol | Test Condition | Ta = 25°C | | Ta = -40 to 85°C | Unit | |
|--|------------------------|----------------|---------------------|------|------------------|------|-------|
| | | | V _{CC} (V) | Typ. | Limit | | Limit |
| Minimum pulse width (CCK, RCK) | t_W (H) t_W (L) | — | 2.0 | — | 75 | 95 | ns |
| | | | 4.5 | — | 15 | 19 | |
| | | | 6.0 | — | 13 | 16 | |
| Minimum pulse width ($\overline{\text{CCLR}}$) | t_W (L) | — | 2.0 | — | 100 | 125 | ns |
| | | | 4.5 | — | 20 | 25 | |
| | | | 6.0 | — | 16 | 21 | |
| Minimum pulse width ($\overline{\text{CLOAD}}$) | t_W (L) | — | 2.0 | — | 175 | 220 | ns |
| | | | 4.5 | — | 35 | 44 | |
| | | | 6.0 | — | 30 | 37 | |
| Minimum set-up time ($\overline{\text{CCKEN}}$ -CCK) | t_s | — | 2.0 | — | 75 | 95 | ns |
| | | | 4.5 | — | 15 | 19 | |
| | | | 6.0 | — | 13 | 16 | |
| Minimum set-up time (RCK- $\overline{\text{CLOAD}}$) | t_s | — | 2.0 | — | 150 | 190 | ns |
| | | | 4.5 | — | 30 | 38 | |
| | | | 6.0 | — | 26 | 32 | |
| Minimum set-up time (A to H-RCK) | t_s | — | 2.0 | — | 100 | 125 | ns |
| | | | 4.5 | — | 20 | 25 | |
| | | | 6.0 | — | 17 | 21 | |
| Minimum hold time | t_h | — | 2.0 | — | 5 | 5 | ns |
| | | | 4.5 | — | 5 | 5 | |
| | | | 6.0 | — | 5 | 5 | |
| Minimum removal time ($\overline{\text{CCLR}}$) | t_{rem} | — | 2.0 | — | 75 | 95 | ns |
| | | | 4.5 | — | 15 | 19 | |
| | | | 6.0 | — | 13 | 16 | |
| Minimum removal time ($\overline{\text{CLOAD}}$) | t_{rem} | — | 2.0 | — | 75 | 95 | ns |
| | | | 4.5 | — | 15 | 19 | |
| | | | 6.0 | — | 13 | 16 | |
| Clock frequency | f | — | 2.0 | — | 4 | 3.5 | MHz |
| | | | 4.5 | — | 22 | 18 | |
| | | | 6.0 | — | 26 | 21 | |

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 | t_{TLH} t_{THL} | — | — | 6 | 12 | ns |
| Propagation delay time ($\overline{\text{CCK}} - \overline{\text{RCO}}$) | t_{pLH} t_{pHL} | — | — | 25 | 38 | ns |
| Propagation delay time ($\overline{\text{RCK}} - \overline{\text{RCO}}$) | t_{pLH} t_{pHL} | — | — | 39 | 60 | ns |
| Propagation delay time ($\overline{\text{CCLR}} - \overline{\text{RCO}}$) | t_{pLH} | — | — | 24 | 36 | ns |
| Propagation delay time ($\overline{\text{CLOAD}} - \overline{\text{RCO}}$) | t_{pLH} t_{pHL} | — | — | 35 | 53 | ns |
| Maximum clock frequency | f_{max} | — | 25 | 35 | — | 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 | t_{TLH} t_{THL} | — | 2.0 | — | 30 | 75 | — | 95 | ns |
| | | | 4.5 | — | 8 | 15 | — | 19 | |
| | | | 6.0 | — | 7 | 13 | — | 16 | |
| Propagation delay time ($\overline{\text{CCK}} - \overline{\text{RCO}}$) | t_{pLH} t_{pHL} | — | 2.0 | — | 94 | 220 | — | 275 | ns |
| | | | 4.5 | — | 29 | 44 | — | 55 | |
| | | | 6.0 | — | 24 | 37 | — | 47 | |
| Propagation delay time ($\overline{\text{RCK}} - \overline{\text{RCO}}$) | t_{pLH} t_{pHL} | — | 2.0 | — | 160 | 340 | — | 425 | ns |
| | | | 4.5 | — | 45 | 68 | — | 85 | |
| | | | 6.0 | — | 34 | 58 | — | 73 | |
| Propagation delay time ($\overline{\text{CCLR}} - \overline{\text{RCO}}$) | t_{pLH} | — | 2.0 | — | 89 | 215 | — | 270 | ns |
| | | | 4.5 | — | 28 | 43 | — | 54 | |
| | | | 6.0 | — | 22 | 37 | — | 46 | |
| Propagation delay time ($\overline{\text{CLOAD}} - \overline{\text{RCO}}$) | t_{pLH} t_{pHL} | — | 2.0 | — | 140 | 300 | — | 375 | ns |
| | | | 4.5 | — | 40 | 60 | — | 75 | |
| | | | 6.0 | — | 30 | 51 | — | 64 | |
| Maximum clock frequency | f_{max} | — | 2.0 | 4 | 20 | — | 3.5 | — | MHz |
| | | | 4.5 | 22 | 33 | — | 18 | — | |
| | | | 6.0 | 26 | 49 | — | 21 | — | |
| Input capacitance | C_{IN} | — | — | 5 | 10 | — | 10 | pF | |
| Power dissipation capacitance | C_{PD} (Note) | — | — | 31 | — | — | — | pF | |

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

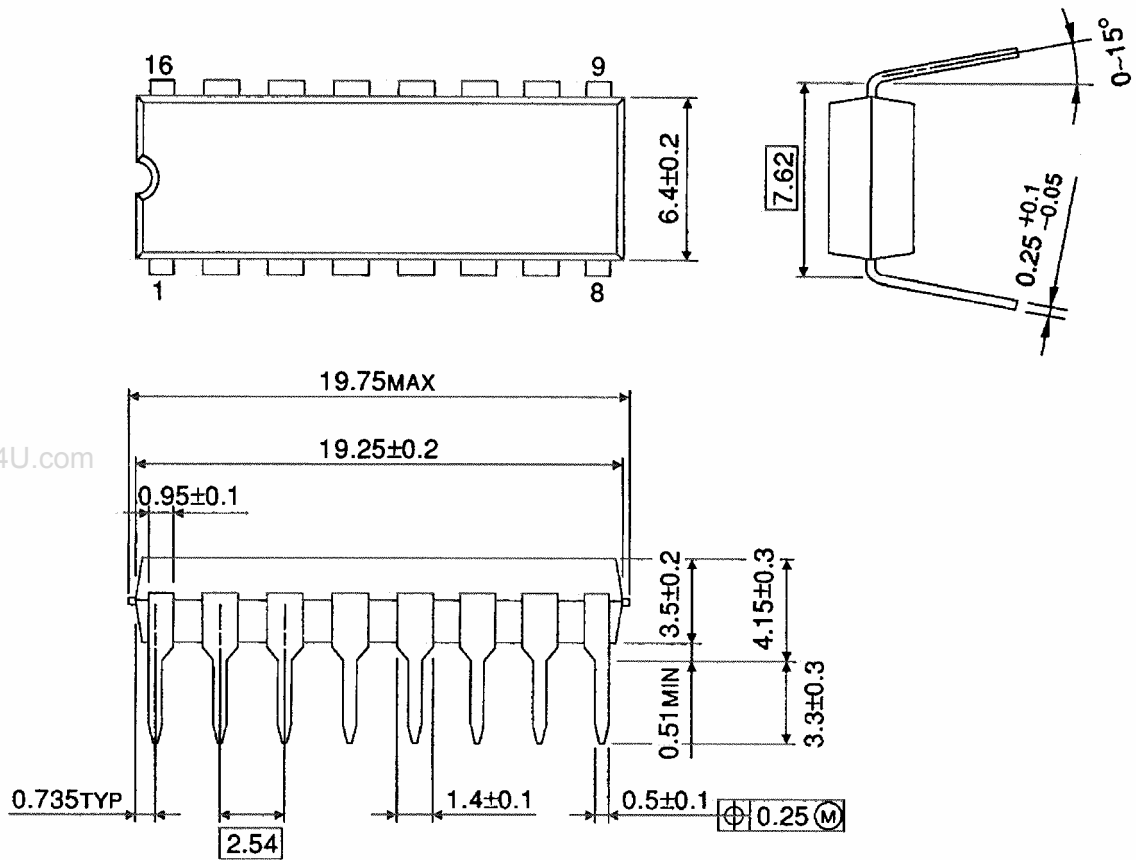
Average operating current can be obtained by the equation:

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

Package Dimensions

DIP16-P-300-2.54A

Unit : mm

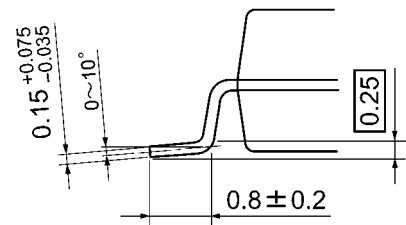
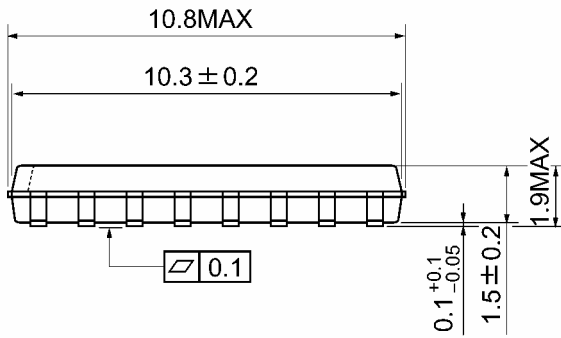
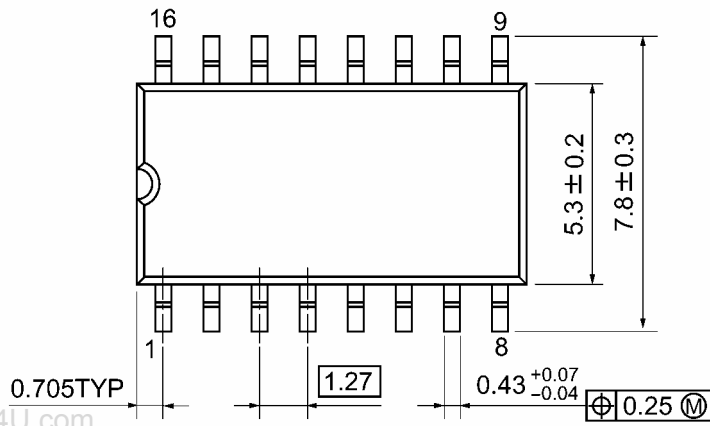


Weight: 1.00 g (typ.)

Package Dimensions

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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20070701-EN GENERAL

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