

**TC74HC165AP, TC74HC165AF, TC74HC165AFN****8 – BIT SHIFT REGISTER (P – IN, S – OUT)**

(Note) The JEDEC SOP (FN) is not available in Japan.

The TC74HC165A is a high speed CMOS 8-BIT PARALLEL/SERIAL-IN, SERIAL-OUT SHIFT REGISTER 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.

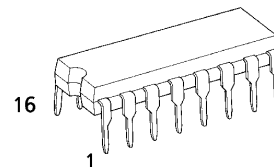
It consists of parallel-in or serial-in, serial-out 8-bit shift register with a gated clock inputs. When the  $\overline{\text{SHIFT/LOAD}}$  input is held high, the serial data input is enabled and the eight flip-flops perform serial shifting with each clock pulse. When the  $\overline{\text{SHIFT/LOAD}}$  input is held low, the parallel data is loaded asynchronously into the register at positive going transition of the clock pulse.

The CK-INH input should be shifted high only when the CK input is held high.

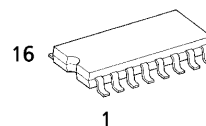
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

**FEATURES:**

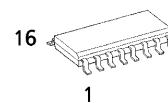
- High Speed..... $f_{\text{MAX}} = 56\text{MHz}(\text{typ.})$  at  $V_{\text{CC}} = 5\text{V}$
- Low Power Dissipation..... $I_{\text{CC}} = 4\mu\text{A}(\text{Max.})$  at  $T_a = 25^\circ\text{C}$
- High Noise Immunity..... $V_{\text{NIH}} = V_{\text{NIL}} = 28\% V_{\text{CC}}(\text{Min.})$
- Output Drive Capability.....10 LSTTL Loads
- Symmetrical Output Impedance..... $|I_{\text{OH}}| = I_{\text{OL}} = 4\text{mA}(\text{Min.})$
- Balanced Propagation Delays..... $t_{\text{PLH}} \approx t_{\text{PHL}}$
- Wide Operating Voltage Range..... $V_{\text{CC}}(\text{opr.}) = 2\text{V} \sim 6\text{V}$
- Pin and Function Compatible with 74LS165



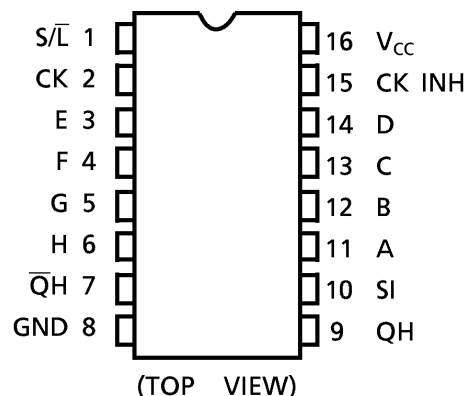
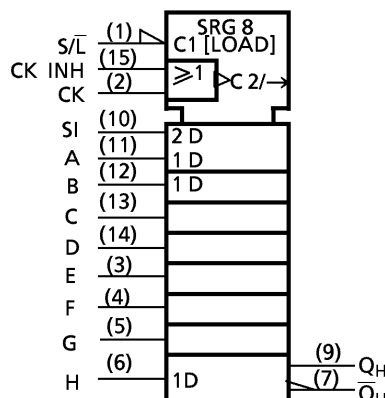
P (DIP16-P-300-2.54A)  
Weight : 1.00g (Typ.)



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



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

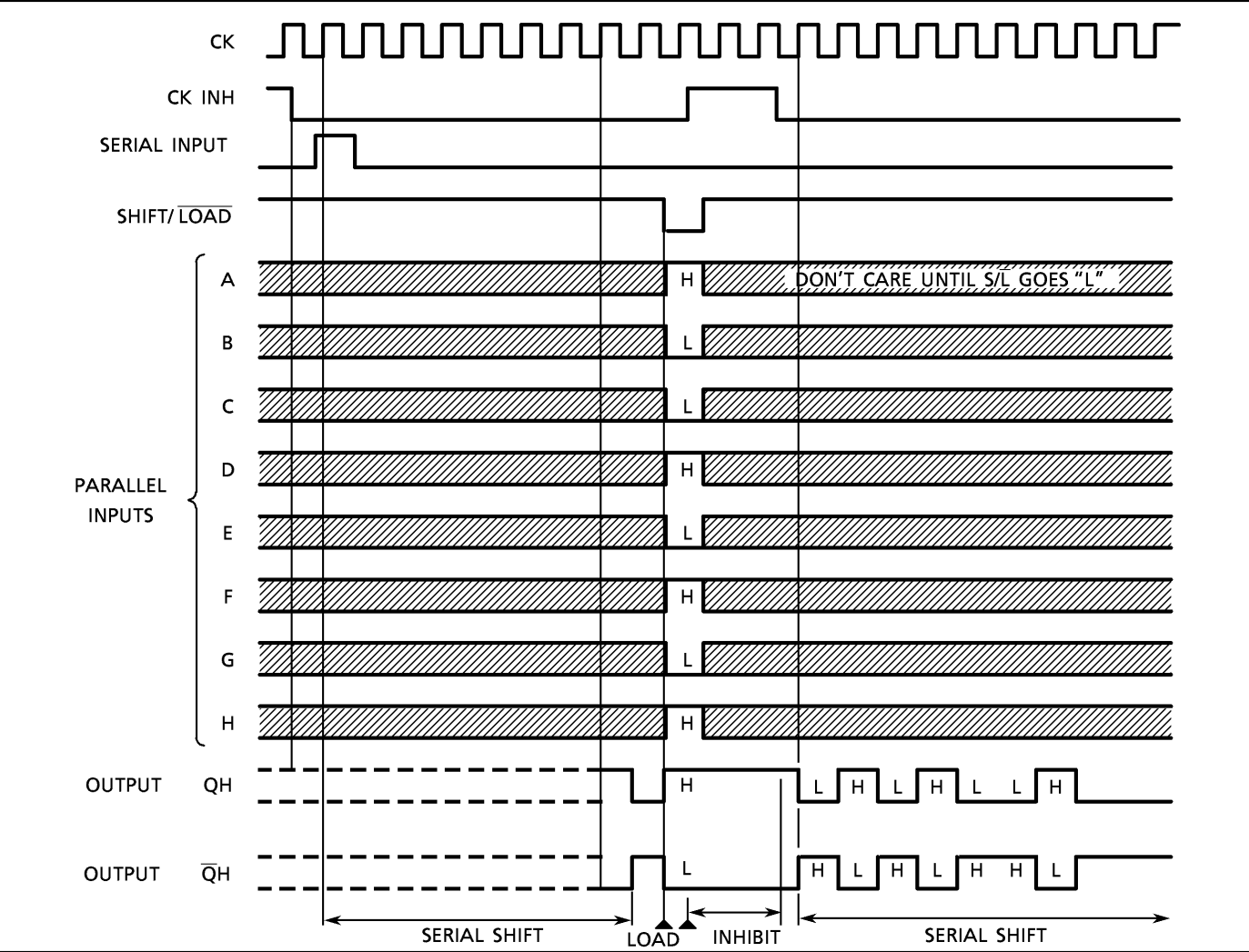
**PIN ASSIGNMENT****IEC LOGIC SYMBOL**

TRUTH TABLE

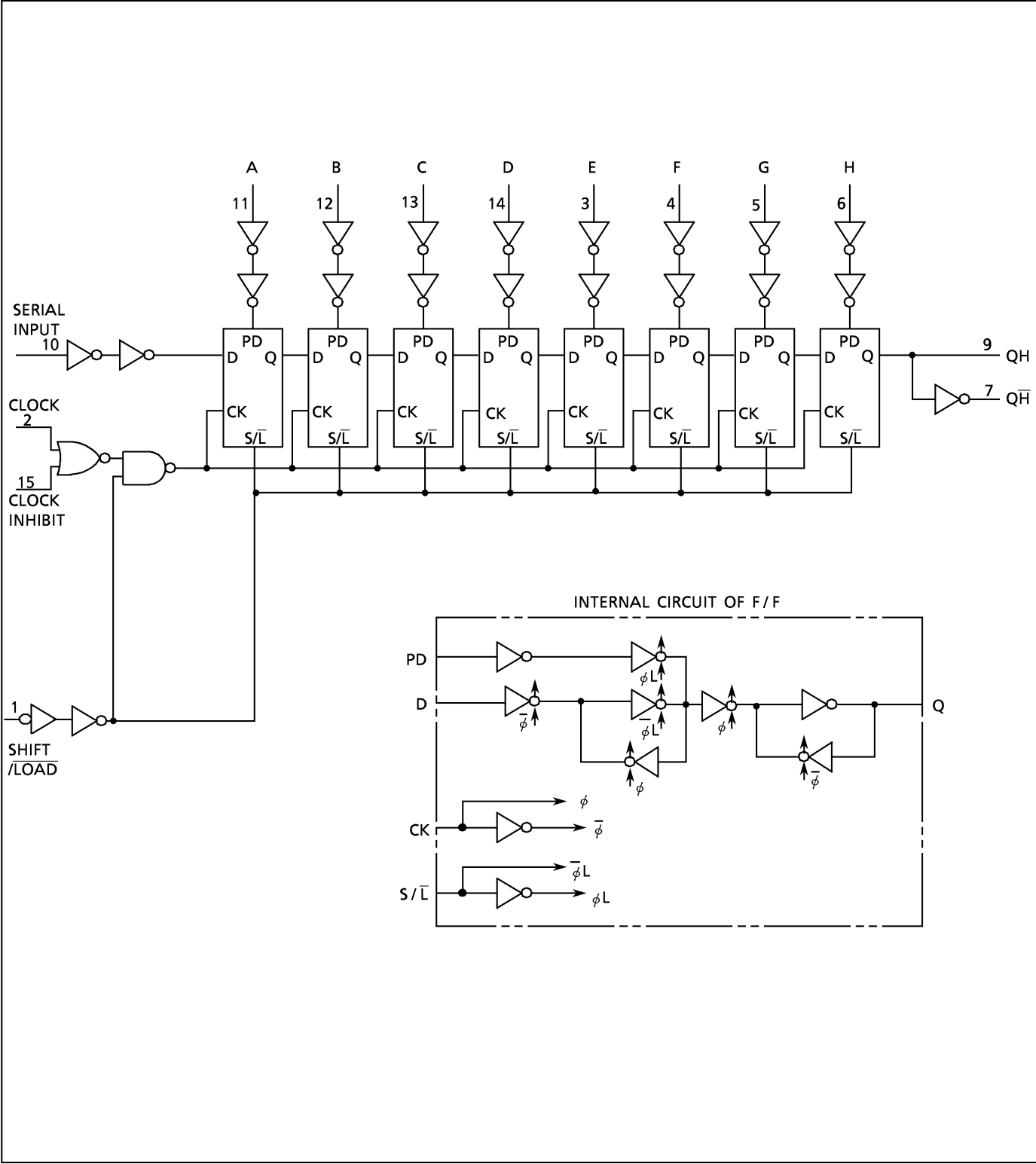
| INPUTS     |           |       |           |                    | INTERNAL OUTPUTS |     | OUTPUT |                  |
|------------|-----------|-------|-----------|--------------------|------------------|-----|--------|------------------|
| SHIFT/LOAD | CLOCK INH | CLOCK | SERIAL IN | PARALLEL A ..... H | QA               | QB  | QH     | $\overline{QH}$  |
| L          | X         | X     | X         | a ..... h          | a                | b   | h      | $\overline{h}$   |
| H          | L         |       | H         | X                  | H                | QAn | QGn    | $\overline{QGn}$ |
| H          | L         |       | L         | X                  | L                | QAn | QGn    | $\overline{QGn}$ |
| H          |           | L     | H         | X                  | H                | QAn | QGn    | $\overline{QGn}$ |
| H          |           | L     | L         | X                  | L                | QAn | QGn    | $\overline{QGn}$ |
| H          | X         | H     | X         | X                  | NO CHANGE        |     |        |                  |
| H          | H         | X     | X         | X                  | NO CHANGE        |     |        |                  |

X : Don't Care  
a ..... h : The level of steady state input voltage at inputs A through H respectively  
QAn~QGn : The level of QA~QG, respectively, before the most recent positive transition of the CK.

TIMING CHART



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 | $V_{OH}$ | $V_{IN} = V_{IH} \text{ or } V_{IL}$                   |                   |                          |                   |                      |                                   |                      | V             |
|                             |          | $I_{OH} = -20\mu\text{A}$                              | 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                 | —<br>—<br>—          |               |
|                             |          | $I_{OH} = -4 \text{ mA}$<br>$I_{OH} = -5.2 \text{ mA}$ | 4.5<br>6.0        | 4.18<br>5.68             | 4.31<br>5.80      | —<br>—               | 4.13<br>5.63                      | —<br>—               | V             |
|                             |          |                                                        |                   |                          |                   |                      |                                   |                      |               |
| Low - Level Output Voltage  | $V_{OL}$ | $V_{IN} = V_{IH} \text{ or } V_{IL}$                   |                   |                          |                   |                      |                                   |                      | V             |
|                             |          | $I_{OL} = 20\mu\text{A}$                               | 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>—                       | 0.1<br>0.1<br>0.1    |               |
|                             |          | $I_{OL} = 4 \text{ mA}$<br>$I_{OL} = 5.2 \text{ mA}$   | 4.5<br>6.0        | —<br>—                   | 0.17<br>0.18      | 0.26<br>0.26         | —<br>—                            | 0.33<br>0.33         | $\mu\text{A}$ |
|                             |          |                                                        |                   |                          |                   |                      |                                   |                      |               |
| 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                 |               |

TIMING REQUIREMENTS OPERATING CONDITIONS (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) | TYP. | LIMIT         | LIMIT |      |
| Minimum Pulse Width<br>(CK, CK INH)                | $t_{W(H)}$<br>$t_{W(L)}$ |                | 2.0                 | —    | 75            | 95    | ns   |
|                                                    |                          |                | 4.5                 | —    | 15            | 19    |      |
|                                                    |                          |                | 6.0                 | —    | 13            | 16    |      |
| Minimum Pulse Width<br>(S/ $\bar{L}$ )             | $t_{W(L)}$               |                | 2.0                 | —    | 75            | 95    |      |
|                                                    |                          |                | 4.5                 | —    | 15            | 19    |      |
|                                                    |                          |                | 6.0                 | —    | 13            | 16    |      |
| Minimum Set-up Time<br>(PI—S/ $\bar{L}$ )          | $t_s$                    |                | 2.0                 | —    | 75            | 95    |      |
|                                                    |                          |                | 4.5                 | —    | 15            | 19    |      |
|                                                    |                          |                | 6.0                 | —    | 13            | 16    |      |
| Minimum Set-up Time<br>(SI—CK, CK INH)             | $t_s$                    |                | 2.0                 | —    | 75            | 95    |      |
|                                                    |                          |                | 4.5                 | —    | 15            | 19    |      |
|                                                    |                          |                | 6.0                 | —    | 13            | 16    |      |
| Minimum Set-up Time<br>(S/ $\bar{L}$ —CK, CK INH)  | $t_s$                    |                | 2.0                 | —    | 75            | 95    |      |
|                                                    |                          |                | 4.5                 | —    | 15            | 19    |      |
|                                                    |                          |                | 6.0                 | —    | 13            | 16    |      |
| Minimum Hold Time<br>(PI—S/ $\bar{L}$ )            | $t_h$                    |                | 2.0                 | —    | 0             | 0     | ns   |
|                                                    |                          |                | 4.5                 | —    | 0             | 0     |      |
|                                                    |                          |                | 6.0                 | —    | 0             | 0     |      |
| Minimum Hold Time<br>(SI—CK, CK INH)               | $t_h$                    |                | 2.0                 | —    | 0             | 0     |      |
|                                                    |                          |                | 4.5                 | —    | 0             | 0     |      |
|                                                    |                          |                | 6.0                 | —    | 0             | 0     |      |
| Minimum Hold Time<br>(S/ $\bar{L}$ —CK, CK INH)    | $t_h$                    |                | 2.0                 | —    | 0             | 0     |      |
|                                                    |                          |                | 4.5                 | —    | 0             | 0     |      |
|                                                    |                          |                | 6.0                 | —    | 0             | 0     |      |
| Minimum Removal Time<br>(CK INH—CK)<br>(CK—CK INH) | $t_{rem}$                |                | 2.0                 | —    | 75            | 95    |      |
|                                                    |                          |                | 4.5                 | —    | 15            | 19    |      |
|                                                    |                          |                | 6.0                 | —    | 13            | 16    |      |
| Clock Frequency                                    | f                        |                | 2.0                 | —    | 7             | 6     | MHz  |
|                                                    |                          |                | 4.5                 | —    | 30            | 24    |      |
|                                                    |                          |                | 6.0                 | —    | 41            | 28    |      |

AC ELECTRICAL CHARACTERISTICS (C<sub>L</sub> = 15pF, V<sub>CC</sub> = 5V, Ta = 25°C, Input  $t_r = t_f = 6\text{ns}$ )

| PARAMETER                                                   | SYMBOL                 | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|-------------------------------------------------------------|------------------------|----------------|------|------|------|------|
| Output Transition Time                                      | $t_{TLH}$<br>$t_{THL}$ |                | —    | 4    | 8    | ns   |
| Propagation Delay Time<br>(CK, CK INH—QH, $\overline{QH}$ ) | $t_{pLH}$<br>$t_{pHL}$ |                | —    | 15   | 25   |      |
| Propagation Delay Time<br>(S/L—QH, $\overline{QH}$ )        | $t_{pLH}$<br>$t_{pHL}$ |                | —    | 15   | 25   |      |
| Propagation Delay Time<br>(H—QH, $\overline{QH}$ )          | $t_{pLH}$<br>$t_{pHL}$ |                | —    | 14   | 26   |      |
| Maximum Clock Frequency                                     | $f_{MAX}$              |                | 35   | 56   | —    | 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                 | —    | 25   | 75            | —    | 95   |
|                                                                                   |                        |                | 4.5                 | —    | 8    | 15            | —    | 19   |
|                                                                                   |                        |                | 6.0                 | —    | 7    | 13            | —    | 16   |
| Propagation Delay Time<br>(CK, CK INH—QH, $\overline{\text{QH}}$ )                | $t_{pLH}$<br>$t_{pHL}$ |                | 2.0                 | —    | 55   | 150           | —    | 190  |
|                                                                                   |                        |                | 4.5                 | —    | 18   | 30            | —    | 38   |
|                                                                                   |                        |                | 6.0                 | —    | 15   | 26            | —    | 33   |
| Propagation Delay Time<br>(S/ $\overline{\text{L}}$ —QH, $\overline{\text{QH}}$ ) | $t_{pLH}$<br>$t_{pHL}$ |                | 2.0                 | —    | 60   | 165           | —    | 205  |
|                                                                                   |                        |                | 4.5                 | —    | 19   | 33            | —    | 41   |
|                                                                                   |                        |                | 6.0                 | —    | 16   | 28            | —    | 35   |
| Propagation Delay Time<br>(H—QH, $\overline{\text{QH}}$ )                         | $t_{pHL}$              |                | 2.0                 | —    | 52   | 135           | —    | 170  |
|                                                                                   |                        |                | 4.5                 | —    | 17   | 27            | —    | 34   |
|                                                                                   |                        |                | 6.0                 | —    | 14   | 23            | —    | 29   |
| Maximum Clock Frequency<br>Frequency                                              | $f_{\text{MAX}}$       |                | 2.0                 | 7    | 14   | —             | 6    | —    |
|                                                                                   |                        |                | 4.5                 | 30   | 46   | —             | 24   | —    |
|                                                                                   |                        |                | 6.0                 | 41   | 65   | —             | 28   | —    |
| Input Capacitance                                                                 | $C_{\text{IN}}$        |                |                     | —    | 5    | 10            | —    | 10   |
| Power Dissipation Capacitance                                                     | $C_{\text{PD}} (1)$    |                |                     | —    | 55   | —             | —    | —    |

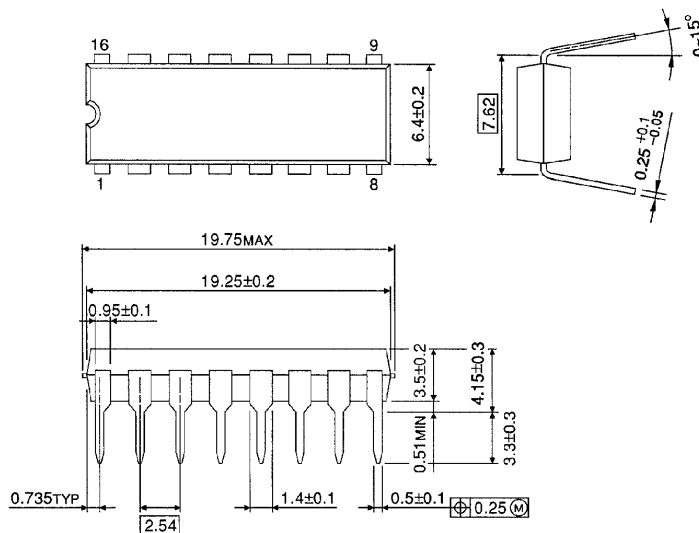
Note (1)  $C_{\text{PD}}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

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

## DIP 16PIN PACKAGE DIMENSIONS (DIP16-P-300-2.54A)

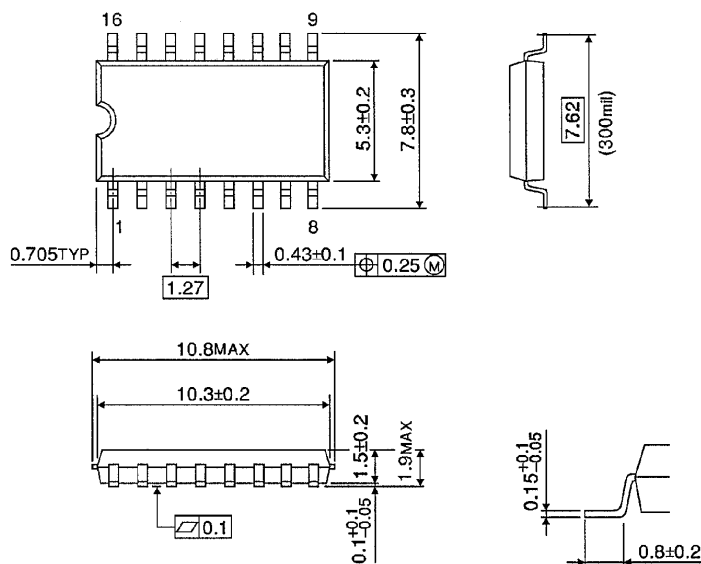
Unit in mm



Weight : 1.00g (Typ.)

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

Unit in mm

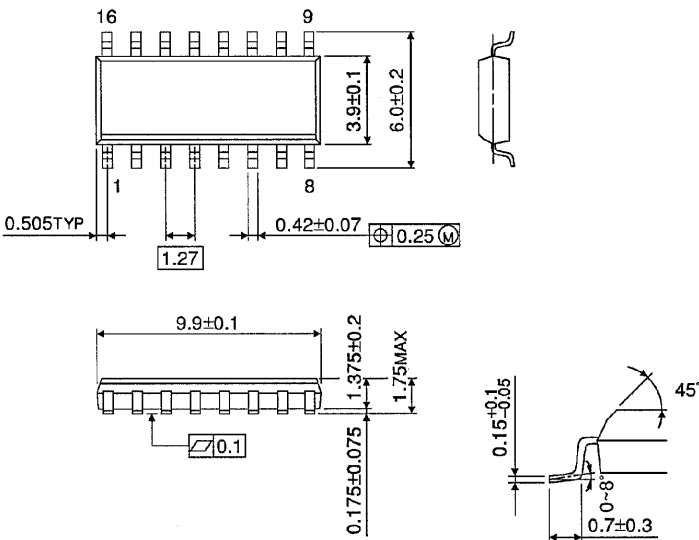


Weight : 0.18g (Typ.)

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.)



**RESTRICTIONS ON PRODUCT USE**

000707EBA

- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk.
- The products described in this document are subject to the foreign exchange and foreign trade laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.