

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74HC393AP, TC74HC393AF, TC74HC393AFN

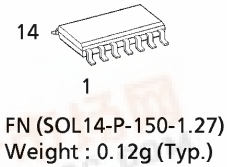
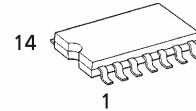
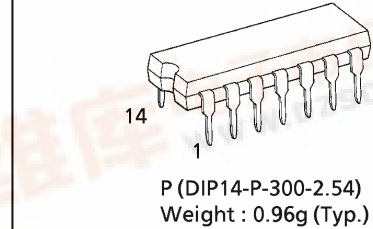
DUAL BINARY COUNTER

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

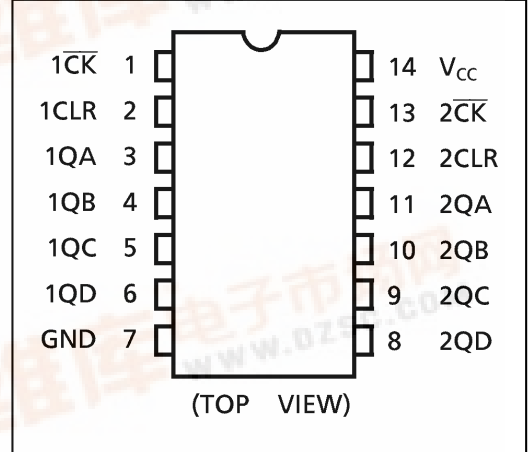
The TC74HC393A is a high speed CMOS 4-BIT BINARY COUNTER fabricated with silicon gate C²MOS technology. It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation. It contains two independent counter circuits in one package, so that counting or frequency division of eight binary bits can be achieved with one IC. This device changes state on the negative going transition of the \overline{CK} pulse. The counter can be reset to "0" (QA~QD="L") by a high at the CLR input regardless of other inputs. All inputs are equipped with protection circuits against static discharge or transient excess voltage.

FEATURES :

- High Speed..... $f_{MAX} = 72\text{MHz}(\text{typ.})$ 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 74LS393



PIN ASSIGNMENT

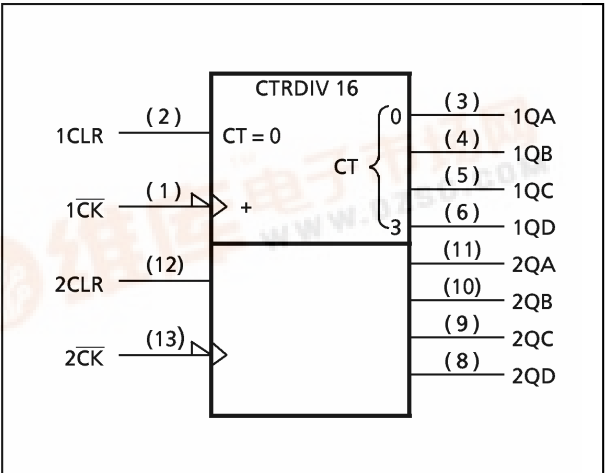


TRUTH TABLE

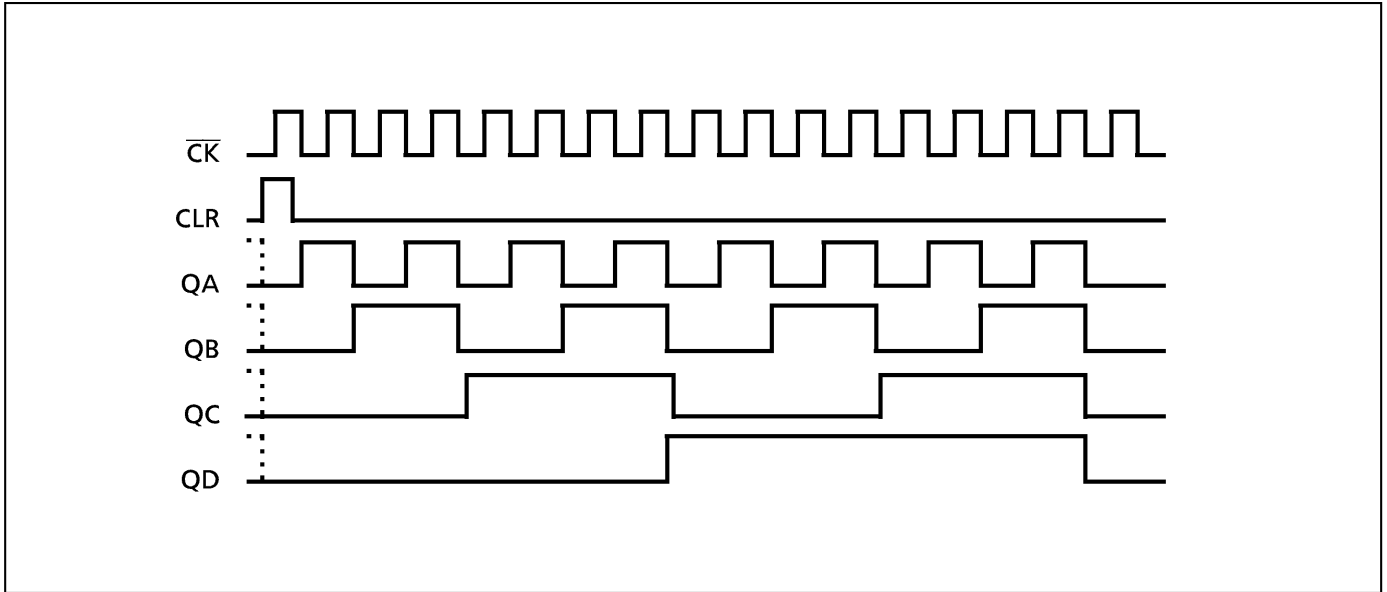
| INPUTS | | OUTPUTS | | | |
|-----------------|-----|-----------|----|----|----|
| \overline{CK} | CLR | QA | QB | QC | QD |
| X | H | L | L | L | L |
| | L | COUNT UP | | | |
| | L | NO CHANGE | | | |

X : Don't Care

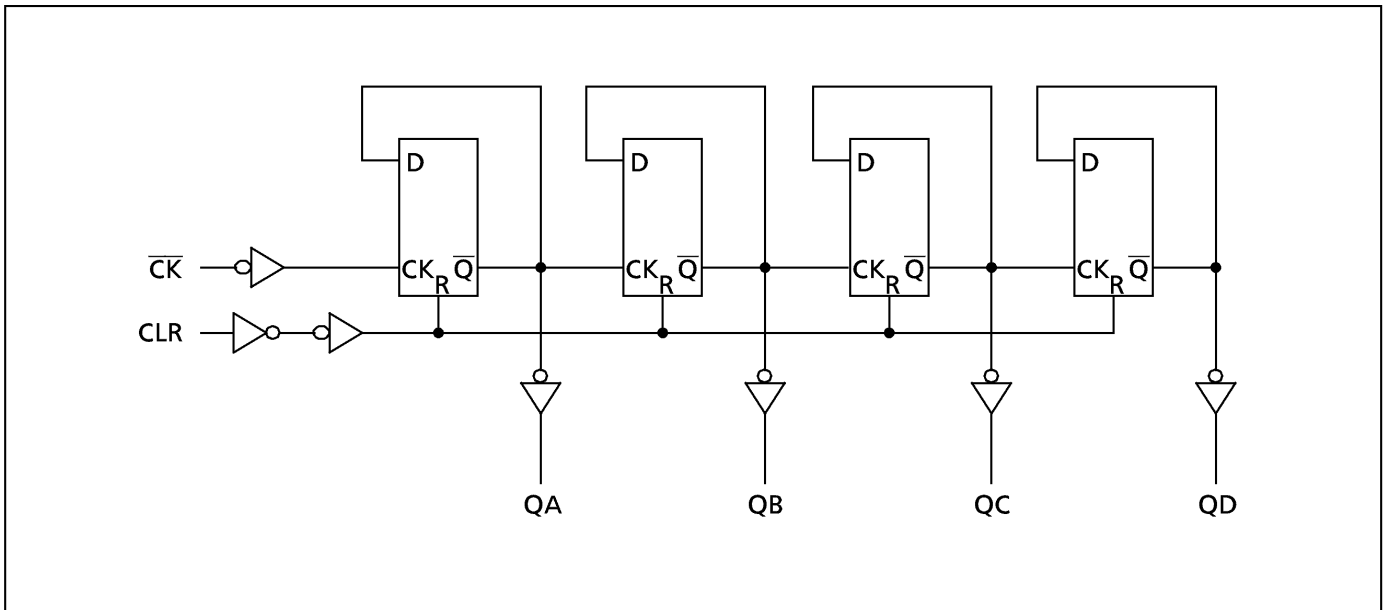
IEC LOGIC SYMBOL



TIMING CHART



SYSTEM 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 | 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°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} | $V_{IN} = V_{IH}$ 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 | — | |
| | | | $I_{OH} = -4\text{ mA}$ $I_{OH} = -5.2\text{ mA}$ | 4.5 | 4.18 | 4.31 | — | 4.13 | — | |
| | | | | 6.0 | 5.68 | 5.80 | — | 5.63 | — | |
| Low - Level Output Voltage | V_{OL} | $V_{IN} = V_{IH}$ 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 | |
| | | | $I_{OL} = 4\text{ mA}$ $I_{OL} = 5.2\text{ mA}$ | 4.5 | — | 0.17 | 0.26 | — | 0.33 | |
| | | | | 6.0 | — | 0.18 | 0.26 | — | 0.33 | |
| Input Leakage Current | I_{IN} | $V_{IN} = V_{CC}$ 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 | | |

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 (CK) | $t_{W(H)}$ $t_{W(L)}$ | | 2.0 | — | 75 | 95 | ns |
| | | | 4.5 | — | 15 | 19 | |
| | | | 6.0 | — | 13 | 16 | |
| Minimum Pulse Width (CLR) | $t_{W(H)}$ | | 2.0 | — | 75 | 95 | |
| | | | 4.5 | — | 15 | 19 | |
| | | | 6.0 | — | 13 | 16 | |
| Minimum Removal Time | t_{rem} | | 2.0 | — | 25 | 30 | |
| | | | 4.5 | — | 5 | 6 | |
| | | | 6.0 | — | 5 | 5 | |
| Clock Frequency | f | | 2.0 | — | 6 | 5 | MHz |
| | | | 4.5 | — | 32 | 27 | |
| | | | 6.0 | — | 38 | 32 | |

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 | t_{TLH} | | — | 4 | 8 | ns |
| | t_{THL} | | | | | |
| Propagation Delay Time (CK-QA) | t_{pLH} | | — | 12 | 20 | |
| | t_{pHL} | | | | | |
| Propagation Delay Time (CK-QB) | t_{pLH} | | — | 16 | 31 | |
| | t_{pHL} | | | | | |
| Propagation Delay Time (CK-QC) | t_{pLH} | | — | 21 | 38 | |
| | t_{pHL} | | | | | |
| Propagation Delay Time (CK-QD) | t_{pLH} | | — | 25 | 46 | |
| | t_{pHL} | | | | | |
| Propagation Delay Time (CLR-Qn) | t_{pHL} | | — | 15 | 26 | |
| Maximum Clock Frequency | f_{MAX} | | 35 | 72 | — | MHz |

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

| PARAMETER | SYMBOL | TEST CONDITION | V_{CC} (V) | $T_a = 25^\circ\text{C}$ | | | $T_a = -40\text{--}85^\circ\text{C}$ | | UNIT |
|--|------------------------|----------------|--------------|--------------------------|------|------|--------------------------------------|------|------|
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | |
| Output Transition Time | t_{TLH} t_{THL} | | 2.0 | — | 25 | 75 | — | 95 | ns |
| | | | 4.5 | — | 7 | 15 | — | 19 | |
| | | | 6.0 | — | 6 | 13 | — | 16 | |
| Propagation Delay Time (\overline{CK} —QA) | t_{pLH} t_{pHL} | | 2.0 | — | 45 | 120 | — | 150 | |
| | | | 4.5 | — | 15 | 24 | — | 30 | |
| | | | 6.0 | — | 13 | 20 | — | 26 | |
| Propagation Delay Time (\overline{CK} —QB) | t_{pLH} t_{pHL} | | 2.0 | — | 60 | 180 | — | 225 | |
| | | | 4.5 | — | 20 | 36 | — | 45 | |
| | | | 6.0 | — | 17 | 31 | — | 38 | |
| Propagation Delay Time (\overline{CK} —QC) | t_{pLH} t_{pHL} | | 2.0 | — | 80 | 220 | — | 275 | |
| | | | 4.5 | — | 25 | 44 | — | 55 | |
| | | | 6.0 | — | 21 | 37 | — | 47 | |
| Propagation Delay Time (\overline{CK} —QD) | t_{pLH} t_{pHL} | | 2.0 | — | 100 | 260 | — | 325 | |
| | | | 4.5 | — | 30 | 52 | — | 65 | |
| | | | 6.0 | — | 26 | 44 | — | 55 | |
| Propagation Delay Time (CLR—Qn) | t_{pHL} | | 2.0 | — | 55 | 150 | — | 190 | |
| | | | 4.5 | — | 18 | 30 | — | 38 | |
| | | | 6.0 | — | 15 | 26 | — | 33 | |
| Maximum Clock Frequency | f_{MAX} | | 2.0 | 6 | 22 | — | 5 | — | MHZ |
| | | | 4.5 | 32 | 67 | — | 27 | — | |
| | | | 6.0 | 38 | 77 | — | 32 | — | |
| Input Capacitance | C_{IN} | | — | 5 | 10 | — | 10 | pF | |
| Power Dissipation Capacitance | C_{PD} (1) | | — | 40 | — | — | — | | |

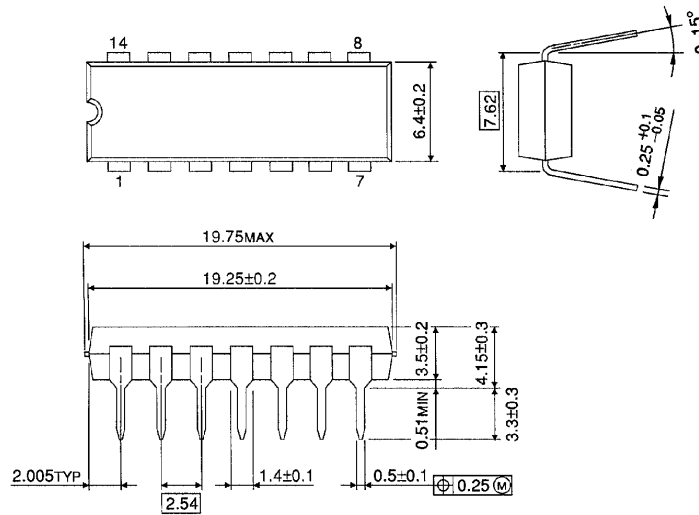
Note (1) C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2 \text{ (per counter)}$$

DIP 14PIN PACKAGE DIMENSIONS (DIP14-P-300-2.54)

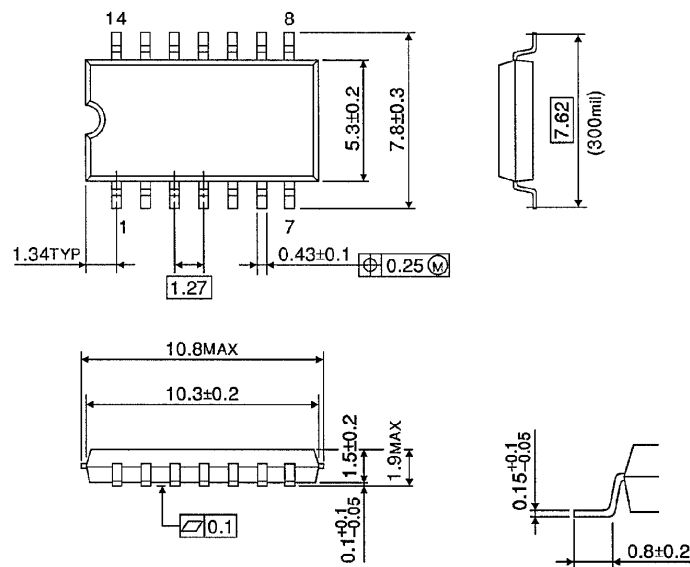
Unit in mm



Weight : 0.96g (Typ.)

SOP 14PIN (200mil BODY) PACKAGE DIMENSIONS (SOP14-P-300-1.27)

Unit in mm

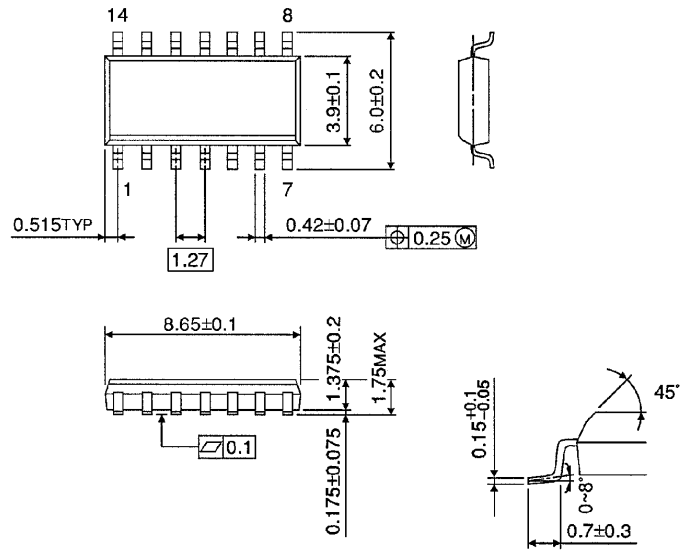


Weight : 0.18g (Typ.)

SOP 14PIN (150mil BODY) PACKAGE DIMENSIONS (SOL14-P-150 -1.27)

Unit in mm

(Note) This package is not available in Japan.



Weight : 0.12g (Typ.)

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