

TC74HC390AP, TC74HC390AF, TC74HC390AFN

DUAL DECADE COUNTER

The TC74HC390A is a high speed CMOS DUAL DECADE COUNTER fabricated with silicon gate C²MOS technology. It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

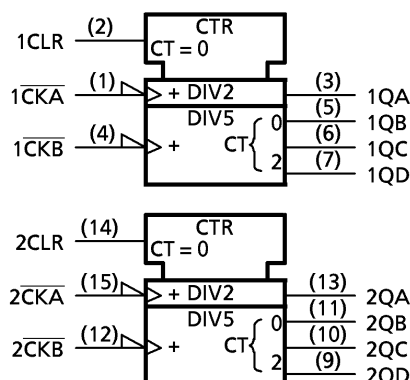
It consists of two independent 4-bit counters, each composed of a divide-by-two and a divide-by-five counter. The divide-by-two counter is incremented on the negative going transition of clock A($\overline{CKA}$). The divided-by-five counter is incremented on the negative going transition of clock B($\overline{CKB}$). The counter can be cascaded to form decade, bi-quinary, or various combinations up to a divide-by-100 counter. When the CLR input is set high, the Q outputs are set to low independent of the clock inputs.

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

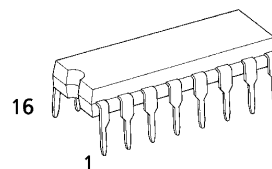
FEATURES:

- High Speed..... $f_{MAX} = 84\text{MHz}(\text{typ.})$
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 74LS390

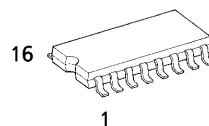
IEC LOGIC SYMBOL



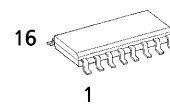
(Note) The JEDEC SOP (FN) is not available in Japan.



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

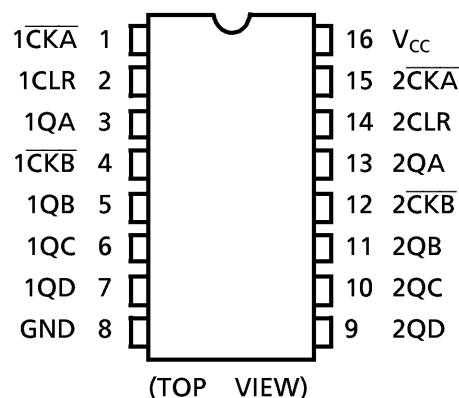


F (SOP16-P-300-1.27)
Weight : 0.18g (Typ.)

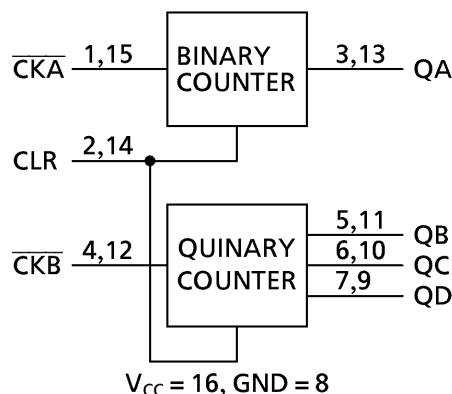


FN (SOL16-P-150-1.27)
Weight : 0.13g (Typ.)

PIN ASSIGNMENT



BLOCK DAIGRAM

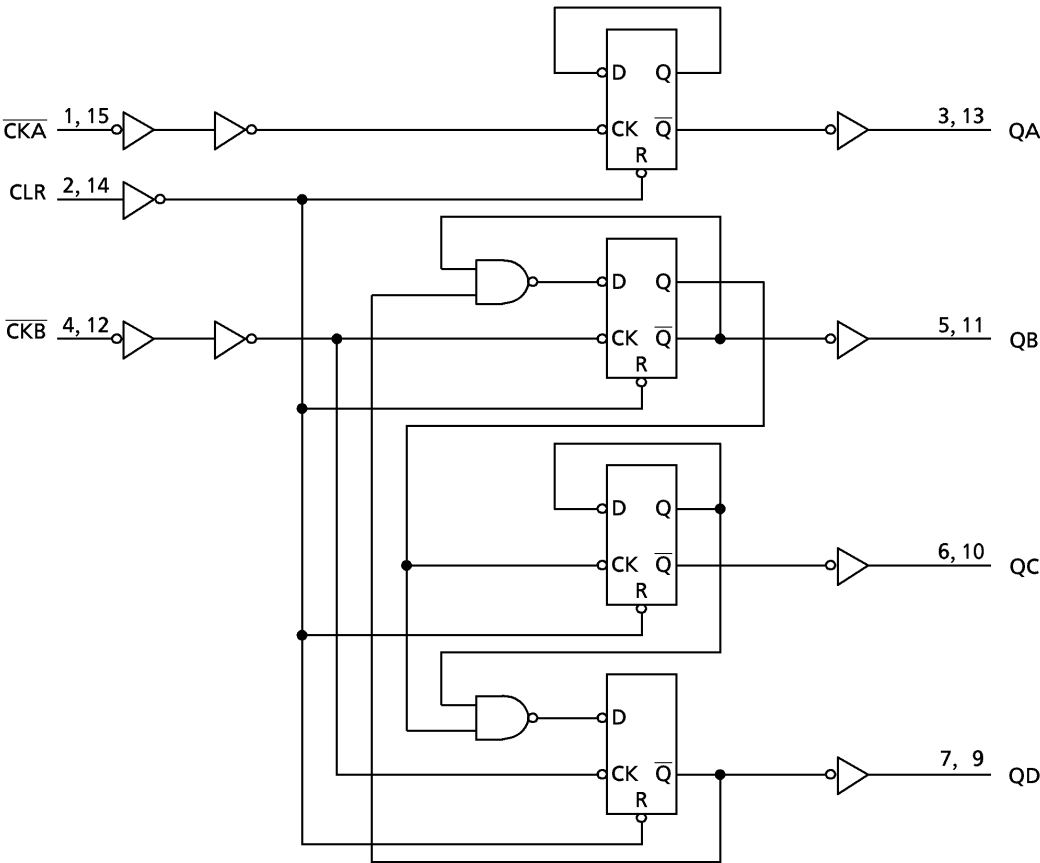


TRUTH TABLE

INPUTS			OUTPUTS			
CKA	CKB	CLR	QA	QB	QC	QD
X	X	H	L	L	L	L
	X	L	BINARY COUNT UP			
X		L	QUINARY COUNT UP			

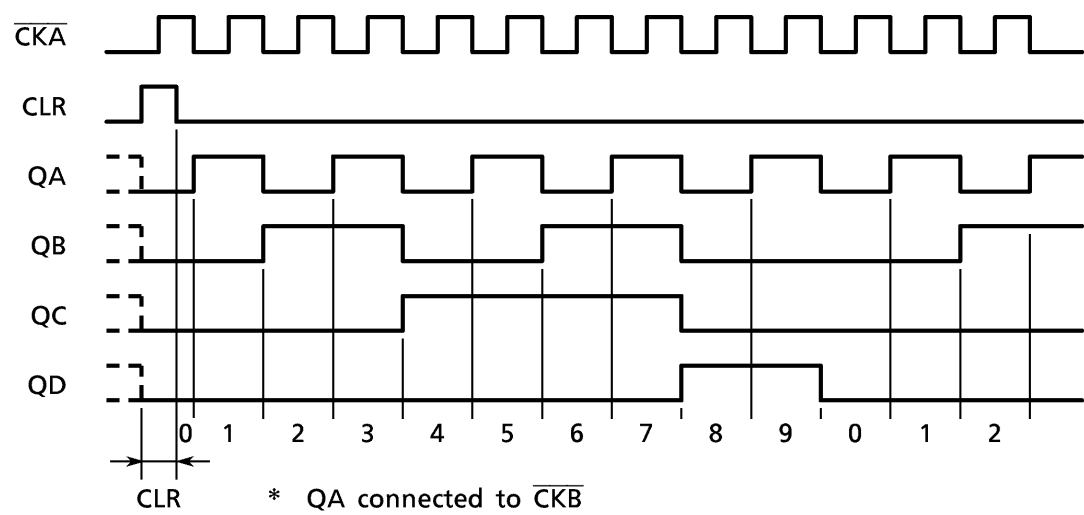
X : Don't Care

SYSTEM DIAGRAM (1/2 package)

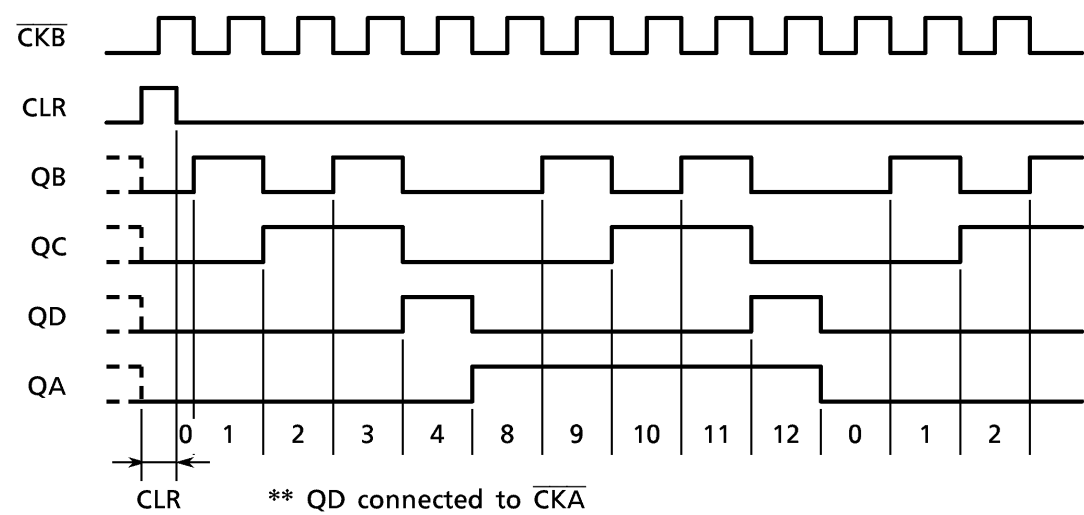


TIMING CHART

(1) BCD COUNT SEQUENCE*



(2) BI-QUINARY COUNT SEQUENCE**



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}	± 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}	$-65 \sim 150$	°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°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	$0 \sim 1000 (V_{CC} = 2.0\text{V})$ $0 \sim 500 (V_{CC} = 4.5\text{V})$ $0 \sim 400 (V_{CC} = 6.0\text{V})$	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 4.5 6.0	1.50 3.15 4.20	— — —	— — —	1.50 3.15 4.20	— — —	V
Low - Level Input Voltage	V_{IL}		2.0 4.5 6.0	— — —	— — —	0.50 1.35 1.80	— — —	0.50 1.35 1.80	V
High - Level Output Voltage	V_{OH}	$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -20\mu\text{A}$	2.0 4.5 6.0	1.9 4.4 5.9	2.0 4.5 6.0	— — —	1.9 4.4 5.9	V
			$I_{OH} = -4 \text{ mA}$ $I_{OH} = -5.2 \text{ mA}$	4.5 6.0	4.18 5.68	4.31 5.80	— —	4.13 5.63	
		$V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 20\mu\text{A}$	2.0 4.5 6.0	— — —	0.0 0.0 0.0	0.1 0.1 0.1	— — —	V
			$I_{OL} = 4 \text{ mA}$ $I_{OL} = 5.2 \text{ mA}$	4.5 6.0	— —	0.17 0.18	0.26 0.26	— —	
Input Leakage Current	I_{IN}	$V_{IN} = V_{CC} \text{ or GND}$	6.0	—	—	± 0.1	—	± 1.0	μA
Quiescent Supply Current	I_{CC}	$V_{IN} = V_{CC} \text{ or GND}$	6.0	—	—	4.0	—	40.0	

TIMING REQUIREMENTS (Input $t_r = t_f = 6\text{ns}$)

PARAMETER	SYMBOL	TEST CONDITION	$V_{CC}(\text{V})$	$T_a = 25^\circ\text{C}$		$T_a = -40\sim 85^\circ\text{C}$	UNIT
				TYP.	LIMIT	LIMIT	
Minimum Pulse Width ($\overline{\text{CK}}$)	$t_{W(H)}$ $t_{W(L)}$		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	MHz
			4.5	—	5	6	
			6.0	—	5	5	
Clock Frequency (CKA)	f		2.0	—	6	5	
			4.5	—	32	26	
			6.0	—	38	31	
Clock Frequency (CKB)	f		2.0	—	6	5	MHz
			4.5	—	31	25	
			6.0	—	36	29	

AC ELECTRICAL CHARACTERISTICS ($C_L = 15\text{pF}$, $V_{CC} = 5\text{V}$, $T_a = 25^\circ\text{C}$, Input $t_r = t_f = 6\text{ns}$)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Transition Time	t_{TLH} t_{THL}		—	4	8	ns
Propagation Delay Time (CKA—QA)	t_{PLH} t_{PHL}		—	10	20	
Propagation Delay Time (CKA—QC)	t_{PLH} t_{PHL}	QA connected to $\overline{\text{CKB}}$	—	29	51	
Propagation Delay Time ($\overline{\text{CKB}}$ —QB, QD)	t_{PLH} t_{PHL}		—	12	22	
Propagation Delay Time ($\overline{\text{CKB}}$ —QC)	t_{PLH} t_{PHL}		—	17	32	
Propagation Delay Time (CLR—Qn)	t_{PHL}		—	12	26	
Maximum Clock Frequency ($\overline{\text{CKA}}$)	f_{MAX}		35	84	—	
Maximum Clock Frequency ($\overline{\text{CKB}}$)	f_{MAX}		33	65	—	

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

PARAMETER	SYMBOL	TEST CONDITION	$V_{CC}(\text{V})$	$T_a = 25^\circ\text{C}$			$T_a = -40\sim 85^\circ\text{C}$		UNIT
				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 ($\overline{\text{CKA}} - \text{QA}$)	t_{pLH} t_{pHL}		2.0	—	39	120	—	150	
			4.5	—	13	24	—	30	
			6.0	—	11	20	—	26	
Propagation Delay Time ($\overline{\text{CKA}} - \text{QC}$)	t_{pLH} t_{pHL}	QA connected to CKB	2.0	—	102	290	—	365	
			4.5	—	34	58	—	73	
			6.0	—	29	49	—	62	
Propagation Delay Time ($\text{CKB} - \text{QB}, \text{QD}$)	t_{pLH} t_{pHL}		2.0	—	45	130	—	165	
			4.5	—	15	26	—	33	
			6.0	—	13	22	—	28	
Propagation Delay Time ($\text{CKB} - \text{QC}$)	t_{pLH} t_{pHL}		2.0	—	63	185	—	230	
			4.5	—	21	37	—	46	
			6.0	—	18	31	—	39	
Propagation Delay Time ($\text{CLR} - \text{Qn}$)	t_{pHL}		2.0	—	45	150	—	190	
			4.5	—	15	30	—	38	
			6.0	—	13	26	—	32	
Maximum Clock Frequency ($\overline{\text{CKA}}$)	f_{MAX}		2.0	6	20	—	5	—	MHz
			4.5	32	77	—	26	—	
			6.0	38	90	—	31	—	
Maximum Clock Frequency ($\overline{\text{CKB}}$)	f_{MAX}		2.0	6	15	—	5	—	
			4.5	32	60	—	25	—	
			6.0	36	70	—	29	—	
Input Capacitance	C_{IN}			—	5	10	—	10	pF
Power Dissipation Capacitance	$C_{\text{PD}}(1)$			—	44	—	—	—	

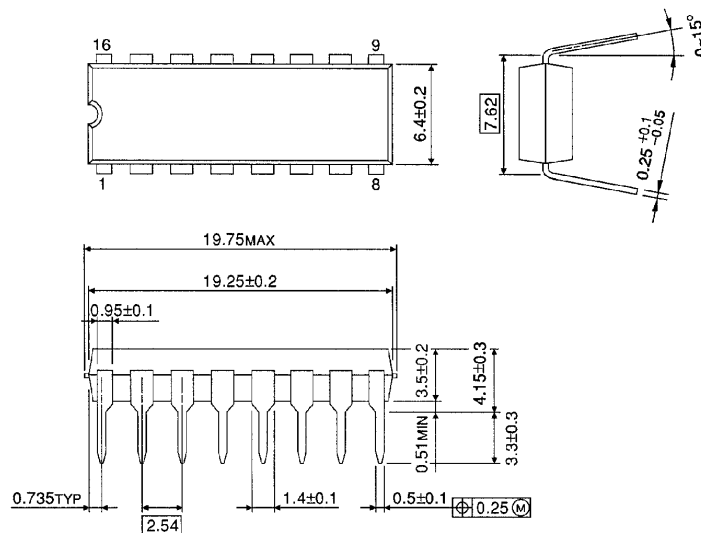
Note (1) C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

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

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

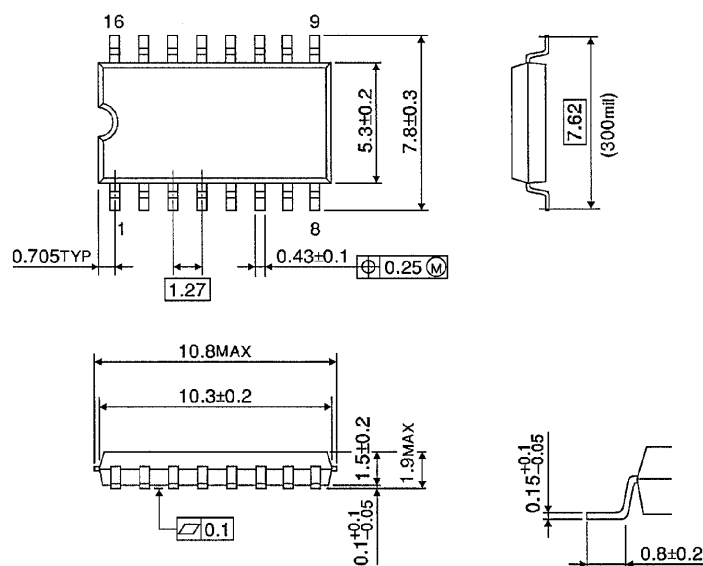
Unit in mm



Weight : 1.00g (Typ.)

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

Unit in mm

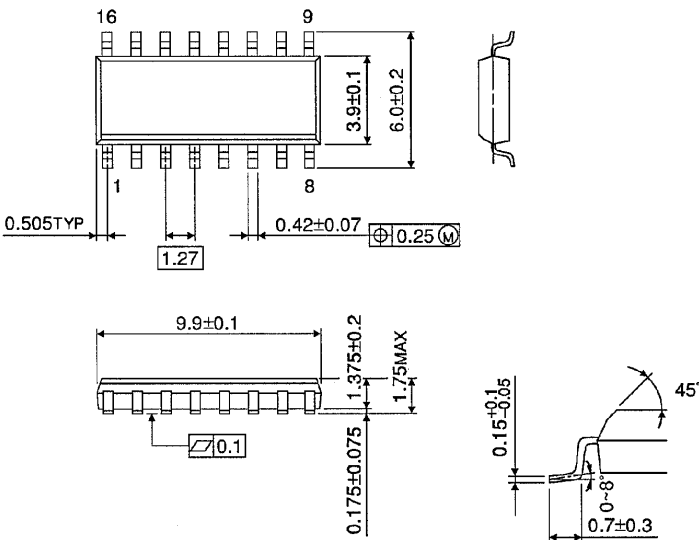


Weight : 0.18g (Typ.)

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.)

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