TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74AC390P, TC74AC390F, TC74AC390FN

DUAL DECADE COUNTER

The TC74AC390 is an advanced high speed CMOS DUAL DECADE COUNTER fabricated with silicon gate and double-layer metal wiring C^2MOS technology.

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

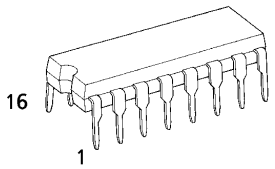
It consists of two independent 4-bit counters, each composed of a divide-by-two and a divide-by-five counter. The divide-by-two counter is incremented on the negative going transition of clock A ($\overline{CKA}$). The divided-by-five counter is incremented on the negative going transition of clock B($\overline{CKB}$).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

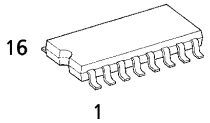
FEATURES :

- High Speed····· f_{MAX} = 160MHz (typ.) at V_{CC} = 5V
- Low Power Dissipation····· I_{CC} = 8μA(Max.) at Ta = 25°C
- High Noise Immunity····· $V_{NIH} = V_{NIL}$ = 28% V_{CC} (Min.)
- Symmetrical Output Impedance··· $|I_{OH}| = I_{OL}$ = 24mA (Min.) Capability of driving 50Ω transmission lines.
- Balanced Propagation Delays····· $t_{pLH} \simeq t_{pHL}$
- Wide Operating Voltage Range···· V_{CC} (opr) = 2V~5.5V
- Pin and Function Compatible with 74HC390

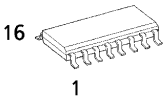
(Note) The JEDEC SOP (FN) is not available in Japan.



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

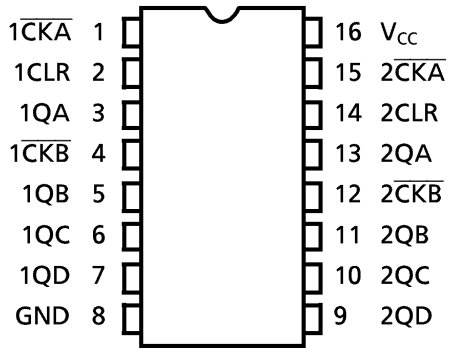


F (SOP16-P-300-1.27)
Weight : 0.18g (Typ.)

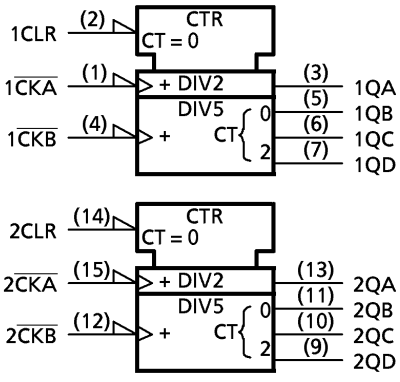


FN (SOL16-P-150-1.27)
Weight : 0.13g (Typ.)

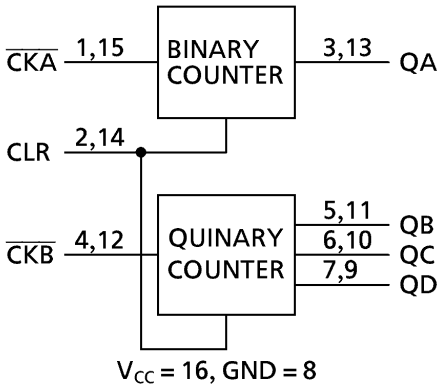
PIN ASSIGNMENT



IEC LOGIC SYMBOL



BLOCK DAIGRAM



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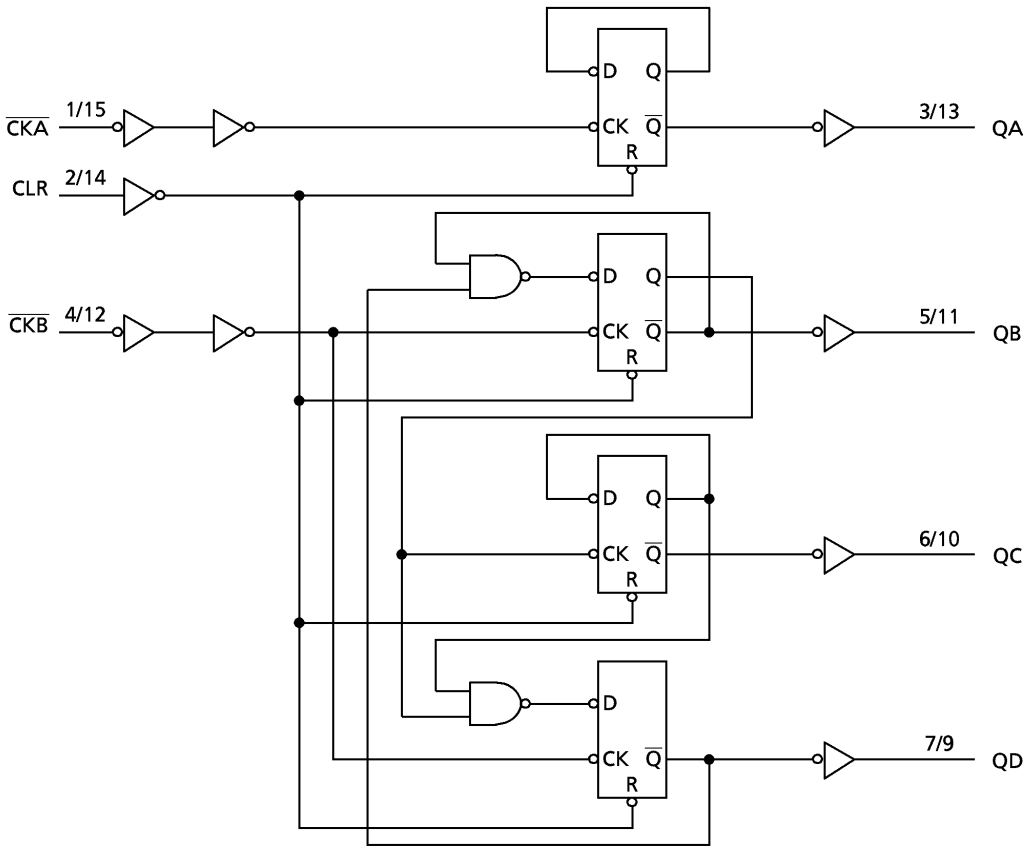
TRUTH TABLE

INPUTS			OUTPUTS			
$\overline{CKA}$	$\overline{CKB}$	CLR	QA	QB	QC	QD
X	X	H	L	L	L	L
↓	X	L	BINARY COUNT UP			
X	↓	L	QUINARY COUNT UP			

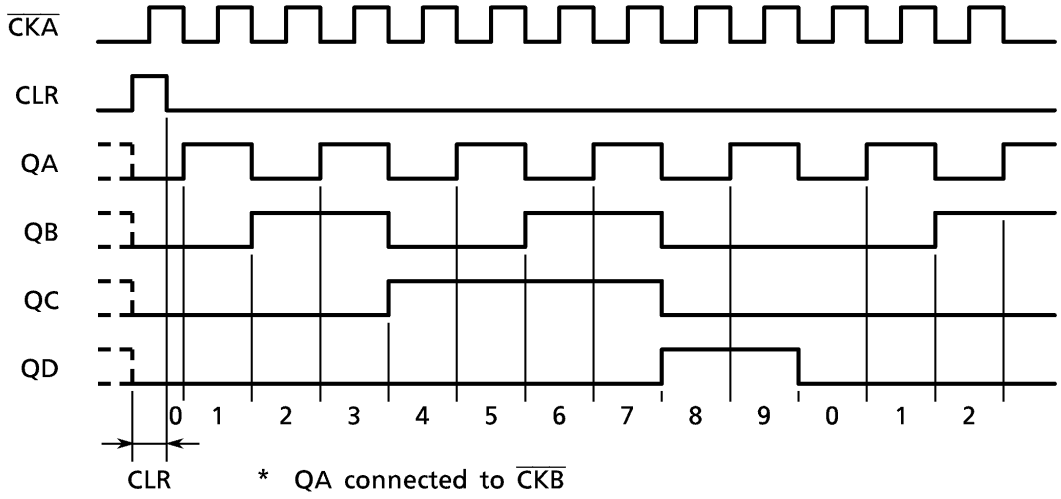
SYSTEM DIAGRAM



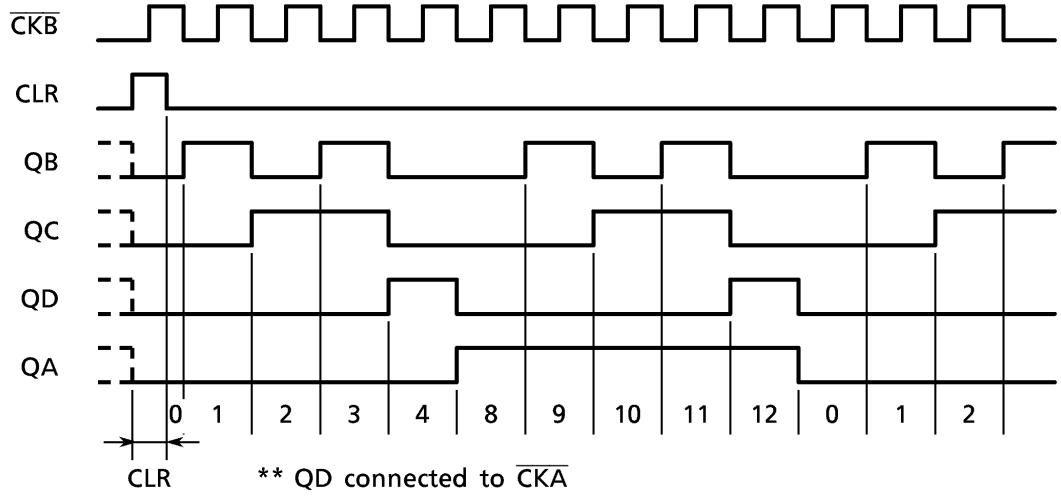
961001EBA2'

TIMING CHART

(1) BCD COUNT SEQUENCE*



(2) BI-QUINARY COUNT SEQUENCE**



ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage Range	V_{CC}	−0.5~7.0	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}	±50	mA
DC Output Current	I_{OUT}	±50	mA
DC V_{CC}/Ground Current	I_{CC}	±200	mA
Power Dissipation	P_D	500 (DIP)* / 180 (SOP)	mW
Storage Temperature	T_{stg}	−65~150	°C

*500mW in the range of Ta = −40°C~65°C. From Ta = 65°C to 85°C a derating factor of −10mW/°C should be applied up to 300mW.

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage	V_{CC}	2.0~5.5	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	dt / dV	0~ 100 (Vcc = 3.3 ± 0.3V) 0~ 20 (Vcc = 5 ± 0.5V)	ns / V

DC ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION		V_{CC} (V)	Ta = 25°C MIN.	Ta = 25°C TYP.	Ta = 25°C MAX.	Ta = −40~85°C MIN.	Ta = −40~85°C MAX.	UNIT
High - Level Input Voltage	V_{IH}			2.0 3.0 5.5	1.50 2.10 3.85	— — —	— — —	1.50 2.10 3.85	— — —	V
Low - Level Input Voltage	V_{IL}			2.0 3.0 5.5	— — —	— — —	0.50 0.90 1.65	— — —	0.50 0.90 1.65	V
High - Level Output Voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = −50μA	2.0 3.0 4.5	1.9 2.9 4.4	2.0 3.0 4.5	— — —	1.9 2.9 4.4	— — —	V
			I_{OH} = −4mA I_{OH} = −24mA I_{OH} = −75mA*	3.0 4.5 5.5	2.58 3.94 —	— — —	— — —	2.48 3.80 3.85	— — —	
Low - Level Output Voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50μA	2.0 3.0 4.5	— — —	0.0 0.0 0.0	0.1 0.1 0.1	— — —	0.1 0.1 0.1	V
			I_{OL} = 12mA I_{OL} = 24mA I_{OL} = 75mA*	3.0 4.5 5.5	— — —	— — —	0.36 0.36 —	— — —	0.44 0.44 1.65	
Input Leakage Current	I_{IN}	V_{IN} = V_{CC} or GND		5.5	—	—	±0.1	—	±1.0	μA
Quiescent Supply Current	I_{CC}	V_{IN} = V_{CC} or GND		5.5	—	—	8.0	—	80.0	

* : This spec indicates the capability of driving 50Ω transmission lines.
One output should be tested at a time for a 10ms maximum duration.

TIMING REQUIREMENTS (Input $t_r = t_f = 3ns$)

PARAMETER	SYMBOL	TEST CONDITION		Ta = 25°C	Ta = −40~85°C	UNIT
			V_{CC} (V)	LIMIT	LIMIT	
Minimum Pulse Width ($\overline{CKA}$, $\overline{CKB}$)	$t_{W(H)}$ $t_{W(L)}$		3.3 ± 0.3 5.0 ± 0.5	7.0 5.0	7.0 5.0	ns
Minimum Pulse Width (CLR)	$t_{W(H)}$		3.3 ± 0.3 5.0 ± 0.5	7.0 5.0	7.0 5.0	
Minimum Removal Time	t_{rem}		3.3 ± 0.3 5.0 ± 0.5	7.0 3.5	7.0 3.5	

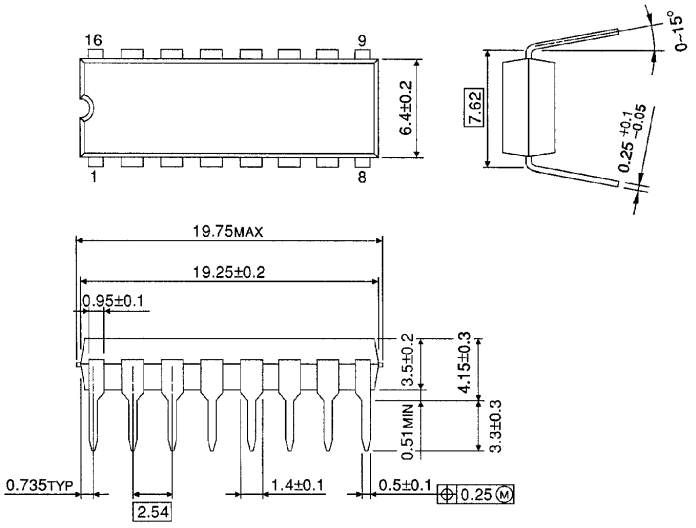
AC ELECTRICAL CHARACTERISTICS ($C_L = 50pF$, $R_L = 500\Omega$, Input $t_r = t_f = 3ns$)

PARAMETER	SYMBOL	TEST CONDITION		Ta = 25°C			Ta = −40~85°C		UNIT
			V_{CC} (V)	MIN.	TYP.	MAX.	MIN.	MAX.	
Propagation Delay Time ($\overline{CKA}$ – QA)	t_{pLH} t_{pHL}		3.3 ± 0.3 5.0 ± 0.5	— —	8.2 5.5	14.0 8.4	1.0 1.0	16.0 9.6	ns
Propagation Delay Time ($\overline{CKA}$ – QC)	t_{pLH} t_{pHL}	QA connected to $\overline{CKB}$	3.3 ± 0.3 5.0 ± 0.5	— —	17.0 10.5	30.0 17.5	1.0 1.0	34.0 20.0	
Propagation Delay Time ($\overline{CKB}$ – QB , QD)	t_{pLH} t_{pHL}		3.3 ± 0.3 5.0 ± 0.5	— —	8.8 6.0	14.9 9.4	1.0 1.0	17.0 10.7	
Propagation Delay Time ($\overline{CKB}$ – QC)	t_{pLH} t_{pHL}		3.3 ± 0.3 5.0 ± 0.5	— —	11.0 7.1	18.8 11.3	1.0 1.0	21.5 12.8	
Propagation Delay Time (CLR – Qn)	t_{pHL}		3.3 ± 0.3 5.0 ± 0.5	— —	7.7 5.7	12.5 8.5	1.0 1.0	14.3 9.7	
Maximum Clock Frequency ($\overline{CKA}$)	f_{MAX}		3.3 ± 0.3 5.0 ± 0.5	60 100	120 180	— —	60 100	— —	MHz
Maximum Clock Frequency ($\overline{CKB}$)	f_{MAX}		3.3 ± 0.3 5.0 ± 0.5	45 90	90 140	— —	45 90	— —	
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 :

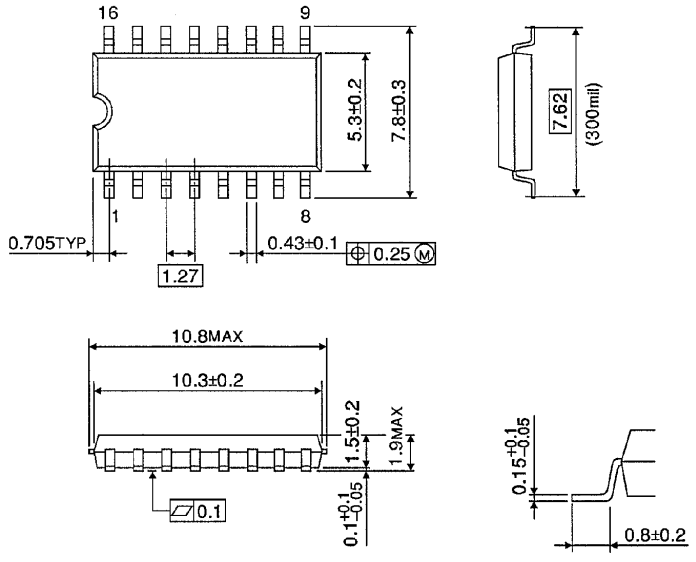
$$I_{CC}(opr.) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 2 \text{ (per Counter)}$$

DIP 16PIN OUTLINE DRAWING (DIP16-P-300-2.54A) Unit in mm



Weight : 1.00g (Typ.)

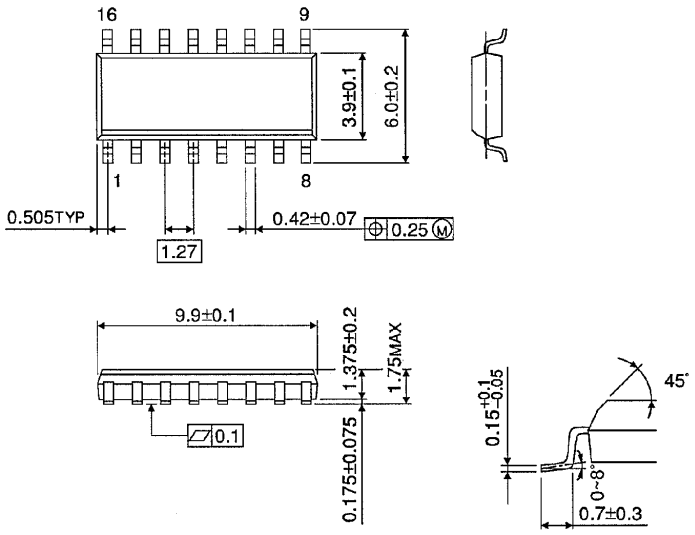
SOP 16PIN (200mil BODY) OUTLINE DRAWING (SOP16-P-300-1.27) Unit in mm



Weight : 0.18g (Typ.)

SOP 16PIN (150mil BODY) OUTLINE DRAWING (SOL16-P-150 -1.27) Unit in mm

(Note) This package is not available in Japan.



Weight : 0.13g (Typ.)