TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74AC390P, TC74AC390F, TC74AC390FN

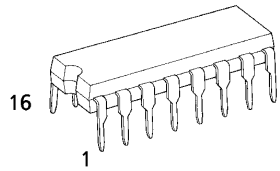
DUAL DECADE COUNTER

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

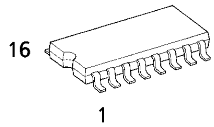
The TC74AC390 is an advanced high speed CMOS DUAL DECADE COUNTER fabricated with silicon gate and double-layer metal wiring C^2MOS technology.
It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.
It consists of two independent 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 :

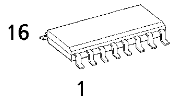
- High Speed ························ f_{MAX} = 160MHz (typ.) at V_{CC} = 5V
- Low Power Dissipation ············ I_{CC} = 8μA(Max.) at Ta = 25°C
- High Noise Immunity ·············· $V_{NIH} = V_{NIL}$ = 28% V_{CC} (Min.)
- Symmetrical Output Impedance ··· $|I_{OH}| = I_{OL}$ = 24mA (Min.) Capability 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



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

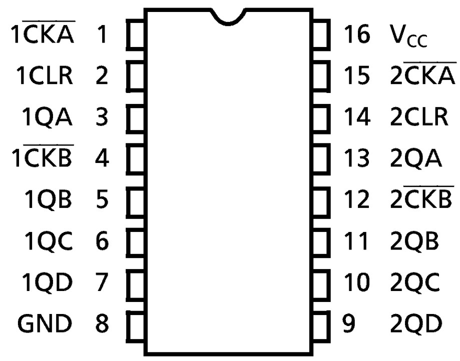


F (SOP16-P-300-1.27)
Weight : 0.18g (Typ.)



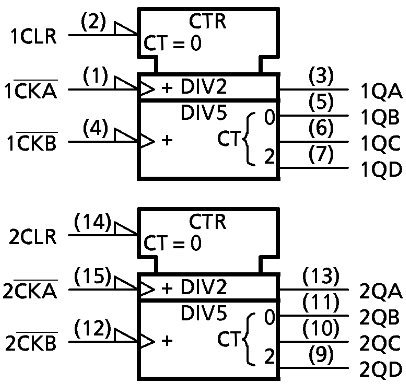
FN (SOL16-P-150-1.27)
Weight : 0.13g (Typ.)

PIN ASSIGNMENT

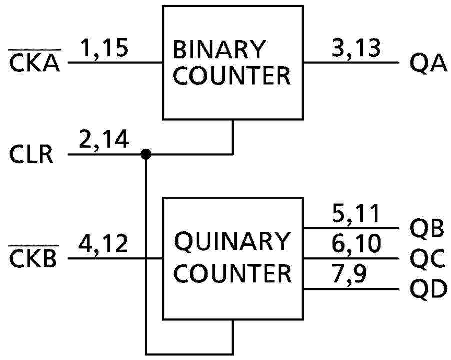


(TOP VIEW)

IEC LOGIC SYMBOL



BLOCK DAIGRAM

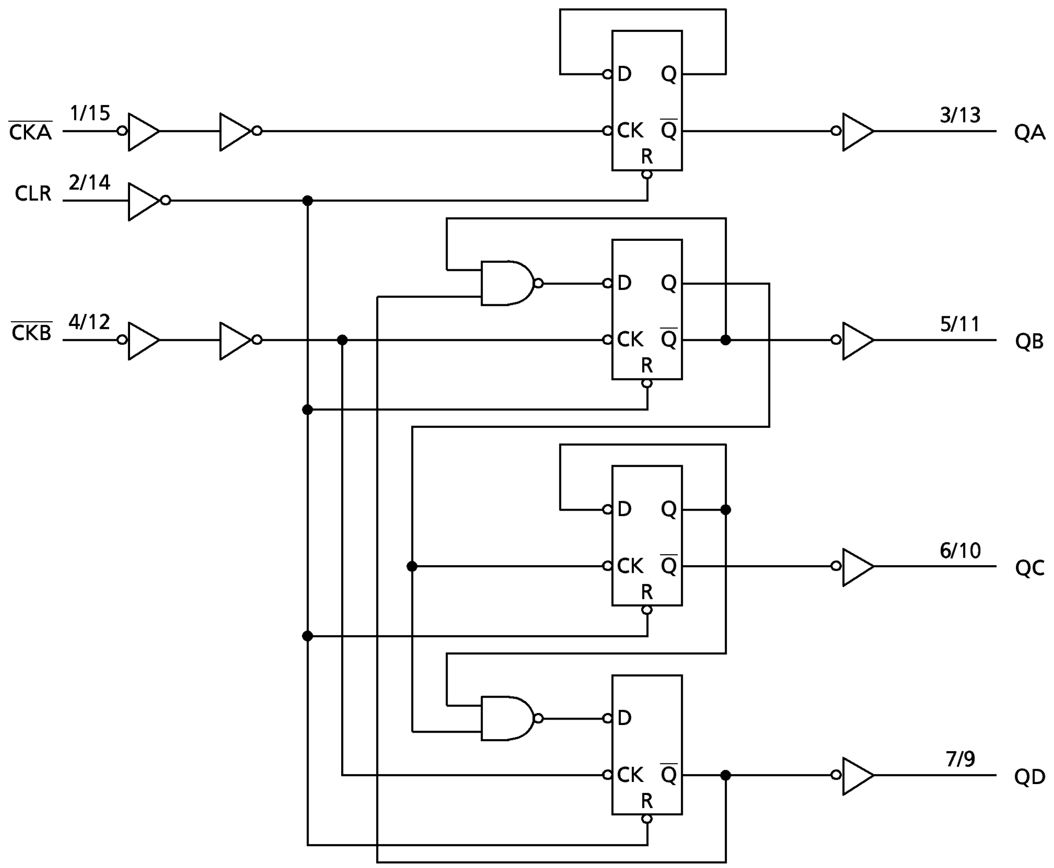


V_{CC} = 16, GND = 8

TRUTH TABLE

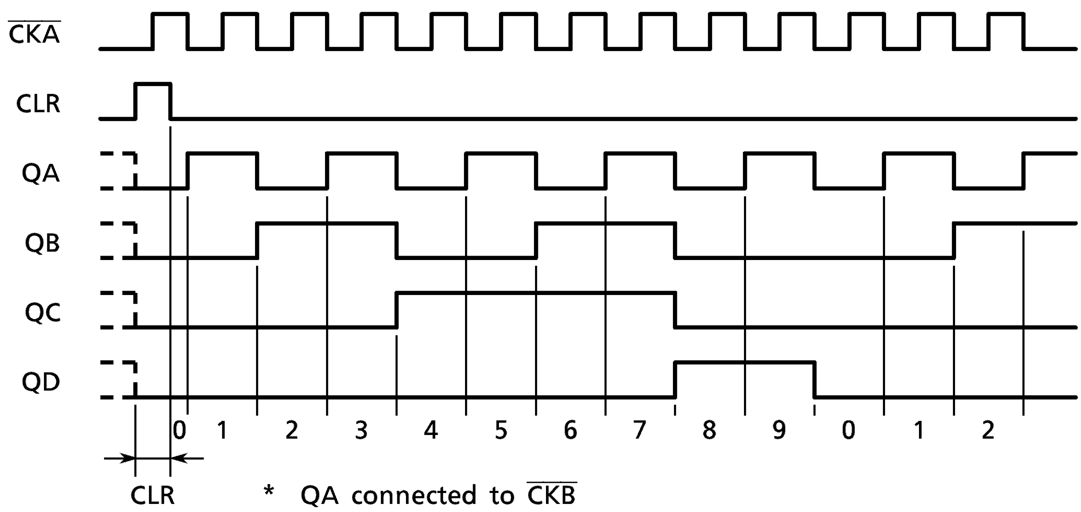
INPUTS			OUTPUTS			
$\overline{CKA}$	$\overline{CKB}$	CLR	QA	QB	QC	QD
X	X	H	L	L	L	L
⤵	X	L	BINARY COUNT UP			
X	⤵	L	QUINARY COUNT UP			

SYSTEM DIAGRAM

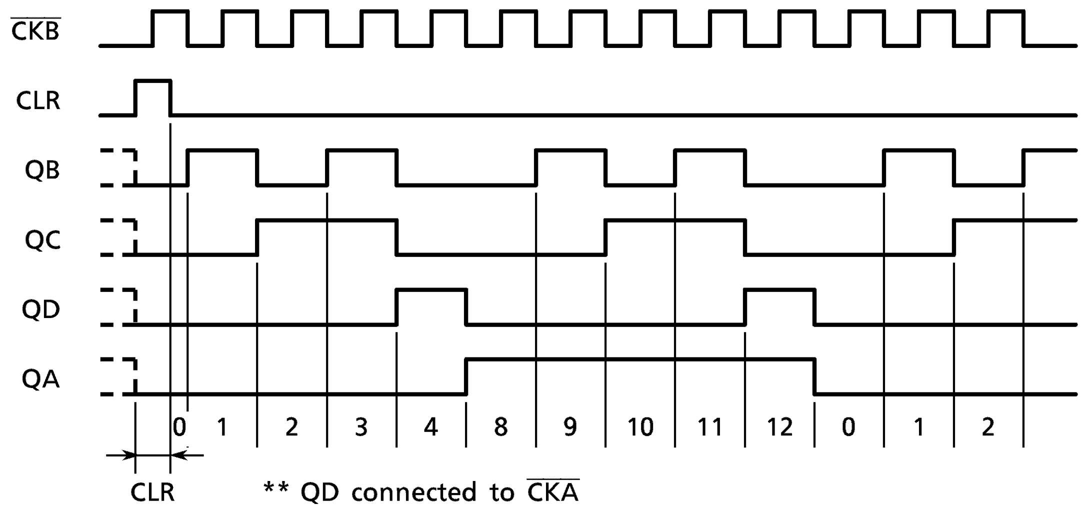


TIMING CHART

(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	

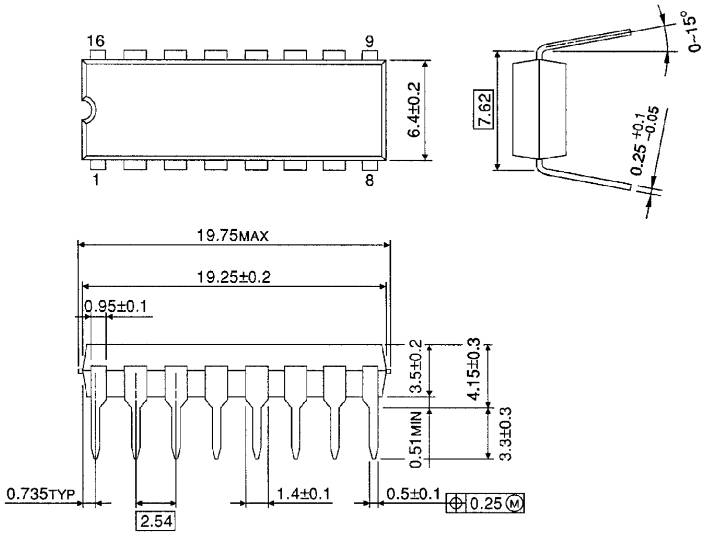
AC ELECTRICAL CHARACTERISTICS ($C_L = 50pF$, $R_L = 500\Omega$, Input $t_r = t_f = 3ns$)

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:

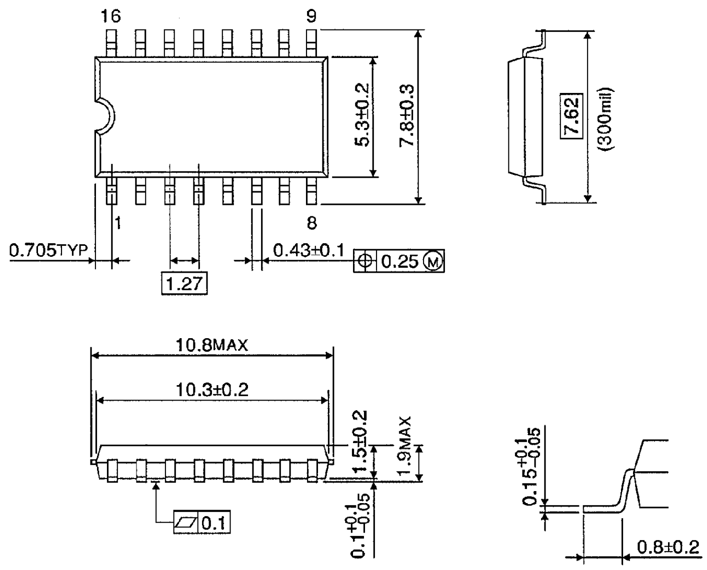
$$I_{CC}(opr.) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 2 \text{ (per Counter)}$$

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



Weight : 1.00g (Typ.)

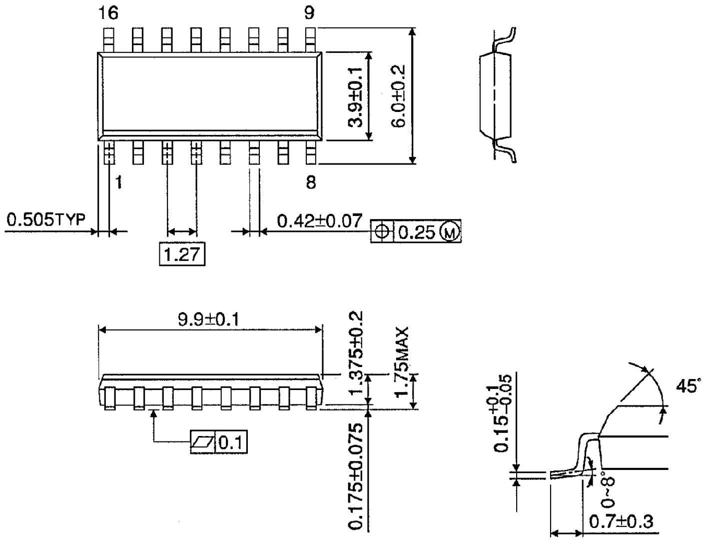
SOP 16PIN (200mil BODY) PACKAGE DIMENSIONS (SOP16-P-300-1.27) Unit in mm



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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