Dual Binary Counter

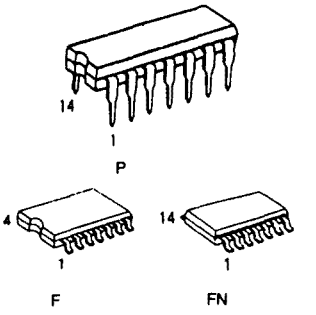
The TC74HC393A is a high speed CMOS 4-BIT BINARY COUNTER fabricated with silicon gate C^2MOS technology.

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

It consists of two independent counter circuits in one package, so that counting or frequency division of eight binary bits can be achieved with one IC.

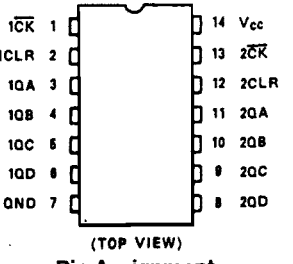
This device changes state on the negative going transition of the $\overline{CLOCK}$ pulse. The counter can be reset to "0" (Q0 ~ Q3 = "L") by a high at the CLEAR input regardless of other inputs.

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

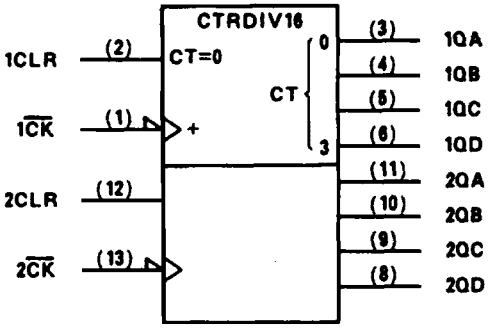


Features

- High Speed: f_{MAX} = 72MHz(Typ.) at V_{CC} = 5V
- Low Power Dissipation: I_{CC} = 4μA(Max.) at Ta = 25°C
- High Noise Immunity: $V_{NIH} = V_{NIL}$ = 28% V_{CC}(Min.)
- Output Drive Capability: 10 LSTTL Loads
- Symmetrical Output Impedance: $|I_{OH}| = I_{OL}$ = 4mA(Min.)
- Balanced Propagation Delays: $t_{pLH} = t_{pHL}$
- Wide Operating Voltage Range: V_{CC}(opr) = 2V~6V
- Pin and Function Compatible with 74LS393



Pin Assignment

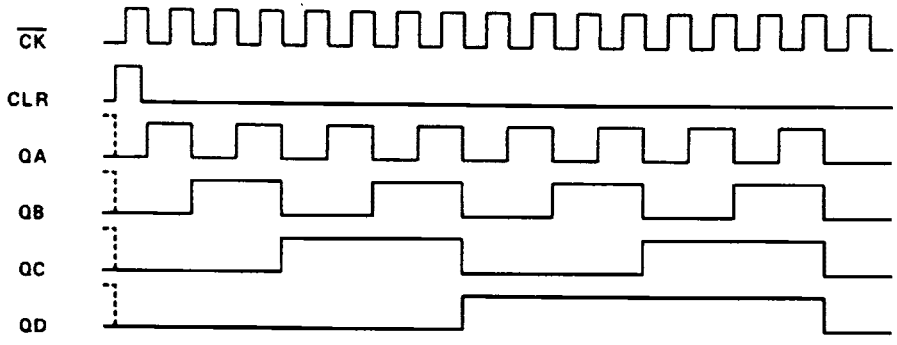


IEC Logic Symbol

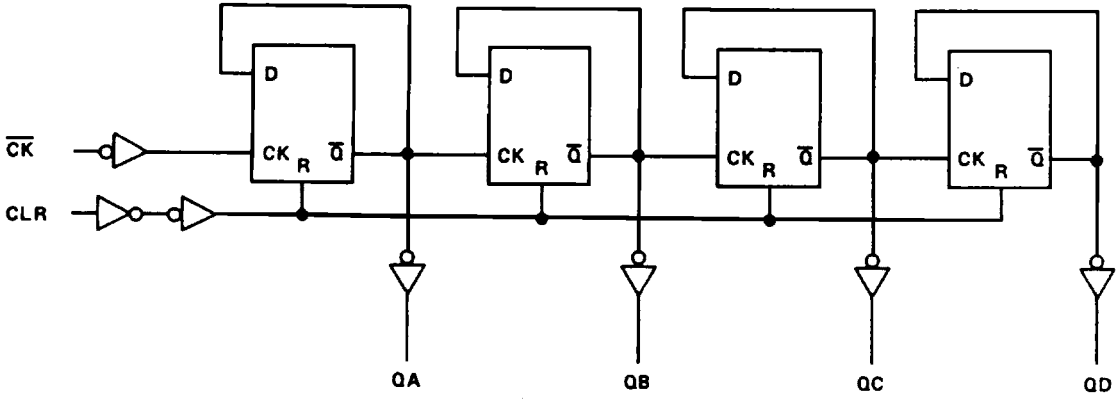
Truth Table

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



Timing Chart



Logic 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(MFP)	mW
Storage Temperature	T_{stg}	-65 ~ 150	°C
Lead Temperature 10sec	T_L	300	°C

*500mW in the range of Ta = -40°C ~ 65°C. From Ta = 65°C to 85°C a derating factor of -10mW/°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} = 2.0V) 0 ~ 500(V_{CC} = 4.5V) 0 ~ 400(V_{CC} = 6.0V)	ns

DC Electrical Characteristics

Parameter	Symbol	Test Condition		V_{CC}	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 4.5 6.0	1.5 3.15 4.2	– – –	– – –	1.5 3.15 4.2	– – –	V
Low-Level Input Voltage	V_{IL}	–		2.0 4.5 6.0	– – –	– – –	0.5 1.35 1.8	– – –	0.5 1.35 1.8	V
High-Level Output Voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = -20μA	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 mA I_{OH} = -5.2mA	4.5 6.0	4.18 5.68	4.31 5.80	– –	4.13 5.63	– –	
Low-Level Output Voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 20μA	2.0 4.5 6.0	– – –	0.0 0.0 0.0	0.1 0.1 0.1	– – –	0.1 0.1 0.1	V
			I_{OL} = 4 mA I_{OL} = 5.2mA	4.5 6.0	– –	0.17 0.18	0.26 0.26	– –	0.33 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 $t_r = t_f = 6ns$)

Parameter	Symbol	Test Condition		Ta = 25°C		Ta = -40 ~ 85°C	Unit
			V_{CC}	Typ.	Limit	Limit	
Minimum Pulse Width (CLOCK)	$t_{W(H)}$ $t_{W(L)}$	–	2.0 4.5 6.0	– – –	75 15 13	95 19 16	ns
Minimum Pulse Time (CLEAR)	$t_{W(H)}$	–	2.0 4.5 6.0	– – –	75 15 13	95 19 16	
Minimum Removal Time	t_{rem}	–	2.0 4.5 6.0	– – –	25 5 5	30 6 5	
Clock Frequency	f	–	2.0 4.5 6.0	– – –	6 32 38	5 27 32	MHz

AC Electrical Characteristics ($C_L = 15pF$, $V_{CC} = 5V$, Ta = 25°C)

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Output Transition Time	t_{TLH} t_{THL}	–	–	4	8	ns
Propagation Delay Time ($\overline{CLOCK}$-QA)	t_{pLH} t_{pHL}	–	–	12	20	
Propagation Delay Time ($\overline{CLOCK}$-QB)	t_{pLH} t_{pHL}	–	–	16	31	
Propagation Delay Time ($\overline{CLOCK}$-QC)	t_{pLH} t_{pHL}	–	–	21	38	
Propagation Delay Time ($\overline{CLOCK}$-QD)	t_{pLH} t_{pHL}	–	–	25	46	
Propagation Delay Time (CLEAR-Qn)	t_{pLH} t_{pHL}	–	–	15	26	
Maximum Clock Frequency	f_{MAX}	–	35	72	–	

AC Electrical Characteristics (C_L = 50pF, Input $t_r = t_f$ = 6ns)

Parameter	Symbol	Test Condition		Ta = 25°C			Ta = -40 ~ 85°C		Unit
			V_{CC}	Min.	Typ.	Max.	Min.	Max.	
Output Transition Time	t_{TLH} t_{THL}	–	2.0 4.5 6.0	– – –	25 7 6	75 15 13	– – –	95 19 16	ns
Propagation Delay Time ($\overline{CLOCK}$-QA)	t_{pLH} t_{pHL}	–	2.0 4.5 6.0	– – –	45 15 13	120 24 20	– – –	150 30 26	
Propagation Delay Time ($\overline{CLOCK}$-QB)	t_{pLH} t_{pHL}	–	2.0 4.5 6.0	– – –	60 20 17	180 24 20	– – –	225 45 38	
Propagation Delay Time ($\overline{CLOCK}$-QC)	t_{pLH} t_{pHL}	–	2.0 4.5 6.0	– – –	80 25 21	220 44 37	– – –	275 55 47	
Propagation Delay Time ($\overline{CLOCK}$-QD)	t_{pLH} t_{pHL}	–	2.0 4.5 6.0	– – –	100 30 26	260 52 44	– – –	325 65 55	
Propagation Delay Time (CLEAR-Qn)	t_{pLH} t_{pHL}	–	2.0 4.5 6.0	– – –	55 18 15	150 30 26	– – –	190 38 33	
Maximum Clock Frequency	f_{MAX}	–	2.0 4.5 6.0	6 32 38	22 67 77	– – –	5 27 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:

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

Notes