

MM54HC390/MM74HC390/MM54HC393/MM74HC393



T-45-23-13

MM54HC390/MM74HC390 Dual 4-Bit Decade Counter MM54HC393/MM74HC393 Dual 4-Bit Binary Counter

General Description

These counter circuits contain independent ripple carry counters and utilize advanced silicon-gate CMOS technology. The MM54HC390/MM74HC390 incorporate dual decade counters, each composed of a divide-by-two and a divide-by-five counter. The divide-by-two and divide-by-five counters can be cascaded to form dual decade, dual bi-quinary, or various combinations up to a single divide-by-100 counter. The MM54HC393/MM74HC393 contain two 4-bit ripple carry binary counters, which can be cascaded to create a single divide-by-256 counter.

Each of the two 4-bit counters is incremented on the high to low transition (negative edge) of the clock input, and each has an independent clear input. When clear is set high all four bits of each counter are set to a low level. This enables count truncation and allows the implementation of divide-by-N counter configurations.

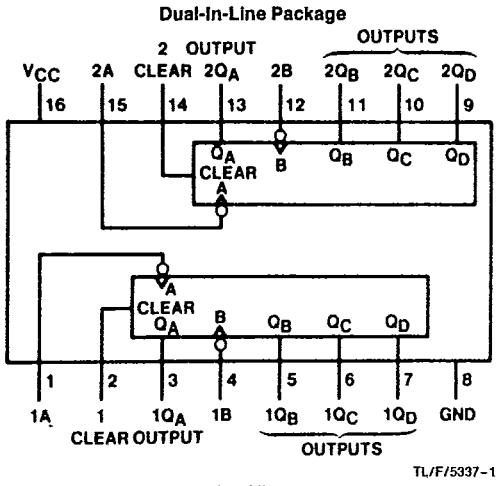
Each of the counters outputs can drive 10 low power Schottky TTL equivalent loads. These counters are func-

tionally as well as pin equivalent to the 54LS390/74LS390 and the 54LS393/74LS393, respectively. All inputs are protected from damage due to static discharge by diodes to VCC and ground.

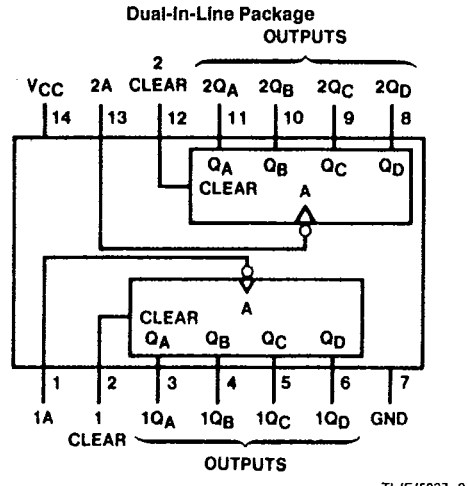
Features

- Typical operating frequency: 50 MHz
- Typical propagation delay: 13 ns (Ck to Q_A)
- Wide operating supply voltage range: 2-6V
- Low input current: <1 μA
- Low quiescent supply current: 80 μA maximum (74HC Series)
- Fanout of 10 LS-TTL loads

Connection Diagrams



Top View
Order Number MM54HC390* or MM74HC390*
*Please look into Section 8, Appendix D for availability of various package types.



Top View
Order Number MM54HC393* or MM74HC393*
*Please look into Section 8, Appendix D for availability of various package types.

3

MM54HC390/MM74HC390/MM54HC393/MM74HC393

T-45-23-13

Absolute Maximum Ratings (Notes 1 & 2)

If Military/Aerospace specified devices are required, contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage (V _{CC})	-0.5 to +7.0V
DC Input Voltage (V _{IN})	-1.5 to V _{CC} +1.5V
DC Output Voltage (V _{OUT})	-0.5 to V _{CC} +0.5V
Clamp Diode Current (I _{IK} , I _{OK})	±20 mA
DC Output Current, per pin (I _{OUT})	±25 mA
DC V _{CC} or GND Current, per pin (I _{CC})	±50 mA
Storage Temperature Range (T _{STG})	-65°C to +150°C
Power Dissipation (P _D)	
(Note 3)	600 mW
S.O. Package only	500 mW
Lead Temp. (T _L) (Soldering 10 seconds)	260°C

Operating Conditions

	Min	Max	Units
Supply Voltage (V _{CC})	2	6	V
DC Input or Output Voltage (V _{IN} , V _{OUT})	0	V _{CC}	V
Operating Temp. Range (T _A)			
MM74HC	-40	+85	°C
MM54HC	-55	+125	°C
Input Rise or Fall Times (t _r , t _f)			
V _{CC} =2.0V		1000	ns
V _{CC} =4.5V		500	ns
V _{CC} =6.0V		400	ns

DC Electrical Characteristics (Note 4)

Symbol	Parameter	Conditions	V _{CC}	T _A =25°C			Units	
				74HC T _A =-40 to 85°C		54HC T _A =-55 to 125°C		
				Typ	Guaranteed Limits			
V _{IH}	Minimum High Level Input Voltage		2.0V	1.5	1.5	1.5	V	
			4.5V	3.15	3.15	3.15	V	
			6.0V	4.2	4.2	4.2	V	
V _{IL}	Maximum Low Level Input Voltage**		2.0V	0.5	0.5	0.5	V	
			4.5V	1.35	1.35	1.35	V	
			6.0V	1.8	1.8	1.8	V	
V _{OH}	Minimum High Level Output Voltage	V _{IN} =V _{IH} or V _{IL} I _{OUT} ≤ 20 μA	2.0V	2.0	1.9	1.9	V	
			4.5V	4.5	4.4	4.4	V	
			6.0V	6.0	5.9	5.9	V	
		V _{IN} =V _{IH} or V _{IL} I _{OUT} ≤ 4.0 mA I _{OUT} ≤ 5.2 mA	4.5V	4.2	3.98	3.84	3.7	V
			6.0V	5.7	5.48	5.34	5.2	V
V _{OL}	Maximum Low Level Output Voltage	V _{IN} =V _{IH} or V _{IL} I _{OUT} ≤ 20 μA	2.0V	0	0.1	0.1	V	
			4.5V	0	0.1	0.1	V	
			6.0V	0	0.1	0.1	V	
		V _{IN} =V _{IH} or V _{IL} I _{OUT} ≤ 4.0 mA I _{OUT} ≤ 5.2 mA	4.5V	0.2	0.26	0.33	0.4	V
			6.0V	0.2	0.26	0.33	0.4	V
I _{IN}	Maximum Input Current	V _{IN} =V _{CC} or GND	6.0V		±0.1	±1.0	±1.0	μA
I _{CC}	Maximum Quiescent Supply Current	V _{IN} =V _{CC} or GND I _{OUT} =0 μA	6.0V		8.0	80	160	μA

Note 1: Absolute Maximum Ratings are those values beyond which damage to the device may occur.
Note 2: Unless otherwise specified all voltages are referenced to ground.
Note 3: Power Dissipation temperature derating — plastic "N" package: -12 mW/°C from 65°C to 85°C; ceramic "J" package: -12 mW/°C from 100°C to 125°C.
Note 4: For a power supply of 5V ± 10% the worst case output voltages (V_{OH} and V_{OL}) occur for HC at 4.5V. Thus the 4.5V values should be used when designing with this supply. Worst case V_{IH} and V_{IL} occur at V_{CC}=5.5V and 4.5V respectively. (The V_{IH} value at 5.5V is 3.85V.) The worst case leakage current (I_{IN}, I_{CC}, and I_{OZ}) occur for CMOS at the higher voltage and so the 6.0V values should be used.
 **V_{IL} limits are currently tested at 20% of V_{CC}. The above V_{IL} specification (30% of V_{CC}) will be implemented no later than Q1, CY'88.

AC Electrical Characteristics MM54HC390/MM74HC390

V_{CC}=5V, T_A=25°C, C_L=15 pF, t_r=t_f=6 ns

7-45-23-13

MM54HC390/MM74HC390/MM54HC393/MM74HC393

Symbol	Parameter	Conditions	Typ	Guaranteed Limit	Units
f _{MAX}	Maximum Operating Frequency, Clock A or B		50	30	MHz
t _{PHL} , t _{PLH}	Maximum Propagation Delay, Clock A to Q _A Output		12	20	ns
t _{PHL} , t _{PLH}	Maximum Propagation Delay, Clock A to Q _C (Q _A Connected to Clock B)		32	50	ns
t _{PHL} , t _{PLH}	Maximum Propagation Delay, Clock B to Q _B or Q _D		15	21	ns
t _{PHL} , t _{PLH}	Maximum Propagation Delay, Clock B to Q _C		20	32	ns
t _{PHL}	Maximum Propagation Delay, Clear to any Output		15	28	ns
t _{REM}	Minimum Removal Time, Clear to Clock		-2	5	ns
t _w	Minimum Pulse Width, Clear or Clock		10	16	ns

AC Electrical Characteristics C_L=50 pF, t_r=t_f=6 ns (unless otherwise specified)

Symbol	Parameter	Conditions	V _{CC}	T _A =25°C			Units
				74HC T _A =-40 to 85°C	54HC T _A =-55 to 125°C	Guaranteed Limits	
f _{MAX}	Maximum Operating Frequency		2.0V	5	4	3	MHz
			4.5V	27	21	18	MHz
			6.0V	31	24	20	MHz
t _{PHL} , t _{PLH}	Maximum Propagation Delay, Clock A to Q _A		2.0V	45	120	180	ns
			4.5V	15	24	30	ns
			6.0V	13	21	26	ns
t _{PHL} , t _{PLH}	Maximum Propagation Delay, Clock A to Q _C (Q _A Connected to Clock B)		2.0V	100	290	430	ns
			4.5V	35	58	72	ns
			6.0V	30	50	62	ns
t _{PHL} , t _{PLH}	Maximum Propagation Delay, Clock B to Q _B or Q _D		2.0V	50	130	195	ns
			4.5V	16	26	33	ns
			6.0V	13	22	28	ns
t _{PHL} , t _{PLH}	Maximum Propagation Delay, Clock B to Q _C		2.0V	60	185	230	ns
			4.5V	20	37	46	ns
			6.0V	17	32	40	ns
t _{PHL}	Maximum Propagation Delay, Clear to any Q		2.0V	55	165	210	ns
			4.5V	17	33	41	ns
			6.0V	15	28	35	ns
t _{REM}	Minimum Removal Time, Clear to Clock		2.0V	25	25	25	ns
			4.5V	5	5	5	ns
			6.0V	5	5	5	ns
t _w	Minimum Pulse Width, Clear or Clock		2.0V	30	80	100	ns
			4.5V	10	16	20	ns
			6.0V	9	14	18	ns
t _{rHL} , t _{rLH}	Maximum Output Rise and Fall Time		2.0V	30	75	95	ns
			4.5V	8	15	19	ns
			6.0V	7	13	16	ns
t _r , t _f	Maximum Input Rise and Fall Time		2.0V	1000	1000	1000	ns
			4.5V	500	500	500	ns
			6.0V	400	400	400	ns
C _{PD}	Power Dissipation Capacitance (Note 5)	(per counter)	55				pF
C _{IN}	Maximum Input Capacitance		5	10	10	10	pF

Note 5: C_{PD} determines the no load dynamic power consumption, P_D=C_{PD}V_{CC}²f+I_{CC}V_{CC}, and the no load dynamic current consumption, I_S=C_{PD}V_{CC}f+I_{CC}.

3

MM54HC390/MM74HC390/MM54HC393/MM74HC393

AC Electrical Characteristics MM54HC393/MM74HC393

T-45-23-13

V_{CC} = 5V, T_A = 25°C, C_L = 15 pF, t_r = t_f = 6 ns

Symbol	Parameter	Conditions	Typ	Guaranteed Limit	Units
f _{MAX}	Maximum Operating Frequency		50	30	MHz
t _{PHL} , t _{PLH}	Maximum Propagation Delay, Clock A to Q _A		13	20	ns
t _{PHL} , t _{PLH}	Maximum Propagation Delay, Clock A to Q _B		19	35	ns
t _{PHL} , t _{PLH}	Maximum Propagation Delay, Clock A to Q _C		23	42	ns
t _{PHL} , t _{PLH}	Maximum Propagation Delay, Clock A to Q _D		27	50	ns
t _{PHL}	Maximum Propagation Delay, Clear to any Q		15	28	ns
t _{REM}	Minimum Removal Time		-2	5	ns
t _w	Minimum Pulse Width Clear or Clock		10	16	ns

AC Electrical Characteristics C_L = 50 pF, t_r = t_f = 6 ns (unless otherwise specified)

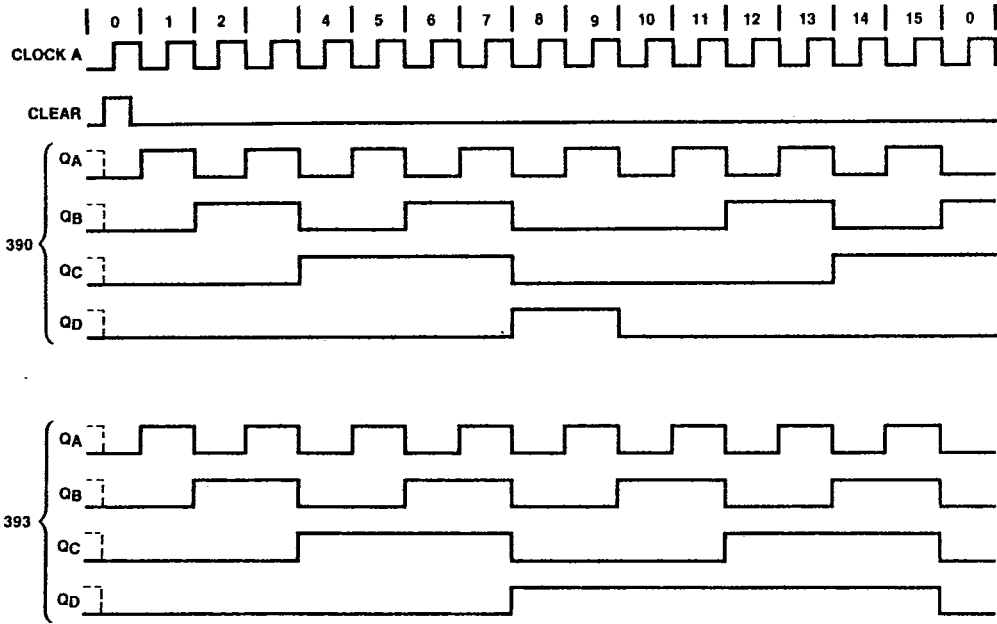
Symbol	Parameter	Conditions	V _{CC}	T _A = 25°C			Units
				Typ	74HC T _A = -40 to 85°C	54HC T _A = -55 to 125°C	
f _{MAX}	Maximum Operating Frequency		2.0V	5	4	3	MHz
			4.5V	27	21	18	
			6.0V	31	24	20	
t _{PHL} , t _{PLH}	Maximum Propagation Delay Clock A to Q _A		2.0V	45	120	150	ns
			4.5V	15	24	30	ns
			6.0V	13	21	26	ns
t _{PHL} , t _{PLH}	Maximum Propagation Delay Clock A to Q _B		2.0V	68	190	240	ns
			4.5V	23	38	47	ns
			6.0V	20	32	40	ns
t _{PHL} , t _{PLH}	Maximum Propagation Delay Clock A to Q _C		2.0V	90	240	300	ns
			4.5V	30	48	60	ns
			6.0V	26	41	51	ns
t _{PHL} , t _{PLH}	Maximum Propagation Delay Clock to Q _D		2.0V	100	290	360	ns
			4.5V	35	58	72	ns
			6.0V	30	50	62	ns
t _{PHL}	Maximum Propagation Delay Clear to any Q		2.0V	54	165	210	ns
			4.5V	18	33	41	ns
			6.0V	15	28	35	ns
t _{REM}	Minimum Clear Removal Time		2.0V	25	25	25	ns
			4.5V	5	5	5	ns
			6.0V	5	5	5	ns
t _w	Minimum Pulse Width Clear or Clock		2.0V	30	80	100	ns
			4.5V	10	16	20	ns
			6.0V	9	14	18	ns
t _{THL} , t _{TLH}	Maximum Output Rise and Fall Time		2.0V	30	75	95	ns
			4.5V	8	15	19	ns
			6.0V	7	13	16	ns
t _r , t _f	Maximum Input Rise and Fall Time			1000	1000	1000	ns
				500	500	500	ns
				400	400	400	ns
C _{PD}	Power Dissipation Capacitance (Note 5)	(per counter)	42				pF
C _{IN}	Maximum Input Capacitance		5	10	10	10	pF

Note 5: C_{PD} determines the no load dynamic power consumption, P_D = C_{PD} V_{CC}² f + I_{CC} V_{CC}, and the no load dynamic current consumption, I_S = C_{PD} V_{CC} f + I_{CC}.

T-45-23-13

Logic Timing Waveforms

MM54HC390/MM74HC390/MM54HC393/MM74HC393



TLF/5337-3

3