MOTOROLA

Dual Decade Counter With A and B Inputs

Military 54LS390

ELECTRICALLY TESTED PER:
MIL-M-38510/32701

The 54LS390 contains a pair of high-speed 4-stage ripple counters. Each half of the 'LS390 is partitioned into a divide-by-two section and divide-by-five section, with separate clock input for each section. The two sections can be connected to count 8.4.2.1 BCD code or they can count in a binary sequence to provide a square wave (50% duty cycle) at the final output.

In the 'LS390 the flip-flops are triggered by a HIGH-to-LOW transition A and B inputs. Each half of each circuit type has a Master Reset input which responds to a HIGH signal by forcing all four outputs to the LOW state.

- Dual Version of the 'LS290
- Separate Clocks Allowing ÷2, ÷ 2.5, ÷ 5
- Individual Asynchronous Clear for Each Counter
- Typical Max Count Frequency of 50 MHz
- Input Clamp Diodes Minimize High-Speed Termination Effects

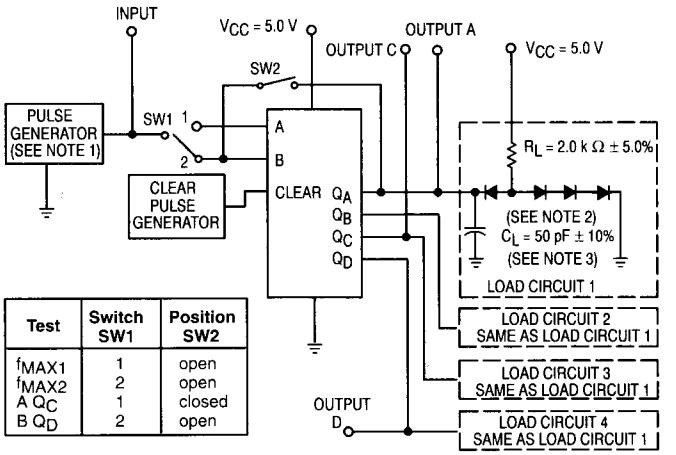
AVAILABLE AS:

1) JAN: JM38510/32701BXA
2) SMD: 7802601
3) 883: 54LS390/BXAJC

X = CASE OUTLINE AS FOLLOWS:
PACKAGE: CERDIP: E
CERFLAT: F
LCC: 2

THE LETTER "M" APPEARS BEFORE THE / ON LCC.

TEST CIRCUIT



Test	Switch SW1	Position SW2
f_{MAX1}	1	open
f_{MAX2}	2	open
A Q_C	1	closed
B Q_D	2	open

PIN ASSIGNMENTS

FUNCT.	DIL 620-09	FLATS 650-05	LCC 756A-02	BURN-IN (COND. A)
A_1	1	1	2	V_{CC}
CLR_1	2	2	3	V_{CC}
Q_{A1}	3	3	4	OPEN
B_1	4	4	5	V_{CC}
Q_{B1}	5	5	7	OPEN
Q_{C1}	6	6	8	OPEN
Q_{D1}	7	7	9	OPEN
GND	8	8	10	GND
Q_{D2}	9	9	12	OPEN
Q_{C2}	10	10	13	OPEN
Q_{B2}	11	11	14	OPEN
B_2	12	12	15	V_{CC}
Q_{A2}	13	13	17	OPEN
CLR_2	14	14	18	V_{CC}
A_2	15	15	19	V_{CC}
V_{CC}	16	16	20	V_{CC}

BURN-IN CONDITIONS:
V_{CC} = 5.0 V MIN/6.0 V MAX

NOTES:
1. The input pulse generator has the following characteristics: V_{gen} = 3.0 V, $t_r \leq 6.0$ ns, $t_f \leq 6.0$ ns, $t_p = 0.5$ µs, PRR ≤ 1.0 MHz, $t_{p(clear)} = 25$ ns, and $Z_{OUT} \approx 50\ \Omega$.
2. All diodes are 1N3064 or equivalent.
3. C_L = 50 pF ± 10%, including scope probe, wiring and stray capacitance.
4. Voltage measurements are to be made with respect to network ground terminal.
5. f_{MAX}: $t_r = t_f \leq 6.0$ ns.
6. Terminal conditions (pins not designated may be high ≥ 2.0 V, low ≤ 0.7 V, or open).

TRUTH TABLE (÷ 5)

Count	Outputs		
	Q_D	Q_C	Q_B
0	L	L	L
1	L	L	H
2	L	H	L
3	L	H	H
4	H	L	L

FUNCTIONAL DESCRIPTION

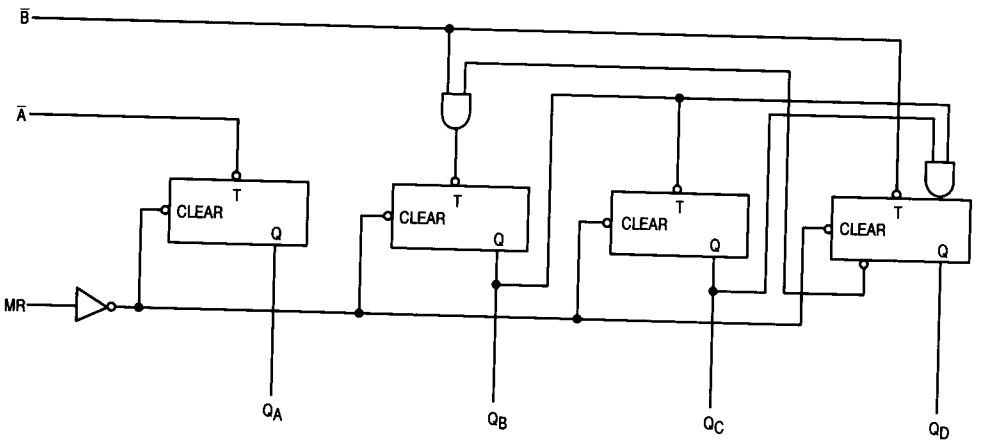
Each half of the 54LS390 contains a ÷ 5 section that is independent except for the common MR function. The ÷ 5 section operates in 4.2.1 binary sequence, as shown in the ÷ 5 Truth Table, with the third stage output exhibiting a 20% duty cycle when the input frequency is constant. To obtain a ÷ 10 function having a 50% duty cycle output, connect the input signal to (B) and connect the Q_C output to the (A) input; the Q_A output provides the desired 50% duty cycle output. If the input frequency is connected to (A) and the Q_A output is connected to (B), a decade divider operating in the 8.4.2.1 BCD code is obtained, as shown in the BCD Truth Table. Since the flip-flops change state asynchronously, logic signals deverted from combinations of 'LS390 outputs are also subject to decoding spikes. A HIGH signal on MR (CLEAR) forces all outputs LOW and prevents counting.

TRUTH TABLE (BCD)

Count	Outputs			
	Q_D	Q_C	Q_B	Q_A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H

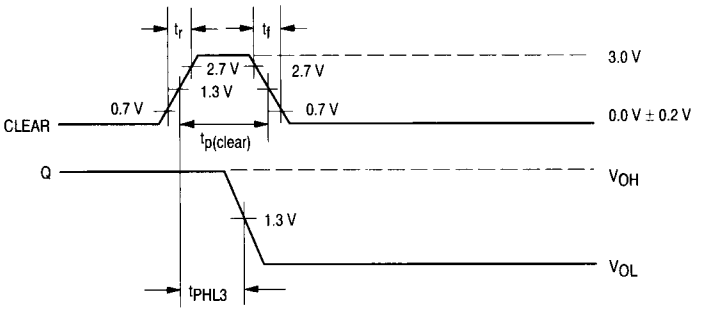
H = HIGH Voltage Level
L = LOW Voltage Level

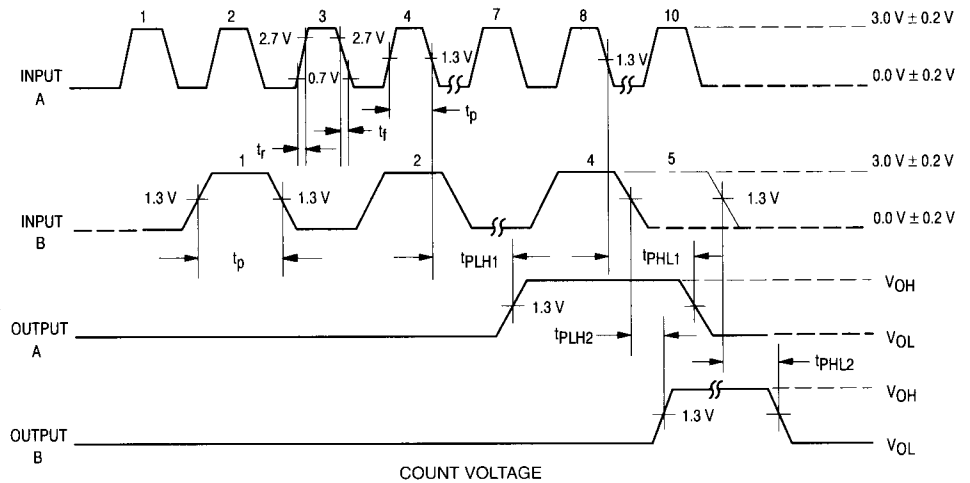
LOGIC DIAGRAM



5

WAVEFORMS





COUNT VOLTAGE

5

Symbol	Parameter	Limits						Unit	Test Condition (Unless Otherwise Specified)
		+ 25°C		+ 125°C		− 55°C			
	Static Parameters:	Subgroup 1		Subgroup 2		Subgroup 3			
		Min	Max	Min	Max	Min	Max		
V_{OH}	Logical "1" Output Voltage	2.5		2.5		2.5		V	V_{CC} = 4.5 V, I_{OH} = − 0.4 mA, V_{IN} = (See Note 1), other input = (See Note 2).
V_{OL}	Logical "0" Output Voltage		0.4		0.4		0.4	V	V_{CC} = 4.5 V, I_{OL} = 4.0 mA, V_{IN} = 2.0 V, other input is open, I_{QA} = 6.4 mA.
V_{IC}	Input Clamping Voltage		− 1.5					V	V_{CC} = 4.5 V, I_{IN} = − 18 mA, other inputs are open.
I_{IH}	Logical "1" Input Current		20		20		20	µA	V_{CC} = 5.5 V, $V_{IH(CLR)}$ = 2.7 V, other inputs are open.
I_{IH}	Logical "1" Input Current		100		100		100	µA	V_{CC} = 5.5 V, $V_{IH(A)}$ = 2.7 V, other inputs are open.
I_{IH}	Logical "1" Input Current		200		200		200	µA	V_{CC} = 5.5 V, $V_{IH(B)}$ = 2.7 V, other inputs are open.
I_{IHH}	Logical "1" Input Current		100		100		100	µA	V_{CC} = 5.5 V, $V_{IHH(CLR)}$ = 5.5 V, other inputs are open.
I_{IHH}	Logical "1" Input Current		200		200		200	µA	V_{CC} = 5.5 V, $V_{IHH(A)}$ = 5.5 V, other inputs are open.
I_{IHH}	Logical "1" Input Current		400		400		400	µA	V_{CC} = 5.5 V, $V_{IHH(B)}$ = 5.5 V, other inputs are open.
I_{IL}	Logical "0" Input Current	− 0.15	− 0.38	− 0.15	− 0.38	− 0.15	− 0.38	mA	V_{CC} = 5.5 V, V_{IN} = 0.4 V (CLR), other inputs are open.
I_{IL}	Logical "0" Input Current	− 0.35	− 1.6	− 0.35	− 1.6	− 0.35	− 1.6	mA	V_{CC} = 5.5 V, $V_{IN(A)}$ = 0.4 V, other input is GND.
I_{IL}	Logical "0" Input Current	− 0.6	− 2.4	− 0.6	− 2.4	− 0.6	− 2.4	mA	V_{CC} = 5.5 V, $V_{IN(B)}$ = 0.4 V, other input is GND.
I_{OS}	Short Circuit Output Current	− 15	− 100	− 15	− 100	− 15	− 100	mA	V_{CC} = 5.5 V, CLR = (See Note 2), A = (See Note 1), B = (See Notes 1, 3, 4), V_{OUT} = GND.
I_{CC}	Power Supply Current Off		26		26		26	mA	V_{CC} = 5.5 V, V_{IN} = (See Note 2), other inputs are GND.
V_{IH}	Logical "1" Input Voltage	2.0		2.0		2.0		V	V_{CC} = 4.5 V.
V_{IL}	Logical "0" Input Voltage		0.7		0.7		0.7	V	V_{CC} = 4.5 V.
	Functional Tests	Subgroup 7		Subgroup 8A		Subgroup 8B			per Truth Table with V_{CC} = 5.0 V, V_{INL} = 0.4 V, and V_{INH} = 2.5 V.

NOTES:

1. Apply 2.0 V MIN/5.5 V MAX, 0.0 V ± 0.2 V } prior to test after clear pulse.
2. Apply 2.0 V MIN/5.5 V MAX, 0.0 V ± 0.2 V } prior to test
3. Apply 2 pulses prior to test after clear pulse (See Note 1.)
4. Apply 4 pulses prior to test after clear pulse (See Note 1.)

Symbol	Parameter	Limits						Unit	Test Condition (Unless Otherwise Specified)
	Switching Parameters:	+ 25°C		+ 125°C		− 55°C			
		Subgroup 9		Subgroup 10		Subgroup 11			
		Min	Max	Min	Max	Min	Max		
t_{PHL1} t_{PHL1}	Propagation Delay /Data-Output A to Q_n	2.0 —	65 60	2.0 —	84 79	2.0 —	84 79	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF.
t_{PLH1} t_{PLH1}	Propagation Delay /Data-Output A to Q_n	2.0 —	65 60	2.0 —	84 79	2.0 —	84 79	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF.
t_{PHL2} t_{PHL2}	Propagation Delay /Data-Output A to Q_n	2.0 —	26 20	2.0 —	34 29	2.0 —	34 29	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF.
t_{PLH2} t_{PLH2}	Propagation Delay /Data-Output B to Q_n	2.0 —	26 20	2.0 —	34 29	2.0 —	34 29	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF.
t_{PHL3} t_{PHL3}	Propagation Delay /Data-Output CLR to Q_n	2.0 —	44 39	2.0 —	56 51	2.0 —	56 51	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF.
f_{MAX1} f_{MAX1}	Maximum Clock Frequency (A-Q_A)	25 25		25		25		MHz	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF.
f_{MAX1} f_{MAX1}	Maximum Clock Frequency (B-Q_B)	12.5 12.5		12.5		12.5		MHz	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF.

NOTE:
The limit specified for C_L = 15 pF is guaranteed but not tested.

5