FAIRCHILD SEMICONDUCTOR™

August 1986
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DM74LS390
Dual 4-Bit Decade Counter

General Description

Each of these monolithic circuits contains eight master-slave flip-flops and additional gating to implement two individual four-bit counters in a single package. The DM74LS390 incorporates dual divide-by-two and divide-by-five counters, which can be used to implement cycle lengths equal to any whole and/or cumulative multiples of 2 and/or 5 up to divide-by-100. When connected as a bi-quinary counter, the separate divide-by-two circuit can be used to provide symmetry (a square wave) at the final output stage. The DM74LS390 has parallel outputs from each counter stage so that any submultiple of the input count frequency is available for system-timing signals.

Features

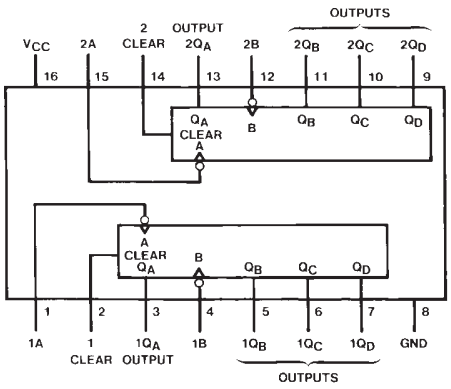
- Dual version of the popular DM74LS90
- DM74LS390…individual clocks for A and B flip-flops provide dual ÷ 2 and ÷ 5 counters
- Direct clear for each 4-bit counter
- Dual 4-bit version can significantly improve system densities by reducing counter package count by 50%
- Typical maximum count frequency…35 MHz
- Buffered outputs reduce possibility of collector commutation

Ordering Code:

Order Number	Package Number	Package Description
DM74LS390M	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow
DM74LS390N	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

Connection Diagram



Function Tables

BCD Count Sequence

(Each Counter) (Note 1)

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

Bi-Quinary (5-2)

(Each Counter) (Note 2)

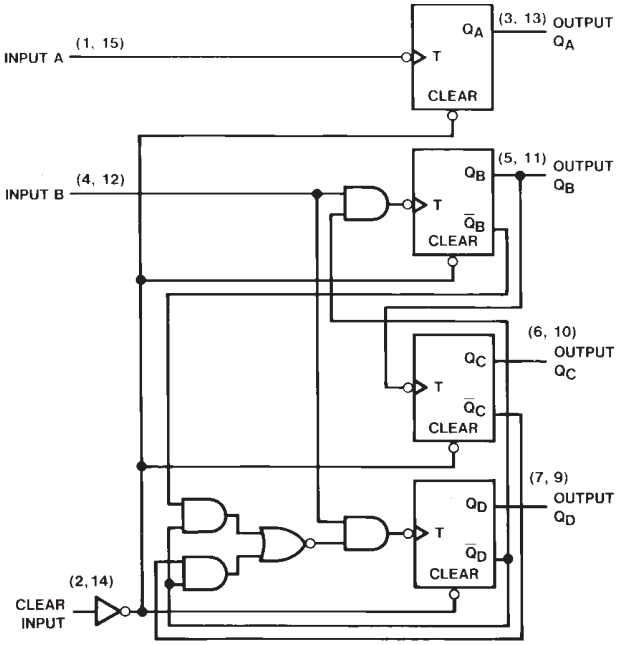
Count	Outputs			
	Q_A	Q_D	Q_C	Q_B
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	H	L	L	L
6	H	L	L	H
7	H	L	H	L
8	H	L	H	H
9	H	H	L	L

H = HIGH Level
L = LOW Level

Note 1: Output Q_A is connected to input B for BCD count.

Note 2: Output Q_D is connected to input A for Bi-quinary count.

Logic Diagram



Absolute Maximum Ratings(Note 3)

Supply Voltage	7V
Input Voltage	
Clear	7V
A or B	5.5V
Operating Free Air Temperature Range	0°C to +70°C
Storage Temperature Range	−65°C to +150°C

Note 3: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Recommended Operating Conditions

Symbol	Parameter		Min	Nom	Max	Units
V_{CC}	Supply Voltage		4.75	5	5.25	V
V_{IH}	HIGH Level Input Voltage		2			V
V_{IL}	LOW Level Input Voltage				0.8	V
I_{OH}	HIGH Level Output Current				−0.4	mA
I_{OL}	LOW Level Output Current				8	mA
f_{CLK}	Clock Frequency (Note 4)	A to Q_A	0		25	MHz
		B to Q_B	0		20	
f_{CLK}	Clock Frequency (Note 5)	A to Q_A	0		20	MHz
		B to Q_B	0		15	
t_W	Pulse Width (Note 4)	A	20			ns
		B	25			
		Clear HIGH	20			
t_{REL}	Clear Release Time (Note 6)(Note 7)		25↓			ns
T_A	Free Air Operating Temperature		0		70	°C

Note 4: C_L = 15 pF, R_L = 2 kΩ, T_A = 25°C and V_{CC} = 5V.

Note 5: C_L = 50 pF, R_L = 2 kΩ, T_A = 25°C and V_{CC} = 5V.

Note 6: The symbol (↓) indicates the falling edge of the clear pulse is used for reference.

Note 7: T_A = 25°C and V_{CC} = 5V.

Electrical Characteristics

over recommended operating free air temperature range (unless otherwise noted)

Symbol	Parameter	Conditions		Min	Typ (Note 8)	Max	Units
V_I	Input Clamp Voltage	V_{CC} = Min, I_I = −18 mA				−1.5	V
V_{OH}	HIGH Level Output Voltage	V_{CC} = Min, I_{OH} = Max V_{IL} = Max, V_{IH} = Min		2.7	3.4		V
V_{OL}	LOW Level Output Voltage	V_{CC} = Min, I_{OL} = Max V_{IL} = Max, V_{IH} = Min			0.35	0.5	V
		I_{OL} = 4 mA, V_{CC} = Min			0.25	0.4	
I_I	Input Current @ Max Input Voltage	V_{CC} = Max, V_I = 7V	Clear			0.1	mA
		V_{CC} = Max	A			0.2	
		V_I = 5.5V	B			0.4	
I_{IH}	HIGH Level Input Current	V_{CC} = Max	Clear			20	μA
		V_I = 2.7V	A			40	
			B			80	
I_{IL}	LOW Level Input Current	V_{CC} = Max, V_I = 0.4V	Clear			−0.4	mA
			A			−1.6	
			B			−2.4	
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 9)		−20		−100	mA
I_{CC}	Supply Current	V_{CC} = Max (Note 10)			15	26	mA

Note 8: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 9: Not more than one output should be shorted at a time, and the duration should not exceed one second.

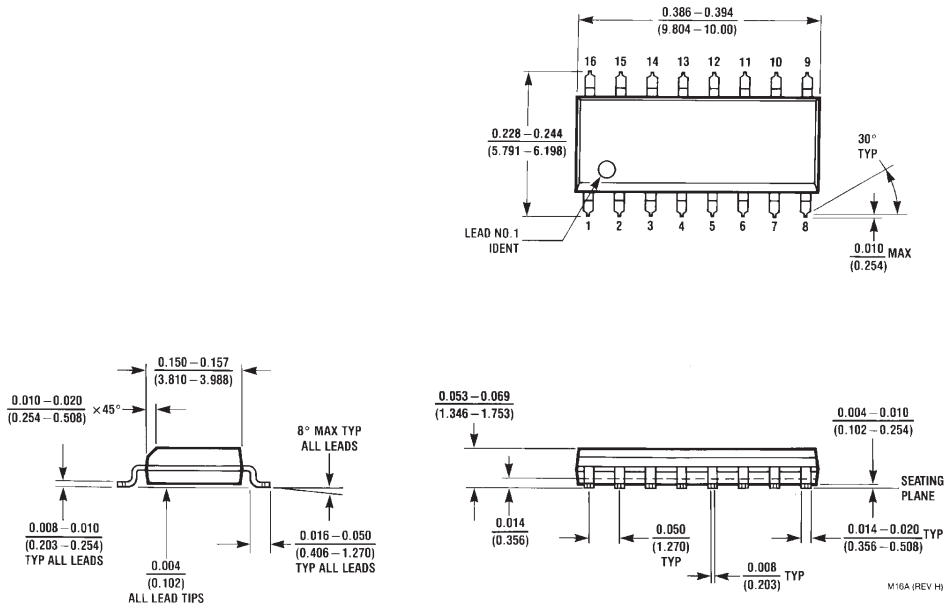
Note 10: I_{CC} is measured with all outputs OPEN, both CLEAR inputs grounded following momentary connection to 4.5 and all other inputs grounded.

Switching Characteristics

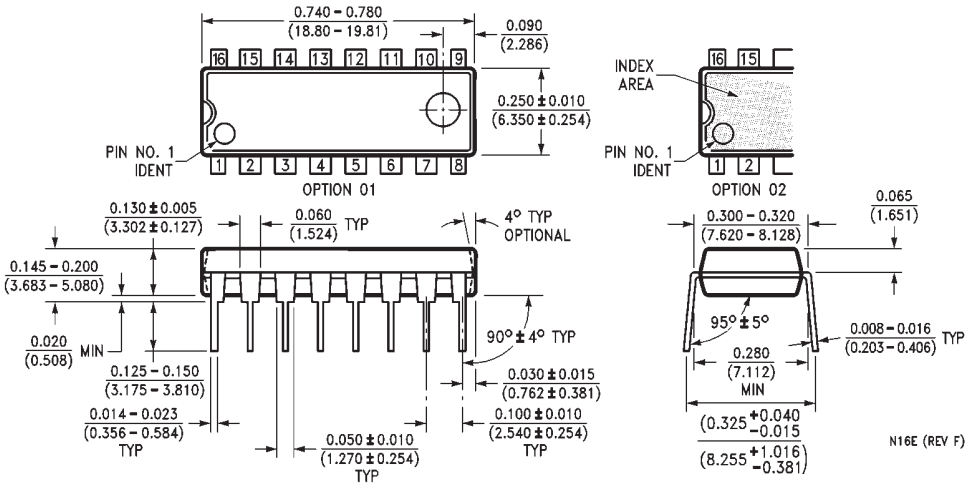
at $V_{CC} = 5V$ and $T_A = 25°C$

Symbol	Parameter	From (Input) To (Output)	$R_L = 2\ k\Omega$				Units
			$C_L = 15$ pF		$C_L = 50$ pF		
			Min	Max	Min	Max	
f_{MAX}	Maximum Clock Frequency	A to Q_A	25		20		MHz
		B to Q_B	20		15		
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output	A to Q_A		20		24	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output	A to Q_A		20		30	ns
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output	A to Q_C		60		81	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output	A to Q_C		60		81	ns
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output	B to Q_B		21		27	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output	B to Q_B		21		33	ns
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output	B to Q_C		39		51	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output	B to Q_C		39		54	ns
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output	B to Q_D		21		27	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output	B to Q_D		21		33	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output	Clear to Any Q		39		45	ns

Physical Dimensions inches (millimeters) unless otherwise noted



16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow
Package Number M16A



16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide
Package Number N16E