National Semiconductor

June 1989

DM74LS293 4-Bit Binary Counter

General Description

The 'LS293 counter is electrically and functionally identical to the 'LS93. Only the arrangement of the terminals has been changed for the 'LS293.

Each of these monolithic counters contains four master-slave flip-flops and additional gating to provide a divide-by-two counter and a three-stage binary counter for which the count cycle length is divide-by-eight.

All of these counters have a gated zero reset.

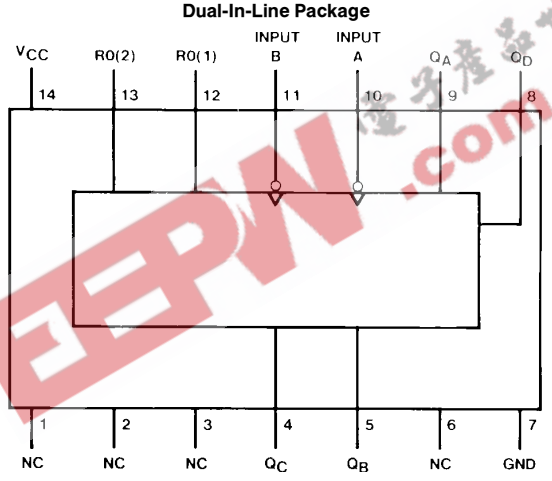
To use the maximum count length (four-bit binary) of these counters, the B input is connected to the Q_A output. The input count pulses are applied to input A and the outputs are as described in the appropriate function table.

Features

- GND and V_{CC} on Corner Pins (Pins 7 and 14 respectively)
- Typical power dissipation 45 mW
- Count frequency 42 MHz

Connection Diagram

Dual-In-Line Package



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Order Number DM74LS293M or DM74LS293N
See NS Package Number M14A or N14A

  RRD-B30M105/Printed in U. S. A.

Absolute Maximum Ratings (Note)

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

Supply Voltage	7V
Input Voltage	7V
Operating Free Air Temperature Range	
DM74LS	0°C to +70°C
Storage Temperature Range	−65°C to +150°C

Note: *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" table 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		DM74LS293			Units
			Min	Nom	Max	
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 1)	A to Q_A	0		32	MHz
		B to Q_B	0		16	
f_{CLK}	Clock Frequency (Note 2)	A to Q_A	0		20	MHz
		B to Q_B	0		10	
t_W	Pulse Width (Note 6)	A	15			ns
		B	30			
		Reset	15			
t_{REL}	Reset Release Time (Note 6)		25			ns
T_A	Free Air Operating Temperature		0		70	°C

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

Symbol	Parameter	Conditions		Min	Typ (Note 3)	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	Reset			0.1	mA
			A			0.2	
			B			0.2	
I_{IH}	High Level Input Current	V_{CC} = Max, V_I = 2.7V	Reset			20	μA
			A			40	
			B			40	
I_{IL}	Low Level Input Current	V_{CC} = Max, V_I = 0.4V	Reset			−0.4	mA
			A			−2.4	
			B			−1.6	
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 4)		−20		−100	mA
I_{CC}	Supply Current	V_{CC} = Max (Note 5)			9	15	mA

Switching Characteristics at $V_{CC} = 5V$ and $T_A = 25°C$ (See Section 1 for Test Waveforms and Output Load)

Symbol	Parameter	From (Input) To (Output)	$R_L = 2\ k\Omega$				Units
			$C_L = 15\ pF$		$C_L = 50\ pF$		
			Min	Max	Min	Max	
t_{MAX}	Maximum Clock Frequency	A to Q_A	32		20		MHz
		B to Q_B	16		10		
t_{PLH}	Propagation Delay Time Low to High Level Output	A to Q_A		16		23	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	A to Q_A		18		30	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	A to Q_D		70		87	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	A to Q_D		70		93	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	B to Q_B		16		23	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	B to Q_B		21		35	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	B to Q_C		32		48	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	B to Q_C		35		53	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	B to Q_D		51		71	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	B to Q_D		51		71	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	SET-0 to Any Q		40		53	ns

Note 1: $C_L = 15\ pF$, $R_L = 2\ k\Omega$, $T_A = 25°C$ and $V_{CC} = 5V$.

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

Note 3: All typicals are at $V_{CC} = 5V$, $T_A = 25°C$.

Note 4: Not more than one output should be shorted at a time, and the duration should not exceed one second.

Note 5: I_{CC} is measured with all outputs open, both RO inputs grounded following momentary connection to 4.5V and all other inputs grounded.

Note 6: $T_A = 25°C$ and $V_{CC} = 5V$.

Function Tables

Count Sequence (See Note C)

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
10	H	L	H	L
11	H	L	H	H
12	H	H	L	L
13	H	H	L	H
14	H	H	H	L
15	H	H	H	H

Note C: Output Q_A is connected to input B.

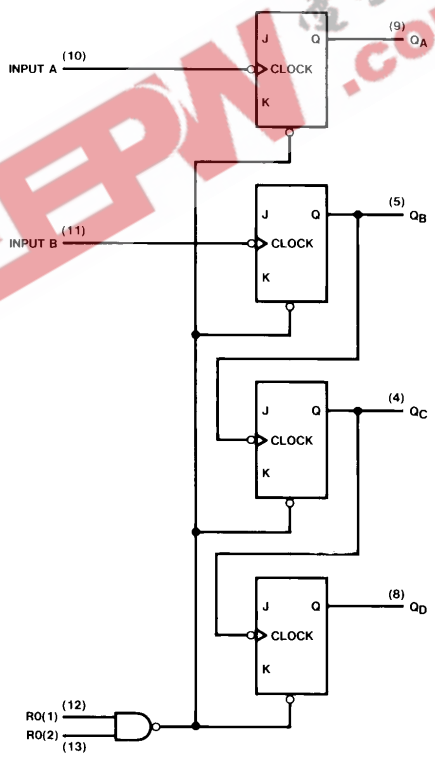
Reset/Count Truth Table

Reset Inputs		Outputs			
R0(1)	R0(2)	Q_D	Q_C	Q_B	Q_A
H	H	L	L	L	L
L	X	COUNT			
X	L	COUNT			

H = High Level, L = Low Level, X = Don't Care.

Logic Diagram

LS293



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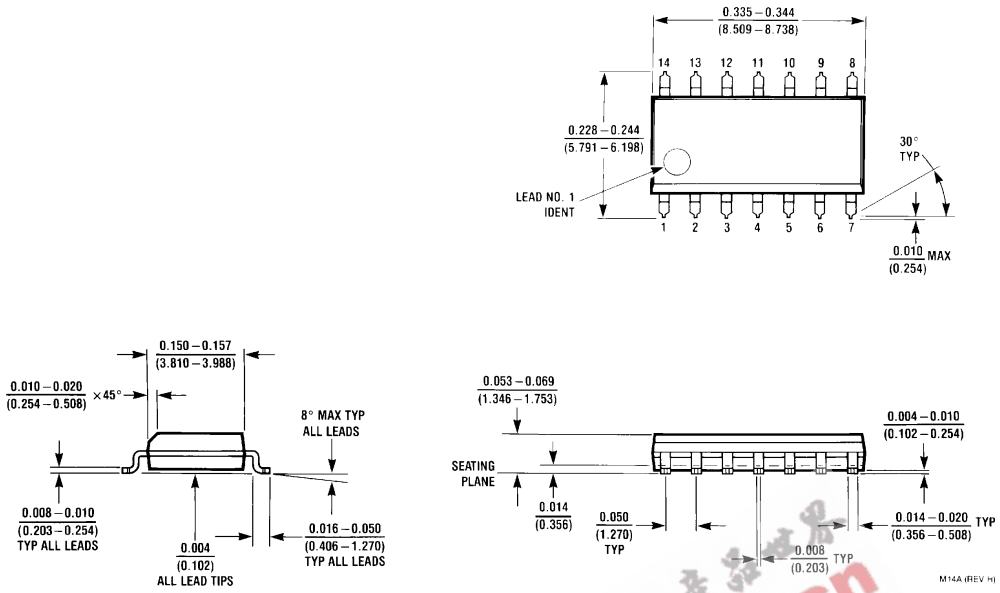
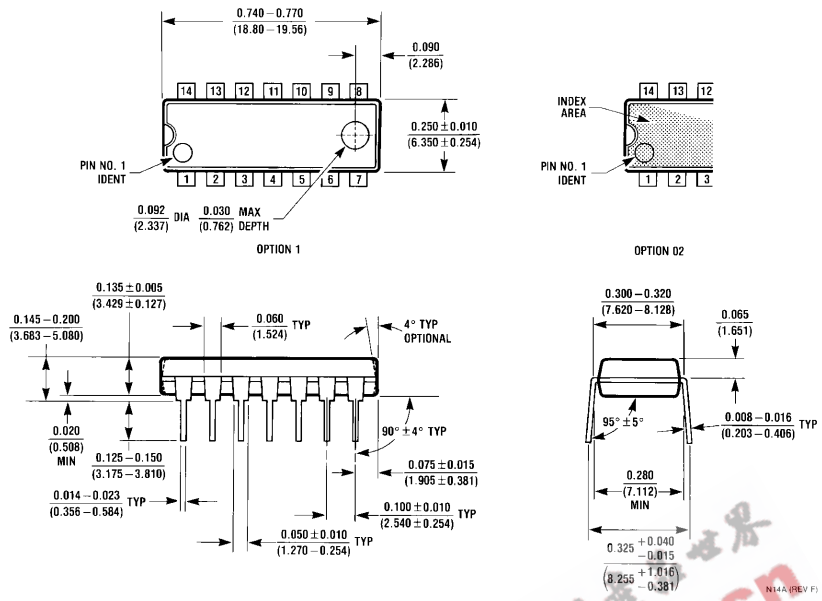
Note: The J and K inputs shown without connection are for reference only and are functionally at a high level.

Physical Dimensions inches (millimeters)



14-Lead Small Outline Molded Package (M)
Order Number DM74LS293M
NS Package Number M14A

Physical Dimensions inches (millimeters) (Continued)



14-Lead Molded Dual-In-Line Package (N)
Order Number DM74LS293N
NS Package Number N14A

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