National Semiconductor

DM54L90/DM74L90, DM54L93/DM74L93 Decade, Divide-by-12, and Binary Counters

General Description

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-five for the L90 and divide-by-eight for the L93.

All of these counters have a gated zero reset and the L90 also has gated set-to-nine inputs for use in BCD nine's complement applications.

To use their maximum count length (decade, divide-by-twelve, or four-bit binary), 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 truth table. A symmetrical divide-by-ten count can be obtained from the L90 counters by connecting the Q_D output to the A input and applying the input count to the B input which gives a divide-by-ten square wave at output Q_A.

Features

- Typical power dissipation
  - L90 20 mW
  - L93 16 mW
- Count frequency
  - L90 11 MHz
  - L93 15 MHz

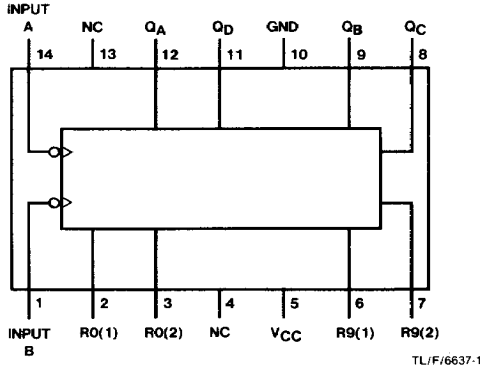
Absolute Maximum Ratings (Note 1)

Supply Voltage	8V
Input Voltage	5.5V
Storage Temperature Range	−65°C to 150°C

Note 1: The "Absolute Maximum Ratings" are those values beyond which the safety of the device can not 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.

Connection Diagrams

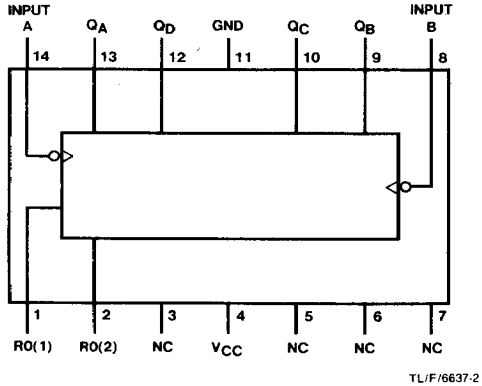
Dual-In-Line Package



TL/F/6637-1

54L90 (J) **74L90 (N)**

Dual-In-Line Package



TL/F/6637-2

54L93 (J) **74L93 (N)**

Function Tables

L90
BCD COUNT SEQUENCE
(See Note A)

Count	Output			
	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

L90
BI-QUINARY (5-2)
(See Note B)

Count	Output			
	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

L93
COUNT SEQUENCE
(See Note C)

Count	Output			
	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

L90
RESET/COUNT TRUTH TABLE

Reset Inputs				Output			
R0(1)	R0(2)	R9(1)	R9(2)	Q_D	Q_C	Q_B	Q_A
H	H	L	X	L	L	L	L
H	H	X	L	L	L	L	L
X	X	H	H	H	L	L	H
X	L	X	L	COUNT			
L	X	L	X	COUNT			
L	X	X	L	COUNT			
X	L	L	X	COUNT			

L93
RESET/COUNT TRUTH TABLE

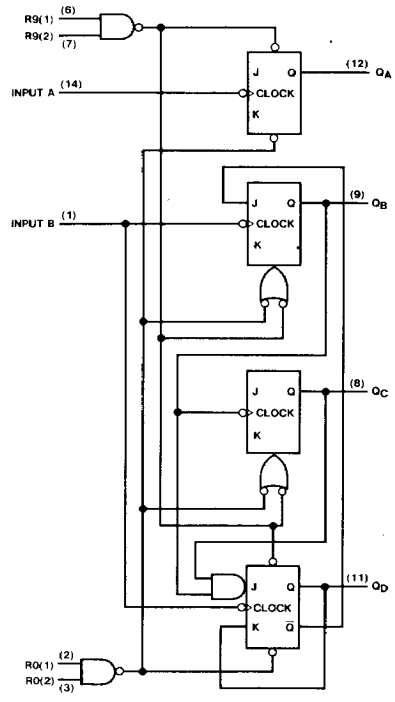
Reset Inputs		Output			
R0(1)	R0(2)	Q_D	Q_C	Q_B	Q_A
H	H	L	L	L	L
L	X	COUNT			
X	L	COUNT			

Note A: Output Q_A is connected to input B for BCD count.
Note B: Output Q_D is connected to input A for bi-quinary count.
Note C: Output Q_A is connected to input B.
Note D: H = High Level, L = Low Level, X = Don't Care.

7

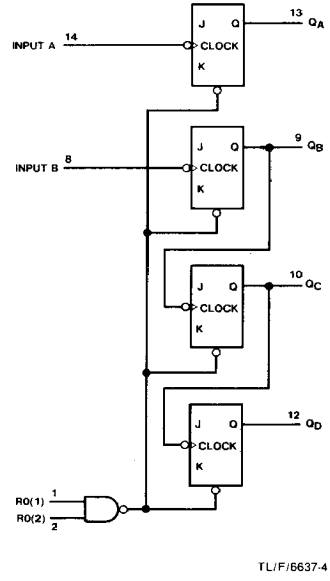
Logic Diagrams

L90



TL/F/6637-3

L93



TL/F/6637-4

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

Recommended Operating Conditions

Sym	Parameter		DM54L90			DM74L90			Units
			Min	Nom	Max	Min	Nom	Max	
V_{CC}	Supply Voltage		4.5	5	5.5	4.75	5	5.25	V
V_{IH}	High Level Input Voltage		2			2			V
V_{IL}	Low Level Input Voltage				0.7			0.7	V
I_{OH}	High Level Output Current				−0.2			−0.2	mA
I_{OL}	Low Level Output Current				2			3.6	mA
f_{CLK}	Clock Frequency		0		6	0		6	MHz
t_W	Pulse Width	A	90			90			ns
		B	90			90			
		Reset	200			200			
t_{REL}	Reset Release Time		200			200			ns
T_A	Free Air Operating Temperature		−55		125	0		70	°C

'L90 Electrical Characteristics

over recommended operating free air temperature (unless otherwise noted)

Sym	Parameter	Conditions		Min	Typ (Note 1)	Max	Units
V_{OH}	High Level Output Voltage	V_{CC} = Min, I_{OH} = Max V_{IL} = Max, V_{IH} = Min		2.4	3.4		V
V_{OL}	Low Level Output Voltage	V_{CC} = Min I_{OL} = Max V_{IL} = Max V_{IH} = Min (Note 4)	DM54		0.15	0.3	V
			DM74		0.25	0.4	
I_I	Input Current@Max Input Voltage	V_{CC} = Max V_I = 5.5V	Reset			0.1	mA
			A			0.2	
			B			0.4	
I_{IH}	High Level Input Current	V_{CC} = Max V_I = 2.4V	Reset			10	μA
			A			20	
			B			40	
I_{IL}	Low Level Input Current	V_{CC} = Max V_I = 0.3V	Reset			−0.18	mA
			A			−0.36	
			B			−0.72	
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 2)	DM54	−3		−15	mA
			DM74	−3		−15	
I_{CC}	Supply Current	V_{CC} = Max (Note 3)				5.5	mA

Note 1: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 2: Not more than one output should be shorted at a time.

Note 3: I_{CC} is measured with all outputs open, R0 inputs grounded following momentary connection to 4.5V and all other inputs grounded.

Note 4: Q_A outputs are tested at I_{OL} = max plus the limit value of I_{IL} for the B input. This permits driving the B input while maintaining full fan-out capability.

'L90 Switching Characteristics at $V_{CC} = 5V$ and $T_A = 25°C$

(See Section 1 for Test Waveforms and Output Load)

Parameter	From (Input) To (Output)	$R_L = 4\ k\Omega$, $C_L = 50\ pF$			Units
		Min	Typ	Max	
f_{MAX} Maximum Clock Frequency	A to Q_A	6	11		MHz
t_{PLH} Propagation Delay Time Low to High Level Output	A to Q_D		175	300	ns
t_{PHL} Propagation Delay Time High to Low Level Output	A to Q_D		190	300	ns

Recommended Operating Conditions

Sym	Parameter		DM54L93			DM74L93			Units
			Min	Nom	Max	Min	Nom	Max	
V_{CC}	Supply Voltage		4.5	5	5.5	4.75	5	5.25	V
V_{IH}	High Level Input Voltage		2			2			V
V_{IL}	Low Level Input Voltage				0.7			0.7	V
I_{OH}	High Level Output Current				−0.2			−0.2	mA
I_{OL}	Low Level Output Current				2			3.6	mA
f_{CLK}	Clock Frequency		0		6	0		6	MHz
t_W	Pulse Width	A	90			90			ns
		B	90			90			
		Reset	200			200			
t_{REL}	Reset Release Time		200			200			ns
T_A	Free Air Operating Temperature		−55		125	0		70	°C

'L93 Electrical Characteristics over recommended operating free air temperature (unless otherwise noted)

Sym	Parameter	Conditions		Min	Typ (Note 1)	Max	Units
V_{OH}	High Level Output Voltage	V_{CC} = Min, I_{OH} = Max V_{IL} = Max, V_{IH} = Min		2.4	3.4		V
V_{OL}	Low Level Output Voltage	V_{CC} = Min I_{OL} = Max V_{IL} = Max V_{IH} = Min (Note 4)	DM54		0.15	0.3	V
			DM74		0.25	0.4	
I_I	Input Current@Max Input Voltage	V_{CC} = Max V_I = 5.5V	Reset			0.1	mA
			A			0.2	
			B			0.2	
I_{IH}	High Level Input Current	V_{CC} = Max V_I = 2.4V	Reset			10	μA
			A			20	
			B			20	
I_{IL}	Low Level Input Current	V_{CC} = Max V_I = 0.3V	Reset			−0.18	mA
			A			−0.36	
			B			−0.36	
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 2)	DM54	−3		−15	mA
			DM74	−3		−15	
I_{CC}	Supply Current	V_{CC} = Max (Note 3)				5.5	mA

Note 1: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 2: Not more than one output should be shorted at a time.

Note 3: I_{CC} is measured with all outputs open, R0 inputs grounded following momentary connection to 4.5V and all other inputs grounded.

Note 4: Q_A outputs are tested at I_{OL} = max plus the limit value of I_{IL} for the B input. This permits driving the B input while maintaining full fan-out capability.

'L93 Switching Characteristics at V_{CC} = 5V and T_A = 25°C

(See Section 1 for Test Waveforms and Output Load)

Parameter	From (Input) To (Output)	R_L = 4 kΩ, C_L = 50 pF			Units
		Min	Typ	Max	
f_{MAX} Maximum Clock Frequency	A to Q_A	6	15		MHz
t_{PLH} Propagation Delay Time Low to High Level Output	A to Q_D		210	400	ns
t_{PHL} Propagation Delay Time High to Low Level Output	A to Q_D		230	400	ns