

Rochester Electronics Manufactured Components

Rochester branded components are manufactured using either die/wafers purchased from the original suppliers or Rochester wafers recreated from the original IP. All recreations are done with the approval of the OCM.

Parts are tested using original factory test programs or Rochester developed test solutions to guarantee product meets or exceed the OCM data sheet.

Quality Overview

- ISO-9001
- AS9120 certification
- Qualified Manufacturers List (QML) MIL-PRF-35835
 - Class Q Military
 - Class V Space Level
- Qualified Suppliers List of Distributors (QSLD)
 - Rochester is a critical supplier to DLA and meets all industry and DLA standards.

Rochester Electronics, LLC is committed to supplying products that satisfy customer expectations for quality and are equal to those originally supplied by industry manufacturers.

The original manufacturer's datasheet accompanying this document reflects the performance and specifications of the Rochester manufactured version of this device. Rochester Electronics guarantees the performance of its semiconductor products to the original OEM specifications. 'Typical' values are for reference purposes only. Certain minimum or maximum ratings may be based on product characterization, design, simulation, or sample testing.

SN74LS90

DECADE COUNTER; DIVIDE-BY-TWELVE COUNTER; 4-BIT BINARY COUNTER



ON Semiconductor®

<http://onsemi.com>

The SN54/74LS90, SN54/74LS92 and SN54/74LS93 are high-speed 4-bit ripple type counters partitioned into two sections. Each counter has a divide-by-two section and either a divide-by-five (LS90), divide-by-six (LS92) or divide-by-eight (LS93) section which are triggered by a HIGH-to-LOW transition on the clock inputs. Each section can be used separately or tied together (Q to \overline{CP}) to form BCD, bi-quinary, modulo-12, or modulo-16 counters. All of the counters have a 2-input gated Master Reset (Clear), and the LS90 also has a 2-input gated Master Set (Preset 9).

- Low Power Consumption . . . Typically 45 mW
- High Count Rates . . . Typically 42 MHz
- Choice of Counting Modes . . . BCD, Bi-Quinary, Divide-by-Twelve, Binary
- Input Clamp Diodes Limit High Speed Termination Effects

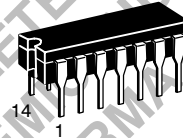
DECADE COUNTER; DIVIDE-BY-TWELVE COUNTER; 4-BIT BINARY COUNTER LOW POWER SCHOTTKY

PIN NAMES

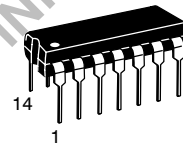
		LOADING (Note a)	
		HIGH	LOW
\overline{CP}_0	Clock (Active LOW going edge) Input to +2 Section	0.5 U.L.	1.5 U.L.
\overline{CP}_1	Clock (Active LOW going edge) Input to +5 Section (LS90), +6 Section (LS92)	0.5 U.L.	2.0 U.L.
\overline{CP}_1	Clock (Active LOW going edge) Input to +8 Section (LS93)	0.5 U.L.	1.0 U.L.
MR ₁ , MR ₂	Master Reset (Clear) Inputs	0.5 U.L.	0.25 U.L.
MS ₁ , MS ₂	Master Set (Preset-9, LS90) Inputs	0.5 U.L.	0.25 U.L.
Q ₀	Output from +2 Section (Notes b & c)	10 U.L.	5 (2.5) U.L.
Q ₁ , Q ₂ , Q ₃	Outputs from +5 (LS90), +6 (LS92), +8 (LS93) Sections (Note b)	10 U.L.	5 (2.5) U.L.

NOTES:

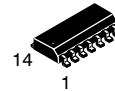
- 1 TTL Unit Load (U.L.) = 40 μ A HIGH/1.6 mA LOW.
- The Output LOW drive factor is 2.5 U.L. for Military, (54) and 5 U.L. for commercial (74) Temperature Ranges.
- The Q₀ Outputs are guaranteed to drive the full fan-out plus the \overline{CP}_1 input of the device.
- To insure proper operation the rise (t_r) and fall time (t_f) of the clock must be less than 100 ns.



J SUFFIX
CERAMIC
CASE 632-08



N SUFFIX
PLASTIC
CASE 646-06

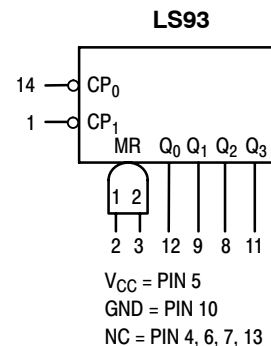
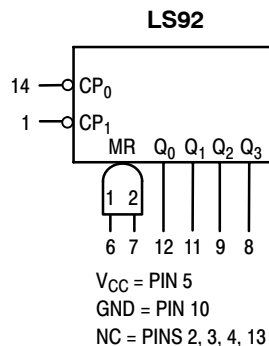
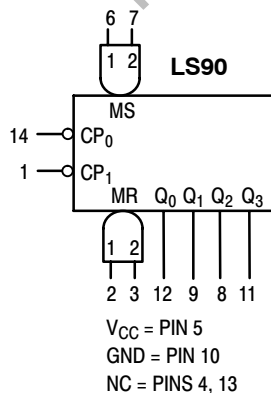


D SUFFIX
SOIC
CASE 751A-02

ORDERING INFORMATION

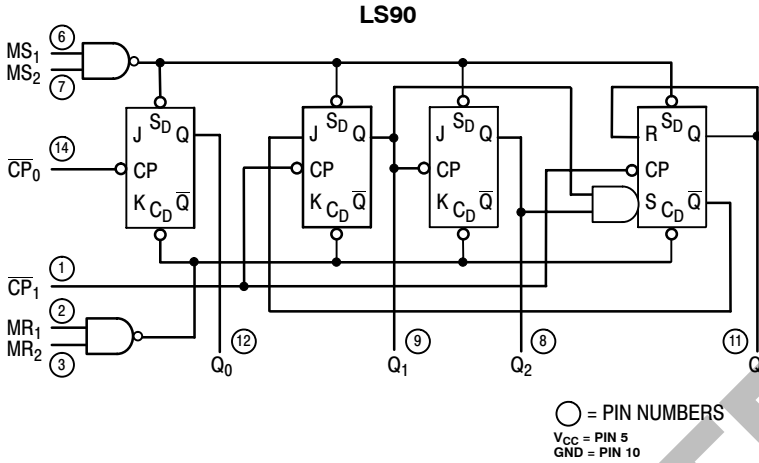
SN54LSXXJ	Ceramic
SN74LSXXN	Plastic
SN74LSXXD	SOIC

LOGIC SYMBOL



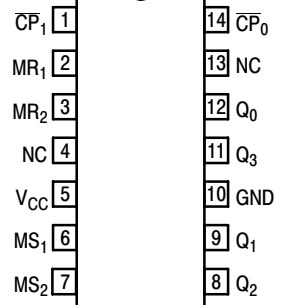
SN74LS90

LOGIC DIAGRAM



CONNECTION DIAGRAM

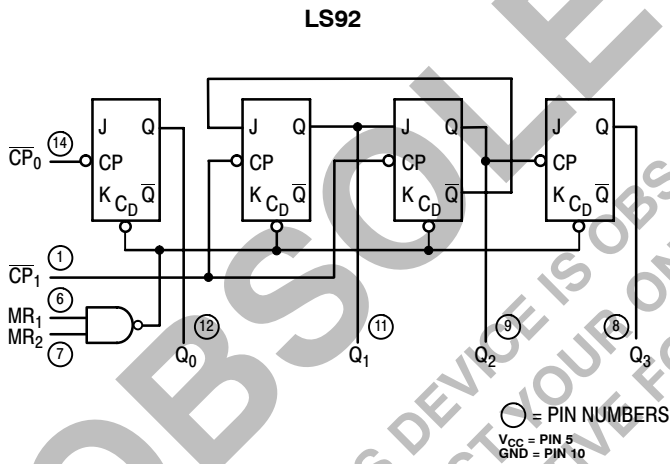
DIP (TOP VIEW)



NC = NO INTERNAL CONNECTION

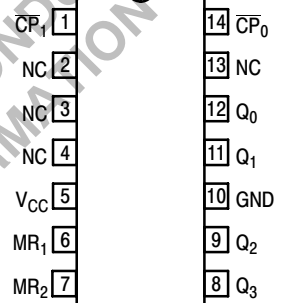
NOTE:
The Flatpak version has the same pinouts (Connection Diagram) as the Dual In-Line Package.

LOGIC DIAGRAM



CONNECTION DIAGRAM

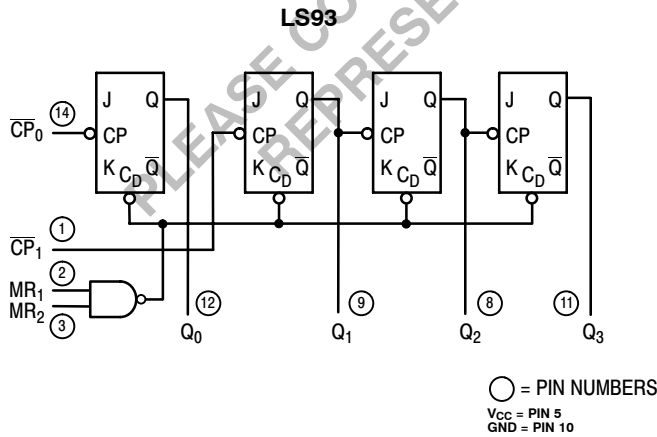
DIP (TOP VIEW)



NC = NO INTERNAL CONNECTION

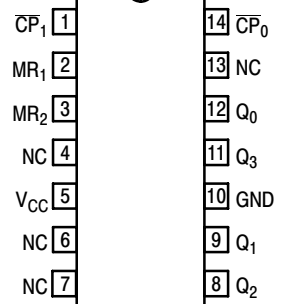
NOTE:
The Flatpak version has the same pinouts (Connection Diagram) as the Dual In-Line Package.

LOGIC DIAGRAM



CONNECTION DIAGRAM

DIP (TOP VIEW)



NC = NO INTERNAL CONNECTION

NOTE:
The Flatpak version has the same pinouts (Connection Diagram) as the Dual In-Line Package.

FUNCTIONAL DESCRIPTION

The LS90, LS92, and LS93 are 4-bit ripple type Decade, Divide-By-Twelve, and Binary Counters respectively. Each device consists of four master/slave flip-flops which are internally connected to provide a divide-by-two section and a divide-by-five (LS90), divide-by-six (LS92), or divide-by-eight (LS93) section. Each section has a separate clock input which initiates state changes of the counter on the HIGH-to-LOW clock transition. State changes of the Q outputs do not occur simultaneously because of internal ripple delays. Therefore, decoded output signals are subject to decoding spikes and should not be used for clocks or strobes. The Q_0 output of each device is designed and specified to drive the rated fan-out plus the \overline{CP}_1 input of the device.

A gated AND asynchronous Master Reset ($MR_1 \cdot MR_2$) is provided on all counters which overrides and clocks and resets (clears) all the flip-flops. A gated AND asynchronous Master Set ($MS_1 \cdot MS_2$) is provided on the LS90 which overrides the clocks and the MR inputs and sets the outputs to nine (HLLH).

Since the output from the divide-by-two section is not internally connected to the succeeding stages, the devices may be operated in various counting modes.

LS90

- A. BCD Decade (8421) Counter — The \overline{CP}_1 input must be externally connected to the Q_0 output. The \overline{CP}_0 input receives the incoming count and a BCD count sequence is produced.
- B. Symmetrical Bi-quinary Divide-By-Ten Counter — The Q_3 output must be externally connected to the \overline{CP}_0 input. The input count is then applied to the \overline{CP}_1 input and a divide-by-ten square wave is obtained at output Q_0 .

- C. Divide-By-Two and Divide-By-Five Counter — No external interconnections are required. The first flip-flop is used as a binary element for the divide-by-two function (\overline{CP}_0 as the input and Q_0 as the output). The \overline{CP}_1 input is used to obtain binary divide-by-five operation at the Q_3 output.

LS92

- A. Modulo 12, Divide-By-Twelve Counter — The \overline{CP}_1 input must be externally connected to the Q_0 output. The \overline{CP}_0 input receives the incoming count and Q_3 produces a symmetrical divide-by-twelve square wave output.
- B. Divide-By-Two and Divide-By-Six Counter — No external interconnections are required. The first flip-flop is used as a binary element for the divide-by-two function. The \overline{CP}_1 input is used to obtain divide-by-three operation at the Q_1 and Q_2 outputs and divide-by-six operation at the Q_3 output.

LS93

- A. 4-Bit Ripple Counter — The output Q_0 must be externally connected to input \overline{CP}_1 . The input count pulses are applied to input \overline{CP}_0 . Simultaneous divisions of 2, 4, 8, and 16 are performed at the Q_0 , Q_1 , Q_2 , and Q_3 outputs as shown in the truth table.
- B. 3-Bit Ripple Counter — The input count pulses are applied to input \overline{CP}_1 . Simultaneous frequency divisions of 2, 4, and 8 are available at the Q_1 , Q_2 , and Q_3 outputs. Independent use of the first flip-flop is available if the reset function coincides with reset of the 3-bit ripple-through counter.

SN74LS90

LS90
MODE SELECTION

RESET/SET INPUTS				OUTPUTS			
MR ₁	MR ₂	MS ₁	MS ₂	Q ₀	Q ₁	Q ₂	Q ₃
H	H	L	X	L	L	L	L
H	H	X	L	L	L	L	L
X	X	H	H	H	L	L	L
L	X	L	X	H	L	L	H
X	L	X	X				
L	X	X	L				
L	L	X	X				
X	L	L	X				

H = HIGH Voltage Level
L = LOW Voltage Level
X = Don't Care

LS92 AND LS93
MODE SELECTION

RESET INPUTS		OUTPUTS			
MR ₁	MR ₂	Q ₀	Q ₁	Q ₂	Q ₃
H	H	L	L	L	L
L	H				
L	L				

H = HIGH Voltage Level
L = LOW Voltage Level
X = Don't Care

LS90
BCD COUNT SEQUENCE

COUNT	OUTPUT			
	Q ₀	Q ₁	Q ₂	Q ₃
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	H	L
5	H	L	H	L
6	L	H	H	L
7	H	H	H	L
8	L	L	L	H
9	H	L	L	H

NOTE: Output Q₀ is connected to Input CP₁ for BCD count.

LS92
TRUTH TABLE

COUNT	OUTPUT			
	Q ₀	Q ₁	Q ₂	Q ₃
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	H	L
5	H	L	H	L
6	L	H	H	L
7	H	H	L	H
8	L	H	L	H
9	H	L	L	H
10	L	L	L	H
11	H	L	H	H

NOTE: Output Q₀ is connected to Input CP₁.

LS93
TRUTH TABLE

COUNT	OUTPUT			
	Q ₀	Q ₁	Q ₂	Q ₃
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	H	L
5	H	L	H	L
6	L	H	H	L
7	H	H	H	L
8	L	L	L	H
9	H	L	L	H
10	L	H	L	H
11	H	H	L	H
12	L	L	H	H
13	H	L	H	H
14	L	H	H	H
15	H	H	H	H

NOTE: Output Q₀ is connected to Input CP₁.

GUARANTEED OPERATING RANGES

Symbol	Parameter		Min	Typ	Max	Unit
V _{CC}	Supply Voltage	54	4.5	5.0	5.5	V
		74	4.75	5.0	5.25	
T _A	Operating Ambient Temperature Range	54	-55	25	125	°C
		74	0	25	70	
I _{OH}	Output Current — High	54, 74			-0.4	mA
I _{OL}	Output Current — Low	54			4.0	mA
		74			8.0	

SN74LS90

DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (unless otherwise specified)

Symbol	Parameter		Limits			Unit	Test Conditions
			Min	Typ	Max		
V_{IH}	Input HIGH Voltage		2.0			V	Guaranteed Input HIGH Voltage for All Inputs
V_{IL}	Input LOW Voltage	54			0.7	V	Guaranteed Input LOW Voltage for All Inputs
		74			0.8		
V_{IK}	Input Clamp Diode Voltage			-0.65	-1.5	V	$V_{CC} = \text{MIN}$, $I_{IN} = -18 \text{ mA}$
V_{OH}	Output HIGH Voltage	54	2.5	3.5		V	$V_{CC} = \text{MIN}$, $I_{OH} = \text{MAX}$, $V_{IN} = V_{IH}$ or V_{IL} per Truth Table
		74	2.7	3.5		V	
V_{OL}	Output LOW Voltage	54, 74		0.25	0.4	V	$I_{OL} = 4.0 \text{ mA}$ $V_{CC} = V_{CC} \text{ MIN}$, $V_{IN} = V_{IL}$ or V_{IH} per Truth Table
		74		0.35	0.5	V	
I_{IH}	Input HIGH Current				20	μA	$V_{CC} = \text{MAX}$, $V_{IN} = 2.7 \text{ V}$
					0.1	mA	$V_{CC} = \text{MAX}$, $V_{IN} = 7.0 \text{ V}$
I_{IL}	Input LOW Current MS, MR \overline{CP}_0 \overline{CP}_1 (LS90, LS92) \overline{CP}_1 (LS93)				-0.4	mA	$V_{CC} = \text{MAX}$, $V_{IN} = 0.4 \text{ V}$
					-2.4		
					-3.2		
					-1.6		
I_{OS}	Short Circuit Current (Note 1)		-20		-100	mA	$V_{CC} = \text{MAX}$
I_{CC}	Power Supply Current				15	mA	$V_{CC} = \text{MAX}$

Note 1: Not more than one output should be shorted at a time, nor for more than 1 second.

SN74LS90

AC CHARACTERISTICS (T_A = 25°C, V_{CC} = 5.0 V, C_L = 15 pF)

Symbol	Parameter	Limits									Unit
		LS90			LS92			LS93			
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
f _{MAX}	CP ₀ Input Clock Frequency	32			32			32			MHz
f _{MAX}	CP ₁ Input Clock Frequency	16			16			16			MHz
t _{PLH} t _{PHL}	Propagation Delay, CP ₀ Input to Q ₀ Output		10 12	16 18		10 12	16 18		10 12	16 18	ns
t _{PLH} t _{PHL}	CP ₀ Input to Q ₃ Output		32 34	48 50		32 34	48 50		46 46	70 70	ns
t _{PLH} t _{PHL}	CP ₁ Input to Q ₁ Output		10 14	16 21		10 14	16 21		10 14	16 21	ns
t _{PLH} t _{PHL}	CP ₁ Input to Q ₂ Output		21 23	32 35		10 14	16 21		21 23	32 35	ns
t _{PLH} t _{PHL}	CP ₁ Input to Q ₃ Output		21 23	32 35		21 23	32 35		34 34	51 51	ns
t _{PLH}	MS Input to Q ₀ and Q ₃ Outputs		20	30							ns
t _{PHL}	MS Input to Q ₁ and Q ₂ Outputs		26	40							ns
t _{PHL}	MR Input to Any Output		26	40		26	40		26	40	ns

AC SETUP REQUIREMENTS (T_A = 25°C, V_{CC} = 5.0 V)

Symbol	Parameter	Limits						Unit
		LS90		LS92		LS93		
		Min	Max	Min	Max	Min	Max	
t _W	CP ₀ Pulse Width	15		15		15		ns
t _W	CP ₁ Pulse Width	30		30		30		ns
t _W	MS Pulse Width	15						ns
t _W	MR Pulse Width	15		15		15		ns
t _{rec}	Recovery Time MR to CP	25		25		25		ns

RECOVERY TIME (t_{rec}) is defined as the minimum time required between the end of the reset pulse and the clock transition from HIGH-to-LOW in order to recognize and transfer HIGH data to the Q outputs

AC WAVEFORMS

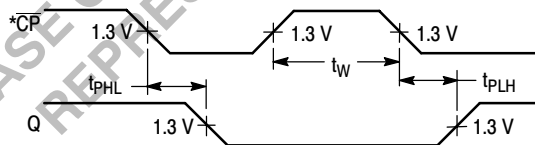


Figure 1

*The number of Clock Pulses required between the t_{PHL} and t_{PLH} measurements can be determined from the appropriate Truth Tables.

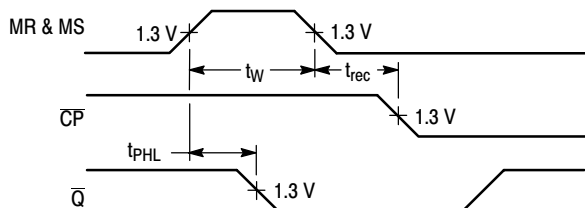


Figure 2

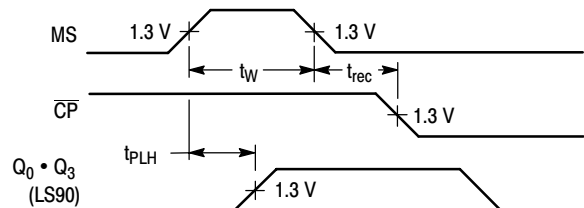


Figure 3

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