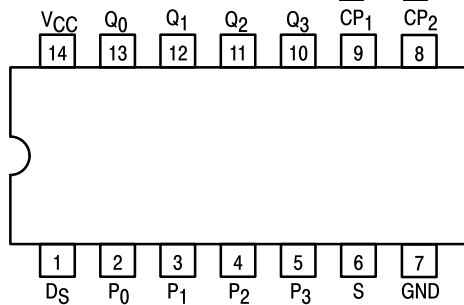**MOTOROLA**

4-BIT SHIFT REGISTER

The SN54/74LS95B is a 4-Bit Shift Register with serial and parallel synchronous operating modes. The serial shift right and parallel load are activated by separate clock inputs which are selected by a mode control input. The data is transferred from the serial or parallel D inputs to the Q outputs synchronous with the HIGH to LOW transition of the appropriate clock input.

The LS95B is fabricated with the Schottky barrier diode process for high speed and is completely compatible with all Motorola TTL families.

- Synchronous, Expandable Shift Right
- Synchronous Shift Left Capability
- Synchronous Parallel Load
- Separate Shift and Load Clock Inputs
- Input Clamp Diodes Limit High Speed Termination Effects

SN54/74LS95B

4-BIT SHIFT REGISTER

LOW POWER SCHOTTKY

J SUFFIX
CERAMIC
CASE 632-08

N SUFFIX
PLASTIC
CASE 646-06
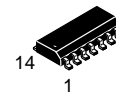
D SUFFIX
SOIC
CASE 751A-02

ORDERING INFORMATION

SN54LSXXJ   Ceramic
SN74LSXXN   Plastic
SN74LSXXD   SOIC

CONNECTION DIAGRAM DIP (TOP VIEW)

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

V_{CC} = PIN 14
GND = PIN 7

PIN NAMES

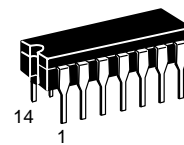|		LOADING (Note a)	
		HIGH	LOW
S	Mode Control Input	0.5 U.L.	0.25 U.L.
D_S	Serial Data Input	0.5 U.L.	0.25 U.L.
P_0–P_3	Parallel Data Inputs	0.5 U.L.	0.25 U.L.
$\overline{CP_1}$	Serial Clock (Active LOW Going Edge) Input	0.5 U.L.	0.25 U.L.
$\overline{CP_2}$	Parallel Clock (Active LOW Going Edge) Input	0.5 U.L.	0.25 U.L.
Q_0–Q_3	Parallel Outputs (Note b)	10 U.L.	5 (2.5) U.L.

NOTES:
a. 1 TTL Unit Load (U.L.) = 40 µA HIGH/1.6 mA LOW.
b. The Output LOW drive factor is 2.5 U.L. for Military (54) and 5 U.L. for Commercial (74) Temperature Ranges.
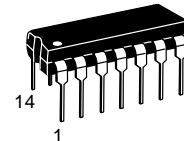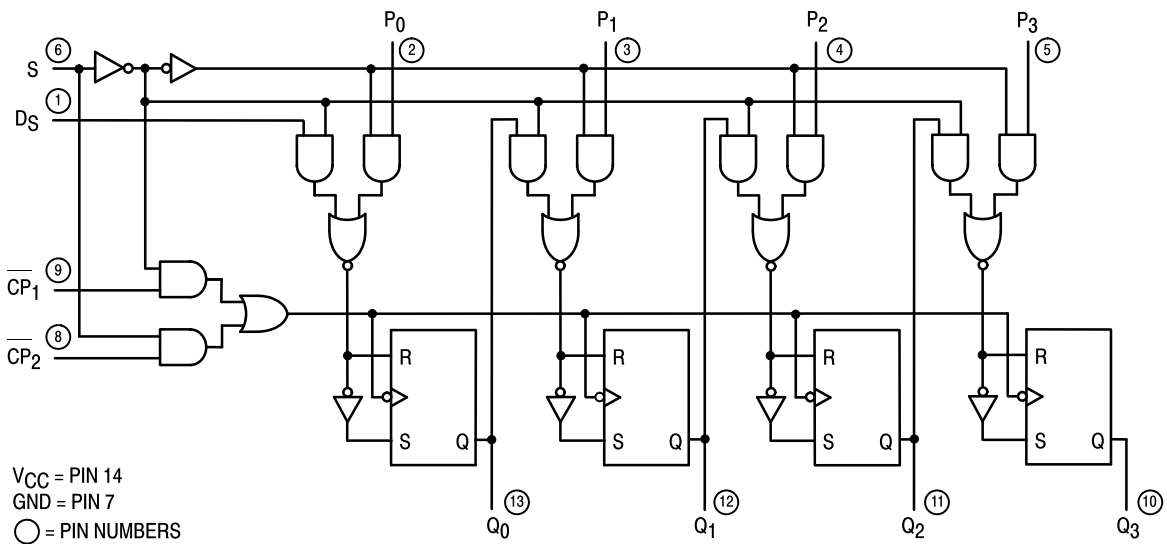
GUARANTEED OPERATING RANGES

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	

SN54/74LS95B

LOGIC DIAGRAM

V_{CC} = PIN 14
GND = PIN 7
◯ = PIN NUMBERS

FUNCTIONAL DESCRIPTION

The LS95B is a 4-Bit Shift Register with serial and parallel synchronous operating modes. It has a Serial (D_S) and four Parallel (P_0-P_3) Data inputs and four Parallel Data outputs (Q_0-Q_3). The serial or parallel mode of operation is controlled by a Mode Control input (S) and two Clock Inputs (CP_1) and (CP_2). The serial (right-shift) or parallel data transfers occur synchronous with the HIGH to LOW transition of the selected clock input.

When the Mode Control input (S) is HIGH, $\overline{CP_2}$ is enabled. A HIGH to LOW transition on enabled CP_2 transfers parallel data from the P_0-P_3 inputs to the Q_0-Q_3 outputs.

When the Mode Control input (S) is LOW, CP_1 is enabled. A HIGH to LOW transition on enabled $\overline{CP_1}$ transfers the data from Serial input (D_S) to Q_0 and shifts the data in Q_0 to Q_1, Q_1 to Q_2, and Q_2 to Q_3 respectively (right-shift). A left-shift is accomplished by externally connecting Q_3 to P_2, Q_2 to P_1, and Q_1 to P_0, and operating the LS95B in the parallel mode (S = HIGH).

For normal operation, S should only change states when both Clock inputs are LOW. However, changing S from LOW to HIGH while CP_2 is HIGH, or changing S from HIGH to LOW while CP_1 is HIGH and CP_2 is LOW will not cause any changes on the register outputs.

MODE SELECT — TRUTH TABLE

OPERATING MODE	INPUTS					OUTPUTS			
	S	CP_1	CP_2	D_S	P_n	Q_0	Q_1	Q_2	Q_3
Shift	L	⌐	X	I	X	L	q_0	q_1	q_2
	L	⌐	X	h	X	H	q_0	q_1	q_2
Parallel Load	H	X	⌐	X	P_n	P_0	P_1	P_2	P_3
Mode Change	⌐	L	L	X	X	No Change			
	⌐	L	L	X	X	No Change			
	⌐	H	L	X	X	No Change			
	⌐	H	L	X	X	Undetermined			
	⌐	L	H	X	X	Undetermined			
	⌐	L	H	X	X	No Change			
	⌐	H	H	X	X	Undetermined			
	⌐	H	H	X	X	No Change			

L = LOW Voltage Level
H = HIGH Voltage Level
X = Don't Care
I = LOW Voltage Level one set-up time prior to the HIGH to LOW clock transition.
h = HIGH Voltage Level one set-up time prior to the HIGH to LOW clock transition.
P_n = Lower case letters indicate the state of the referenced input (or output) one set-up time prior to the HIGH to LOW clock transition.

FAST AND LS TTL DATA

SN54/74LS95B

DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (unless otherwise specified)

Symbol	Parameter		Min	Typ	Max	Unit	Test Conditions	
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} = $ MIN, $I_{IN} = -18$ mA	
V_{OH}	Output HIGH Voltage	54	2.5	3.5		V	$V_{CC} = $ MIN, $I_{OH} = $ 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	$I_{OL} = 4.0$ mA	$V_{CC} = V_{CC}$ MIN, $V_{IN} = V_{IL}$ or V_{IH} per Truth Table
		74		0.35	0.5	V	$I_{OL} = 8.0$ mA	
I_{IH}	Input HIGH Current				20	µA	$V_{CC} = $ MAX, $V_{IN} = 2.7$ V	
					0.1	mA	$V_{CC} = $ MAX, $V_{IN} = 7.0$ V	
I_{IL}	Input HIGH Current				-0.4	mA	$V_{CC} = $ MAX, $V_{IN} = 0.4$ V	
I_{OS}	Short Circuit Current (Note 1)		-20		-100	mA	$V_{CC} = $ MAX	
I_{CC}	Power Supply Current				21	mA	$V_{CC} = $ MAX	

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

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

Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
f_{MAX}	Maximum Clock Frequency	25	36		MHz	$V_{CC} = 5.0$ V $C_L = 15$ pF
t_{PLH} t_{PHL}	CP to Output		18	27	ns	
			21	32	ns	

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

Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
t_W	CP Pulse Width	20			ns	
t_s	Data Setup Time	20			ns	
t_h	Data Hold Time	20			ns	$V_{CC} = 5.0$ V
t_s	Mode Control Setup Time	20			ns	
t_h	Mode Control Hold Time	20			ns	

SN54/74LS95B

DESCRIPTION OF TERMS

SETUP TIME(ts) —is defined as the minimum time required for the correct logic level to be present at the logic input prior to the clock transition from HIGH to LOW in order to be recognized and transferred to the outputs.

HOLD TIME (th) — is defined as the minimum time following the clock transition from HIGH to LOW that the logic level must be maintained at the input in order to ensure continued recognition. A negative HOLD TIME indicates that the correct logic level may be released prior to the clock transition from HIGH to LOW and still be recognized.

AC WAVEFORMS

The shaded areas indicate when the input is permitted to change for predictable output performance.
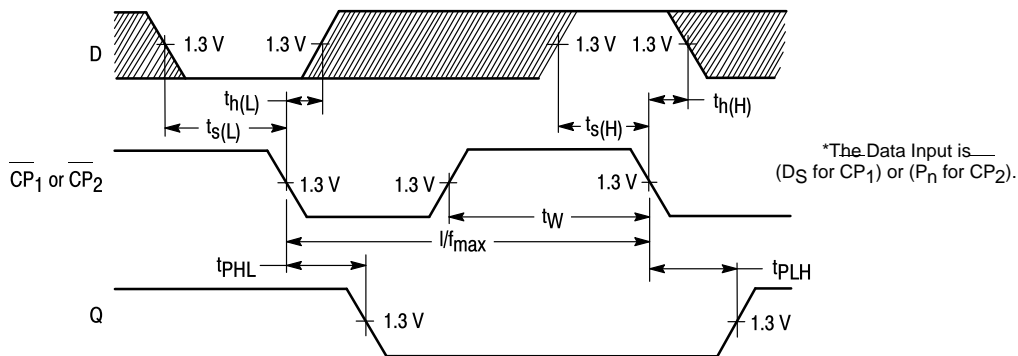
Figure 1
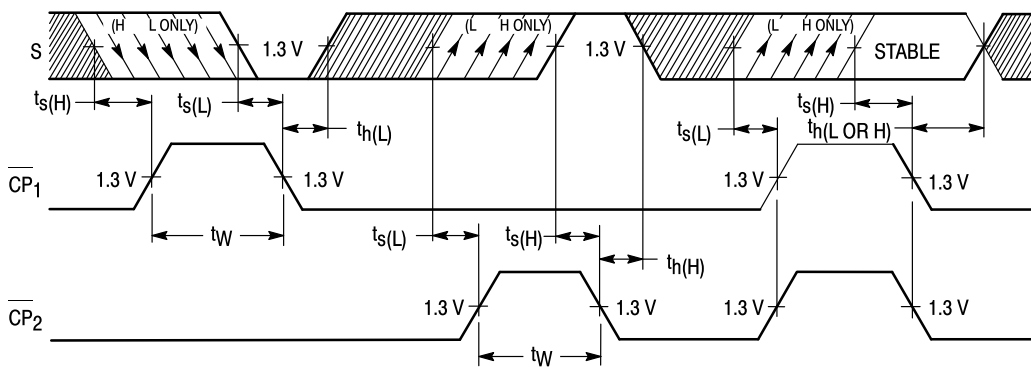
Figure 2

Case 751A-02 D Suffix
14-Pin Plastic
SO-14
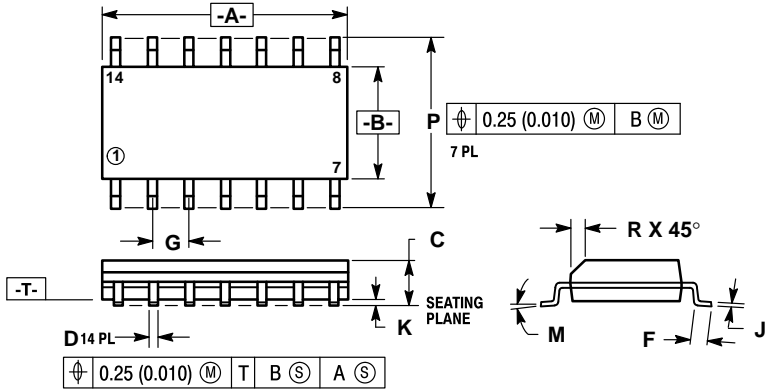
NOTES:
1. DIMENSIONS "A" AND "B" ARE DATUMS AND "T" IS A DATUM SURFACE.
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
3. CONTROLLING DIMENSION: MILLIMETER.
4. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
5. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
6. 751A-01 IS OBSOLETE, NEW STANDARD 751A-02.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.344
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

Case 632-08 J Suffix
14-Pin Ceramic Dual In-Line
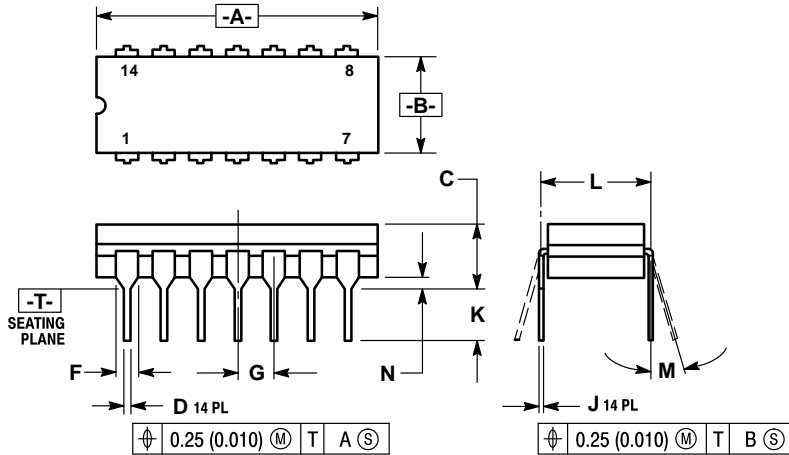
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
4. DIM F MAY NARROW TO 0.76 (0.030) WHERE THE LEAD ENTERS THE CERAMIC BODY.
5. 632-01 THRU -07 OBSOLETE, NEW STANDARD 632-08.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	19.05	19.94	0.750	0.785
B	6.23	7.11	0.245	0.280
C	3.94	5.08	0.155	0.200
D	0.39	0.50	0.015	0.020
F	1.40	1.65	0.055	0.065
G	2.54 BSC		0.100 BSC	
J	0.21	0.38	0.008	0.015
K	3.18	4.31	0.125	0.170
L	7.62 BSC		0.300 BSC	
M	0°	15°	0°	15°
N	0.51	1.01	0.020	0.040

Case 646-06 N Suffix
14-Pin Plastic

NOTE 4
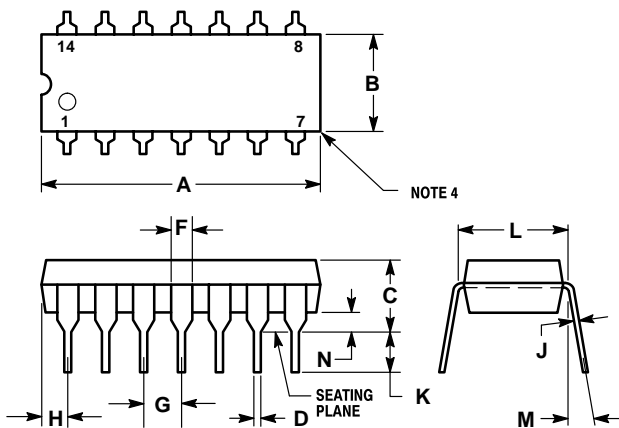
NOTES:
1. LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
2. DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION "B" DOES NOT INCLUDE MOLD FLASH.
4. ROUNDED CORNERS OPTIONAL.
5. 646-05 OBSOLETE, NEW STANDARD 646-06.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	18.16	19.56	0.715	0.770
B	6.10	6.60	0.240	0.260
C	3.69	4.69	0.145	0.185
D	0.38	0.53	0.015	0.021
F	1.02	1.78	0.040	0.070
G	2.54 BSC		0.100 BSC	
H	1.32	2.41	0.052	0.095
J	0.20	0.38	0.008	0.015
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M	0°	10°	0°	10°
N	0.39	1.01	0.015	0.039

MOTOROLA

◊