MSI TTL SHIFT REGISTERS
for applications in

● Digital Computer Systems   ● Data-Handling Systems   ● Control Systems

SN5491A, SN54LS91 . . . J PACKAGE
SN54L91, SN7491A, SN74L91, SN74LS91 . . . J OR N PACKAGE
DUAL-IN-LINE PACKAGE (TOP VIEW)

SN5491A, SN54LS91 . . . W PACKAGE
SN54L91, SN74L91 . . . T PACKAGE
FLAT PACKAGE (TOP VIEW)

FUNCTION TABLE

INPUTS AT t_n		OUTPUTS AT t_{n+8}	
A	B	Q_H	$\overline{Q}_H$
H	H	H	L
L	X	L	H
X	L	L	H

H = high, L = low,
X = irrelevant
t_n = Reference bit time, clock low
t_{n+8} = Bit time after 8 low-to-high clock transitions.   NC—No internal connection
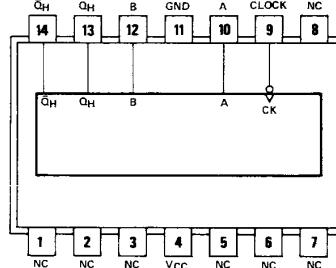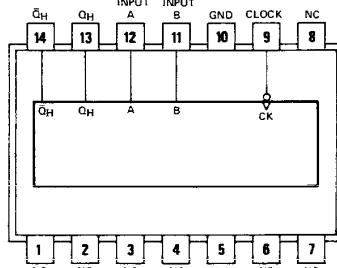
positive logic: see function table

| TYPE	TYPICAL MAXIMUM CLOCK FREQUENCY	TYPICAL POWER DISSIPATION
'91A	18 MHz	175 mW
'L91	6.5 MHz	17.5 mW
'LS91	18 MHz	60 mW

description

These monolithic serial-in, serial-out, 8-bit registers utilize transistor-transistor logic (TTL) circuits and are composed of eight R-S master-slave flip-flops, input gating, and a clock driver. Single-rail data and input control are gated through inputs A and B and an internal inverter to form the complementary inputs to the first bit of the shift register. Drive for the internal common clock line is provided by an inverting clock driver. This clock pulse inverter/driver causes these circuits to shift information one bit on the positive edge of an input clock pulse.

schematics of inputs and outputs

'91A, 'L91

EQUIVALENT OF EACH INPUT

V_{CC}
R_{eq}
INPUT

'91A: R_{eq} = 4 kΩ NOM
'L91: R_{eq} = 40 kΩ NOM

'LS91

EQUIVALENT OF EACH INPUT

V_{CC}
17 kΩ NOM
INPUT

'91A, 'L91

TYPICAL OF BOTH OUTPUTS

V_{CC}
R
OUTPUT

'91A: R = 130 Ω NOM
'L91: R = 500 Ω NOM

'LS91

TYPICAL OF BOTH OUTPUTS

V_{CC}
120 Ω NOM
OUTPUT
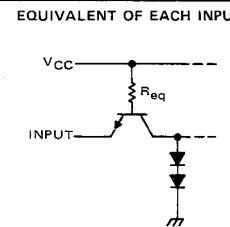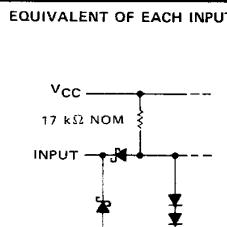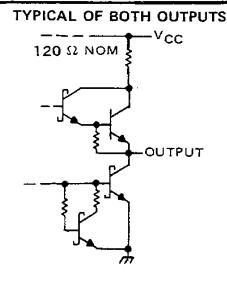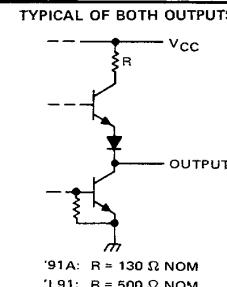
functional block diagram
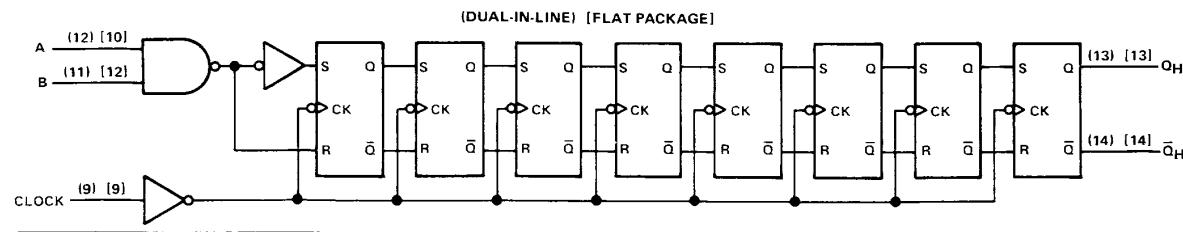
(DUAL-IN-LINE) [FLAT PACKAGE]

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1) . . . . 7 V
Input voltage (see Note 2) . . . . 5.5 V
Operating free-air temperature range: SN5491A . . . . −55°C to 125°C
SN7491A . . . . 0°C to 70°C
Storage temperature range . . . . −65°C to 150°C

NOTES: 1. Voltage values are with respect to network ground terminal.
2. Input signals must be zero or positive with respect to network ground terminal.

recommended operating conditions

	SN5491A			SN7491A			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}	4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}			−400			−400	µA
Low-level output current, I_{OL}			16			16	mA
Width of clock input pulse, t_w	25			25			ns
Setup time, t_{su} (see Figure 1)	25			25			ns
Hold time, t_h (see Figure 1)	0			0			ns
Operating free-air temperature, T_A	−55		125	0		70	°C

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

PARAMETER		TEST CONDITIONS[†]	SN5491A			SN7491A			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V_{IH}	High-level input voltage		2			2			V
V_{IL}	Low-level input voltage				0.8			0.8	V
V_{OH}	High-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OH} = −400 µA	2.4	3.5		2.4	3.5		V
V_{OL}	Low-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OL} = 16 mA		0.2	0.4		0.2	0.4	V
I_I	Input current at maximum input voltage	V_{CC} = MAX, V_I = 5.5 V			1			1	mA
I_{IH}	High-level input current	V_{CC} = MAX, V_I = 2.4 V			40			40	µA
I_{IL}	Low-level input current	V_{CC} = MAX, V_I = 0.4 V			−1.6			−1.6	mA
I_{OS}	Short-circuit output current[§]	V_{CC} = MAX	−20		−57	−18		−57	mA
I_{CC}	Supply current	V_{CC} = MAX, See Note 3		35	50		35	58	mA

[†]For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
[‡]All typical values are at V_{CC} = 5 V, T_A = 25°C.
[§]Not more than one output should be shorted at a time.
NOTE 3: I_{CC} is measured after the eighth clock pulse with the output open and A and B inputs grounded.

switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}	Maximum clock frequency	C_L = 15 pF, R_L = 400 Ω, See Figure 1	10	18		MHz
t_{PLH}	Propagation delay time, low-to-high-level output			24	40	ns
t_{PHL}	Propagation delay time, high-to-low-level output			27	40	ns

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TEXAS INSTRUMENTS
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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1) . . . . 8 V
Input voltage (see Note 2) . . . . 5.5 V
Operating free-air temperature range: SN54L91 . . . . −55°C to 125°C
SN74L91 . . . . 0°C to 70°C
Storage temperature range . . . . −65°C to 150°C

NOTES: 1. Voltage values are with respect to network ground terminal.
2. Input signals must be zero or positive with respect to network ground terminal.

recommended operating conditions

		SN54L91			SN74L91			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}		4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}				−100			−200	μA
Low-level output current, I_{OL}				2			3.6	mA
Width of clock input pulse, $t_{w(clock)}$	High logic level	100			100			ns
	Low logic level	150			150			ns
Setup time, t_{su} (see Figure 1)		120			120			ns
Hold time, t_h (see Figure 1)		0			0			ns
Operating free-air temperature, T_A		−55		125	0		70	°C

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

PARAMETER		TEST CONDITIONS[†]	SN54L91			SN74L91			UNIT
			MIN	TYP[‡]	MAX	MIN	TYP[‡]	MAX	
V_{IH}	High-level input voltage		2			2			V
V_{IL}	Low-level input voltage				0.7			0.7	V
V_{OH}	High-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.7 V, I_{OH} = MAX	2.4	3.3		2.4	3.2		V
V_{OL}	Low-level output voltage	V_{CC} = MIN, V_{IH} = 2 V V_{IL} = 0.7 V, I_{OL} = MAX		0.15	0.3		0.2	0.4	V
I_I	Input current at maximum input voltage	V_{CC} = MAX, V_I = 5.5 V			100			100	μA
I_{IH}	High-level input current	V_{CC} = MAX, V_I = 2.4 V			10			10	μA
I_{IL}	Low-level input current	V_{CC} = MAX, V_I = 0.3 V			−0.18			−0.18	mA
I_{OS}	Short-circuit output current	V_{CC} = MAX	−3		−15	−3		−15	mA
I_{CC}	Supply current	V_{CC} = MAX, See Note 3		3.5	6.6		3.5	6.6	mA

[†]For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
[‡]All typical values are at V_{CC} = 5 V, T_A = 25°C.
NOTE 3: I_{CC} is measured after the eighth clock pulse with the outputs open and A and B inputs grounded.

switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}	Maximum clock frequency	C_L = 50 pF, R_L = 4 kΩ, See Figure 1	3	6.5		MHz
t_{PLH}	Propagation delay time, low-to-high-level output			55	100	ns
t_{PHL}	Propagation delay time, high-to-low-level output			100	150	ns

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TEXAS INSTRUMENTS
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TYPES SN54LS91, SN74LS91
8-BIT SHIFT REGISTERS

REVISED OCTOBER 1976

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1) . . . . 7 V
Input voltage . . . . 7 V
Operating free-air temperature range: SN54LS91 . . . . −55°C to 125°C
                                        SN74LS91 . . . . 0°C to 70°C
Storage temperature range . . . . −65°C to 150°C

NOTES: 1. Voltage values are with respect to network ground terminal.

recommended operating conditions

	SN54LS91			SN74LS91			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}	4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}			−400			−400	μA
Low-level output current, I_{OL}			4			8	mA
Width of clock input pulse, t_w	25			25			ns
Setup time, t_{su} (see Figure 1)	25			25			ns
Hold time, t_h (see Figure 1)	0			0			ns
Operating free-air temperature, T_A	−55		125	0		70	°C

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

PARAMETER		TEST CONDITIONS†		SN54LS91			SN74LS91			UNIT
				MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IH}	High-level input voltage			2			2			V
V_{IL}	Low-level input voltage					0.7			0.8	V
V_{IK}	Input clamp voltage	V_{CC} = MIN, I_I = −18 mA				−1.5			−1.5	V
V_{OH}	High-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = V_{IL} max, I_{OH} = −400 μA		2.5	3.5		2.7	3.5		V
V_{OL}	Low-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = V_{IL} max	I_{OL} = 4 mA		0.25	0.4		0.25	0.4	V
			I_{OL} = 8 mA					0.35	0.5	
I_I	Input current at maximum input voltage	V_{CC} = MAX, V_I = 7 V				0.1			0.1	mA
I_{IH}	High-level input current	V_{CC} = MAX, V_I = 2.7 V				20			20	μA
I_{IL}	Low-level input current	V_{CC} = MAX, V_I = 0.4 V				−0.4			−0.4	mA
I_{OS}	Short-circuit output current§	V_{CC} = MAX		−20		−100	−20		−100	mA
I_{CC}	Supply current	V_{CC} = MAX, See Note 3		12		20	12		20	mA

†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡All typical values are at V_{CC} = 5 V, T_A = 25°C.
§Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.
NOTE 3: I_{CC} is measured after the eighth clock pulse with the output open and A and B inputs grounded.

switching characteristics, V_{CC} = 5 V, T_A = 25°C

| PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}	Maximum clock frequency	C_L = 15 pF, R_L = 2 kΩ, See Figure 1	10	18		MHz
t_{PLH}	Propagation delay time, low-to-high-level output			24	40	ns
t_{PHL}	Propagation delay time, high-to-low-level output			27	40	ns

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TYPES SN5491A, SN54L91, SN54LS91, SN7491A, SN74L91, SN74LS91
8-BIT SHIFT REGISTERS

PARAMETER MEASUREMENT INFORMATION

TEST CIRCUIT

TYPICAL INPUT/OUTPUT WAVEFORMS

PROPAGATION DELAY TIMES VOLTAGE WAVEFORMS

SWITCHING TIMES VOLTAGE WAVEFORMS
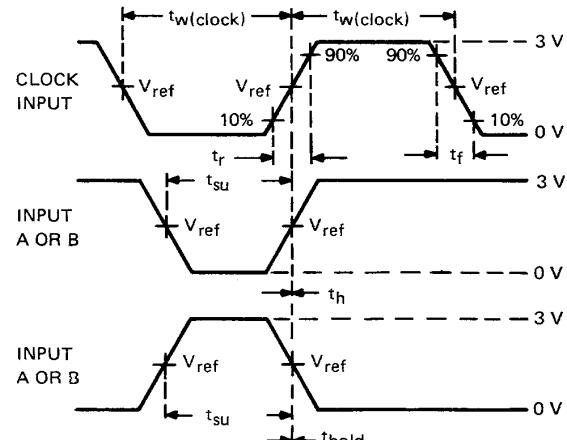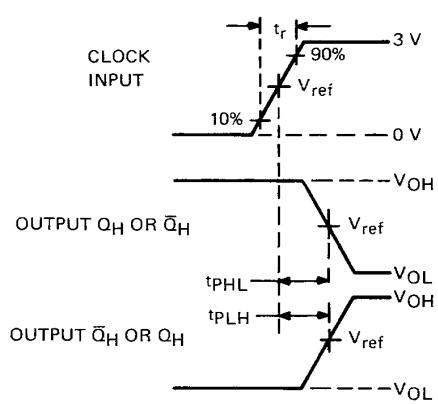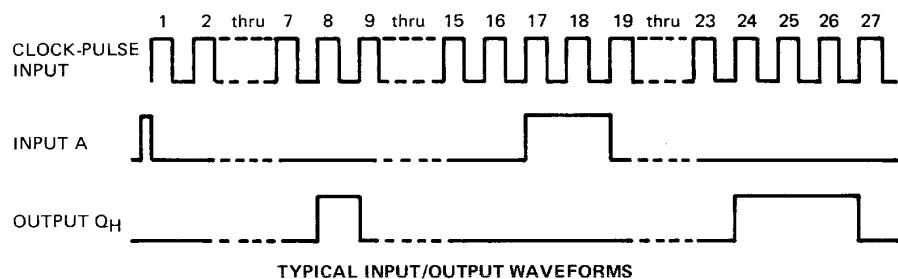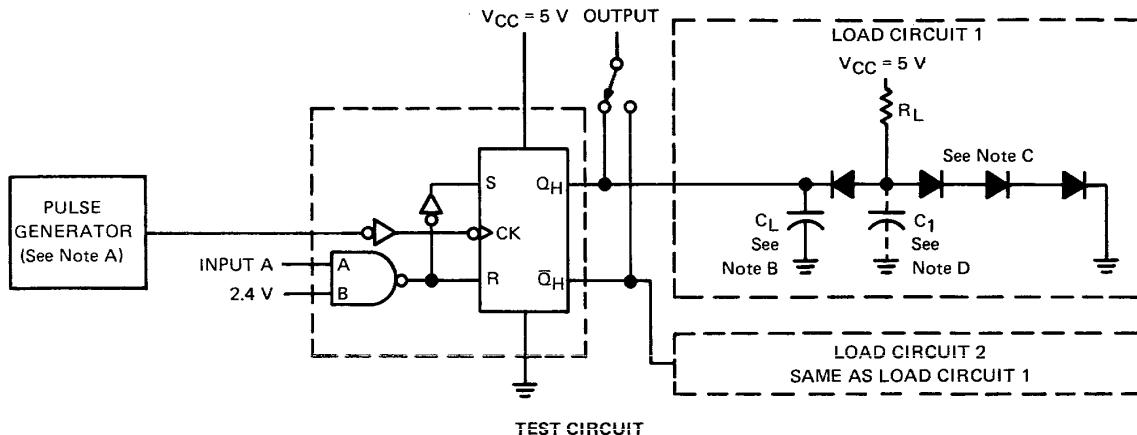
NOTES: A. The generator has the following characteristics: $t_{w(clock)}$ = 500 ns, PRR ≤ 1 MHz, Z_{out} ≈ 50 Ω. For SN5491A/SN7491A, t_r ≤ 10 ns and t_f ≤ 10 ns; for SN54L91/SN74L91, t_r ≤ 15 ns and t_f ≤ 15 ns; and for SN54LS91/SN74LS91, t_r = 15 ns, and t_f = 6 ns.
   B. C_L includes probe and jig capacitance.
   C. All diodes are 1N3064 or 1N916.
   D. C_1 = 30 pF and is used for SN54L91/SN74L91 only.
   E. For SN5491A/SN7491A, V_{ref} = 1.5 V; for SN54L91/SN74L91 and SN54LS91/SN74LS91, V_{ref} = 1.3 V.

FIGURE 1—SWITCHING TIMES