

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

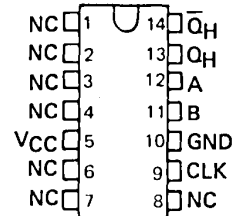
MARCH 1974 — REVISED DECEMBER 1983

- For applications in:
Digital Computer Systems
Data-Handling Systems
Control Systems

SN5491A, SN54L91, SN54LS91 ... J PACKAGE
SN7491A ... J OR N PACKAGE
SN74LS91 ... D, J OR N PACKAGE

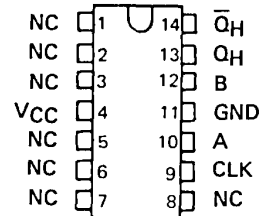
TYPE	TYPICAL MAXIMUM CLOCK FREQUENCY	TYPICAL POWER DISSIPATION
'91A	18 MHz	175 mW
'L91	6.5 MHz	17.5 mW
'LS91	18 MHz	60 mW

(TOP VIEW)



SN5491A, SN54LS91 ... W PACKAGE

(TOP VIEW)



NC - No internal connection

description

These monolithic serial-in, serial-out, 8-bit shift 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.

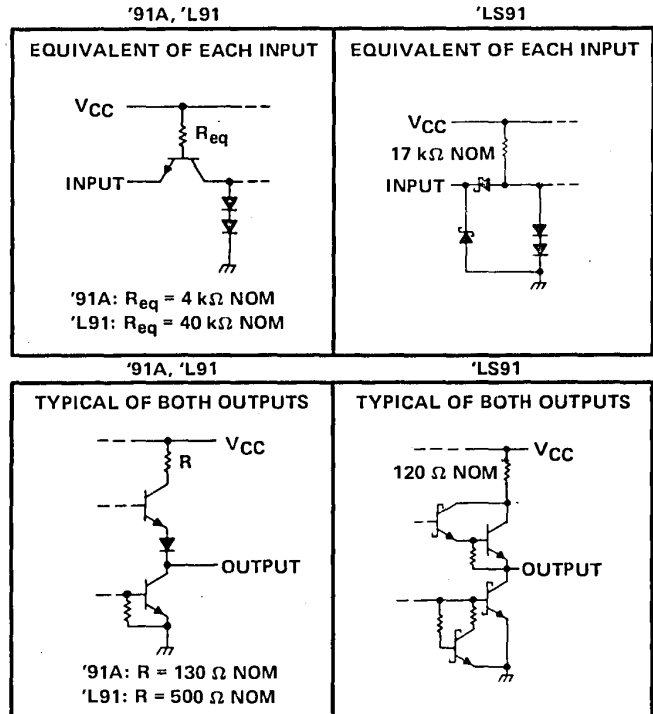
FUNCTION TABLE

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

t_n = Reference bit time,
clock low

t_{n+8} = Bit time after 8
low-to-high
clock transitions.

schematics of inputs and outputs



TTL DEVICES

PRODUCTION DATA

This document contains information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

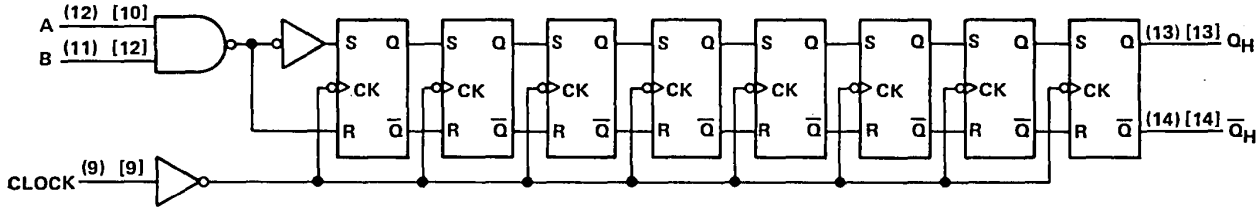
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INSTRUMENTS

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TYPES SN5491A, SN7491A 8-BIT SHIFT REGISTERS

logic diagram



Pin numbers shown in () are for the D, J or N packages and pin numbers shown in [] are for the W 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	μ A
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	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OH} = -400 \mu\text{A}$	2.4	3.5		2.4	3.5		V
V_{OL} Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OL} = 16 \text{ mA}$		0.2	0.4		0.2	0.4	V
I_I Input current at maximum input voltage	$V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$			1			1	mA
I_{IH} High-level input current	$V_{CC} = \text{MAX}, V_I = 2.4 \text{ V}$			40			40	μ A
I_{IL} Low-level input current	$V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$			-1.6			-1.6	mA
I_{OS} Short-circuit output current‡	$V_{CC} = \text{MAX}$	-20		-57	-18		-57	mA
I_{CC} Supply current	$V_{CC} = \text{MAX}$, 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 $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$.

§ 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, $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
f_{max} Maximum clock frequency	$C_L = 15 \text{ pF}, R_L = 400 \Omega,$ 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

TYPE SN54L91 8-BIT REGISTERS

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 V
Operating free-air temperature range.....	-55°C to 125°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			UNIT
		MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5	5.5	V
V_{IH}	High-level input voltage	2			V
V_{IL}	Low-level input voltage			0.7	V
I_{OH}	High-level output current			-0.1	mA
I_{OL}	Low-level output current			2	mA
$t_{w(\text{clock})}$	Width of clock input pulse	High logic level		100	ns
		Low logic level		150	ns
t_{su}	Setup time (See Figure 1)			120	ns
t_h	Hold time (See Figure 1)			0	ns
T_A	Operating free-air temperature	-55		125	°C

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

PARAMETER	TEST CONDITIONS †	SN54L91			UNIT
		MIN	TYP ‡	MAX	
V_{OH}	$V_{CC} = \text{MIN}$, $V_{IH} = 2 \text{ V}$, $V_{IL} = 0.7 \text{ V}$, $I_{OH} = -0.1 \text{ mA}$	2.4	3.3		V
V_{OL}	$V_{CC} = \text{MIN}$, $V_{IH} = 2 \text{ V}$, $V_{IL} = 0.7 \text{ V}$, $I_{OL} = 2 \text{ mA}$		0.15	0.3	V
I_I	$V_{CC} = \text{MAX}$, $V_I = 5.5 \text{ V}$			0.1	mA
I_{IH}	$V_{CC} = \text{MAX}$, $V_I = 2.4 \text{ V}$			10	μA
I_{IL}	$V_{CC} = \text{MAX}$, $V_I = 0.3 \text{ V}$			-0.18	mA
I_{OS}	$V_{CC} = \text{MAX}$,	-3		-15	mA
I_{CC}	$V_{CC} = \text{MAX}$, See Note 3		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 $V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$.

NOTE 3: I_{CC} is measured after the eighth clock pulse with the outputs open and A and B inputs grounded.

switching characteristics, $V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$ (see note 4)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}	Any	Q_H, \bar{Q}_h	$R_L = 4 \text{ k}\Omega$, $C_L = 50 \text{ pF}$	3	6.5		MHz
t_{PLH}					55	100	ns
t_{PHL}					100	150	ns

NOTE 4: For load circuits and voltage waveforms, see Figure 1.

3

TTL DEVICES

TYPES SN54LS91, SN74LS91

8-BIT SHIFT REGISTERS

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	μ A
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	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$			-1.5		-1.5	V	
V_{OH} High-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, I_{OH} = -400 \mu\text{A}$	2.5	3.5		2.7	3.5	V	
V_{OL} Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}$						V	
				$I_{OL} = 4 \text{ mA}$	0.25	0.4		
				$I_{OL} = 8 \text{ mA}$		0.35	0.5	
I_I Input current at maximum input voltage	$V_{CC} = \text{MAX}, V_I = 7 \text{ V}$			0.1		0.1	mA	
I_{IH} High-level input current	$V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$			20		20	μ A	
I_{IL} Low-level input current	$V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$			-0.4		-0.4	mA	
I_{OS} Short-circuit output current §	$V_{CC} = \text{MAX}$	-20		-100	-20	-100	mA	
I_{CC} Supply current	$V_{CC} = \text{MAX}, \text{ See Note 3}$		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 $V_{CC} = 5 \text{ V}, T_A = 25^\circ \text{C}$.

§ 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, $V_{CC} = 5 \text{ V}, T_A = 25^\circ \text{C}$

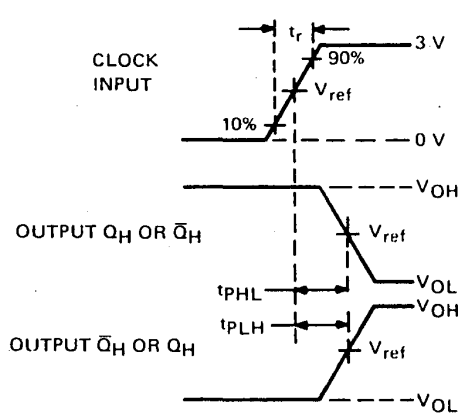
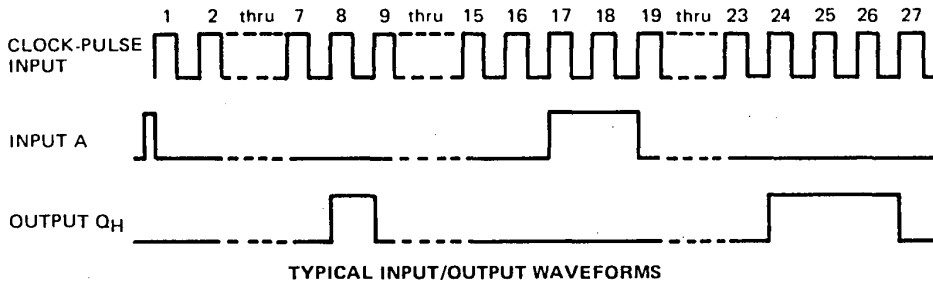
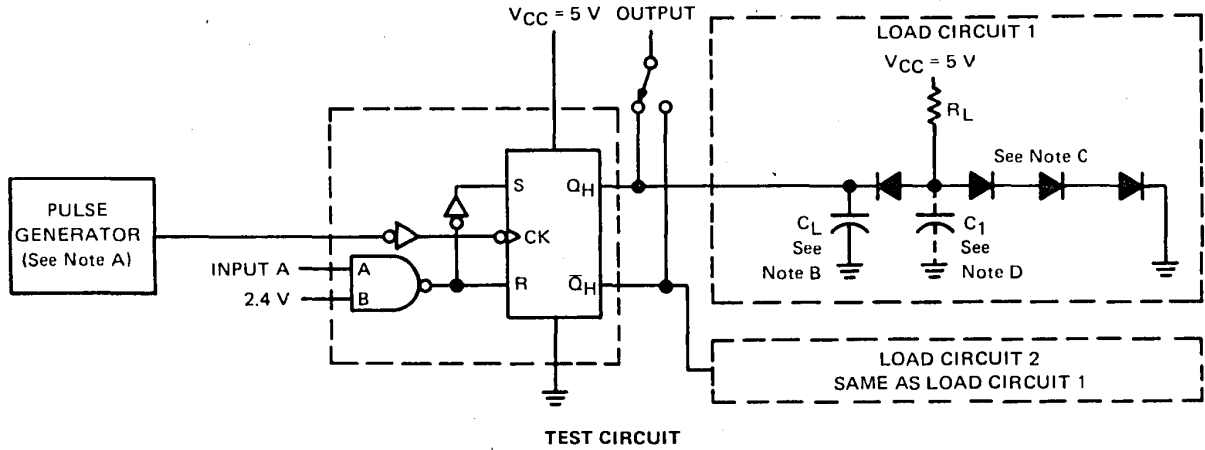
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max} Maximum clock frequency	$C_L = 15 \text{ pF},$	10	18		MHz
t_{PLH} Propagation delay time, low-to-high-level output	$R_L = 2 \text{ k}\Omega,$		24	40	ns
t_{PHL} Propagation delay time, high-to-low-level output	See Figure 1		27	40	ns

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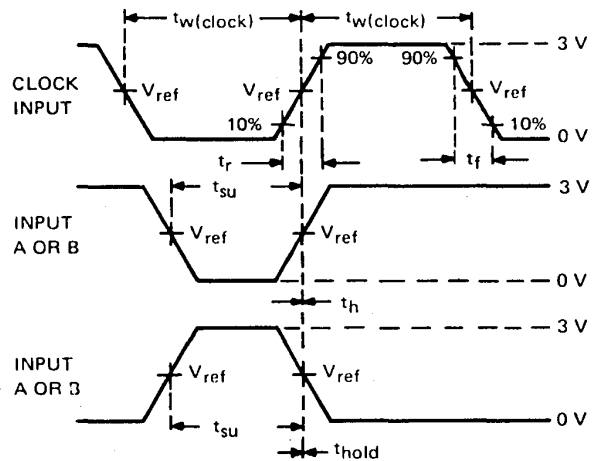
TTL DEVICES

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

PARAMETER MEASUREMENT INFORMATION



PROPAGATION DELAY TIMES VOLTAGE WAVEFORMS



SWITCHING TIMES VOLTAGE WAVEFORMS

- NOTES: A. The generator has the following characteristics: $t_w(\text{clock}) = 500 \text{ ns}$, $\text{PRR} \leq 1 \text{ MHz}$, $Z_{\text{out}} \approx 50 \Omega$. For SN5491A/SN7491A, $t_r \leq 10 \text{ ns}$ and $t_f \leq 10 \text{ ns}$; for SN54L91, $t_r \leq 15 \text{ ns}$ and $t_f \leq 15 \text{ ns}$; and for SN54LS91, $t_r = 15 \text{ ns}$, and $t_f = 6 \text{ ns}$.
 B. C_L includes probe and jig capacitance.
 C. All diodes are 1N3064 or equivalent.
 D. $C_1 = 30 \text{ pF}$ and is used for SN54L91 only.
 E. For SN5491A/SN7491A, $V_{\text{ref}} = 1.5 \text{ V}$; for SN54L91 and SN54LS91/SN74LS91, $V_{\text{ref}} = 1.3 \text{ V}$.

FIGURE 1—SWITCHING TIMES