

TTL
MSI

TYPES SN5490A, SN5492A, SN5493A, SN54L90, SN54L93, SN54LS90, SN54LS92, SN54LS93, SN7490A, SN7492A, SN7493A, SN74L90, SN74L93, SN74LS90, SN74LS92, SN74LS93 DECADE, DIVIDE-BY-TWELVE, AND BINARY COUNTERS

BULLETIN NO. DLS 7611807, MARCH 1974—REVISED OCTOBER 1976

'90A, 'L90, 'LS90 . . . DECADE COUNTERS

'92A, 'LS92 . . . DIVIDE-BY-TWELVE
COUNTERS

'93A, 'L93, 'LS93 . . . 4-BIT BINARY
COUNTERS

TYPES	TYPICAL POWER DISSIPATION
'90A	145 mW
'L90	20 mW
'LS90	45 mW
'92A, '93A	130 mW
'LS92, 'LS93	45 mW
'L93	16 mW

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 '90A, 'L90, and 'LS90, divide-by-six for the '92A and 'LS92, and divide-by-eight for the '93A, 'L93, and 'LS93.

All of these counters have a gated zero reset and the '90A, 'L90, and 'LS90 also have gated set-to-nine inputs for use in BCD nine's complement applications.

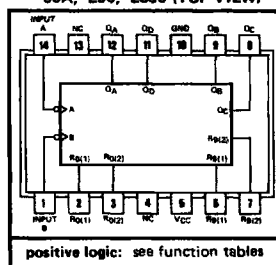
To use their maximum count length (decade, divide-by-twelve, or four-bit binary) of these counters, the B input is connected to the Q_A output. The input count pulses are applied to input A and the outputs are as described in the appropriate function table. A symmetrical divide-by-ten count can be obtained from the '90A, 'L90, or 'LS90 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 .

SN54', SN54LS' . . . J OR W PACKAGE

SN54L' . . . J OR T PACKAGE

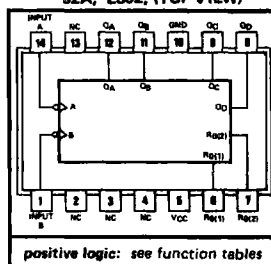
SN54', SN74L', SN74LS' . . . J OR N PACKAGE

'90A, 'L90, 'LS90 (TOP VIEW)



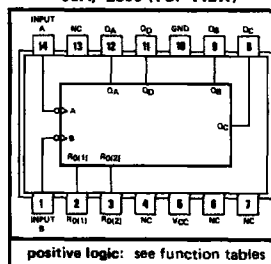
positive logic: see function tables

'92A, 'LS92, (TOP VIEW)



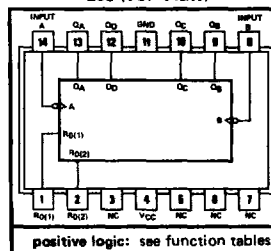
positive logic: see function tables

'93A, 'LS93 (TOP VIEW)



positive logic: see function tables

'L93 (TOP VIEW)



positive logic: see function tables

NC—No internal connection

TYPES SN5490A, '92A, '93A, SN54L90, 'L93, SN54LS90, 'LS92, 'LS93, SN7490A, '92A, '93A, SN74L90, 'L93, SN74LS90, 'LS92, 'LS93 DECADE, DIVIDE-BY-TWELVE, AND BINARY COUNTERS

'90A, 'L90, 'LS90
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

'90A, 'L90, 'LS90
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

'92A, 'LS92
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	H	L	L	L
7	H	L	L	H
8	H	L	H	L
9	H	L	H	H
10	H	H	L	L
11	H	H	L	H

'93A, 'L93, 'LS93
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

'90A, 'L90, 'LS90

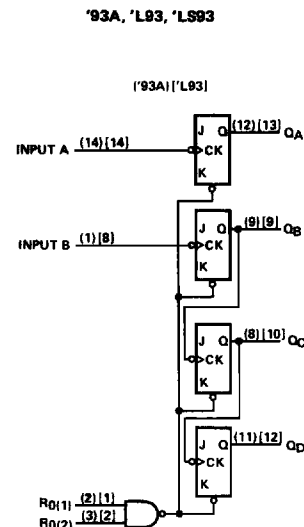
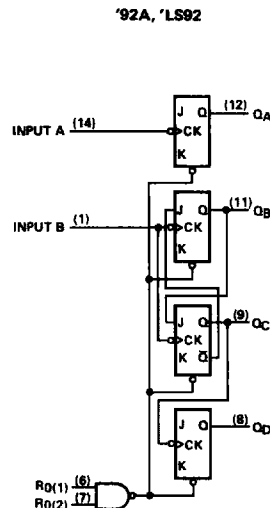
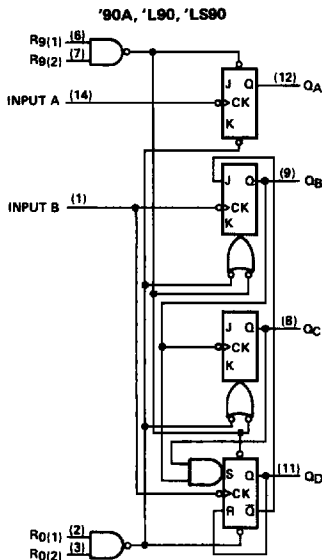
RESET/COUNT FUNCTION TABLE				
RESET INPUTS				OUTPUT
R ₀ (1)	R ₀ (2)	R ₉ (1)	R ₉ (2)	Q _D Q _C Q _B Q _A
H	H	L	X	L L L L
H	H	X	L	L L L L
X	X	H	H	H L L H
X	L	X	L	COUNT
L	X	L	X	COUNT
L	X	X	L	COUNT
X	L	L	X	COUNT

'92A, 'LS92, '93A, 'L93, 'LS93
RESET/COUNT FUNCTION TABLE

RESET INPUTS		OUTPUT			
R ₀ (1)	R ₀ (2)	Q _D	Q _C	Q _B	Q _A
H	H	L	L	L	L
L	X	COUNT			
X	L	COUNT			

- NOTES: A. Output Q_A is connected to input B for BCD count.
B. Output Q_D is connected to input A for bi-quinary count.
C. Output Q_A is connected to input B.
D. H = high level, L = low level, X = irrelevant

functional block diagrams

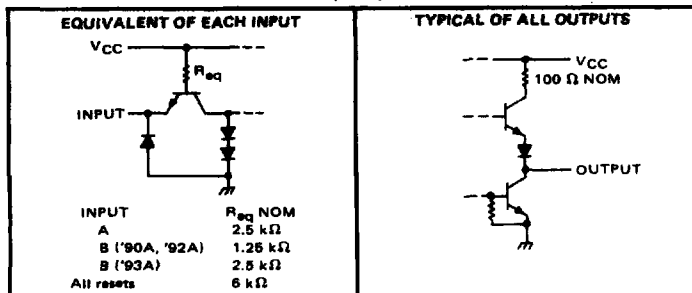


The J and K inputs shown without connection are for reference only and are functionally at a high level.

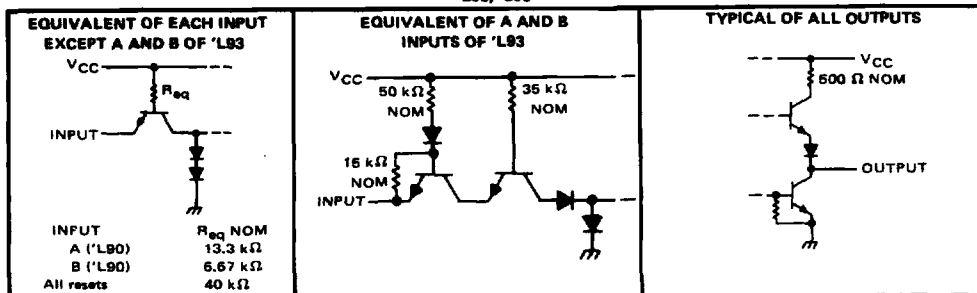
**TYPES SN5490A, '92A, '93A, SN54LS90, 'LS92, 'LS93,
SN7490A, '92A, '93A, SN74LS90, 'LS92, 'LS93
DECADE, DIVIDE-BY-TWELVE, AND BINARY COUNTERS**
REVISED AUGUST 1977

schematics of inputs and outputs

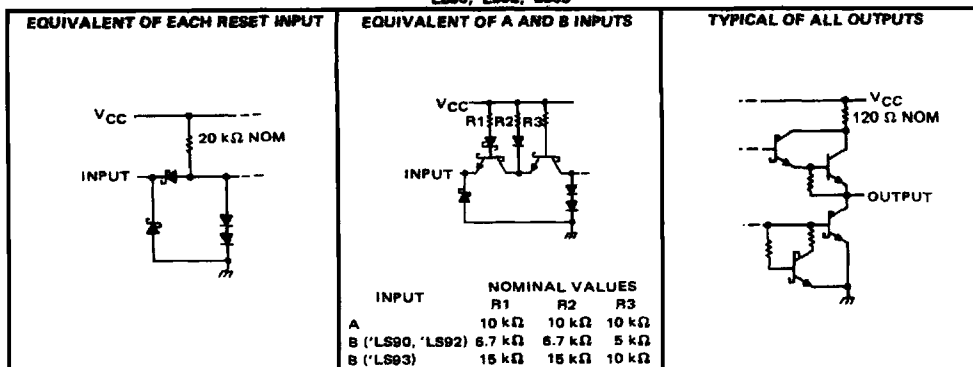
'90A, '92A, '93A



'L90, 'L93



'LS90, 'LS92, 'LS93



TYPES SN5490A, SN5492A, SN5493A, SN7490A, SN7492A, SN7493A DECADE, DIVIDE-BY-TWELVE, AND BINARY COUNTERS

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

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage	5.5 V
Intermitter voltage (see Note 2)	5.5 V
Operating free-air temperature range: SN5490A, SN5492A, SN5493A	-55°C to 125°C
SN7490A, SN7492A, SN7493A	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTES: 1. Voltage values, except intermitter voltage, are with respect to network ground terminal.

2. This is the voltage between two emitters of a multiple-emitter transistor. For these circuits, this rating applies between the two R_D inputs, and for the '90A circuit, it also applies between the two R_D inputs.

recommended operating conditions

		SN5490A, SN5492A SN5493A			SN7490A, SN7492A SN7493A			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}		-800			-800			μ A
Low-level output current, I_{OL}		16			16			mA
Count frequency, f_{count} (see Figure 1)	A input	0	32		0	32		MHz
	B input	0	16		0	16		
Pulse width, t_W	A input	15			15			ns
	B input	30			30			
	Reset inputs	15			15			
Reset inactive-state setup time, t_{SU}		25			25			ns
Operating free-air temperature, T_A		-65	125		0	70		°C

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

PARAMETER		TEST CONDITIONS†		'90A			'92A			'93A			UNIT
				MIN	TYP‡	MAX	MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IH}	High-level input voltage			2			2			2			V
V_{IL}	Low-level input voltage					0.8			0.8			0.8	V
V_{IK}	Input clamp voltage	$V_{CC} = \text{MIN}, I_I = -12 \text{ mA}$				-1.5			-1.5			-1.5	V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OH} = -800 \mu\text{A}$	2.4	3.4			2.4	3.4		2.4	3.4		V
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OL} = 16 \text{ mA}^\S$		0.2	0.4			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			1		mA
I_{IH}	High-level input current	Any reset			40			40			40		μ A
		A input	$V_{CC} = \text{MAX}, V_I = 2.4 \text{ V}$		80			80			80		
		B input			120			120			80		
I_{IL}	Low-level input current	Any reset	$V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$		-1.6			-1.6			-1.6		mA
		A input			-3.2			-3.2			-3.2		
		B input			-4.8			-4.8			-3.2		
I_{OS}	Short-circuit output current§	$V_{CC} = \text{MAX}$	SN54'	-20	-57		-20	-57		-20	-57		mA
			SN74'	-18	-57		-18	-57		-18	-57		
I_{CC}	Supply current	$V_{CC} = \text{MAX}$, See Note 3		29	42		26	39		26	39		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.

¶ Q_A outputs are tested at $I_{OL} = 16 \text{ mA}$ plus the limit value for I_{IL} for the B input. This permits driving the B input while maintaining full fan-out capability.

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

TYPES SN5490A, SN5492A, SN5493A, SN7490A, SN7492A, SN7493A DECADE, DIVIDE-BY-TWELVE, AND BINARY COUNTERS

REVISED OCTOBER 1978

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

PARAMETER†	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'90A			'92A			'93A			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
f_{max}	A	Q_A	$C_L = 15\text{ pF}$, $R_L = 400\ \Omega$, See Figure 1	32	42		32	42		32	42		MHz
	B	Q_B		16			16			16			
t_{PLH}	A	Q_A		10	16		10	16		10	16		ns
t_{PHL}		Q_A		12	18		12	18		12	18		
t_{PLH}	A	$m50Q_D$		32	48		32	48		46	70		ns
t_{PHL}		$m50Q_D$		34	50		34	50		46	70		
t_{PLH}	B	Q_B		10	16		10	16		10	16		ns
t_{PHL}		Q_B		14	21		14	21		14	21		
t_{PLH}	B	Q_C		21	32		10	16		21	32		ns
t_{PHL}		Q_C		23	35		14	21		23	35		
t_{PLH}	B	Q_D		21	32		21	32		34	51		ns
t_{PHL}		Q_D		23	35		23	35		34	51		
t_{PHL}	Set-to-0	Any		26	40		26	40		26	40		ns
t_{PLH}	Set-to-9	Q_A, Q_D		20	30								ns
t_{PHL}		Q_B, Q_C		26	40								

† f_{max} $\equiv$ maximum count frequency

t_{PLH} $\equiv$ propagation delay time, low-to-high-level output

t_{PHL} $\equiv$ propagation delay time, high-to-low-level output

TYPES SN54L90, SN54L93, SN74L90, SN74L93

DECADE AND BINARY COUNTERS

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

Supply voltage, V_{CC} (see Note 4)	8 V
Input voltage (see Note 5)	5.5 V
Operating free-air temperature range: SN54L90, SN54L93	-55°C to 125°C
SN74L90, SN74L93	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTES: 4. Voltage values are with respect to network ground terminal.
5. Input voltages must be zero or positive with respect to network ground terminal.

recommended operating conditions

	SN54L90, SN54L93			SN74L90, SN74L93			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}	4.5	5	5.5	4.75	5	5.25	V
Count frequency, f_{count}	0		3	0		3	MHz
High-level output current, I_{OH}			-100			-200	μ A
Low-level output current, I_{OL}			2			3.6	mA
Width of input count pulse, $t_w(\text{count})$	200			200			ns
Width of reset pulse, $t_w(\text{reset})$	200			200			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†	'L90		'L93		UNIT
				MIN	TYP‡	MAX	MIN	
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	SN54L'	V _{CC} = MIN, V _{IH} = 2 V,	2.4	3.3	2.4	3.3	V
		SN74L'	V _{IL} = 0.7 V, I _{OH} = MAX	2.4	3.2	2.4	3.2	
V _{OL}	Low-level output voltage	SN54L'	V _{CC} = MIN, V _{IH} = 2 V,	0.15	0.3	0.15	0.3	V
		SN74L'	V _{IL} = 0.7 V, I _{OL} = MAX¶	0.2	0.4	0.2	0.4	
I _I	Input current at maximum input voltage	Any reset input	V _{CC} = MAX, V _I = 5.5 V	100		100		μA
		A input		300		200		
		B input		600		200		
I _{IH}	High-level input current	Any reset input	V _{CC} = MAX, V _I = 2.4 V	10		10		μA
		A input		30		20		
		B input		60		20		
I _{IL}	Low-level input current	Any reset input	V _{CC} = MAX, V _I = 0.3 V	-0.18		-0.18		mA
		A input		-0.54		-0.36		
		B input		-1.08		-0.36		
I _{OS}	Short-circuit output current§		V _{CC} = MAX	-3	-15	-3	-15	mA
I _{CC}	Supply current		V _{CC} = MAX, See Note 3	4	7.2	3.2	6.6	mA

†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡All typical values are at $V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$.

§Not more than one output should be shorted at a time.

¶ I_{OL} outputs are tested at $I_{OL} = \text{MAX}$ plus the limit value for I_{IL} for the B input. This permits driving the B input while maintaining full fan-out capability.

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

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

PARAMETER		TEST CONDITIONS	'L90			'L93			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
f_{max}	Maximum count frequency		3	6		3	6		MHz
t_{PLH}	Propagation delay time, low-to-high-level Q_D output from input A	$C_L = 50 \text{ pF}, R_L = 4 \text{ k}\Omega$, See Figure 1	230	340		280	450		ns
t_{PHL}	Propagation delay time, high-to-low-level Q_D output from input A		230	340		280	450		ns

TYPES SN54LS90, SN54LS92, SN54LS93, SN74LS90, SN74LS92, SN74LS93 DECADE, DIVIDE-BY-TWELVE, AND BINARY COUNTERS

REVISED OCTOBER 1976

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

Supply voltage, V_{CC} (see Note 4)	7 V
Input voltage: R inputs	7 V
A and B inputs	5.5 V
Operating free-air temperature range: SN54LS [†] Circuits	-55°C to 125°C
SN74LS [†] Circuits	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTE 4: Voltage values are with respect to network ground terminal.

recommended operating conditions

		SN54LS90 SN54LS92 SN54LS93			SN74LS90 SN74LS92 SN74LS93			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
Count frequency, f_{count} (see Figure 1)	A input	0		32	0		32	MHz
	B input	0		16	0		16	
Pulse width, t_w	A input	15			15			ns
	B input	30			30			
	Reset inputs	15			15			
Reset inactive-state setup time, t_{su}		25			25			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 [†]		SN54LS90 SN54LS92			SN74LS90 SN74LS92			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	$V_{CC} = \text{MIN}$, $V_{IL} = V_{IL \text{ max}}$, $I_{OH} = -400 \mu\text{A}$		2.5	3.4		2.7	3.4		V
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}$, $V_{IL} = V_{IL \text{ max}}$, $I_{OL} = 4 \text{ mA}^{\S}$		0.25	0.4		0.25	0.4		V
		$V_{CC} = \text{MIN}$, $V_{IL} = V_{IL \text{ max}}$, $I_{OL} = 8 \text{ mA}^{\S}$					0.35	0.5		
I_I	Input current at maximum input voltage	Any reset	$V_{CC} = \text{MAX}$, $V_I = 7 \text{ V}$			0.1			0.1	mA
		A input	$V_{CC} = \text{MAX}$, $V_I = 5.5 \text{ V}$			0.2			0.2	
		B input	$V_{CC} = \text{MAX}$, $V_I = 5.5 \text{ V}$			0.4			0.4	
I_{IH}	High-level input current	Any reset	$V_{CC} = \text{MAX}$, $V_I = 2.7 \text{ V}$			20			20	μ A
		A input	$V_{CC} = \text{MAX}$, $V_I = 2.7 \text{ V}$			40			40	
		B input	$V_{CC} = \text{MAX}$, $V_I = 2.7 \text{ V}$			80			80	
I_{IL}	Low-level input current	Any reset	$V_{CC} = \text{MAX}$, $V_I = 0.4 \text{ V}$			-0.4			-0.4	mA
		A input	$V_{CC} = \text{MAX}$, $V_I = 0.4 \text{ V}$			-2.4			-2.4	
		B input	$V_{CC} = \text{MAX}$, $V_I = 0.4 \text{ V}$			-3.2			-3.2	
I_{OS}	Short-circuit output current [§]	$V_{CC} = \text{MAX}$		-20		-100	-20		-100	mA
I_{CC}	Supply current	$V_{CC} = \text{MAX}$, See Note 3	'LS90		9	15		9	15	mA
		$V_{CC} = \text{MAX}$, See Note 3	'LS92		9	15		9	15	

[†]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.

[¶] Q_A outputs are tested at specified I_{OL} plus the limit value of I_{IL} for the B input. This permits driving the B input while maintaining full fan-out capability.

NOTE 3: I_{CC} is measured with all outputs open, both R_0 inputs grounded following momentary connection to 4.5 V, and all other inputs grounded.

**TYPES SN54LS90, SN54LS92, SN54LS93,
SN74LS90, SN74LS92, SN74LS93
DECADE, DIVIDE-BY-TWELVE, AND BINARY COUNTERS**
REVISED OCTOBER 1976

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

PARAMETER	TEST CONDITIONS†	SN54LS93			SN74LS93			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	3.4		2.7	3.4		V
V _{OL} Low-level output voltage	V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = V _{IL} max							V
	I _{OL} = 4 mA¶		0.25	0.4		0.25	0.4	
	I _{OL} = 8 mA¶					0.35	0.5	
I _I Input current at maximum input voltage	Any reset			0.1			0.1	mA
	A or B input			0.2			0.2	
I _{IH} High-level input current	Any reset			20			20	µA
	A or B input			40			80	
I _{IL} Low-level input current	Any reset			-0.4			-0.4	mA
	A input			-2.4			-2.4	
	B input			-1.6			-1.6	
I _{OS} Short-circuit output current§	V _{CC} = MAX	-20		-100	-20		-100	mA
I _{CC} Supply current	V _{CC} = MAX, See Note 3		9	15		9	15	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.

¶Q_A outputs are tested at specified I_{OL} plus the limit value for I_{IL} for the B input. This permits driving the B input while maintaining full fan-out capability.

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

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

PARAMETER†	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'LS90			'LS92			'LS93			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
f _{max}	A	Q _A	C _L = 15 pF, R _L = 2 kΩ See Figure 1	32	42		32	42		32	42		MHz
	B	Q _B		16			16			16			
tp _{LH}	A	Q _A		10	16		10	16		10	16		ns
tp _{HL}	A	Q _A		12	18		12	18		12	18		
tp _{LH}	A	Q _D		32	48		32	48		46	70		ns
tp _{HL}	A	Q _D		34	50		34	50		46	70		
tp _{LH}	B	Q _B		10	16		10	16		10	16		ns
tp _{HL}	B	Q _B		14	21		14	21		14	21		
tp _{LH}	B	Q _C		21	32		10	16		21	32		ns
tp _{HL}	B	Q _C		23	35		14	21		23	35		
tp _{LH}	B	Q _D		21	32		21	32		34	51		ns
tp _{HL}	B	Q _D		23	35		23	35		34	51		
tp _{HL}	Set-to-0	Any		26	40		26	40		26	40		ns
tp _{LH}	Set-to-9	Q _A , Q _D		20	30								
tp _{HL}	Set-to-9	Q _B , Q _C		26	40								ns

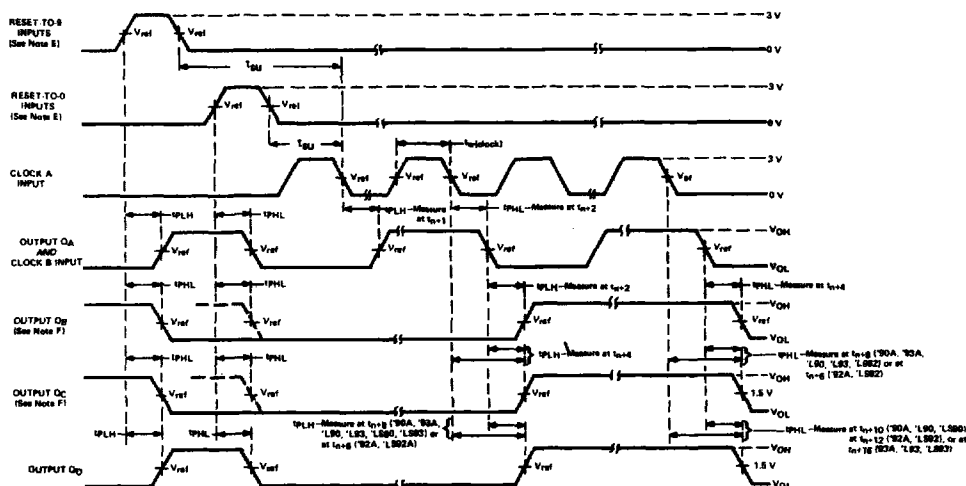
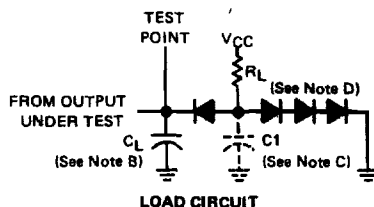
†f_{max} = maximum count frequency

tp_{LH} = propagation delay time, low-to-high-level output

tp_{HL} = propagation delay time, high-to-low-level output

**TYPES SN5490A, SN5492A, SN5493A, SN54L90, SN54L93,
SN54LS90, SN54LS92, SN54LS93, SN7490A, SN7492A, SN7493A,
SN74L90, SN74L93, SN74LS90, SN74LS92, SN74LS93
DECADE, DIVIDE-BY-TWELVE, AND BINARY COUNTERS**

PARAMETER MEASUREMENT INFORMATION



VOLTAGE WAVEFORMS

- NOTES:**
- A. Input pulses are supplied by a generator having the following characteristics:
for '90A, '92A, '93A, $t_r \leq 5$ ns, $t_f \leq 5$ ns, PRR = 1 MHz, duty cycle = 50%, $Z_{out} \approx 50$ ohms;
for 'L90, 'L93, $t_r \leq 15$ ns, $t_f \leq 15$ ns, PRR = 500 kHz, duty cycle = 50%, $Z_{out} \approx 80$ ohms;
for 'LS90, 'LS92, 'LS93, $t_r \leq 15$ ns, $t_f \leq 5$ ns, PRR = 1 MHz, duty cycle = 50%, $Z_{out} \approx 50$ ohms.
 - B. C_L includes probe and jig capacitance.
 - C. C1 (30 pF) is applicable for testing 'L90 and 'L93.
 - D. All diodes are 1N916 or 1N3064.
 - E. Each reset input is tested separately with the other reset at 4.5 V.
 - F. Reference waveforms are shown with dashed lines.
 - G. For '90A, '92A, and '93A: $V_{ref} = 1.5$ V. For 'L90, 'L93, 'LS90, 'LS92, and 'LS93: $V_{ref} = 1.3$ V.

FIGURE 1