'290, 'LS290 . . . DECADE COUNTERS '293, 'LS293 . . . 4-BIT BINARY COUNTERS

 GND and V_{CC} on Corner Pins (Pins 7 and 14 Respectively)

description

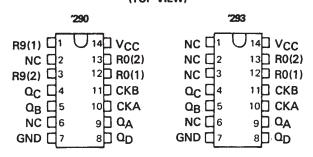
The SN54290/SN74290, SN54LS290/SN74LS290, SN54293/SN74293, and SN54LS293/SN74LS293 counters are electrically and functionally identical to the SN5490A/SN7490A, SN54LS90/SN74LS90, SN5493A/SN7493A, and SN54LS93/SN74LS93, respectively. Only the arrangement of the terminals has been changed for the '290, 'LS290, '293, and 'LS293.

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 '290 and 'LS290 and divide-by-eight for the '293 and 'LS293.

All of these counters have a gated zero reset and the '290 and 'LS290 also have gated set-to-nine inputs for use in BCD nine's complement applications.

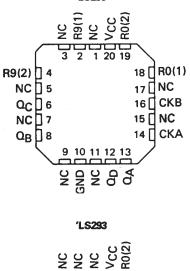
To use the maximum count length (decade or four-bit binary) of these counters, the B input is connected to the Q_A output. The input count pulses are applied to input A and the outputs are as described in the appropriate function table. A symmetrical divide-by-ten count can be obtained from the '290 and 'LS290 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 .

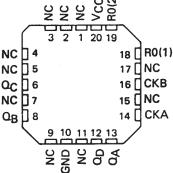
SN54290, SN54LS290, SN54293, SN54LS293...J OR W PACKAGE SN74290, SN74293...N PACKAGE SN74LS290, SN74LS293...D OR N PACKAGE (TOP VIEW)



SN54LS290, SN54LS293 . . . FK PACKAGE (TOP VIEW)

'LS290





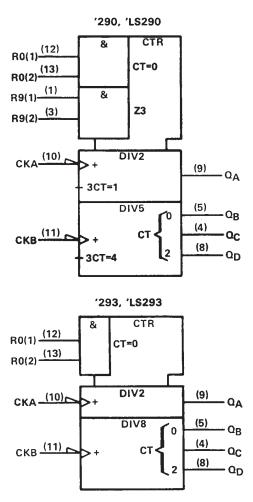
NC - No internal connection

PRODUCTION DATA information is 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.



SN54290, SN54293, SN54LS290, SN54LS293 SN74290, SN74293, SN74LS290, SN74LS293 **DECADE AND 4-BIT BINARY COUNTERS** SDLS097 – MARCH 1974 – REVISED MARCH 1988

logic symbols[†]



[†] These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for D, J, N, and W packages.



SDLS097 – MARCH 1974 – REVISED MARCH 1988

'290, 'LS290 BCD COUNT SEQUENCE (See Note A)

0	L	L	L	니	
1	L	L	L	н	
2	L	L.	н	L	
3	Ł	L	н	н	
4	L	н	L	L	
5	L	н	L	н	
6	Ł	н	н	L	
7	L	н	н	н	
8	н	L	L	L	
9	н	L	L	н	

'290, 'LS290 **BI-QUINARY (5-2)** (See Note B) OUTPUT COUNT QA. ad ac ab 0 L L L L н 1 L L L 2 L н L L 3 н L L н 4 L н L L 5 н L L L н 6 н L L L 7 н н L 8 L н н н 9 н н L

RESET/COUNT FUNCTION TABLE RESET INPUTS OUTPUT														
R ₀₍₁₎	R ₀₍₂₎	QD	oc	QB	٩D									
Н	н	L	X	L	L	L	L							
н	н	×	L	L	L	L.	L							
x	×	н	н	н	L	L	н							
х	L	x	L		со	UNT	•							
L	х	L	x		со	UNT								
L	x	x	L		со	UNT								
x	L	L	×		со	UNT								

'293, 'LS293 RESET/COUNT FUNCTION TABLE

RESET	INPUTS		OUT	PUT	
R ₀₍₁₎	R ₀₍₂₎	QD	QC	QB	QA
н	н	L	L	L	L
L	×		CO	JNT	
x	L		COI	JNT	

' 293	, 'L	S2	93	
COUNT	SE	QI	JENCI	E
10			~	

(See Note C) OUTPUT COUNT QC QB QA **Q**D 0 L L L L Н L 1 L L 2 н L L L 3 н н L L 4 L н L L 5 L L н н 6 н н L L 7 н н н L L L 8 н L 9 н L L, н 10 н L н L н н 11 н L 12 Ĥ н L. L 13 н L н н 14 н н н Ļ 15 н н н н

logic diagrams (positive logic)

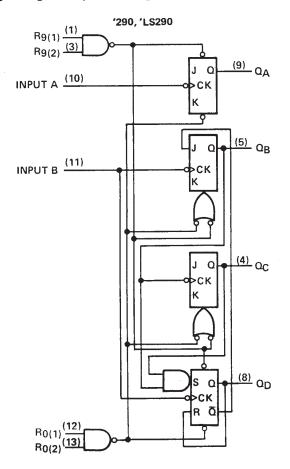
count.

NOTES: A. Output Ω_A is connected to input B for BCD count.

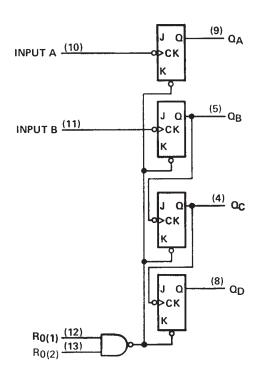
D. H = high level, L = low level, X = irrelevant

C. Output Q_A is connected to input B.

B. Output QD is connected to input A for bi-quinary





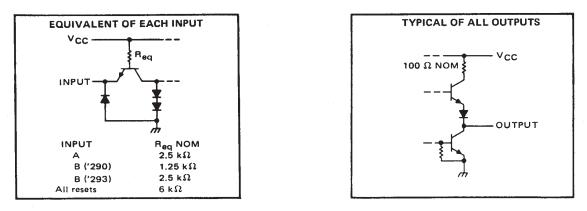


Pin numbers shown are for D, J, N, and W packages. The J and K inputs shown without connection are for reference only and are functionally at a high level.



SDLS097 – MARCH 1974 – REVISED MARCH 1988

schematics of inputs and outputs



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

Supply voltage, V _{CC} (see Note 1)	• •							•				7V
Input voltage												5.5 V
Interemitter voltage (see Note 2)												
Operating free-air temperature range: SN54' Circuit	s.			•			•			•	•	–55°C to 125°C
												. 0°C to 70°C
Storage temperature range						•				•		–65°C to 150°C

NOTES: 1. Voltage values, except interemitter 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 R₀ inputs, and for the '290 circuit, it also applies between the two R9 inputs.

SN54' SN74' UNIT NOM MAX MIN NOM MAX MIN Supply voltage, V_{CC} 4.5 5 5.5 4.75 5.25 5 v -800 -800 μA High-level output current, IOH 16 16 mA Low-level output current, IOL 32 A input 0 0 32 MHz Count frequency, fcount B input 16 0 16 0 15 15 A input Pulse width, tw B input 30 30 ns 15 15 **Reset inputs** Reset inactive-state setup time, t_{su} 25 25 ns -55 125 0 70 °C Operating free-air temperature, TA

recommended operating conditions



SDLS097 - MARCH 1974 - REVISED MARCH 1988

electrical characteristics over recommended operating	free-air temperature range (unless otherwise noted)
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					ot		'290		'293				
	PARAMETER		TEST CONE	JITION	5'	MIN	τγρ‡	MAX	MIN	τγρ‡	MAX	UNIT	
VIH	High-level input voltage					2			2	-		V	
VIL	Low-level input voltage							0.8			0.8	V	
VIK	Input clamp voltage		V _{CC} = MIN, I	= -12	mA			-1.5			-1.5	V	
v _{он}	High-level output voltage		V _{CC} = MIN, V V _{IL} = 0.8 V, I _C			2.4	3.4		2.4	3.4		v	
VOL	Low-level output voltage		V _{CC} = MIN, V V _{IL} = 0.8 V, I _C				0.2	0.4		0.2	0.4	v	
4	Input current at maximum inp	ut voltage	V _{CC} = MAX, V	′ _l = 5.5	V			1			1	mA	
	a construction of the second	Any reset						40			40]	
Чн	High-level input current	A input	V _{CC} = MAX, V	/ ₁ = 2.4	v			80			80	μA	
		B input	1					120			80		
		Any reset						-1.6			-1.6		
IIL.	Low-level input current	A input	V _{CC} = MAX, V	/ = 0.4	v	[-3.2			-3.2	mA	
		B input	1					-4.8			-3.2]	
	Charles and the second second		Mar - MAX		SN54'	-20		-57	-20		-57	mA	
los	Short-circuit output current §		V _{CC} = MAX		SN74'	-18		-57	-18		-57	<u>] "'``</u>	
Icc	Supply current		V _{CC} = MAX, S	ee Note	3		29	42		26	39	mA	

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

 \ddagger All typical values are at V_{CC} = 5 V, T_A = 25°C.

SNot more than one output should be shorted at a time.

 \P_{Q_A} outputs are tested at I_{OL} = 16 mA 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: ICC is measured with all outputs open, both R0 inputs grounded following momentary connection to 4.5 V, and all other inputs grounded.

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

4	FROM	то	TEST CONDITIONS		' 290			'293		UNIT
PARAMETER#	(INPUT)	(OUTPUT)	TEST CONDITIONS	MIN	ТҮР	MAX	MIN	TYP	MAX	0.4.1
	A	Q _A		32	42		32	42		MHz
f _{max}	В	QB]	16			16			1911.12
^t PLH	А	0.			10	16		10	16	ns
^t PHL		QA			12	18		12	18	
tPLH		0	1		32	48		46	70	ns
^t PHL	A	QD	0. m 15 m5	Γ	34	50		46	70	113
^t PLH		0-	C _L = 15 pF,		10	16		10	16	ns
tPHL.	В	QB	$R_{L} = 400 \Omega$,		14	21		14	21	113
^t PLH	D	0-	See Note 4		21	32		21	32	ns
tPHL	В	۵ _C			23	35		23	35	113
^t PLH		0			21	32		34	51	ns
^t PHL	В	QD			23	35		34	51	
tPHL	Set-to-0	Any			26	40		26	40	ns
tPLH	00	Q _A , Q _D			20	30				ns
tPHL.	Set-to-9	QB, QC	1		26	40				113

#fmax = maximum count frequency

tpLH = propagation delay time, low-to-high-level output

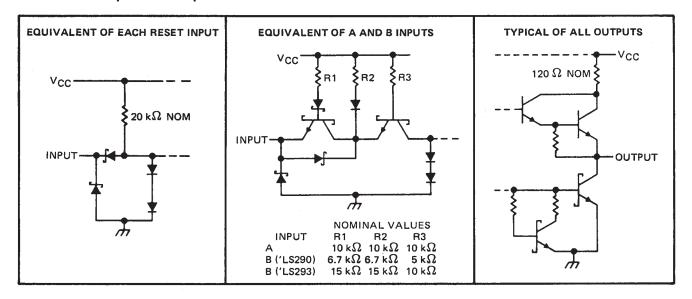
tPHL = propagation delay time, high-to-low-level output

NOTE 4: Load circuits and voltage waveforms are shown in Section 1.



SN54290, SN54293, SN54LS290, SN54LS293 SN74290, SN74293, SN74LS290, SN74LS293 DECADE AND 4-BIT BINARY COUNTERS SDLS097 – MARCH 1974 – REVISED MARCH 1988

schematics of inputs and outputs



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

Supply voltage, V _{CC} (see Note 5)										•		•							•								•	7 V
Input voltage: R inputs																											•	7 V
A and B inputs .																												
Operating free-air temperature rang	ge:	SN	154	LS	290	, S	N54	415	5293	3	•								•					-5	،5°(C to	125	5°C
		SN	174	LS	290	, S	N74	4LS	5293	3			•												0	°Cı	to 7(С°С
Storage temperature range			•	•	•••	•				•		•	•	•	•	•	•	•	•	•	•	•	•	-6	،5°	C to	o 150	О°С

NOTE 5: Voltage values are with respect to network ground terminal.

recommended operating conditions

		S	SN54LS	,				
		MIN	NOM	MAX	MIN	NOM	MAX	UNIT
Supply voltage, V _{CC}		4.5	5	5.5	4.75	5	5.25	V
High-level output current, IOH				-400			-400	μA
Low-level output current, IOL				4			8	mA
• • •	A input	0		32	0		32	MHz
Count frequency, f _{count}	B input	0		16	0		16	WITZ
	A input	15			15			
Pulse width, tw	B input	30			30			ns
	Reset inputs	30			30			1
Reset inactive-state setup time, t _{su}	n, an	25			25		_	ns
Operating free-air temperature, TA		-55		125	0		70	°C



SDLS097 - MARCH 1974 - REVISED MARCH 1988

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

					+		SN54LS	•		SN74LS	ť	
	PARAMET	FER	TE	ST CONDITIONS	51	MIN	TYP‡	МАХ	MIN	түр‡	MAX	UNII
VIH	High-level inpu	t voltage				2			2			V
VIL	Low-level input	tvoltage						0.7			0.8	V
VIK	Input clamp vo		V _{CC} = MIN,	I _I =18 mA				-1.5			-1.5	V
	High-level outp		V _{CC} = MIN, V _{IL} = V _{IL} max,	V _{IH} = 2 V,		2.5	3.4		2.7	3.4		v
			V _{CC} = MIN,	V _{1H} = 2 V,	1 _{0L} = 4 mA¶		0.25	0.4		0.25	0.4	
VOL	Low-level outp	ut voltage	VIL = VIL max		IOL = 8 mA¶					0.35	0.5	V
		Any reset	V _{CC} = MAX,	V ₁ = 7 V				0.1			0.1	
	Input current	A input						0.2			0.2	-
Ц	at maximum	B of 'LS290	V _{CC} = MAX,	Vi = 5.5 V				0.4			0,4	mA
	input voltage	B of 'LS293						0.2			0.2	
		Any reset						20		-	20	
	High-level	A input	1					40			40	
ΙΗ	input current	B of 'LS290	V _{CC} = MAX,	V _I = 2.7 V				80			80	μΑ
		B of 'LS293						40			40	· ·
		Any reset						-0.4			-0.4	
	Low-level	A input	1					-2.4			-2.4	
ЧL	input current	B of 'LS290	V _{CC} = MAX,	V ₁ = 0.4 V				-3.2			-3.2	mA
	-	B of 'LS293	1					-1.6			-1.6	
los	Short-circuit o	utput current§	V _{CC} = MAX			-20		100	-20		-100	mA
	<u> </u>			Cas Nata 2	'LS290		9	15		9	15	mA
ICC	Supply current		V _{CC} = MAX,	See Note 3	'LS293		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 $V_{CC} = 5 V$, $T_{\Delta} = 25^{\circ}C$.

 ${
m \$}$ 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: ICC is measured with all outputs open, both R0 inputs grounded following momentary connection to 4.5 V, and all other inputs grounded.

PARAMETER#	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'LS290			'LS293			
				MIN	ТҮР	MAX	MIN	түр	MAX	UNIT
fmax	A	QA	- CL = 15 pF, RL = 2 kΩ, See Note 4	32	42		32	42		- MHz
	В	QB		16			16			
tPLH	A	Q _A			10	16		10	16	ns
^t PHL					12	18		12	18	
^t PLH	A	۵ _D			32	48		46	70	ns
^t PHL					34	50		46	70	
^t PLH	В	QB			10	16		10	16	ns
^t PHL					14	21		14	21	
^t PLH	в	Q _C			21	32		21	32	ns
^t PHL					23	35		23	35	
^t ԲԼH	В	۵ _D			21	32		34	51	ns
^t PHL					23	35		34	51	
^t PHL	Set-to-0	Any			26	40		26	40	ns
tPLH	Set-to-9	Q _A , Q _D			20	30				ns
ΦΗL		QB, QC			26	40				

switching characteristics, VCC = 5 V, TA = 25°C

#fmax = maximum count frequency

tpLH = propagation delay time, low-to-high-level output

tpHL = propagation delay time, high-to-low-level output

NOTE 4: Load circuits and voltage waveforms are shown in Section 1.



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