

SN54290, SN54293, SN54LS290, SN54LS293, SN74290, SN74293, SN74LS290, SN74LS293 **DECADE AND 4-BIT BINARY COUNTERS**

SDLS007 MARCH 1974 - REVISED MARCH 1988

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

- GND and VCC on Corner Pins
(Pins 7 and 14 Respectively)

description

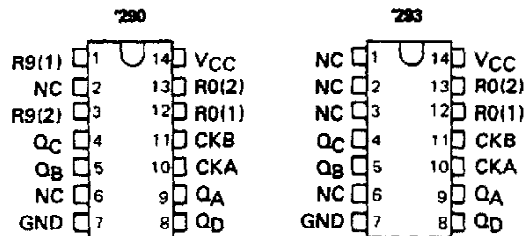
The SN54290/SN74290, SN54LS290/SN74LS290, SN54293/SN74293, and SN54LS293/SN74LS293 counters are electrically and functionally identical to the SN5490A/SN7490A, SN54LS90/SN74LS90, SN5493A/SN7493A, and SN54LS93/SN74LS93, respectively. Only the arrangement of the terminals has been changed for the '290,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

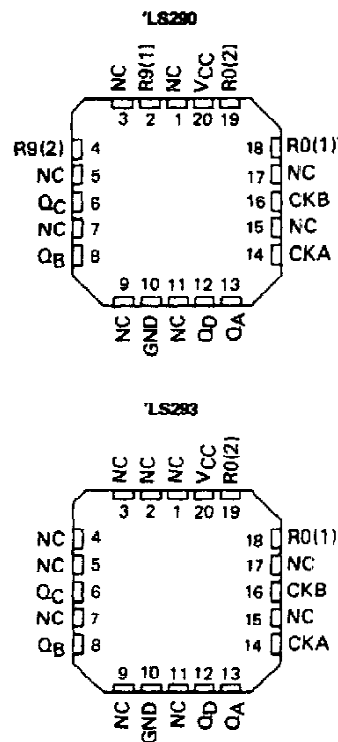
All of these counters have a gated zero reset and the '290 and 'LS290 also have gated set-to-nine inputs for use in BCD nine's complement applications.

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)



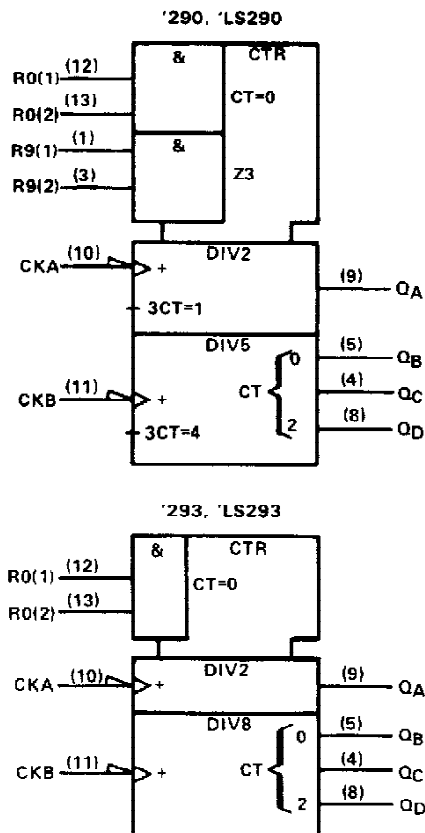
NC - No internal connection

PRODUCTION DATA documents contain 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.

TEXAS
INSTRUMENTS

**SN54290, SN54293, SN54LS290, SN54LS293,
SN74290, SN74293, SN74LS290, SN74LS293
DECADE AND 4-BIT BINARY COUNTERS**

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.

**SN54290, SN54293, SN54LS290, SN54LS293,
SN74290, SN74293, SN74LS290, SN74LS293
DECADE AND 4-BIT BINARY COUNTERS**

**'290, 'LS290
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

**'290, 'LS290
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

**'290, 'LS290
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			

**'293, 'LS293
COUNT SEQUENCE
(See Note C)**

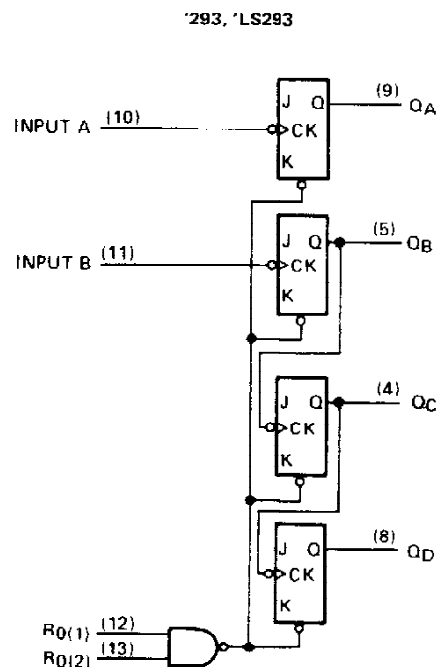
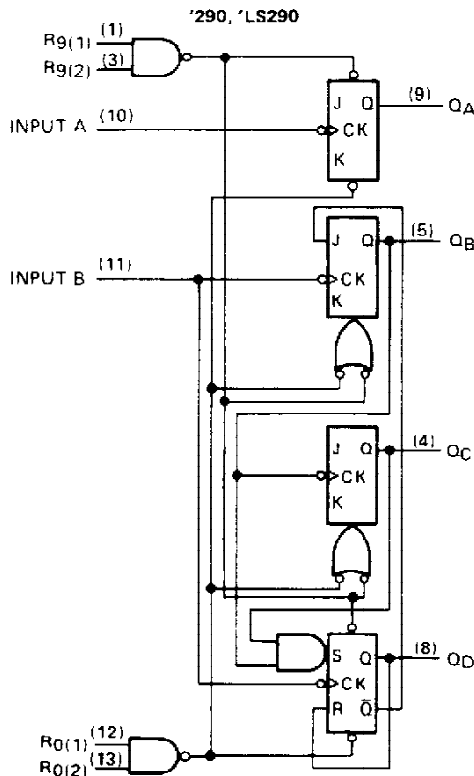
COUNT	OUTPUT			
	Q _D	Q _C	Q _B	Q _A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H
10	H	L	H	L
11	H	L	H	H
12	H	H	L	L
13	H	H	L	H
14	H	H	H	L
15	H	H	H	H

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

**'293, 'LS293
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			

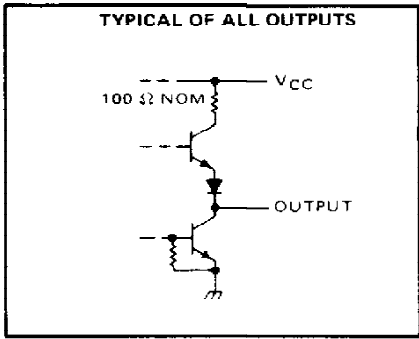
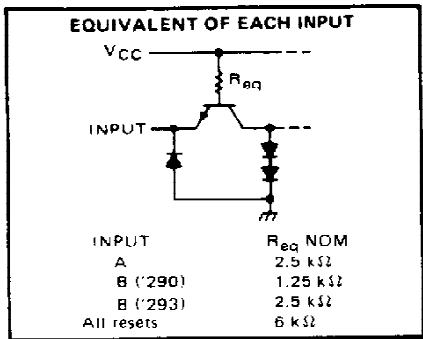
logic diagrams (positive logic)



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.

SN54290, SN54293, SN74290, SN74293
DECADE AND 4-BIT BINARY COUNTERS

schematics of inputs and outputs



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
Interemitter voltage (see Note 2)	5.5 V
Operating free-air temperature range: SN54' Circuits	-55°C to 125°C
SN74' Circuits	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 R_Q inputs, and for the '290 circuit, it also applies between the two R_9 inputs.

recommended operating conditions

		SN54'			SN74'			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}	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

SN54290, SN54293, SN74290, SN74293 DECADE AND 4-BIT BINARY COUNTERS

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

PARAMETER		TEST CONDITIONS†	'290			'293			UNIT
			MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V _{IH}	High-level input voltage		2			2			V
V _{IL}	Low-level input voltage				0.8			0.8	V
V _{IK}	Input clamp voltage	V _{CC} = MIN, I _I = -12 mA			-1.5			-1.5	V
V _{OH}	High-level output voltage	V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = 0.8 V, I _{OH} = -800 µA	2.4	3.4		2.4	3.4		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	Any reset		40			40		µA
		A input		80			80		
		B input		120			80		
I _{IL}	Low-level input current	Any reset		-1.6			-1.6		mA
		A input		-3.2			-3.2		
		B input		-4.8			-3.2		
I _{OS}	Short-circuit output current§	V _{CC} = MAX	SN54†	-20	-57	-20	-57		mA
			SN74†	-18	-57	-18	-57		
I _{CC}	Supply current	V _{CC} = MAX, See Note 3		29	42		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 V, T_A = 25°C.

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

¶ 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: 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	'290			'293			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
f _{max}	A	Q _A	C _L = 15 pF. R _L = 400 Ω. See Note 4	32	42		32	42		MHz
	B	Q _B		16			16			
t _{PLH}	A	Q _A			10	16		10	16	ns
t _{PHL}					12	18		12	18	
t _{PLH}	A	Q _D			32	48		46	70	ns
t _{PHL}					34	50		46	70	
t _{PLH}	B	Q _B			10	16		10	16	ns
t _{PHL}					14	21		14	21	
t _{PLH}	B	Q _C			21	32		21	32	ns
t _{PHL}					23	35		23	35	
t _{PLH}	B	Q _D			21	32		34	51	ns
t _{PHL}					23	35		34	51	
t _{PHL}	Set-to-0	Any			26	40		26	40	ns
t _{PLH}	Set-to-0	Q _A , Q _D			20	30				ns
t _{PHL}		Q _B , Q _C			26	40				

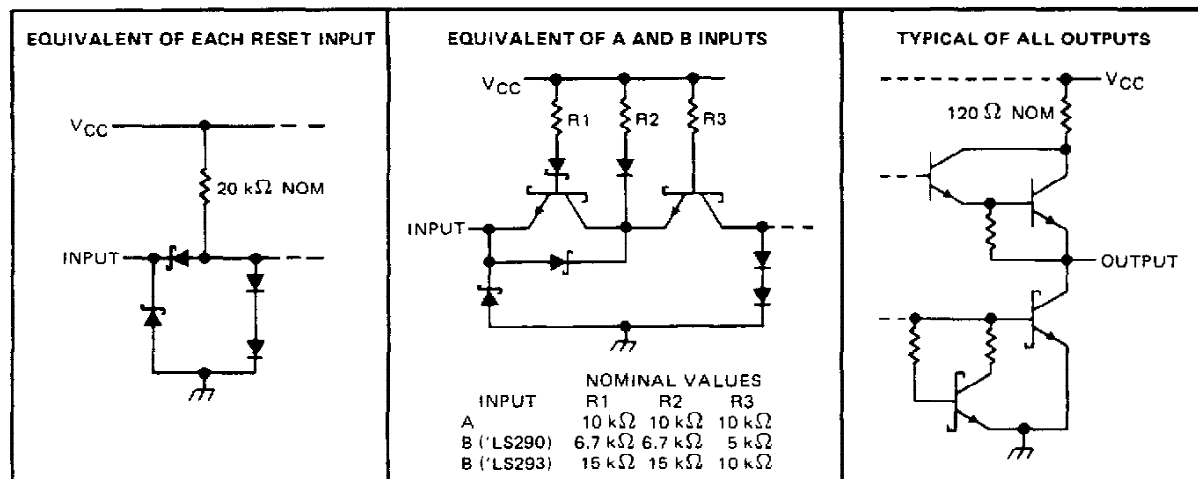
f_{max} = maximum count frequency

t_{PLH} = propagation delay time, low-to-high-level output

t_{PHL} = propagation delay time, high-to-low-level output

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

schematics of inputs and outputs



Supply voltage, V_{CC} (see Note 5)	7 V
Input voltage: R inputs	7 V
A and B inputs	5.5 V
Operating free-air temperature range: SN54LS290, SN54LS293	−55°C to 125°C
SN74LS290, SN74LS293	0°C to 70°C
Storage temperature range	−65°C to 150°C

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

recommended operating conditions

		SN54LS'			SN74LS'			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
Count frequency, f_{count}	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	30			30			
Reset inactive-state setup time, t_{SU}		25			25			ns
Operating free-air temperature, T_A		-55		125	0		70	$^{\circ}C$

SN54LS290, SN54LS293, SN74LS290, SN74LS293

DECADE AND 4-BIT BINARY COUNTERS

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

PARAMETER		TEST CONDITIONS†	SN54LS*			SN74LS*			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¶ I _{OL} = 8 mA¶	0.25	0.4	0.25	0.4	0.35	0.5		
I _I	Input current at maximum input voltage	Any reset	V _{CC} = MAX, V _I = 7 V			0.1			mA	
		A input				0.2				
		B of 'LS290	V _{CC} = MAX, V _I = 5.5 V			0.4				
		B of 'LS293				0.2				
I _{IH}	High-level input current	Any reset				20			µA	
		A input	V _{CC} = MAX, V _I = 2.7 V			40				
		B of 'LS290				80				
		B of 'LS293				40				
I _{IL}	Low-level input current	Any reset				-0.4			mA	
		A input	V _{CC} = MAX, V _I = 0.4 V			-2.4				
		B of 'LS290				-3.2				
		B of 'LS293				-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	'LS290		9	15	9		15	mA
			'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_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 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_G 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	'LS290			'LS293			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
f _{max}	A	Q _A	C _L = 15 pF, R _L = 2 kΩ, See Note 4	32	42		32	42		MHz
	B	Q _B		16			16			
t _{PLH}	A	Q _A			10	16		10	16	ns
t _{PHL}	A	Q _A			12	18		12	18	
t _{PLH}	A	Q _D			32	48		46	70	ns
t _{PHL}	A	Q _D			34	50		46	70	
t _{PLH}	B	Q _B			10	16		10	16	ns
t _{PHL}	B	Q _B			14	21		14	21	
t _{PLH}	B	Q _C			21	32		21	32	ns
t _{PHL}	B	Q _C			23	35		23	35	
t _{PLH}	B	Q _D			21	32		34	51	ns
t _{PHL}	B	Q _D			23	35		34	51	
t _{PHL}	Set to 0	Any			26	40		26	40	ns
t _{PLH}	Set to 9	Q _A , Q _D			20	30				
t _{PHL}		Q _B , Q _C			26	40				

f_{max} = maximum count frequency

t_{PLH} = propagation delay time, low-to-high-level output

t_{PHL} = propagation delay time, high-to-low-level output

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

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