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

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

description

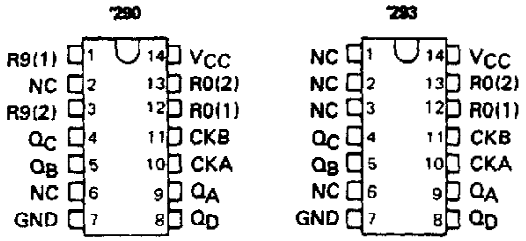
The SN54290/SN74290, SN54LS290/SN74LS290, SN54293/SN74293, and SN54LS293/SN74LS293 counters are electrically and functionally identical to the SN5490A/SN7490A, SN54LS90/SN74LS90, SN5493A/SN7493A, and SN54LS93/SN74LS93, respectively. Only the arrangement of the terminals has been changed for the '290,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

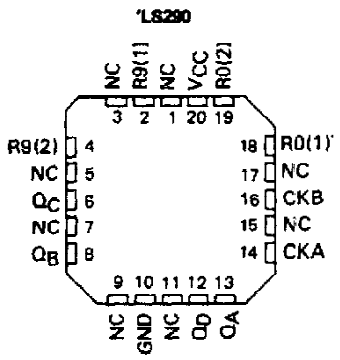
All of these counters have a gated zero reset and the '290 and 'LS290 also have gated set-to-nine inputs for use in BCD nine's complement applications.

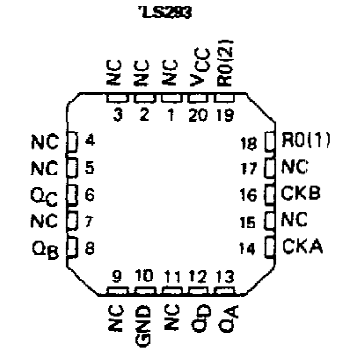
To use the maximum count length (decade or four-bit binary) of these counters, the B input is connected to the Q_A output. The input count pulses are applied to input A and the outputs are as described in the appropriate function table. A symmetrical divide-by-ten count can be obtained from the '290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



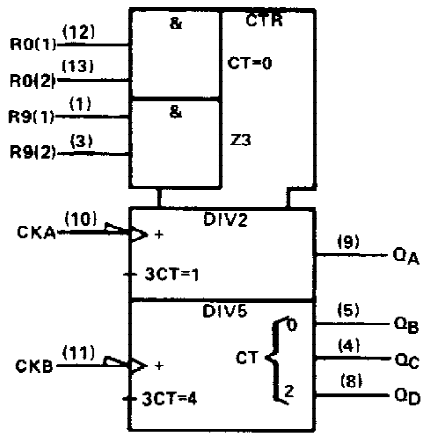


NC – No internal connection

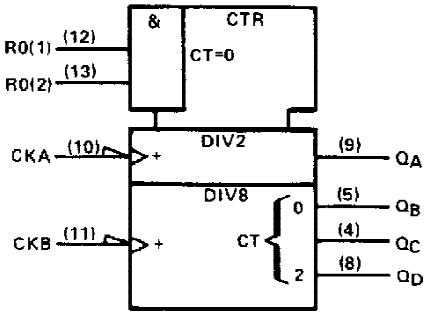
PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

logic symbols†

'290, 'LS290



'293, 'LS293



† 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.

'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
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			

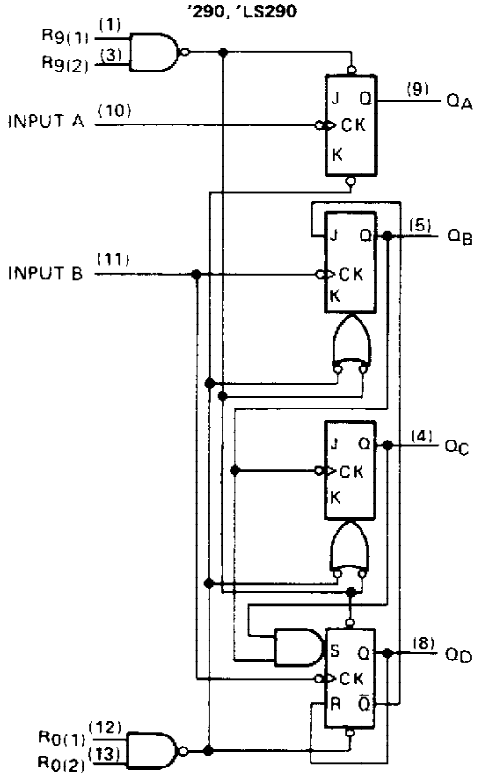
'293, 'LS293
COUNT SEQUENCE
(See Note C)

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

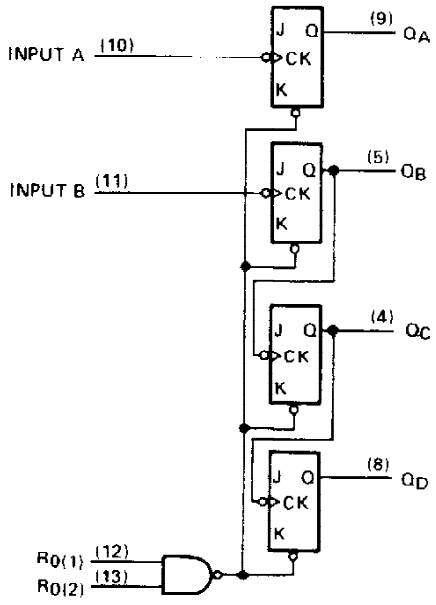
NOTES: A. Output Q_A is connected to input B for BCD count.
B. Output Q_D is connected to input A for bi-quinary count.
C. Output Q_A is connected to input B.
D. H = high level, L = low level, X = irrelevant

logic diagrams (positive logic)

'290, 'LS290

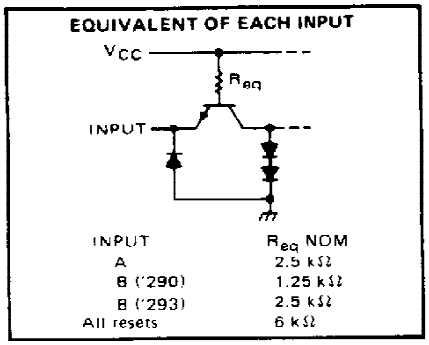


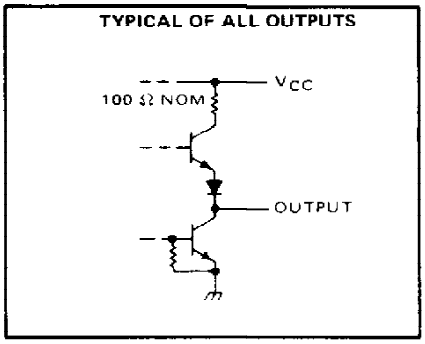
'293, 'LS293



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.

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_0 inputs, and for the '290 circuit, it also applies between the two R9 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	μA
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

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

PARAMETER			TEST CONDITIONS†		'290 MIN	'290 TYP‡	'290 MAX	'293 MIN	'293 TYP‡	'293 MAX	UNIT
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	V_{CC} = MAX, V_I = 2.4 V				40			40	μA
		A input					80			80	
		B input					120			80	
I_{IL}	Low-level input current	Any reset	V_{CC} = MAX, V_I = 0.4 V				−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 R_0 inputs grounded following momentary connection to 4.5 V, and all other inputs grounded.

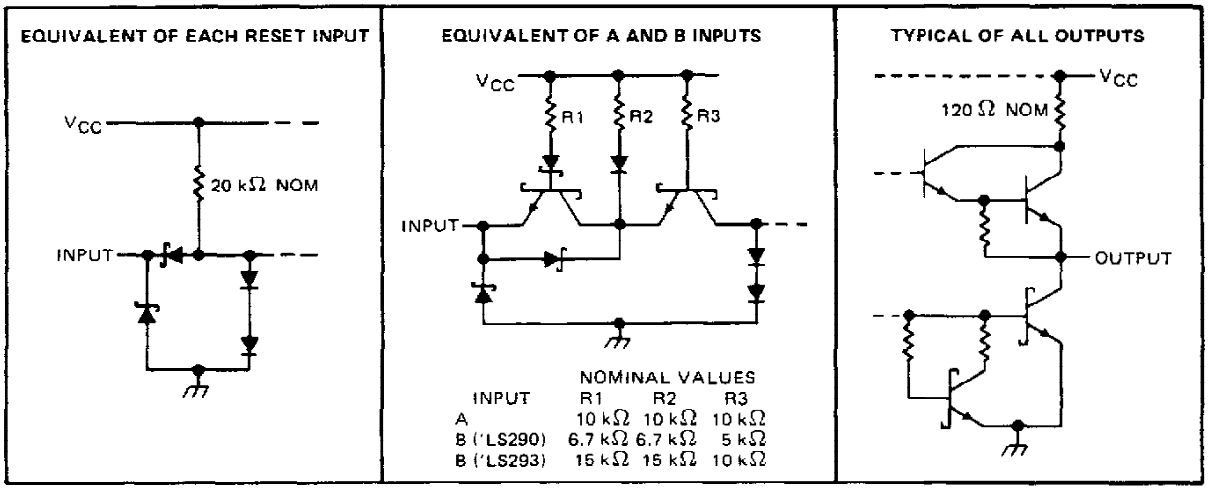
switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER#	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'290 MIN	'290 TYP	'290 MAX	'293 MIN	'293 TYP	'293 MAX	UNIT
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-9	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.

TEXAS INSTRUMENTS
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

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 . . . . . 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	°C

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_{IL} = V_{IL} max,	V_{IH} = 2 V, I_{OH} = −400 μA		2.5	3.4		2.7	3.4		V
V_{OL}	Low-level output voltage		V_{CC} = MIN, V_{IL} = V_{IL} max	V_{IH} = 2 V,	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	Any reset	V_{CC} = MAX,	V_I = 7 V				0.1			0.1	mA
		A input	V_{CC} = MAX,	V_I = 5.5 V				0.2			0.2	
		B of 'LS290						0.4			0.4	
		B of 'LS293						0.2			0.2	
I_{IH}	High-level input current	Any reset	V_{CC} = MAX,	V_I = 2.7 V				20			20	μA
		A input						40			40	
		B of 'LS290						80			80	
		B of 'LS293						40			40	
I_{IL}	Low-level input current	Any reset	V_{CC} = MAX,	V_I = 0.4 V				−0.4			−0.4	mA
		A input						−2.4			−2.4	
		B of 'LS290						−3.2			−3.2	
		B of 'LS293						−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	'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_0 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}					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-9	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.

IMPORTANT NOTICE

Texas Instruments (TI) reserves the right to make changes to its products or to discontinue any semiconductor product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

TI warrants performance of its semiconductor products and related software to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Certain applications using semiconductor products may involve potential risks of death, personal injury, or severe property or environmental damage ("Critical Applications").

TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS.

Inclusion of TI products in such applications is understood to be fully at the risk of the customer. Use of TI products in such applications requires the written approval of an appropriate TI officer. Questions concerning potential risk applications should be directed to TI through a local SC sales office.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards should be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein. Nor does TI warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used.

Copyright © 1996, Texas Instruments Incorporated