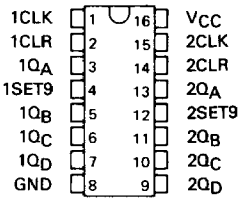
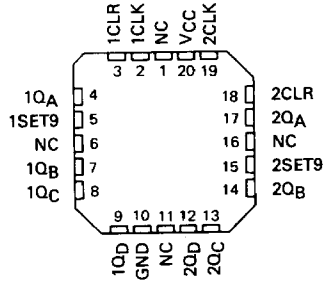
OCTOBER 1976—REVISED DECEMBER 1983

- Dual Versions of Popular SN5490A, SN54LS90, SN7490A, and SN74LS90 Counters
- Individual Clock, Direct Clear, and Set-to-9 Inputs for Each Decade Counter
- Dual Counters Can Significantly Improve System Densities as Package Count Can Be Reduced by 50%
- Maximum Count Frequency . . . 35 MHz Typical
- Buffered Outputs Reduce Possibility of Collector Commutation

SN54490, SN54LS490 . . . J OR W PACKAGE
SN74490 . . . J OR N PACKAGE
SN74LS490 . . . D, J OR N PACKAGE
(TOP VIEW)



SN54LS490 . . . FK PACKAGE
SN74LS490 . . . FN PACKAGE
(TOP VIEW)



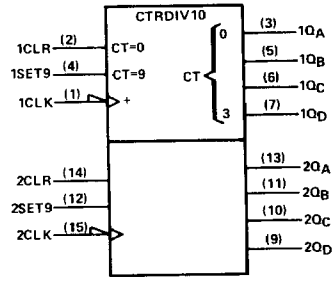
NC - No internal connection

description

Each of these monolithic circuits contains eight master-slave flip-flops and additional gating to implement two individual 4-bit decade counters in a single package. Each decade counter has individual clock, clear, and set-to-9 inputs. BCD count sequences of any length up to divide-by-100 may be implemented with a single '490 or 'LS490. Buffering on each output is provided to ensure that susceptibility to collector commutation is reduced significantly. All inputs are diode-clamped to reduce the effects of line ringing. The counters have parallel outputs from each counter stage so that submultiples of the input count frequency are available for system timing signals.

The SN54490 and SN54LS490 are characterized for operation over the full military temperature range of −55°C to 125°C; the SN74490 and SN74LS490 are characterized for use in industrial systems operating from 0°C to 70°C.

logic symbol



Pin numbers shown on logic notation are for D, J or N packages.
NC — No internal connection

BCD COUNT SEQUENCE
(EACH COUNTER)

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

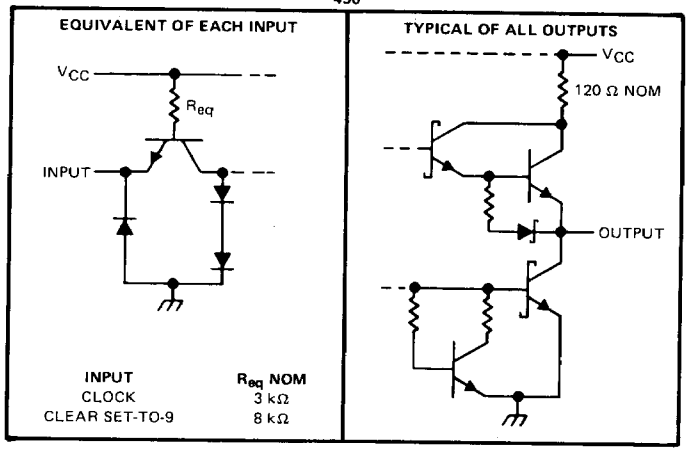
CLEAR/SET-TO-9
FUNCTION TABLE
(EACH COUNTER)

INPUTS		OUTPUTS			
CLEAR	SET-TO-9	Q_A	Q_B	Q_C	Q_D
H	L	L	L	L	L
L	H	H	L	L	H
L	L	COUNT			

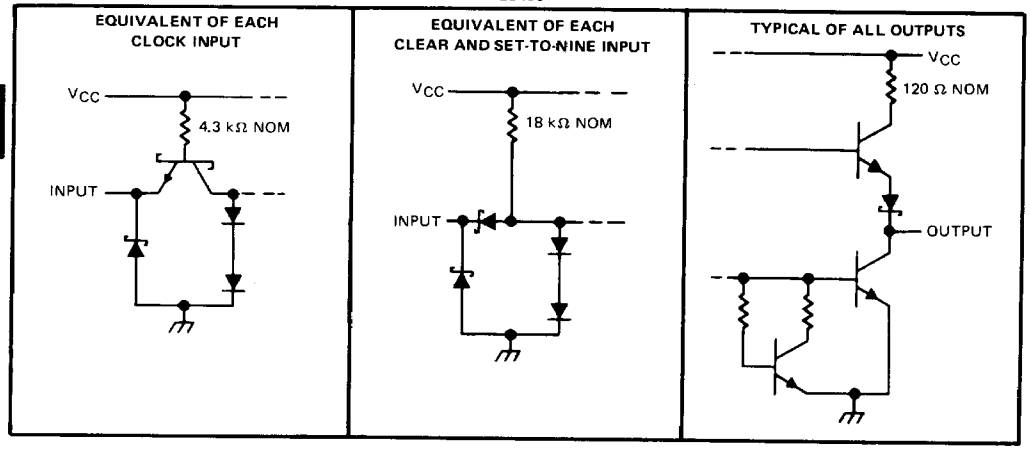
H = high level, L = low level

schematics of inputs and outputs

'490



'LS490



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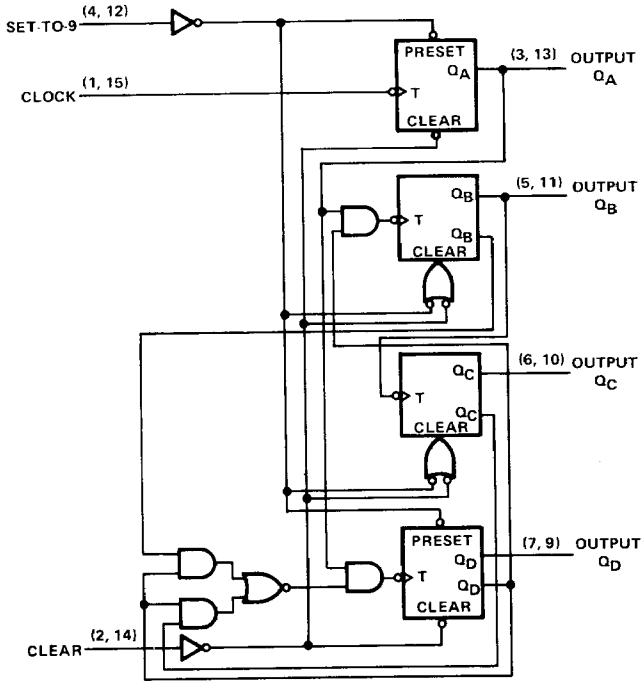
logic diagram (each counter)



Pin numbers shown on logic notation are for D, J or N packages.

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
Operating free-air temperature range: SN54490 . . . . . −55°C to 125°C
SN74490 . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

	SN54490			SN74490			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}	0		25	0		25	MHz
Pulse width, t_w (any input)	20↓			20↓			ns
Clear or set-to-9 inactive-state setup time, t_{su}	25↓			25↓			ns
Operating free-air temperature, T_A	−55		125	0		70	°C

↓The arrow indicates that the falling edge of the clock pulse is used for reference.

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

PARAMETER		TEST CONDITIONS†		MIN	TYP‡	MAX	UNIT
V_{IH} High-level input voltage				2			V
V_{IL} Low-level input voltage						0.8	V
V_{IK} Input clamp voltage		V_{CC} = MIN, I_I = −12 mA				−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		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	V
I_I Input current at maximum input voltage		V_{CC} = MAX, V_I = 5.5 V				1	mA
I_{IH} High-level input current	Clear, set-to-9	V_{CC} = MAX, V_I = 2.4 V				40	μA
	Clock					80	
I_{IL} Low-level input current	Clear, set-to-9	V_{CC} = MAX, V_I = 0.4 V				−1	mA
	Clock					−3.2	
I_{OS} Short-circuit output current§		V_{CC} = MAX	SN54490	−20		−57	mA
			SN74490	−18		−57	
I_{CC} Supply current		V_{CC} = MAX, See Note 2			45	70	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.
NOTE 2: I_{CC} is measured with all outputs open, both clear inputs grounded following momentary connection to 4.5 V, and all other inputs grounded.

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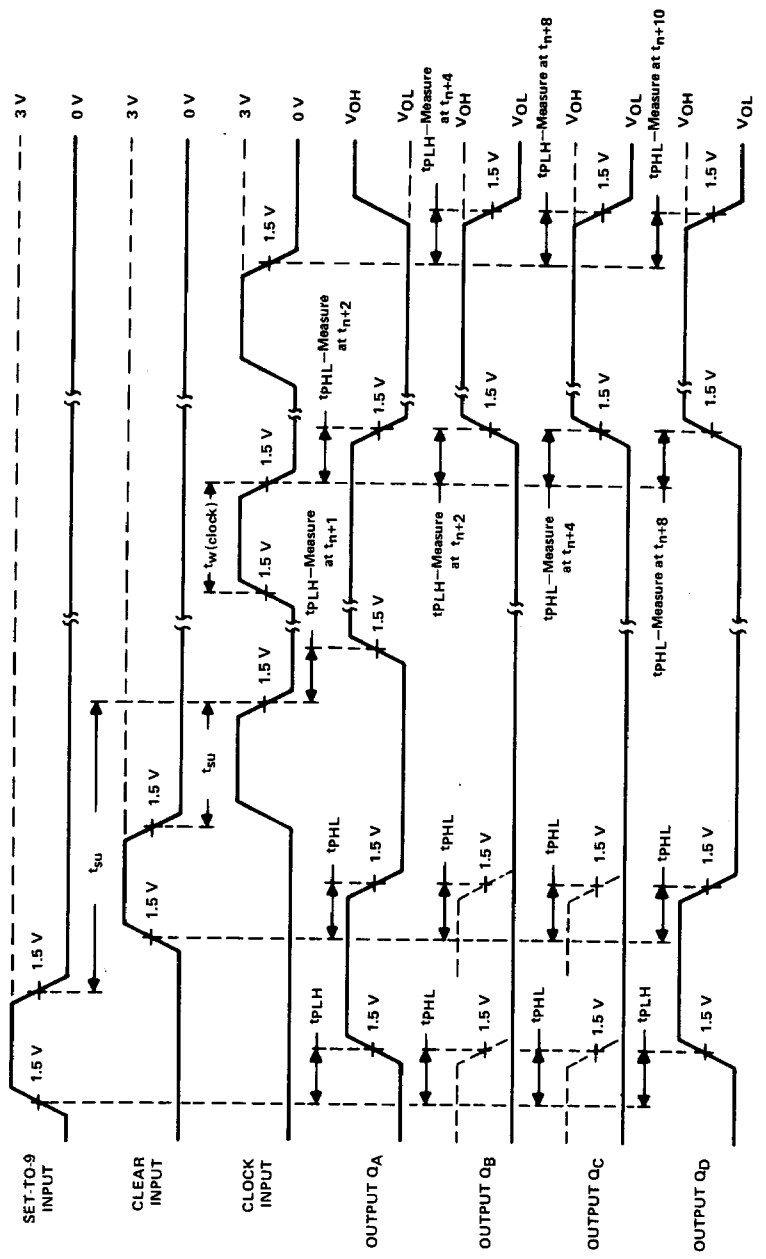
switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER¶	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}	Clock	Q_A	C_L = 15 pF, R_L = 400 Ω, See Figure 1 and Note 3	25	35		MHz
t_{PLH}	Clock	Q_A			12	20	ns
t_{PHL}					13	20	
t_{PLH}	Clock	Q_B, Q_D			24	39	ns
t_{PHL}					26	39	
t_{PLH}	Clock	Q_C			32	54	ns
t_{PHL}					36	54	
t_{PHL}	Clear	Any			24	39	ns
t_{PLH}	Set-to-9	Q_A, Q_D			24	39	ns
t_{PHL}		Q_B, Q_C			20	36	

¶ 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 3: See General Information Section for load circuits and voltage waveforms.



VOLTAGE WAVEFORMS

NOTES: A. Input pulses are supplied by a generator having the following characteristics: $t_r \leq 5$ ns, $t_f \leq 5$ ns, PRR = 1 MHz, duty cycle = 50%, $Z_{out} \approx 50$ ohms.

FIGURE 1

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

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Clear and set-to-9 input voltage . . . . . 7 V
Clock input voltage . . . . . 5.5 V
Operating free-air temperature range: SN54LS490 . . . . . −55°C to 125°C
SN74LS490 . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

	SN54LS490			SN74LS490			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}	0		25	0		25	MHz
Pulse width, t_w (any input)	20			20			ns
Clear or set-to-9 inactive-state setup time, t_{su}	25↓			25↓			ns
Operating free-air temperature, T_A	−55		125	0		70	°C

↓The arrow indicates that the falling edge of the clock pulse is used for reference.

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

PARAMETER			TEST CONDITIONS†		SN54LS490			SN74LS490			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,	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	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	Clear, set-to-9	V_{CC} = MAX,	V_I = 7 V			0.1			0.1	mA
		Clock		V_I = 5.5 V			0.2			0.2	
I_{IH}	High-level input current	Clear, set-to-9	V_{CC} = MAX,	V_I = 2.7 V			20			20	μA
		Clock					100			100	
I_{IL}	Low-level input current	Clear, set-to-9	V_{CC} = MAX,	V_I = 0.4 V			−0.4			−0.4	mA
		Clock					−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 2		15	26		15	26	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.
NOTE 2: I_{CC} is measured with all outputs open, both clear 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	MIN	TYP	MAX	UNIT
f_{max}	Clock	Q_A	C_L = 15 pF, R_L = 2 kΩ See Figure 2 and Note 3	25	35		MHz
t_{PLH}	Clock	Q_A			12	20	ns
t_{PHL}					13	20	
t_{PLH}	Clock	Q_B, Q_D			24	39	ns
t_{PHL}					26	39	
t_{PLH}	Clock	Q_C			32	54	ns
t_{PHL}					36	54	
t_{PHL}	Clear	Any			24	39	ns
t_{PLH}	Set-to-9	Q_A, Q_D			24	39	ns
t_{PHL}		Q_B, Q_C			20	36	

¶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 3: See General Information Section for load circuits and voltage waveforms.

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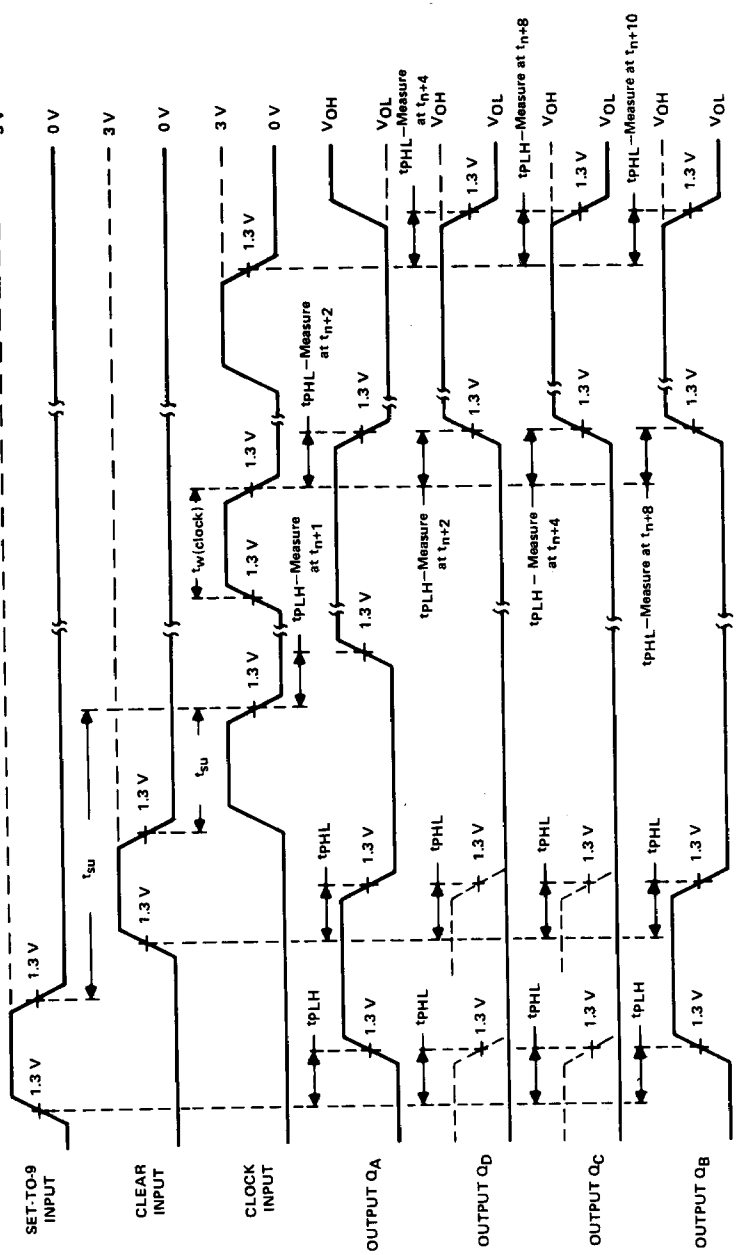

VOLTAGE WAVEFORMS

NOTES: A. Input pulses are supplied by a generator having the following characteristics: $t_r \leq 15$ ns, $t_f \leq 6$ ns, PRR = 1 MHz, duty cycle = 50%, $Z_{out} \approx 50$ ohms.

FIGURE 2