

SN54LS690, SN54LS691, SN54LS693, SN74LS690, SN74LS691, SN74LS693 SYNCHRONOUS COUNTERS WITH OUTPUT REGISTERS AND MULTIPLEXED 3-STATE OUTPUTS

SDLS198

D2423, JANUARY 1981—REVISED MARCH 1988

- 4-Bit Counters/Registers
- Multiplexed Outputs for Counter or Latched Data
- 3-State Outputs Drive Bus Lines Directly
- 'LS690 . . . Decade Counter, Direct Clear
- 'LS691 . . . Binary Counter, Direct Clear
- 'LS693 . . . Binary Counter, Synchronous Clear

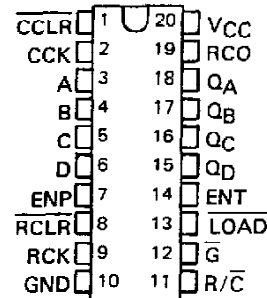
description

These low-power Schottky LSI devices incorporate synchronous counters, four-bit D-type registers, and quadruple two-line to one-line multiplexers with three-state outputs in a single 20-pin package. The counters can be programmed from the data inputs and have enable P inputs and enable T inputs and a ripple-carry output for easy expansion. The register/counter select input, R/\bar{C} , selects the counter when low or the register when high for the three-state outputs, Q_A , Q_B , Q_C , and Q_D . These outputs are rated at 12 and 24 milliamperes (54LS/74LS) for good bus-driving performance.

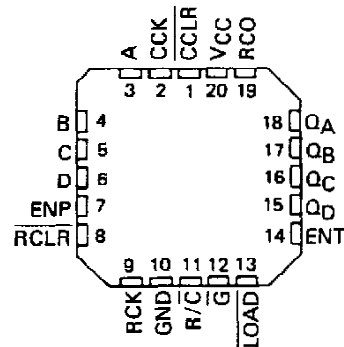
Individual clock and clear inputs are provided for both the counter and the register. Both clock inputs are positive-edge triggered: The clear line is active low and is asynchronous on the 'LS690 and 'LS691, synchronous on the 'LS693. Loading of the counter is accomplished when \overline{LOAD} is taken low and a positive-transition occurs on the counter clock CCK .

Expansion is easily accomplished by connecting RCO of the first stage to ENT of the second stage, etc. All ENP inputs can be tied common and used as master enable or disable control.

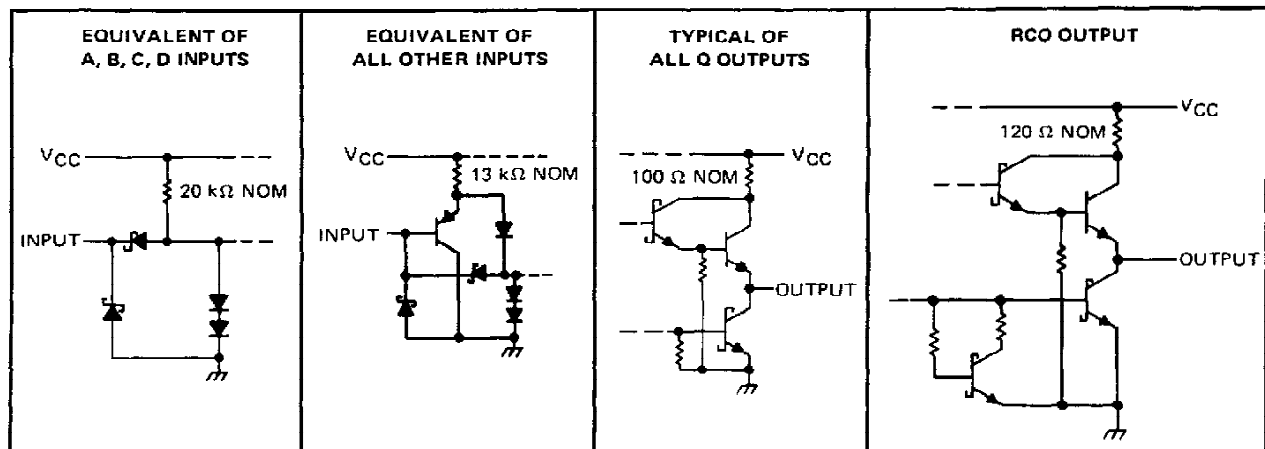
SN54LS690, SN54LS691, SN54LS693 . . . J PACKAGE
SN74LS690, SN74LS691, SN74LS693 . . . DW OR N PACKAGE
(TOP VIEW)



SN54LS690, SN54LS691, SN54LS693 . . . FK PACKAGE
(TOP VIEW)



schematics of inputs and outputs



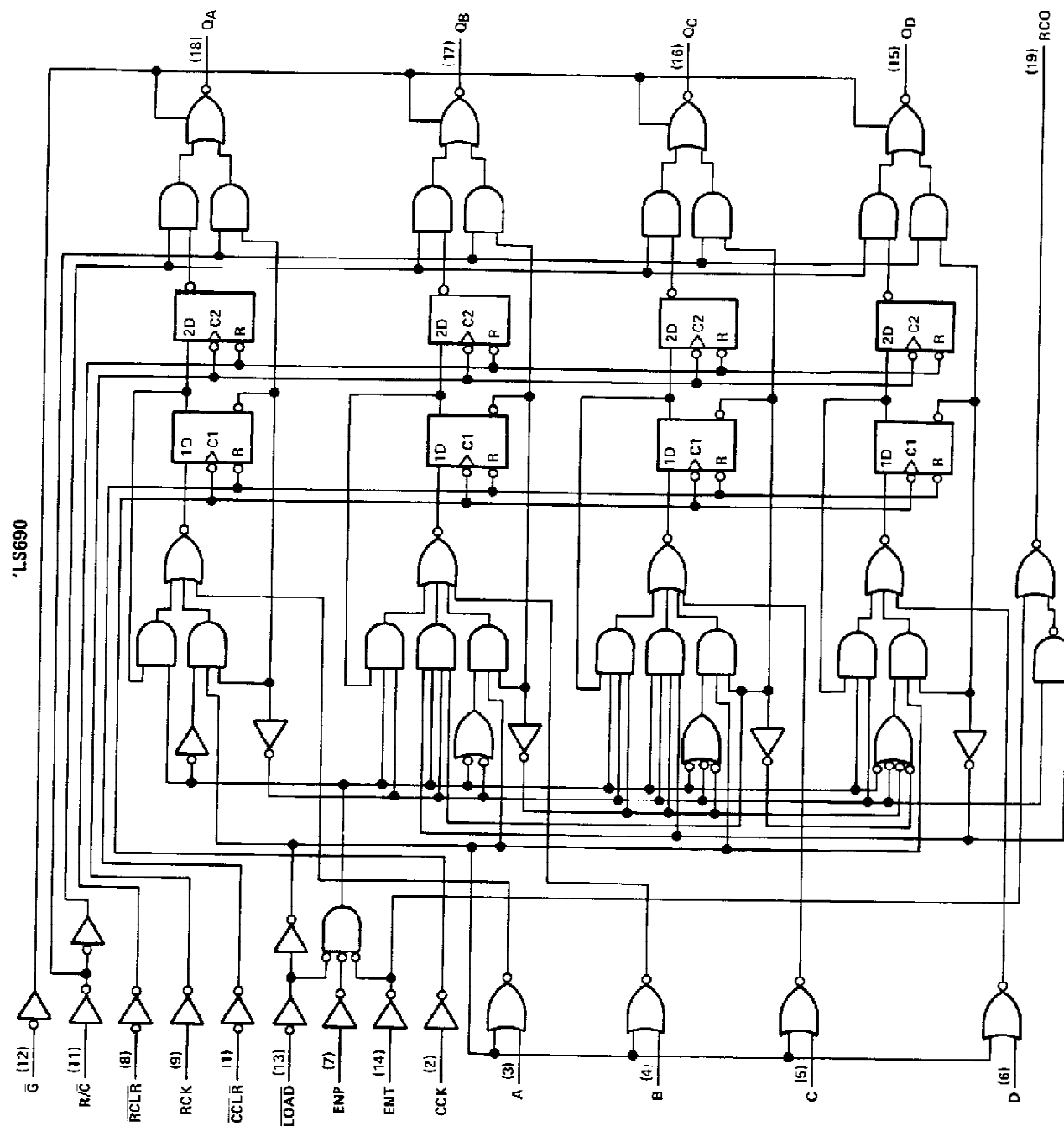
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AND MULTIPLEXED 3-STATE OUTPUTS

logic diagrams (positive logic)

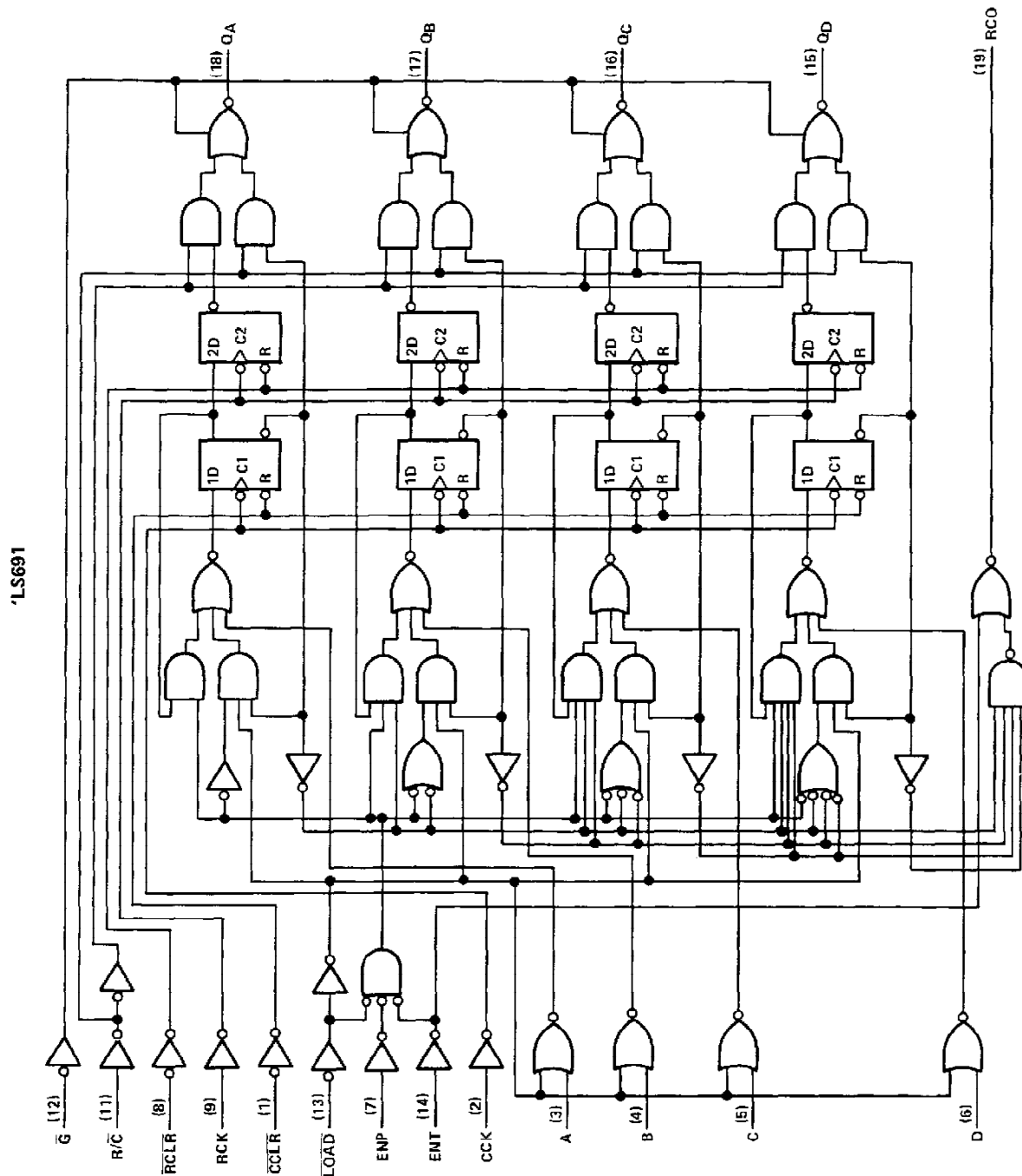


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SYNCHRONOUS COUNTERS WITH OUTPUT REGISTERS
AND MULTIPLEXED 3-STATE OUTPUTS

logic diagrams (positive logic) (continued)



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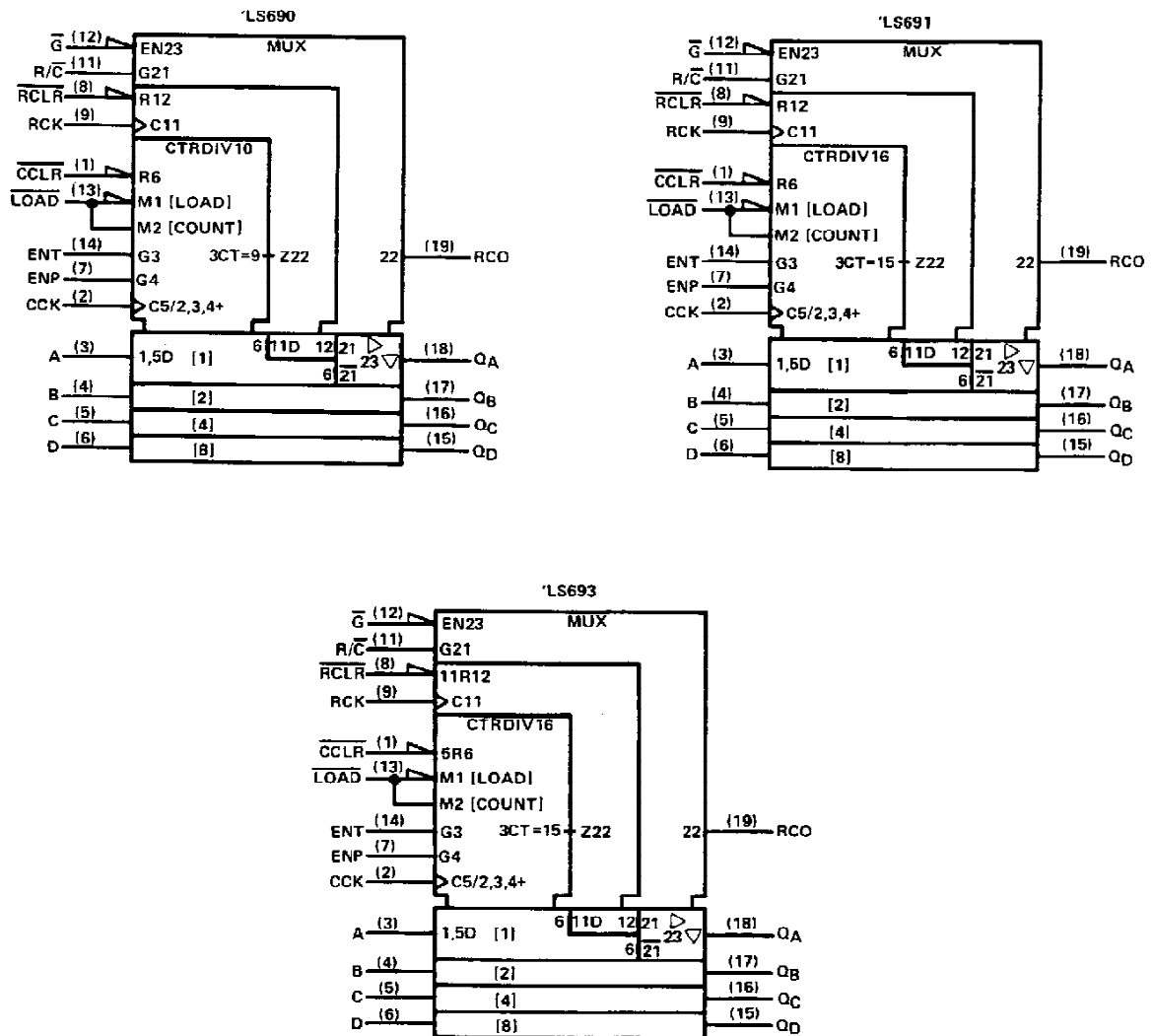
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logic diagrams (positive logic) (continued)



SN54LS690, SN54LS691, SN54LS693, SN74LS690, SN74LS691, SN74LS693
SYNCHRONOUS COUNTERS WITH OUTPUT REGISTERS
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logic symbols[†]



[†]These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.

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SN54LS690, SN54LS691, SN54LS693, SN74LS690, SN74LS691, SN74LS693 **SYNCHRONOUS COUNTERS WITH OUTPUT REGISTERS** **AND MULTIPLEXED 3-STATE OUTPUTS**

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

Supply voltage, V_{CC} (See Note 1)	7 V
Input voltage	7 V
Off-state output voltage	5.5 V
Operating free-air temperature range: SN54LS690, SN54LS691, SN54LS693	–55°C to 125°C
SN74LS690, SN74LS691, SN74LS693	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

			SN54LS [*]			SN74LS [*]			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
V_{IH}	High-level input voltage		2			2			V
V_{IL}	Low-level input voltage				0.7			0.8	V
I_{OH}	High-level output current	Q			–1			–2.6	mA
		R _{CO}			–0.4			–0.4	mA
I_{OL}	Low-level output current	Q			12			24	mA
		R _{CO}			4			8	mA
f_{clock}	Clock frequency	CCK	0		20	0		20	MHz
		RCK	0		20	0		20	MHz
t_w	Pulse duration	CCK high or low	25			25			ns
		RCK high or low	25			25			
		'LS690, 'LS691 RCLR low	20			20			
		CCLR low	20			20			
t_{su}	Setup time before CCK ↑	A thru D	30			30			ns
		ENP or ENT	30			30			
		LOAD ↓	30			30			
		'LS693 CCLR ↓	40			40			
		'LS690, 'LS691 CCLR ↑ inactive	25			25			
t_{su}	Setup time before RCK ↑	CCK ↑ (see Note 2)	30			30			ns
		'LS690, 'LS691 RCLR ↑ inactive	25			25			
		'LS693 RCLR ↓	20			20			
t_h	Hold time	Any input from CCK ↑ or RCK ↑	0			0			ns
T_A	Operating free-air temperature		–55		125	0		70	°C

NOTE 2: This set up time ensures the register will see stable data from the counter outputs. The clocks may be tied together in which case the register state will be one clock pulse behind the counter.

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SYNCHRONOUS COUNTERS WITH OUTPUT REGISTERS
AND MULTIPLEXED 3-STATE OUTPUTS

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 _{IK}		V _{CC} = MIN, I _I = - 18 mA		- 1.5			- 1.5			V
V _{OH}	Any Q	V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = MAX	I _{OH} = - 1 mA		2.4 3.1					V
	I _{OH} = - 2.6 mA				2.4 3.1					
	I _{OH} = - 0.4 mA		2.5 3.2		2.7 3.2					
V _{OL}	Any Q	V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = MAX	I _{OL} = 12 mA		0.25 0.4		0.25 0.4		V	
	I _{OL} = 24 mA				0.35 0.5					
	I _{OL} = 4 mA		0.25 0.4		0.25 0.4					
	I _{OL} = 8 mA				0.35 0.5					
I _{OZH}	Any Q	V _{CC} = MAX, V _{IH} = 2 V, V _{IL} = MAX, V _O = 2.7 V		20			20			μA
I _{OZL}	Any Q	V _{CC} = MAX, V _{IH} = 2 V, V _{IL} = MAX, V _O = 0.4 V		- 20			- 20			μA
I _I		V _{CC} = MAX, V _I = 7 V		0.1			0.1			mA
I _{IH}		V _{CC} = MAX, V _I = 2.7 V		20			20			μA
I _{IL}	A thru D	V _{CC} = MAX, V _I = 0.4 V		- 0.4			- 0.4			mA
	- 0.2			- 0.2						
I _{OS} §	Any Q	V _{CC} = MAX, V _O = 0 V		- 30	- 130	- 30	- 130		mA	
	- 20			- 100	- 20	- 100				
I _{CCH}		V _{CC} = MAX, All outputs open	See Note 3		46 65		46 65		mA	
I _{CCL}			See Note 4		48 70		48 70			
I _{CCZ}			See Note 5		48 70		48 70			

† 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 short-circuit should not exceed one second.

NOTES: 3. I_{CCH} is measured after two 4.5 V to 0-V to 4.5-V pulses have been applied to CCK and RCK while \bar{G} is grounded and all other inputs are at 4.5 V.

4. I_{CCL} is measured after two 0-V to 4.5-V to 0-V pulses have been applied to CCK and RCK while all other inputs are grounded.

5. I_{CCZ} is measured after two 0-V to 4.5-V to 0-V pulses have been applied to CCK and RCK while \bar{G} is at 4.5 V and all other inputs are grounded.


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SYNCHRONOUS COUNTERS WITH OUTPUT REGISTERS
AND MULTIPLEXED 3-STATE OUTPUTS

switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$ (see note 6)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'LS690, 'LS691		'LS693		UNIT
				MIN	TYP	MAX	MIN	
tPLH	CCK↑	RCO	RL = 2 kΩ, CL = 15 pF	23	40	23	40	ns
tPHL				23	40	23	40	
tPLH	ENT	RCO		13	20	13	20	ns
tPHL				13	20	13	20	
tPLH	CCK↑	Q	RL = 667 Ω, CL = 45 pF	12	20	12	20	ns
tPHL				17	25	17	25	
tPLH	RCK↑	Q		12	20	12	20	ns
tPHL				17	25	17	25	
tPHL	CCLR↓	Q		23	40			ns
tPHL	RCLR↓	Q		20	30			ns
tPLH	R/C	Q		16	25	16	25	ns
tPHL				16	25	16	25	
tPZH	G↓	Q		19	30	19	30	ns
tPZL				19	30	19	30	
tPHZ	G↑	Q	RL = 667 Ω, CL = 5 pF	17	30	17	30	ns
tPLZ				17	30	17	30	

NOTE 6: Load circuits and voltage waveforms are shown in Section 1.

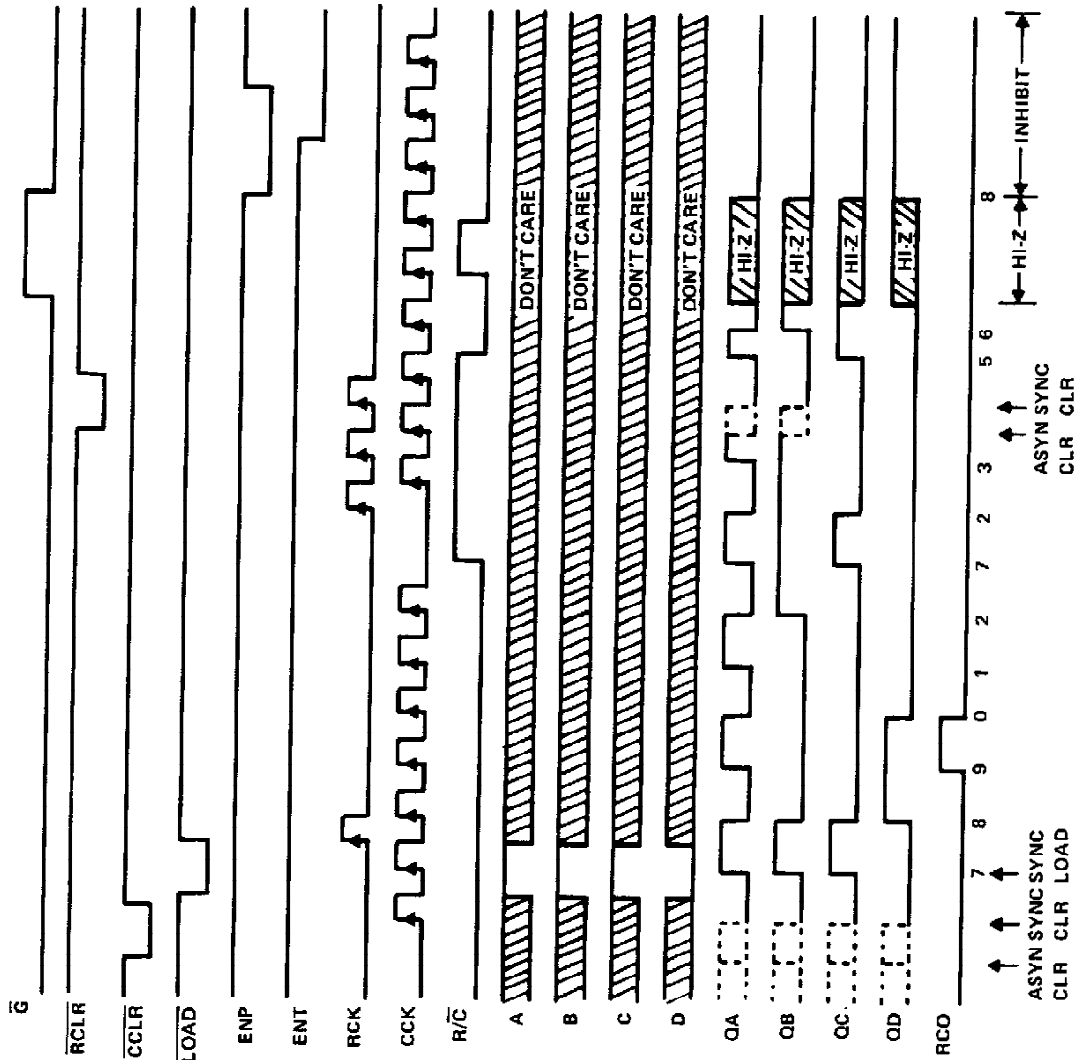
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typical operating sequences

'LS690 DECADE COUNTER, Asynchronous Clear

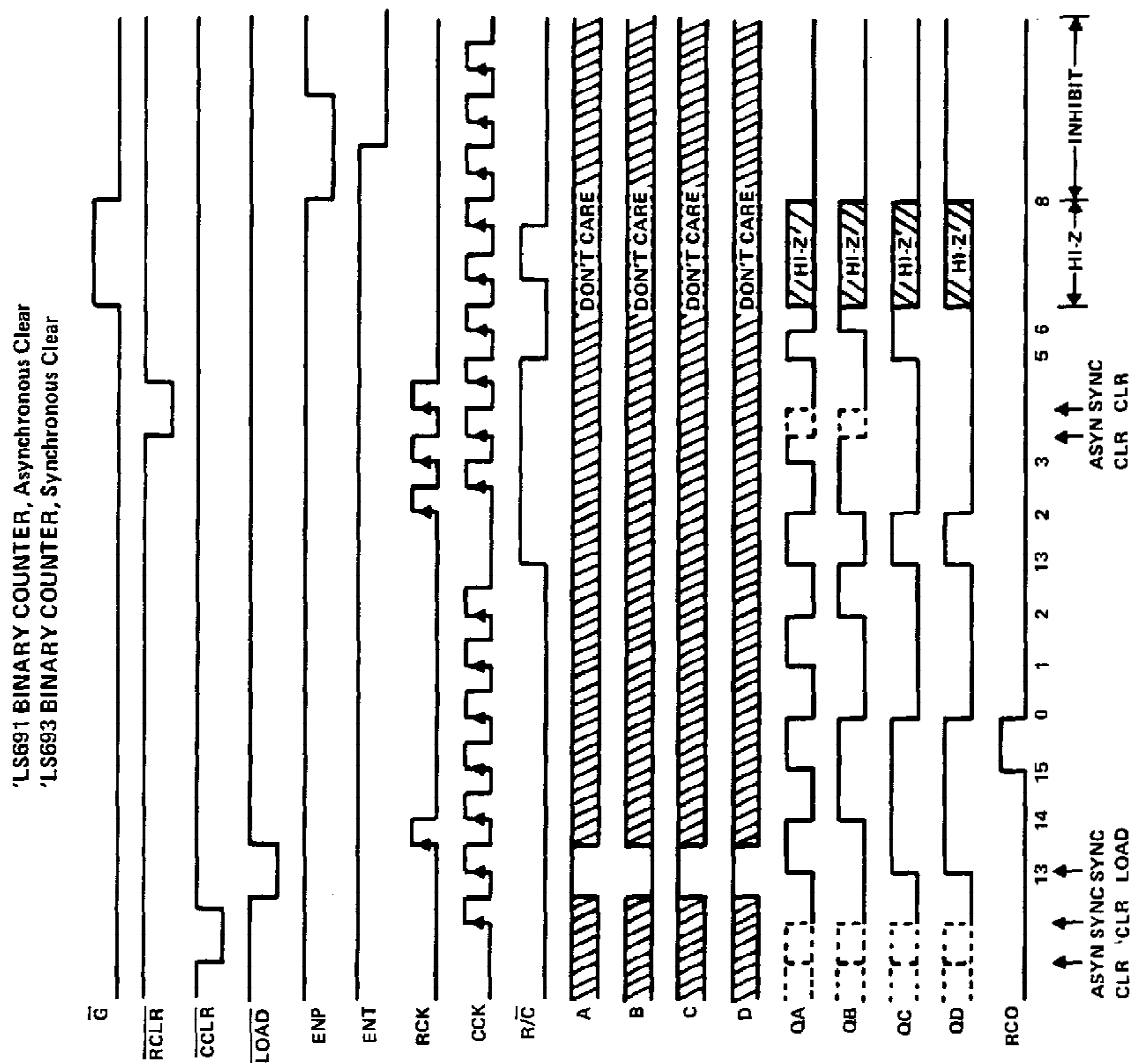


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typical operating sequences (continued)



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