

# TYPES SN54LS696 THRU SN54LS699, SN74LS696 THRU SN74LS699 SYNCHRONOUS UP/DOWN COUNTERS WITH OUTPUT REGISTERS AND MULTIPLEXED 3-STATE OUTPUTS

D2424, JANUARY 1981

- 4-Bit Counters/Registers
- Multiplexed Outputs for Counter or Latched Data
- 3-State Outputs Drive Bus Lines Directly
- 'LS696 . . . Decade Counter, Direct Clear
- 'LS697 . . . Binary Counter, Direct Clear
- 'LS698 . . . Decade Counter, Synchronous Clear
- 'LS699 . . . Binary Counter, Synchronous Clear

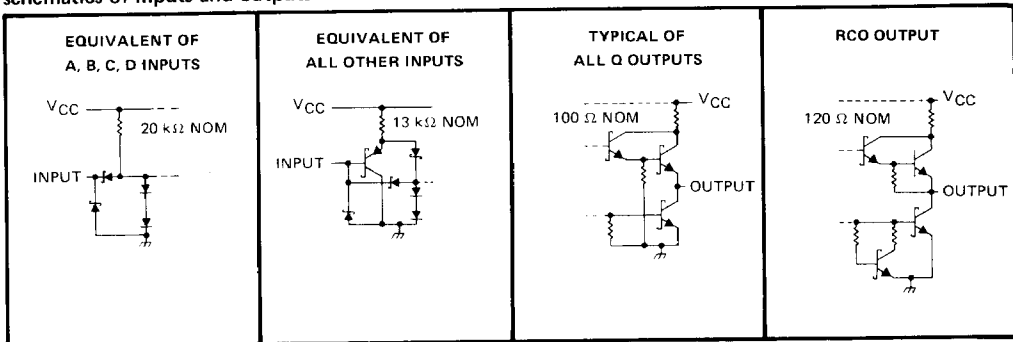
### description

These low-power Schottky LSI devices incorporate synchronous up/down 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 up/down counters are programmable from the data inputs and feature enable P and enable  $\bar{T}$  and a ripple-carry output for easy expansion. The register/counter select input R/C, selects the counter when low and the register when high for the three-state outputs, Q<sub>A</sub>, Q<sub>B</sub>, Q<sub>C</sub>, and Q<sub>D</sub>. These outputs are rated at 12 and 24 milliamperes (54LS/74LS) for good bus driving performance.

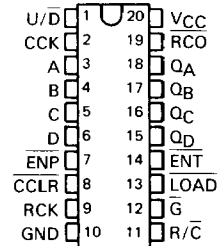
Both the counter clock CCK and register clock RCK are positive-edge triggered. The counter clear CCLR is active low and is a synchronous on the 'LS696 and 'LS697, synchronous on the 'LS698 and 'LS699. Loading of the counter is accomplished when  $\overline{LOAD}$  is taken low and a positive transition occurs on the counter clock CCK.

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

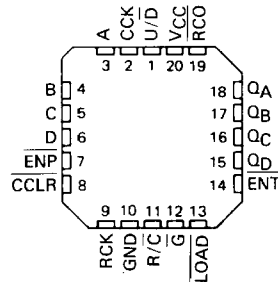
### schematics of inputs and outputs



SN54LS696 THRU SN54LS699 . . . J PACKAGE  
SN74LS696 THRU SN74LS699 . . . DW, J OR N PACKAGE  
(TOP VIEW)



SN54LS696 THRU SN54LS699 . . . FK PACKAGE  
SN74LS696 THRU SN74LS699 . . . FN PACKAGE  
(TOP VIEW)



3

TTL DEVICES

#### PRODUCTION DATA

This document contains 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.

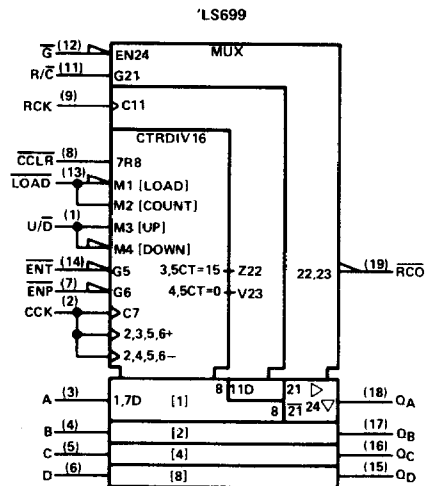
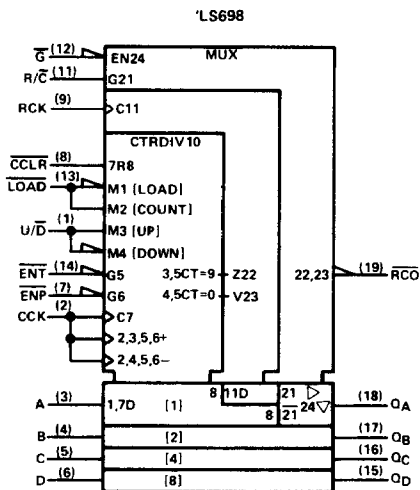
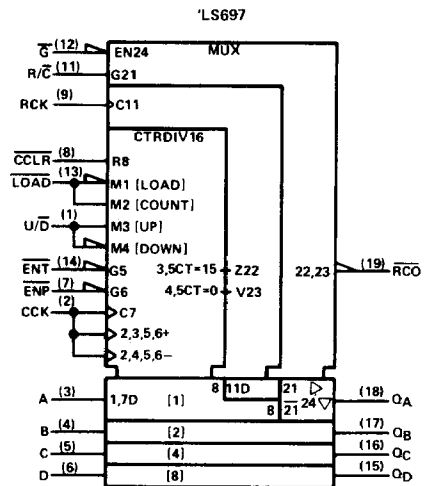
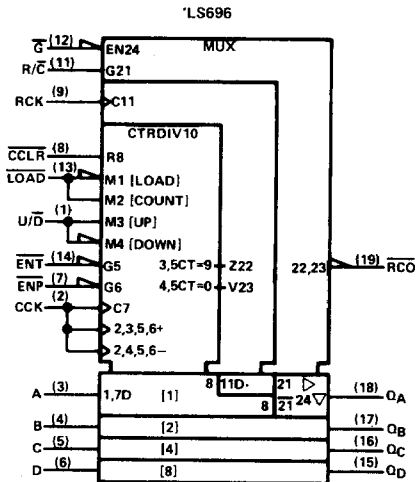


POST OFFICE BOX 225012 • DALLAS, TEXAS 75265

3-1315

# TYPES SN54LS696 THRU SN54LS699, SN74LS696 THRU SN74LS699 SYNCHRONOUS UP/DOWN COUNTERS WITH OUTPUT REGISTERS AND MULTIPLEXED 3-STATE OUTPUTS

logic symbols



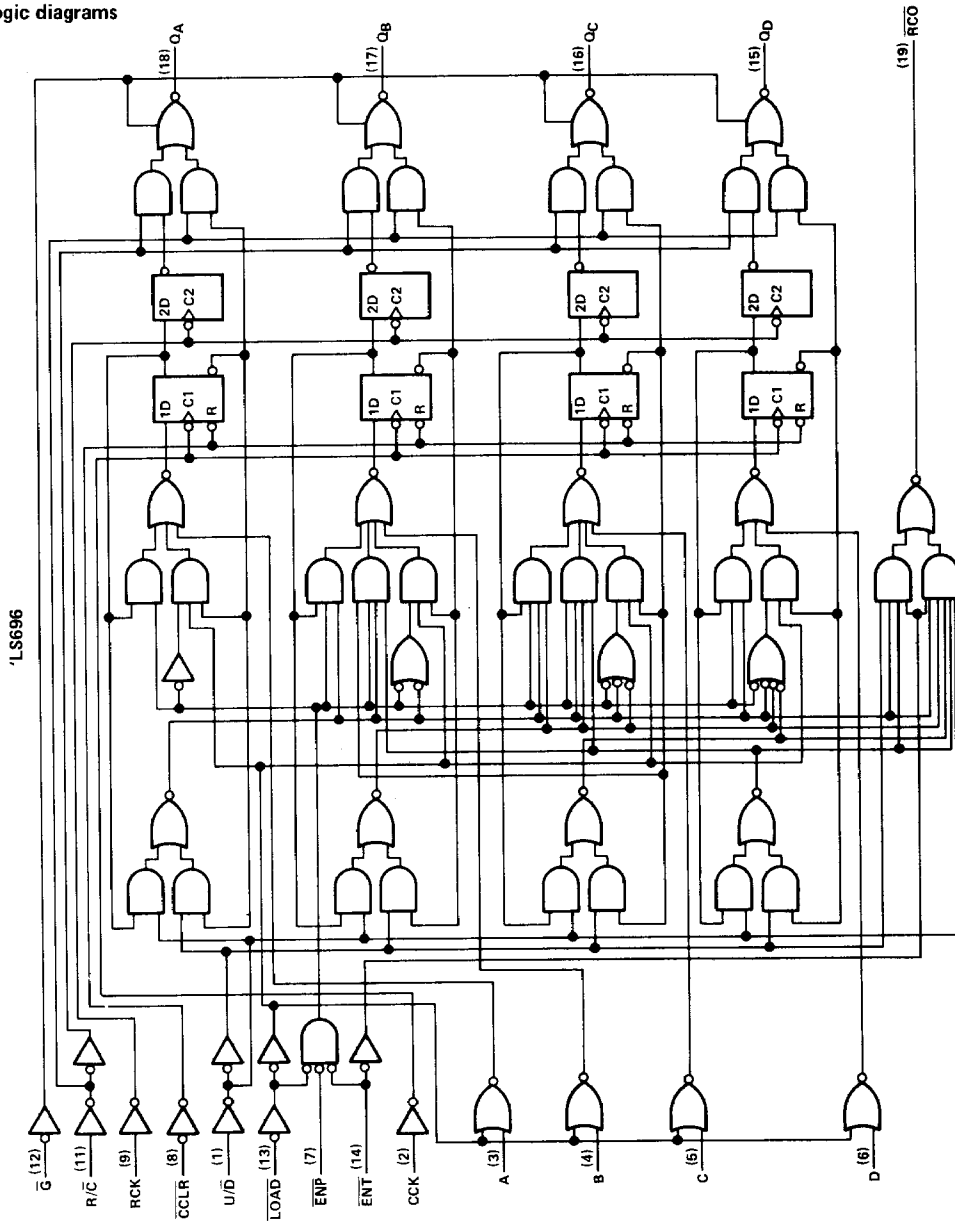
Pin numbers shown on logic notation are for DW, J or N packages.

3

TTL DEVICES

TYPES SN54LS696, SN74LS696  
 SYNCHRONOUS UP/DOWN COUNTERS  
 WITH OUTPUT REGISTERS AND MULTIPLEXED 3-STATE OUTPUTS

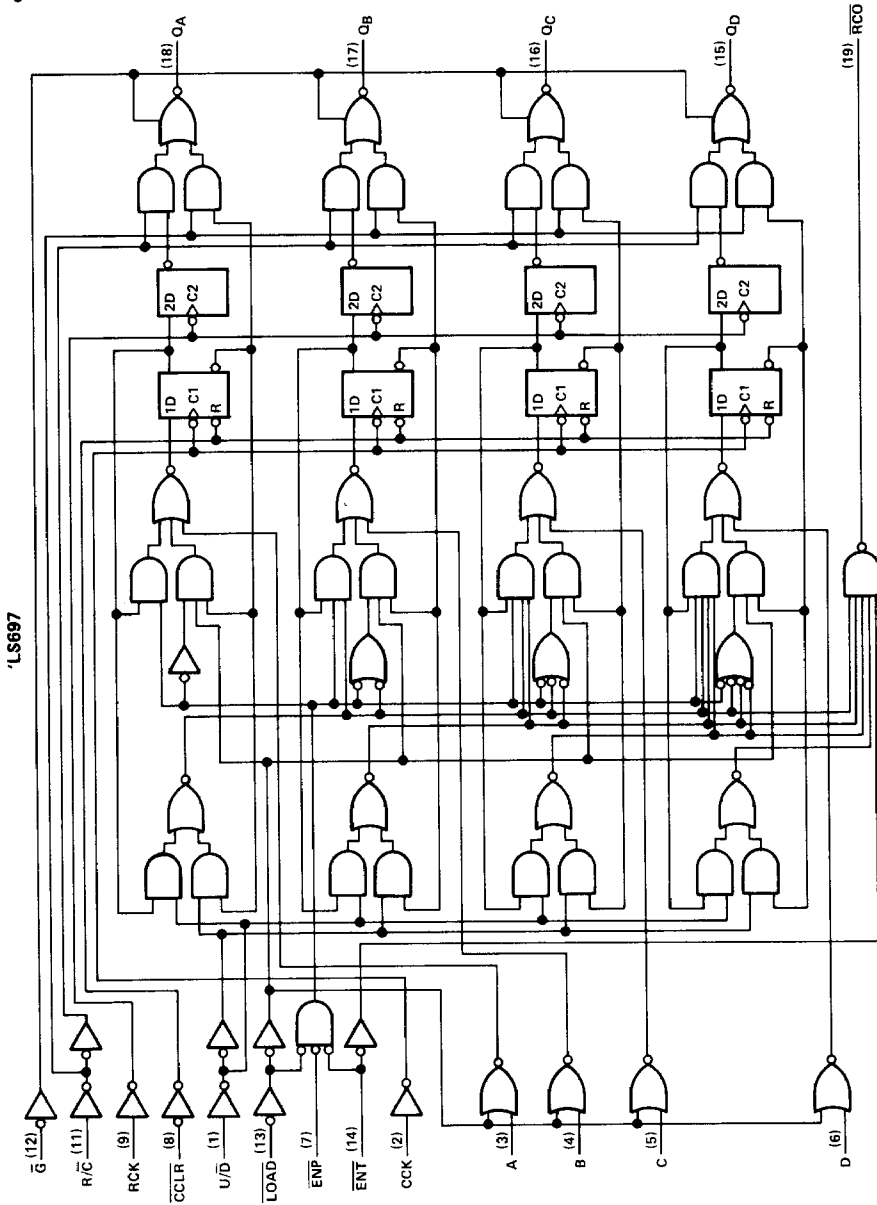
logic diagrams



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

**TYPES SN54LS697, SN74LS697**  
**SYNCHRONOUS UP/DOWN COUNTERS**  
**WITH OUTPUT REGISTERS AND MULTIPLEXED 3-STATE OUTPUTS**

logic diagrams (continued)

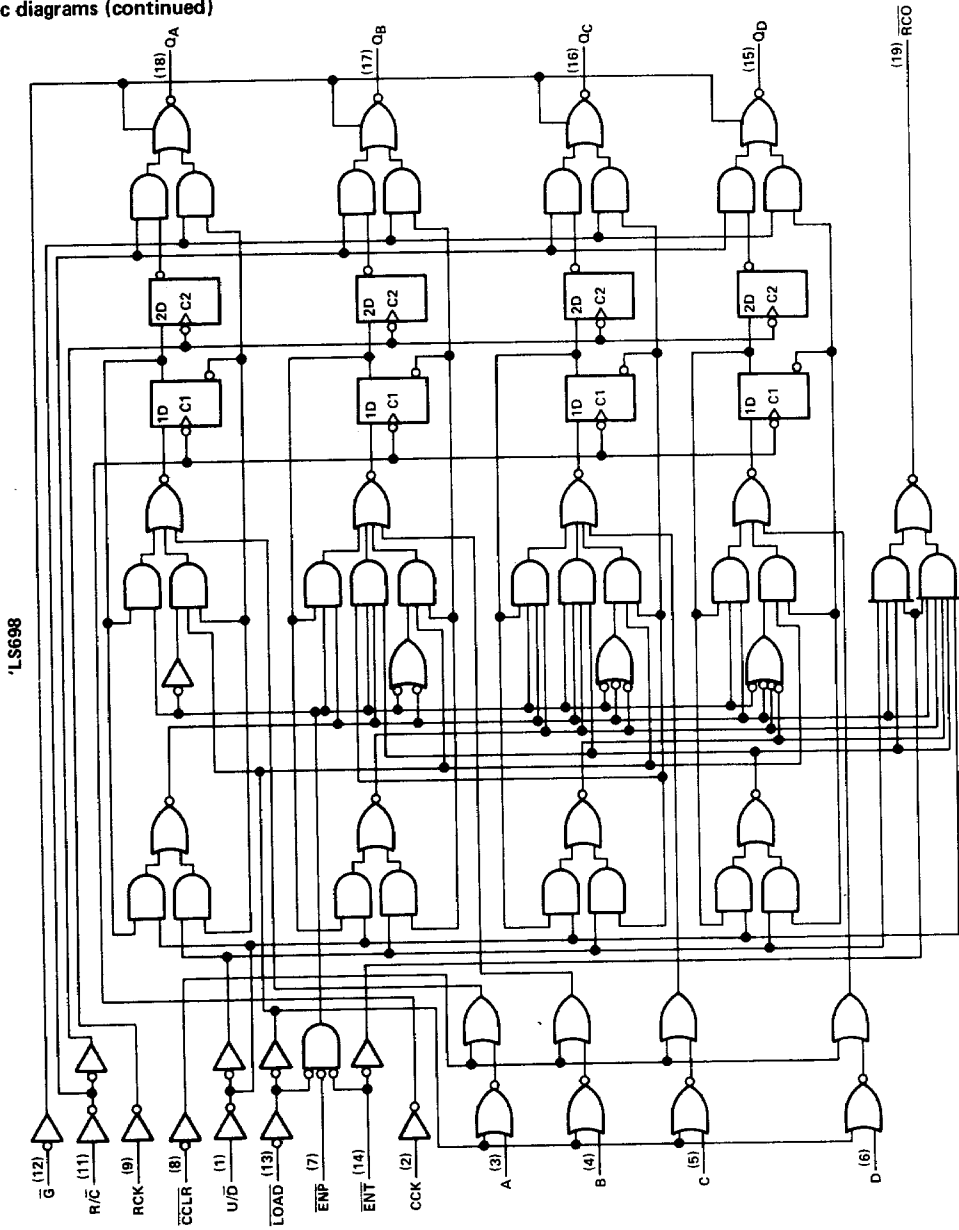


Pin numbers shown on logic notation are for DW, J, or N packages.

**TTL DEVICES**

TYPES SN54LS696, SN74LS696, SN54LS698, SN74LS698  
 SYNCHRONOUS UP/DOWN COUNTERS  
 WITH OUTPUT REGISTERS AND MULTIPLEXED 3-STATE OUTPUTS

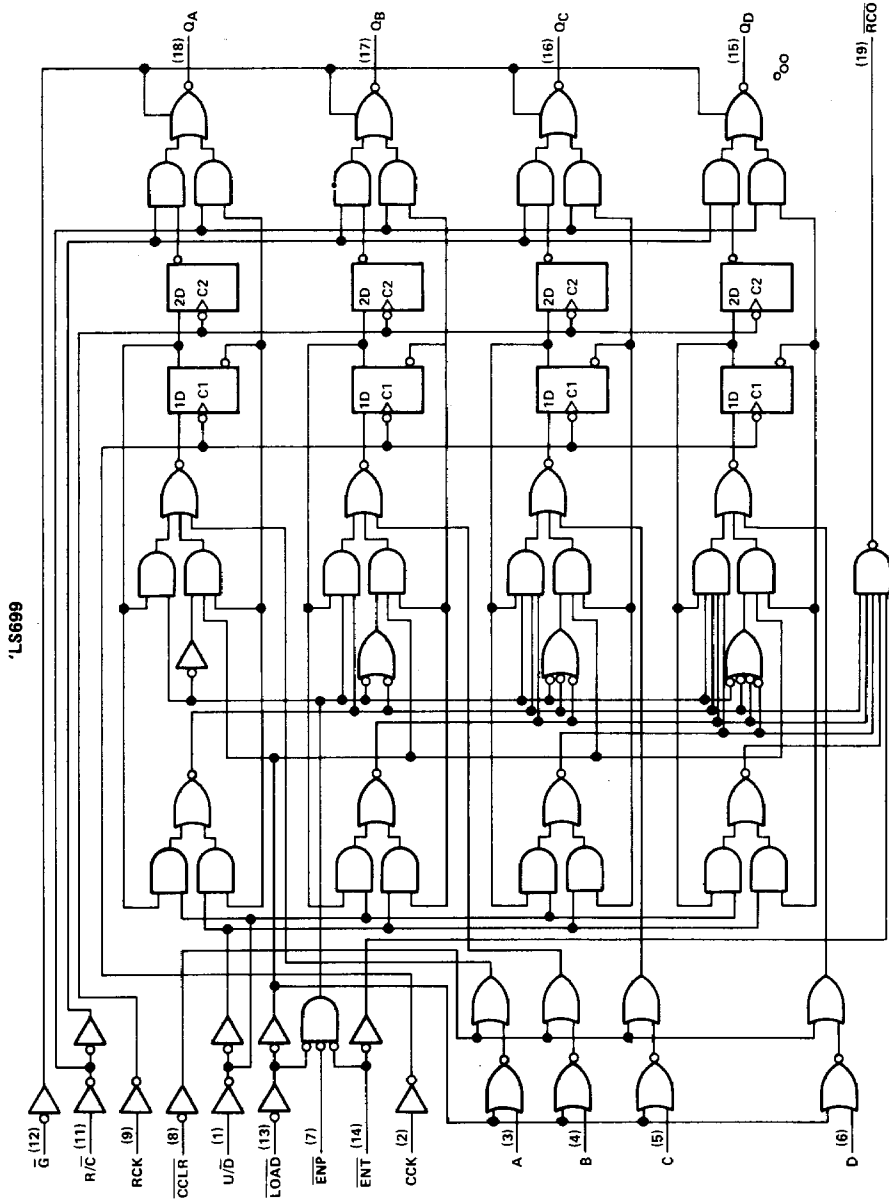
logic diagrams (continued)



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

**TYPES SN54LS697, SN74LS697, SN54LS699, SN74LS699**  
**SYNCHRONOUS UP/DOWN COUNTERS**  
**WITH OUTPUT REGISTERS AND MULTIPLEXED 3-STATE OUTPUTS**

logic diagrams (continued)



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

**3 TTL DEVICES**

'LS699

# TYPES SN54LS696 THRU SN54LS699, SN74LS696 THRU SN74LS699 SYNCHRONOUS UP/DOWN 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: SN54LS696 thru SN54LS699	-55°C to 125°C
SN74LS696 thru SN74LS699	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
$I_{OH}$	High-level output current	Q		-1	-2.6		mA	
		$\overline{RCO}$		-0.4	-0.4			
$I_{OL}$	Low-level output current	Q		12	24		mA	
		$\overline{RCO}$		4	8			
$f_{clock}$	Clock frequency	CCK	0	20	0	20	MHz	
		RCK	0	20	0	20		
$t_w$	Pulse duration	CCK high or low		25	25		ns	
		RCK high or low		25	25			
		'LS696, 'LS697 CCLR low		20	20			
$t_{su}$	Setup time before CCK ↑	A thru D		30	30		ns	
		$\overline{ENP}$ or $\overline{ENT}$		30	30			
		LOAD		30	30			
		U/ $\overline{D}$		35	35			
		'LS696, 'LS697, $\overline{CCLR}$ inactive		25	25			
		'LS698, 'LS699, $\overline{CCLR}$		30	30			
$t_{su}$	Setup time CCK ↑ before RCK ↑ (see Note 2)	30		30		ns		
$t_h$	Hold time	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.

3

TTL DEVICES

# TYPES SN54LS696 THRU SN54LS699, SN74LS696 THRU SN74LS699 SYNCHRONOUS UP/DOWN 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 <sub>IH</sub> High-level input voltage		2			2			V
V <sub>IL</sub> Low-level input voltage				0.7			0.8	V
V <sub>IK</sub> Input clamp voltage	V <sub>CC</sub> =MIN, I <sub>I</sub> =-18 mA			-1.5			-1.5	V
V <sub>OH</sub> High-level output voltage	Any Q	V <sub>CC</sub> =MIN, V <sub>IH</sub> =2 V, V <sub>IL</sub> =V <sub>IL</sub> max	I <sub>OH</sub> =-1 mA	2.4	3.1			V
	Any Q		I <sub>OH</sub> =-2.6 mA			2.4	3.1	
	RCO		I <sub>OH</sub> =-400 μA	2.5	3.2	2.7	3.2	
V <sub>OL</sub> Low-level output voltage	Any Q	V <sub>CC</sub> =MIN, V <sub>IH</sub> =2 V, V <sub>IL</sub> =V <sub>IL</sub> max	I <sub>OL</sub> =12 mA		0.25	0.4	0.25	0.4
	Any Q		I <sub>OL</sub> =24 mA				0.35	0.5
	RCO		I <sub>OL</sub> =4 mA		0.25	0.4	0.25	0.4
	RCO		I <sub>OL</sub> =8 mA				0.35	0.5
I <sub>OZH</sub> Off-state output current, high-level voltage applied	Any Q	V <sub>CC</sub> =MAX, $\bar{G}$ at 2 V, V <sub>O</sub> =2.7 V				20	20	μA
I <sub>OZL</sub> Off-state output current, low-level voltage applied	Any Q	V <sub>CC</sub> =MAX, $\bar{G}$ at 2 V, V <sub>O</sub> =0.4 V				-20	-20	μA
I <sub>I</sub> Input current at maximum input voltage		V <sub>CC</sub> =MAX, V <sub>I</sub> =7 V			0.1		0.1	mA
I <sub>IH</sub> High-level input current		V <sub>CC</sub> =MAX, V <sub>I</sub> =2.7 V			20		20	μA
I <sub>IL</sub> Low-level input current	A thru D	V <sub>CC</sub> =MAX, V <sub>I</sub> =0.4 V				-0.4	-0.4	mA
	All others					-0.2	-0.2	
I <sub>OS</sub> Short-circuit output current §	Any Q	V <sub>CC</sub> =MAX, V <sub>O</sub> =0 V		-30	-130	-30	-130	mA
	RCO			-20	-100	-20	-100	
I <sub>CC</sub> H Supply current, outputs high		V <sub>CC</sub> =MAX,	See Note 3	46	65	46	65	mA
I <sub>CC</sub> L Supply current, outputs low		All outputs open	See Note 4	48	70	48	70	
I <sub>CC</sub> Z Supply current, outputs off			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<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

§ Only one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

NOTES: 3. I<sub>CC</sub>H 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<sub>CC</sub>L 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<sub>CC</sub>Z 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.

switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C (see note 6)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'LS696, 'LS697			'LS698, 'LS699			UNIT	
				MIN	TYP	MAX	MIN	TYP	MAX		
t <sub>PLH</sub>	CCK↑	RCO	R <sub>L</sub> = 2 kΩ, C <sub>L</sub> = 15 pF	23	40		23	40	ns		
t <sub>PHL</sub>				23	40		23	40	ns		
t <sub>PLH</sub>				13	20		13	20	ns		
t <sub>PHL</sub>	ENT	RCO		13	20		13	20	ns		
t <sub>PLH</sub>				CCK↓	Q	12	20		12	20	ns
t <sub>PHL</sub>						17	25		17	25	ns
t <sub>PLH</sub>	RCK↓	Q	12			20		12	20	ns	
t <sub>PHL</sub>			17	25		17	25	ns			
t <sub>PLH</sub>			CCLR↓	Q	23	40				ns	
t <sub>PHL</sub>	16	25				16	25	ns			
t <sub>PLH</sub>	R/C	Q			16	25		16	25	ns	
t <sub>PHL</sub>			19	30		19	30	ns			
t <sub>PZH</sub>			$\bar{G}$ ↓	Q	19	30		19	30	ns	
t <sub>PZL</sub>	17	30				17	30	ns			
t <sub>PHZ</sub>	$\bar{G}$ ↑	Q			17	30		17	30	ns	
t <sub>PLZ</sub>			17	30		17	30	ns			

NOTE 6: See General Information Section for load circuits and voltage waveforms.

3

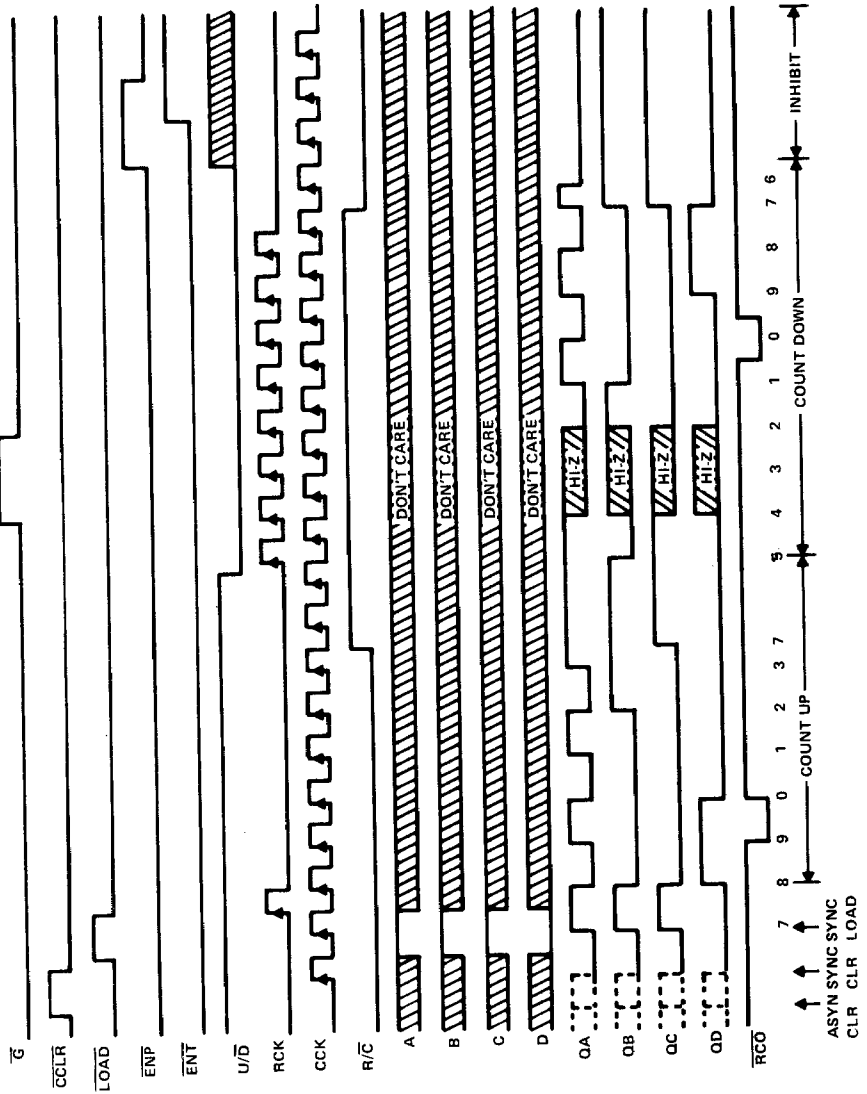
TTL DEVICES



TYPES SN54LS696, SN54LS698, SN74LS696, SN74LS698  
 SYNCHRONOUS UP/DOWN COUNTERS  
 WITH OUTPUT REGISTERS AND MULTIPLEXED 3-STATE OUTPUTS

typical operating sequences

'LS696 DECADE COUNTER, Asynchronous Clear  
 'LS698 DECADE COUNTER, Synchronous Clear



TTL DEVICES **3**

TYPES SN54LS697, SN54LS699, SN74LS697, SN74LS699  
 SYNCHRONOUS UP/DOWN COUNTERS  
 WITH OUTPUT REGISTERS AND MULTIPLEXED 3-STATE OUTPUTS

typical operating sequences (continued)

3

TTL DEVICES

'LS697 BINARY COUNTER, Asynchronous Clear  
 'LS699 BINARY COUNTER, Synchronous Clear

