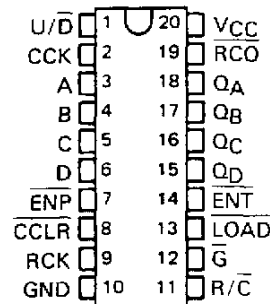


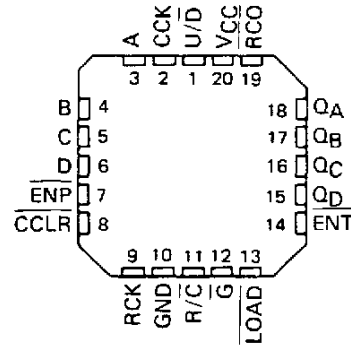
SN54LS696, SN54LS697, SN54LS699, SN74LS696, SN74LS697, SN74LS699
SYNCHRONOUS UP/DOWN COUNTERS
WITH OUTPUT REGISTERS AND MULTIPLEXED 3-STATE OUTPUTS
SDLS199 D2424, JANUARY 1981—REVISED MARCH 1988

- 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
- 'LS699 . . . Binary Counter, Synchronous Clear

SN54LS696, SN54LS697,
SN54LS699 . . . J OR W PACKAGE
SN74LS696, SN74LS697,
SN74LS699 . . . DW OR N PACKAGE
(TOP VIEW)



SN54LS696, SN54LS697,
SN54LS699 . . . FK PACKAGE
(TOP VIEW)



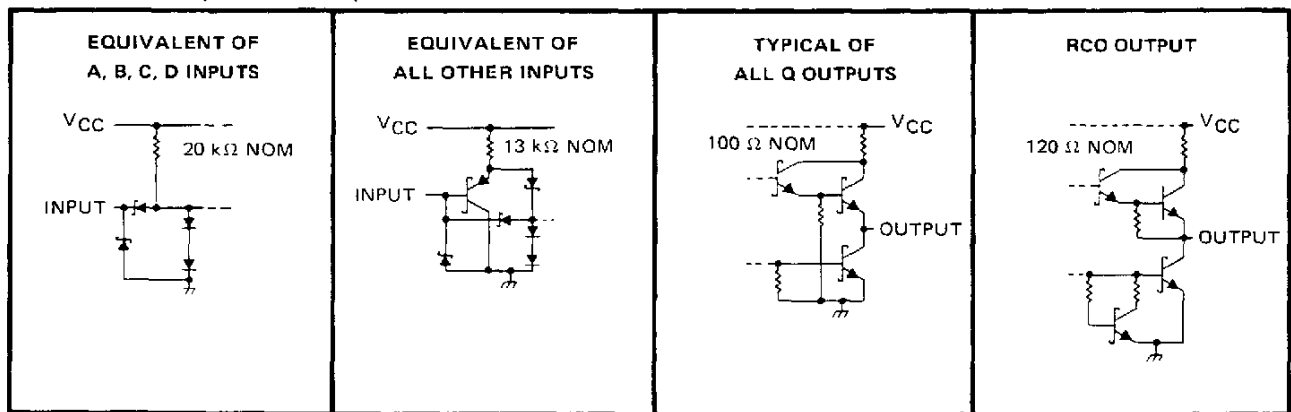
description

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 \bar{P} and enable \bar{T} and a ripple-carry output for easy expansion. The register/counter select input R/\bar{C} , selects the counter when low and 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.

Both the counter CCK and register clock RCK are positive-edge triggered. The counter clear \overline{CCLR} is active low and is asynchronous on the 'LS696 and 'LS697, synchronous on the '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

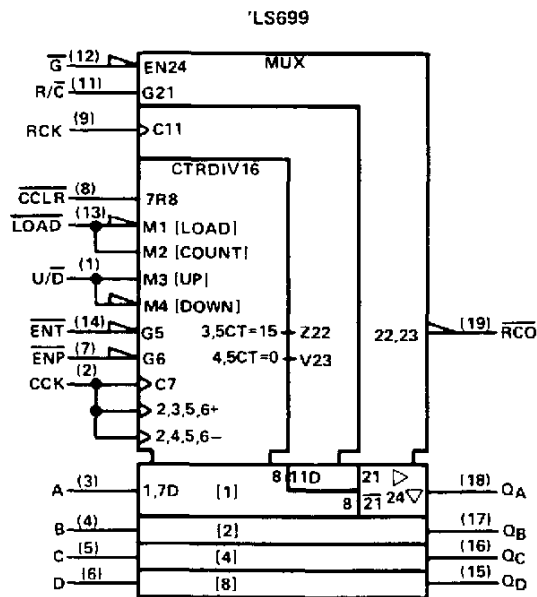
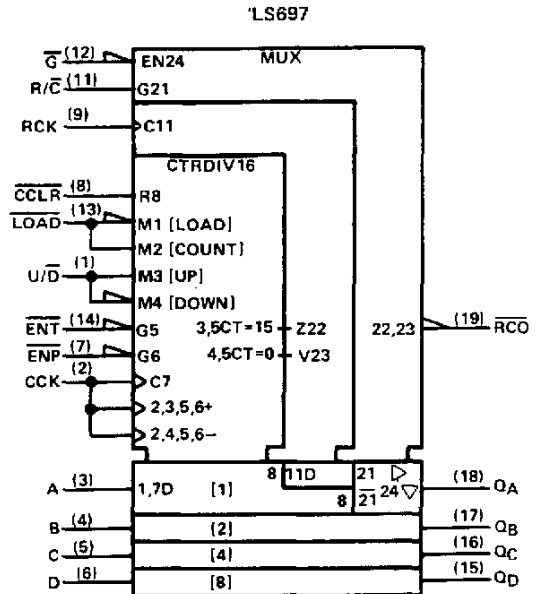
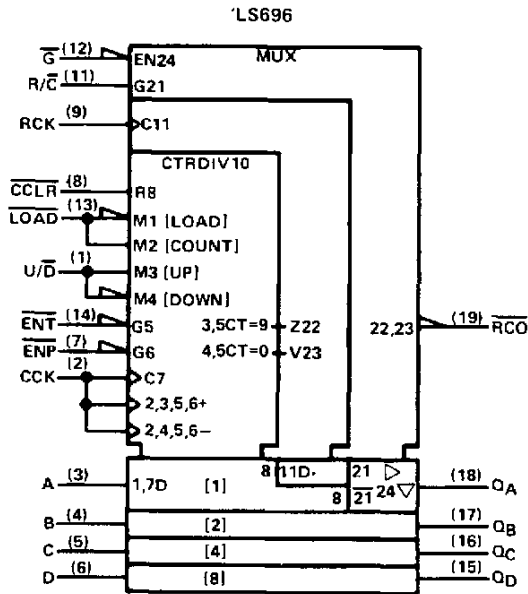


PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



SN54LS696, SN54LS697, SN54LS699, SN74LS696, SN74LS697, SN74LS699
SYNCHRONOUS UP/DOWN COUNTERS
WITH OUTPUT REGISTERS AND MULTIPLEXED 3-STATE OUTPUTS

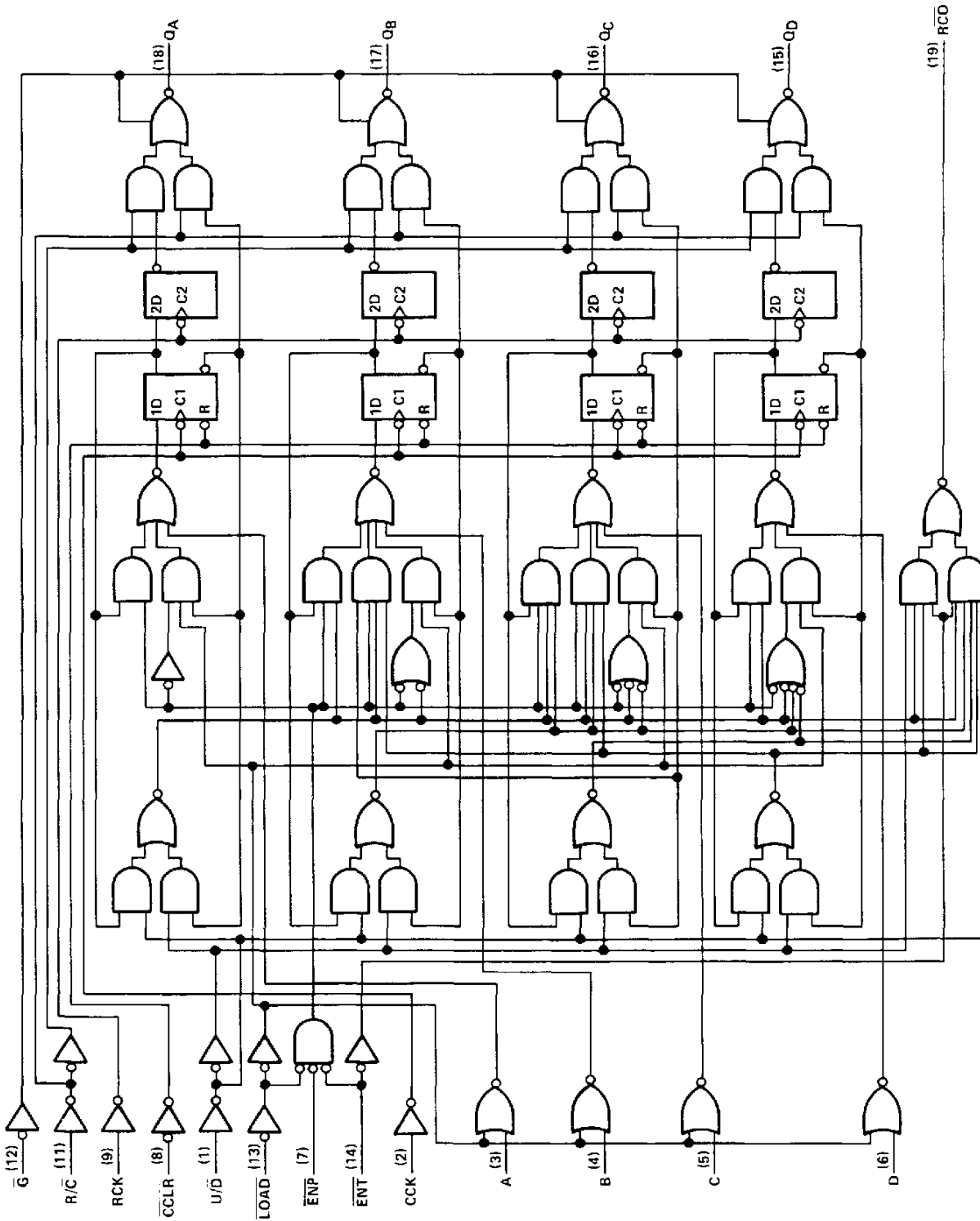
logic symbols†



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

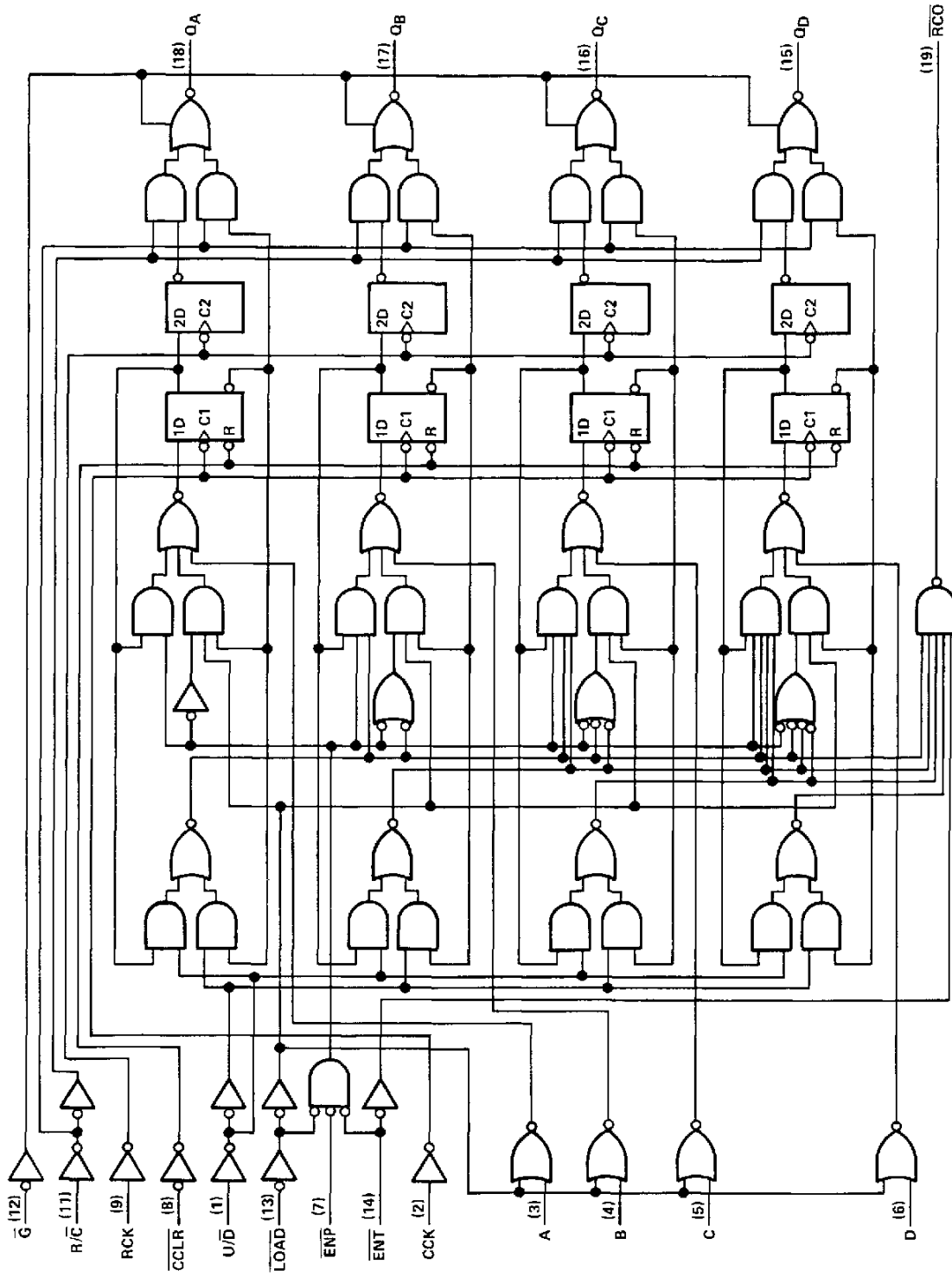
SN54LS696, SN74LS696
SYNCHRONOUS UP/DOWN COUNTERS
WITH OUTPUT REGISTERS AND MULTIPLEXED 3-STATE OUTPUTS

logic diagrams (positive logic)



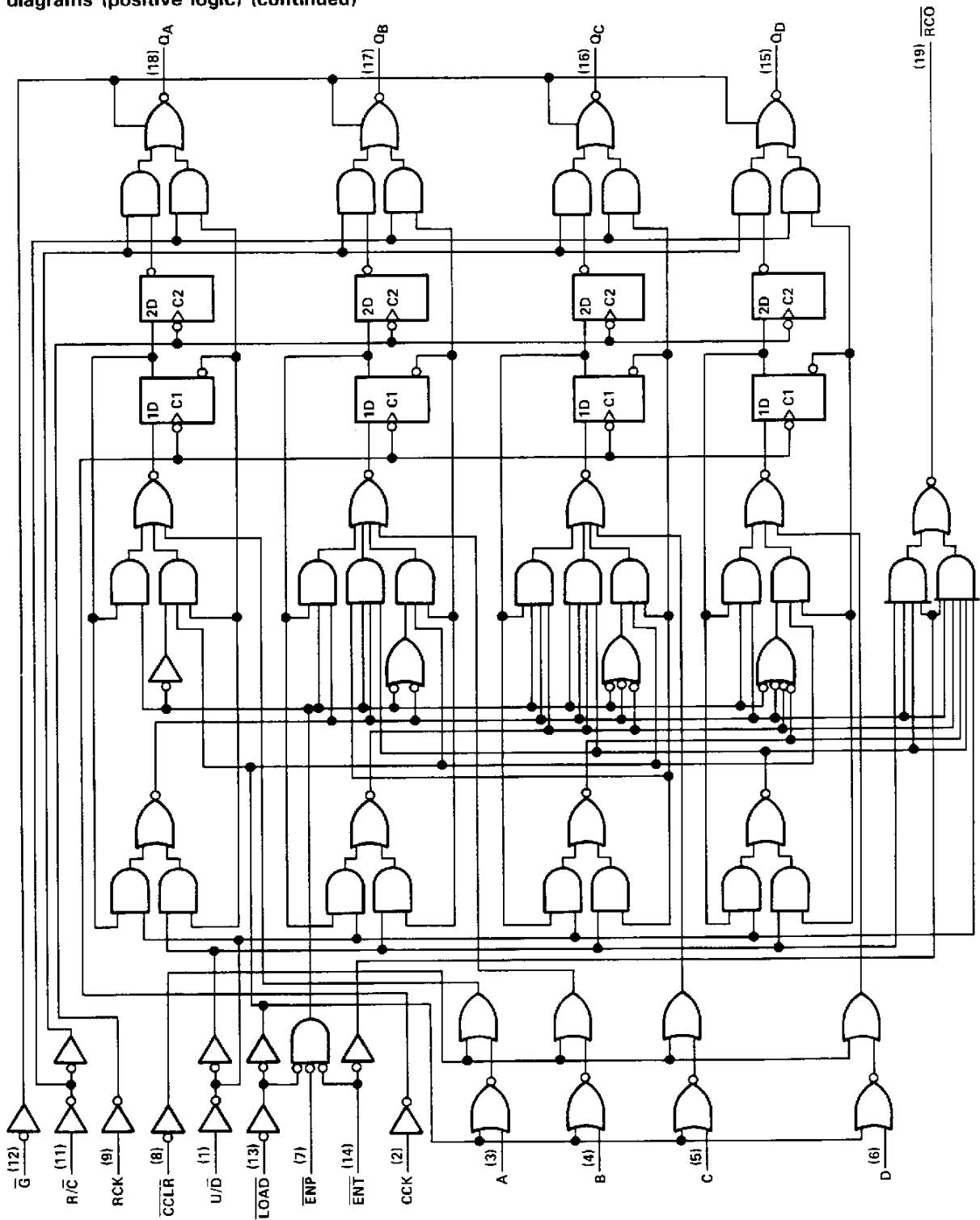
SN54LS697, SN74LS697
SYNCHRONOUS UP/DOWN COUNTERS
WITH OUTPUT REGISTERS AND MULTIPLEXED 3-STATE OUTPUTS

logic diagrams (positive logic) (continued)



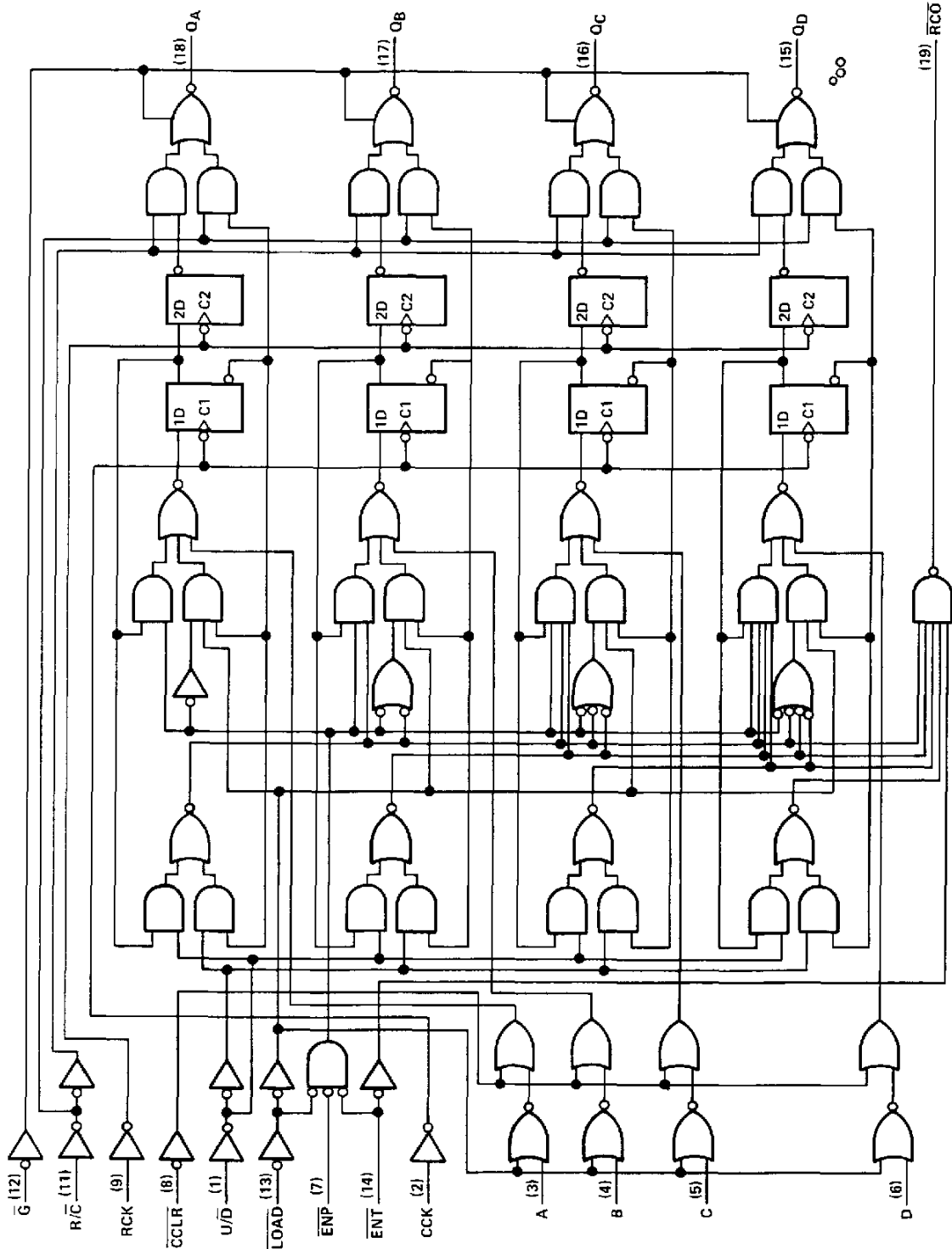
SN54LS698, SN74LS698
SYNCHRONOUS UP/DOWN COUNTERS
WITH OUTPUT REGISTERS AND MULTIPLEXED 3-STATE OUTPUTS

logic diagrams (positive logic) (continued)



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

logic diagrams (positive logic) (continued)



SN54LS696, SN54LS697, SN54LS699, SN74LS696, SN74LS697, 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, SN54LS697, SN54LS699	-55°C to 125°C
SN74LS696, SN74LS697, SN74LS699	0°C to 70°C
Storage temperature range	-65°C to 150°C

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

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{RCD}		-0.4			-0.4	
I_{OL}	Low-level output current	Q		12			24	mA
		\overline{RCD}		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 \overline{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			
'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.



SN54LS696, SN54LS697, SN54LS699, SN74LS696, SN74LS697, 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 _{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	Any Q	V _{CC} =MIN, V _{IH} =2 V, V _{IL} =V _{IL} max	I _{OH} =-1 mA	2.4	3.1			V	
		Any Q		I _{OH} =-2.6 mA			2.4	3.1		
		\overline{RCO}		I _{OH} =-400 μ A	2.5	3.2	2.7	3.2		
V _{OL}	Low-level output voltage	Any Q	V _{CC} =MIN, V _{IH} =2 V, V _{IL} =V _{IL} max	I _{OL} =12 mA		0.25	0.4	0.25	0.4	V
		Any Q		I _{OL} =24 mA				0.35	0.5	
		\overline{RCO}		I _{OL} =4 mA		0.25	0.4	0.25	0.4	
		\overline{RCO}		I _{OL} =8 mA				0.35	0.5	
I _{OZH}	Off-state output current, high-level voltage applied	Any Q	V _{CC} =MAX, \overline{G} at 2 V, V _O =2.7 V			20		20	μ A	
I _{OZL}	Off-state output current, low-level voltage applied	Any Q	V _{CC} =MAX, \overline{G} at 2 V, V _O =0.4 V			-20		-20	μ A	
I _I	Input current at maximum input voltage		V _{CC} =MAX, V _I =7 V			0.1		0.1	mA	
I _{IH}	High-level input current		V _{CC} =MAX, V _I =2.7 V			20		20	μ A	
I _{IL}	Low-level input current	A thru D	V _{CC} =MAX, V _I =0.4 V			-0.4		-0.4	mA	
		All others				-0.2		-0.2		
I _{OS}	Short-circuit output current§	Any Q	V _{CC} =MAX, V _O =0 V		-30	-130	-30	-130	mA	
		\overline{RCO}			-20	-100	-20	-100		
I _{CCH}	Supply current, outputs high		V _{CC} =MAX, All outputs open	See Note 3	46	65	46	65	mA	
I _{CCL}	Supply current, outputs low	See Note 4		48	70	48	70			
I _{CCZ}	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_{CC} = 5 V, T_A = 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_{CCH} is measured after two 4.5 V to 0 V to 4.5 V pulses have been applied to CCK and RCK while \overline{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 \overline{G} is at 4.5 V and all other inputs are grounded.

switching characteristics, V_{CC} = 5 V, T_A = 25°C (see note 6)

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

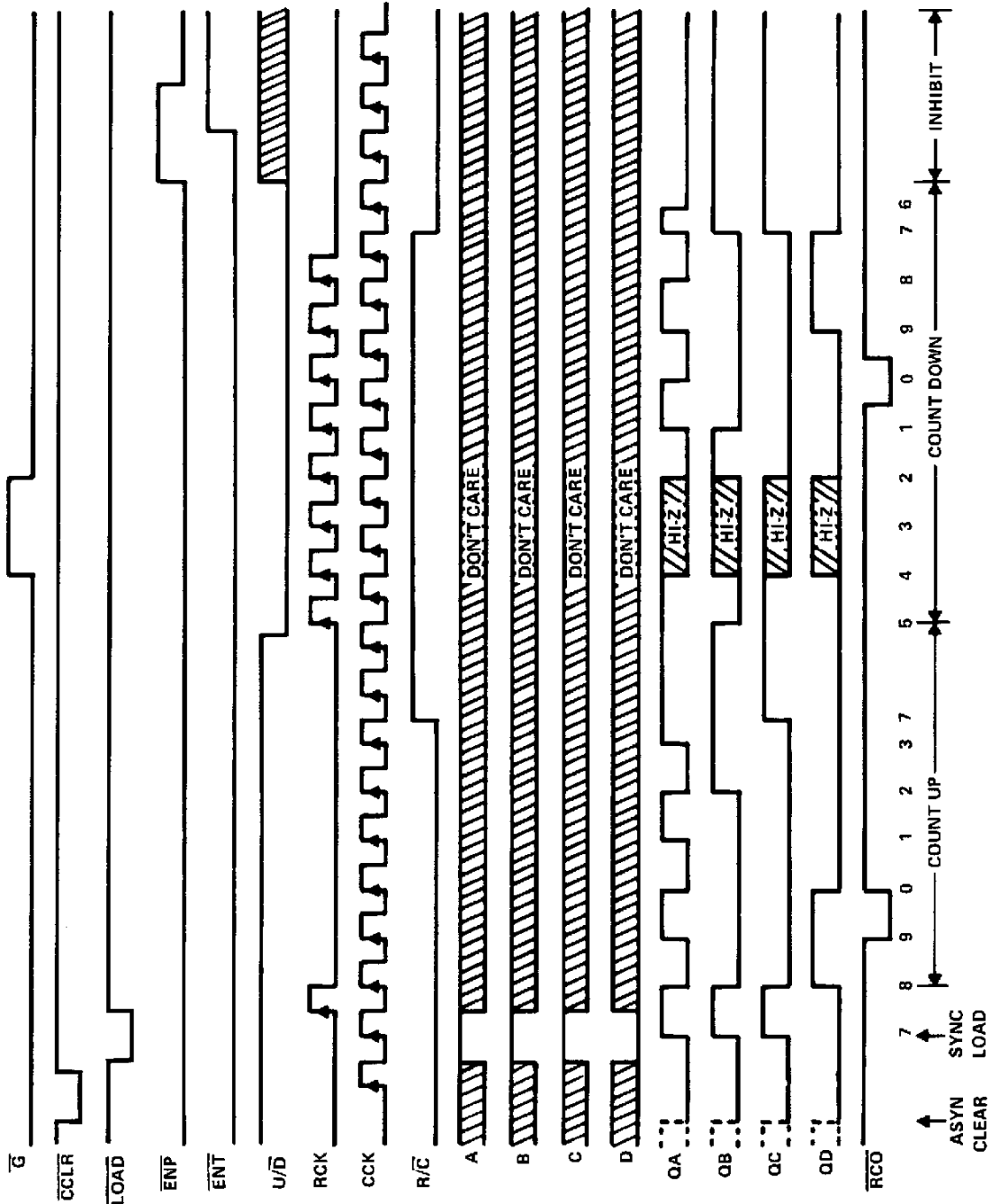
NOTE 6: Load circuits and voltage waveforms are shown in Section 1.



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

typical operating sequences

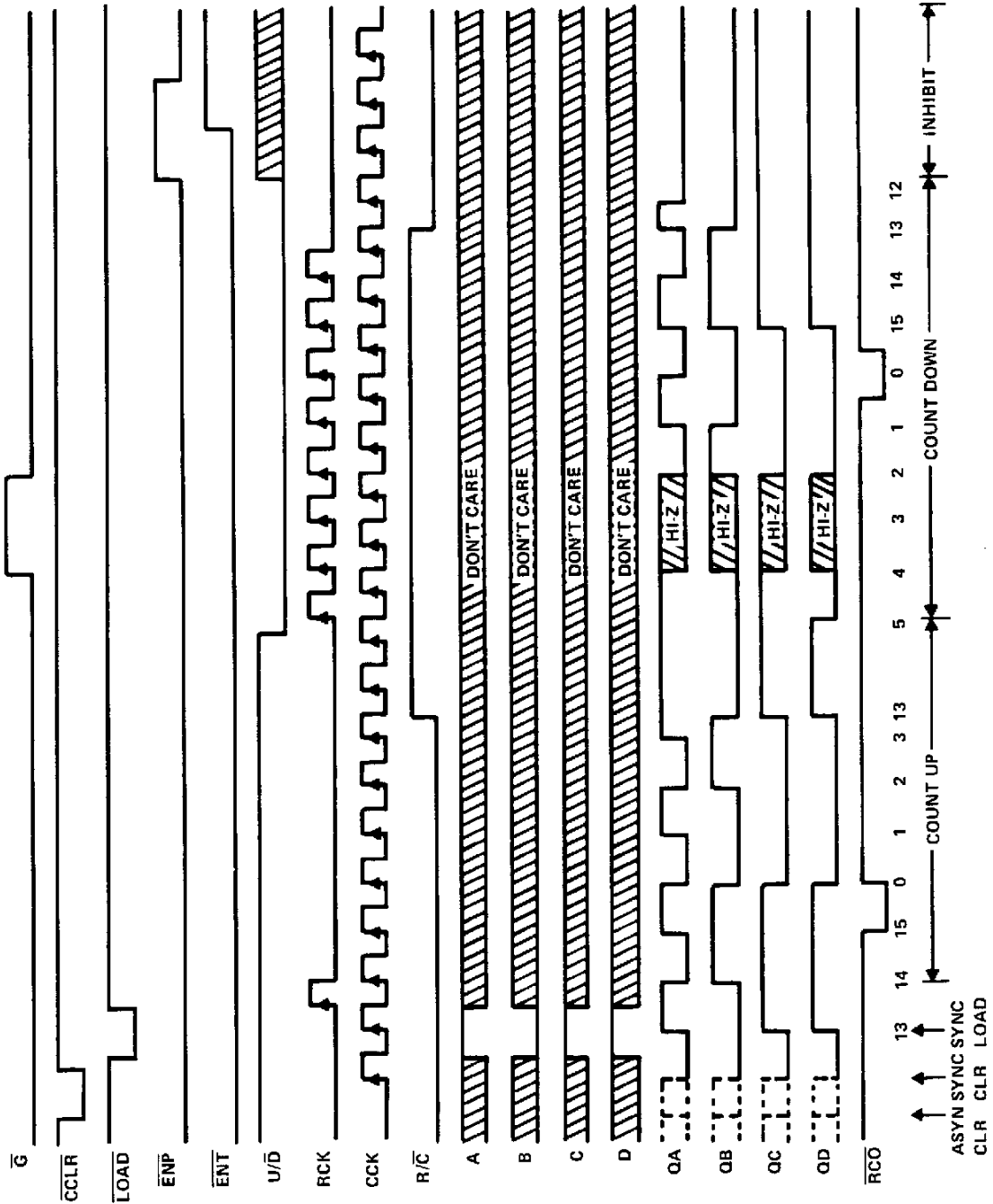
'LS696 DECADE COUNTER, Asynchronous Clear



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

typical operating sequences (continued)

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



TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74LS697NSR	SO	NS	20	2000	330.0	24.4	8.2	13.0	2.5	12.0	24.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LS697NSR	SO	NS	20	2000	346.0	346.0	41.0

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN74LS697DW	ACTIVE	SOIC	DW	20	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LS697	Samples
SN74LS697N	ACTIVE	PDIP	N	20	20	RoHS & Non-Green	NIPDAU	N / A for Pkg Type	0 to 70	SN74LS697N	Samples
SNJ54LS697J	ACTIVE	CDIP	J	20	20	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	SNJ54LS697J	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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OTHER QUALIFIED VERSIONS OF SN54LS697, SN74LS697 :

- Catalog : [SN74LS697](#)
- Military : [SN54LS697](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

TUBE


*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
SN74LS697DW	DW	SOIC	20	25	507	12.83	5080	6.6
SN74LS697N	N	PDIP	20	20	506	13.97	11230	4.32

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package is hermetically sealed with a ceramic lid using glass frit.
 - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - $\triangle D$ The 20 pin end lead shoulder width is a vendor option, either half or full width.

EXAMPLE BOARD LAYOUT

DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE
SCALE:6X



SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DW0020A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:6X

4220724/A 05/2016

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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