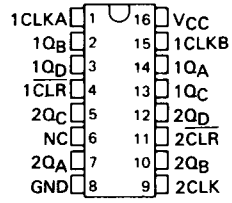
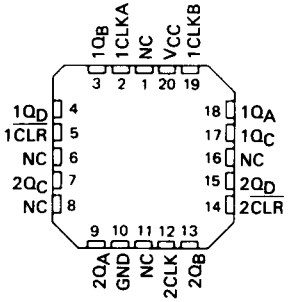
DECEMBER 1983 – REVISED MARCH 1988

- **Heavy Duty Outputs I_{OL} Rated at 8mA/16 mA**
- **Counter One of Either 'LS68 or 'LS69 Has Individual Clicks for the A Flip-Flop**
- **Direct Clear for Each 4-Bit Counter**
- **Guaranteed Maximum Count Frequency is 50 MHz for 'LS69 and 40 MHz for 'LS68**

5N54LS68, SN54LS69 . . . J PACKAGE
SN74LS68, SN74LS69 . . . D OR N PACKAGE
(TOP VIEW)



SN54LS68, SN54LS69 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

description

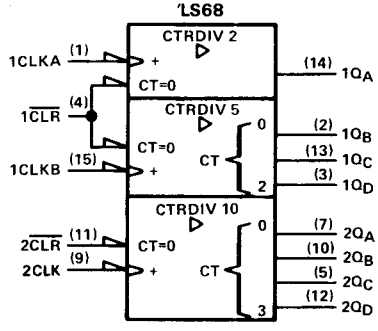
Each of the 'LS68 and 'LS69 circuits contain two four-bit counters. The 'LS68 is a dual decade counter, while the 'LS69 is a dual binary counter. Counter number one of both the 'LS68 and 'LS69 has two clock pins. Clock 1 is for the A flip-flop, while clock 2 is for the B, C, D flip-flops. Counter one of the 'LS68 can perform bi-quinary counting. All $1Q_A$ outputs are rated with sufficient I_{OL} to drive clock 2 while maintaining a full fan-out.

All clocks trigger on the high-to-low transition of the clock pulse. All counters have direct overriding clear pins which, when low, reset Q_A, Q_B, Q_C, and Q_D low regardless of the state of the clock.

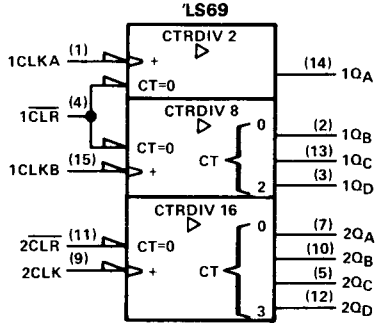
The SN54LS68 and SN54LS69 circuits are characterized for operation over the full military temperature range of −55°C to 125°C. The SN74LS68 and SN74LS69 circuits are characterized for operation from 0°C to 70°C

logic symbols†

'LS68



'LS69



†These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for D, J, and N packages.

count sequence tables

'LS68 DECADE COUNTER
BCD COUNT SEQUENCE
(See Note 1)
Applies to Counters 1 & 2

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

'LS68 DECADE COUNTER
BI-QUINARY SEQUENCE
(See Note 2)
Applies to Counter 1 only

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

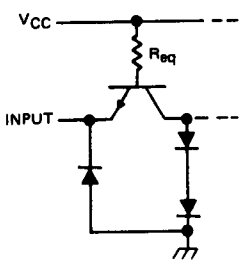
'LS69 BINARY COUNTER
BCD COUNT SEQUENCE
(See Note 3)
Applies to Counters 1 & 2

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: 1. Output $1Q_A$ is connected to 1CLK2 for BCD count.
2. Output $1Q_A$ is connected to 1CLK1 for bi-quinary count.
3. Output $1Q_A$ is connected to 1CLK2 for binary count.

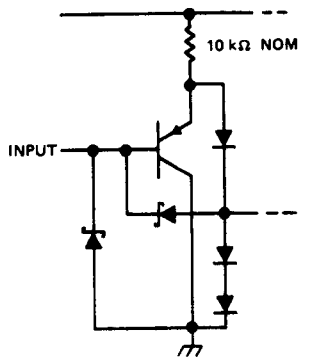
schematics of inputs and outputs

EQUIVALENT OF CLOCK INPUTS

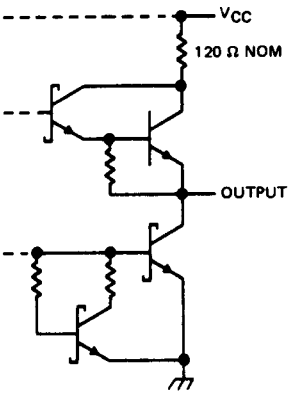


INPUT	R_{eq} NOM
1CLK1, 2CLK	4.5k Ω
1CLK2	7.5k Ω

EQUIVALENT OF $\overline{CLR}$ INPUTS



TYPICAL OF ALL OUTPUTS



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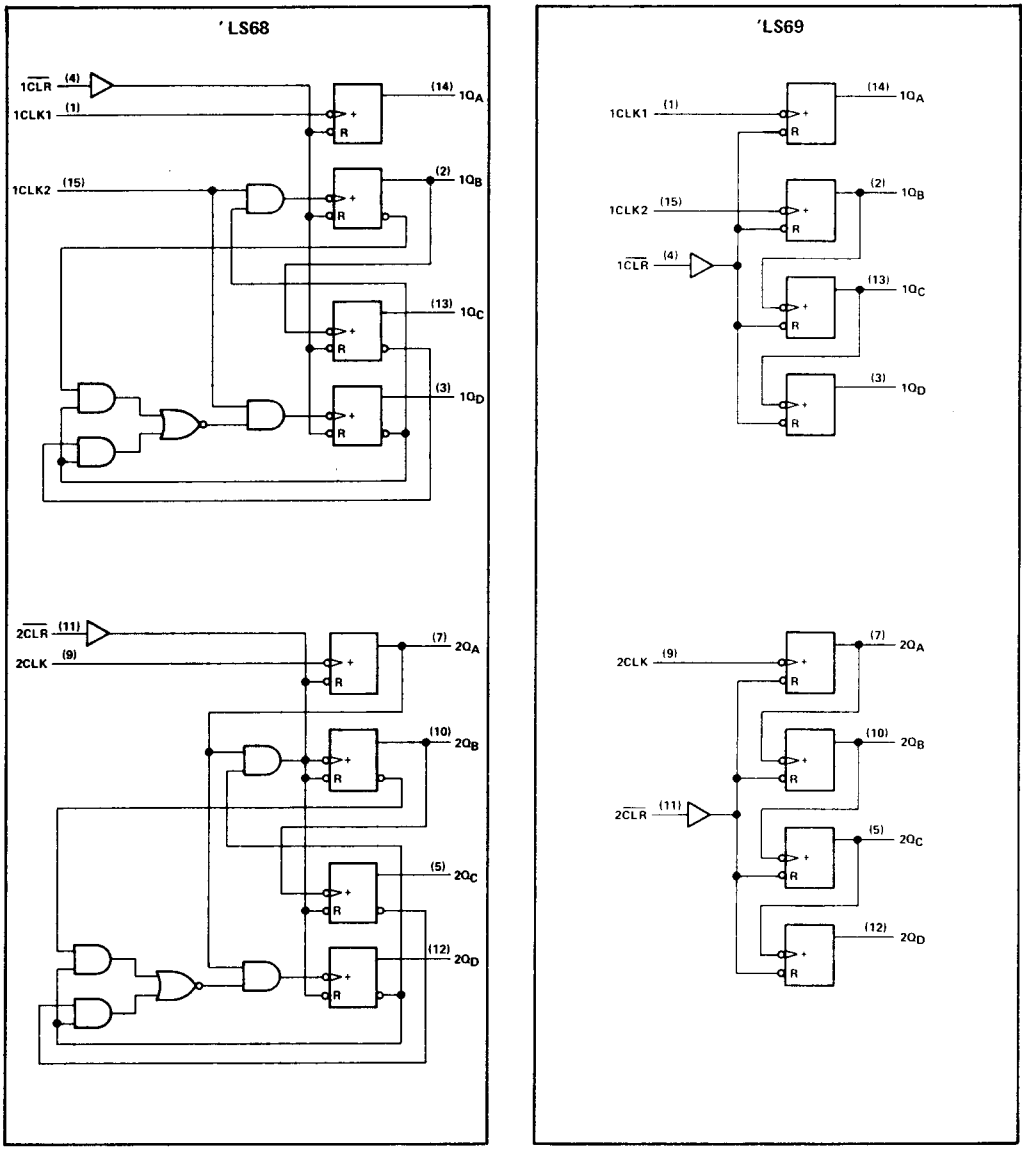
logic diagrams (positive logic)



Pin numbers shown are for D, J, and N packages.

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

Supply voltage, V_{CC} (see Note 4) . . . . . 7 V
Input voltage: Clear inputs . . . . . 7 V
Clock inputs . . . . . 5.5 V
Operating free-air temperature range: SN54LS' . . . . . −55°C to 125°C
SN74LS' . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

NOTE 4: 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					−1			−1	mA
I_{OL}	Low-level output current					8			16	mA
f_{max}	Clock frequency	1CLK1		0		50	0		50	MHz
		1CLK2	'LS68	0		20	0		20	
			'LS69	0		25	0		25	
		2CLK	'LS68	0		40	0		40	
			'LS69	0		50	0		50	
t_w	Pulse width	1CLK1		10			10			ns
		1CLK2	'LS68	25			25			
			'LS69	20			20			
		2CLK	'LS68	13			13			
			'LS69	10			10			
		$\overline{\text{CLEAR}}$		15			15			
t_{su}	Clear inactive-state set-up time			25			25			ns
T_A	Operating free-air temperature			−55		125	0		70	°C

TEXAS INSTRUMENTS
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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}		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = MAX	I_{OH} = −1 mA	2.5	3.4		2.7	3.4		V
V_{OL}		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = MAX	I_{OL} = 8 mA		0.25	0.4		0.25	0.4	V
			I_{OL} = 16 mA					0.35	0.5	
I_I	CLK	V_{CC} = MAX, V_I = 5.5 V				0.1			0.1	mA
	$\overline{CLR}$	V_{CC} = MAX, V_I = 7 V				0.1			0.1	
I_{IH}	CLK	V_{CC} = MAX, V_I = 2.7 V				40			40	μA
	$\overline{CLR}$					20			20	
I_{IL}	1CLK1, 2CLK	V_{CC} = MAX, V_I = 0.4 V				−2			−2	mA
	1CLK2					−1.2			−1.2	
	$\overline{CLR}$					−0.2			−0.2	
I_{OS}§		V_{CC} = MAX, V_O = 0 V		−20		−100	−20		−100	mA
I_{CC}		V_{CC} = MAX, see Note 5			36	54		36	54	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 5: I_{CC} is measured with all inputs grounded and all outputs open.

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'LS68			'LS69			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
f_{max}	1CLK1	$1Q_A$	R_L = 1 kΩ, C_L = 30 pF	50	70		50	70		MHz
f_{max}		$1Q_B$, $1Q_C$, $1Q_D$		20	30		25	35		MHz
f_{max}		$2Q_A$, $2Q_B$ $2Q_C$, $2Q_D$		40	60		50	70		MHz
t_{PLH}	1CLK1	$1Q_A$			7	11		7	11	ns
t_{PHL}					14	21		14	21	
t_{PLH}	1CLK2	$1Q_B$			8	12		7	11	ns
t_{PHL}					12	18		14	21	
t_{PLH}		$1Q_C$			15	23		16	24	
t_{PHL}					21	32		21	32	
t_{PLH}		$1Q_D$			8	12		25	38	
t_{PHL}					13	20		30	45	
t_{PLH}	2CLK	$2Q_A$			7	11		7	11	ns
t_{PHL}					14	21		14	21	
t_{PLH}		$2Q_B$			16	24		14	21	
t_{PHL}					19	29		19	29	
t_{PLH}		$2Q_C$			23	35		23	35	
t_{PHL}					27	40		27	40	
t_{PLH}		$2Q_D$			16	24		32	48	
t_{PHL}					19	29		36	54	
t_{PHL}	Any $\overline{CLR}$	Any Q			20	30		20	30	ns

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