

SN54LS68, SN54LS69, SN74LS68, SN74LS69 DUAL 4-BIT DECADE OR BINARY COUNTERS

SDLS196

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

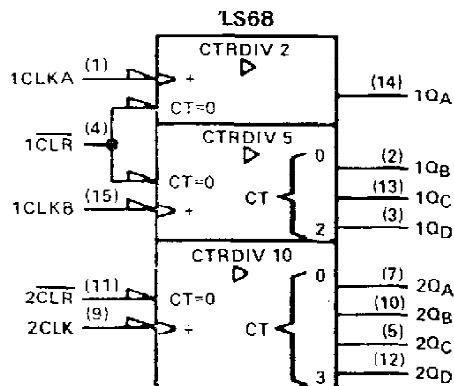
description

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.

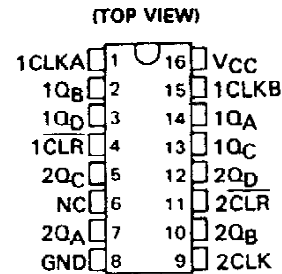
All clocks trigger on the high-to-low transition of the clock pulse. All counters have direct overriding clear pins which, when low, reset Q_A , Q_B , Q_C , and Q_D low regardless of the state of the clock.

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 .

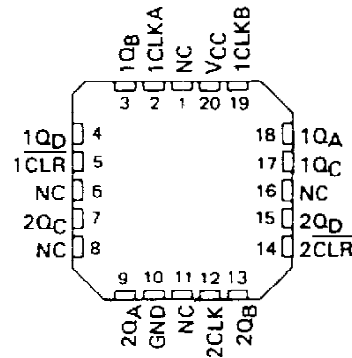
logic symbols†



SN54LS68, SN54LS69 . . . J PACKAGE
SN74LS68, SN74LS69 . . . D OR N PACKAGE



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



NC — No internal connection

† 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.

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

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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

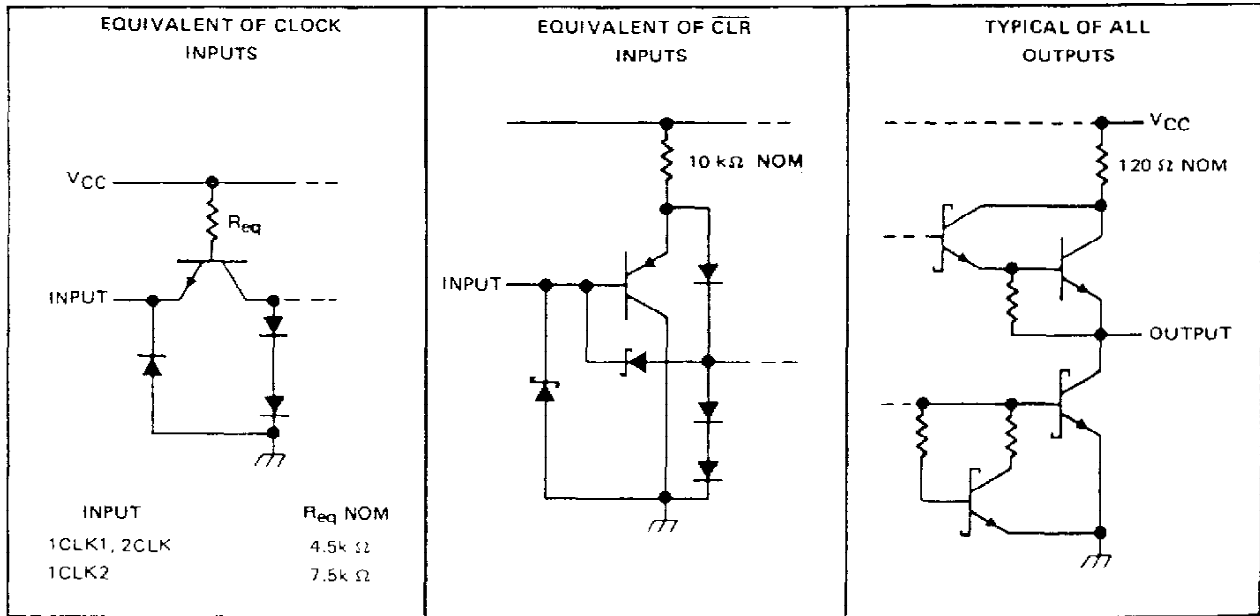
(See Note 3)

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

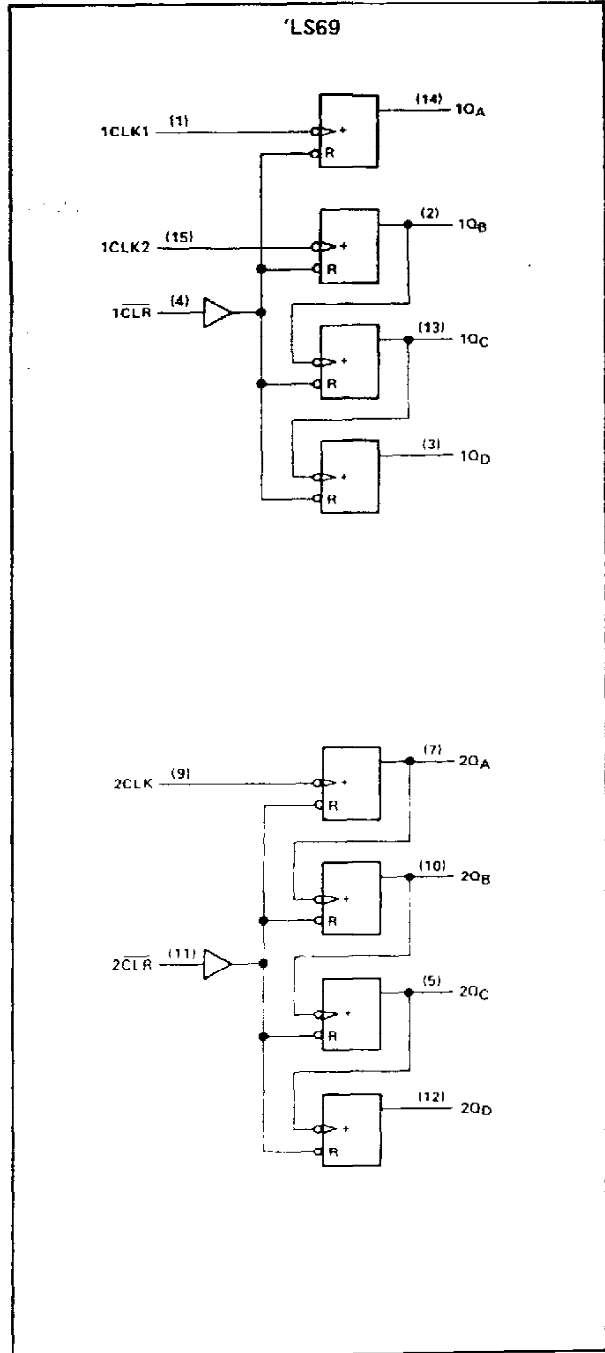
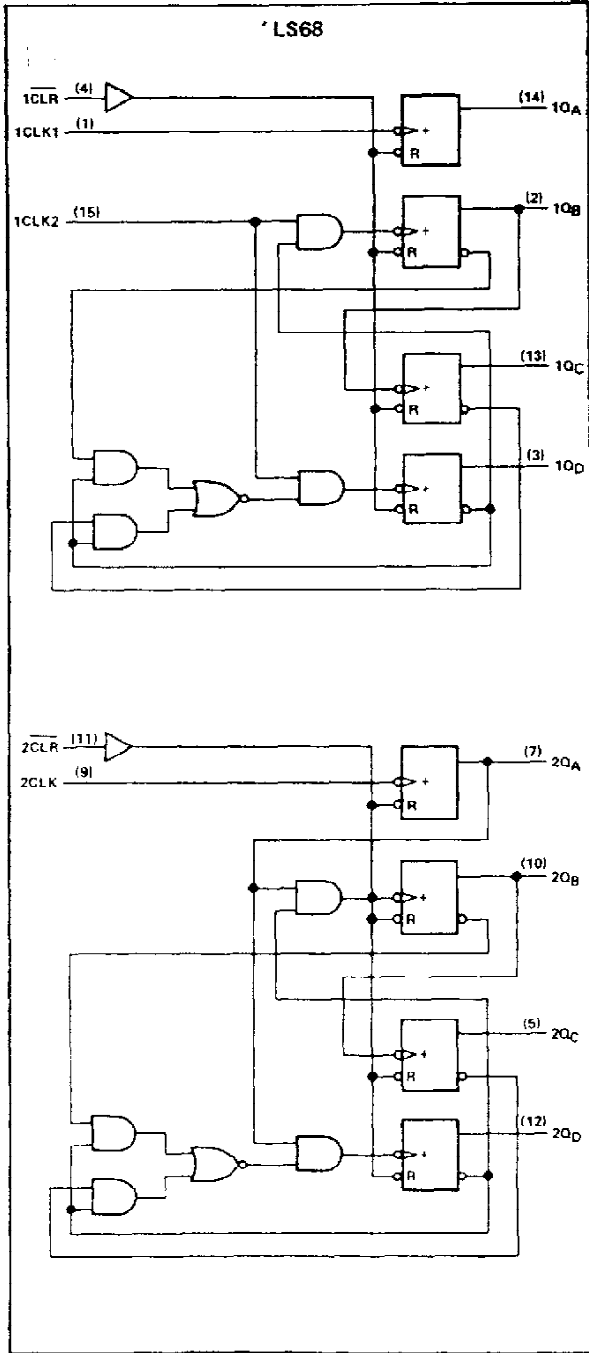


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logic diagrams (positive logic)



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

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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 |
| | V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = MAX, I _{OL} = 16 mA | | | | 0.35 | 0.5 | | V |
| I _I | CLK, V _{CC} = MAX, V _I = 5.5 V | 0.1 | | | 0.1 | | | mA |
| | 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 |
| | CLR, V _{CC} = MAX, V _I = 2.7 V | 20 | | | 20 | | | |
| I _{IIL} | 1CLK1, 2CLK, V _{CC} = MAX, V _I = 0.4 V | -2 | | | -2 | | | mA |
| | 1CLK2, V _{CC} = MAX, V _I = 0.4 V | -1.2 | | | -1.2 | | | |
| | CLR, V _{CC} = MAX, V _I = 0.4 V | -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 CLR | Any Q | 20 | 30 | | 20 | 30 | | ns | |

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


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