

# SN54LS671, SN54LS672, SN74LS671, SN74LS672 4-BIT UNIVERSAL SHIFT REGISTERS/LATCHES WITH 3-STATE OUTPUTS

SDLS194

D2638, JANUARY 1981 — REVISED MARCH 1988

- 4-Bit Universal Shift Registers/Latches
- Multiplexed Outputs for Shift Register or Latched Data
- Choice of Direct SR Clear ('LS671) or Synchronous SR Clear ('LS672)
- 3-State Outputs Drive Bus Lines Directly
- Expandable to Any Word Length

## description

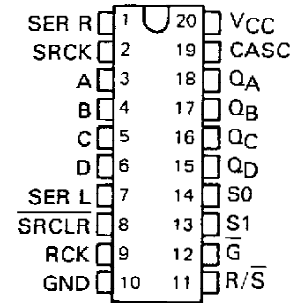
The 'LS671 and 'LS672 each contain a 4-bit universal shift register (similar to the 'LS194A) and a 4-bit storage register (similar to the 'LS175) multiplexed to a 3-state output stage (similar to the 'LS258). The user has the option of selecting the shift or storage register via the register/shift select input R/ $\bar{S}$ . The 'LS671 has a direct-overriding shift register clear while the 'LS672 features a synchronous shift register clear. The shift register has four distinct modes of operation, namely:

- Inhibit clock (do nothing)
- Shift right (in the direction  $Q_A$  toward  $Q_D$ )
- Shift left (in the direction  $Q_D$  toward  $Q_A$ )
- Parallel (broadside) load

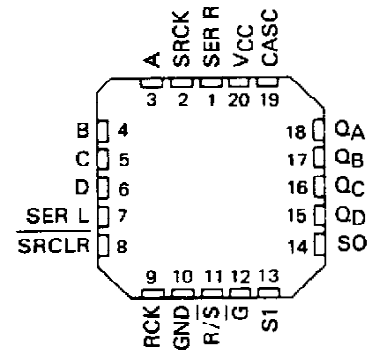
A cascade output for the shift register is provided so that full shift register functionality is provided even while the outputs are in the high-impedance mode. The cascade output presents  $Q_A$  data in the shift-left mode,  $Q_D$  data in the shift-right mode.

Both the shift register clock and the latch clock are triggered on the positive transition. The output control ( $\bar{G}$ ) activates  $Q_A$  thru  $Q_D$  when low, it places  $Q_A$  thru  $Q_D$  into the high-impedance state when high.

SN54LS671, SN54LS672 . . . J PACKAGE  
SN74LS671, SN74LS672 . . . DW OR N PACKAGE  
(TOP VIEW)



SN54LS671, SN54LS672 . . . FK PACKAGE  
(TOP VIEW)



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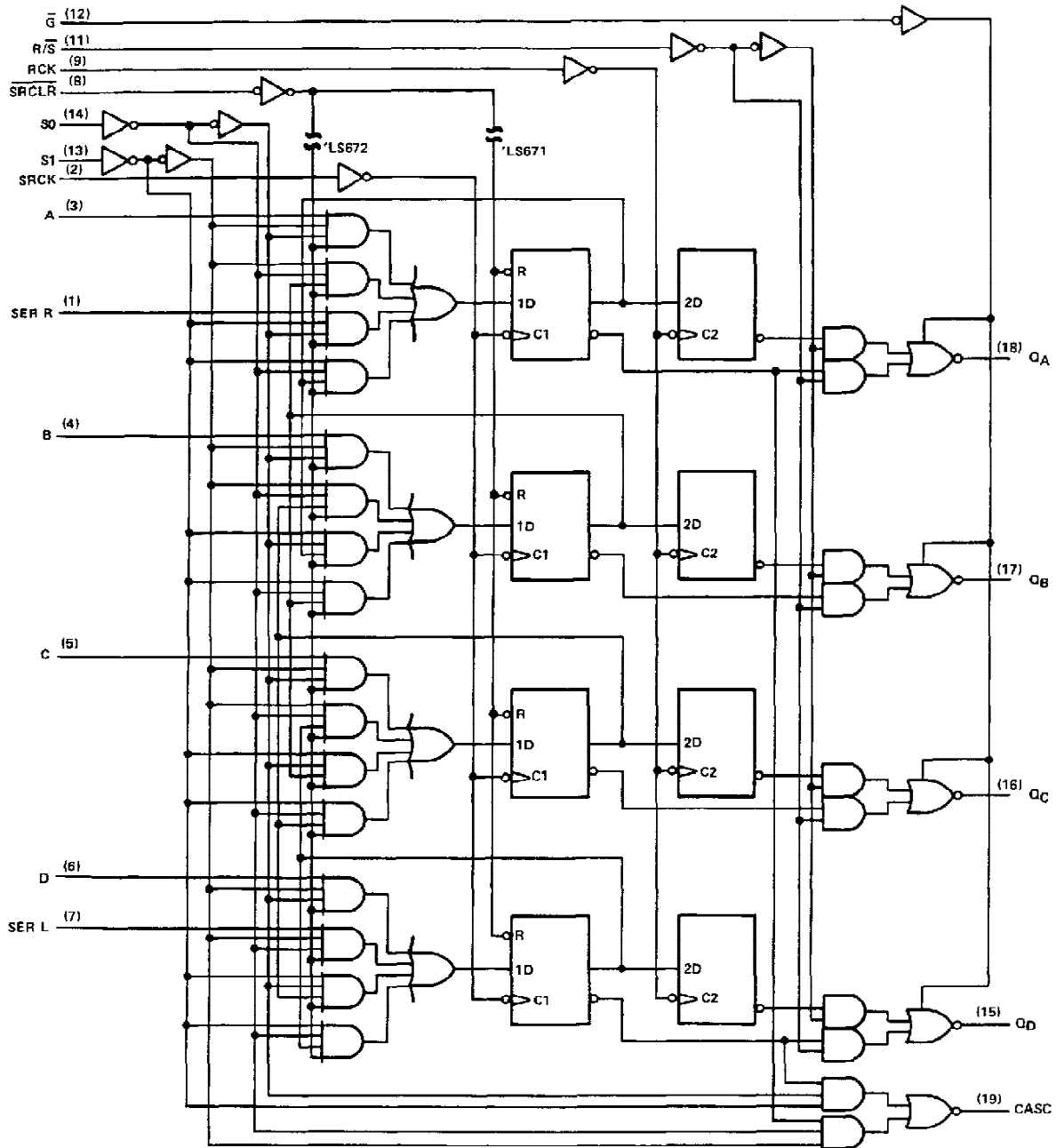
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# SN54LS671, SN54LS672, SN74LS671, SN74LS672

## 4-BIT UNIVERSAL SHIFT REGISTER/LATCHES WITH 3-STATE OUTPUTS

logic diagram (positive logic)



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

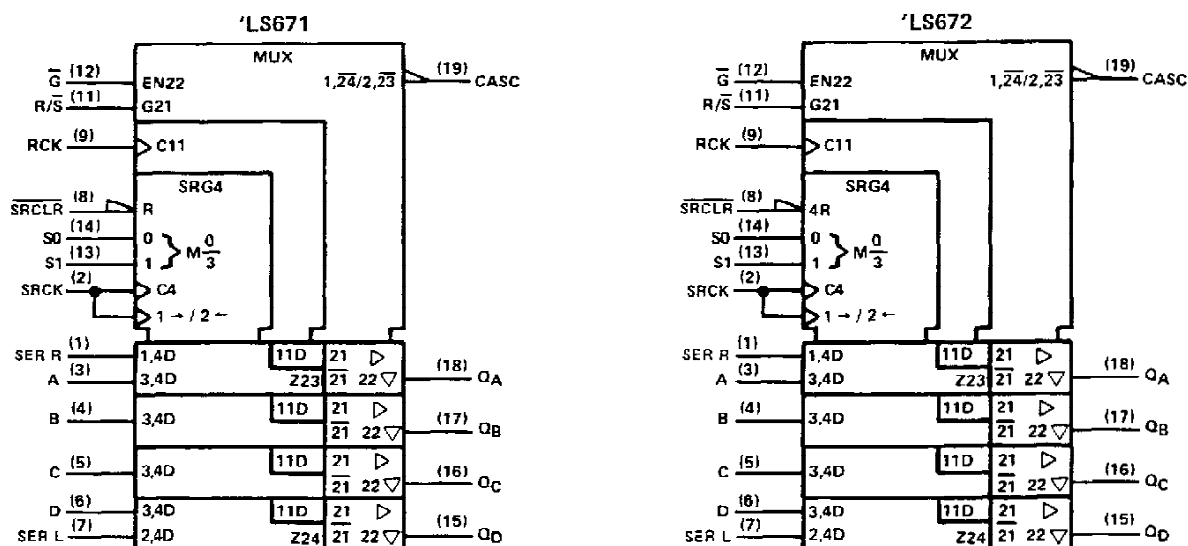
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# SN54LS671, SN54LS672, SN74LS671, SN74LS672

## 4-BIT UNIVERSAL SHIFT REGISTERS/LATCHES WITH 3-STATE OUTPUTS

logic symbols †



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

FUNCTION TABLE

| G | R/S | SRCLR | SR MODE |    | SRCK   |        | SERIAL INPUTS |   | PARALLEL INPUTS |   |    |    | PARALLEL OUTPUTS |                            |     |     | CASC† |     |     |
|---|-----|-------|---------|----|--------|--------|---------------|---|-----------------|---|----|----|------------------|----------------------------|-----|-----|-------|-----|-----|
|   |     |       |         |    | 'LS671 | 'LS672 |               |   |                 |   |    |    |                  |                            |     |     |       |     |     |
|   |     |       | S1      | S0 | SL     | SR     | A             | B | C               | D | QA | QB | QC               | QD                         |     |     |       |     |     |
| L | L   | L     | X       | X  | X      | †      | X             | X | X               | X | X  | X  | X                | L                          | L   | L   | L     | (‡) |     |
| L | L   | H     | X       | X  | L      | L      | X             | X | X               | X | X  | X  | X                | QA0                        | QB0 | QC0 | QD0   | (‡) |     |
| L | L   | H     | L       | L  | X      | X      | X             | X | X               | X | X  | X  | X                | QA0                        | QB0 | QC0 | QD0   | H   |     |
| L | L   | H     | L       | H  | †      | †      | X             | H | X               | X | X  | X  | X                | H                          | QAn | QBn | QCn   | QAn |     |
| L | L   | H     | L       | H  | †      | †      | X             | L | X               | X | X  | X  | X                | L                          | QAn | QBn | QCn   | QAn |     |
| L | L   | H     | H       | L  | †      | †      | H             | X | X               | X | X  | X  | X                | QBn                        | QCn | QDn | H     | QBn |     |
| L | L   | H     | H       | L  | †      | †      | L             | X | X               | X | X  | X  | X                | QBn                        | QCn | QDn | L     | QBn |     |
| L | L   | H     | H       | H  | †      | †      | X             | X | a               | b | c  | d  | a                | b                          | c   | d   | a     | H   |     |
| H | X   | X     | L       | H  | †      | †      | X             | X | X               | X | X  | X  | X                | Z                          | Z   | Z   | Z     | Z   | QCn |
| H | X   | X     | H       | L  | †      | †      | X             | X | X               | X | X  | X  | X                | Z                          | Z   | Z   | Z     | Z   | QBn |
| L | H   | X     | X       | X  | X      | X      | X             | X | X               | X | X  | X  | X                | Internal register contents |     |     |       | (‡) |     |

When the output control G is high, the 3-state outputs are disabled to the high-impedance state; however, sequential operation of the shift register and the output at CASC are not affected.

H = high level (steady state)

L = low level (steady state)

X = irrelevant (any input, including transitions)

† = transition from low to high level

a, b, c, d = the level of steady-state input at A, B, C, or D, respectively

QA0, QB0, QC0, QD0 = the level of QA, QB, QC, or QD, respectively, before the indicated steady-state input conditions were established

QAn, QBn, QCn = the level of QA, QB, or QC, respectively, before the most-recent transition of the clock

Z = high-impedance state

‡ The cascade output displays the D bit of the shift register in mode 1 (S1, S0 = L, H), the A bit in mode 2 (S1, S0 = HL), and is inactive (H) in modes 0 and 3 (S1, S0 = LL and HH).

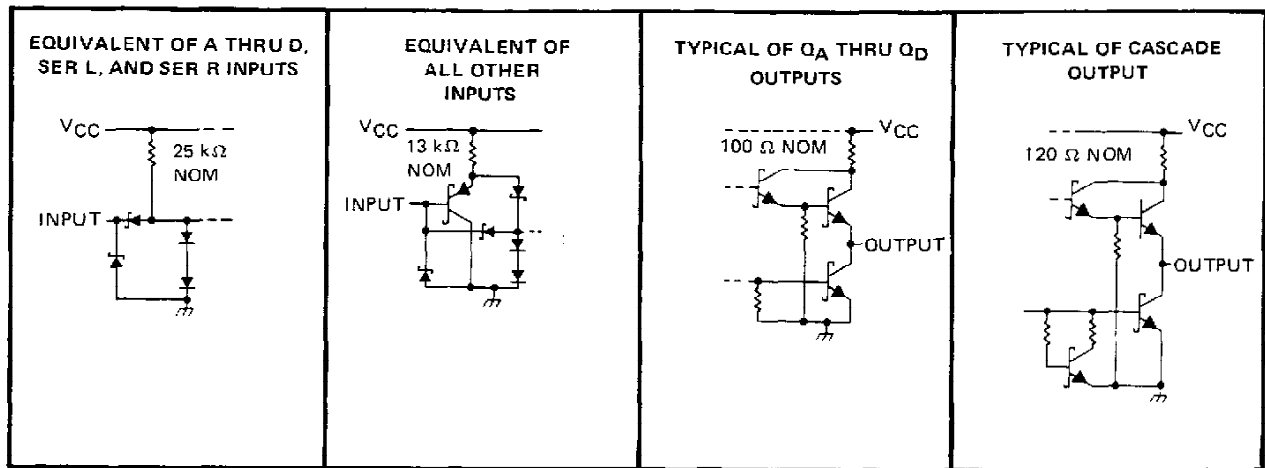
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# SN54LS671, SN54LS672, SN74LS671, SN74LS672

## 4-BIT UNIVERSAL SHIFT REGISTERS/LATCHES WITH 3-STATE OUTPUTS

schematics of inputs and 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: SN54LS671, SN54LS672 | $-55^{\circ}\text{C}$ to $125^{\circ}\text{C}$ |
| SN74LS671, SN74LS672                                       | $0^{\circ}\text{C}$ to $70^{\circ}\text{C}$    |
| Storage temperature range                                  | $-65^{\circ}\text{C}$ to $150^{\circ}\text{C}$ |

NOTE 1: Voltage values are with respect to the 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                              | Cascade out                       |     | -0.4 | -0.4    |     | mA   |                    |
|          |  | $Q_A, Q_B, Q_C, Q_D$              |     | -1   | -2.6    |     |      |                    |
| $I_{OL}$ | Low-level output current                               | Cascade out                       |     | 4    | 8       |     | mA   |                    |
|          |  | $Q_A, Q_B, Q_C, Q_D$              |     | 12   | 24      |     |      |                    |
| $t_w$    | Width of SRCK, RCK, or SRCLR ('LS671 only) input pulse | 30                                |     |      | 30      |     |      | ns                 |
| $t_{su}$ | Inactive state setup time                              | SRCLR before SRCK ↑ ('LS671 only) |     |      | 30      |     |      | ns                 |
| $t_{su}$ | Setup time   | S0 or S1 to SRCK ↑                |     | 45   |         |     | ns   |                    |
|          |  | SRCLR ↓ ('LS672 only) to SRCK ↑   |     | 25   |         |     |      |                    |
|          |  | A, B, C, D to SRCK ↑              |     | 30   |         |     |      |                    |
|          |  | SRCK ↑ to RCK ↓                   |     | 30   |         |     |      |                    |
|          | SER to SRCK ↑  | 35                                |     |      | 35      |     |      |                    |
| $t_h$    | Hold time  | Any input from SRCK ↑             |     |      | 0       |     |      | ns                 |
| $T_A$    | Operating free-air temperature                         | -65                               |     |      | 125     |     |      | $^{\circ}\text{C}$ |

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## SN54LS671, SN54LS672, SN74LS671, SN74LS672 4-BIT UNIVERSAL SHIFT REGISTERS/LATCHES WITH 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                            | Q <sub>A</sub> - Q <sub>D</sub>              | V <sub>CC</sub> = MIN, I <sub>OH</sub> = -1 mA  | 2.4                     | 3.1  |      |         |      |      | V    |
|                  |  | Q <sub>A</sub> - Q <sub>D</sub>              | V <sub>IH</sub> = 2 V, I <sub>OH</sub> = -2.6 mA  |                         |      |      | 2.4     | 3.1  |      |      |
|                  |  | CASC   | V <sub>IL</sub> = V <sub>IL max</sub> , I <sub>OH</sub> = -400 μA   | 2.5                     | 3.2  |      | 2.7     | 3.2  |      |      |
| V <sub>OL</sub>  | Low-level output voltage                             | Q <sub>A</sub> - Q <sub>D</sub>              | V <sub>CC</sub> = MIN, I <sub>OL</sub> = 12 mA  |                         | 0.25 | 0.4  |         | 0.25 | 0.4  | V    |
|                  |  | Q <sub>A</sub> - Q <sub>D</sub>              |   | I <sub>OL</sub> = 24 mA |      |      |         | 0.35 | 0.5  |      |
|                  |  | CASC   | V <sub>IH</sub> = 2 V, I <sub>OL</sub> = 4 mA   |                         | 0.25 | 0.4  |         | 0.25 | 0.4  |      |
|                  |  | CASC   |   | I <sub>OL</sub> = 8 mA  |      |      |         | 0.35 | 0.5  |      |
| I <sub>OZH</sub> | Off-state output current, high-level voltage applied | Q <sub>A</sub> - Q <sub>D</sub>              | V <sub>CC</sub> = MAX, V <sub>IH</sub> = 2 V, V <sub>O</sub> = 2.7 V, V <sub>IL</sub> = V <sub>IL max</sub> |                         |      | 20   |         | 20   | μA   |      |
| I <sub>OZL</sub> | Off-state output current, low-level voltage applied  | Q <sub>A</sub> - Q <sub>D</sub>              | V <sub>CC</sub> = MAX, V <sub>IH</sub> = 2 V, V <sub>O</sub> = 0.4 V, V <sub>IL</sub> = V <sub>IL max</sub> |                         |      | -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, B, C, 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 §                       | Q <sub>A</sub> - Q <sub>D</sub>              | V <sub>CC</sub> = MAX, V <sub>O</sub> = 0 V   |                         |      | -30  |         | -130 | mA   |      |
|                  |  | CASC   |   |                         |      | -20  |         | -100 |      |      |
| I <sub>CC</sub>  | Supply current                                       | All outputs low                              | V <sub>CC</sub> = MAX, See Note 2   |                         | 35   | 70   |         | 35   | 70   | mA   |
|                  |  | All outputs high                             | All outputs   |                         | 30   | 65   |         | 30   | 65   |      |
|                  |  | Q <sub>A</sub> thru Q <sub>D</sub> , at Hi-Z | open  |                         | 37   | 70   |         | 37   | 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.

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

NOTES: 2. I<sub>CC1</sub> is tested after two 0-V to 4.5 V to 0-V pulses have been applied to SRCK and RCK while S0 is at 4.5 V and all other inputs are grounded.

3. I<sub>CC2</sub> is tested after two 4.5-V to 0-V to 4.5 V pulses have been applied to SRCK and RCK while all other inputs are at 4.5 V.

4. I<sub>CC3</sub> is tested after two 0-V to 4.5-V to 0-V pulses have been applied to SRCK and RCK while S0 and  $\bar{G}$  are at 4.5 V and all other inputs are grounded.

# SN54LS671, SN54LS672, SN74LS671, SN74LS672

## 4-BIT UNIVERSAL SHIFT REGISTERS/LATCHES WITH 3-STATE OUTPUTS

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

| PARAMETER | FROM (INPUT)           | TO (OUTPUT)        | TEST CONDITIONS        |  | 'LS671             |   |  | 'LS672 |   |                   | UNIT               |  |    |    |    |    |    |    |
|-----------|------------------------|--------------------|------------------------|--|--------------------|---|--|--------|---|-------------------|--------------------|--|----|----|----|----|----|----|
|           |                        |                    | MODE                   | LOAD   | MIN                | TYP   | MAX  | MIN    | TYP   | MAX               |                    |  |    |    |    |    |    |    |
| $t_{PLH}$ | SRCK $\uparrow$        | CASCADE            | SHIFT LEFT<br>OR RIGHT | $R_L = 2\text{ k}\Omega$ ,<br>$C_L = 15\text{ pF}$ | 31                 | 45  |  | 31     | 45  | ns                |                    |  |    |    |    |    |    |    |
| $t_{PHL}$ |                        |                    |                        |  | 14                 | 25  |  | 14     | 25  |                   |                    |  |    |    |    |    |    |    |
| $t_{PLH}$ | S0, S1                 |                    |                        |  | SR CLEAR           | 11  | 20   |        | 12  | 20                | ns                 |  |    |    |    |    |    |    |
| $t_{PHL}$ |                        |                    |                        |  |                    | 11  | 20   |        | 12  | 20                |                    |  |    |    |    |    |    |    |
| $t_{PHL}$ | SRCK $\uparrow$        |                    |                        |  |                    | 19  | 30   |        |   |                   | ns                 |  |    |    |    |    |    |    |
| $t_{PHL}$ | SRCLR $\downarrow$     |                    |                        |  |                    | 19  | 30   |        |   |                   | ns                 |  |    |    |    |    |    |    |
| $t_{PLH}$ | SRCK $\uparrow$        | $Q_A - Q_D$        | SHIFT LEFT<br>OR RIGHT | $R_L = 667\ \Omega$ ,<br>$C_L = 45\text{ pF}$      |                    | 10  | 20   |        | 10  | 20                | ns                 |  |    |    |    |    |    |    |
| $t_{PHL}$ |                        |                    |                        |  |                    | 16  | 25   |        | 16  | 25                |                    |  |    |    |    |    |    |    |
| $t_{PLH}$ |                        |                    |                        |  | SR LOAD            | 10  | 20   |        | 10  | 20                | ns                 |  |    |    |    |    |    |    |
| $t_{PHL}$ |                        |                    |                        |  |                    | 15  | 25   |        | 15  | 25                |                    |  |    |    |    |    |    |    |
| $t_{PHL}$ |                        |                    |                        |  | SR CLEAR           | 17  | 30   |        |   |                   | ns                 |  |    |    |    |    |    |    |
| $t_{PHL}$ |                        |                    |                        |  |                    | 21  | 30   |        |   |                   |                    |  |    |    |    |    |    |    |
| $t_{PLH}$ | RCK $\uparrow$         |                    | LATCH                  |  | MUX                | $R_L = 667\ \Omega$ ,<br>$C_L = 45\text{ pF}$ | 10   | 20     |   | 10                | 20                 | ns   |    |    |    |    |    |    |
| $t_{PHL}$ |                        |                    |                        |  |                    |   | 15   | 25     |   | 15                | 25                 |  |    |    |    |    |    |    |
| $t_{PLH}$ | R/S $\uparrow$         |                    |                        |  |                    |   | MUX  | MUX    | $R_L = 667\ \Omega$ ,<br>$C_L = 45\text{ pF}$ | 12                | 25                 |  | 13 | 25 | ns |    |    |    |
| $t_{PHL}$ |                        |                    |                        |  |                    |   |  |        |   | 15                | 25                 |  | 15 | 25 |    |    |    |    |
| $t_{PLH}$ | R/S $\downarrow$       |                    |                        |  |                    |   |  |        |   | 3-STATE<br>ENABLE | 3-STATE<br>DISABLE | $R_L = 667\ \Omega$ ,<br>$C_L = 5\text{ pF}$ | 17 | 25 |    | 17 | 25 | ns |
| $t_{PHL}$ |                        |                    |                        |  |                    |   |  |        |   |                   |                    |  | 16 | 25 |    | 16 | 25 |    |
| $t_{PZH}$ | $\bar{G}$ $\downarrow$ | 3-STATE<br>DISABLE | 3-STATE<br>DISABLE     | $R_L = 667\ \Omega$ ,<br>$C_L = 5\text{ pF}$       | 16                 | 25  |  |        |   |                   |                    |  |    | 16 | 25 | ns |    |    |
| $t_{PZL}$ |                        |                    |                        |  | 19                 | 30  |  |        |   |                   |                    |  |    | 19 | 30 |    |    |    |
| $t_{PHZ}$ | $\bar{G}$ $\uparrow$   |                    |                        |  | 3-STATE<br>DISABLE | 3-STATE<br>DISABLE                            | $R_L = 667\ \Omega$ ,<br>$C_L = 5\text{ pF}$ | 16     | 25  |                   |                    |  |    | 16 | 25 | ns |    |    |
| $t_{PLZ}$ |                        |                    |                        |  |                    |   |  | 16     | 25  |                   |                    |  |    | 16 | 25 |    |    |    |

NOTE 5: Load circuits and voltage waveforms are shown in Section 1.

### TYPICAL APPLICATION DATA

The 'LS671 or 'LS672 can easily be expanded utilizing the cascade output and the SER L and SER R inputs. A typical expansion is shown below.

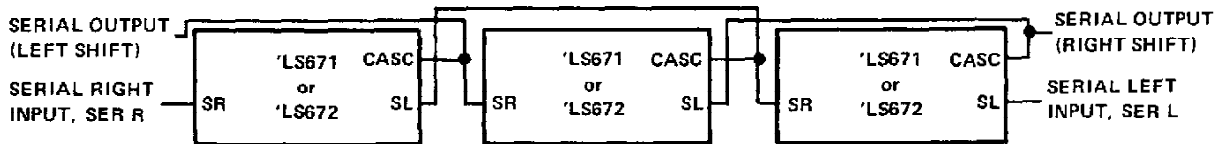


FIGURE 1 - 'LS671, 'LS672 EXPANDED TO 12 BITS, (3 PACKAGES)

Any desired word length may be obtained using the scheme shown. Corresponding control pins of all the packages are tied in common, i.e., all S0 pins are connected together, all S1 pins are connected together, etc.

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