

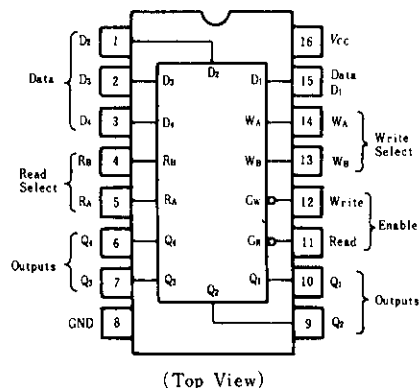
# HD74LS670 ● 4-by-4 Register File (with three-state outputs)

The HD74LS670, 16-bit register file incorporates the equivalent of 98 gates. The register file is organized as 4 words of 4 bits each and separate on-chip decoding is provided for addressing the the four word locations to either write-in or retrieve data.

This permits simultaneous writing into one location and reading from another word location. Four data inputs are available which are used to supply the 4-bit word to be stored. Location of the word is determined by the write-address inputs A and B in conjunction with a write-enable signal. Data applied at the inputs should be in its true form. That is, if a high-level signal is desired from the output, a high-level is applied at the data input for that particular bit location. The latch inputs are arranged so that new data will be accepted only if both internal address gate inputs are high. When this condition exists, data at the D input is transferred to the latch output. When the write-enable input,  $G_W$ , is high, the data inputs are inhibited and their levels can cause no change in the information stored in the internal latches. When the read-enable input,  $G_R$ , is high, the data outputs are inhibited and go into the high-impedance state. The individual address lines permit direct acquisition of data stored in any four of the latches. Four individual decoding gates are used to complete the address for reading a word.

When the read address is made in conjunction with the read-enable signal, the word appears at the four outputs.

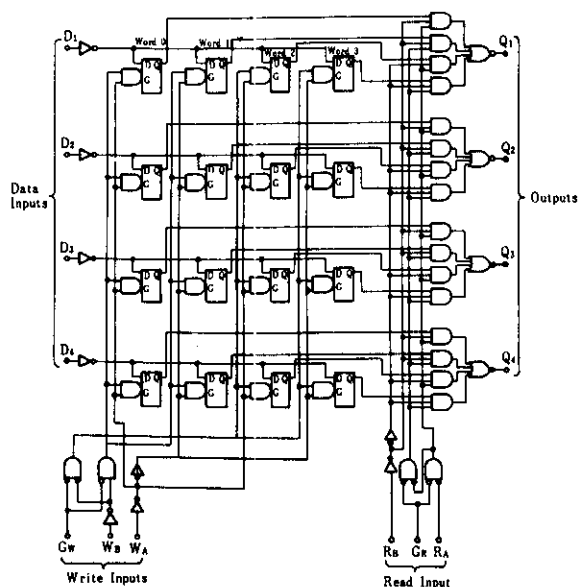
## PIN ARRANGEMENT



## FUNCTION TABLE

| Write Inputs |       |       | Word    |         |         |         |
|--------------|-------|-------|---------|---------|---------|---------|
| $W_B$        | $W_A$ | $G_W$ | 0       | 1       | 2       | 3       |
| L            | L     | L     | $Q = D$ | $Q_0$   | $Q_0$   | $Q_0$   |
| L            | H     | L     | $Q_0$   | $Q = D$ | $Q_0$   | $Q_0$   |
| H            | L     | L     | $Q_0$   | $Q_0$   | $Q = D$ | $Q_0$   |
| H            | H     | L     | $Q_0$   | $Q_0$   | $Q_0$   | $Q = D$ |
| X            | X     | H     | $Q_0$   | $Q_0$   | $Q_0$   | $Q_0$   |

## BLOCK DIAGRAM



| Read Inputs |       |       | Outputs   |           |           |           |
|-------------|-------|-------|-----------|-----------|-----------|-----------|
| $R_B$       | $R_A$ | $G_R$ | $Q_1$     | $Q_2$     | $Q_3$     | $Q_4$     |
| L           | L     | L     | $W_0 B_1$ | $W_0 B_2$ | $W_0 B_3$ | $W_0 B_4$ |
| L           | H     | L     | $W_1 B_1$ | $W_1 B_2$ | $W_1 B_3$ | $W_1 B_4$ |
| H           | L     | L     | $W_2 B_1$ | $W_2 B_2$ | $W_2 B_3$ | $W_2 B_4$ |
| H           | H     | L     | $W_3 B_1$ | $W_3 B_2$ | $W_3 B_3$ | $W_3 B_4$ |
| X           | X     | H     | Z         | Z         | Z         | Z         |

Notes: H = high level, L = low level, X = irrelevant, Z = high impedance (off)  
 $(Q=D)$  = The four selected internal flip-flop outputs will assume the states applied to the four external data inputs.  
 $Q_0$  = The level of Q before the indicated input conditions were established.  
 $W_0 B_1$  = The first bit of word 0, etc.

## RECOMMENDED OPERATING CONDITIONS

| Item           | Symbol       | min      | typ  | max  | Unit |
|----------------|--------------|----------|------|------|------|
| Supply voltage | $V_{CC}$     | 4.75     | 5.00 | 5.25 | V    |
| Output current | $I_{OH}$     | —        | —    | -2.6 | mA   |
|                | $I_{OL}$     | —        | —    | 8    | mA   |
| Pulse width    | Read enable  | $t_w$    | 25   | —    | ns   |
|                | Write enable |          | 60   | —    |      |
| Setup time     | Data         | $t_{su}$ | 10   | —    | ns   |
|                | Write enable |          | 15   | —    |      |
| Hold time      | Data         | $t_h$    | 15   | —    | ns   |
|                | Write enable |          | 5    | —    |      |
| Latch time     | $t_{LATCH}$  | 60       | —    | —    | ns   |

## ELECTRICAL CHARACTERISTICS ( $T_a = -20 \sim +75^\circ\text{C}$ )

| Item                         | Symbol        | Test Conditions                                                                            | min               | typ* | max  | Unit          |
|------------------------------|---------------|--------------------------------------------------------------------------------------------|-------------------|------|------|---------------|
| Input voltage                | $V_{IH}$      |                                                                                            | 2.0               | —    | —    | V             |
|                              | $V_{IL}$      |                                                                                            | —                 | —    | 0.8  | V             |
| Output voltage               | $V_{OH}$      | $V_{CC}=4.75\text{V}$ , $V_{IH}=2\text{V}$ , $V_{IL}=0.8\text{V}$ , $I_{OH}=-2.6\text{mA}$ | 2.4               | —    | —    | V             |
|                              | $V_{OL}$      | $V_{CC}=4.75\text{V}$ , $V_{IH}=2\text{V}$ , $V_{IL}=0.8\text{V}$ , $I_{OL}=4\text{mA}$    | —                 | —    | 0.4  | V             |
|                              |               | $I_{OL}=8\text{mA}$                                                                        | —                 | —    | 0.5  |               |
| Off-state output current     | $I_{OZH}$     | $V_{CC}=5.25\text{V}$ , $V_{IH}=2\text{V}$                                                 | $V_O=2.7\text{V}$ | —    | 20   | $\mu\text{A}$ |
|                              | $I_{OZL}$     |                                                                                            | $V_O=0.4\text{V}$ | —    | -20  |               |
| Input current                | $I_{IH}$      | $V_{CC}=5.25\text{V}$ , $V_I=2.7\text{V}$                                                  | Any D, R or W     | —    | 20   | $\mu\text{A}$ |
|                              |               |                                                                                            | $G_W$             | —    | 40   |               |
|                              |               |                                                                                            | $G_R$             | —    | 60   |               |
|                              | $I_{IL}$      | $V_{CC}=5.25\text{V}$ , $V_I=0.4\text{V}$                                                  | Any D, R or W     | —    | -0.4 | mA            |
|                              |               |                                                                                            | $G_W$             | —    | -0.8 |               |
|                              |               |                                                                                            | $G_R$             | —    | -1.2 |               |
|                              | $I_I$         | $V_{CC}=5.25\text{V}$ , $V_I=7\text{V}$                                                    | Any D, R or W     | —    | 0.1  | mA            |
|                              |               |                                                                                            | $G_W$             | —    | 0.2  |               |
|                              |               |                                                                                            | $G_R$             | —    | 0.3  |               |
| Short-circuit output current | $I_{OS}$      | $V_{CC}=5.25\text{V}$                                                                      | -30               | —    | -130 | mA            |
| Supply current               | $I_{CC}^{**}$ | $V_{CC}=5.25\text{V}$                                                                      | —                 | 30   | 50   | mA            |
| Input clamp voltage          | $V_{IK}$      | $V_{CC}=4.75\text{V}$ , $I_{IN}=-18\text{mA}$                                              | —                 | —    | -1.5 | V             |

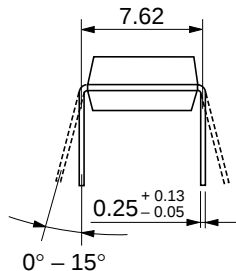
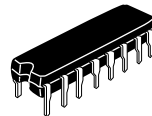
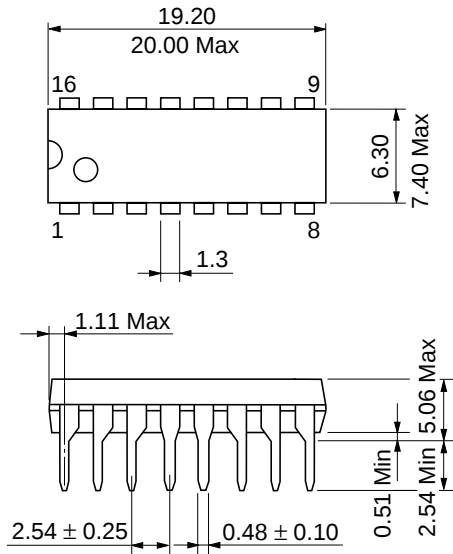
\*  $V_{CC}=5\text{V}$ ,  $T_a=25^\circ\text{C}$

\*\* : Maximum  $I_{CC}$  is guaranteed for the following worst case conditions: 4.5V is applied to all data inputs and both enable inputs, all address inputs are grounded and all outputs are open.

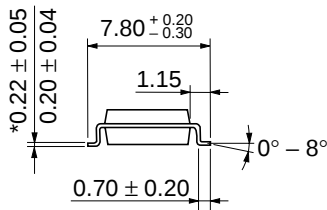
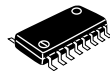
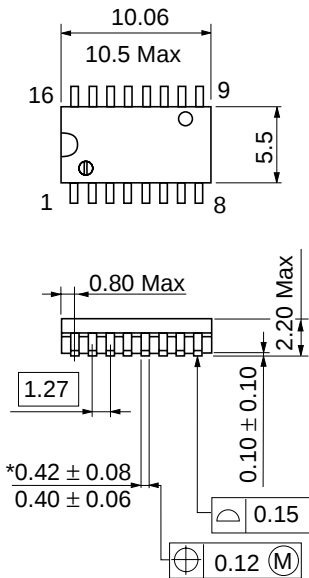
## SWITCHING CHARACTERISTICS ( $V_{CC}=5\text{V}$ , $T_a=25^\circ\text{C}$ )

| Item                   | Symbol    | Inputs | Outputs        | Test Conditions                                  | min | typ | max | Unit |
|------------------------|-----------|--------|----------------|--------------------------------------------------|-----|-----|-----|------|
| Propagation delay time | $t_{PLH}$ | Read   | $Q_1 \sim Q_4$ | $C_L = 15\text{pF}$ ,<br>$R_L = 2\text{k}\Omega$ | —   | 23  | 40  | ns   |
|                        | $t_{PHL}$ | select |                |                                                  | —   | 25  | 45  |      |
|                        | $t_{PLH}$ | Write  | $Q_1 \sim Q_4$ |                                                  | —   | 26  | 45  |      |
|                        | $t_{PHL}$ | enable |                |                                                  | —   | 28  | 50  |      |
|                        | $t_{PLH}$ | Data   | $Q_1 \sim Q_4$ |                                                  | —   | 25  | 45  |      |
|                        | $t_{PHL}$ |        |                |                                                  | —   | 23  | 40  |      |
| Output enable time     | $t_{ZH}$  | Read   | $Q_1 \sim Q_4$ | —                                                | 15  | 35  |     |      |
|                        | $t_{ZL}$  |        |                | —                                                | 22  | 40  |     |      |
| Output disable time    | $t_{HZ}$  | enable |                | $C_L = 5\text{pF}$ ,<br>$R_L = 2\text{k}\Omega$  | —   | 30  | 50  |      |
|                        | $t_{LZ}$  |        |                | —                                                | 16  | 35  |     |      |



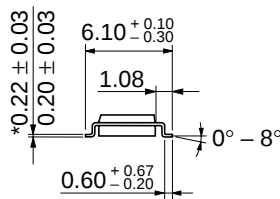
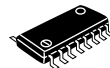
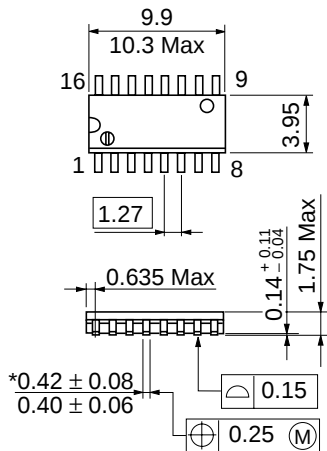


|                          |          |
|--------------------------|----------|
| Hitachi Code             | DP-16    |
| JEDEC                    | Conforms |
| EIAJ                     | Conforms |
| Weight (reference value) | 1.07 g   |



|                          |          |
|--------------------------|----------|
| Hitachi Code             | FP-16DA  |
| JEDEC                    | —        |
| EIAJ                     | Conforms |
| Weight (reference value) | 0.24 g   |

\*Dimension including the plating thickness  
Base material dimension



\*Dimension including the plating thickness  
Base material dimension

|                          |          |
|--------------------------|----------|
| Hitachi Code             | FP-16DN  |
| JEDEC                    | Conforms |
| EIAJ                     | Conforms |
| Weight (reference value) | 0.15 g   |

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