

# DATA SHEET

For a complete data sheet, please also download:

- The IC06 74HC/HCT/HCU/HCMOS Logic Family Specifications
- The IC06 74HC/HCT/HCU/HCMOS Logic Package Information
- The IC06 74HC/HCT/HCU/HCMOS Logic Package Outlines

## **74HC/HCT4511** BCD to 7-segment latch/decoder/driver

Product specification  
File under Integrated Circuits, IC06

December 1990

## BCD to 7-segment latch/decoder/driver

## 74HC/HCT4511

## FEATURES

- Latch storage of BCD inputs
- Blanking input
- Lamp test input
- Driving common cathode LED displays
- Guaranteed 10 mA drive capability per output
- Output capability: non-standard
- I<sub>CC</sub> category: MSI

## GENERAL DESCRIPTION

The 74HC/HCT4511 are high-speed Si-gate CMOS devices and are pin compatible with "4511" of the "4000B" series. They are specified in compliance with JEDEC standard no. 7A.

The 74HC/HCT4511 are BCD to 7-segment latch/decoder/drivers with four address inputs (D<sub>1</sub> to D<sub>4</sub>), an active LOW latch enable input ( $\overline{LE}$ ), an active LOW

ripple blanking input ( $\overline{BI}$ ), an active LOW lamp test input ( $\overline{LT}$ ), and seven active HIGH segment outputs (Q<sub>a</sub> to Q<sub>g</sub>).

When  $\overline{LE}$  is LOW, the state of the segment outputs (Q<sub>a</sub> to Q<sub>g</sub>) is determined by the data on D<sub>1</sub> to D<sub>4</sub>.

When  $\overline{LE}$  goes HIGH, the last data present on D<sub>1</sub> to D<sub>4</sub> are stored in the latches and the segment outputs remain stable.

When  $\overline{LT}$  is LOW, all the segment outputs are HIGH independent of all other input conditions. With  $\overline{LT}$  HIGH, a LOW on  $\overline{BI}$  forces all segment outputs LOW. The inputs  $\overline{LT}$  and  $\overline{BI}$  do not affect the latch circuit.

## APPLICATIONS

- Driving LED displays
- Driving incandescent displays
- Driving fluorescent displays
- Driving LCD displays
- Driving gas discharge displays

## QUICK REFERENCE DATA

GND = 0 V; T<sub>amb</sub> = 25 °C; t<sub>r</sub> = t<sub>f</sub> = 6 ns

| SYMBOL                              | PARAMETER                               | CONDITIONS                                    | TYPICAL |     | UNIT |
|-------------------------------------|---|---|---------|-----|------|
|                                     |   |   | HC      | HCT |      |
| t <sub>PHL</sub> / t <sub>PLH</sub> | propagation delay                       | C <sub>L</sub> = 15 pF; V <sub>CC</sub> = 5 V |         |     |      |
|                                     | D <sub>n</sub> to Q <sub>n</sub>        |   | 24      | 24  | ns   |
|                                     | $\overline{LE}$ to Q <sub>n</sub>       |   | 23      | 24  | ns   |
|                                     | $\overline{BI}$ to Q <sub>n</sub>       |   | 19      | 20  | ns   |
|                                     | $\overline{LT}$ to Q <sub>n</sub>       |   | 12      | 13  | ns   |
| C <sub>I</sub>                      | input capacitance                       |   | 3.5     | 3.5 | pF   |
| C <sub>PD</sub>                     | power dissipation capacitance per latch | notes 1 and 2                                 | 64      | 64  | pF   |

## Notes

1. C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW):

$$P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

f<sub>i</sub> = input frequency in MHz

f<sub>o</sub> = output frequency in MHz

∑ (C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs

C<sub>L</sub> = output load capacitance in pF

V<sub>CC</sub> = supply voltage in V

2. For HC the condition is V<sub>I</sub> = GND to V<sub>CC</sub>

For HCT the condition is V<sub>I</sub> = GND to V<sub>CC</sub> – 1.5 V

# BCD to 7-segment latch/decoder/driver

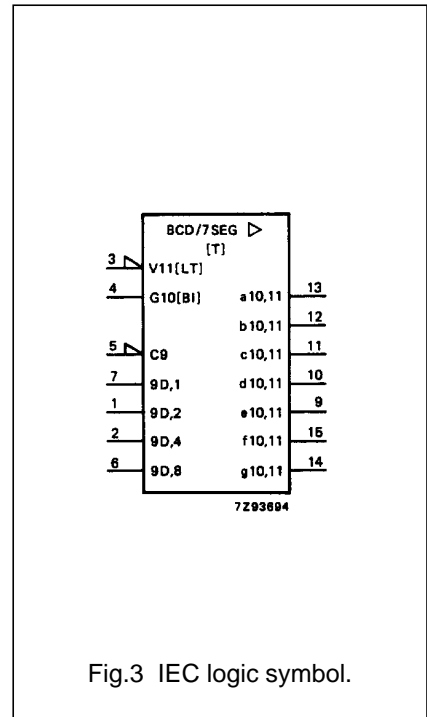
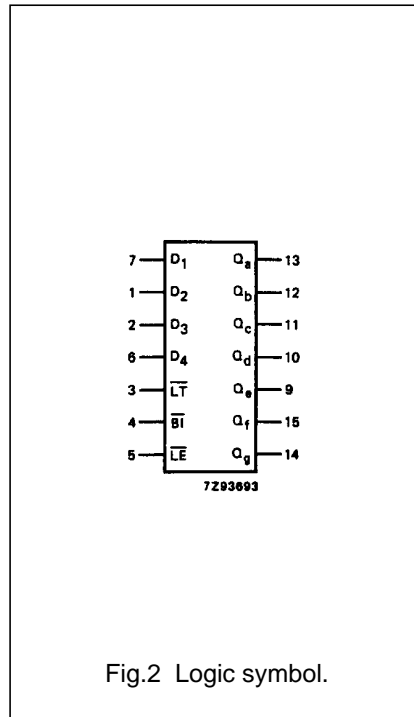
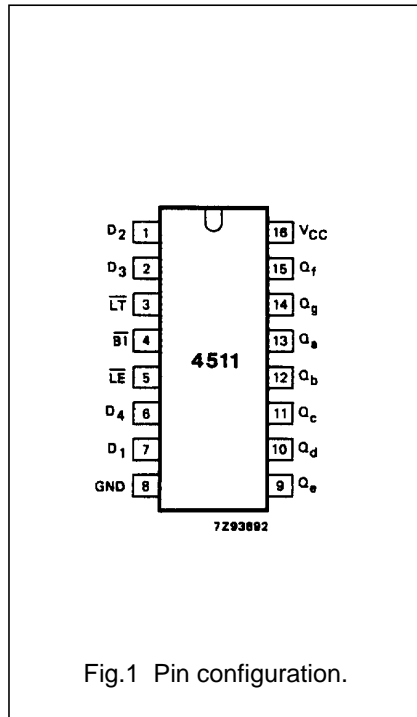
# 74HC/HCT4511

## ORDERING INFORMATION

See "74HC/HCT/HCU/HCMOS Logic Package Information".

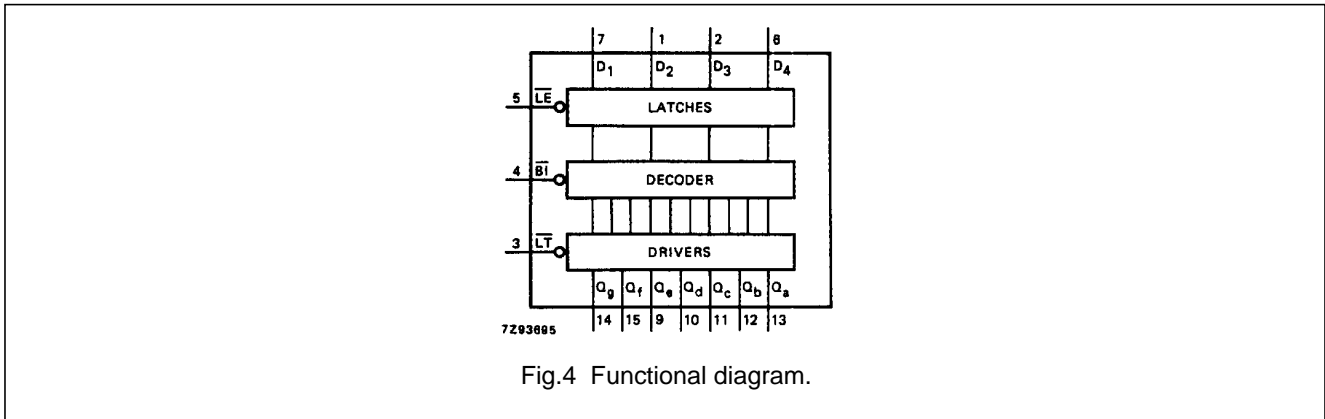
## PIN DESCRIPTION

| PIN NO.                   | SYMBOL                           | NAME AND FUNCTION                  |
|---------------------------|----------------------------------|------------------------------------|
| 3                         | $\overline{LT}$                  | lamp test input (active LOW)       |
| 4                         | $\overline{BI}$                  | ripple blanking input (active LOW) |
| 5                         | $\overline{LE}$                  | latch enable input (active LOW)    |
| 7, 1, 2, 6                | D <sub>1</sub> to D <sub>4</sub> | BCD address inputs                 |
| 8                         | GND                              | ground (0 V)                       |
| 13, 12, 11, 10, 9, 15, 14 | Q <sub>a</sub> to Q <sub>g</sub> | segments outputs                   |
| 16                        | V <sub>CC</sub>                  | positive supply voltage            |



BCD to 7-segment latch/decoder/driver

74HC/HCT4511



FUNCTION TABLE

| INPUTS          |                 |                 |                |                |                |                | OUTPUTS        |                |                |                |                |                |                | DISPLAY |
|-----------------|-----------------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------|
| $\overline{LE}$ | $\overline{BI}$ | $\overline{LT}$ | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | Q <sub>a</sub> | Q <sub>b</sub> | Q <sub>c</sub> | Q <sub>d</sub> | Q <sub>e</sub> | Q <sub>f</sub> | Q <sub>g</sub> |         |
| X               | X               | L               | X              | X              | X              | X              | H              | H              | H              | H              | H              | H              | H              | 8       |
| X               | L               | H               | X              | X              | X              | X              | L              | L              | L              | L              | L              | L              | L              | blank   |
| L               | H               | H               | L              | L              | L              | L              | H              | H              | H              | H              | H              | H              | L              | 0       |
| L               | H               | H               | L              | L              | L              | H              | L              | H              | H              | L              | L              | L              | L              | 1       |
| L               | H               | H               | L              | L              | H              | L              | H              | H              | L              | H              | H              | L              | H              | 2       |
| L               | H               | H               | L              | L              | H              | H              | H              | H              | H              | H              | L              | L              | H              | 3       |
| L               | H               | H               | L              | H              | L              | L              | L              | H              | H              | L              | L              | H              | H              | 4       |
| L               | H               | H               | L              | H              | L              | H              | H              | L              | H              | H              | L              | H              | H              | 5       |
| L               | H               | H               | L              | H              | H              | L              | L              | L              | H              | H              | H              | H              | H              | 6       |
| L               | H               | H               | L              | H              | H              | H              | H              | H              | H              | L              | L              | L              | L              | 7       |
| L               | H               | H               | H              | L              | L              | L              | H              | H              | H              | H              | H              | H              | H              | 8       |
| L               | H               | H               | H              | L              | L              | H              | H              | H              | H              | L              | L              | H              | H              | 9       |
| L               | H               | H               | H              | L              | H              | L              | L              | L              | L              | L              | L              | L              | L              | blank   |
| L               | H               | H               | H              | L              | H              | H              | L              | L              | L              | L              | L              | L              | L              | blank   |
| L               | H               | H               | H              | H              | L              | L              | L              | L              | L              | L              | L              | L              | L              | blank   |
| L               | H               | H               | H              | H              | L              | H              | L              | L              | L              | L              | L              | L              | L              | blank   |
| L               | H               | H               | H              | H              | H              | L              | L              | L              | L              | L              | L              | L              | L              | blank   |
| L               | H               | H               | H              | H              | H              | H              | L              | L              | L              | L              | L              | L              | L              | blank   |
| H               | H               | H               | X              | X              | X              | X              | (1)            |                |                |                |                |                |                | (1)     |

Note

- Depends upon the BCD-code applied during the LOW-to-HIGH transition of  $\overline{LE}$ .  
 H = HIGH voltage level  
 L = LOW voltage level  
 X = don't care

BCD to 7-segment latch/decoder/driver

74HC/HCT4511

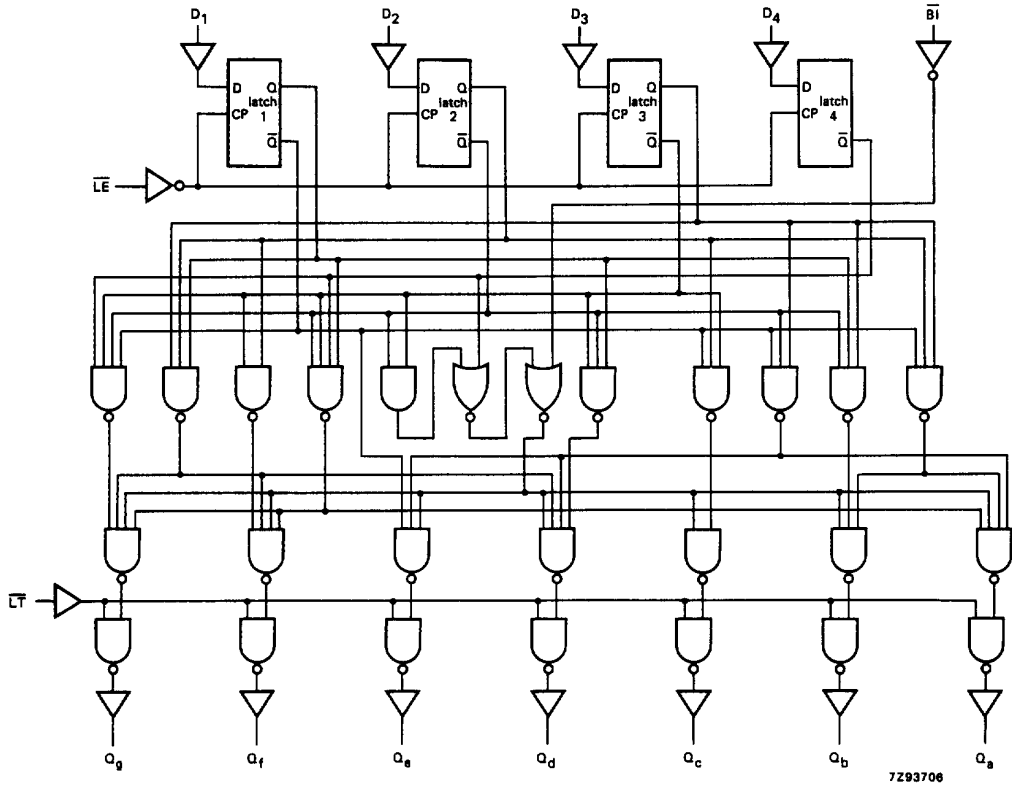


Fig.5 Logic diagram.

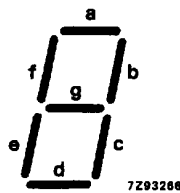


Fig.6 Segment designation.

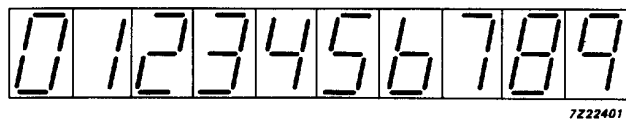


Fig.7 Display.

## BCD to 7-segment latch/decoder/driver

## 74HC/HCT4511

**DC CHARACTERISTICS FOR 74HC**

For the DC characteristics see *"74HC/HCT/HCU/HCMOS Logic Family Specifications"*.

Output capability: standard, excepting  $V_{OH}$  which is given below  
 $I_{CC}$  category: MSI

**Non-standard DC characteristics for 74HC**

Voltages are referenced to GND (ground = 0 V)

| SYMBOL   | PARAMETER                 | $T_{amb}$ (°C) |      |      |            |      |             |      | UNIT | TEST CONDITIONS |                         |                     |
|----------|---------------------------|----------------|------|------|------------|------|-------------|------|------|-----------------|-------------------------|---------------------|
|          |                           | 74HC           |      |      |            |      |             |      |      | $V_{CC}$<br>(V) | $V_I$                   | $-I_o$<br>(mA)      |
|          |                           | +25            |      |      | -40 to +85 |      | -40 to +125 |      |      |                 |                         |                     |
|          |                           | min.           | typ. | max. | min.       | max. | min.        | max. |      |                 |                         |                     |
| $V_{OH}$ | HIGH level output voltage | 3.98           |      |      | 3.84       |      | 3.70        |      | V    | 4.5             | $V_{IH}$ or<br>$V_{IL}$ | 7.5<br>10.0         |
| $V_{OH}$ | HIGH level output voltage | 5.60           |      |      | 5.45       |      | 5.35        |      | V    | 6.0             | $V_{IH}$ or<br>$V_{IL}$ | 7.5<br>10.0<br>15.0 |

## BCD to 7-segment latch/decoder/driver

## 74HC/HCT4511

## AC CHARACTERISTICS FOR 74HC

GND = 0 V;  $t_r = t_f = 6$  ns;  $C_L = 50$  pF

| SYMBOL                              | PARAMETER   | T <sub>amb</sub> (°C) |                 |                 |                 |                 |                 | UNIT            | TEST CONDITIONS        |                   |                  |
|-------------------------------------|---|-----------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------------|-------------------|------------------|
|                                     |   | 74HC                  |                 |                 |                 |                 |                 |                 | V <sub>CC</sub><br>(V) | WAVEFORMS         |                  |
|                                     |   | +25                   |                 |                 | -40 to +85      |                 | -40 to +125     |                 |                        |                   |                  |
|                                     |   | min.                  | typ.            | max.            | min.            | max.            | min.            |                 |                        |                   | max.             |
| t <sub>PHL</sub> / t <sub>PLH</sub> | propagation delay<br>D <sub>n</sub> to Q <sub>n</sub> |                       | 77<br>28<br>22  | 300<br>60<br>51 |                 | 375<br>75<br>64 |                 | 450<br>90<br>77 | ns                     | 2.0<br>4.5<br>6.0 | Fig.8            |
| t <sub>PHL</sub> / t <sub>PLH</sub> | propagation delay<br>LE to Q <sub>n</sub>             |                       | 74<br>27<br>22  | 270<br>54<br>46 |                 | 330<br>68<br>58 |                 | 405<br>81<br>69 | ns                     | 2.0<br>4.5<br>6.0 | Fig.9            |
| t <sub>PHL</sub> / t <sub>PLH</sub> | propagation delay<br>BI to Q <sub>n</sub>             |                       | 61<br>22<br>18  | 220<br>44<br>37 |                 | 275<br>55<br>47 |                 | 330<br>66<br>56 | ns                     | 2.0<br>4.5<br>6.0 | Fig.10           |
| t <sub>PHL</sub> / t <sub>PLH</sub> | propagation delay<br>LT to Q <sub>n</sub>             |                       | 41<br>15<br>12  | 150<br>30<br>26 |                 | 190<br>38<br>33 |                 | 225<br>45<br>38 | ns                     | 2.0<br>4.5<br>6.0 | Fig.8            |
| t <sub>THL</sub> / t <sub>TLH</sub> | output transition time                                |                       | 19<br>7<br>6    | 75<br>15<br>13  |                 | 95<br>19<br>16  |                 | 110<br>22<br>19 | ns                     | 2.0<br>4.5<br>6.0 | Figs 8, 9 and 10 |
| t <sub>W</sub>                      | latch enable pulse width<br>LOW                       | 80<br>16<br>14        | 11<br>4<br>3    |                 | 100<br>20<br>17 |                 | 120<br>24<br>20 |                 | ns                     | 2.0<br>4.5<br>6.0 | Fig.9            |
| t <sub>SU</sub>                     | set-up time<br>D <sub>n</sub> to LE                   | 60<br>12<br>10        | 14<br>5<br>4    |                 | 75<br>15<br>13  |                 | 90<br>18<br>15  |                 | ns                     | 2.0<br>4.5<br>6.0 | Fig.11           |
| t <sub>H</sub>                      | hold time<br>D <sub>n</sub> to LE                     | 0<br>0<br>0           | -11<br>-4<br>-3 |                 | 0<br>0<br>0     |                 | 0<br>0<br>0     |                 | ns                     | 2.0<br>4.5<br>6.0 | Fig.11           |

## BCD to 7-segment latch/decoder/driver

## 74HC/HCT4511

**DC CHARACTERISTICS FOR 74HCT**

For the DC characteristics see *"74HC/HCT/HCU/HCMOS Logic Family Specifications"*.

Output capability: standard, excepting  $V_{OH}$  which is given below  
 $I_{CC}$  category: MSI

**Non-standard DC characteristics for 74HCT**

Voltages are referenced to GND (ground = 0 V)

| SYMBOL   | PARAMETER                 | $T_{amb}$ (°C) |      |      |            |      |             |      | UNIT | TEST CONDITIONS |                         |                |
|----------|---------------------------|----------------|------|------|------------|------|-------------|------|------|-----------------|-------------------------|----------------|
|          |                           | 74HCT          |      |      |            |      |             |      |      | $V_{CC}$<br>(V) | $V_I$                   | $-I_o$<br>(mA) |
|          |                           | +25            |      |      | -40 to +85 |      | -40 to +125 |      |      |                 |                         |                |
|          |                           | min.           | typ. | max. | min.       | max. | min.        | max. |      |                 |                         |                |
| $V_{OH}$ | HIGH level output voltage | 3.98           |      |      | 3.84       |      | 3.70        |      | V    | 4.5             | $V_{IH}$ or<br>$V_{IL}$ | 7.5<br>10.0    |

**Note to HCT types**

The value of additional quiescent supply current ( $\Delta I_{CC}$ ) for a unit load of 1 is given in the family specifications.  
 To determine  $\Delta I_{CC}$  per input, multiply this value by the unit load coefficient shown in the table below.

| INPUT                             | UNIT LOAD COEFFICIENT |
|-----------------------------------|-----------------------|
| $\overline{LT}$ , $\overline{LE}$ | 1.50                  |
| $\overline{BI}$ , $D_n$           | 0.30                  |



## BCD to 7-segment latch/decoder/driver

## 74HC/HCT4511

## AC CHARACTERISTICS FOR 74HCT

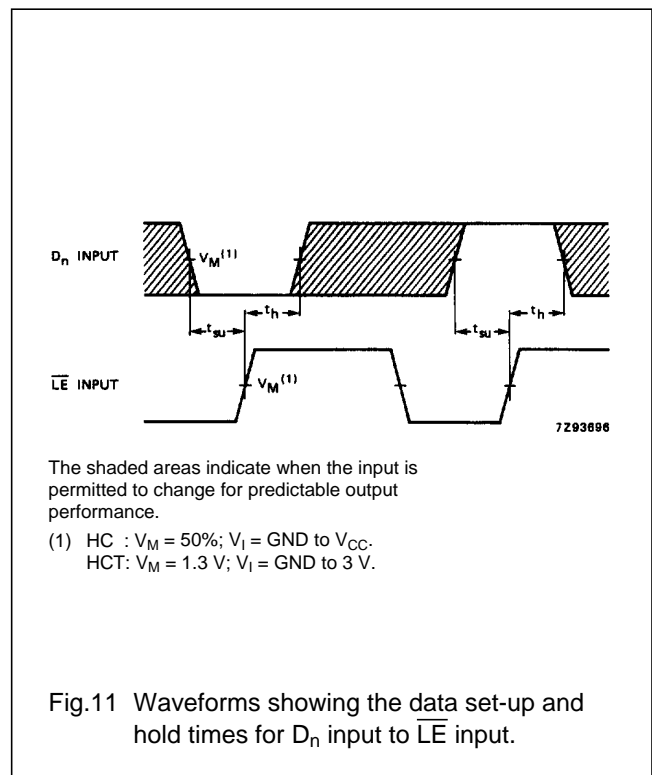
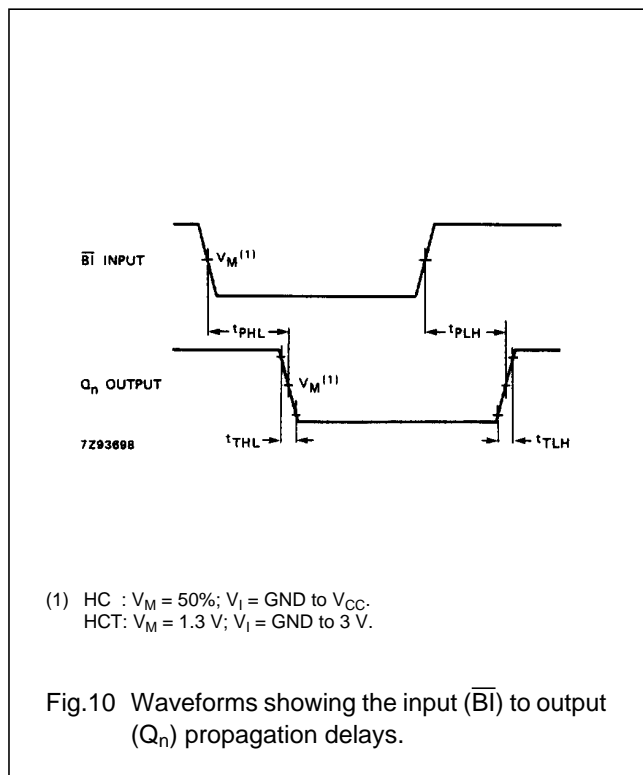
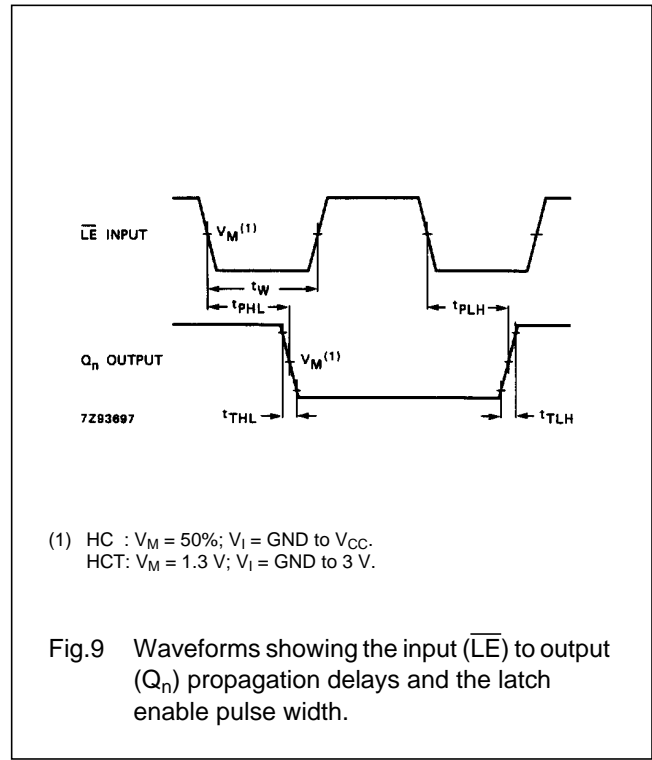
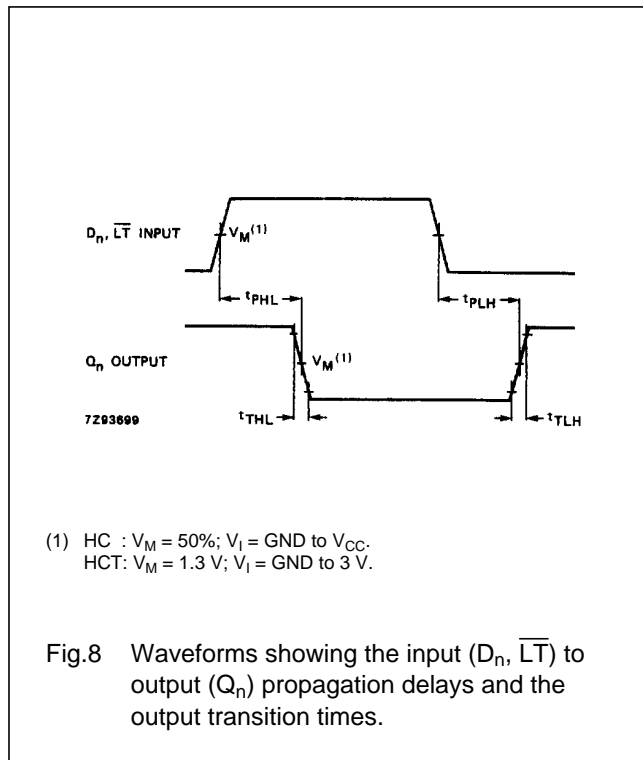
GND = 0 V;  $t_r = t_f = 6$  ns;  $C_L = 50$  pF

| SYMBOL            | PARAMETER                                     | $T_{amb}$ (°C) |      |      |            |      |             |      | UNIT | TEST CONDITIONS |                  |
|-------------------|---|----------------|------|------|------------|------|-------------|------|------|-----------------|------------------|
|                   |   | 74HCT          |      |      |            |      |             |      |      | $V_{CC}$<br>(V) | WAVEFORMS        |
|                   |   | +25            |      |      | -40 to +85 |      | -40 to +125 |      |      |                 |                  |
|                   |   | min.           | typ. | max. | min.       | max. | min.        | max. |      |                 |                  |
| $t_{PHL}/t_{PLH}$ | propagation delay<br>$D_n$ to $Q_n$           |                | 28   | 60   |            | 75   |             | 90   | ns   | 4.5             | Fig.8            |
| $t_{PHL}/t_{PLH}$ | propagation delay<br>$\overline{LE}$ to $Q_n$ |                | 27   | 54   |            | 68   |             | 81   | ns   | 4.5             | Fig.9            |
| $t_{PHL}/t_{PLH}$ | propagation delay<br>$\overline{BI}$ to $Q_n$ |                | 23   | 44   |            | 55   |             | 66   | ns   | 4.5             | Fig.10           |
| $t_{PHL}/t_{PLH}$ | propagation delay<br>$\overline{LT}$ to $Q_n$ |                | 16   | 30   |            | 38   |             | 45   | ns   | 4.5             | Fig.8            |
| $t_{THL}/t_{TLH}$ | output transition time                        |                | 7    | 15   |            | 19   |             | 22   | ns   | 4.5             | Figs 8, 9 and 10 |
| $t_W$             | latch enable pulse width<br>LOW               | 16             | 5    |      | 20         |      | 24          |      | ns   | 4.5             | Fig.9            |
| $t_{su}$          | set-up time<br>$D_n$ to $\overline{LE}$       | 12             | 5    |      | 15         |      | 18          |      | ns   | 4.5             | Fig.11           |
| $t_h$             | hold time<br>$D_n$ to $\overline{LE}$         | 0              | -4   |      | 0          |      | 0           |      | ns   | 4.5             | Fig.11           |

BCD to 7-segment latch/decoder/driver

74HC/HCT4511

AC WAVEFORMS



BCD to 7-segment latch/decoder/driver

74HC/HCT4511

APPLICATION DIAGRAMS

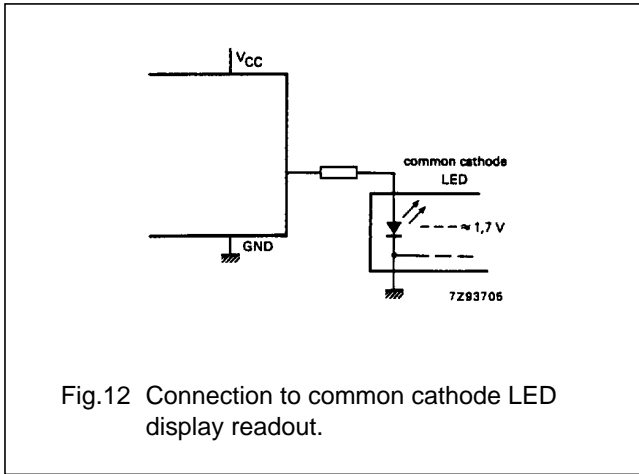


Fig.12 Connection to common cathode LED display readout.

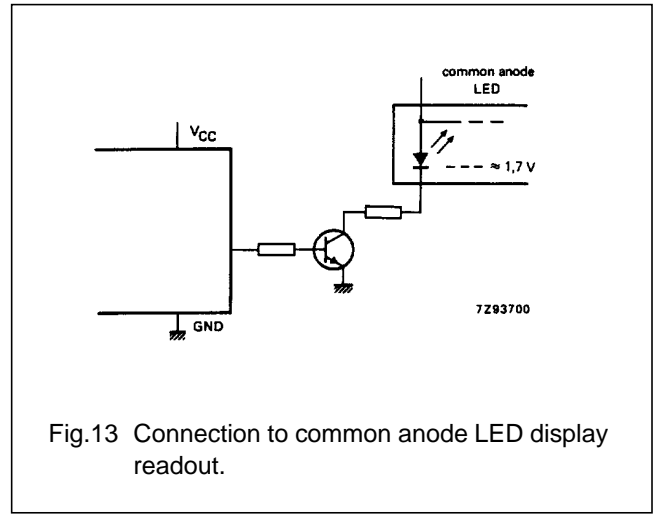


Fig.13 Connection to common anode LED display readout.

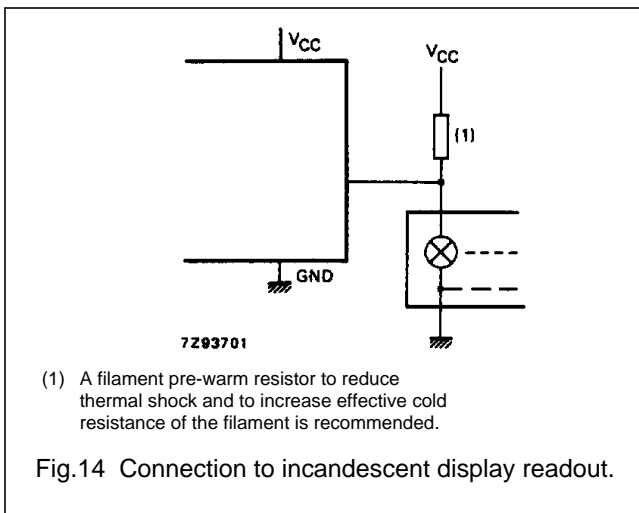


Fig.14 Connection to incandescent display readout.

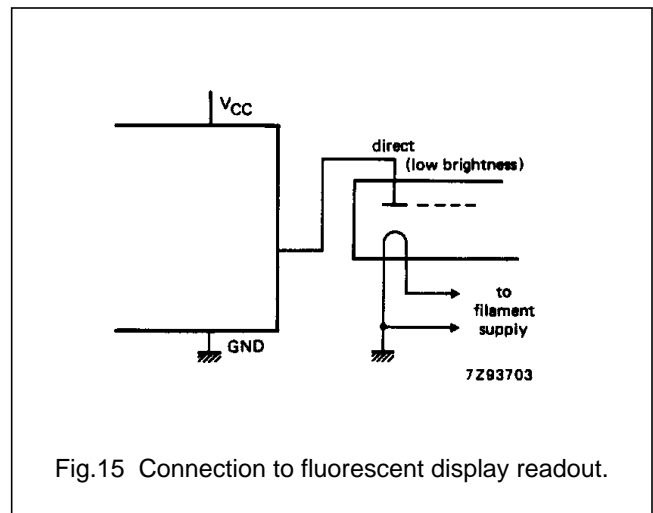


Fig.15 Connection to fluorescent display readout.

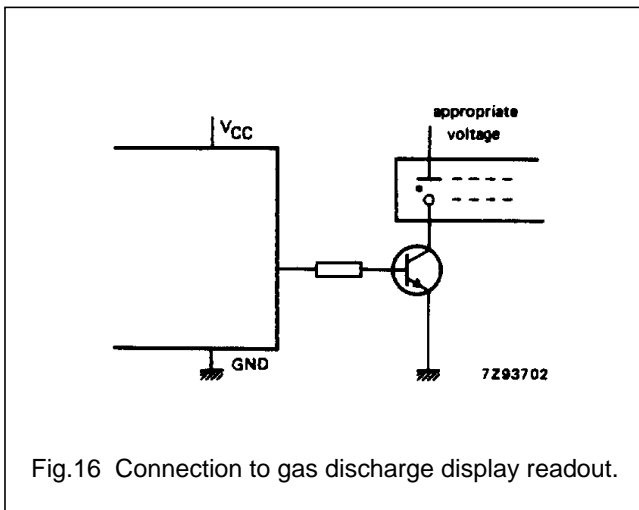


Fig.16 Connection to gas discharge display readout.

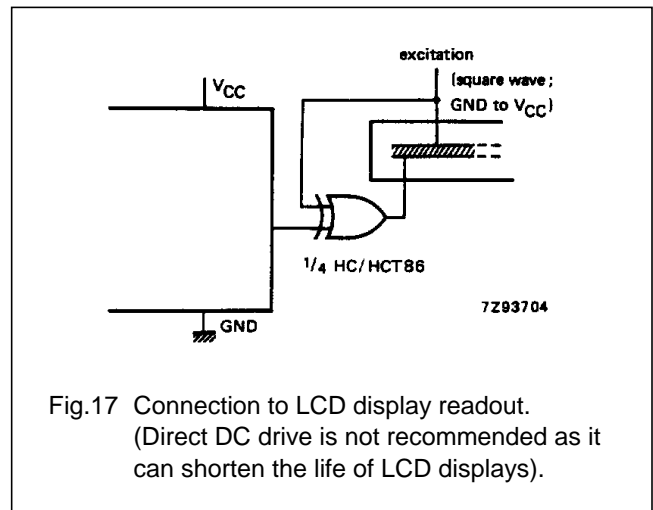


Fig.17 Connection to LCD display readout. (Direct DC drive is not recommended as it can shorten the life of LCD displays).

BCD to 7-segment latch/decoder/driver

74HC/HCT4511

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**PACKAGE OUTLINES**

See *"74HC/HCT/HCU/HCMOS Logic Package Outlines"*.