

# 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/HCT4052**

Dual 4-channel analog  
multiplexer/demultiplexer

Product specification  
File under Integrated Circuits, IC06

December 1990

## Dual 4-channel analog multiplexer/demultiplexer

## 74HC/HCT4052

### FEATURES

- Wide analog input voltage range:  $\pm 5$  V.
- Low "ON" resistance:  
80  $\Omega$  (typ.) at  $V_{CC} - V_{EE} = 4.5$  V  
70  $\Omega$  (typ.) at  $V_{CC} - V_{EE} = 6.0$  V  
60  $\Omega$  (typ.) at  $V_{CC} - V_{EE} = 9.0$  V
- Logic level translation:  
to enable 5 V logic to communicate  
with  $\pm 5$  V analog signals
- Typical "break before make" built in
- Output capability: non-standard
- $I_{CC}$  category: MSI

### GENERAL DESCRIPTION

The 74HC/HCT4052 are high-speed Si-gate CMOS devices and are pin compatible with the "4052" of the "4000B" series. They are specified in compliance with JEDEC standard no. 7A.

The 74HC/HCT4052 are dual 4-channel analog multiplexers/demultiplexers with common select logic. Each multiplexer has four independent inputs/outputs ( $nY_0$  to  $nY_3$ ) and a common input/output ( $nZ$ ). The common channel select logics include two digital select inputs ( $S_0$  and  $S_1$ ) and an active LOW enable input ( $\bar{E}$ ).

With  $\bar{E}$  LOW, one of the four switches is selected (low impedance ON-state) by  $S_0$  and  $S_1$ . With  $\bar{E}$  HIGH, all switches are in the high impedance OFF-state, independent of  $S_0$  and  $S_1$ .

$V_{CC}$  and GND are the supply voltage pins for the digital control inputs ( $S_0$  and  $S_1$ , and  $\bar{E}$ ). The  $V_{CC}$  to GND ranges are 2.0 to 10.0 V for HC and 4.5 to 5.5 V for HCT. The analog inputs/outputs ( $nY_0$  to  $nY_3$ , and  $nZ$ ) can swing between  $V_{CC}$  as a positive limit and  $V_{EE}$  as a negative limit.  $V_{CC} - V_{EE}$  may not exceed 10.0 V.

For operation as a digital multiplexer/demultiplexer,  $V_{EE}$  is connected to GND (typically ground).

### QUICK REFERENCE DATA

$V_{EE} = \text{GND} = 0$  V;  $T_{\text{amb}} = 25$  °C;  $t_r = t_f = 6$  ns

| SYMBOL            | PARAMETER                                      | CONDITIONS                                               | TYPICAL |     | UNIT |
|-------------------|------------------------------------------------|----------------------------------------------------------|---------|-----|------|
|                   |                                                |                                                          | HC      | HCT |      |
| $t_{PZH}/t_{PZL}$ | turn "ON" time $\bar{E}$ or $S_n$ to $V_{OS}$  | $C_L = 15$ pF ; $R_L = 1$ k $\Omega$ ;<br>$V_{CC} = 5$ V | 28      | 18  | ns   |
| $t_{PHZ}/t_{PLZ}$ | turn "OFF" time $\bar{E}$ or $S_n$ to $V_{OS}$ |                                                          | 21      | 13  | ns   |
| $C_I$             | input capacitance                              |                                                          | 3.5     | 3.5 | pF   |
| $C_{PD}$          | power dissipation capacitance per switch       | notes 1 and 2                                            | 57      | 57  | pF   |
| $C_S$             | max. switch capacitance<br>independent (Y)     |                                                          | 5       | 5   | pF   |
|                   | common (Z)                                     |                                                          | 12      | 12  | pF   |

### Notes

1.  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu$ W):

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

$f_i$  = input frequency in MHz

$f_o$  = output frequency in MHz

$\sum \{(C_L + C_S) \times V_{CC}^2 \times f_o\}$  = sum of outputs

$C_L$  = output load capacitance in pF

$C_S$  = max. switch capacitance in pF

$V_{CC}$  = supply voltage in V

2. For HC the condition is  $V_I = \text{GND to } V_{CC}$   
For HCT the condition is  $V_I = \text{GND to } V_{CC} - 1.5$  V

Dual 4-channel analog  
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ORDERING INFORMATION

See *“74HC/HCT/HCU/HCMOS Logic Package Information”*.

PIN DESCRIPTION

| PIN NO.        | SYMBOL                             | NAME AND FUNCTION          |
|----------------|------------------------------------|----------------------------|
| 1, 5, 2, 4     | 2Y <sub>0</sub> to 2Y <sub>3</sub> | independent inputs/outputs |
| 6              | $\overline{E}$                     | enable input (active LOW)  |
| 7              | V <sub>EE</sub>                    | negative supply voltage    |
| 8              | GND                                | ground (0 V)               |
| 10, 9          | S <sub>0</sub> , S <sub>1</sub>    | select inputs              |
| 12, 14, 15, 11 | 1Y <sub>0</sub> to 1Y <sub>3</sub> | independent inputs/outputs |
| 13, 3          | 1Z, 2Z                             | common inputs/outputs      |
| 16             | V <sub>CC</sub>                    | positive supply voltage    |

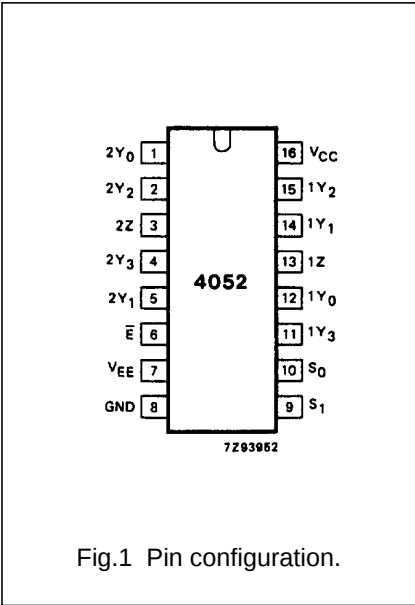


Fig.1 Pin configuration.

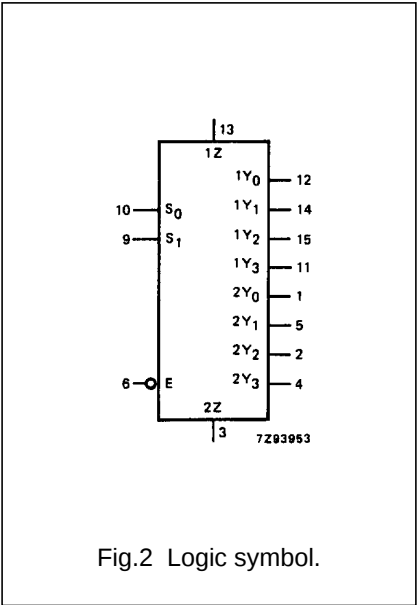


Fig.2 Logic symbol.

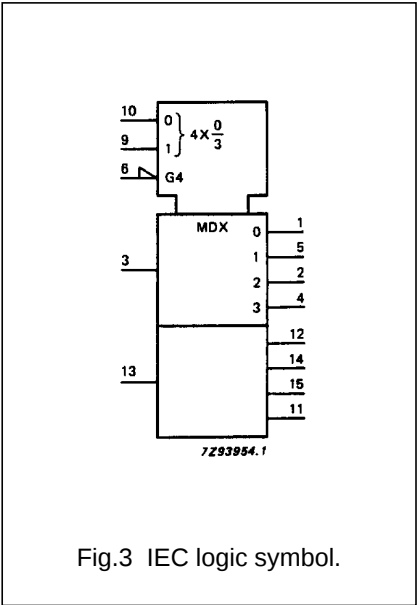
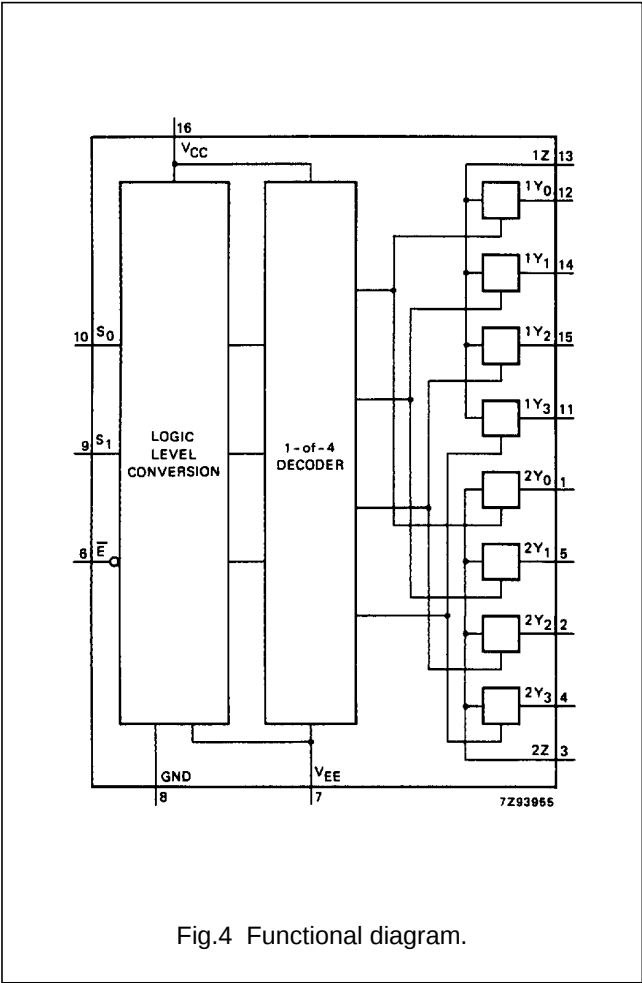


Fig.3 IEC logic symbol.

Dual 4-channel analog  
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APPLICATIONS

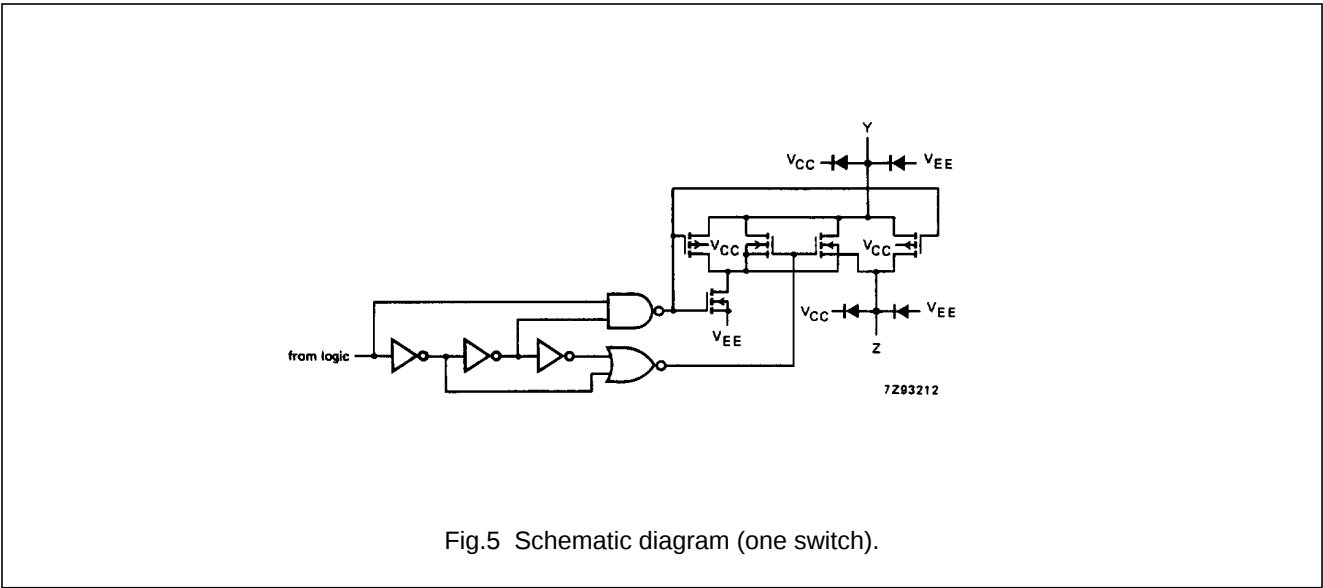
- Analog multiplexing and demultiplexing
- Digital multiplexing and demultiplexing
- demultiplexing
- Signal gating

FUNCTION TABLE

| INPUTS         |       |       | CHANNEL ON  |
|----------------|-------|-------|-------------|
| $\overline{E}$ | $S_1$ | $S_0$ |             |
| L              | L     | L     | $nY_0 - nZ$ |
| L              | L     | H     | $nY_1 - nZ$ |
| L              | H     | L     | $nY_2 - nZ$ |
| L              | H     | H     | $nY_3 - nZ$ |
| H              | X     | X     | none        |

Notes

1. H = HIGH voltage level  
L = LOW voltage level  
X = don't care



# Dual 4-channel analog multiplexer/demultiplexer

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## RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages are referenced to  $V_{EE} = \text{GND}$  (ground = 0 V)

| SYMBOL                    | PARAMETER                      | MIN. | MAX.  | UNIT | CONDITIONS                                                   |
|---------------------------|--------------------------------|------|-------|------|--------------------------------------------------------------|
| $V_{CC}$                  | DC supply voltage              | -0.5 | +11.0 | V    |                                                              |
| $\pm I_{IK}$              | DC digital input diode current |      | 20    | mA   | for $V_I < -0.5 \text{ V}$ or $V_I > V_{CC} + 0.5 \text{ V}$ |
| $\pm I_{SK}$              | DC switch diode current        |      | 20    | mA   | for $V_S < -0.5 \text{ V}$ or $V_S > V_{CC} + 0.5 \text{ V}$ |
| $\pm I_S$                 | DC switch current              |      | 25    | mA   | for $-0.5 \text{ V} < V_S < V_{CC} + 0.5 \text{ V}$          |
| $\pm I_{EE}$              | DC $V_{EE}$ current            |      | 20    | mA   |                                                              |
| $\pm I_{CC}; \pm I_{GND}$ | DC $V_{CC}$ or GND current     |      | 50    | mA   |                                                              |
| $T_{stg}$                 | storage temperature range      | -65  | +150  | °C   |                                                              |
| $P_{tot}$                 | power dissipation per package  |      |       |      | for temperature range: -40 to +125 °C<br>74HC/HCT            |
|                           | plastic DIL                    |      | 750   | mW   | above +70 °C: derate linearly with 12 mW/K                   |
|                           | plastic mini-pack (SO)         |      | 500   | mW   | above +70 °C: derate linearly with 8 mW/K                    |
| $P_S$                     | power dissipation per switch   |      | 100   | mW   |                                                              |

## Note to ratings

- To avoid drawing  $V_{CC}$  current out of terminals nZ, when switch current flows in terminals nY<sub>n</sub>, the voltage drop across the bidirectional switch must not exceed 0.4 V. If the switch current flows into terminals nZ, no  $V_{CC}$  current will flow out of terminals nY<sub>n</sub>. In this case there is no limit for the voltage drop across the switch, but the voltages at nY<sub>n</sub> and nZ may not exceed  $V_{CC}$  or  $V_{EE}$ .

## RECOMMENDED OPERATING CONDITIONS

| SYMBOL     | PARAMETER                             | 74HC     |      |                           | 74HCT    |      |          | UNIT | CONDITIONS                                                                                                    |
|------------|---------------------------------------|----------|------|---------------------------|----------|------|----------|------|---------------------------------------------------------------------------------------------------------------|
|            |                                       | min.     | typ. | max.                      | min.     | typ. | max.     |      |                                                                                                               |
| $V_{CC}$   | DC supply voltage $V_{CC}-\text{GND}$ | 2.0      | 5.0  | 10.0                      | 4.5      | 5.0  | 5.5      | V    | see Fig.6 and Fig.7                                                                                           |
| $V_{CC}$   | DC supply voltage $V_{CC}-V_{EE}$     | 2.0      | 5.0  | 10.0                      | 2.0      | 5.0  | 10.0     | V    | see Fig.6 and Fig.7                                                                                           |
| $V_I$      | DC input voltage range                | GND      |      | $V_{CC}$                  | GND      |      | $V_{CC}$ | V    |                                                                                                               |
| $V_S$      | DC switch voltage range               | $V_{EE}$ |      | $V_{CC}$                  | $V_{EE}$ |      | $V_{CC}$ | V    |                                                                                                               |
| $T_{amb}$  | operating ambient temperature range   | -40      |      | +85                       | -40      |      | +85      | °C   | see DC and AC<br>CHARACTERISTICS                                                                              |
| $T_{amb}$  | operating ambient temperature range   | -40      |      | +125                      | -40      |      | +125     | °C   |                                                                                                               |
| $t_r, t_f$ | input rise and fall times             |          | 6.0  | 1000<br>500<br>400<br>250 |          | 6.0  | 500      | ns   | $V_{CC} = 2.0 \text{ V}$<br>$V_{CC} = 4.5 \text{ V}$<br>$V_{CC} = 6.0 \text{ V}$<br>$V_{CC} = 10.0 \text{ V}$ |

# Dual 4-channel analog multiplexer/demultiplexer

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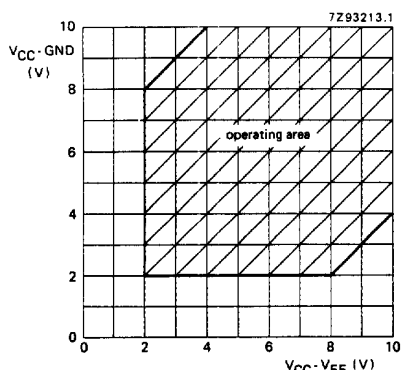


Fig.6 Guaranteed operating area as a function of the supply voltages for 74HC4052.

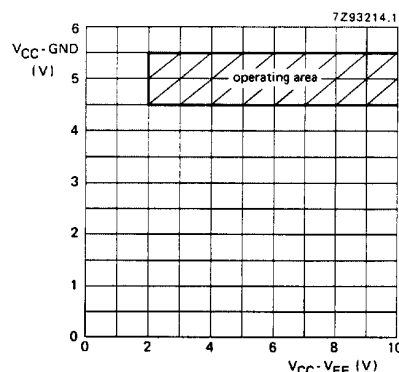


Fig.7 Guaranteed operating area as a function of the supply voltages for 74HCT4052.

### DC CHARACTERISTICS FOR 74HC/HCT

For 74HC:  $V_{CC} - GND$  or  $V_{CC} - V_{EE} = 2.0, 4.5, 6.0$  and  $9.0$  V

For 74HCT:  $V_{CC} - GND = 4.5$  and  $5.5$  V;  $V_{CC} - V_{EE} = 2.0, 4.5, 6.0$  and  $9.0$  V

| SYMBOL           | PARAMETER                                             | T <sub>amb</sub> (°C) |                       |                        |            |                        |             |                        | UNIT             | TEST CONDITIONS          |                        |                             |                                          |                                          |
|------------------|-------------------------------------------------------|-----------------------|-----------------------|------------------------|------------|------------------------|-------------|------------------------|------------------|--------------------------|------------------------|-----------------------------|------------------------------------------|------------------------------------------|
|                  |                                                       | 74HC/HCT              |                       |                        |            |                        |             |                        |                  | V <sub>CC</sub><br>(V)   | V <sub>EE</sub><br>(V) | I <sub>S</sub><br>(μA)      | V <sub>is</sub>                          | V <sub>I</sub>                           |
|                  |                                                       | +25                   |                       |                        | −40 to +85 |                        | −40 to +125 |                        |                  |                          |                        |                             |                                          |                                          |
|                  |                                                       | min.                  | typ.                  | max.                   | min.       | max.                   | min.        | max.                   |                  |                          |                        |                             |                                          |                                          |
| R <sub>ON</sub>  | ON resistance<br>(peak)                               |                       | −<br>100<br>90<br>70  | −<br>180<br>160<br>130 |            | −<br>225<br>200<br>165 |             | −<br>270<br>240<br>195 | Ω<br>Ω<br>Ω<br>Ω | 2.0<br>4.5<br>6.0<br>4.5 | 0<br>0<br>0<br>−4.5    | 100<br>1000<br>1000<br>1000 | V <sub>CC</sub><br>to<br>V <sub>EE</sub> | V <sub>IH</sub><br>or<br>V <sub>IL</sub> |
| R <sub>ON</sub>  | ON resistance (rail)                                  |                       | 150<br>80<br>70<br>60 | −<br>140<br>120<br>105 |            | −<br>175<br>150<br>130 |             | −<br>210<br>180<br>160 | Ω<br>Ω<br>Ω<br>Ω | 2.0<br>4.5<br>6.0<br>4.5 | 0<br>0<br>0<br>−4.5    | 100<br>1000<br>1000<br>1000 | V <sub>EE</sub>                          | V <sub>IH</sub><br>or<br>V <sub>IL</sub> |
| R <sub>ON</sub>  | ON resistance (rail)                                  |                       | 150<br>90<br>80<br>65 | −<br>160<br>140<br>120 |            | −<br>200<br>175<br>150 |             | −<br>240<br>210<br>180 | Ω<br>Ω<br>Ω<br>Ω | 2.0<br>4.5<br>6.0<br>4.5 | 0<br>0<br>0<br>−4.5    | 100<br>1000<br>1000<br>1000 | V <sub>CC</sub>                          | V <sub>IH</sub><br>or<br>V <sub>IL</sub> |
| ΔR <sub>ON</sub> | maximum ΔON<br>resistance between<br>any two channels |                       | −<br>9<br>8<br>6      |                        |            |                        |             |                        | Ω<br>Ω<br>Ω<br>Ω | 2.0<br>4.5<br>6.0<br>4.5 | 0<br>0<br>0<br>−4.5    |                             | V <sub>CC</sub><br>to<br>V <sub>EE</sub> | V <sub>H</sub><br>or<br>V <sub>IL</sub>  |

### Notes to the characteristics

- At supply voltages ( $V_{CC} - V_{EE}$ ) approaching 2.0 V the Analog switch ON-resistance becomes extremely non-linear. There it is recommended that these devices be used to transmit digital signals only, when using these supply voltages
- For test circuit measuring  $R_{ON}$  see Fig.8

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## DC CHARACTERISTICS FOR 74HC

Voltages are referenced to GND (ground = 0 V)

| SYMBOL          | PARAMETER                                    | T <sub>amb</sub> (°C)     |                          |                           |                           |                           |                           |                           |    | UNIT                     | TEST CONDITIONS        |                                          |                                                                                                                      |       |
|-----------------|----------------------------------------------|---------------------------|--------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|----|--------------------------|------------------------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------|-------|
|                 |                                              | 74HC                      |                          |                           |                           |                           |                           |                           |    |                          | V <sub>CC</sub><br>(V) | V <sub>EE</sub><br>(V)                   | V <sub>I</sub>                                                                                                       | OTHER |
|                 |                                              | +25                       |                          |                           | −40 to +85                |                           | −40 to +125               |                           |    |                          |                        |                                          |                                                                                                                      |       |
|                 |                                              | min.                      | typ.                     | max.                      | min.                      | max.                      | min.                      | max.                      |    |                          |                        |                                          |                                                                                                                      |       |
| V <sub>IH</sub> | HIGH level input voltage                     | 1.5<br>3.15<br>4.2<br>6.3 | 1.2<br>2.4<br>3.2<br>4.7 |                           | 1.5<br>3.15<br>4.2<br>6.3 |                           | 1.5<br>3.15<br>4.2<br>6.3 |                           | V  | 2.0<br>4.5<br>6.0<br>9.0 |                        |                                          |                                                                                                                      |       |
| V <sub>IL</sub> | LOW level input voltage                      |                           | 0.8<br>2.1<br>2.8<br>4.3 | 0.5<br>1.35<br>1.8<br>2.7 |                           | 0.5<br>1.35<br>1.8<br>2.7 |                           | 0.5<br>1.35<br>1.8<br>2.7 | V  | 2.0<br>4.5<br>6.0<br>9.0 |                        |                                          |                                                                                                                      |       |
| ±I <sub>I</sub> | input leakage current                        |                           |                          | 0.1<br>0.2                |                           | 1.0<br>2.0                |                           | 1.0<br>2.0                | μA | 6.0<br>10.0              | 0<br>0                 | V <sub>CC</sub><br>or<br>GND             |                                                                                                                      |       |
| ±I <sub>S</sub> | analog switch OFF-state current per channel  |                           |                          | 0.1                       |                           | 1.0                       |                           | 1.0                       | μA | 10.0                     | 0                      | V <sub>IH</sub><br>or<br>V <sub>IL</sub> | V <sub>S</sub>   =<br>V <sub>CC</sub> − V <sub>EE</sub><br>(see Fig.10)                                              |       |
| ±I <sub>S</sub> | analog switch OFF-state current all channels |                           |                          | 0.2                       |                           | 2.0                       |                           | 2.0                       | μA | 10.0                     | 0                      | V <sub>IH</sub><br>or<br>V <sub>IL</sub> | V <sub>S</sub>   =<br>V <sub>CC</sub> − V <sub>EE</sub><br>(see Fig.10)                                              |       |
| ±I <sub>S</sub> | analog switch ON-state current               |                           |                          | 0.2                       |                           | 2.0                       |                           | 2.0                       | μA | 10.0                     | 0                      | V <sub>IH</sub><br>or<br>V <sub>IL</sub> | V <sub>S</sub>   =<br>V <sub>CC</sub> − V <sub>EE</sub><br>(see Fig.11)                                              |       |
| I <sub>CC</sub> | quiescent supply current                     |                           |                          | 8.0<br>16.0               |                           | 80.0<br>160.0             |                           | 160<br>320.0              | μA | 6.0<br>10.0              | 0<br>0                 | V <sub>CC</sub><br>or<br>GND             | V <sub>IS</sub> = V <sub>EE</sub><br>or V <sub>CC</sub> ;<br>V <sub>OS</sub> = V <sub>CC</sub><br>or V <sub>EE</sub> |       |

# Dual 4-channel analog multiplexer/demultiplexer

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## 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)   | V <sub>EE</sub><br>(V) | OTHER                                                                     |
|                                     |                                                                               | +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>V <sub>IS</sub> to V <sub>OS</sub>                       |                       | 14<br>5<br>4<br>4     | 60<br>12<br>10<br>8   |            | 75<br>15<br>13<br>10  |             | 90<br>18<br>15<br>12  | ns   | 2.0<br>4.5<br>6.0<br>4.5 | 0<br>0<br>0<br>−4.5    | R <sub>L</sub> = ∞; C <sub>L</sub> = 50 pF<br>(see Fig.18)                |
| t <sub>PZH</sub> / t <sub>PZL</sub> | turn “ON” time<br>E̅ to V <sub>OS</sub><br>S <sub>n</sub> to V <sub>OS</sub>  |                       | 105<br>38<br>30<br>26 | 325<br>65<br>55<br>46 |            | 405<br>81<br>69<br>58 |             | 490<br>98<br>83<br>69 | ns   | 2.0<br>4.5<br>6.0<br>4.5 | 0<br>0<br>0<br>−4.5    | R <sub>L</sub> = ∞; C <sub>L</sub> = 50 pF<br>see Fig.19, 20 and 21       |
| t <sub>PHZ</sub> / t <sub>PLZ</sub> | turn “OFF” time<br>E̅ to V <sub>OS</sub><br>S <sub>n</sub> to V <sub>OS</sub> |                       | 74<br>27<br>22<br>22  | 250<br>50<br>43<br>38 |            | 315<br>63<br>54<br>48 |             | 375<br>75<br>64<br>57 | ns   | 2.0<br>4.5<br>6.0<br>4.5 | 0<br>0<br>0<br>−4.5    | R <sub>L</sub> = 1 kΩ;<br>C <sub>L</sub> = 50 pF<br>see Fig.19, 20 and 21 |

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## DC CHARACTERISTICS FOR 74HCT

Voltages are referenced to GND (ground = 0)

| SYMBOL           | PARAMETER                                                                                 | T <sub>amb</sub> (°C) |      |             |            |               |             |                | UNIT | TEST CONDITIONS        |                        |                                    |                                                                                                             |
|------------------|-------------------------------------------------------------------------------------------|-----------------------|------|-------------|------------|---------------|-------------|----------------|------|------------------------|------------------------|------------------------------------|-------------------------------------------------------------------------------------------------------------|
|                  |                                                                                           | 74HCT                 |      |             |            |               |             |                |      | V <sub>CC</sub><br>(V) | V <sub>EE</sub><br>(V) | V <sub>I</sub>                     | OTHER                                                                                                       |
|                  |                                                                                           | +25                   |      |             | −40 to +85 |               | −40 to +125 |                |      |                        |                        |                                    |                                                                                                             |
|                  |                                                                                           | min.                  | typ. | max.        | min.       | max.          | min.        | max.           |      |                        |                        |                                    |                                                                                                             |
| V <sub>IH</sub>  | HIGH level input voltage                                                                  | 2.0                   | 1.6  |             | 2.0        |               | 2.0         |                | V    | 4.5 to 5.5             |                        |                                    |                                                                                                             |
| V <sub>IL</sub>  | LOW level input voltage                                                                   |                       | 1.2  | 0.8         |            | 0.8           |             | 0.8            | V    | 4.5 to 5.5             |                        |                                    |                                                                                                             |
| ±I <sub>I</sub>  | input leakage current                                                                     |                       |      | 0.1         |            | 1.0           |             | 1.0            | μA   | 5.5                    | 0                      | V <sub>CC</sub> or GND             |                                                                                                             |
| ±I <sub>S</sub>  | analog switch OFF-state current per channel                                               |                       |      | 0.1         |            | 1.0           |             | 1.0            | μA   | 10.0                   | 0                      | V <sub>IH</sub> or V <sub>IL</sub> | M <sub>S</sub>   = V <sub>CC</sub> − V <sub>EE</sub> (see Fig.10)                                           |
| ±I <sub>S</sub>  | analog switch OFF-state current all channels                                              |                       |      | 0.2         |            | 2.0           |             | 2.0            | μA   | 10.0                   | 0                      | V <sub>IH</sub> or V <sub>IL</sub> | M <sub>S</sub>   = V <sub>CC</sub> − V <sub>EE</sub> (see Fig.10)                                           |
| ±I <sub>S</sub>  | analog switch ON-state current                                                            |                       |      | 0.2         |            | 2.0           |             | 2.0            | μA   | 10.0                   | 0                      | V <sub>IH</sub> or V <sub>IL</sub> | M <sub>S</sub>   = V <sub>CC</sub> − V <sub>EE</sub> (see Fig.11)                                           |
| I <sub>CC</sub>  | quiescent supply current                                                                  |                       |      | 8.0<br>16.0 |            | 80.0<br>160.0 |             | 160.0<br>320.0 | μA   | 5.5<br>5.0             | 0<br>−5.0              | V <sub>CC</sub> or GND             | V <sub>IS</sub> = V <sub>EE</sub> or V <sub>CC</sub> ; V <sub>OS</sub> = V <sub>CC</sub> or V <sub>EE</sub> |
| ΔI <sub>CC</sub> | additional quiescent supply current per input pin for unit load coefficient is 1 (note 1) |                       | 100  | 360         |            | 450           |             | 490            | μA   | 4.5 to 5.5             | 0                      | V <sub>CC</sub> −2.1 V             | other inputs at V <sub>CC</sub> or GND                                                                      |

### Note to HCT types

- The value of additional quiescent supply current (ΔI<sub>CC</sub>) for a unit load of 1 is given here.  
To determine ΔI<sub>CC</sub> per input, multiply this value by the unit load coefficient shown in the table below.

| INPUT          | UNIT LOAD COEFFICIENT |
|----------------|-----------------------|
| S <sub>n</sub> | 0.45                  |
| $\overline{E}$ | 0.45                  |

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AC CHARACTERISTICS FOR 74HCT

GND = 0 V;  $t_r = t_f = 6 \text{ ns}$ ;  $C_L = 50 \text{ pF}$

| SYMBOL                              | PARAMETER                                                                     | T <sub>amb</sub> (°C) |          |          |            |          |             |           | UNIT | TEST CONDITIONS        |                        |                                                                             |
|-------------------------------------|-------------------------------------------------------------------------------|-----------------------|----------|----------|------------|----------|-------------|-----------|------|------------------------|------------------------|-----------------------------------------------------------------------------|
|                                     |                                                                               | 74HCT                 |          |          |            |          |             |           |      | V <sub>CC</sub><br>(V) | V <sub>EE</sub><br>(V) | OTHER                                                                       |
|                                     |                                                                               | +25                   |          |          | −40 to +85 |          | −40 to +125 |           |      |                        |                        |                                                                             |
|                                     |                                                                               | min.                  | typ.     | max.     | min.       | max.     | min.        | max.      |      |                        |                        |                                                                             |
| t <sub>PHL</sub> / t <sub>PLH</sub> | propagation delay V <sub>is</sub> to V <sub>os</sub>                          |                       | 5<br>4   | 12<br>8  |            | 15<br>10 |             | 18<br>12  | ns   | 4.5<br>4.5             | 0<br>−4.5              | R <sub>L</sub> = ∞;<br>C <sub>L</sub> = 50 pF<br>(see Fig.18)               |
| t <sub>PZH</sub> / t <sub>PZL</sub> | turn “ON” time<br>E̅ to V <sub>os</sub><br>S <sub>n</sub> to V <sub>os</sub>  |                       | 41<br>28 | 70<br>48 |            | 88<br>60 |             | 105<br>72 | ns   | 4.5<br>4.5             | 0<br>−4.5              | R <sub>L</sub> = 1 kΩ;<br>C <sub>L</sub> = 50 pF see<br>(Fig.19, 20 and 21) |
| t <sub>PHZ</sub> / t <sub>PLZ</sub> | turn “OFF” time<br>E̅ to V <sub>os</sub><br>S <sub>n</sub> to V <sub>os</sub> |                       | 26<br>21 | 50<br>38 |            | 63<br>48 |             | 75<br>57  | ns   | 4.5<br>4.5             | 0<br>−4.5              | R <sub>L</sub> = 1 kΩ;<br>C <sub>L</sub> = 50 pF<br>(Fig.19, 20 and 21)     |

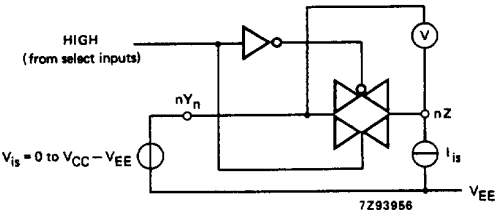


Fig.8 Test circuit for measuring  $R_{ON}$ .

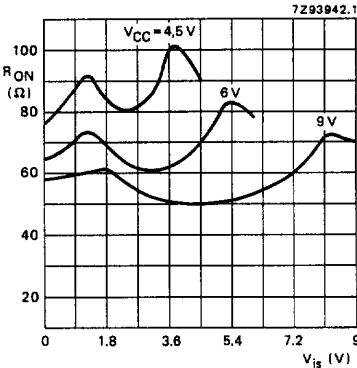


Fig.9 Typical  $R_{ON}$  as a function of input voltage  $V_{is}$  for  $V_{is} = 0$  to  $V_{CC} - V_{EE}$ .

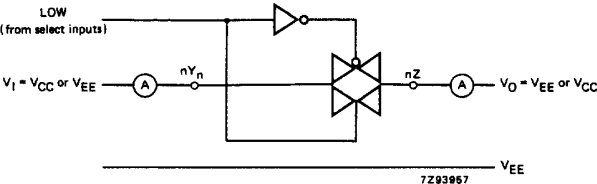


Fig.10 Test circuit for measuring OFF-state current.

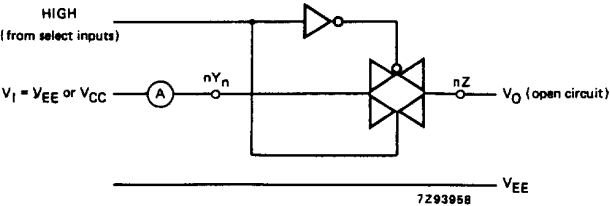


Fig.11 Test circuit for measuring ON-state current.

# Dual 4-channel analog multiplexer/demultiplexer

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## ADDITIONAL AC CHARACTERISTICS FOR 74HC/HCT

### Recommended conditions and typical values

GND = 0 V;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ 

| SYMBOL      | PARAMETER                                                                   | typ.         | UNIT       | $V_{CC}$<br>(V) | $V_{EE}$<br>(V) | $V_{is(p-p)}$<br>(V) | CONDITIONS                                                                                                                                                                              |
|-------------|-----------------------------------------------------------------------------|--------------|------------|-----------------|-----------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | sine-wave distortion<br>$f = 1\text{ kHz}$                                  | 0.04<br>0.02 | %<br>%     | 2.25<br>4.5     | -2.25<br>-4.5   | 4.0<br>8.0           | $R_L = 10\text{ k}\Omega$ ; $C_L = 50\text{ pF}$<br>(see Fig.14)                                                                                                                        |
|             | sine-wave distortion<br>$f = 10\text{ kHz}$                                 | 0.12<br>0.06 | %<br>%     | 2.25<br>4.5     | -2.25<br>-4.5   | 4.0<br>8.0           | $R_L = 10\text{ k}\Omega$ ; $C_L = 50\text{ pF}$<br>(see Fig.14)                                                                                                                        |
|             | switch "OFF" signal<br>feed-through                                         | -50<br>-50   | dB<br>dB   | 2.25<br>4.5     | -2.25<br>-4.5   | note 1               | $R_L = 600\text{ }\Omega$ ; $C_L = 50\text{ pF}$ ;<br>$f = 1\text{ MHz}$ see<br>(Fig.12 and Fig.15)                                                                                     |
|             | crosstalk between any two<br>switches/ multiplexers                         | -60<br>-60   | dB<br>dB   | 2.25<br>4.5     | -2.25<br>-4.5   | note 1               | $R_L = 600\text{ }\Omega$ ; $C_L = 50\text{ pF}$ ;<br>$f = 1\text{ MHz}$ (see Fig.16)                                                                                                   |
| $V_{(p-p)}$ | crosstalk voltage between<br>control and any switch<br>(peak-to-peak value) | 110<br>220   | mV<br>mV   | 4.5<br>4.5      | 0<br>-4.5       |                      | $R_L = 600\text{ }\Omega$ ; $C_L = 50\text{ pF}$ ;<br>$f = 1\text{ MHz}$ ( $\bar{E}$ or $S_n$ ,<br>square-wave between $V_{CC}$<br>and GND, $t_r = t_f = 6\text{ ns}$ )<br>(see Fig.17) |
| $f_{max}$   | minimum frequency<br>response (-3dB)                                        | 170<br>180   | MHz<br>MHz | 2.25<br>4.5     | -2.25<br>-4.5   | note 2               | $R_L = 50\text{ }\Omega$ ; $C_L = 50\text{ pF}$<br>see (Fig.13 and Fig.14)                                                                                                              |
| $C_S$       | maximum switch<br>capacitance<br>independent (Y)<br>common (Z)              | 5<br>12      | pF<br>pF   |                 |                 |                      |                                                                                                                                                                                         |

### Notes to AC characteristics

1. Adjust input voltage  $V_{is}$  to 0 dBm level (0 dBm = 1 mW into 600  $\Omega$ ).
2. Adjust input voltage  $V_{is}$  to 0 dBm level at  $V_{OS}$  for 1 MHz (0 dBm = 1 mW into 50  $\Omega$ ).

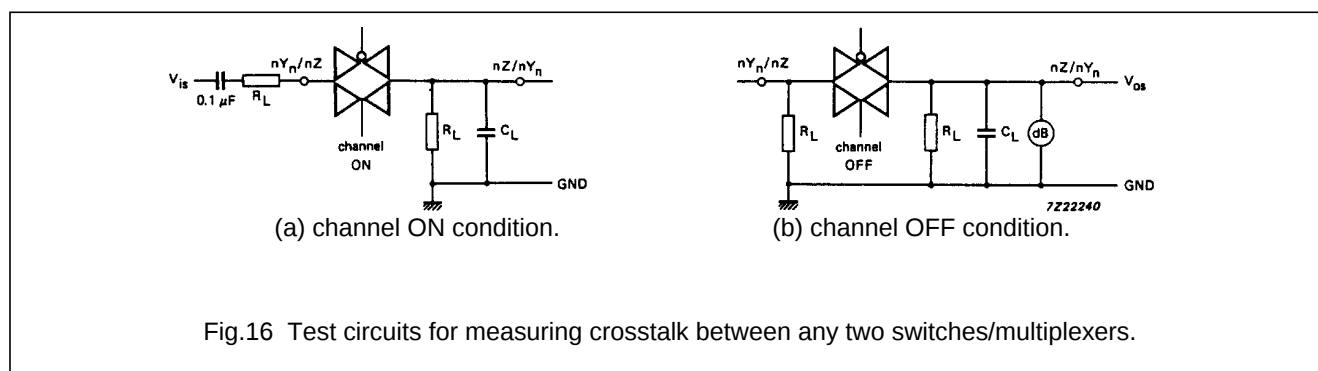
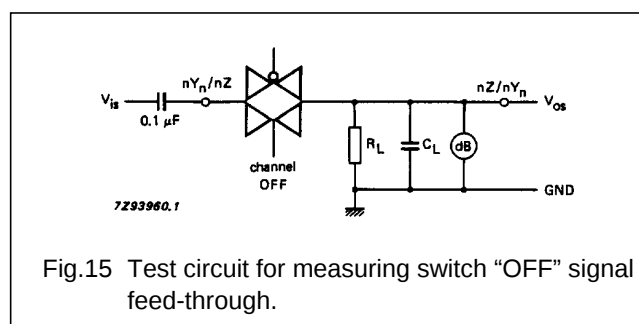
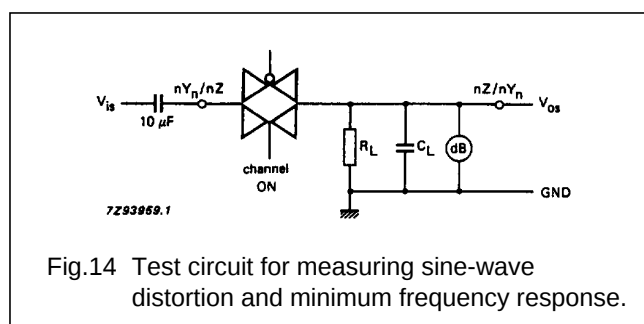
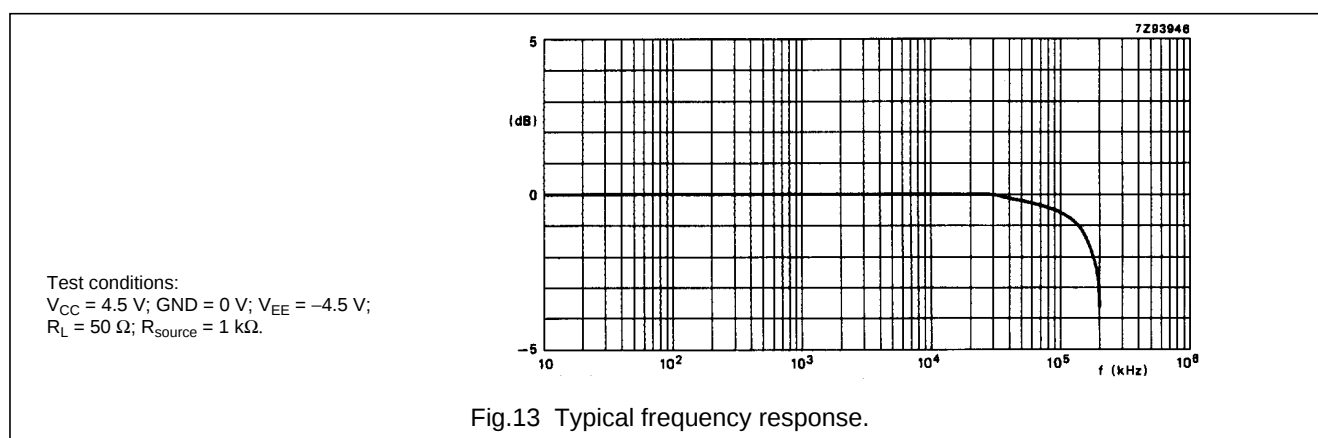
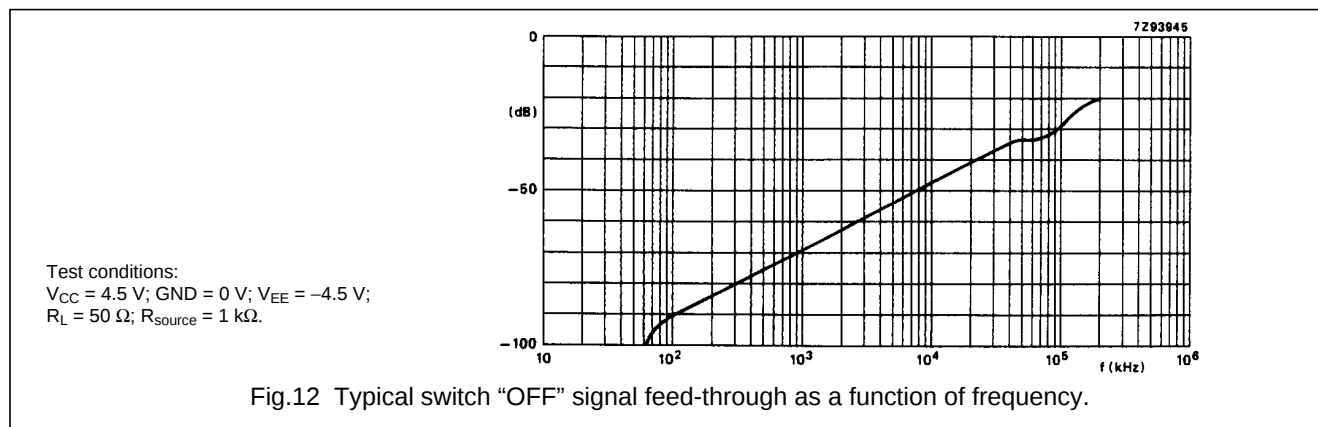
### General notes

$V_{is}$  is the input voltage at an  $nY_n$  or  $nZ$  terminal, whichever is assigned as an input

$V_{OS}$  is the output voltage at an  $nY_n$  or  $nZ$  terminal, whichever is assigned as an output

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# Dual 4-channel analog multiplexer/demultiplexer

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The crosstalk is defined as follows  
(oscilloscope output):

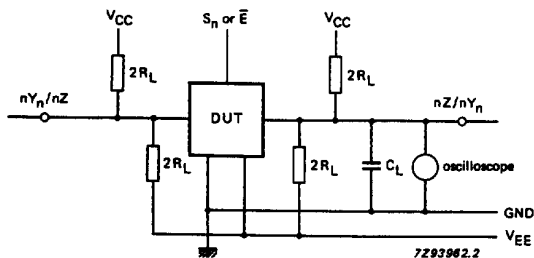
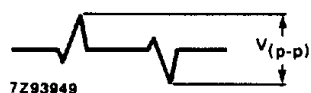


Fig.17 Test circuit for measuring crosstalk between control and any switch.

## AC WAVEFORMS

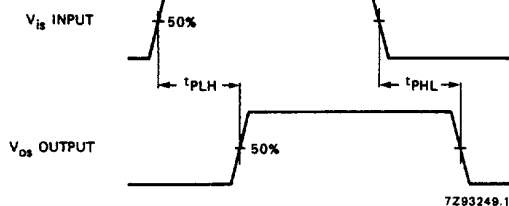
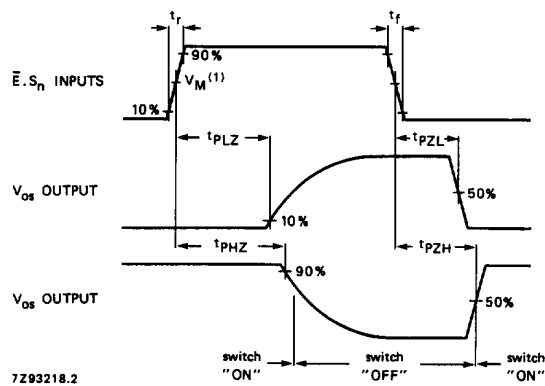


Fig.18 Waveforms showing the input ( $V_{is}$ ) to output ( $V_{os}$ ) propagation delays.



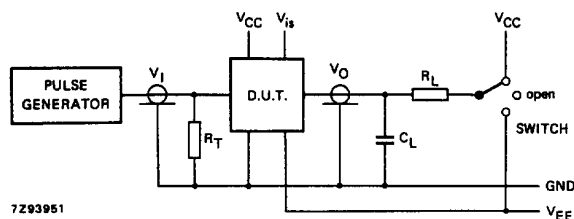
- (1) HC :  $V_M = 50\%$ ;  $V_I = \text{GND to } V_{CC}$ .  
HCT:  $V_M = 1.3 \text{ V}$ ;  $V_I = \text{GND to } 3\text{V}$ .

Fig.19 Waveforms showing the turn-ON and turn-OFF times.

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## TEST CIRCUIT AND WAVEFORMS



## Conditions

| TEST      | SWITCH   | $V_{is}$ |
|-----------|----------|----------|
| $t_{PZH}$ | $V_{EE}$ | $V_{CC}$ |
| $t_{PZL}$ | $V_{CC}$ | $V_{EE}$ |
| $t_{PHZ}$ | $V_{EE}$ | $V_{CC}$ |
| $t_{PLZ}$ | $V_{CC}$ | $V_{EE}$ |
| others    | open     | pulse    |

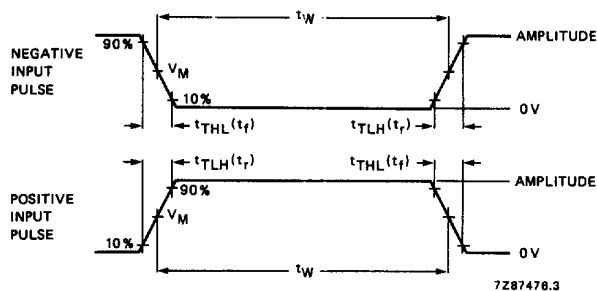
| FAMILY | AMPLITUDE | $V_M$ | $t_r; t_f$                |       |
|--------|-----------|-------|---------------------------|-------|
|        |           |       | $f_{max};$<br>PULSE WIDTH | OTHER |
| 74HC   | $V_{CC}$  | 50%   | < 2 ns                    | 6 ns  |
| 74HCT  | 3.0 V     | 1.3 V | < 2 ns                    | 6 ns  |

$C_L$  = load capacitance including jig and probe capacitance (see AC CHARACTERISTICS for values).

$R_T$  = termination resistance should be equal to the output impedance  $Z_O$  of the pulse generator.

$t_r = t_f = 6$  ns; when measuring  $f_{max}$ , there is no constraint to  $t_r, t_f$  with 50% duty factor.

Fig.20 Test circuit for measuring AC performance.



## Conditions

| TEST      | SWITCH   | $V_{is}$ |
|-----------|----------|----------|
| $t_{PZH}$ | $V_{EE}$ | $V_{CC}$ |
| $t_{PZL}$ | $V_{CC}$ | $V_{EE}$ |
| $t_{PHZ}$ | $V_{EE}$ | $V_{CC}$ |
| $t_{PLZ}$ | $V_{CC}$ | $V_{EE}$ |
| others    | open     | pulse    |

| FAMILY | AMPLITUDE | $V_M$ | $t_r; t_f$                |       |
|--------|-----------|-------|---------------------------|-------|
|        |           |       | $f_{max};$<br>PULSE WIDTH | OTHER |
| 74HC   | $V_{CC}$  | 50%   | < 2 ns                    | 6 ns  |
| 74HCT  | 3.0 V     | 1.3 V | < 2 ns                    | 6 ns  |

$C_L$  = load capacitance including jig and probe capacitance (see AC CHARACTERISTICS for values).

$R_T$  = termination resistance should be equal to the output impedance  $Z_O$  of the pulse generator.

$t_r = t_f = 6$  ns; when measuring  $f_{max}$ , there is no constraint to  $t_r, t_f$  with 50% duty factor.

Fig.21 Input pulse definitions.

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**PACKAGE OUTLINES**

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