

# 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/HCT4053**

Triple 2-channel analog  
multiplexer/demultiplexer

Product specification  
File under Integrated Circuits, IC06

December 1990

## Triple 2-channel analog multiplexer/demultiplexer

## 74HC/HCT4053

### FEATURES

- 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/HCT4053 are high-speed Si-gate CMOS devices and are pin compatible with the “4053” of the “4000B” series. They are specified in compliance with JEDEC standard no. 7A.

The 74HC/HCT4053 are triple 2-channel analog multiplexers/demultiplexers with a common enable input ( $\bar{E}$ ). Each multiplexer/demultiplexer has two independent inputs/outputs ( $nY_0$  and  $nY_1$ ), a common input/output ( $nZ$ ) and three digital select inputs ( $S_1$  to  $S_3$ ).

With  $\bar{E}$  LOW, one of the two switches is selected (low impedance ON-state) by  $S_1$  to  $S_3$ . With  $\bar{E}$  HIGH, all switches are in the high impedance OFF-state, independent of  $S_1$  to  $S_3$ .

$V_{CC}$  and GND are the supply voltage pins for the digital control inputs ( $S_1$ , to  $S_3$ , 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 ( $nY_0$  and  $nY_1$ , 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<br>$\bar{E}$ to $V_{OS}$<br>$S_n$ to $V_{OS}$  | $C_L = 15$ pF; $R_L = 1$ k $\Omega$ ; $V_{CC} = 5$ V | 17      | 23  | ns   |
|                   |   |  | 21      | 21  | ns   |
| $t_{PHZ}/t_{PLZ}$ | turn “OFF” time<br>$\bar{E}$ to $V_{OS}$<br>$S_n$ to $V_{OS}$ |  | 18      | 20  | ns   |
|                   |   |  | 17      | 19  | ns   |
| $C_I$             | input capacitance   |  | 3.5     | 3.5 | pF   |
| $C_{PD}$          | power dissipation capacitance per switch                      | notes 1 and 2  | 36      | 36  | pF   |
| $C_S$             | max. switch capacitance<br>independent (Y)<br>common (Z)      |  | 5       | 5   | pF   |
|                   |   |  | 8       | 8   | 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

# Triple 2-channel analog multiplexer/demultiplexer

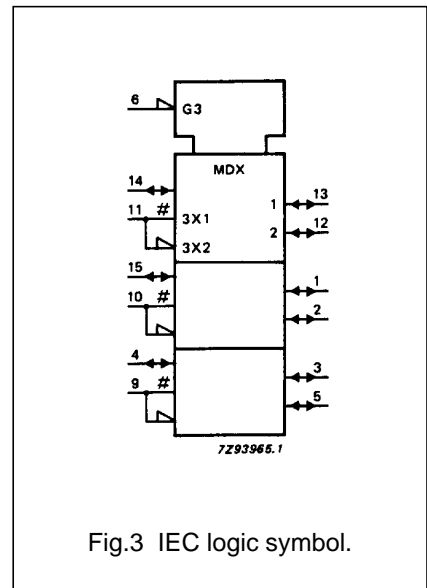
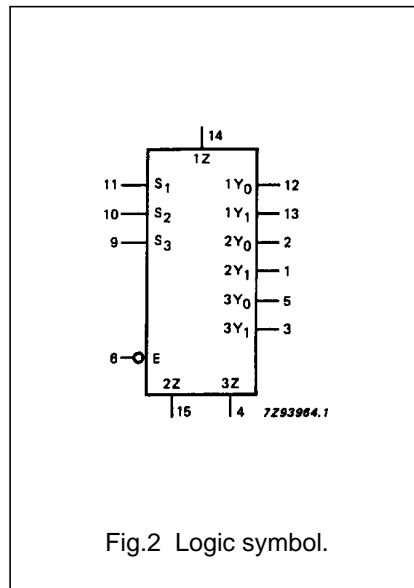
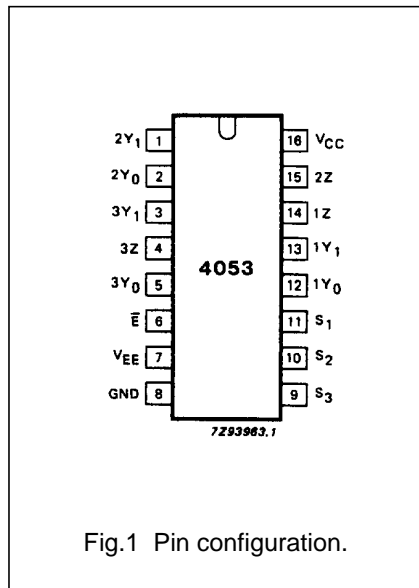
## 74HC/HCT4053

### ORDERING INFORMATION

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

### PIN DESCRIPTION

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



# Triple 2-channel analog multiplexer/demultiplexer

74HC/HCT4053

## APPLICATIONS

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

## FUNCTION TABLE

| INPUTS    |       | CHANNEL ON  |
|-----------|-------|-------------|
| $\bar{E}$ | $S_n$ |             |
| L         | L     | $nY_0 - nZ$ |
| L         | H     | $nY_1 - nZ$ |
| H         | X     | none        |

### Note

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

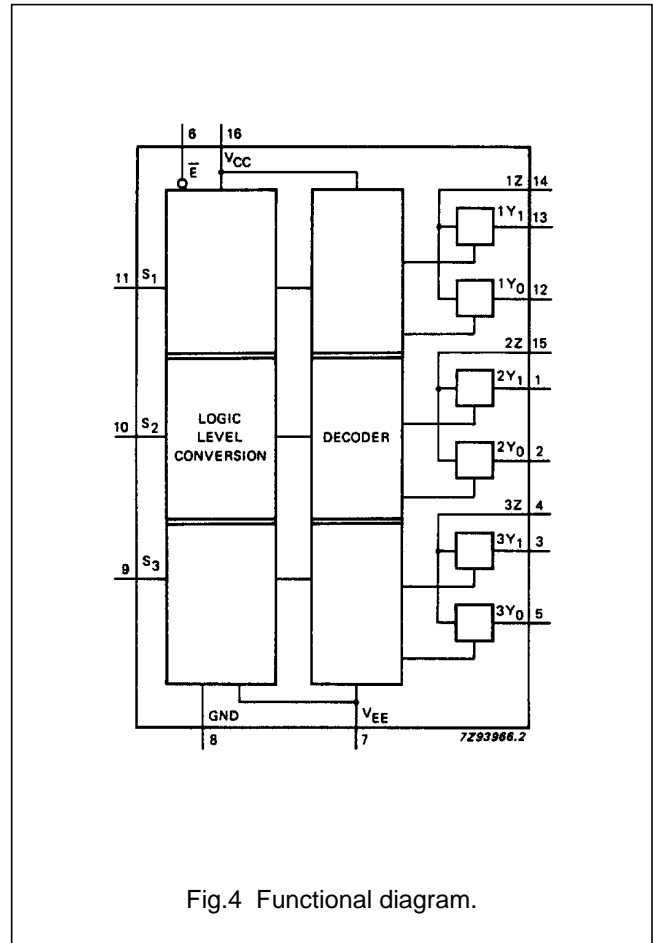


Fig.4 Functional diagram.

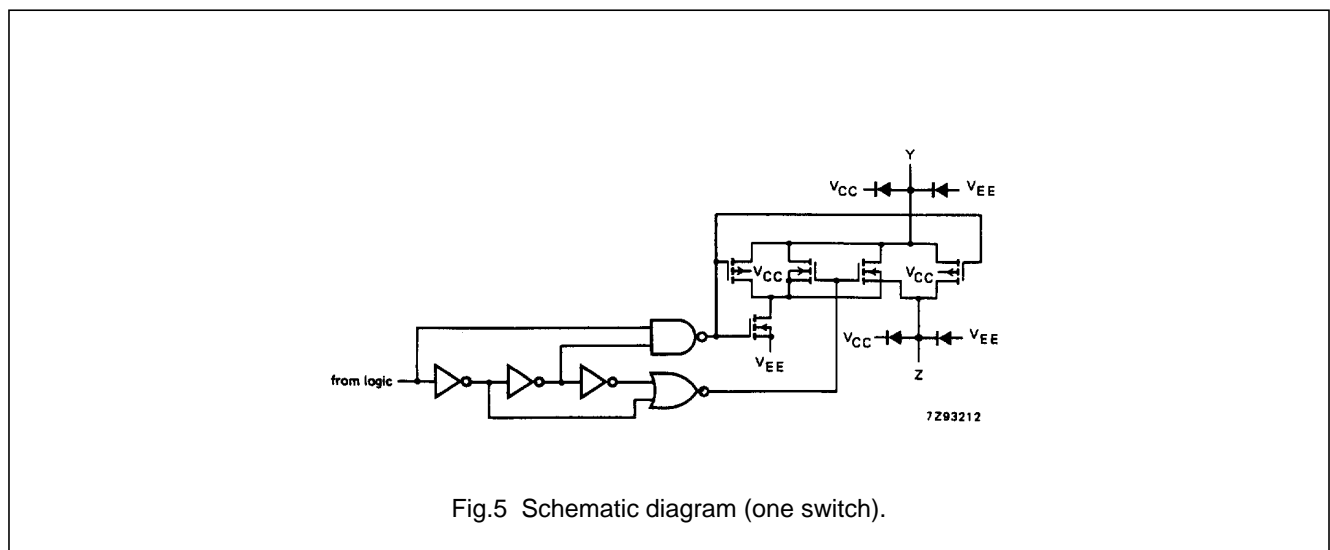


Fig.5 Schematic diagram (one switch).

# Triple 2-channel analog multiplexer/demultiplexer

74HC/HCT4053

## 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  $nY_n$ , 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  $nY_n$ . In this case there is no limit for the voltage drop across the switch, but the voltages at  $nY_n$  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 Figs 6 and 7  |
| $V_{CC}$   | DC supply voltage $V_{CC}-V_{EE}$     | 2.0      | 5.0  | 10.0                      | 2.0      | 5.0  | 10.0     | V    | see Figs 6 and 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 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>$V_{CC} = 10.0 \text{ V}$ |

# Triple 2-channel analog multiplexer/demultiplexer

## 74HC/HCT4053

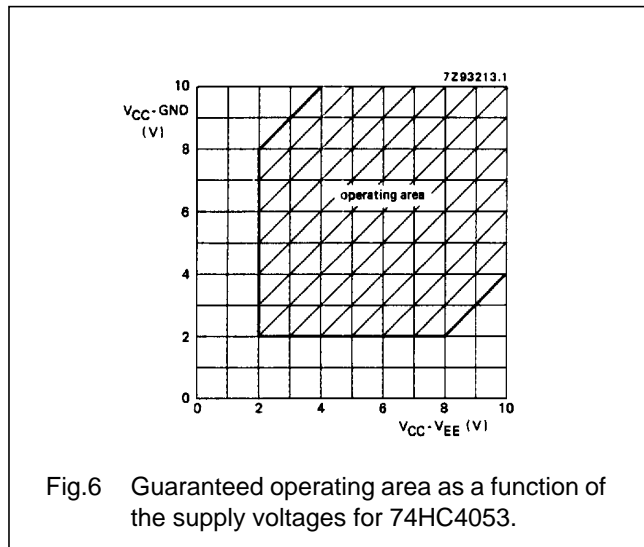


Fig.6 Guaranteed operating area as a function of the supply voltages for 74HC4053.

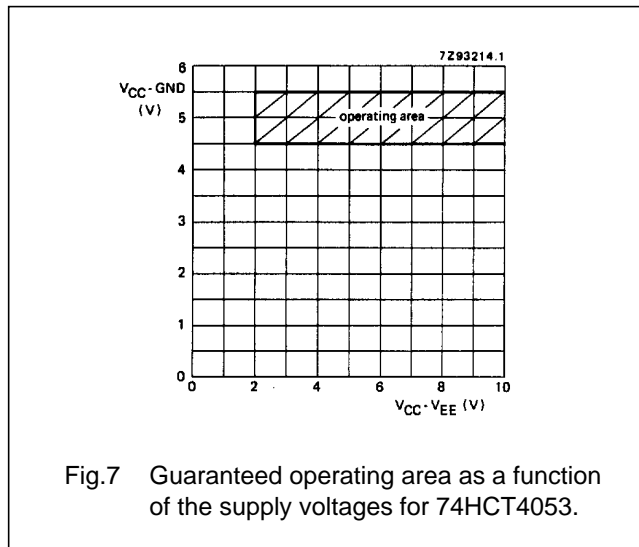


Fig.7 Guaranteed operating area as a function of the supply voltages for 74HCT4053.

### 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   | $T_{amb}$ (°C) |      |      |            |      |             |      |          | UNIT | TEST CONDITIONS |                 |                            |                            |       |
|-----------------|---|----------------|------|------|------------|------|-------------|------|----------|------|-----------------|-----------------|----------------------------|----------------------------|-------|
|                 |   | 74HC/HCT       |      |      |            |      |             |      |          |      | $V_{CC}$<br>(V) | $V_{EE}$<br>(V) | $I_S$<br>( $\mu A$ )       | $V_{is}$                   | $V_I$ |
|                 |   | + 25           |      |      | -40 to +85 |      | -40 to +125 |      |          |      |                 |                 |                            |                            |       |
|                 |   | min.           | typ. | max. | min.       | max. | min.        | max. |          |      |                 |                 |                            |                            |       |
| $R_{ON}$        | ON resistance (peak)  |                | -    | -    |            | -    |             | -    | $\Omega$ | 2.0  | 0               | 100             | $V_{CC}$<br>to<br>$V_{EE}$ | $V_{IH}$<br>or<br>$V_{IL}$ |       |
|                 |   |                | 100  | 180  |            | 225  |             | 270  | $\Omega$ | 4.5  | 0               | 1000            |                            |                            |       |
|                 |   |                | 90   | 160  |            | 200  |             | 240  | $\Omega$ | 6.0  | 0               | 1000            |                            |                            |       |
|                 |   |                | 70   | 130  |            | 165  |             | 195  | $\Omega$ | 4.5  | -4.5            | 1000            |                            |                            |       |
| $R_{ON}$        | ON resistance (rail)  |                | 150  | -    |            | -    |             | -    | $\Omega$ | 2.0  | 0               | 100             | $V_{EE}$                   | $V_{IH}$<br>or<br>$V_{IL}$ |       |
|                 |   |                | 80   | 140  |            | 175  |             | 210  | $\Omega$ | 4.5  | 0               | 1000            |                            |                            |       |
|                 |   |                | 70   | 120  |            | 150  |             | 180  | $\Omega$ | 6.0  | 0               | 1000            |                            |                            |       |
|                 |   |                | 60   | 105  |            | 130  |             | 160  | $\Omega$ | 4.5  | -4.5            | 1000            |                            |                            |       |
| $R_{ON}$        | ON resistance (rail)  |                | 150  | -    |            | -    |             | -    | $\Omega$ | 2.0  | 0               | 100             | $V_{CC}$                   | $V_{IH}$<br>or<br>$V_{IL}$ |       |
|                 |   |                | 90   | 160  |            | 200  |             | 240  | $\Omega$ | 4.5  | 0               | 1000            |                            |                            |       |
|                 |   |                | 80   | 140  |            | 175  |             | 210  | $\Omega$ | 6.0  | 0               | 1000            |                            |                            |       |
|                 |   |                | 65   | 120  |            | 150  |             | 180  | $\Omega$ | 4.5  | -4.5            | 1000            |                            |                            |       |
| $\Delta R_{ON}$ | maximum $\Delta R_{ON}$ resistance between any two channels |                | -    |      |            |      |             |      | $\Omega$ | 2.0  | 0               |                 | $V_{CC}$<br>to<br>$V_{EE}$ | $V_{IH}$<br>or<br>$V_{IL}$ |       |
|                 |   |                | 9    |      |            |      |             |      | $\Omega$ | 4.5  | 0               |                 |                            |                            |       |
|                 |   |                | 8    |      |            |      |             |      | $\Omega$ | 6.0  | 0               |                 |                            |                            |       |
|                 |   |                | 6    |      |            |      |             |      | $\Omega$ | 4.5  | -4.5            |                 |                            |                            |       |

### Notes to the characteristics

- At supply voltages ( $V_{CC} - V_{EE}$ ) approaching 2.0 V the analog switch ON-resistance becomes extremely non-linear. Therefore 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.

# Triple 2-channel analog multiplexer/demultiplexer

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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> | M <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 |                           |                          | 0.1                       |                           | 1.0                       |                           | 1.0                       | µA | 10.0                     | 0                    | V <sub>IH</sub><br>or<br>V <sub>IL</sub> | M <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               |                           |                          | 0.1                       |                           | 1.0                       |                           | 1.0                       | µA | 10.0                     | 0                    | V <sub>IH</sub><br>or<br>V <sub>IL</sub> | M <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             |                           | 160.0<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> |       |

# Triple 2-channel analog multiplexer/demultiplexer

74HC/HCT4053

**AC CHARACTERISTICS FOR 74HC**GND = 0 V;  $t_r = t_f = 6$  ns;  $C_L = 50$  pF

| SYMBOL            | PARAMETER                                 | $T_{amb}$ (°C) |                      |                       |            |                       |             |                       |    | UNIT                     | TEST CONDITIONS     |  |       |
|-------------------|---|----------------|----------------------|-----------------------|------------|-----------------------|-------------|-----------------------|----|--------------------------|---------------------|--|-------|
|                   |   | 74HC           |                      |                       |            |                       |             |                       |    |                          | $V_{CC}$<br>(V)     | $V_{EE}$<br>(V)  | OTHER |
|                   |   | +25            |                      |                       | -40 to +85 |                       | -40 to +125 |                       |    |                          |                     |  |       |
|                   |   | min.           | typ.                 | max.                  | min.       | max.                  | min.        | max.                  |    |                          |                     |  |       |
| $t_{PHL}/t_{PLH}$ | propagation delay<br>$V_{is}$ to $V_{os}$ |                | 15<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 | $R_L = \infty$ ;<br>$C_L = 50$ pF<br>(see Fig.18)                      |       |
| $t_{PZH}/t_{PZL}$ | turn "ON" time<br>$\bar{E}$ to $V_{os}$   |                | 60<br>20<br>16<br>15 | 220<br>44<br>37<br>31 |            | 275<br>55<br>47<br>39 |             | 330<br>66<br>56<br>47 | ns | 2.0<br>4.5<br>6.0<br>4.5 | 0<br>0<br>0<br>-4.5 | $R_L = 1$ k $\Omega$ ;<br>$C_L = 50$ pF<br>(see Figs 19,<br>20 and 21) |       |
| $t_{PZH}/t_{PZL}$ | turn "ON" time<br>$S_n$ to $V_{os}$       |                | 75<br>25<br>20<br>15 | 220<br>44<br>37<br>31 |            | 275<br>55<br>47<br>39 |             | 330<br>66<br>56<br>47 | ns | 2.0<br>4.5<br>6.0<br>4.5 | 0<br>0<br>0<br>-4.5 | $R_L = 1$ k $\Omega$ ;<br>$C_L = 50$ pF<br>(see Figs 19,<br>20 and 21) |       |
| $t_{PHZ}/t_{PLZ}$ | turn "OFF" time<br>$\bar{E}$ to $V_{os}$  |                | 63<br>21<br>17<br>15 | 210<br>42<br>36<br>29 |            | 265<br>53<br>45<br>36 |             | 315<br>63<br>54<br>44 | ns | 2.0<br>4.5<br>6.0<br>4.5 | 0<br>0<br>0<br>-4.5 | $R_L = 1$ k $\Omega$ ;<br>$C_L = 50$ pF<br>(see Figs 19,<br>20 and 21) |       |
| $t_{PHZ}/t_{PLZ}$ | turn "OFF" time<br>$S_n$ to $V_{os}$      |                | 60<br>20<br>16<br>15 | 210<br>42<br>36<br>29 |            | 265<br>53<br>45<br>36 |             | 315<br>63<br>54<br>44 | ns | 2.0<br>4.5<br>6.0<br>4.5 | 0<br>0<br>0<br>-4.5 | $R_L = 1$ k $\Omega$ ;<br>$C_L = 50$ pF<br>(see Figs 19,<br>20 and 21) |       |



# Triple 2-channel analog multiplexer/demultiplexer

74HC/HCT4053

## DC CHARACTERISTICS FOR 74HCT

Voltages are referenced to GND (ground = 0 V)

| 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<br>to<br>5.5       |                        |  |  |
| V <sub>IL</sub>  | LOW level input voltage   |                       | 1.2  | 0.8         |            | 0.8           |             | 0.8            | V    | 4.5<br>to<br>5.5       |                        |  |  |
| ±I <sub>I</sub>  | input leakage current   |                       |      | 0.1         |            | 1.0           |             | 1.0            | μA   | 5.5                    | 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> | M <sub>S</sub>   =<br>V <sub>CC</sub> - V <sub>EE</sub><br>Fig.10  |
| ±I <sub>S</sub>  | analog switch OFF-state current all channels  |                       |      | 0.1         |            | 1.0           |             | 1.0            | μA   | 10.0                   | 0                      | V <sub>IH</sub><br>or<br>V <sub>IL</sub> | M <sub>S</sub>   =<br>V <sub>CC</sub> - V <sub>EE</sub><br>Fig.10  |
| ±I <sub>S</sub>  | analog switch ON-state current  |                       |      | 0.1         |            | 1.0           |             | 1.0            | μA   | 10.0                   | 0                      | V <sub>IH</sub><br>or<br>V <sub>IL</sub> | M <sub>S</sub>   =<br>V <sub>CC</sub> - V <sub>EE</sub><br>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><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> |
| 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<br>to<br>5.5       | 0                      | V <sub>CC</sub><br>-2.1<br>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> | 0.50                  |
| E              | 0.50                  |

# Triple 2-channel analog multiplexer/demultiplexer

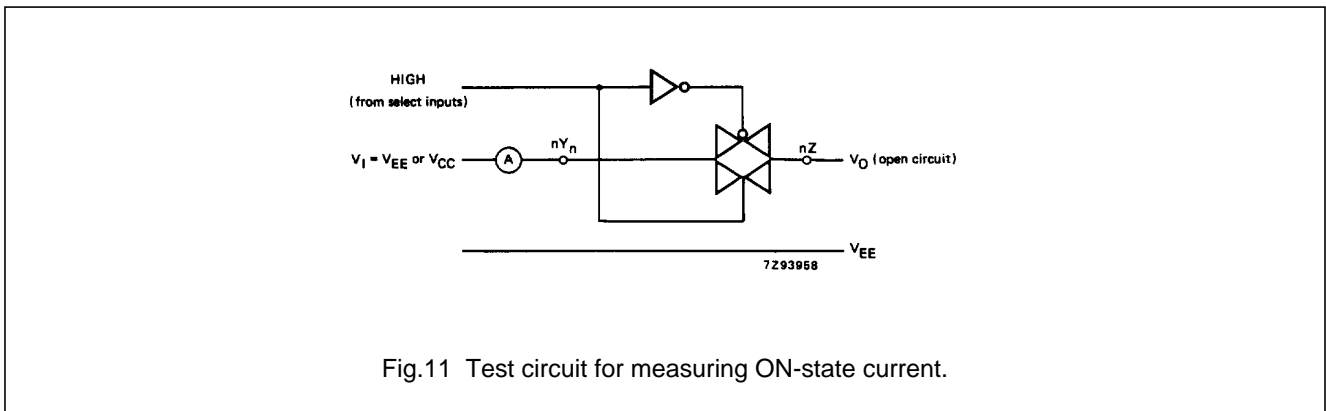
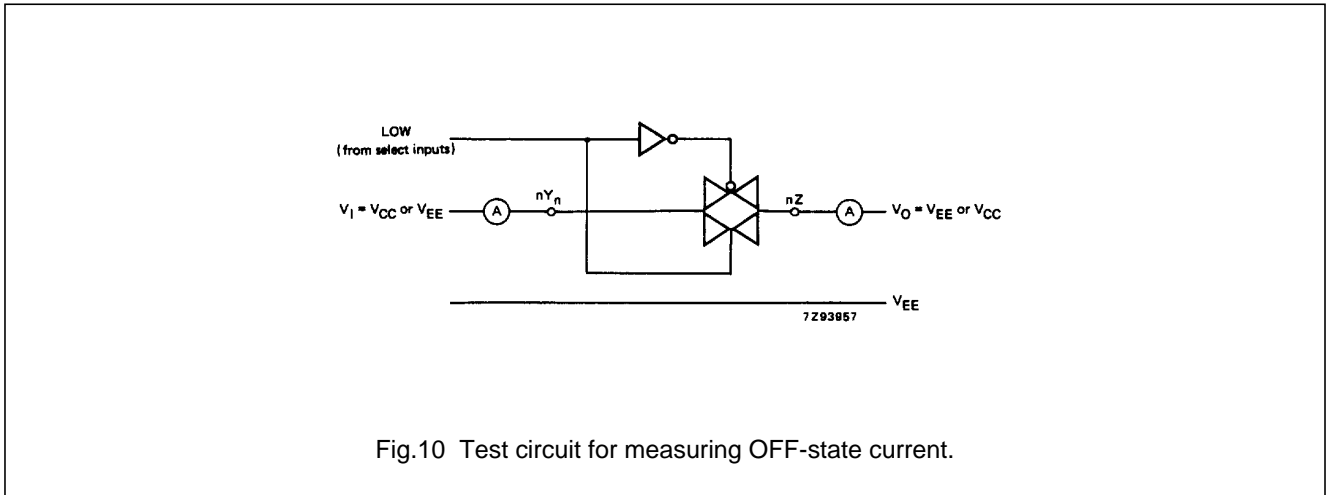
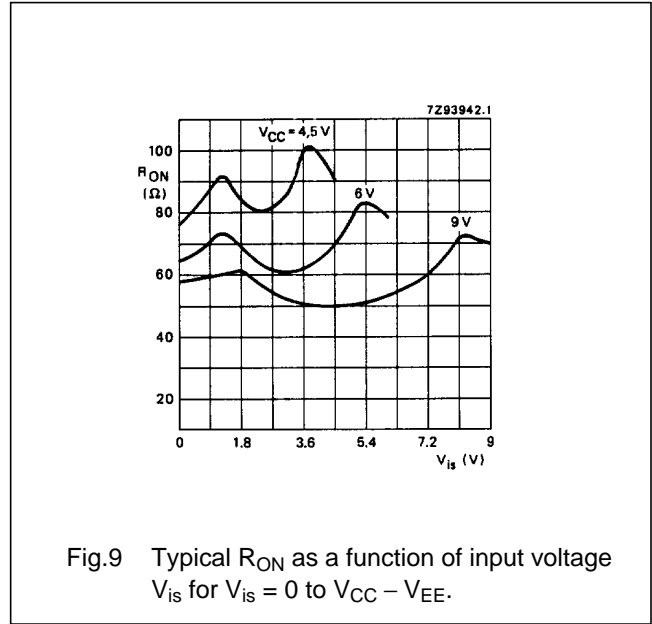
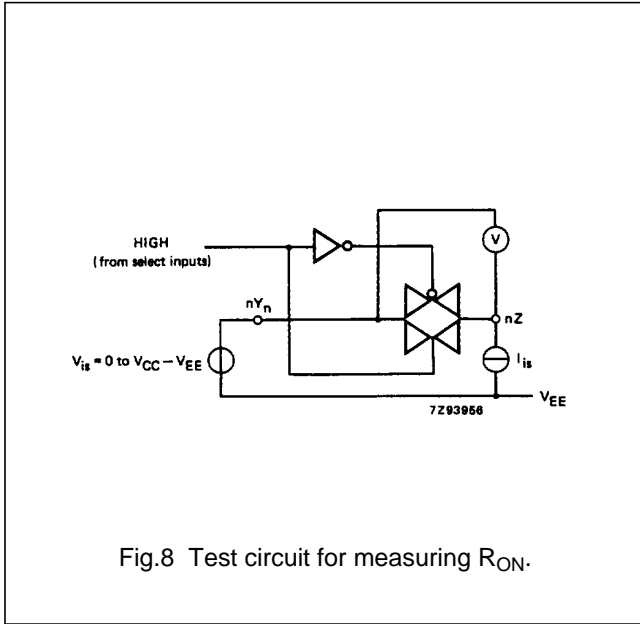
74HC/HCT4053

**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) | $V_{EE}$<br>(V)  | OTHER |
|                   |   | +25            |          |          | -40 to +85 |          | -40 to +125 |          |    |            |                 |  |       |
|                   |   | min.           | typ.     | max.     | min.       | max.     | min.        | max.     |    |            |                 |  |       |
| $t_{PHL}/t_{PLH}$ | propagation delay<br>$V_{is}$ to $V_{os}$ |                | 5<br>4   | 12<br>8  |            | 15<br>10 |             | 18<br>12 | ns | 4.5<br>4.5 | 0<br>-4.5       | $R_L = \infty$ ;<br>$C_L = 50$ pF<br>(see Fig.18)                      |       |
| $t_{PZH}/t_{PZL}$ | turn "ON" time<br>$\bar{E}$ to $V_{os}$   |                | 27<br>16 | 48<br>34 |            | 60<br>43 |             | 72<br>51 | ns | 4.5<br>4.5 | 0<br>-4.5       | $R_L = 1$ k $\Omega$ ;<br>$C_L = 50$ pF<br>(see Figs 19,<br>20 and 21) |       |
| $t_{PZH}/t_{PZL}$ | turn "ON" time<br>$S_n$ to $V_{os}$       |                | 25<br>16 | 48<br>34 |            | 60<br>43 |             | 72<br>51 | ns | 4.5<br>4.5 | 0<br>-4.5       | $R_L = 1$ k $\Omega$ ;<br>$C_L = 50$ pF<br>(see Figs 19,<br>20 and 21) |       |
| $t_{PHZ}/t_{PLZ}$ | turn "OFF" time<br>$\bar{E}$ to $V_{os}$  |                | 24<br>15 | 44<br>31 |            | 55<br>39 |             | 66<br>47 | ns | 4.5<br>4.5 | 0<br>-4.5       | $R_L = 1$ k $\Omega$ ;<br>$C_L = 50$ pF<br>(see Figs 19,<br>20 and 21) |       |
| $t_{PHZ}/t_{PLZ}$ | turn "OFF" time<br>$S_n$ to $V_{os}$      |                | 22<br>15 | 44<br>31 |            | 55<br>39 |             | 66<br>47 | ns | 4.5<br>4.5 | 0<br>-4.5       | $R_L = 1$ k $\Omega$ ;<br>$C_L = 50$ pF<br>(see Figs 19,<br>20 and 21) |       |

Triple 2-channel analog  
multiplexer/demultiplexer

74HC/HCT4053



# Triple 2-channel analog multiplexer/demultiplexer

74HC/HCT4053

## 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 (Fig.12 and 15)   |
|             | crosstalk between<br>any two switches/<br>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       |                      | $R_L = 600\text{ k}\Omega$ ; $C_L = 50\text{ pF}$ ;<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 response<br>(-3dB)  | 160<br>170   | MHz<br>MHz | 2.25<br>4.5     | -2.25<br>-4.5   | note 2               | $R_L = 50\text{ }\Omega$ ; $C_L = 10\text{ pF}$<br>(see Fig.13 and 14)   |
| $C_S$       | maximum switch capacitance<br>independent (Y)<br>common (Z)                 | 5<br>8       | pF<br>pF   |                 |                 |                      |  |

### Notes to the 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  $\Omega$ ).

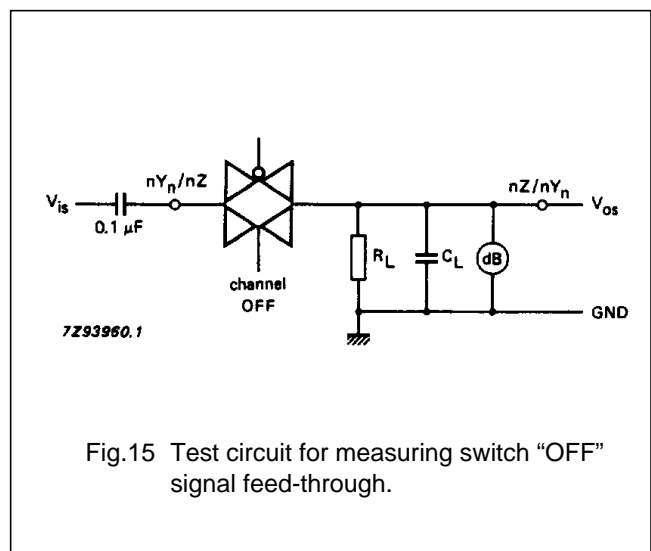
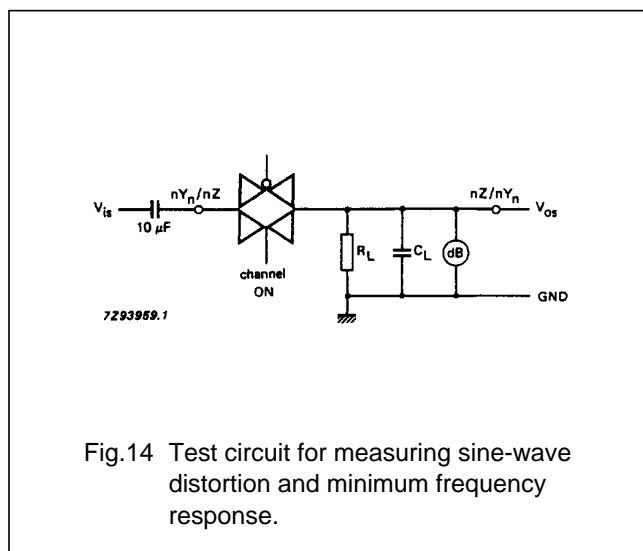
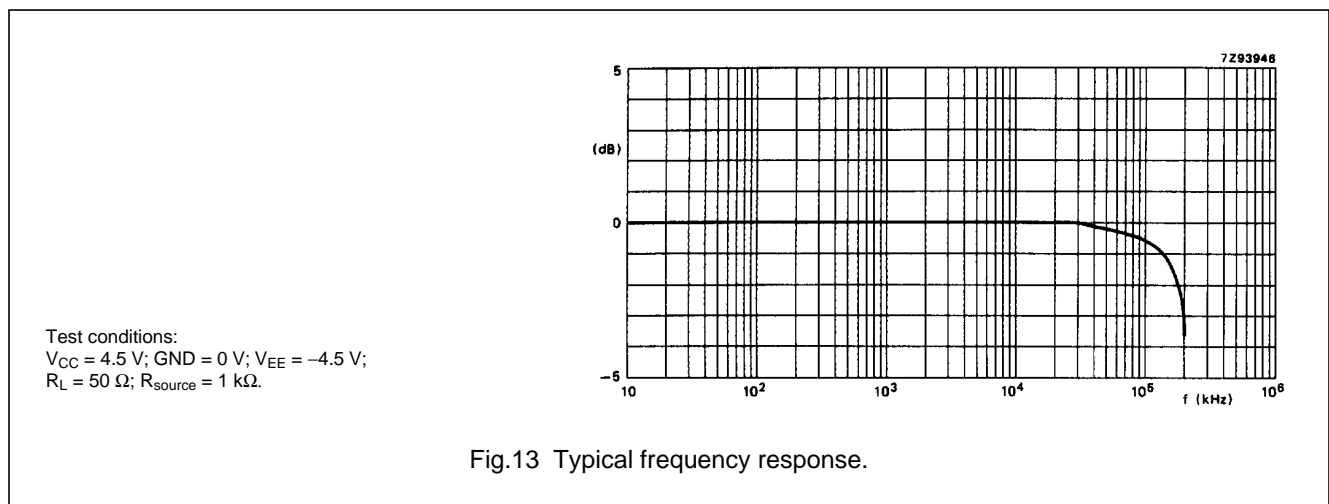
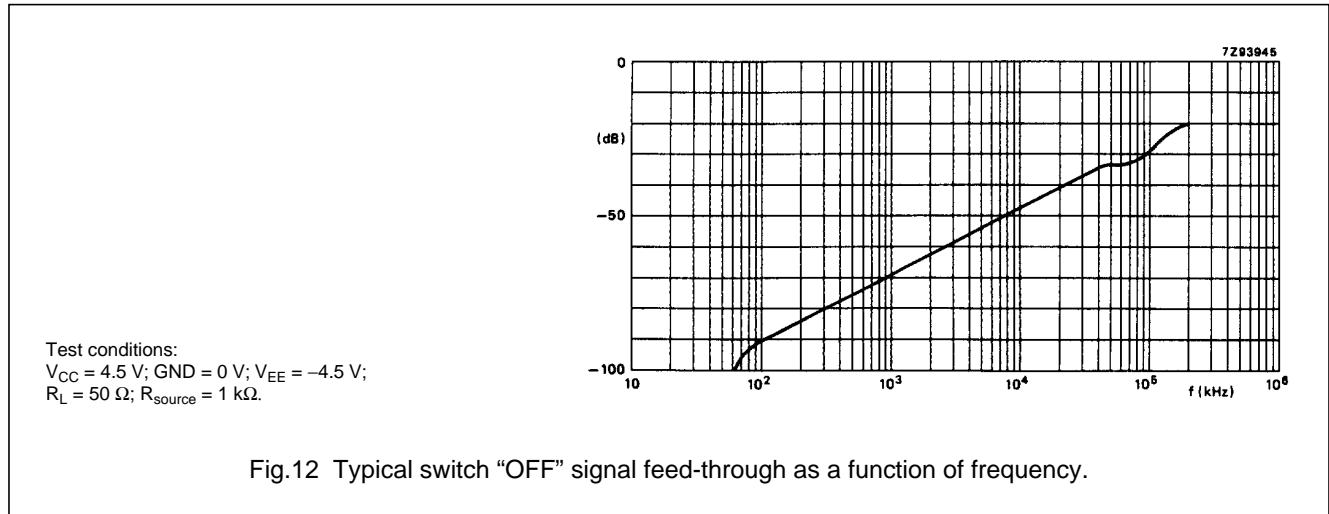
### General note

$V_{is}$  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

# Triple 2-channel analog multiplexer/demultiplexer

74HC/HCT4053



Triple 2-channel analog  
multiplexer/demultiplexer

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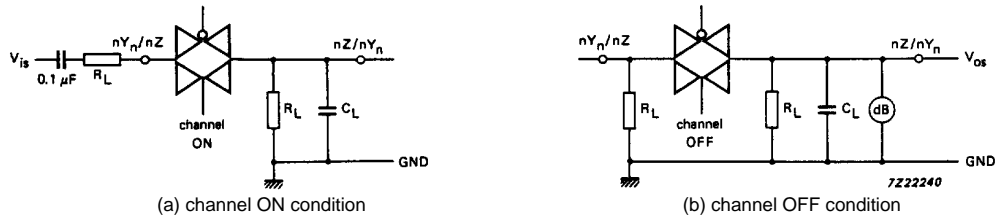


Fig.16 Test circuits for measuring crosstalk between any two switches/multiplexers.

The crosstalk is defined as follows  
(oscilloscope output):

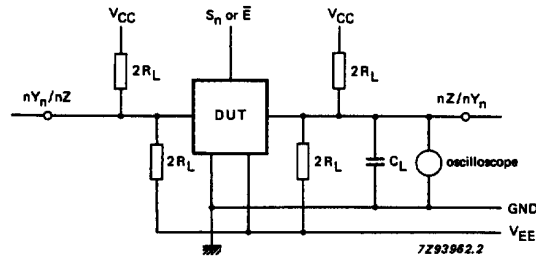
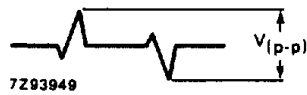


Fig.17 Test circuit for measuring crosstalk between control and any switch.

Triple 2-channel analog  
multiplexer/demultiplexer

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AC WAVEFORMS

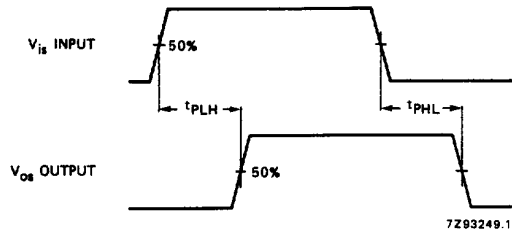
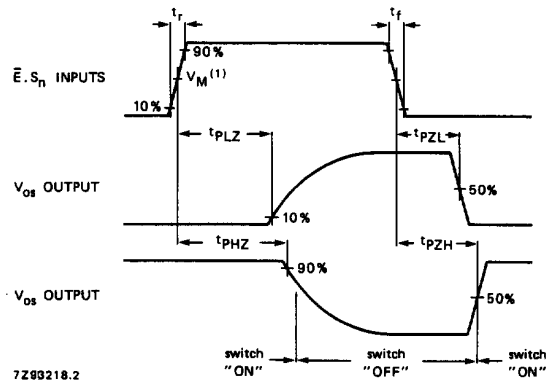


Fig.18 Waveforms showing the input ( $V_{is}$ ) to output ( $V_{os}$ ) propagation delays.



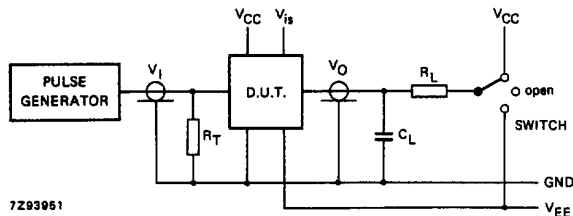
(1) HC :  $V_M = 50\%$ ;  $V_I = \text{GND to } V_{CC}$ .  
HCT:  $V_M = 1.3 V_I = \text{GND to } 3 \text{ V}$ .

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

# Triple 2-channel analog multiplexer/demultiplexer

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## TEST CIRCUIT AND WAVEFORMS



### Conditions

| TEST             | SWITCH          | V <sub>IS</sub> |
|------------------|-----------------|-----------------|
| t <sub>PZH</sub> | V <sub>EE</sub> | V <sub>CC</sub> |
| t <sub>PZL</sub> | V <sub>CC</sub> | V <sub>EE</sub> |
| t <sub>PHZ</sub> | V <sub>EE</sub> | V <sub>CC</sub> |
| t <sub>PLZ</sub> | V <sub>CC</sub> | V <sub>EE</sub> |
| others           | open            | pulse           |

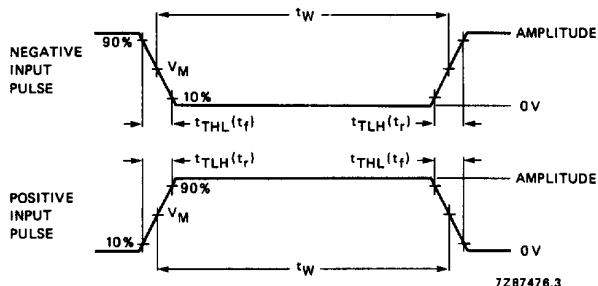
| FAMILY | AMPLITUDE       | V <sub>M</sub> | t <sub>r</sub> ; t <sub>f</sub> |       |
|--------|-----------------|----------------|---------------------------------|-------|
|        |                 |                | f <sub>max</sub> ; PULSE WIDTH  | OTHER |
| 74HC   | V <sub>CC</sub> | 50%            | <2 ns                           | 6 ns  |
| 74HCT  | 3.0 V           | 1.3 V          | <2 ns                           | 6 ns  |

C<sub>L</sub> = load capacitance including jig and probe capacitance (see AC CHARACTERISTICS for values).

R<sub>T</sub> = termination resistance should be equal to the output impedance Z<sub>O</sub> of the pulse generator.

t<sub>r</sub> = t<sub>f</sub> = 6 ns; when measuring f<sub>max</sub>, there is no constraint to t<sub>r</sub>, t<sub>f</sub> with 50% duty factor.

Fig.20 Test circuit for measuring AC performance.



### Conditions

| TEST             | SWITCH          | V <sub>IS</sub> |
|------------------|-----------------|-----------------|
| t <sub>PZH</sub> | V <sub>EE</sub> | V <sub>CC</sub> |
| t <sub>PZL</sub> | V <sub>CC</sub> | V <sub>EE</sub> |
| t <sub>PHZ</sub> | V <sub>EE</sub> | V <sub>CC</sub> |
| t <sub>PLZ</sub> | V <sub>CC</sub> | V <sub>EE</sub> |
| others           | open            | pulse           |

| FAMILY | AMPLITUDE       | V <sub>M</sub> | t <sub>r</sub> ; t <sub>f</sub> |       |
|--------|-----------------|----------------|---------------------------------|-------|
|        |                 |                | f <sub>max</sub> ; PULSE WIDTH  | OTHER |
| 74HC   | V <sub>CC</sub> | 50%            | <2 ns                           | 6 ns  |
| 74HCT  | 3.0 V           | 1.3 V          | <2 ns                           | 6 ns  |

C<sub>L</sub> = load capacitance including jig and probe capacitance (see AC CHARACTERISTICS for values).

R<sub>T</sub> = termination resistance should be equal to the output impedance Z<sub>O</sub> of the pulse generator.

t<sub>r</sub> = t<sub>f</sub> = 6 ns; when measuring f<sub>max</sub>, there is no constraint to t<sub>r</sub>, t<sub>f</sub> with 50% duty factor.

Fig.21 Input pulse definitions.



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Triple 2-channel analog  
multiplexer/demultiplexer

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74HC/HCT4053

**PACKAGE OUTLINES**

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