

# 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/HCT4316** Quad bilateral switches

Product specification  
File under Integrated Circuits, IC06

September 1993

## Quad bilateral switches

## 74HC/HCT4316

## FEATURES

- Low “ON” resistance:  
160  $\Omega$  (typ.) at  $V_{CC} - V_{EE} = 4.5$  V  
120  $\Omega$  (typ.) at  $V_{CC} - V_{EE} = 6.0$  V  
80  $\Omega$  (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/HCT4316 are high-speed Si-gate CMOS devices. They are specified in compliance with JEDEC standard no. 7A.

The 74HC/HCT4316 have four independent analog switches. Each switch has two input/output terminals (nY, nZ) and an active HIGH select input (nS). When the enable input ( $\bar{E}$ ) is HIGH, all four analog switches are turned off.

Current through a switch will not cause additional  $V_{CC}$  current provided the voltage at the terminals of the switch is maintained within the supply voltage range;  $V_{CC} \gg (V_Y, V_Z) \gg V_{EE}$ . Inputs nY and nZ are electrically equivalent terminals.

$V_{CC}$  and GND are the supply voltage pins for the digital control inputs ( $\bar{E}$  and nS). 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 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.

See the “4016” for the version without logic level translation.

## 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 |      |
| $t_{PZH}$         | turn “ON” time<br>$\bar{E}$ to $V_{OS}$<br>nS to $V_{OS}$  | $C_L = 15$ pF; $R_L = 1$ k $\Omega$ ;<br>$V_{CC} = 5$ V | 19      | 19  | ns   |
|                   |  |   | 16      | 17  | ns   |
| $t_{PZL}$         | turn “ON” time<br>$\bar{E}$ to $V_{OS}$<br>nS to $V_{OS}$  |   | 19      | 24  | ns   |
|                   |  |   | 16      | 21  | ns   |
| $t_{PHZ}/t_{PLZ}$ | turn “OFF” time<br>$\bar{E}$ to $V_{OS}$<br>nS to $V_{OS}$ |   | 20      | 21  | ns   |
|                   |  |   | 16      | 19  | ns   |
| $C_I$             | input capacitance  |   | 3.5     | 3.5 | pF   |
| $C_{PD}$          | power dissipation capacitance per switch                   | notes 1 and 2   | 13      | 14  | pF   |
| $C_S$             | max. switch capacitance                                    |   | 5       | 5   | pF   |

## Notes

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

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

- 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

Quad bilateral switches

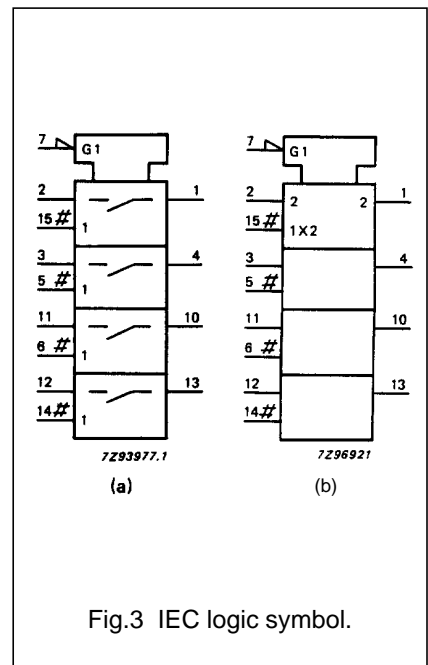
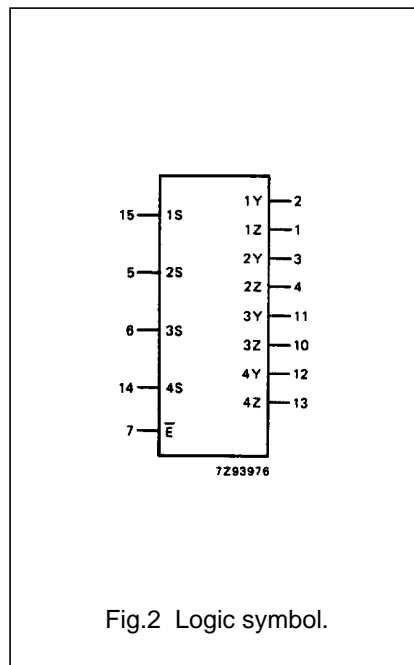
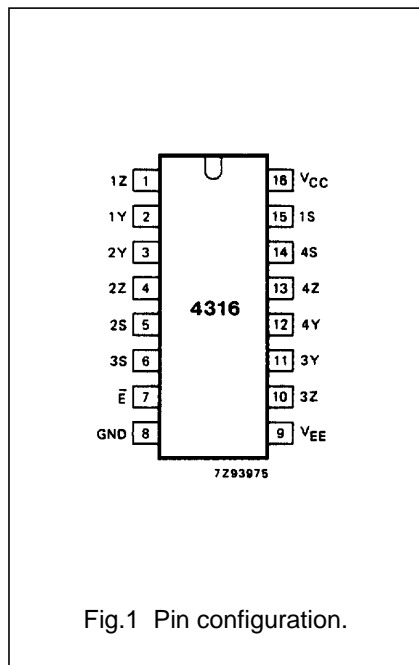
74HC/HCT4316

ORDERING INFORMATION

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

PIN DESCRIPTION

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



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FUNCTION TABLE

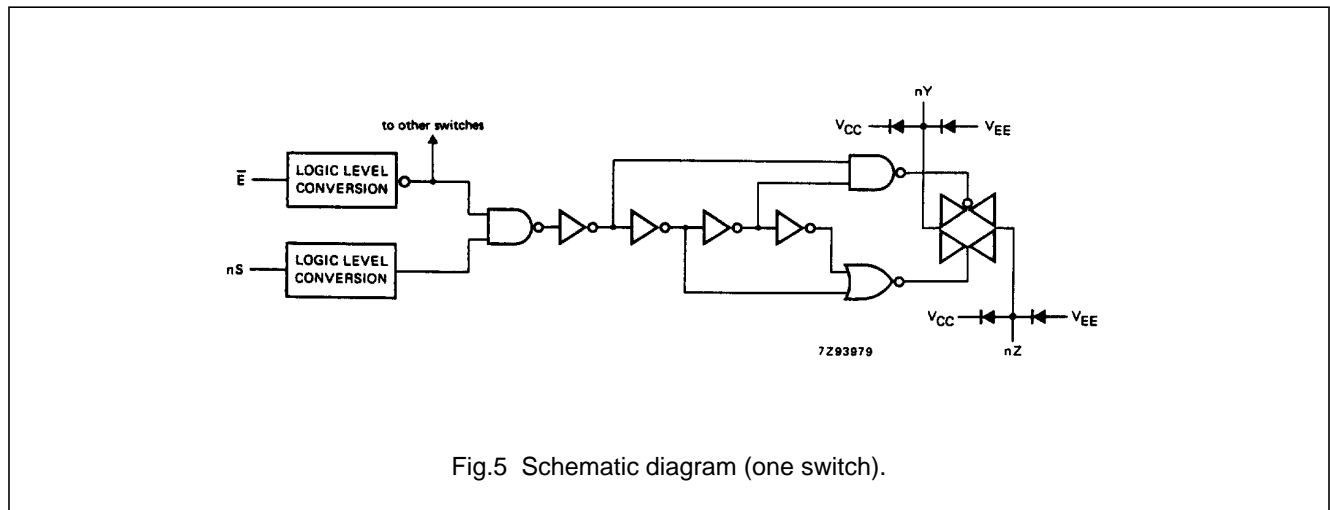
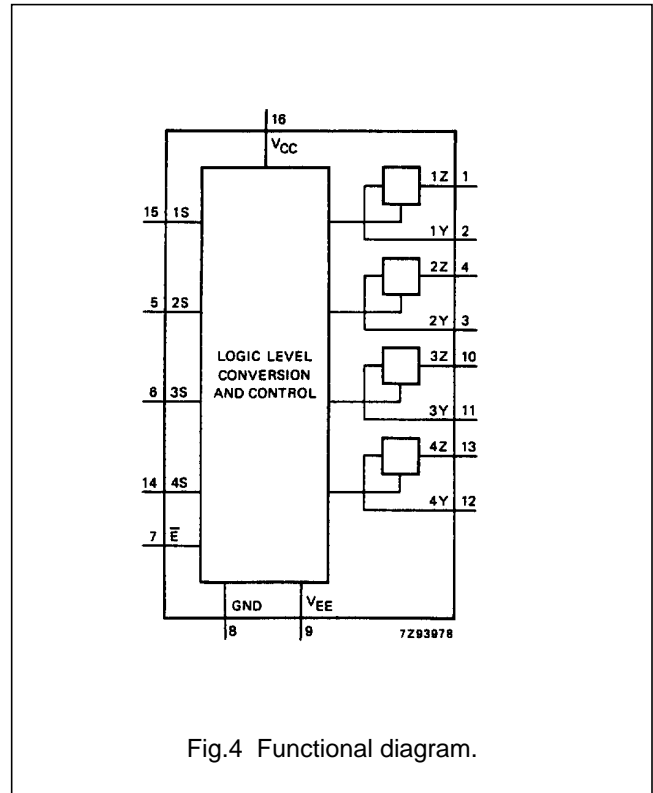
| INPUTS    |    | SWITCH |
|-----------|----|--------|
| $\bar{E}$ | nS |        |
| L         | L  | off    |
| L         | H  | on     |
| H         | X  | off    |

Note

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

APPLICATIONS

- Signal gating
- Modulation
- Demodulation
- Chopper



## Quad bilateral switches

## 74HC/HCT4316

**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   |  |
| $\pm I_{CC};$<br>$\pm I_{GND}$ | 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 terminal Z, when switch current flows in terminals  $Y_n$ , the voltage drop across the bidirectional switch must not exceed 0.4 V. If the switch current flows into terminals Z, no  $V_{CC}$  current will flow out of terminal  $Y_n$ . In this case there is no limit for the voltage drop across the switch, but the voltages at  $Y_n$  and Z 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<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>$V_{CC} = 10.0 \text{ V}$ |

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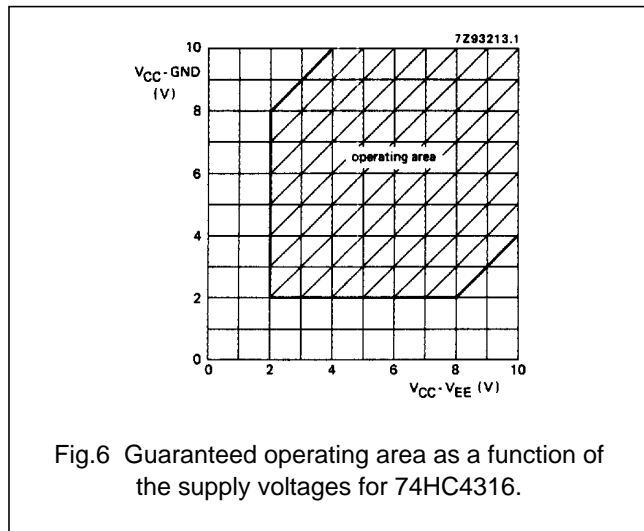


Fig.6 Guaranteed operating area as a function of the supply voltages for 74HC4316.

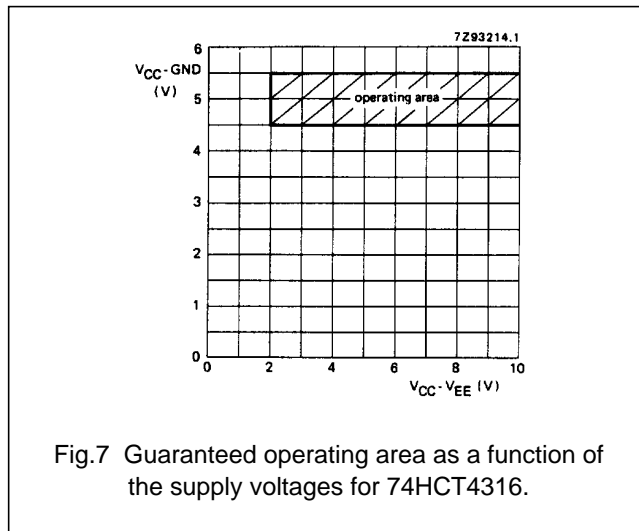


Fig.7 Guaranteed operating area as a function of the supply voltages for 74HCT4316.

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>$V_{IL}$ |
|                 |   |                | 160  | 320  |            | 400  |             | 480  | $\Omega$        | 4.5             | 0                    | 1000     |                            |                            |
|                 |   |                | 120  | 240  |            | 300  |             | 360  | $\Omega$        | 6.0             | 0                    | 1000     |                            |                            |
|                 |   |                | 85   | 170  |            | 215  |             | 255  | $\Omega$        | 4.5             | -4.5                 | 1000     |                            |                            |
| $R_{ON}$        | ON resistance (rail)                                    |                | 160  | —    |            | —    |             | —    | $\Omega$        | 2.0             | 0                    | 100      | $V_{EE}$                   | $V_{IH}$<br>or<br>$V_{IL}$ |
|                 |   |                | 80   | 160  |            | 200  |             | 240  | $\Omega$        | 4.5             | 0                    | 1000     |                            |                            |
|                 |   |                | 70   | 140  |            | 175  |             | 210  | $\Omega$        | 6.0             | 0                    | 1000     |                            |                            |
|                 |   |                | 60   | 120  |            | 150  |             | 180  | $\Omega$        | 4.5             | -4.5                 | 1000     |                            |                            |
| $R_{ON}$        | ON resistance (rail)                                    |                | 170  | —    |            | —    |             | —    | $\Omega$        | 2.0             | 0                    | 100      | $V_{CC}$                   | $V_{IH}$<br>or<br>$V_{IL}$ |
|                 |   |                | 90   | 180  |            | 225  |             | 270  | $\Omega$        | 4.5             | 0                    | 1000     |                            |                            |
|                 |   |                | 80   | 160  |            | 200  |             | 240  | $\Omega$        | 6.0             | 0                    | 1000     |                            |                            |
|                 |   |                | 65   | 135  |            | 170  |             | 205  | $\Omega$        | 4.5             | -4.5                 | 1000     |                            |                            |
| $\Delta R_{ON}$ | maximum $\Delta ON$ resistance between any two channels |                | —    |      |            |      |             |      | $\Omega$        | 2.0             | 0                    |          | $V_{CC}$<br>to<br>$V_{EE}$ | $V_H$<br>or<br>$V_{IL}$    |
|                 |   |                | 16   |      |            |      |             |      | $\Omega$        | 4.5             | 0                    |          |                            |                            |
|                 |   |                | 9    |      |            |      |             |      | $\Omega$        | 6.0             | 0                    |          |                            |                            |
|                 |   |                | 6    |      |            |      |             |      | $\Omega$        | 4.5             | -4.5                 |          |                            |                            |

Notes

- 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 are used to transmit digital signals only, when using these supply voltages.
- For test circuit measuring  $R_{ON}$  see Fig.8.

## Quad bilateral switches

## 74HC/HCT4316

**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)          | $V_{EE}$<br>(V) | $V_I$  | OTHER                      |  |
|           |                                 | +25                       |                          |                           | -40 to +85                |                           | -40 to +125               |                |      |                          |                 |        |                            |  |
|           |                                 | min.                      | typ.                     | max.                      | min.                      | max.                      | min.                      | max.           |      |                          |                 |        |                            |  |
| $V_{IH}$  | HIGH level input voltage        | 1.5<br>3.15<br>4.2<br>6.3 | 1.2<br>2.4<br>3.2<br>4.3 |                           | 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 |                 |        |                            |  |
| $V_{IL}$  | 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 |                 |        |                            |  |
| $\pm I_I$ | input leakage current           |                           |                          | 0.1<br>0.2                |                           | 1.0<br>2.0                |                           | 1.0<br>2.0     |      | $\mu A$                  | 6.0<br>10.0     | 0<br>0 | $V_{CC}$<br>or<br>GND      |  |
| $\pm I_S$ | analog switch OFF-state current |                           |                          | 0.1                       |                           | 1.0                       |                           | 1.0            |      | $\mu A$                  | 10.0            | 0      | $V_{IH}$<br>or<br>$V_{IL}$ | $ M_S  = V_{CC} - V_{EE}$<br>(see Fig.10)                              |
| $\pm I_S$ | analog switch ON-state current  |                           |                          | 0.1                       |                           | 1.0                       |                           | 1.0            |      | $\mu A$                  | 10.0            | 0      | $V_{IH}$<br>or<br>$V_{IL}$ | $ M_S  = V_{CC} - V_{EE}$<br>(see Fig.11)                              |
| $I_{CC}$  | quiescent supply current        |                           |                          | 8.0<br>16.0               |                           | 80.0<br>160.0             |                           | 160.0<br>320.0 |      | $\mu A$                  | 6.0<br>10.0     | 0<br>0 | $V_{CC}$<br>or<br>GND      | $V_{is} = V_{EE}$<br>or $V_{CC}$ ;<br>$V_{OS} = V_{CC}$<br>or $V_{EE}$ |

## Quad bilateral switches

## 74HC/HCT4316

## 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 $V_{os}$ |                | 17<br>6<br>5<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 | $R_L = \infty$ ; $C_L = 50$ pF<br>(see Fig.18)                      |
| $t_{PZH}/t_{PZL}$ | turn "ON" time<br>$\bar{E}$ to $V_{os}$   |                | 61<br>22<br>18<br>19 | 205<br>41<br>35<br>37 |            | 255<br>51<br>43<br>47 |             | 310<br>62<br>53<br>56 | 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, 20 and 21) |
| $t_{PZH}/t_{PZL}$ | turn "ON" time<br>nS to $V_{os}$          |                | 52<br>19<br>15<br>17 | 175<br>35<br>30<br>34 |            | 220<br>44<br>37<br>43 |             | 265<br>53<br>45<br>51 | 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, 20 and 21) |
| $t_{PHZ}/t_{PLZ}$ | turn "OFF" time<br>$\bar{E}$ to $V_{os}$  |                | 63<br>23<br>18<br>21 | 220<br>44<br>37<br>39 |            | 275<br>55<br>47<br>49 |             | 330<br>66<br>56<br>59 | 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, 20 and 21) |
| $t_{PHZ}/t_{PLZ}$ | turn "OFF" time<br>nS to $V_{os}$         |                | 55<br>20<br>16<br>18 | 175<br>35<br>30<br>36 |            | 220<br>44<br>37<br>45 |             | 265<br>53<br>45<br>54 | 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, 20 and 21) |



## Quad bilateral switches

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**DC CHARACTERISTICS FOR 74HCT**

Voltages are referenced to GND (ground = 0)

| SYMBOL          | PARAMETER   | $T_{amb}$ (°C) |      |             |            |               |             |                | UNIT    | TEST CONDITIONS |                 |                      |   |
|-----------------|---|----------------|------|-------------|------------|---------------|-------------|----------------|---------|-----------------|-----------------|----------------------|---|
|                 |   | 74HCT          |      |             |            |               |             |                |         | $V_{CC}$<br>(V) | $V_{EE}$<br>(V) | $V_I$                | OTHER   |
|                 |   | +25            |      |             | -40 to +85 |               | -40 to +125 |                |         |                 |                 |                      |   |
|                 |   | min.           | typ. | max.        | min.       | max.          | min.        | max.           |         |                 |                 |                      |   |
| $V_{IH}$        | HIGH level input voltage  | 2.0            | 1.6  |             | 2.0        |               | 2.0         |                | V       | 4.5 to 5.5      |                 |                      |   |
| $V_{IL}$        | LOW level input voltage   |                | 1.2  | 0.8         |            | 0.8           |             | 0.8            | V       | 4.5 to 5.5      |                 |                      |   |
| $\pm I_I$       | input leakage current   |                |      | 0.1         |            | 1.0           |             | 1.0            | $\mu A$ | 5.5             | 0               | $V_{CC}$ or GND      |   |
| $\pm I_S$       | analog switch OFF-state current   |                |      | 0.1         |            | 1.0           |             | 1.0            | $\mu A$ | 10.0            | 0               | $V_{IH}$ or $V_{IL}$ | $ V_S  = V_{CC} - V_{EE}$ (see Fig.10)                        |
| $\pm I_S$       | analog switch ON-state current  |                |      | 0.1         |            | 1.0           |             | 1.0            | $\mu A$ | 10.0            | 0               | $V_{IH}$ or $V_{IL}$ | $ V_S  = V_{CC} - V_{EE}$ (see Fig.11)                        |
| $I_{CC}$        | quiescent supply current  |                |      | 8.0<br>16.0 |            | 80.0<br>160.0 |             | 160.0<br>320.0 | $\mu A$ | 5.5<br>5.0      | 0<br>-5.0       | $V_{CC}$ or GND      | $V_{is} = V_{EE}$ or $V_{CC}$ ; $V_{OS} = V_{CC}$ or $V_{EE}$ |
| $\Delta I_{CC}$ | additional quiescent supply current per input pin for unit load coefficient is 1 (note 1) |                | 100  | 360         |            | 450           |             | 490            | $\mu A$ | 4.5 to 5.5      | 0               | $V_{CC} - 2.1 V$     | other inputs at $V_{CC}$ or GND                               |

**Note**

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

| INPUT     | UNIT LOAD COEFFICIENT |
|-----------|-----------------------|
| nS        | 0.50                  |
| $\bar{E}$ | 0.50                  |

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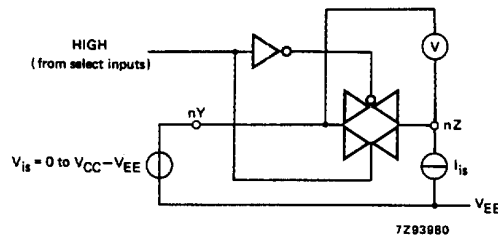


Fig.8 Test circuit for measuring  $R_{ON}$ .

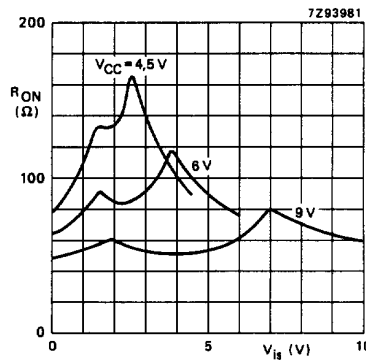


Fig.9 Typical  $R_{ON}$  as a function of input voltage  $V_{is}$  for  $V_{is} = 0$  to  $V_{CC} - V_{EE}$ .

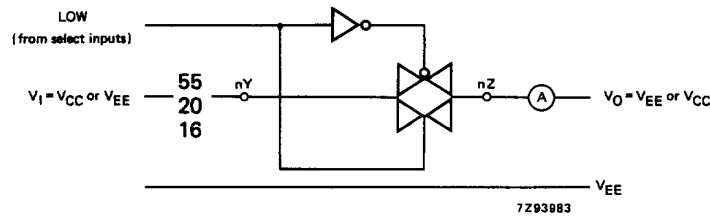


Fig.10 Test circuit for measuring OFF-state current.

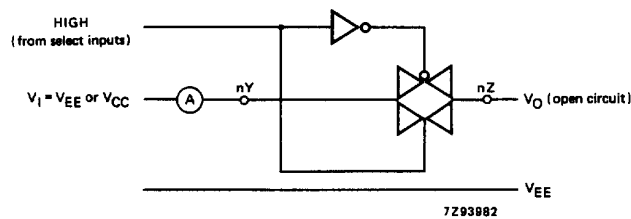


Fig.11 Test circuit for measuring ON-state current.

## Quad bilateral switches

## 74HC/HCT4316

**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 $V_{os}$ |                | 6<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)                      |
| $t_{PZH}$         | turn "ON" time<br>$\bar{E}$ to $V_{os}$   |                | 22<br>21 | 44<br>42 |            | 55<br>53 |             | 66<br>63 | 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) |
| $t_{PZL}$         | turn "ON" time<br>$\bar{E}$ to $V_{os}$   |                | 28<br>21 | 56<br>42 |            | 70<br>53 |             | 84<br>63 | ns   | 4.5<br>4.5      | 0<br>-4.5       | (see Figs 19,<br>20 and 21)  |
| $t_{PZH}$         | turn "ON" time<br>nS to $V_{os}$          |                | 20<br>17 | 40<br>34 |            | 53<br>43 |             | 60<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) |
| $t_{PZL}$         | turn "ON" time<br>nS to $V_{os}$          |                | 25<br>17 | 50<br>34 |            | 63<br>43 |             | 75<br>51 | ns   | 4.5<br>4.5      | 0<br>-4.5       | (see Figs 19,<br>20 and 21)  |
| $t_{PHZ}/t_{PLZ}$ | turn "OFF" time<br>$\bar{E}$ to $V_{os}$  |                | 25<br>23 | 50<br>46 |            | 63<br>58 |             | 75<br>69 | 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>nS to $V_{os}$         |                | 22<br>20 | 44<br>40 |            | 55<br>50 |             | 66<br>60 | 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) |

Quad bilateral switches

74HC/HCT4316

ADDITIONAL AC CHARACTERISTICS FOR 74HC/HCT

Recommended conditions and typical values

GND = 0 V; T<sub>amb</sub> = 25 °C

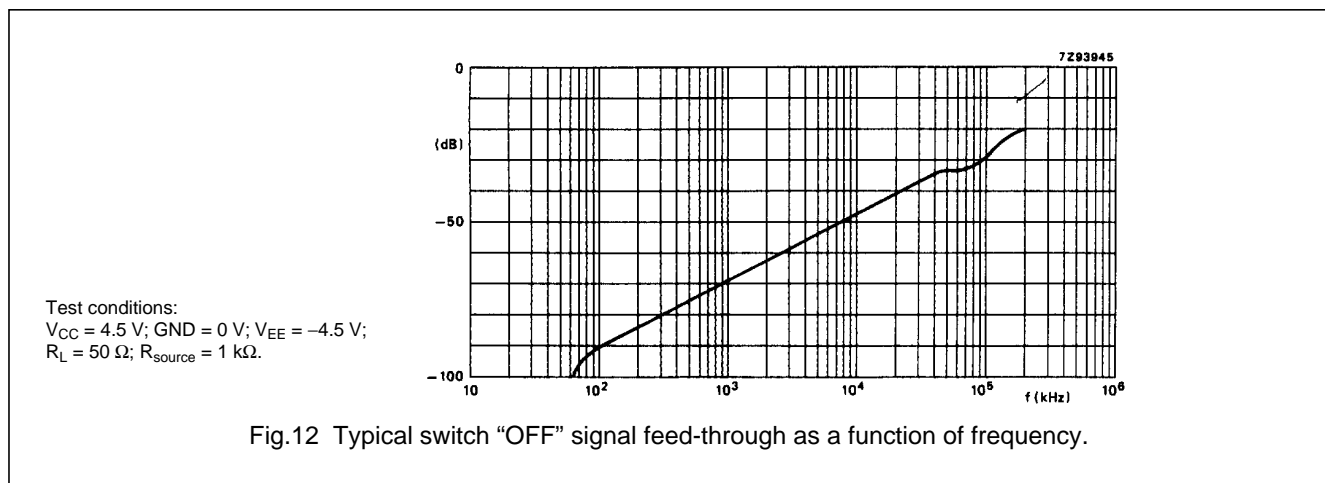
| SYMBOL             | PARAMETER   | typ.         | UNIT       | V <sub>CC</sub><br>(V) | V <sub>EE</sub><br>(V) | V <sub>is(p-p)</sub><br>(V) | CONDITIONS  |
|--------------------|---|--------------|------------|------------------------|------------------------|-----------------------------|---|
|                    | sine-wave distortion<br>f = 1 kHz   | 0.80<br>0.40 | %<br>%     | 2.25<br>4.5            | -2.25<br>-4.5          | 4.0<br>8.0                  | R <sub>L</sub> = 10 kΩ; C <sub>L</sub> = 50 pF<br>(see Fig.14)  |
|                    | sine-wave distortion<br>f = 10 kHz  | 2.40<br>1.20 | %<br>%     | 2.25<br>4.5            | -2.25<br>-4.5          | 4.0<br>8.0                  | R <sub>L</sub> = 10 kΩ; C <sub>L</sub> = 50 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 <sub>L</sub> = 600 Ω; C <sub>L</sub> = 50 pF<br>f = 1 MHz (see Figs 12 and 15)  |
|                    | crosstalk between<br>any two switches                                       | -60<br>-60   | dB<br>dB   | 2.25<br>4.5            | -2.25<br>-4.5          | note 1                      | R <sub>L</sub> = 600 Ω; C <sub>L</sub> = 50 pF;<br>f = 1 MHz; (see Fig.16)  |
| V <sub>(p-p)</sub> | 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 <sub>L</sub> = 600 kΩ; C <sub>L</sub> = 50 pF;<br>f = 1 MHz ( $\bar{E}$ or nS,<br>square-wave between V <sub>CC</sub><br>and GND, t <sub>r</sub> = t <sub>f</sub> = 6 ns)<br>(see Fig.17) |
| f <sub>max</sub>   | minimum frequency response<br>(-3 dB)                                       | 150<br>160   | MHz<br>MHz | 2.25<br>4.5            | -2.25<br>-4.5          | note 2                      | R <sub>L</sub> = 50 Ω; C <sub>L</sub> = 10 pF<br>(see Figs 13 and 14)   |
| C <sub>S</sub>     | maximum switch capacitance  | 5            | pF         |                        |                        |                             |   |

Notes

1. Adjust input voltage V<sub>is</sub> to 0 dBm level (0 dBm = 1 mW into 600 Ω).
2. Adjust input voltage V<sub>is</sub> to 0 dBm level at V<sub>OS</sub> for 1 MHz (0 dBm = 1 mW into 50 Ω).

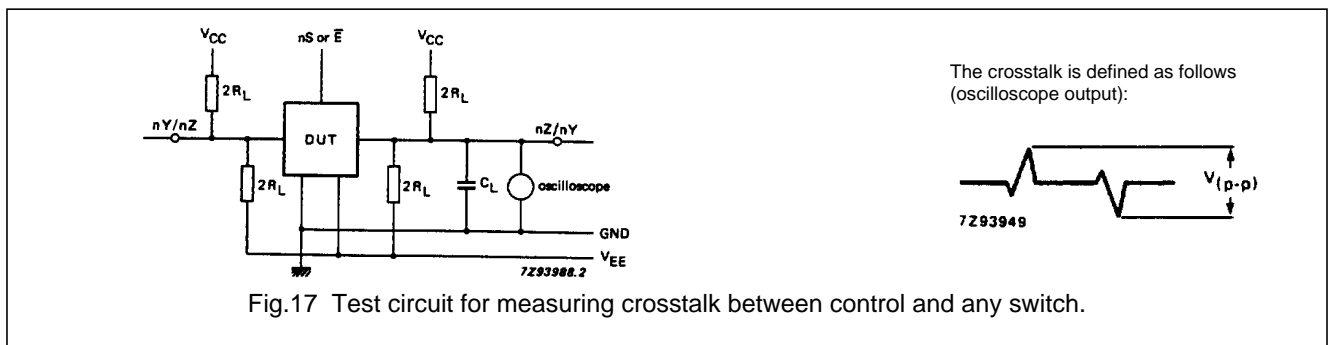
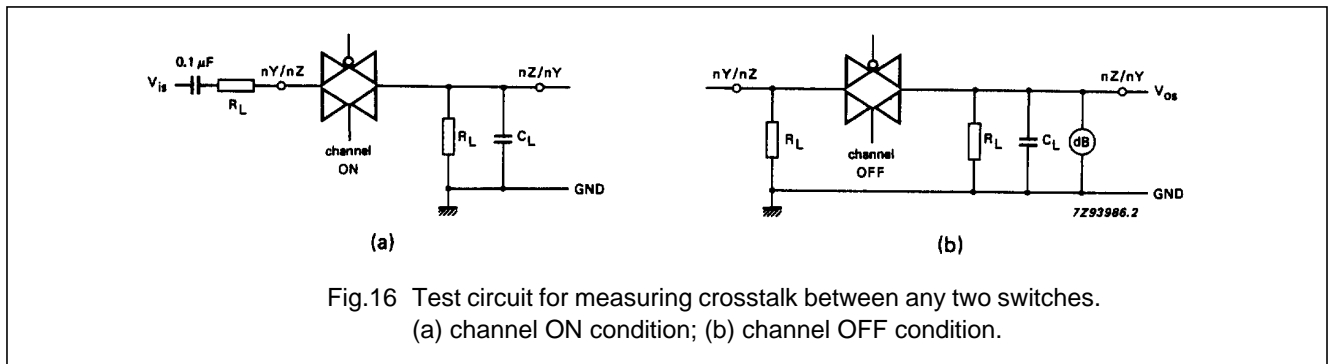
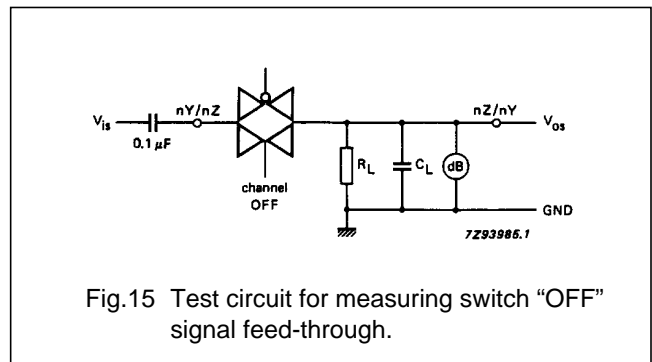
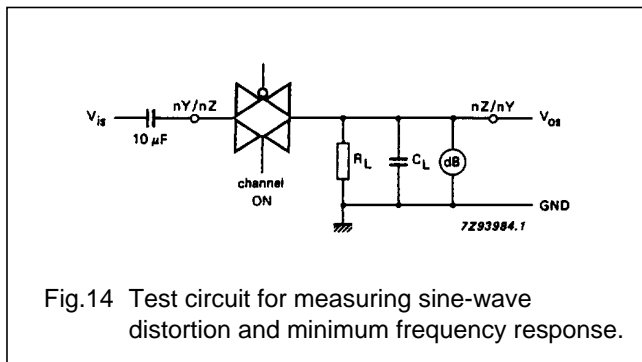
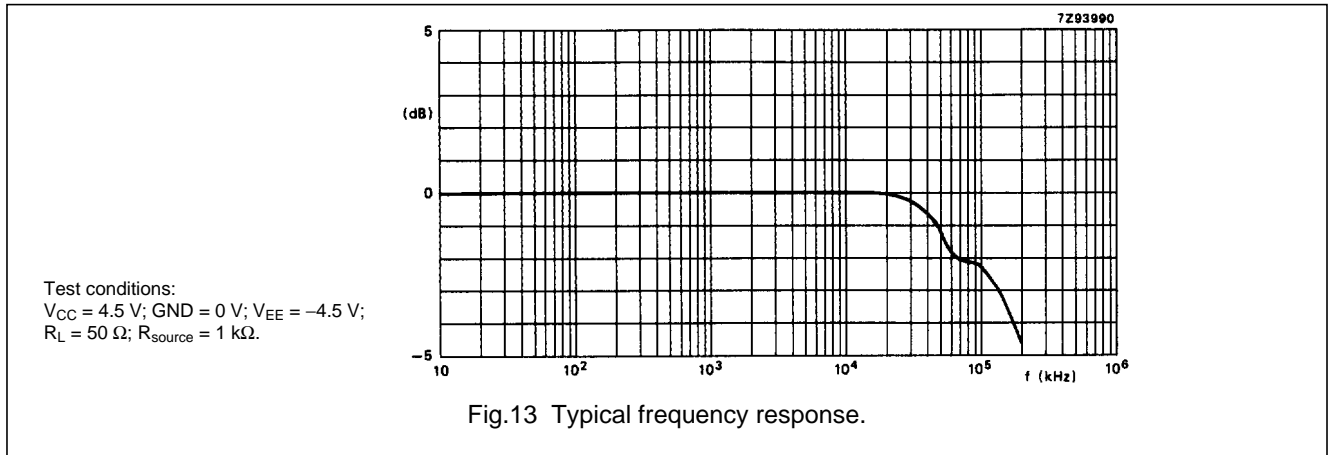
General note

V<sub>is</sub> is the input voltage at an nY or nZ terminal, whichever is assigned as an input.  
V<sub>OS</sub> is the output voltage at an nY or nZ terminal, whichever is assigned as an output.



Quad bilateral switches

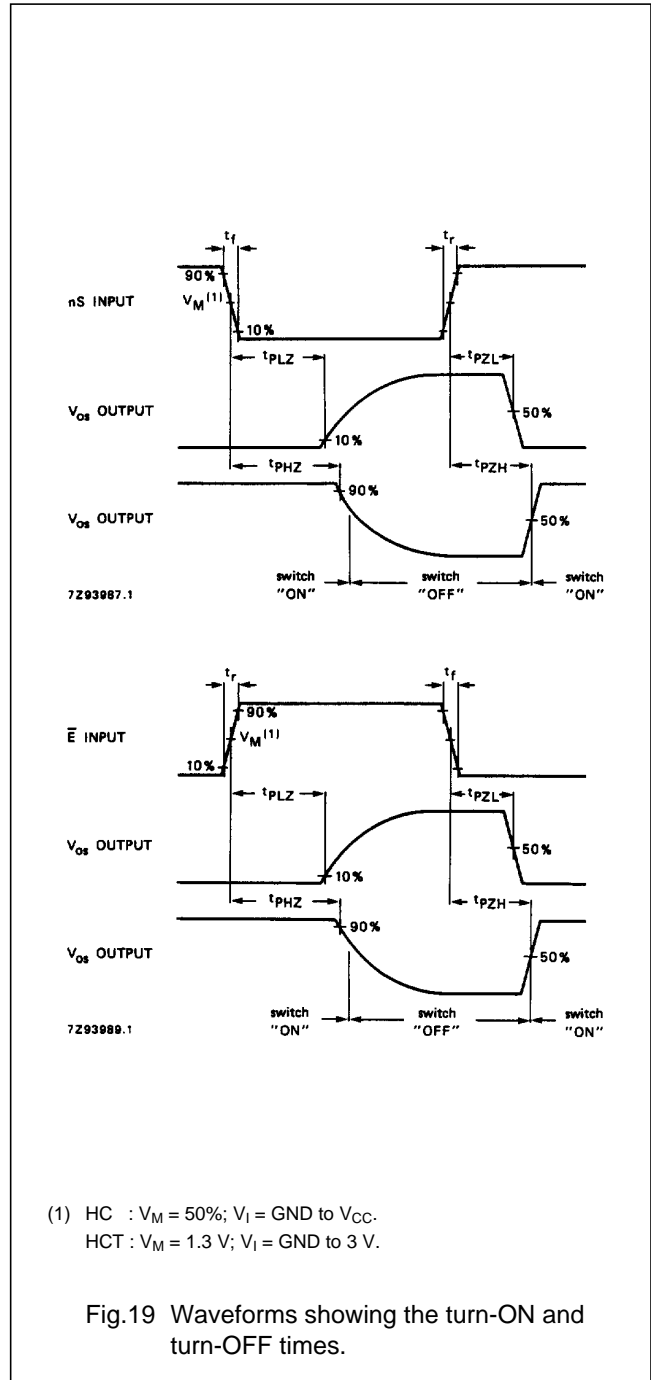
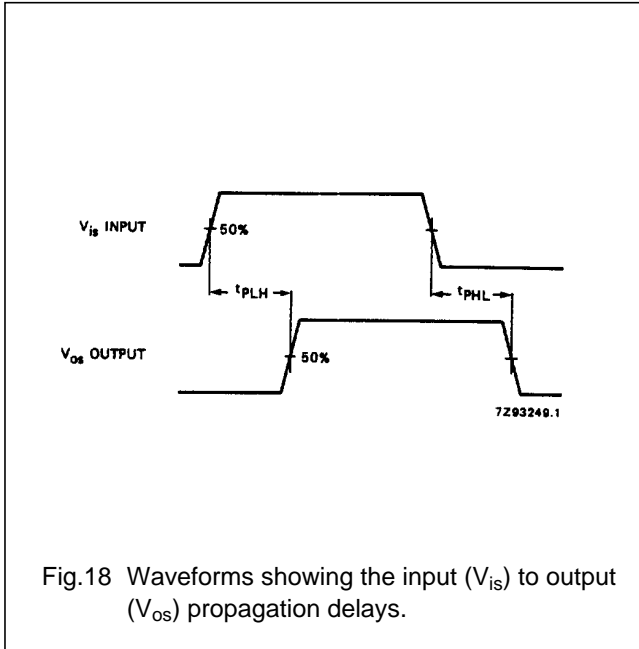
74HC/HCT4316



Quad bilateral switches

74HC/HCT4316

AC WAVEFORMS



Quad bilateral switches

74HC/HCT4316

TEST CIRCUIT AND WAVEFORMS

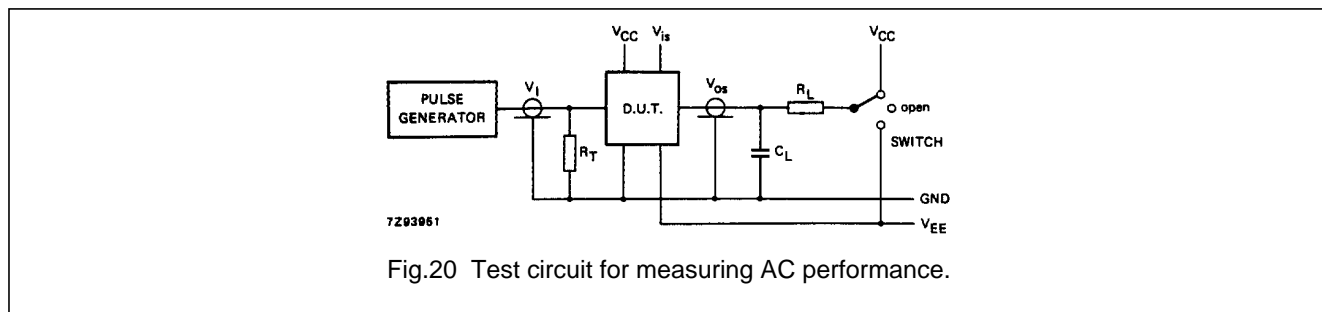


Fig.20 Test circuit for measuring AC performance.

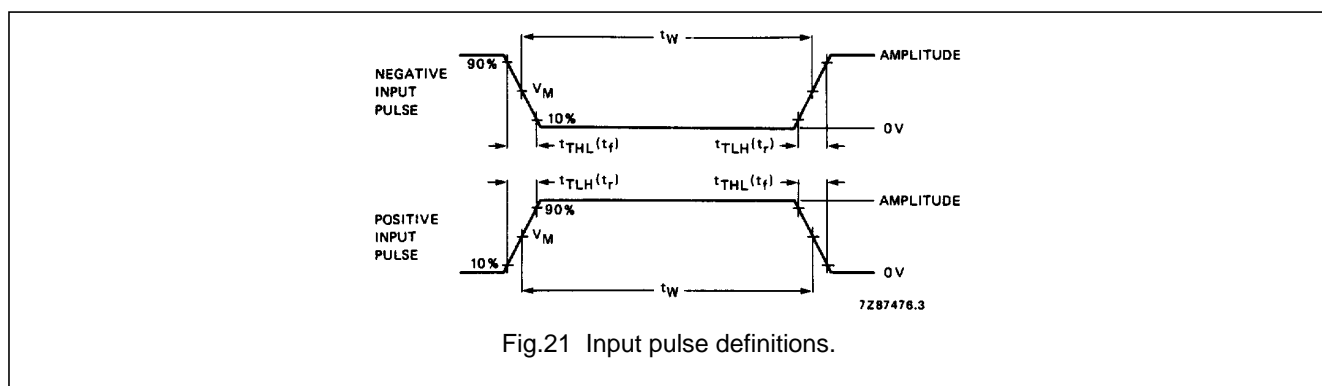


Fig.21 Input pulse definitions.

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  |

Definitions for Figs 20 and 21:

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.

PACKAGE OUTLINES

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