

# 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/HCT4016** Quad bilateral switches

Product specification  
File under Integrated Circuits, IC06

December 1990

## Quad bilateral switches

## 74HC/HCT4016

## FEATURES

- Low “ON” resistance:  
160  $\Omega$  (typ.) at  $V_{CC} = 4.5$  V  
120  $\Omega$  (typ.) at  $V_{CC} = 6.0$  V  
80  $\Omega$  (typ.) at  $V_{CC} = 9.0$  V
- Individual switch controls
- Typical “break before make” built in
- Output capability: non-standard
- $I_{CC}$  category: SSI

## GENERAL DESCRIPTION

The 74HC/HCT4016 are high-speed Si-gate CMOS devices and are pin compatible with the “4016” of the

“4000B” series. They are specified in compliance with JEDEC standard no. 7A.

The 74HC/HCT4016 have four independent analog switches (transmission gates).

Each switch has two input/output terminals ( $Y_n$ ,  $Z_n$ ) and an active HIGH enable input ( $E_n$ ). When  $E_n$  is connected to  $V_{CC}$ , a low bidirectional path between  $Y_n$  and  $Z_n$  is established (ON condition). When  $E_n$  is connected to ground (GND), the switch is disabled and a high impedance between  $Y_n$  and  $Z_n$  is established (OFF condition).

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;  $V_{CC} \gg (V_Y, V_Z) \gg$  GND. Inputs  $Y_n$  and  $Z_n$  are electrically equivalent terminals.

## QUICK REFERENCE DATA

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

| SYMBOL            | PARAMETER                                | CONDITIONS                                              | TYPICAL |     | UNIT |
|-------------------|------------------------------------------|---------------------------------------------------------|---------|-----|------|
|                   |                                          |                                                         | HC      | HCT |      |
| $t_{PZH}/t_{PZL}$ | turn “ON” time $E_n$ to $V_{OS}$         | $C_L = 15$ pF; $R_L = 1$ k $\Omega$ ;<br>$V_{CC} = 5$ V | 16      | 17  | ns   |
| $t_{PHZ}/t_{PLZ}$ | turn “OFF” time $E_n$ to $V_{OS}$        |                                                         | 14      | 20  | ns   |
| $C_I$             | input capacitance                        |                                                         | 3.5     | 3.5 | pF   |
| $C_{PD}$          | power dissipation capacitance per switch | notes 1 and 2                                           | 12      | 12  | pF   |
| $C_S$             | max. switch capacitance                  |                                                         | 5       | 5   | 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

## ORDERING INFORMATION

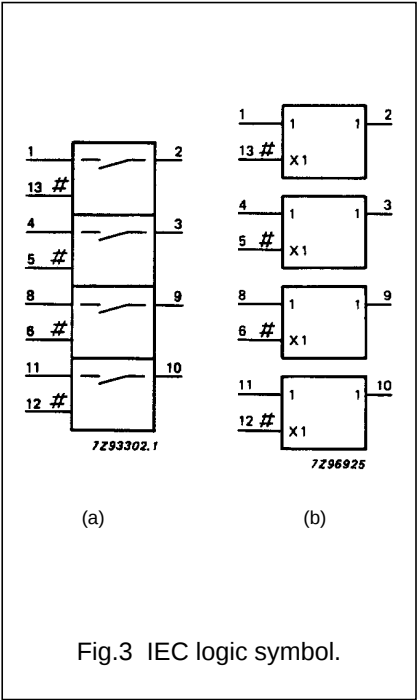
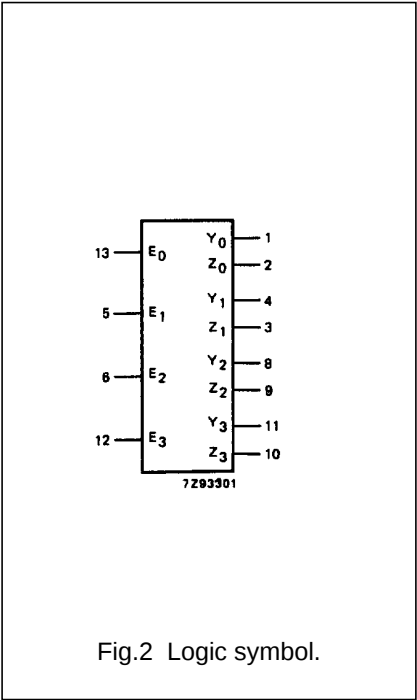
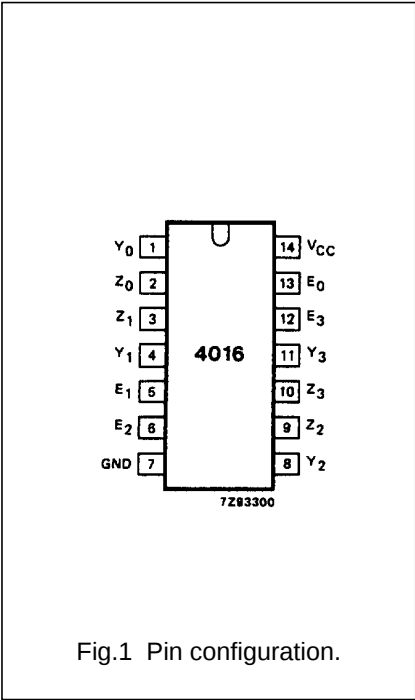
See “74HC/HCT/HCU/HCMOS Logic Package Information”.

Quad bilateral switches

74HC/HCT4016

PIN DESCRIPTION

| PIN NO.      | SYMBOL                           | NAME AND FUNCTION           |
|--------------|----------------------------------|-----------------------------|
| 1, 4, 8, 11  | Y <sub>0</sub> to Y <sub>3</sub> | independent inputs/outputs  |
| 7            | GND                              | ground (0 V)                |
| 2, 3, 9, 10  | Z <sub>0</sub> to Z <sub>3</sub> | independent inputs/outputs  |
| 13, 5, 6, 12 | E <sub>0</sub> to E <sub>3</sub> | enable inputs (active HIGH) |
| 14           | V <sub>CC</sub>                  | positive supply voltage     |



## Quad bilateral switches

74HC/HCT4016

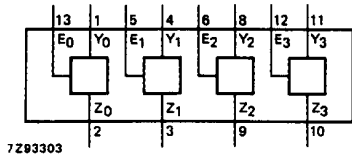


Fig.4 Functional diagram.

## APPLICATIONS

- Signal gating
- Modulation
- Demodulation
- Chopper

## FUNCTION TABLE

| INPUT<br>E <sub>n</sub> | CHANNEL<br>IMPEDANCE |
|-------------------------|----------------------|
| L                       | high                 |
| H                       | low                  |

## Notes

1. H = HIGH voltage level  
L = LOW voltage level

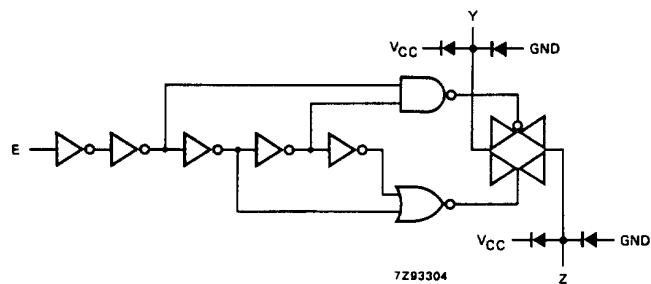


Fig.5 Schematic diagram (one switch).

## Quad bilateral switches

## 74HC/HCT4016

**RATINGS**

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

Voltages are referenced to 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 $V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V      |
| $\pm I_{SK}$              | DC switch diode current        |      | 20    | mA   | for $V_S < -0.5$ V or $V_S > V_{CC} + 0.5$ V      |
| $\pm I_S$                 | DC switch current              |      | 25    | mA   | for $-0.5$ V $< V_S < V_{CC} + 0.5$ V             |
| $\pm I_{CC}; \pm I_{GND}$ | 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   |                                                   |

**RECOMMENDED OPERATING CONDITIONS**

| SYMBOL     | PARAMETER                           | 74HC |      |                           | 74HCT |      |          | UNIT | CONDITIONS                                                                    |
|------------|-------------------------------------|------|------|---------------------------|-------|------|----------|------|-------------------------------------------------------------------------------|
|            |                                     | min. | typ. | max.                      | min.  | typ. | max.     |      |                                                                               |
| $V_{CC}$   | DC supply voltage                   | 2.0  | 5.0  | 10.0                      | 4.5   | 5.0  | 5.5      | V    |                                                                               |
| $V_I$      | DC input voltage range              | GND  |      | $V_{CC}$                  | GND   |      | $V_{CC}$ | V    |                                                                               |
| $V_S$      | DC switch voltage range             | GND  |      | $V_{CC}$                  | GND   |      | $V_{CC}$ | V    |                                                                               |
| $T_{amb}$  | operating ambient temperature range | -40  |      | +85                       | -40   |      | +85      | °C   | see DC and AC<br>CHARACTERIS-<br>TICS                                         |
| $T_{amb}$  | 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   | $V_{CC} = 2.0$ V<br>$V_{CC} = 4.5$ V<br>$V_{CC} = 6.0$ V<br>$V_{CC} = 10.0$ V |

Quad bilateral switches

74HC/HCT4016

DC CHARACTERISTICS FOR 74HC/HCT

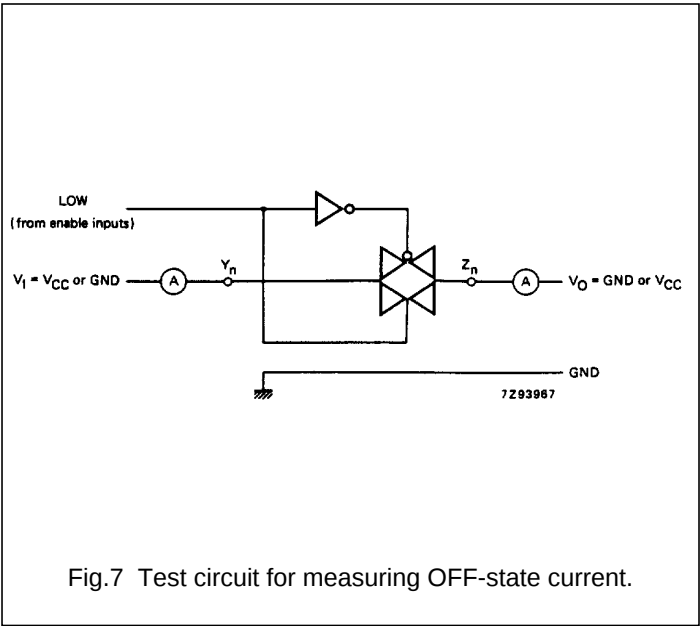
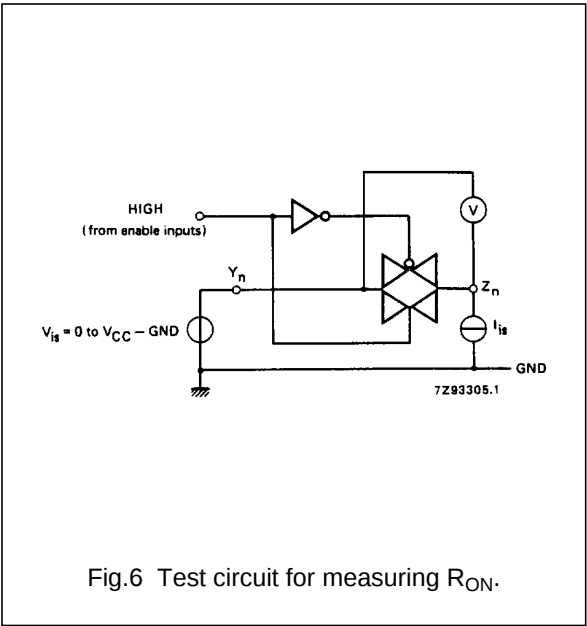
For 74HC:  $V_{CC} = 2.0, 4.5, 6.0$  and  $9.0\text{ V}$

For 74HCT:  $V_{CC} = 4.5\text{ V}$

| SYMBOL           | PARAMETER                                             | T <sub>amb</sub> (°C) |                    |      |            |      |             |      | UNIT             | TEST CONDITIONS          |                        |                              |                                          |
|------------------|-------------------------------------------------------|-----------------------|--------------------|------|------------|------|-------------|------|------------------|--------------------------|------------------------|------------------------------|------------------------------------------|
|                  |                                                       | 74HC/HCT              |                    |      |            |      |             |      |                  | V <sub>CC</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 (peak)                                  |                       | −                  | −    |            | −    |             | −    | Ω                | 2.0                      | 100                    | V <sub>CC</sub><br>to<br>GND | V <sub>IH</sub><br>or<br>V <sub>IL</sub> |
|                  |                                                       |                       | 160                | 320  |            | 400  |             | 480  | Ω                | 4.5                      | 1000                   |                              |                                          |
|                  |                                                       |                       | 120                | 240  |            | 300  |             | 360  | Ω                | 6.0                      | 1000                   |                              |                                          |
|                  |                                                       |                       | 85                 | 170  |            | 213  |             | 255  | Ω                | 9.0                      | 1000                   |                              |                                          |
| R <sub>ON</sub>  | ON resistance (rail)                                  |                       | 160                | −    |            | −    |             | −    | Ω                | 2.0                      | 100                    | GND                          | V <sub>IH</sub><br>or<br>V <sub>IL</sub> |
|                  |                                                       |                       | 80                 | 160  |            | 200  |             | 240  | Ω                | 4.5                      | 1000                   |                              |                                          |
|                  |                                                       |                       | 70                 | 140  |            | 175  |             | 210  | Ω                | 6.0                      | 1000                   |                              |                                          |
|                  |                                                       |                       | 60                 | 120  |            | 150  |             | 180  | Ω                | 9.0                      | 1000                   |                              |                                          |
| R <sub>ON</sub>  | ON resistance (rail)                                  |                       | 170                | −    |            | −    |             | −    | Ω                | 2.0                      | 100                    | V <sub>CC</sub>              | V <sub>IH</sub><br>or<br>V <sub>IL</sub> |
|                  |                                                       |                       | 90                 | 180  |            | 225  |             | 270  | Ω                | 4.5                      | 1000                   |                              |                                          |
|                  |                                                       |                       | 80                 | 160  |            | 200  |             | 240  | Ω                | 6.0                      | 1000                   |                              |                                          |
|                  |                                                       |                       | 65                 | 135  |            | 170  |             | 205  | Ω                | 9.0                      | 1000                   |                              |                                          |
| ΔR <sub>ON</sub> | maximum ΔON<br>resistance between<br>any two channels |                       | −<br>16<br>12<br>9 |      |            |      |             |      | Ω<br>Ω<br>Ω<br>Ω | 2.0<br>4.5<br>6.0<br>9.0 |                        | V <sub>CC</sub><br>to<br>GND | V <sub>IH</sub><br>or<br>V <sub>IL</sub> |

Notes to the DC Characteristics

- At supply voltages 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.6.



## Quad bilateral switches

## 74HC/HCT4016

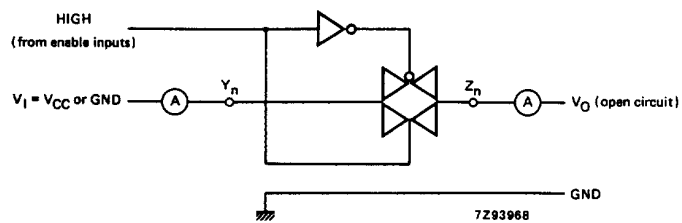
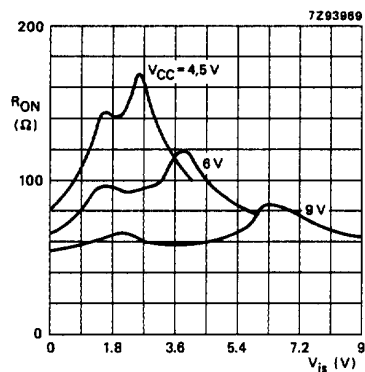


Fig.8 Test circuit for measuring ON-state current.

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

## Quad bilateral switches

## 74HC/HCT4016

**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>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>4.3 |                              | 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 <sub>IL</sub> | LOW level input voltage                     |                           | 0.8<br>2.1<br>2.8<br>4.3 | 0.50<br>1.35<br>1.80<br>2.70 |                           | 0.50<br>1.35<br>1.80<br>2.70 |                           | 0.50<br>1.35<br>1.80<br>2.70 | 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              | 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                     | V <sub>IH</sub><br>or<br>V <sub>IL</sub> | V <sub>S</sub>   =<br>V <sub>CC</sub> – GND<br>(see Fig.7)                                |       |
| ±I <sub>S</sub> | analog switch ON-state current              |                           |                          | 0.1                          |                           | 1.0                          |                           | 1.0                          | μA | 10.0                     | V <sub>IH</sub><br>or<br>V <sub>IL</sub> | V <sub>S</sub>   =<br>V <sub>CC</sub> – GND<br>(see Fig.8)                                |       |
| I <sub>CC</sub> | quiescent supply current                    |                           |                          | 2.0<br>4.0                   |                           | 20.0<br>40.0                 |                           | 40.0<br>80.0                 | μA | 6.0<br>10.0              | V <sub>CC</sub><br>or<br>GND             | V <sub>IS</sub> = GND or<br>V <sub>CC</sub> ; V <sub>OS</sub> =<br>V <sub>CC</sub> or GND |       |

**AC CHARACTERISTICS FOR 74HC**GND = 0 V; t<sub>r</sub> = t<sub>f</sub> = 6 ns; C<sub>L</sub> = 50 pF

| SYMBOL                              | PARAMETER                                               | T <sub>amb</sub> (°C) |                      |                       |            |                       |             |                       | UNIT | TEST CONDITIONS          |                                                                       |
|-------------------------------------|---------------------------------------------------------|-----------------------|----------------------|-----------------------|------------|-----------------------|-------------|-----------------------|------|--------------------------|-----------------------------------------------------------------------|
|                                     |                                                         | 74HC                  |                      |                       |            |                       |             |                       |      | V <sub>CC</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> |                       | 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>9.0 | R <sub>L</sub> = ∞; C <sub>L</sub> = 50 pF<br>(see Fig.16)            |
| t <sub>PZH</sub> / t <sub>PZL</sub> | turn “ON” time<br>E <sub>n</sub> to V <sub>os</sub>     |                       | 52<br>19<br>15<br>11 | 190<br>38<br>32<br>28 |            | 240<br>48<br>41<br>35 |             | 235<br>57<br>48<br>42 | ns   | 2.0<br>4.5<br>6.0<br>9.0 | R <sub>L</sub> = 1 kΩ; C <sub>L</sub> = 50 pF<br>(see Figs 17 and 18) |
| t <sub>PHZ</sub> / t <sub>PLZ</sub> | turn “OFF” time<br>E <sub>n</sub> to V <sub>os</sub>    |                       | 47<br>17<br>14<br>13 | 145<br>29<br>25<br>22 |            | 180<br>36<br>31<br>28 |             | 220<br>44<br>38<br>33 | ns   | 2.0<br>4.5<br>6.0<br>9.0 | R <sub>L</sub> = 1 kΩ; C <sub>L</sub> = 50 pF<br>(see Figs 17 and 18) |

## Quad bilateral switches

## 74HC/HCT4016

**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>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                    | V <sub>CC</sub> or GND             |                                                                                     |
| ±I <sub>S</sub>  | analog switch OFF-state current per channel                                               |                       |      | 0.1  |            | 1.0  |             | 1.0  | μA   | 5.5                    | V <sub>IH</sub> or V <sub>IL</sub> | V <sub>S</sub>   = V <sub>CC</sub> – GND (see Fig.7)                                |
| ±I <sub>S</sub>  | analog switch ON-state current                                                            |                       |      | 0.1  |            | 1.0  |             | 1.0  | μA   | 5.5                    | V <sub>IH</sub> or V <sub>IL</sub> | V <sub>S</sub>   = V <sub>CC</sub> – GND (see Fig.8)                                |
| I <sub>CC</sub>  | quiescent supply current                                                                  |                       |      | 2.0  |            | 20.0 |             | 40.0 | μA   | 4.5 to 5.5             | V <sub>CC</sub> or GND             | V <sub>is</sub> = GND or V <sub>CC</sub> ; V <sub>os</sub> = V <sub>CC</sub> or GND |
| 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             | V <sub>CC</sub> –2.1V              | other inputs at V <sub>CC</sub> or GND                                              |

**Note**

- 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 |
|----------------|-----------------------|
| E <sub>N</sub> | 1.00                  |

## Quad bilateral switches

## 74HC/HCT4016

## AC CHARACTERISTICS FOR 74HCT

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

| SYMBOL                              | PARAMETER                                               | T <sub>amb</sub> (°C) |      |      |            |      |             |      | UNIT | TEST CONDITIONS        |                                                                       |
|-------------------------------------|---------------------------------------------------------|-----------------------|------|------|------------|------|-------------|------|------|------------------------|-----------------------------------------------------------------------|
|                                     |                                                         | 74HCT                 |      |      |            |      |             |      |      | V <sub>CC</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> |                       | 6    | 12   |            | 15   |             | 18   | ns   | 4.5                    | R <sub>L</sub> = ∞; C <sub>L</sub> = 50 pF<br>(see Fig.16)            |
| t <sub>PZH</sub>                    | turn “ON” time<br>E <sub>n</sub> to V <sub>os</sub>     |                       | 19   | 35   |            | 44   |             | 53   | ns   | 4.5                    | R <sub>L</sub> = 1 kΩ; C <sub>L</sub> = 50 pF<br>(see Figs 17 and 18) |
| t <sub>PZL</sub>                    | turn “ON” time<br>E <sub>n</sub> to V <sub>os</sub>     |                       | 20   | 35   |            | 44   |             | 53   | ns   | 4.5                    | R <sub>L</sub> = 1 kΩ; C <sub>L</sub> = 50 pF<br>(see Figs 17 and 18) |
| t <sub>PHZ</sub> / t <sub>PLZ</sub> | turn “OFF” time<br>E <sub>n</sub> to V <sub>os</sub>    |                       | 23   | 35   |            | 44   |             | 53   | ns   | 4.5                    | R <sub>L</sub> = 1 kΩ; C <sub>L</sub> = 50 pF<br>(see Figs 17 and 18) |

## ADDITIONAL AC CHARACTERISTICS FOR 74HC/HCT

## Recommended conditions and typical values

GND = 0 V;  $t_r = t_f = 6$  ns

| SYMBOL      | PARAMETER                                                                                     | typ.         | UNIT       | $V_{CC}$<br>(V) | $V_{is(p-p)}$<br>(V) | CONDITIONS                                                                                                                                  |
|-------------|-----------------------------------------------------------------------------------------------|--------------|------------|-----------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
|             | sine-wave distortion<br>$f = 1$ kHz                                                           | 0.80<br>0.40 | %<br>%     | 4.5<br>9.0      | 4.0<br>8.0           | $R_L = 10$ k $\Omega$ ; $C_L = 50$ pF<br>(see Fig.14)                                                                                       |
|             | sine-wave distortion<br>$f = 10$ kHz                                                          | 2.40<br>1.20 | %<br>%     | 4.5<br>9.0      | 4.0<br>8.0           | $R_L = 10$ k $\Omega$ ; $C_L = 50$ pF<br>(see Fig.14)                                                                                       |
|             | switch “OFF” signal<br>feed-through                                                           | −50<br>−50   | dB<br>dB   | 4.5<br>9.0      | note 3               | $R_L = 600$ $\Omega$ ; $C_L = 50$ pF;<br>$f = 1$ MHz (see Figs 10 and 15)                                                                   |
|             | crosstalk between<br>any two switches                                                         | −60<br>−60   | dB<br>dB   | 4.5<br>9.0      | note 3               | $R_L = 600$ $\Omega$ ; $C_L = 50$ pF;<br>$f = 1$ MHz (see Fig.12)                                                                           |
| $V_{(p-p)}$ | crosstalk voltage between<br>enable or address input<br>to any switch<br>(peak-to-peak value) | 110<br>220   | mV<br>mV   | 4.5<br>9.0      |                      | $R_L = 600$ $\Omega$ ; $C_L = 50$ pF;<br>$f = 1$ MHz ( $E_n$ , square wave<br>between $V_{CC}$ and GND,<br>$t_r = t_f = 6$ ns) (see Fig.13) |
| $f_{max}$   | minimum frequency response<br>(−3dB)                                                          | 150<br>160   | MHz<br>MHz | 4.5<br>9.0      | note 4               | $R_L = 50$ $\Omega$ ; $C_L = 10$ pF<br>(see Figs 11 and 14)                                                                                 |
| $C_S$       | maximum switch capacitance                                                                    | 5            | pF         |                 |                      |                                                                                                                                             |

## Notes

1.  $V_{is}$  is the input voltage at a  $Y_n$  or  $Z_n$  terminal, whichever is assigned as an input.
2.  $V_{os}$  is the output voltage at a  $Y_n$  or  $Z_n$  terminal, whichever is assigned as an output.
3. Adjust input voltage  $V_{is}$  to 0 dBm level (0 dBm = 1 mW into 600  $\Omega$ ).
4. Adjust input voltage  $V_{is}$  to 0 dBm level at  $V_{os}$  for 1 MHz (0 dBm = 1 mW into 50  $\Omega$ ).

## Quad bilateral switches

74HC/HCT4016

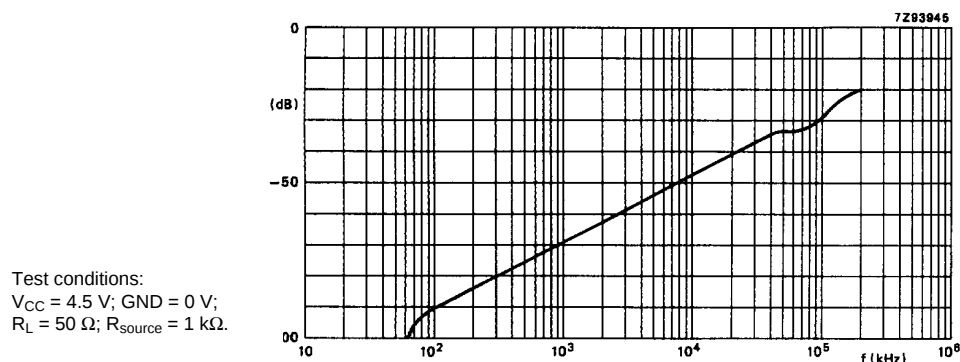


Fig.10 Typical switch "OFF" signal feed-through as a function of frequency.

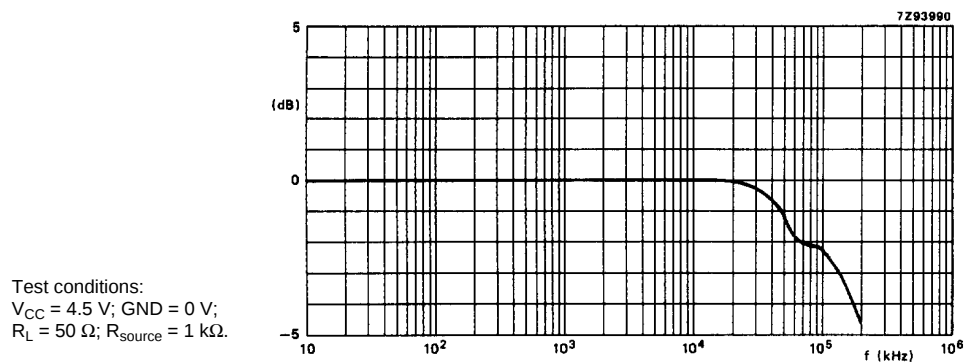


Fig.11 Typical frequency response.

## Quad bilateral switches

74HC/HCT4016

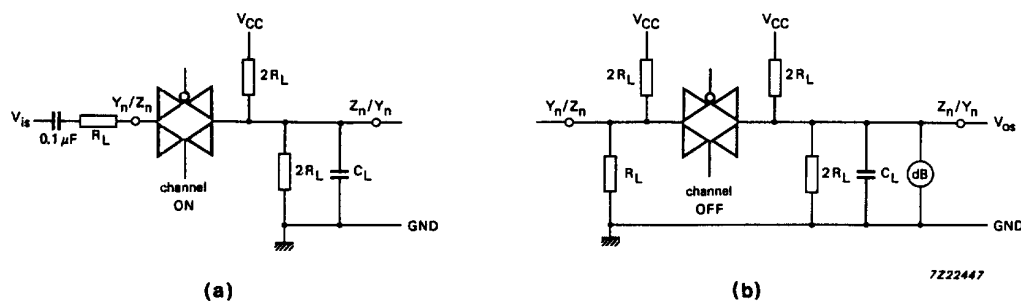


Fig.12 Test circuit for measuring crosstalk between any two switches.  
(a) channel ON condition; (b) channel OFF condition.

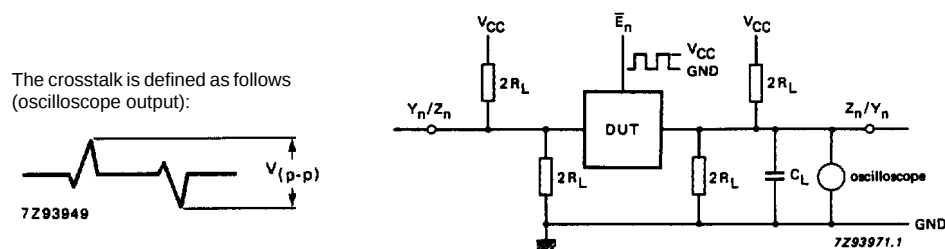


Fig.13 Test circuit for measuring crosstalk between control and any switch.

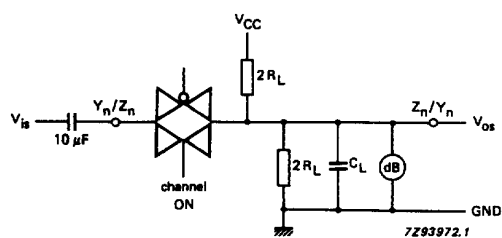


Fig.14 Test circuit for measuring sine-wave distortion and minimum frequency response.

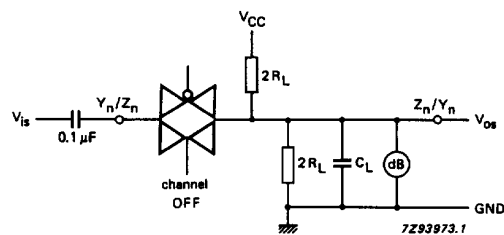


Fig.15 Test circuit for measuring switch “OFF” signal feed-through.

## Quad bilateral switches

## 74HC/HCT4016

## AC WAVEFORMS

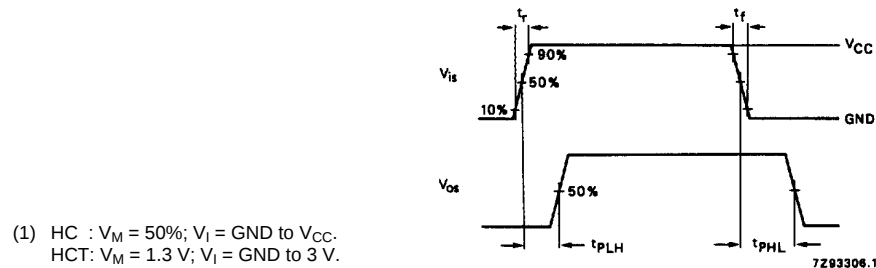
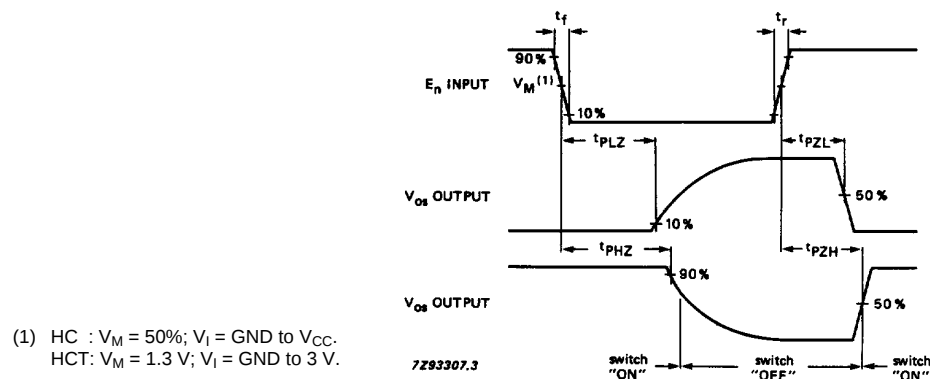
Fig.16 Waveforms showing the input ( $V_{is}$ ) to output ( $V_{os}$ ) propagation delays.

Fig.17 Waveforms showing the turn-ON and turn-OFF times.

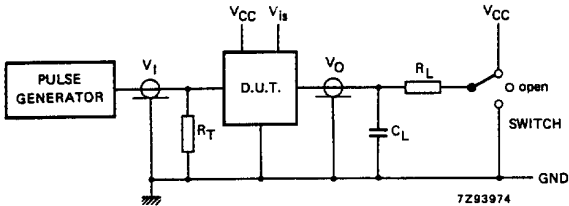
Quad bilateral switches

74HC/HCT4016

TEST CIRCUIT AND WAVEFORMS

Conditions

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

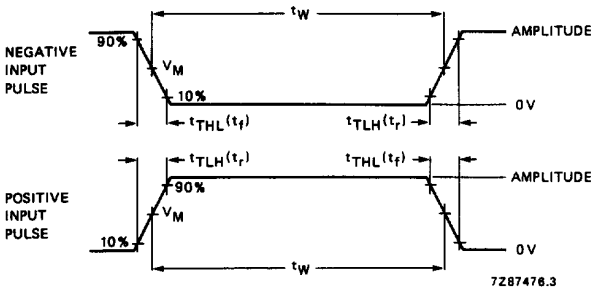


C<sub>L</sub> = load capacitance including jig and probe capacitance (see AC CHARACTERISTICS for values).  
R<sub>T</sub> = termination resistance should be equal to the output impedance Z<sub>O</sub> of the pulse generator.  
t<sub>r</sub> = t<sub>f</sub> = 6 ns; when measuring f<sub>max</sub>, there is no constraint t<sub>r</sub>, t<sub>f</sub> with 50% duty factor.

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

Fig.18 Test circuit for measuring AC performance.

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 t<sub>r</sub>, t<sub>f</sub> with 50% duty factor.



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

Fig.19 Input pulse definitions.

PACKAGE OUTLINES

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



**ООО «НИОКРсистемс»** - это оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов. Реализуемая нашей компанией продукция насчитывает более полумиллиона наименований.

Благодаря этому наша компания предлагает к поставке практически не ограниченный ассортимент компонентов как оптовыми, мелкооптовыми партиями, так и в розницу.

Благодаря развитой сети поставщиков, помогаем в поиске и приобретении экзотичных или снятых с производства компонентов.

### **Наша компания это:**

- Гарантия качества поставляемой продукции
- Широкий ассортимент
- Минимальные сроки поставок
- Техническая поддержка
- Подбор комплектации
- Индивидуальный подход
- Гибкое ценообразование
- Работаем по 275 ФЗ