

74HC4016

Quad single-pole single-throw analog switch

Rev. 3 — 12 December 2016

Product data sheet

1. General description

The 74HC4016 is a quad single pole, single throw analog switch. Each switch features two input/output terminals (nY and nZ) and an active HIGH enable input (nE). When nE is LOW, the analog switch is turned off. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

2. Features and benefits

- Input levels nE inputs:
 - ◆ For 74HC4016: CMOS level
- Typical 'break before make' built-in
- Low ON resistance:
 - ◆ 160 Ω (typical) at $V_{CC} = 4.5$ V
 - ◆ 120 Ω (typical) at $V_{CC} = 6.0$ V
 - ◆ 85 Ω (typical) at $V_{CC} = 9.0$ V
- Specified in compliance with JEDEC standard no. 7A
- ESD protection:
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V
- Specified from -40 °C to $+85$ °C and -40 °C to $+125$ °C

3. Ordering information

Table 1. Ordering information

| Type number | Package | | | Version |
|-------------|-----------------------|---------|--|----------|
| | Temperature range | Name | Description | |
| 74HC4016D | -40 °C to $+125$ °C | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |
| 74HC4016PW | -40 °C to $+125$ °C | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |

4. Functional diagram

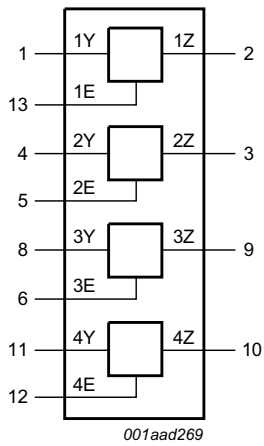


Fig 1. Logic symbol

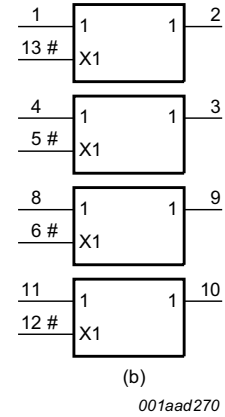
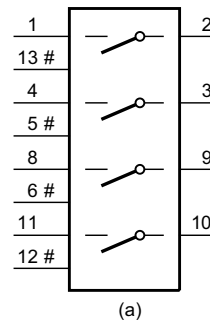


Fig 2. IEC logic symbol

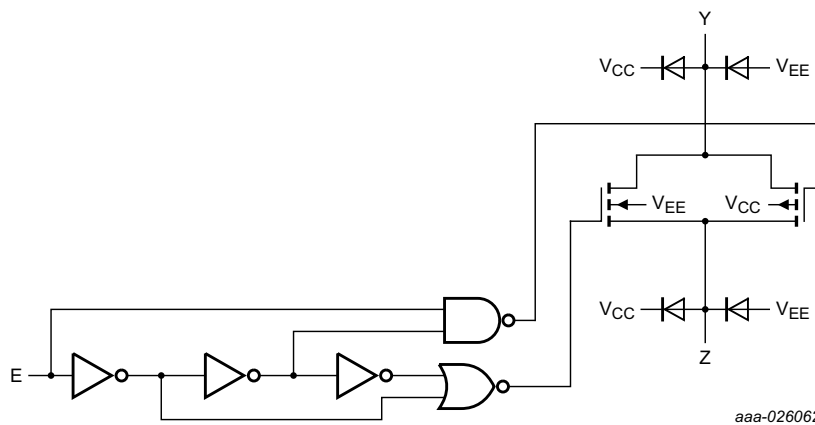
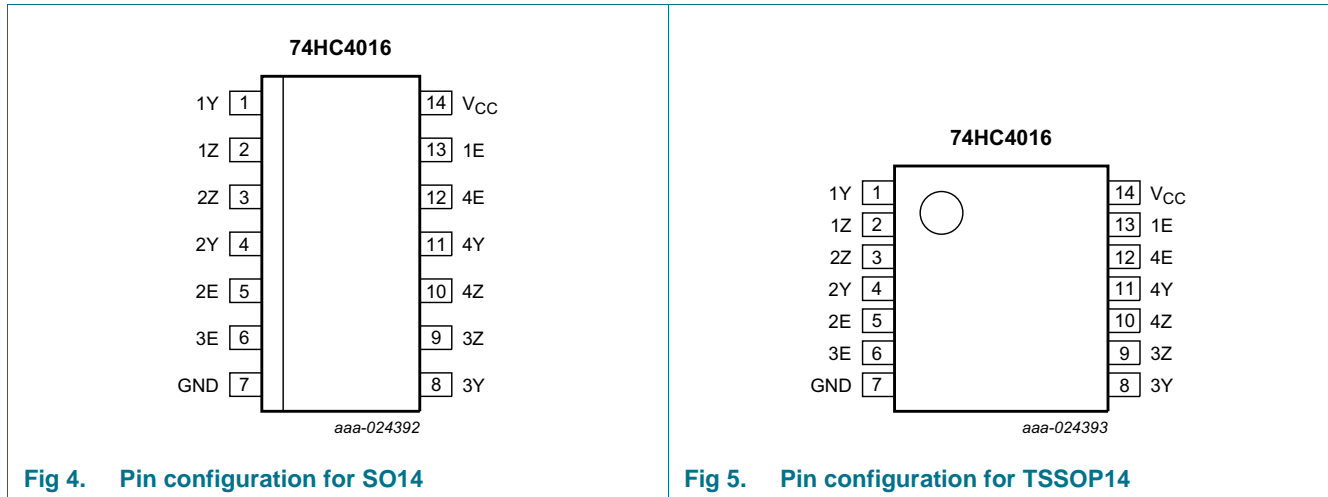


Fig 3. Schematic diagram (one switch)

5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|-----------------|--------------|-----------------------------|
| 1Z, 2Z, 3Z, 4Z | 2, 3, 9, 10 | independent input or output |
| 1Y, 2Y, 3Y, 4Y | 1, 4, 8, 11 | independent input or output |
| GND | 7 | ground (0 V) |
| 1E, 2E, 3E, 4E | 13, 5, 6, 12 | enable input (active HIGH) |
| V _{CC} | 14 | supply voltage |

6. Functional description

Table 3. Function table^[1]

| Input nE | Switch |
|----------|--------|
| L | OFF |
| H | ON |

[1] H = HIGH voltage level;
L = LOW voltage level.

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------|-------------------------|--|------|----------|------|
| V_{CC} | supply voltage | | -0.5 | +11.0 | V |
| I_{IK} | input clamping current | $V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ | - | ± 20 | mA |
| I_{SK} | switch clamping current | $V_{SW} < -0.5\text{ V}$ or $V_{SW} > V_{CC} + 0.5\text{ V}$ | - | ± 20 | mA |
| I_{SW} | switch current | $V_{SW} = -0.5\text{ V}$ to $V_{CC} + 0.5\text{ V}$ [1] | - | ± 25 | mA |
| I_{CC} | supply current | | - | +50 | mA |
| I_{GND} | ground current | | -50 | - | mA |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| P_{tot} | total power dissipation | $T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$ [2] | | | |
| | | SO14 and TSSOP14 packages | - | 500 | mW |
| P | power dissipation | per switch | - | 100 | mW |

[1] To avoid drawing V_{CC} current out of terminal nZ, when switch current flows in terminals nY, the voltage drop across the bidirectional switch must not exceed 0.4 V. If the switch current flows into terminal nZ, no V_{CC} current will flow out of terminals nY. In this case there is no limit for the voltage drop across the switch, but the voltages at nY and nZ may not exceed V_{CC} or GND.

[2] For SO14 package: P_{tot} derates linearly with 8 mW/K above 70 °C.
For TSSOP14 packages: P_{tot} derates linearly with 5.5 mW/K above 60 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------|-------------------------------------|--------------------------|-----|------|----------|------|
| V_{CC} | supply voltage | | 2.0 | 5.0 | 10.0 | V |
| V_I | input voltage | | GND | - | V_{CC} | V |
| V_{SW} | switch voltage | | GND | - | V_{CC} | V |
| T_{amb} | ambient temperature | | -40 | +25 | +125 | °C |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 2.0\text{ V}$ | - | - | 625 | ns/V |
| | | $V_{CC} = 4.5\text{ V}$ | - | 1.67 | 139 | ns/V |
| | | $V_{CC} = 6.0\text{ V}$ | - | - | 83 | ns/V |
| | | $V_{CC} = 10.0\text{ V}$ | - | - | 35 | ns/V |

9. Static characteristics

Table 6. R_{ON} resistance per switch

$V_I = V_{IH}$ or V_{IL} ; for test circuit see [Figure 6](#).

V_{is} is the input voltage at a nY or nZ terminal, whichever is assigned as an input.

V_{os} is the output voltage at a nY or nZ terminal, whichever is assigned as an output.

For 74HC4016: $V_{CC} - GND = 2.0\text{ V}, 4.5\text{ V}, 6.0\text{ V}$ and 9.0 V .

| Symbol | Parameter | Conditions | +25 °C | | −40 °C to +85 °C | | −40 °C to +125 °C | | Unit |
|-----------------|---|---|--------|-----|------------------|-----|-------------------|-----|----------|
| | | | Typ | Max | Min | Max | Min | Max | |
| $R_{ON(peak)}$ | ON resistance (peak) | $V_{is} = V_{CC}$ to GND | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}; I_{SW} = 0.1\text{ mA}$ [1] | - | - | - | - | - | - | Ω |
| | | $V_{CC} = 4.5\text{ V}; I_{SW} = 1\text{ mA}$ | 160 | 320 | - | 400 | - | 480 | Ω |
| | | $V_{CC} = 6.0\text{ V}; I_{SW} = 1\text{ mA}$ | 120 | 240 | - | 300 | - | 360 | Ω |
| | | $V_{CC} = 9.0\text{ V}; I_{SW} = 1\text{ mA}$ | 85 | 170 | - | 213 | - | 255 | Ω |
| $R_{ON(rail)}$ | ON resistance (rail) | $V_{is} = GND$ | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}; I_{SW} = 0.1\text{ mA}$ [1] | 160 | - | - | - | - | - | Ω |
| | | $V_{CC} = 4.5\text{ V}; I_{SW} = 1\text{ mA}$ | 80 | 160 | - | 200 | - | 240 | Ω |
| | | $V_{CC} = 6.0\text{ V}; I_{SW} = 1\text{ mA}$ | 70 | 140 | - | 175 | - | 210 | Ω |
| | | $V_{CC} = 9.0\text{ V}; I_{SW} = 1\text{ mA}$ | 60 | 120 | - | 150 | - | 180 | Ω |
| | | $V_{is} = V_{CC}$ | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}; I_{SW} = 0.1\text{ mA}$ [1] | 170 | - | - | - | - | - | Ω |
| | | $V_{CC} = 4.5\text{ V}; I_{SW} = 1\text{ mA}$ | 90 | 180 | - | 225 | - | 270 | Ω |
| | | $V_{CC} = 6.0\text{ V}; I_{SW} = 1\text{ mA}$ | 80 | 160 | - | 200 | - | 240 | Ω |
| | | $V_{CC} = 9.0\text{ V}; I_{SW} = 1\text{ mA}$ | 65 | 135 | - | 170 | - | 205 | Ω |
| ΔR_{ON} | ON resistance mismatch between channels | $V_{is} = V_{CC}$ to GND | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ [1] | - | - | - | - | - | - | Ω |
| | | $V_{CC} = 4.5\text{ V}$ | 16 | - | - | - | - | - | Ω |
| | | $V_{CC} = 6.0\text{ V}$ | 12 | - | - | - | - | - | Ω |
| | | $V_{CC} = 9.0\text{ V}$ | 9 | - | - | - | - | - | Ω |

- [1] At supply voltages ($V_{CC} - GND$) approaching 2 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.

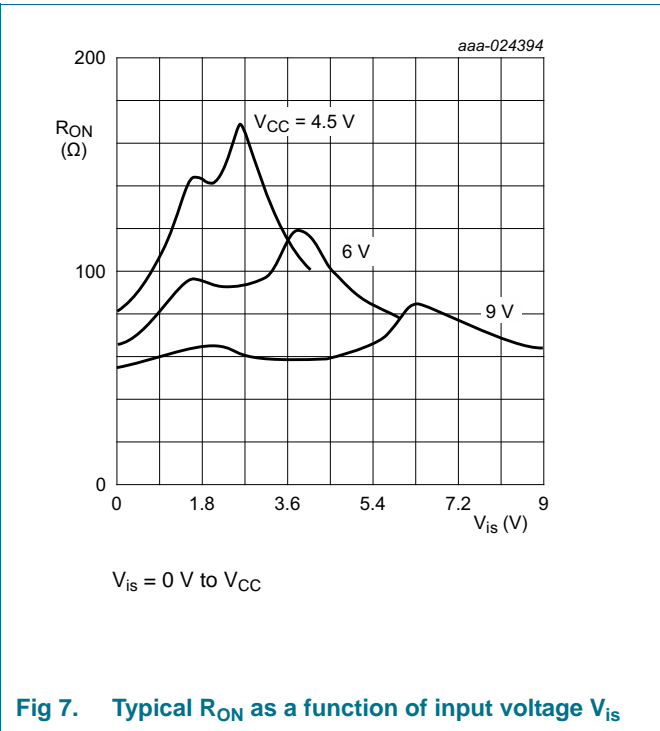
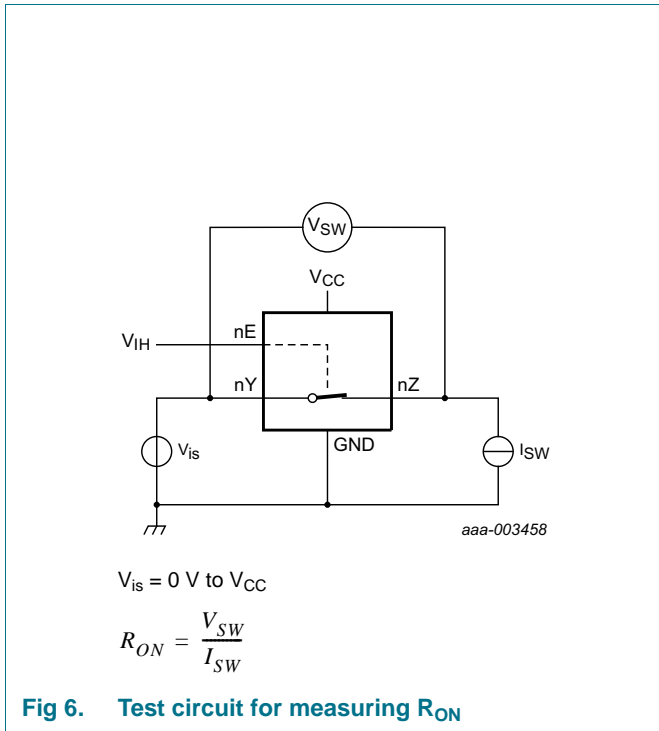


Table 7. Static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

V_{is} is the input voltage at a nY or terminal, whichever is assigned as an input.

V_{os} is the output voltage at a nY or nZ terminal, whichever is assigned as an output.

| Symbol | Parameter | Conditions | Min | Typ ^[1] | Max | Unit |
|--|---------------------------|--|------|--------------------|-----------|---------------|
| $T_{amb} = +25 \text{ }^\circ\text{C}$ | | | | | | |
| V_{IH} | HIGH-level input voltage | $V_{CC} = 2.0 \text{ V}$ | 1.5 | 1.2 | - | V |
| | | $V_{CC} = 4.5 \text{ V}$ | 3.15 | 2.4 | - | V |
| | | $V_{CC} = 6.0 \text{ V}$ | 4.2 | 3.2 | - | V |
| | | $V_{CC} = 9.0 \text{ V}$ | 6.3 | 4.3 | - | V |
| V_{IL} | LOW-level input voltage | $V_{CC} = 2.0 \text{ V}$ | - | 0.8 | 0.5 | V |
| | | $V_{CC} = 4.5 \text{ V}$ | - | 2.1 | 1.35 | V |
| | | $V_{CC} = 6.0 \text{ V}$ | - | 2.8 | 1.80 | V |
| | | $V_{CC} = 9.0 \text{ V}$ | - | 4.3 | 2.70 | V |
| I_I | input leakage current | $V_I = V_{CC} \text{ or } GND$ | | | | |
| | | $V_{CC} = 6.0 \text{ V}$ | - | - | ± 0.1 | μA |
| | | $V_{CC} = 10.0 \text{ V}$ | - | - | ± 0.2 | μA |
| $I_{S(OFF)}$ | OFF-state leakage current | $V_{CC} = 10.0 \text{ V}; V_I = V_{IH} \text{ or } V_{IL}; V_{SW} = V_{CC} - GND$; see Figure 8 | | | | |
| | | per channel | - | - | ± 0.1 | μA |
| $I_{S(ON)}$ | ON-state leakage current | $V_{CC} = 10.0 \text{ V}; V_I = V_{IH} \text{ or } V_{IL}; V_{SW} = V_{CC} - GND$; see Figure 9 | - | - | ± 0.1 | μA |

Table 7. Static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

V_{is} is the input voltage at a nY or terminal, whichever is assigned as an input.

V_{os} is the output voltage at a nY or nZ terminal, whichever is assigned as an output.

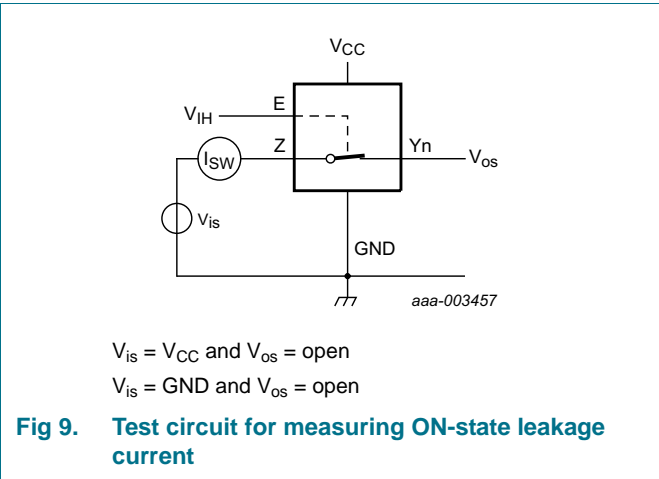
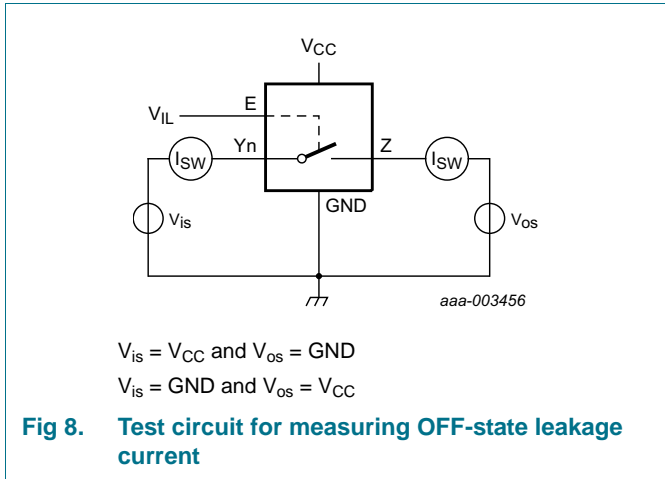
| Symbol | Parameter | Conditions | Min | Typ ^[1] | Max | Unit |
|--|---------------------------|--|------|--------------------|-----------|---------|
| I_{CC} | supply current | $V_I = V_{CC}$ or GND; $V_{is} =$ GND or V_{CC} ; $V_{os} = V_{CC}$ or GND | | | | |
| | | $V_{CC} = 6.0$ V | - | - | 2.0 | μ A |
| | | $V_{CC} = 10.0$ V | - | - | 4.0 | μ A |
| C_I | input capacitance | | - | 3.5 | - | pF |
| C_{SW} | switch capacitance | | - | 5 | - | pF |
| $T_{amb} = -40$ °C to $+85$ °C | | | | | | |
| V_{IH} | HIGH-level input voltage | $V_{CC} = 2.0$ V | 1.5 | - | - | V |
| | | $V_{CC} = 4.5$ V | 3.15 | - | - | V |
| | | $V_{CC} = 6.0$ V | 4.2 | - | - | V |
| | | $V_{CC} = 9.0$ V | 6.3 | - | - | V |
| V_{IL} | LOW-level input voltage | $V_{CC} = 2.0$ V | - | - | 0.50 | V |
| | | $V_{CC} = 4.5$ V | - | - | 1.35 | V |
| | | $V_{CC} = 6.0$ V | - | - | 1.80 | V |
| | | $V_{CC} = 9.0$ V | - | - | 2.70 | V |
| I_I | input leakage current | $V_I = V_{CC}$ or GND | | | | |
| | | $V_{CC} = 6.0$ V | - | - | ± 1.0 | μ A |
| | | $V_{CC} = 10.0$ V | - | - | ± 2.0 | μ A |
| $I_{S(OFF)}$ | OFF-state leakage current | $V_{CC} = 10.0$ V; $V_I = V_{IH}$ or V_{IL} ; $ V_{SW} = V_{CC} - \text{GND}$; see Figure 8 | | | | |
| | | per channel | - | - | ± 1.0 | μ A |
| $I_{S(ON)}$ | ON-state leakage current | $V_{CC} = 10.0$ V; $V_I = V_{IH}$ or V_{IL} ; $ V_{SW} = V_{CC} - \text{GND}$; see Figure 9 | - | - | ± 1.0 | μ A |
| I_{CC} | supply current | $V_I = V_{CC}$ or GND; $V_{is} =$ GND or V_{CC} ; $V_{os} = V_{CC}$ or GND | | | | |
| | | $V_{CC} = 6.0$ V | - | - | 20.0 | μ A |
| | | $V_{CC} = 10.0$ V | - | - | 40.0 | μ A |
| $T_{amb} = -40$ °C to $+125$ °C | | | | | | |
| V_{IH} | HIGH-level input voltage | $V_{CC} = 2.0$ V | 1.5 | - | - | V |
| | | $V_{CC} = 4.5$ V | 3.15 | - | - | V |
| | | $V_{CC} = 6.0$ V | 4.2 | - | - | V |
| | | $V_{CC} = 9.0$ V | 6.3 | - | - | V |
| V_{IL} | LOW-level input voltage | $V_{CC} = 2.0$ V | - | - | 0.50 | V |
| | | $V_{CC} = 4.5$ V | - | - | 1.35 | V |
| | | $V_{CC} = 6.0$ V | - | - | 1.80 | V |
| | | $V_{CC} = 9.0$ V | - | - | 2.70 | V |
| I_I | input leakage current | $V_I = V_{CC}$ or GND | | | | |
| | | $V_{CC} = 6.0$ V | - | - | ± 1.0 | μ A |
| | | $V_{CC} = 10.0$ V | - | - | ± 2.0 | μ A |

Table 7. Static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).
 V_{is} is the input voltage at a nY or terminal, whichever is assigned as an input.
 V_{os} is the output voltage at a nY or nZ terminal, whichever is assigned as an output.

| Symbol | Parameter | Conditions | Min | Typ ^[1] | Max | Unit |
|--------------|---------------------------|--|-----|--------------------|-----------|---------------|
| $I_{S(OFF)}$ | OFF-state leakage current | $V_{CC} = 10.0\text{ V}$; $V_I = V_{IH}$ or V_{IL} ; $ V_{SW} = V_{CC} - \text{GND}$; see Figure 8 | | | | |
| | | per channel | - | - | ± 1.0 | μA |
| $I_{S(ON)}$ | ON-state leakage current | $V_{CC} = 10.0\text{ V}$; $V_I = V_{IH}$ or V_{IL} ; $ V_{SW} = V_{CC} - \text{GND}$; see Figure 9 | - | - | ± 1.0 | μA |
| I_{CC} | supply current | $V_I = V_{CC}$ or GND ; $V_{is} = \text{GND}$ or V_{CC} ; $V_{os} = V_{CC}$ or GND | | | | |
| | | $V_{CC} = 6.0\text{ V}$ | - | - | 40 | μA |
| | | $V_{CC} = 10.0\text{ V}$ | - | - | 80 | μA |

[1] Typical values are measured at $T_{amb} = 25\text{ }^\circ\text{C}$.



10. Dynamic characteristics

Table 8. Dynamic characteristics 74HC4066

$GND = 0\text{ V}$; $t_r = t_f = 6\text{ ns}$; $C_L = 50\text{ pF}$ unless specified otherwise; for test circuit see [Figure 12](#).

V_{is} is the input voltage at a nY or nZ terminal, whichever is assigned as an input.

V_{os} is the output voltage at a nY or nZ terminal, whichever is assigned as an output.

| Symbol | Parameter | Conditions | +25 °C | | −40 °C to +85 °C | | −40 °C to +125 °C | | Unit |
|-----------|-------------------------------|---|--------|-----|------------------|-----|-------------------|-----|------|
| | | | Typ | Max | Min | Max | Min | Max | |
| t_{pd} | propagation delay | nY to nZ or nZ to nY; [1] $R_L = \infty\ \Omega$; see Figure 10 | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | 17 | 60 | - | 75 | - | 90 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | 6 | 12 | - | 15 | - | 18 | ns |
| | | $V_{CC} = 6.0\text{ V}$ | 5 | 10 | - | 13 | - | 15 | ns |
| | | $V_{CC} = 9.0\text{ V}$ | 4 | 8 | - | 10 | - | 12 | ns |
| t_{on} | turn-on time | nE to nY or nZ; [2] see Figure 11 | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | 52 | 190 | - | 240 | - | 235 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | 19 | 38 | - | 48 | - | 57 | ns |
| | | $V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$ | 16 | - | - | - | - | - | ns |
| | | $V_{CC} = 6.0\text{ V}$ | 15 | 32 | - | 41 | - | 48 | ns |
| | $V_{CC} = 9.0\text{ V}$ | 11 | 28 | - | 35 | - | 42 | ns | |
| t_{off} | turn-off time | nE to nY or nZ; [3] see Figure 11 | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | 47 | 145 | - | 180 | - | 220 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | 17 | 29 | - | 36 | - | 44 | ns |
| | | $V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$ | 14 | - | - | - | - | - | ns |
| | | $V_{CC} = 6.0\text{ V}$ | 14 | 25 | - | 31 | - | 38 | ns |
| | $V_{CC} = 9.0\text{ V}$ | 13 | 22 | - | 28 | - | 33 | ns | |
| C_{PD} | power dissipation capacitance | per switch; $V_I = GND$ to V_{CC} [4] | 12 | - | - | - | - | - | pF |

[1] t_{pd} is the same as t_{PHL} and t_{PLH} .

[2] t_{on} is the same as t_{PHZ} and t_{PLZ} .

[3] t_{off} is the same as t_{PZH} and t_{PZL} .

[4] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

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

C_L = output load capacitance in pF;

C_{sw} = switch capacitance in pF;

V_{CC} = supply voltage in V.

11. Waveforms

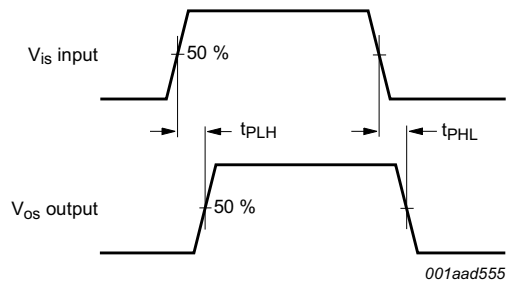
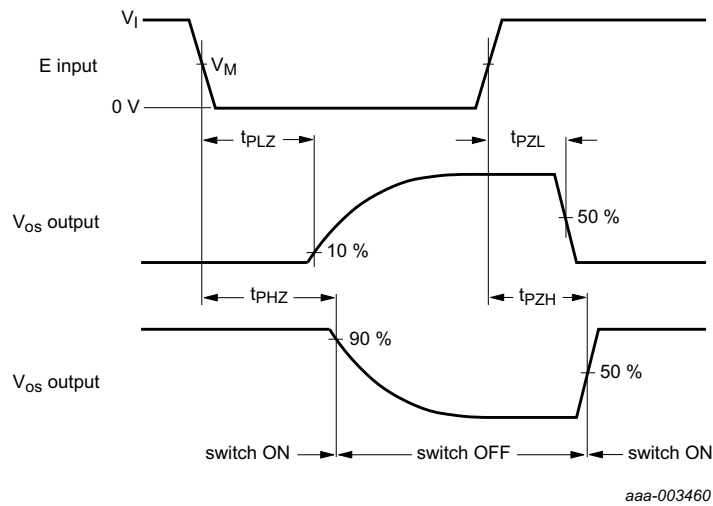


Fig 10. Input (V_{is}) to output (V_{os}) propagation delays



Measurement points are shown in [Table 9](#).

Fig 11. Turn-on and turn-off times

Table 9. Measurement points

| V_I | V_M |
|----------|-------------|
| V_{CC} | $0.5V_{CC}$ |

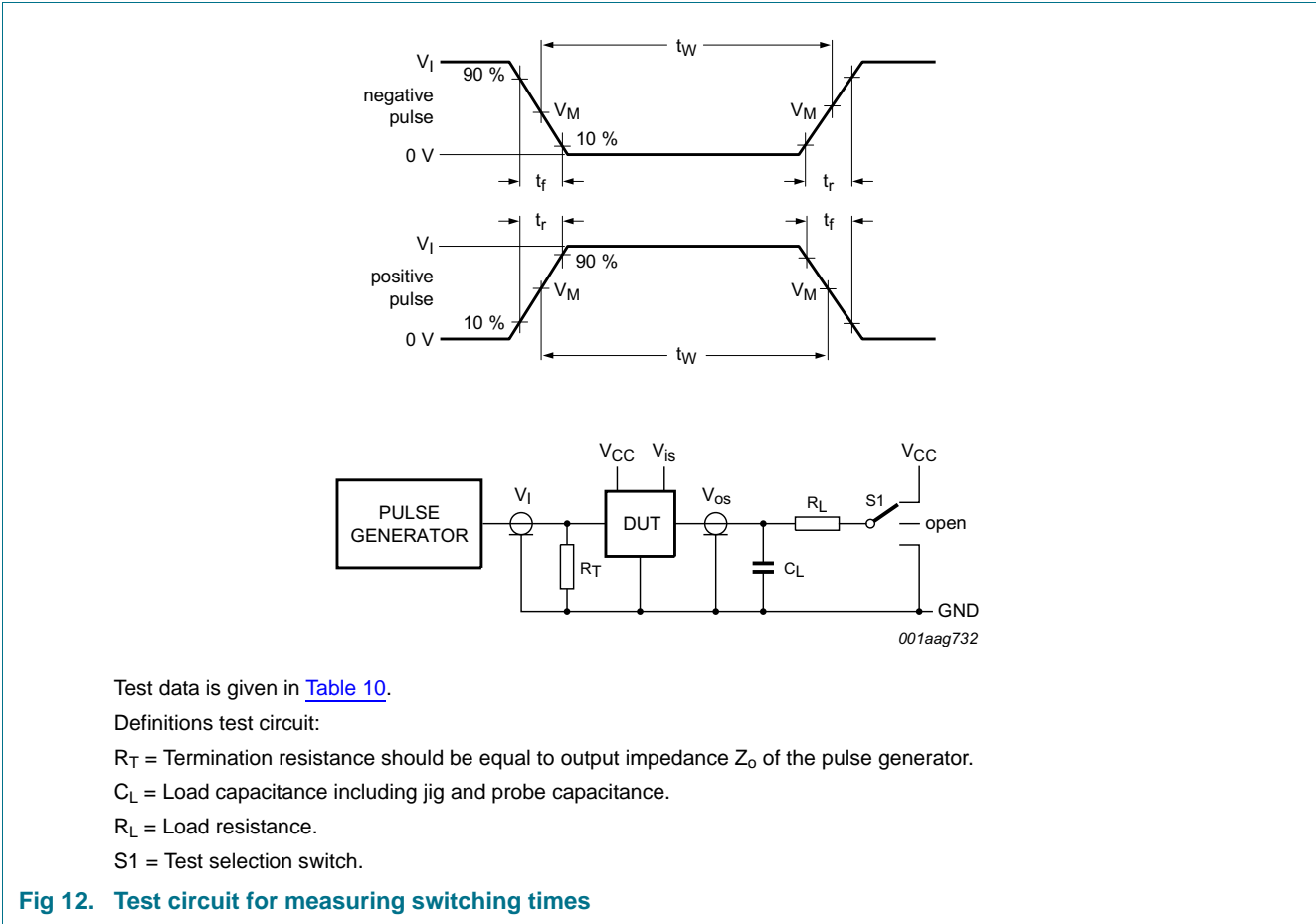


Table 10. Test data

| Test | Input | | | Output | | S1 position |
|--------------------|-----------------|-----------------|------------|----------------|--------------|-------------|
| | Control nE | Switch nY (nZ) | t_r, t_f | Switch nZ (nY) | | |
| | V_I | V_{is} | | C_L | R_L | |
| t_{PHL}, t_{PLH} | GND | GND to V_{CC} | 6 ns | 50 pF | - | open |
| t_{PHZ}, t_{PZH} | GND to V_{CC} | V_{CC} | 6 ns | 50 pF, 15 pF | 1 k Ω | GND |
| t_{PLZ}, t_{PZL} | GND to V_{CC} | GND | 6 ns | 50 pF, 15 pF | 1 k Ω | V_{CC} |

12. Additional dynamic characteristics

Table 11. Additional dynamic characteristics

Recommended conditions and typical values; $GND = 0\text{ V}$; $T_{amb} = 25\text{ }^\circ\text{C}$.
 V_{is} is the input voltage at a nY or nZ terminal, whichever is assigned as an input.
 V_{os} is the output voltage at a nY or nZ terminal, whichever is assigned as an output.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|----------------|---------------------------|---|-----|------|-----|------|
| THD | total harmonic distortion | $f_i = 1\text{ kHz}$; $R_L = 10\text{ k}\Omega$; $C_L = 50\text{ pF}$; see Figure 13 | | | | % |
| | | $V_{CC} = 4.5\text{ V}$; $V_I = 4.0\text{ V (p-p)}$ | - | 0.80 | - | % |
| | | $V_{CC} = 9.0\text{ V}$; $V_I = 8.0\text{ V (p-p)}$ | - | 0.40 | - | % |
| | | $f_i = 10\text{ kHz}$; $R_L = 10\text{ k}\Omega$; $C_L = 50\text{ pF}$; see Figure 13 | | | | |
| | | $V_{CC} = 4.5\text{ V}$; $V_I = 4.0\text{ V (p-p)}$ | - | 2.4 | - | % |
| | | $V_{CC} = 9.0\text{ V}$; $V_I = 8.0\text{ V (p-p)}$ | - | 1.2 | - | % |
| $f_{(-3dB)}$ | -3 dB frequency response | $R_L = 50\text{ }\Omega$; $C_L = 10\text{ pF}$; see Figure 14 [2] | | | | |
| | | $V_{CC} = 4.5\text{ V}$ | - | 150 | - | MHz |
| | | $V_{CC} = 9.0\text{ V}$ | - | 160 | - | MHz |
| α_{iso} | isolation (OFF-state) | $R_L = 600\text{ }\Omega$; $C_L = 50\text{ pF}$; $f_i = 1\text{ MHz}$; see Figure 15 [1] | | | | |
| | | $V_{CC} = 4.5\text{ V}$ | - | -50 | - | dB |
| | | $V_{CC} = 9.0\text{ V}$ | - | -50 | - | dB |
| V_{ct} | crosstalk voltage | between digital input and switch (peak to peak value); $R_L = 600\text{ }\Omega$; $C_L = 50\text{ pF}$; $f_i = 1\text{ MHz}$; see Figure 16 | | | | |
| | | $V_{CC} = 4.5\text{ V}$ | - | 110 | - | mV |
| | | $V_{CC} = 9.0\text{ V}$ | - | 220 | - | mV |
| Xtalk | crosstalk | between switches; $R_L = 600\text{ }\Omega$; $C_L = 50\text{ pF}$; $f_i = 1\text{ MHz}$; see Figure 17 [1] | | | | |
| | | $V_{CC} = 4.5\text{ V}$ | - | -60 | - | dB |
| | | $V_{CC} = 9.0\text{ V}$ | - | -60 | - | dB |

- [1] Adjust input voltage V_{is} to 0 dBm level (0 dBm = 1 mW into 600 Ω).
- [2] Adjust input voltage V_{is} to 0 dBm level at V_{os} for $f_i = 1\text{ MHz}$ (0 dBm = 1 mW into 50 Ω). After set-up, f_i is increased to obtain a reading of -3 dB at V_{os} .

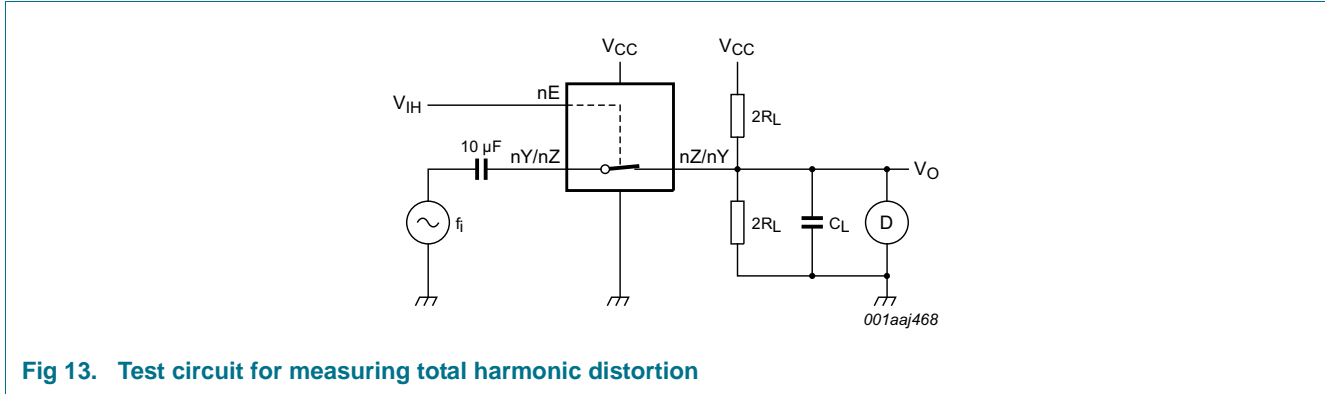
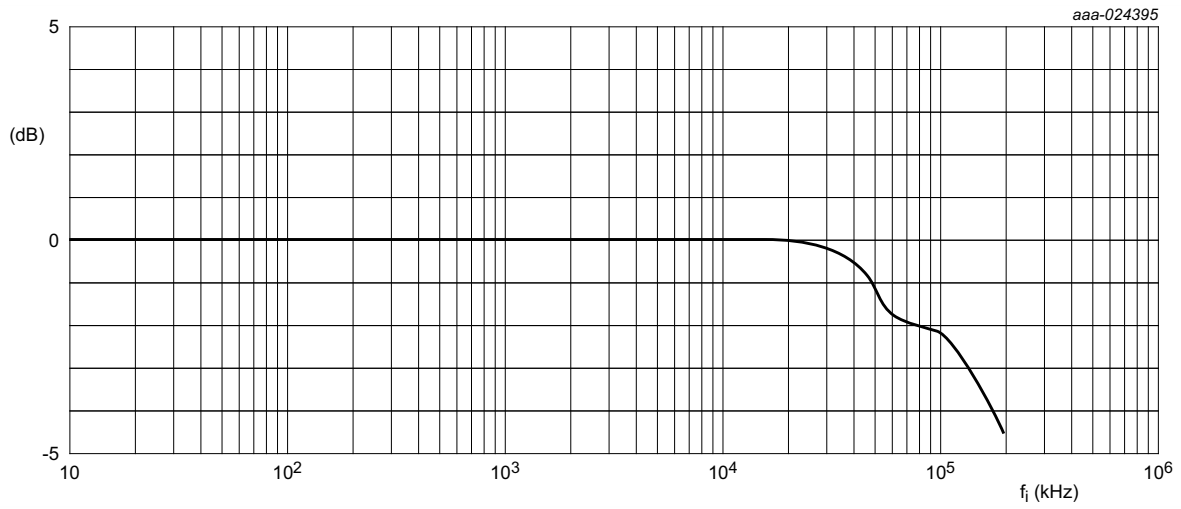
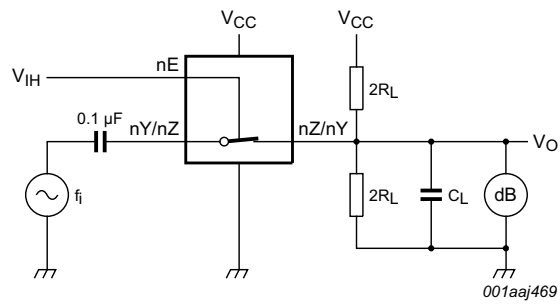


Fig 13. Test circuit for measuring total harmonic distortion



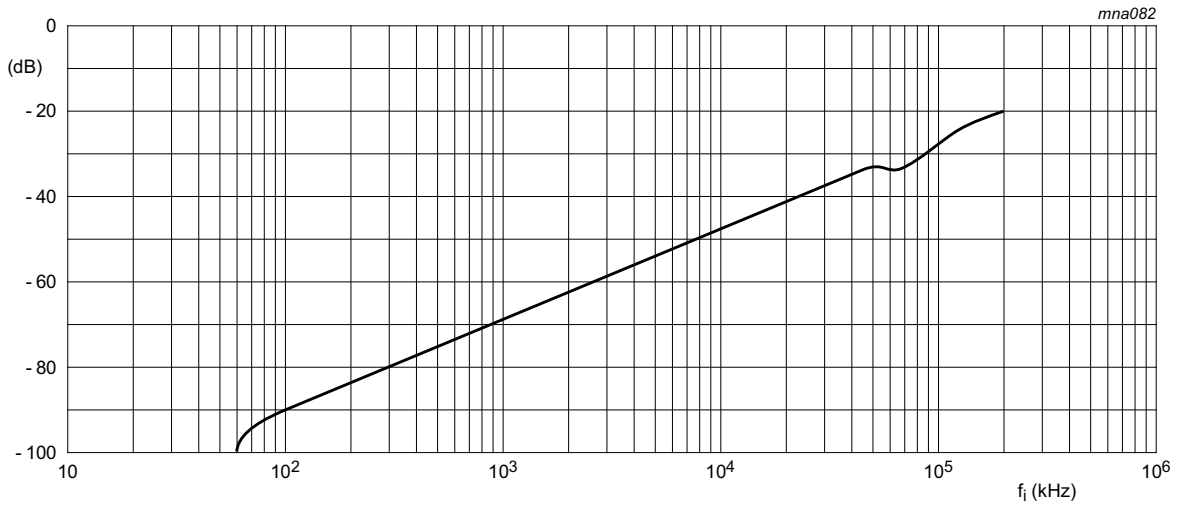
a. Typical -3 dB frequency response



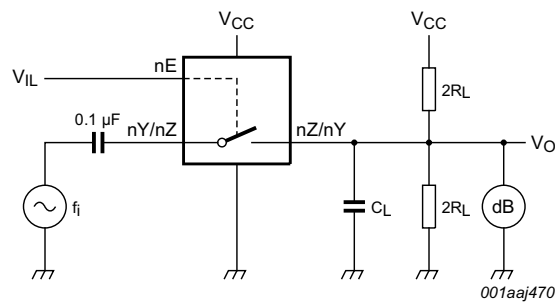
b. Test circuit

$V_{CC} = 4.5\text{ V}$; $GND = 0\text{ V}$; $R_L = 50\ \Omega$; $R_{source} = 1\text{ k}\Omega$.

Fig 14. -3 dB frequency response



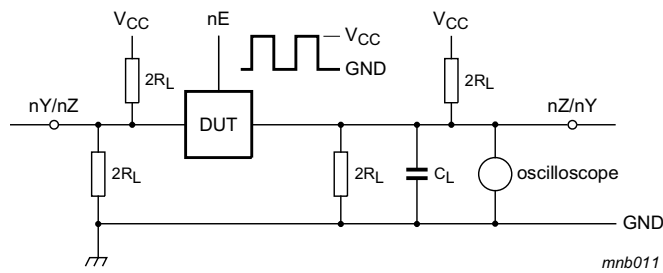
a. Isolation (OFF-state)



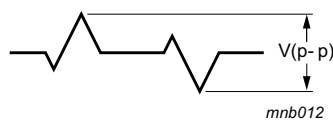
b. Test circuit

$V_{CC} = 4.5\text{ V}$; $GND = 0\text{ V}$; $R_L = 600\ \Omega$; $R_{source} = 1\text{ k}\Omega$.

Fig 15. Isolation (OFF-state) as a function of frequency



a. Circuit



b. Crosstalk voltage

Fig 16. Test circuit for measuring crosstalk voltage (between the digital input and the switch)

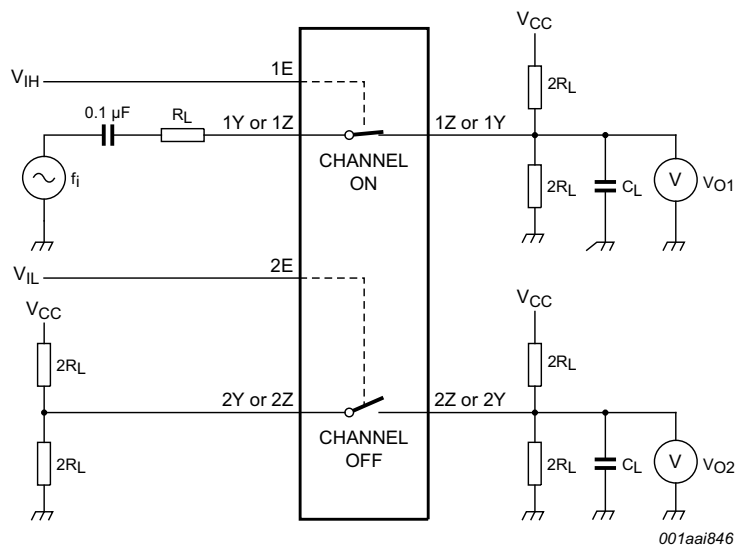


Fig 17. Test circuit for measuring crosstalk (between the switches)

13. Package outline

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1



Fig 18. Package outline SOT108-1 (SO14)

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1

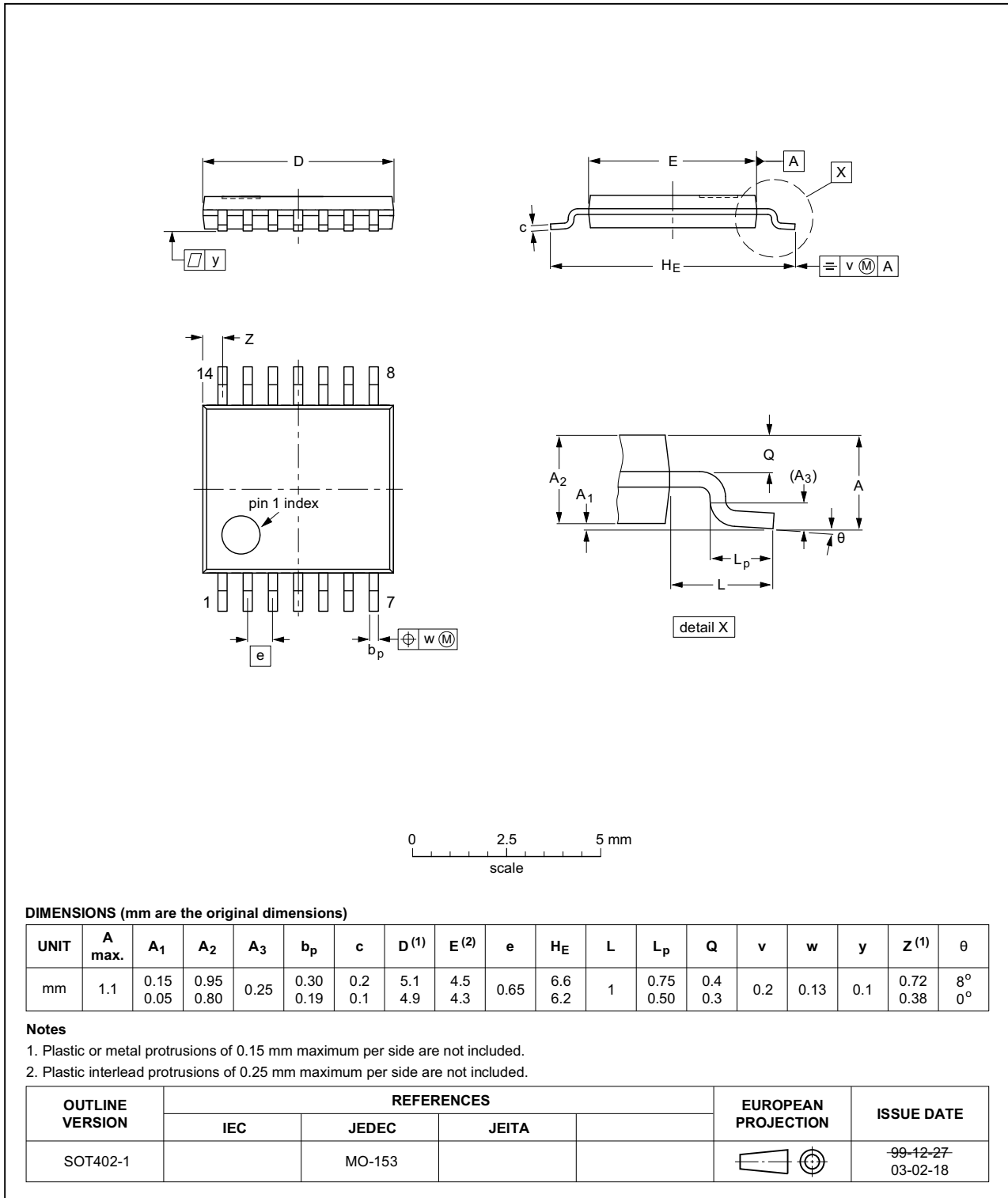


Fig 19. Package outline SOT402-1 (TSSOP14)

14. Abbreviations

Table 12. Abbreviations

| Acronym | Description |
|---------|---|
| CMOS | Complementary Metal-Oxide Semiconductor |
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| MM | Machine Model |

15. Revision history

Table 13. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------------|--|-----------------------|---------------|----------------------|
| 74HC4016 v.3 | 20161212 | Product data sheet | - | 74HC_HCT4016_CNV v.2 |
| Modifications: | • Type numbers 74HC4016N, 74HCT4016N and 74HCT4016D removed. | | | |
| 74HC_HCT4016_CNV v.2 | 19901201 | Product specification | - | - |

16. Legal information

16.1 Data sheet status

| Document status ^{[1][2]} | Product status ^[3] | Definition |
|-----------------------------------|-------------------------------|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification | This document contains data from the preliminary specification. |
| Product [short] data sheet | Production | This document contains the product specification. |

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nexperia.com>.

16.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Nexperia does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local Nexperia sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between Nexperia and its customer, unless Nexperia and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the Nexperia product is deemed to offer functions and qualities beyond those described in the Product data sheet.

16.3 Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, Nexperia does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. Nexperia takes no responsibility for the content in this document if provided by an information source outside of Nexperia.

In no event shall Nexperia be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, Nexperia's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the *Terms and conditions of commercial sale* of Nexperia.

Right to make changes — Nexperia reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — Nexperia products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of a Nexperia product can reasonably be expected to result in personal injury, death or severe property or environmental damage. Nexperia and its suppliers accept no liability for inclusion and/or use of Nexperia products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. Nexperia makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using Nexperia products, and Nexperia accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the Nexperia product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

Nexperia does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using Nexperia products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). Nexperia does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — Nexperia products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nexperia.com/profile/terms>, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. Nexperia hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of Nexperia products by customer.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Non-automotive qualified products — Unless this data sheet expressly states that this specific Nexperia product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. Nexperia accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without Nexperia's warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond

Nexperia's specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies Nexperia for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond Nexperia's standard warranty and Nexperia's product specifications.

Translations — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

16.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

17. Contact information

For more information, please visit: <http://www.nexperia.com>

For sales office addresses, please send an email to: salesaddresses@nexperia.com

18. Contents

| | | |
|-----------|---|-----------|
| 1 | General description | 1 |
| 2 | Features and benefits | 1 |
| 3 | Ordering information | 1 |
| 4 | Functional diagram | 2 |
| 5 | Pinning information | 3 |
| 5.1 | Pinning | 3 |
| 5.2 | Pin description | 3 |
| 6 | Functional description | 3 |
| 7 | Limiting values | 4 |
| 8 | Recommended operating conditions | 4 |
| 9 | Static characteristics | 5 |
| 10 | Dynamic characteristics | 9 |
| 11 | Waveforms | 10 |
| 12 | Additional dynamic characteristics | 12 |
| 13 | Package outline | 16 |
| 14 | Abbreviations | 18 |
| 15 | Revision history | 18 |
| 16 | Legal information | 19 |
| 16.1 | Data sheet status | 19 |
| 16.2 | Definitions | 19 |
| 16.3 | Disclaimers | 19 |
| 16.4 | Trademarks | 20 |
| 17 | Contact information | 20 |
| 18 | Contents | 21 |