

# 74HC4066-Q100; 74HCT4066-Q100

## Quad single-pole single-throw analog switch

Rev. 3 — 16 December 2013

Product data sheet

## 1. General description

---

The 74HC4066-Q100; 74HCT4066-Q100 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  $V_{CC}$ .

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

## 2. Features and benefits

---

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - ◆ Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$
- Input levels nE inputs:
  - ◆ For 74HC4066-Q100: CMOS level
  - ◆ For 74HCT4066-Q100: TTL level
- Low ON resistance:
  - ◆  $50\ \Omega$  (typical) at  $V_{CC} = 4.5\text{ V}$
  - ◆  $45\ \Omega$  (typical) at  $V_{CC} = 6.0\text{ V}$
  - ◆  $35\ \Omega$  (typical) at  $V_{CC} = 9.0\text{ V}$
- Specified in compliance with JEDEC standard no. 7A
- ESD protection:
  - ◆ MIL-STD-883, method 3015 exceeds 2000 V
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V ( $C = 200\text{ pF}$ ,  $R = 0\ \Omega$ )
- Multiple package options

## 3. Ordering information

Table 1. Ordering information

| Type number                         | Package           |          |  | Version  |
|-------------------------------------|-------------------|----------|--|----------|
|                                     | Temperature range | Name     | Description  |          |
| 74HC4066D-Q100<br>74HCT4066D-Q100   | -40 °C to +125 °C | SO14     | plastic small outline package; 14 leads; body width 3.9 mm   | SOT108-1 |
| 74HC4066PW-Q100<br>74HCT4066PW-Q100 | -40 °C to +125 °C | TSSOP14  | plastic thin shrink small outline package; 14 leads; body width 4.4 mm   | SOT402-1 |
| 74HC4066BQ-Q100<br>74HCT4066BQ-Q100 | -40 °C to +125 °C | DHVQFN14 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 × 3 × 0.85 mm | SOT762-1 |

## 4. Functional diagram

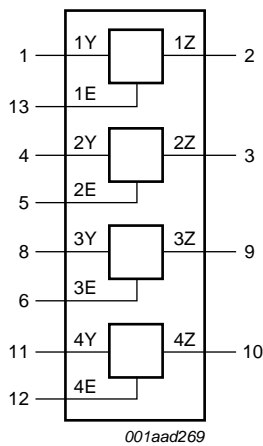


Fig 1. Logic symbol

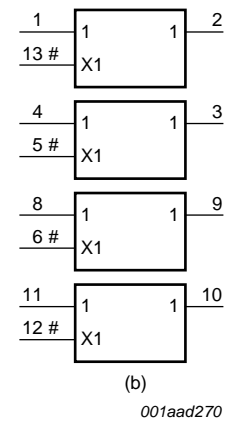
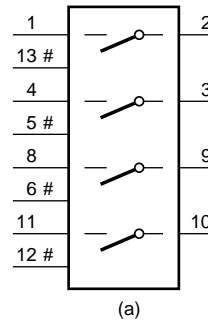


Fig 2. IEC logic symbol

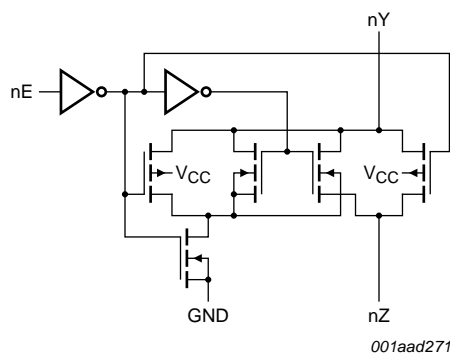
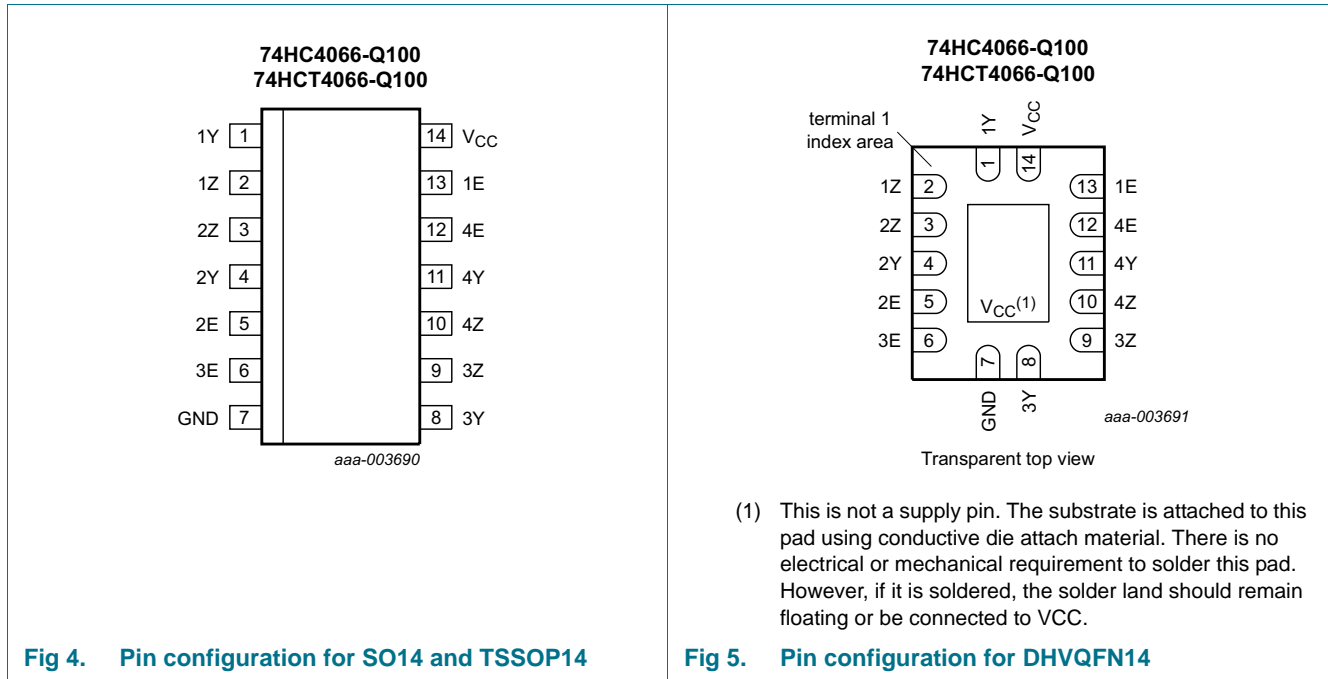


Fig 3. Schematic diagram (one switch)

## 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 <sub>CC</sub> | 14           | supply voltage              |

## 6. Functional description

Table 3. Function table<sup>[1]</sup>

| 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 $V_I > V_{CC} + 0.5\text{ V}$       | -                | $\pm 20$ | mA   |
| $I_{SK}$  | switch clamping current | $V_{SW} < -0.5\text{ V}$ or $V_{SW} > V_{CC} + 0.5\text{ V}$ | -                | $\pm 20$ | mA   |
| $I_{SW}$  | switch current          | $V_{SW} = -0.5\text{ V}$ to $V_{CC} + 0.5\text{ V}$          | <sup>[1]</sup> - | $\pm 25$ | 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 $+125\text{ °C}$                | <sup>[2]</sup>   | -        | 500  |
| P         | power dissipation       | per switch   | -                | 100      | mW   |

- [1] To avoid drawing  $V_{CC}$  current out of terminal Z, when switch current flows in terminals Yn, the voltage drop across the bidirectional switch must not exceed 0.4 V. If the switch current flows into terminal Z, no  $V_{CC}$  current will flow out of terminals Yn. In this case there is no limit for the voltage drop across the switch, but the voltages at Yn and Z may not exceed  $V_{CC}$  or GND.
- [2] For SO14 packages:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.  
For TSSOP14 packages:  $P_{tot}$  derates linearly with 5.5 mW/K above 60 °C.  
For DHVQFN14 packages:  $P_{tot}$  derates linearly with 4.5 mW/K above 60 °C.

## 8. Recommended operating conditions

Table 5. Recommended operating conditions

| Symbol              | Parameter                           | Conditions               | 74HC4066-Q100 |      |          | 74HCT4066-Q100 |      |          | Unit |
|---------------------|-------------------------------------|--------------------------|---------------|------|----------|----------------|------|----------|------|
|                     |                                     |                          | Min           | Typ  | Max      | Min            | Typ  | Max      |      |
| $V_{CC}$            | supply voltage                      |                          | 2.0           | 5.0  | 10.0     | 4.5            | 5.0  | 5.5      | V    |
| $V_I$               | input voltage                       |                          | GND           | -    | $V_{CC}$ | GND            | -    | $V_{CC}$ | V    |
| $V_{SW}$            | switch voltage                      |                          | GND           | -    | $V_{CC}$ | GND            | -    | $V_{CC}$ | V    |
| $T_{amb}$           | ambient temperature                 |                          | -40           | +25  | +125     | -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      | -              | 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 for types 74HC4066-Q100 and 74HCT4066-Q100

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

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

$V_{os}$  is the output voltage at a Yn or Z terminal, whichever is assigned as an output.

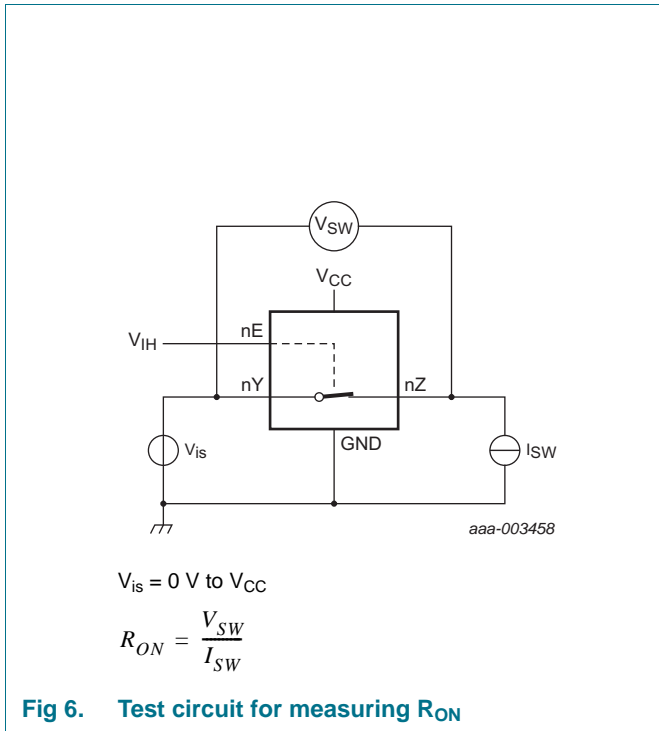
For 74HC4066-Q100:  $V_{CC} - GND = 2.0\text{ V}, 4.5\text{ V}, 6.0\text{ V}$  and  $9.0\text{ V}$ .

For 74HCT4066-Q100:  $V_{CC} - GND = 4.5\text{ V}$ .

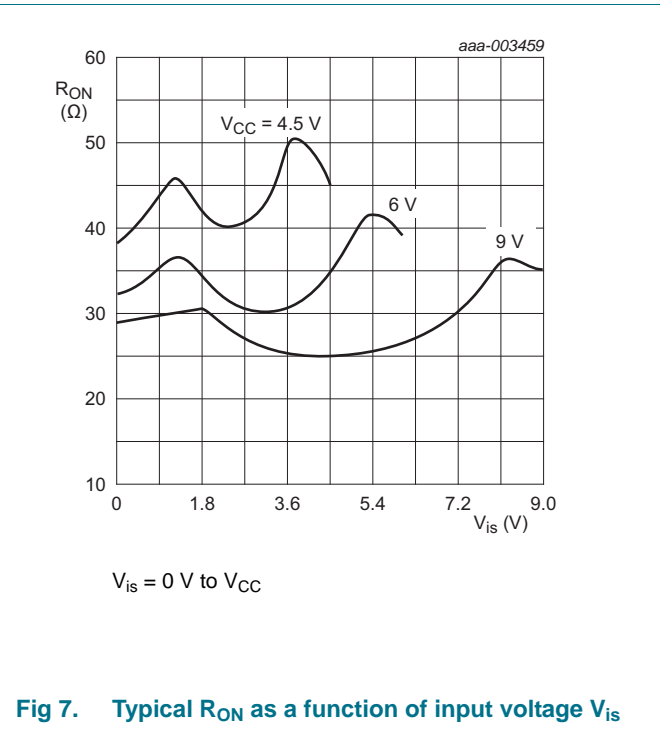
| Symbol                | Parameter                               | Conditions  | -40 °C to +85 °C |                    |     | -40 °C to +125 °C |     | Unit     |
|-----------------------|---|---|------------------|--------------------|-----|-------------------|-----|----------|
|                       |   |   | Min              | Typ <sup>[1]</sup> | Max | Min               | Max |          |
| $R_{ON(\text{peak})}$ | ON resistance (peak)                    | $V_{is} = V_{CC}$ to GND  |                  |                    |     |                   |     |          |
|                       |   | $V_{CC} = 2.0\text{ V}; I_{SW} = 100\ \mu\text{A}$ <sup>[2]</sup> | -                | -                  | -   | -                 | -   | $\Omega$ |
|                       |   | $V_{CC} = 4.5\text{ V}; I_{SW} = 1000\ \mu\text{A}$               | -                | 54                 | -   | 118               | 142 | $\Omega$ |
|                       |   | $V_{CC} = 6.0\text{ V}; I_{SW} = 1000\ \mu\text{A}$               | -                | 42                 | -   | 105               | 126 | $\Omega$ |
|                       |   | $V_{CC} = 9.0\text{ V}; I_{SW} = 1000\ \mu\text{A}$               | -                | 32                 | -   | 88                | 105 | $\Omega$ |
| $R_{ON(\text{rail})}$ | ON resistance (rail)                    | $V_{is} = GND$  |                  |                    |     |                   |     |          |
|                       |   | $V_{CC} = 2.0\text{ V}; I_{SW} = 100\ \mu\text{A}$ <sup>[2]</sup> | -                | 80                 | -   | -                 | -   | $\Omega$ |
|                       |   | $V_{CC} = 4.5\text{ V}; I_{SW} = 1000\ \mu\text{A}$               | -                | 35                 | -   | 95                | 115 | $\Omega$ |
|                       |   | $V_{CC} = 6.0\text{ V}; I_{SW} = 1000\ \mu\text{A}$               | -                | 27                 | -   | 82                | 100 | $\Omega$ |
|                       |   | $V_{CC} = 9.0\text{ V}; I_{SW} = 1000\ \mu\text{A}$               | -                | 20                 | -   | 70                | 85  | $\Omega$ |
|                       |   | $V_{is} = V_{CC}$   |                  |                    |     |                   |     |          |
|                       |   | $V_{CC} = 2.0\text{ V}; I_{SW} = 100\ \mu\text{A}$ <sup>[2]</sup> | -                | 100                | -   | -                 | -   | $\Omega$ |
|                       |   | $V_{CC} = 4.5\text{ V}; I_{SW} = 1000\ \mu\text{A}$               | -                | 42                 | -   | 106               | 128 | $\Omega$ |
|                       |   | $V_{CC} = 6.0\text{ V}; I_{SW} = 1000\ \mu\text{A}$               | -                | 35                 | -   | 94                | 113 | $\Omega$ |
|                       |   | $V_{CC} = 9.0\text{ V}; I_{SW} = 1000\ \mu\text{A}$               | -                | 20                 | -   | 78                | 95  | $\Omega$ |
| $\Delta R_{ON}$       | ON resistance mismatch between channels | $V_{is} = V_{CC}$ to GND  |                  |                    |     |                   |     |          |
|                       |   | $V_{CC} = 2.0\text{ V}$ <sup>[2]</sup>                            | -                | -                  | -   | -                 | -   | $\Omega$ |
|                       |   | $V_{CC} = 4.5\text{ V}$   | -                | 5                  | -   | -                 | -   | $\Omega$ |
|                       |   | $V_{CC} = 6.0\text{ V}$   | -                | 4                  | -   | -                 | -   | $\Omega$ |
|                       |   | $V_{CC} = 9.0\text{ V}$   | -                | 3                  | -   | -                 | -   | $\Omega$ |

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

[2] 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.



**Fig 6. Test circuit for measuring  $R_{ON}$**



**Fig 7. Typical  $R_{ON}$  as a function of input voltage  $V_{is}$**

**Table 7. Static characteristics 74HC4066-Q100**

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

| Symbol  | Parameter                 | Conditions  | Min  | Typ <sup>U</sup> | Max       | Unit    |
|---|---------------------------|---|------|------------------|-----------|---------|
| $T_{amb} = -40 \text{ °C to } +85 \text{ °C}$ |                           |   |      |                  |           |         |
| $V_{IH}$                                      | 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  | 4.7              | -         | 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     | $V_I = V_{CC} \text{ or } GND$  |      |                  |           |         |
|   |                           | $V_{CC} = 6.0 \text{ V}$  | -    | -                | $\pm 1.0$ | $\mu A$ |
|   |                           | $V_{CC} = 10.0 \text{ V}$   | -    | -                | $\pm 2.0$ | $\mu A$ |
| $I_{S(OFF)}$                                  | OFF-state leakage current | $V_{CC} = 10.0 \text{ V}; V_I = V_{IH} \text{ or } V_{IL};$<br>$ V_{SW}  = V_{CC} - GND$ ; see <a href="#">Figure 8</a> |      |                  |           |         |
|   |                           | per channel   | -    | -                | $\pm 1.0$ | $\mu A$ |
| $I_{S(ON)}$                                   | ON-state leakage current  | $V_{CC} = 10.0 \text{ V}; V_I = V_{IH} \text{ or } V_{IL};$<br>$ V_{SW}  = V_{CC} - GND$ ; see <a href="#">Figure 9</a> |      |                  | $\pm 1.0$ | $\mu A$ |

**Table 7.** Static characteristics 74HC4066-Q100 ...continued

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

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

$V_{os}$  is the output voltage at a Yn or Z terminal, whichever is assigned as an output.

| Symbol   | Parameter                 | Conditions   | Min  | Typ <sup>[1]</sup> | Max       | Unit    |
|--|---------------------------|--|------|--------------------|-----------|---------|
| $I_{CC}$   | supply current            | $V_I = V_{CC}$ or GND; $V_{is} =$ GND or $V_{CC}$ ;<br>$V_{os} = V_{CC}$ or GND                                    |      |                    |           |         |
|  |                           | $V_{CC} = 6.0$ V   | -    | -                  | 20.0      | $\mu$ A |
|  |                           | $V_{CC} = 10.0$ V  | -    | -                  | 40.0      | $\mu$ A |
| $C_I$  | input capacitance         |  | -    | 3.5                | -         | pF      |
| $C_{SW}$   | switch capacitance        |  | -    | 8                  | -         | pF      |
| <b><math>T_{amb} = -40</math> °C to <math>+125</math> °C</b> |                           |  |      |                    |           |         |
| $V_{IH}$   | 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   | -    | -                  | $\pm 1.0$ | $\mu$ A |
|  |                           | $V_{CC} = 10.0$ V  | -    | -                  | $\pm 2.0$ | $\mu$ A |
| $I_{S(OFF)}$   | OFF-state leakage current | $V_{CC} = 10.0$ V; $V_I = V_{IH}$ or $V_{IL}$ ;<br>$ V_{SW}  = V_{CC} - \text{GND}$ ; see <a href="#">Figure 8</a> |      |                    |           |         |
|  |                           | per channel  | -    | -                  | $\pm 1.0$ | $\mu$ A |
| $I_{S(ON)}$  | ON-state leakage current  | $V_{CC} = 10.0$ V; $V_I = V_{IH}$ or $V_{IL}$ ;<br>$ V_{SW}  = V_{CC} - \text{GND}$ ; see <a href="#">Figure 9</a> | -    | -                  | $\pm 1.0$ | $\mu$ A |
| $I_{CC}$   | supply current            | $V_I = V_{CC}$ or GND; $V_{is} =$ GND or $V_{CC}$ ;<br>$V_{os} = V_{CC}$ or GND                                    |      |                    |           |         |
|  |                           | $V_{CC} = 6.0$ V   | -    | -                  | 40        | $\mu$ A |
|  |                           | $V_{CC} = 10.0$ V  | -    | -                  | 80        | $\mu$ A |

[1] Typical values are measured at  $T_{amb} = 25$  °C.

**Table 8.** Static characteristics 74HCT4066-Q100

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

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

$V_{os}$  is the output voltage at a Yn or Z terminal, whichever is assigned as an output.

| Symbol  | Parameter                | Conditions                              | Min | Typ <sup>[1]</sup> | Max       | Unit    |
|---|--------------------------|---|-----|--------------------|-----------|---------|
| <b><math>T_{amb} = -40</math> °C to <math>+85</math> °C</b> |                          |   |     |                    |           |         |
| $V_{IH}$  | HIGH-level input voltage | $V_{CC} = 4.5$ V to $5.5$ V             | 2.0 | 1.6                | -         | V       |
| $V_{IL}$  | LOW-level input voltage  | $V_{CC} = 4.5$ V to $5.5$ V             | -   | 1.2                | 0.8       | V       |
| $I_I$   | input leakage current    | $V_I = V_{CC}$ or GND; $V_{CC} = 5.5$ V | -   | -                  | $\pm 1.0$ | $\mu$ A |

**Table 8. Static characteristics 74HCT4066-Q100 ...continued**

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

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

$V_{os}$  is the output voltage at a Yn or Z terminal, whichever is assigned as an output.

| Symbol   | Parameter                 | Conditions   | Min | Typ <sup>[1]</sup> | Max       | Unit          |
|--|---------------------------|--|-----|--------------------|-----------|---------------|
| $I_{S(OFF)}$   | OFF-state leakage current | $V_{CC} = 5.5\text{ V}$ ; $V_I = V_{IH}$ or $V_{IL}$ ;<br>$ V_{SW}  = V_{CC} - \text{GND}$ ; see <a href="#">Figure 8</a><br>per channel | -   | -                  | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{S(ON)}$  | ON-state leakage current  | $V_{CC} = 5.5\text{ V}$ ; $V_I = V_{IH}$ or $V_{IL}$ ;<br>$ V_{SW}  = V_{CC} - \text{GND}$ ; see <a href="#">Figure 9</a>                | -   | -                  | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{CC}$   | supply current            | $V_I = V_{CC}$ or GND; $V_{is} = \text{GND}$ or $V_{CC}$ ;<br>$V_{os} = V_{CC}$ or GND; $V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$        | -   | -                  | 20.0      | $\mu\text{A}$ |
| $\Delta I_{CC}$  | additional supply current | per input pin; $V_I = V_{CC} - 2.1\text{ V}$ ; other inputs<br>at $V_{CC}$ or GND; $V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$             | -   | 100                | 450       | $\mu\text{A}$ |
| $C_I$  | input capacitance         |  | -   | 3.5                | -         | pF            |
| $C_{sw}$   | switch capacitance        |  | -   | 8                  | -         | pF            |
| <b><math>T_{amb} = -40\text{ }^\circ\text{C}</math> to <math>+125\text{ }^\circ\text{C}</math></b> |                           |  |     |                    |           |               |
| $V_{IH}$   | HIGH-level input voltage  | $V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$  | 2.0 | -                  | -         | V             |
| $V_{IL}$   | LOW-level input voltage   | $V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$  | -   | -                  | 0.8       | V             |
| $I_I$  | input leakage current     | $V_I = V_{CC}$ or GND; $V_{CC} = 5.5\text{ V}$   | -   | -                  | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{S(OFF)}$   | OFF-state leakage current | $V_{CC} = 5.5\text{ V}$ ; $V_I = V_{IH}$ or $V_{IL}$ ;<br>$ V_{SW}  = V_{CC} - \text{GND}$ ; see <a href="#">Figure 8</a><br>per channel | -   | -                  | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{S(ON)}$  | ON-state leakage current  | $V_{CC} = 5.5\text{ V}$ ; $V_I = V_{IH}$ or $V_{IL}$ ;<br>$ V_{SW}  = V_{CC} - \text{GND}$ ; see <a href="#">Figure 9</a>                | -   | -                  | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{CC}$   | supply current            | $V_I = V_{CC}$ or GND; $V_{is} = \text{GND}$ or $V_{CC}$ ;<br>$V_{os} = V_{CC}$ or GND; $V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$        | -   | -                  | 40        | $\mu\text{A}$ |
| $\Delta I_{CC}$  | additional supply current | per input pin; $V_I = V_{CC} - 2.1\text{ V}$ ; other inputs<br>at $V_{CC}$ or GND; $V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$             | -   | -                  | 490       | $\mu\text{A}$ |

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

$V_{is} = V_{CC}$  and  $V_{os} = \text{GND}$   
 $V_{is} = \text{GND}$  and  $V_{os} = V_{CC}$

**Fig 8. Test circuit for measuring OFF-state leakage current**

$V_{is} = V_{CC}$  and  $V_{os} = \text{open}$   
 $V_{is} = \text{GND}$  and  $V_{os} = \text{open}$

**Fig 9. Test circuit for measuring ON-state leakage current**



## 10. Dynamic characteristics

**Table 9. Dynamic characteristics 74HC4066-Q100**

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

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

$V_{os}$  is the output voltage at a Yn or Z terminal, whichever is assigned as an output.

| Symbol    | Parameter                     | Conditions  | −40 °C to +85 °C |                    |     | −40 °C to +125 °C |     | Unit |
|-----------|-------------------------------|---|------------------|--------------------|-----|-------------------|-----|------|
|           |                               |   | Min              | Typ <sup>[1]</sup> | Max | Min               | Max |      |
| $t_{pd}$  | propagation delay             | nY to nZ or nZ to nY; $R_L = \infty\ \Omega$ ; see <a href="#">Figure 10</a> <sup>[2]</sup> |                  |                    |     |                   |     |      |
|           |                               | $V_{CC} = 2.0\text{ V}$   | -                | 8                  | 75  | -                 | 90  | ns   |
|           |                               | $V_{CC} = 4.5\text{ V}$   | -                | 3                  | 15  | -                 | 18  | ns   |
|           |                               | $V_{CC} = 6.0\text{ V}$   | -                | 2                  | 13  | -                 | 15  | ns   |
|           |                               | $V_{CC} = 9.0\text{ V}$   | -                | 2                  | 10  | -                 | 12  | ns   |
| $t_{off}$ | turn-off time                 | nE to nY or nZ; see <a href="#">Figure 11</a> <sup>[4]</sup>                                |                  |                    |     |                   |     |      |
|           |                               | $V_{CC} = 2.0\text{ V}$   | -                | 44                 | 190 | -                 | 225 | ns   |
|           |                               | $V_{CC} = 4.5\text{ V}$   | -                | 16                 | 38  | -                 | 45  | ns   |
|           |                               | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$  | -                | 13                 | -   | -                 | -   | ns   |
|           |                               | $V_{CC} = 6.0\text{ V}$   | -                | 13                 | 33  | -                 | 38  | ns   |
| $t_{on}$  | turn-on time                  | nE to nY or nZ; see <a href="#">Figure 11</a> <sup>[3]</sup>                                |                  |                    |     |                   |     |      |
|           |                               | $V_{CC} = 2.0\text{ V}$   | -                | 36                 | 125 | -                 | 150 | ns   |
|           |                               | $V_{CC} = 4.5\text{ V}$   | -                | 13                 | 25  | -                 | 30  | ns   |
|           |                               | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$  | -                | 11                 | -   | -                 | -   | ns   |
|           |                               | $V_{CC} = 6.0\text{ V}$   | -                | 10                 | 21  | -                 | 26  | ns   |
| $C_{PD}$  | power dissipation capacitance | per switch; $V_I = GND$ to $V_{CC}$ <sup>[5]</sup>  | 11               |                    | -   | -                 | -   | pF   |

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

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

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

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

[5]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

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

$f_i$  = 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.

**Table 10. Dynamic characteristics 74HCT4066-Q100**

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

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

$V_{os}$  is the output voltage at a Yn or Z terminal, whichever is assigned as an output.

| Symbol    | Parameter                     | Conditions  | -40 °C to +85 °C |                    |     | -40 °C to +125 °C |     | Unit |
|-----------|-------------------------------|---|------------------|--------------------|-----|-------------------|-----|------|
|           |                               |   | Min              | Typ <sup>[1]</sup> | Max | Min               | Max |      |
| $t_{pd}$  | propagation delay             | nY to nZ or nZ to nY; $R_L = \infty\ \Omega$ ; see <a href="#">Figure 10</a> <sup>[2]</sup> |                  |                    |     |                   |     |      |
|           |                               | $V_{CC} = 4.5\text{ V}$   | -                | 3                  | 15  | -                 | 18  | ns   |
| $t_{off}$ | turn-off time                 | nE to nY or nZ; see <a href="#">Figure 11</a> <sup>[4]</sup>                                |                  |                    |     |                   |     |      |
|           |                               | $V_{CC} = 4.5\text{ V}$   | -                | 20                 | 44  | -                 | 53  | ns   |
|           |                               | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$  | -                | 16                 | -   | -                 | -   | ns   |
| $t_{on}$  | turn-on time                  | nE to nY or nZ; see <a href="#">Figure 11</a> <sup>[3]</sup>                                |                  |                    |     |                   |     |      |
|           |                               | $V_{CC} = 4.5\text{ V}$   | -                | 12                 | 30  | -                 | 36  | ns   |
|           |                               | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$  | -                | 12                 | -   | -                 | -   | ns   |
| $C_{PD}$  | power dissipation capacitance | per switch; $V_I = GND$ to $(V_{CC} - 1.5\text{ V})$ <sup>[5]</sup>                         | -                | 12                 | -   | -                 | -   | pF   |

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

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

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

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

[5]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

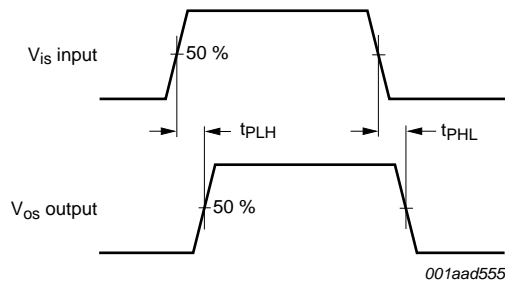
$\sum\{(C_L + C_{sw}) \times V_{CC}^2 \times f_o\}$  = sum of outputs;

$C_L$  = output load capacitance in pF;

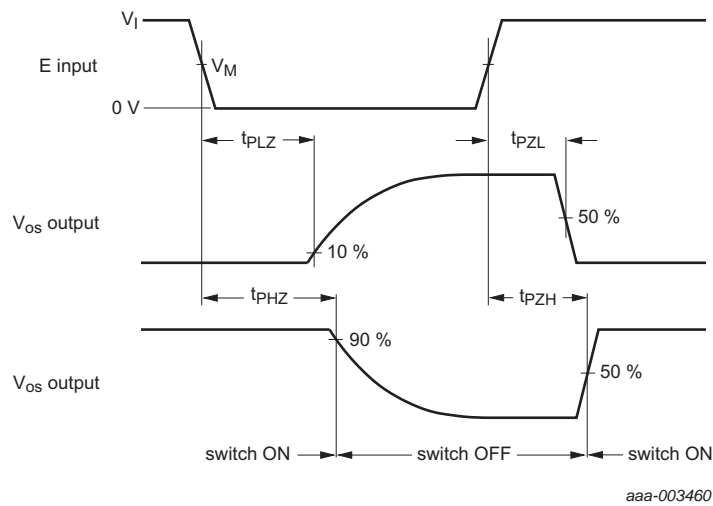
$C_{sw}$  = switch capacitance in pF;

$V_{CC}$  = supply voltage in V.

## 11. Waveforms



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

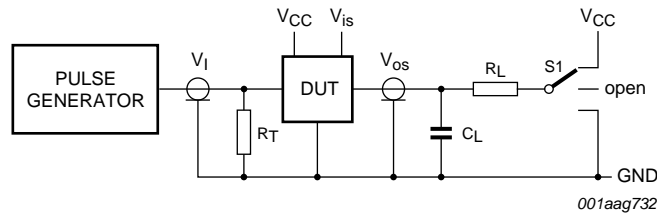
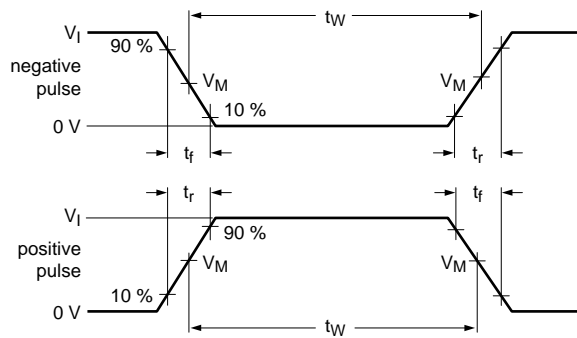


Measurement points are shown in [Table 11](#).

**Fig 11.** Turn-on and turn-off times

**Table 11.** Measurement points

| Type           | $V_I$    | $V_M$       |
|----------------|----------|-------------|
| 74HC4066-Q100  | $V_{CC}$ | $0.5V_{CC}$ |
| 74HCT4066-Q100 | 3.0 V    | 1.3 V       |



Test data is given in [Table 12](#).

Definitions test circuit:

$R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator.

$C_L$  = Load capacitance including jig and probe capacitance.

$R_L$  = Load resistor.

S1 = Test selection switch.

**Fig 12. Load circuitry for measuring switching times**

**Table 12. Test data**

| Test               | Input                |                 |            | Output        |              | S1 position |
|--------------------|----------------------|-----------------|------------|---------------|--------------|-------------|
|                    | Control E            | Switch Yn (Z)   | $t_r, t_f$ | Switch Z (Yn) |              |             |
|                    | $V_I$ <sup>[1]</sup> | $V_{is}$        |            | $C_L$         | $R_L$        |             |
| $t_{PHL}, t_{PLH}$ | 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 $\Omega$ | GND         |
| $t_{PLZ}, t_{PZL}$ | GND to $V_{CC}$      | GND             | 6 ns       | 50 pF, 15 pF  | 1 k $\Omega$ | $V_{CC}$    |

[1] For 74HCT4066-Q100: maximum input voltage  $V_I = 3.0$  V.

## 12. Additional dynamic characteristics

**Table 13. Additional dynamic characteristics**

Recommended conditions and typical values;  $GND = 0\text{ V}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .

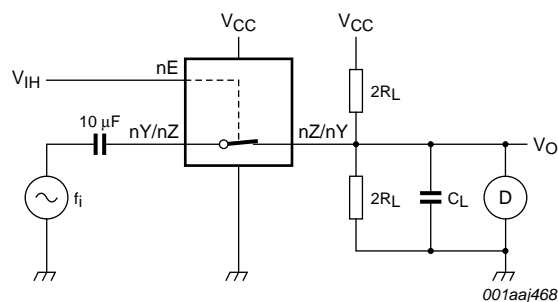
$V_{is}$  is the input voltage at a Yn or Z terminal, whichever is assigned as an input.

$V_{os}$  is the output voltage at a Yn or Z terminal, whichever is assigned as an output.

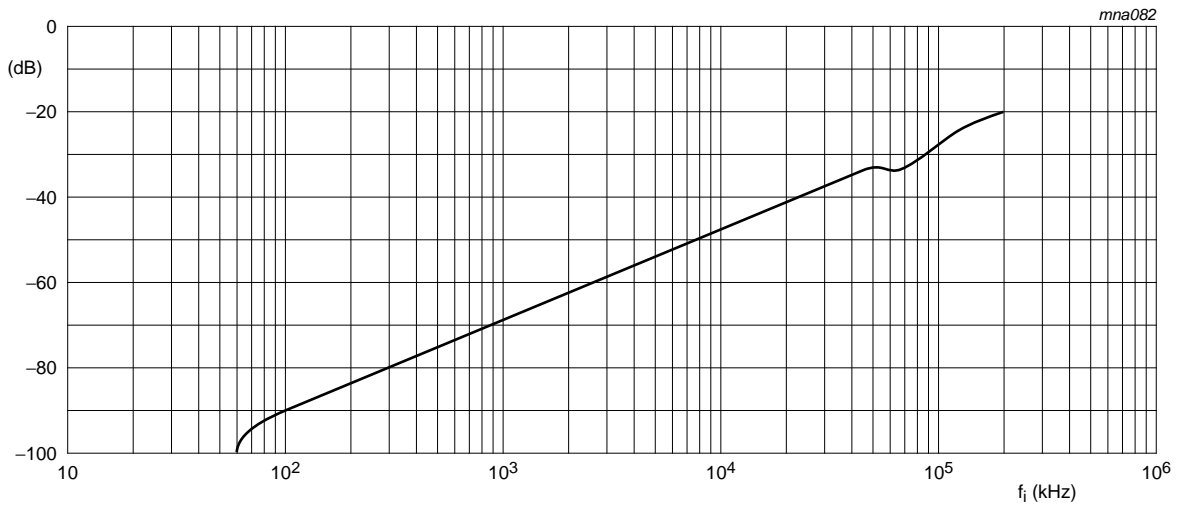
| Symbol         | Parameter                 | Conditions   | Min                 | Typ  | Max | Unit |
|----------------|---------------------------|--|---------------------|------|-----|------|
| THD            | total harmonic distortion | $f_i = 1\text{ kHz}$ ; $R_L = 10\text{ k}\Omega$ ; $C_L = 50\text{ pF}$ ;<br>see <a href="#">Figure 13</a>   |                     |      |     | %    |
|                |                           | $V_{CC} = 4.5\text{ V}$ ; $V_I = 4.0\text{ V (p-p)}$   | -                   | 0.04 | -   | %    |
|                |                           | $V_{CC} = 9.0\text{ V}$ ; $V_I = 8.0\text{ V (p-p)}$   | -                   | 0.02 | -   | %    |
|                |                           | $f_i = 10\text{ kHz}$ ; $R_L = 10\text{ k}\Omega$ ; $C_L = 50\text{ pF}$ ;<br>see <a href="#">Figure 13</a>  |                     |      |     |      |
|                |                           | $V_{CC} = 4.5\text{ V}$ ; $V_I = 4.0\text{ V (p-p)}$   | -                   | 0.12 | -   | %    |
|                |                           | $V_{CC} = 9.0\text{ V}$ ; $V_I = 8.0\text{ V (p-p)}$   | -                   | 0.06 | -   | %    |
| $f_{(-3dB)}$   | -3 dB frequency response  | $R_L = 50\text{ }\Omega$ ; $C_L = 10\text{ pF}$ ; see <a href="#">Figure 15</a>  | <a href="#">[2]</a> |      |     |      |
|                |                           | $V_{CC} = 4.5\text{ V}$  | -                   | 180  | -   | MHz  |
|                |                           | $V_{CC} = 9.0\text{ V}$  | -                   | 200  | -   | MHz  |
| $\alpha_{iso}$ | isolation (OFF-state)     | $R_L = 600\text{ }\Omega$ ; $C_L = 50\text{ pF}$ ; $f_i = 1\text{ MHz}$ ;<br>see <a href="#">Figure 14</a>   | <a href="#">[1]</a> |      |     |      |
|                |                           | $V_{CC} = 4.5\text{ V}$  | -                   | -50  | -   | dB   |
|                |                           | $V_{CC} = 9.0\text{ V}$  | -                   | -50  | -   | dB   |
| $V_{ct}$       | crosstalk voltage         | between digital input and switch (peak to<br>peak value); $R_L = 600\text{ }\Omega$ ; $C_L = 50\text{ pF}$ ;<br>$f_i = 1\text{ MHz}$ ; see <a href="#">Figure 16</a> |                     |      |     |      |
|                |                           | $V_{CC} = 4.5\text{ V}$  | -                   | 110  | -   | mV   |
|                |                           | $V_{CC} = 9.0\text{ V}$  | -                   | 220  | -   | mV   |
| Xtalk          | crosstalk                 | between switches; $R_L = 600\text{ }\Omega$ ; $C_L = 50\text{ pF}$ ;<br>$f_i = 1\text{ MHz}$ ; see <a href="#">Figure 17</a>   | <a href="#">[1]</a> |      |     |      |
|                |                           | $V_{CC} = 4.5\text{ V}$  | -                   | -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  $\Omega$ ).

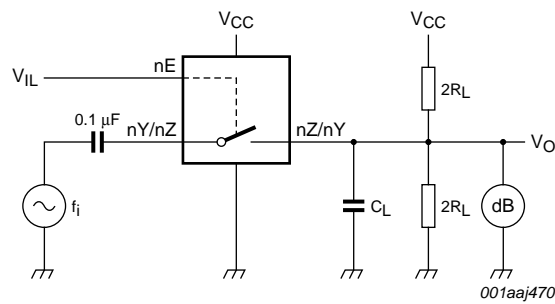
[2] Adjust input voltage  $V_{is}$  to 0 dBm level at  $V_{os}$  for  $f_i = 1\text{ MHz}$  (0 dBm = 1 mW into 50  $\Omega$ ). After set-up,  $f_i$  is increased to obtain a reading of -3 dB at  $V_{os}$ .



**Fig 13. Test circuit for measuring total harmonic distortion**



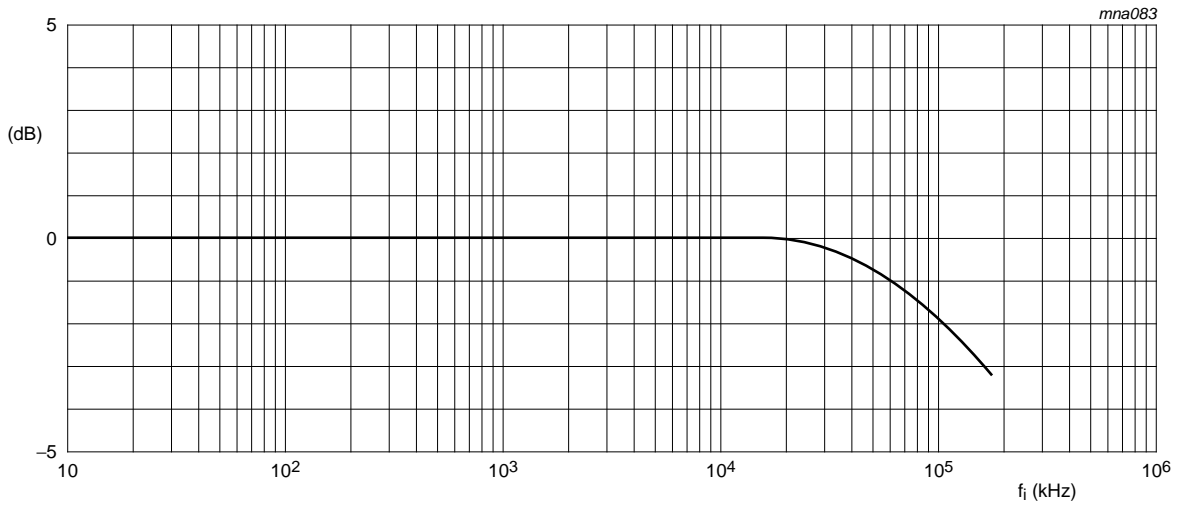
a. Isolation (OFF-state)



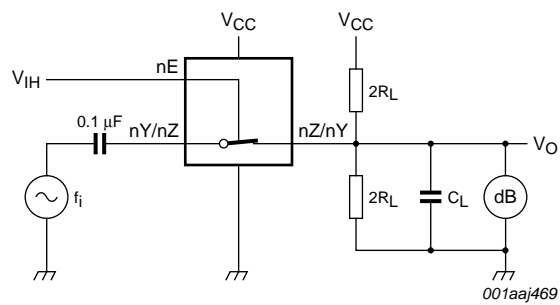
b. Test circuit

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

**Fig 14. Isolation (OFF-state) as a function of frequency**



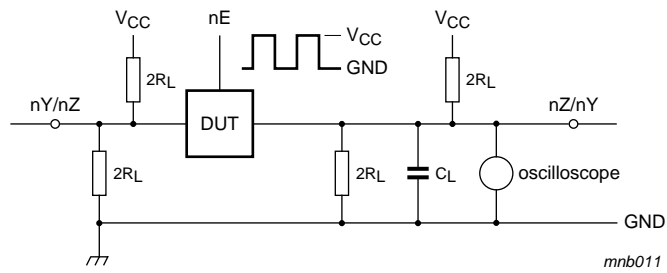
a. Typical -3 dB frequency response



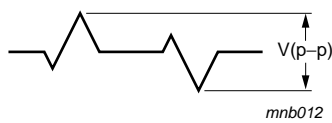
b. Test circuit

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

**Fig 15. -3 dB frequency response**

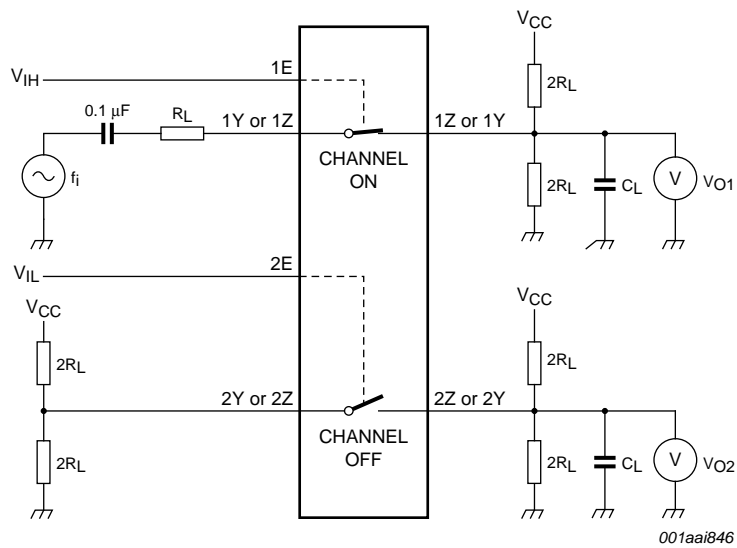


a. Circuit



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

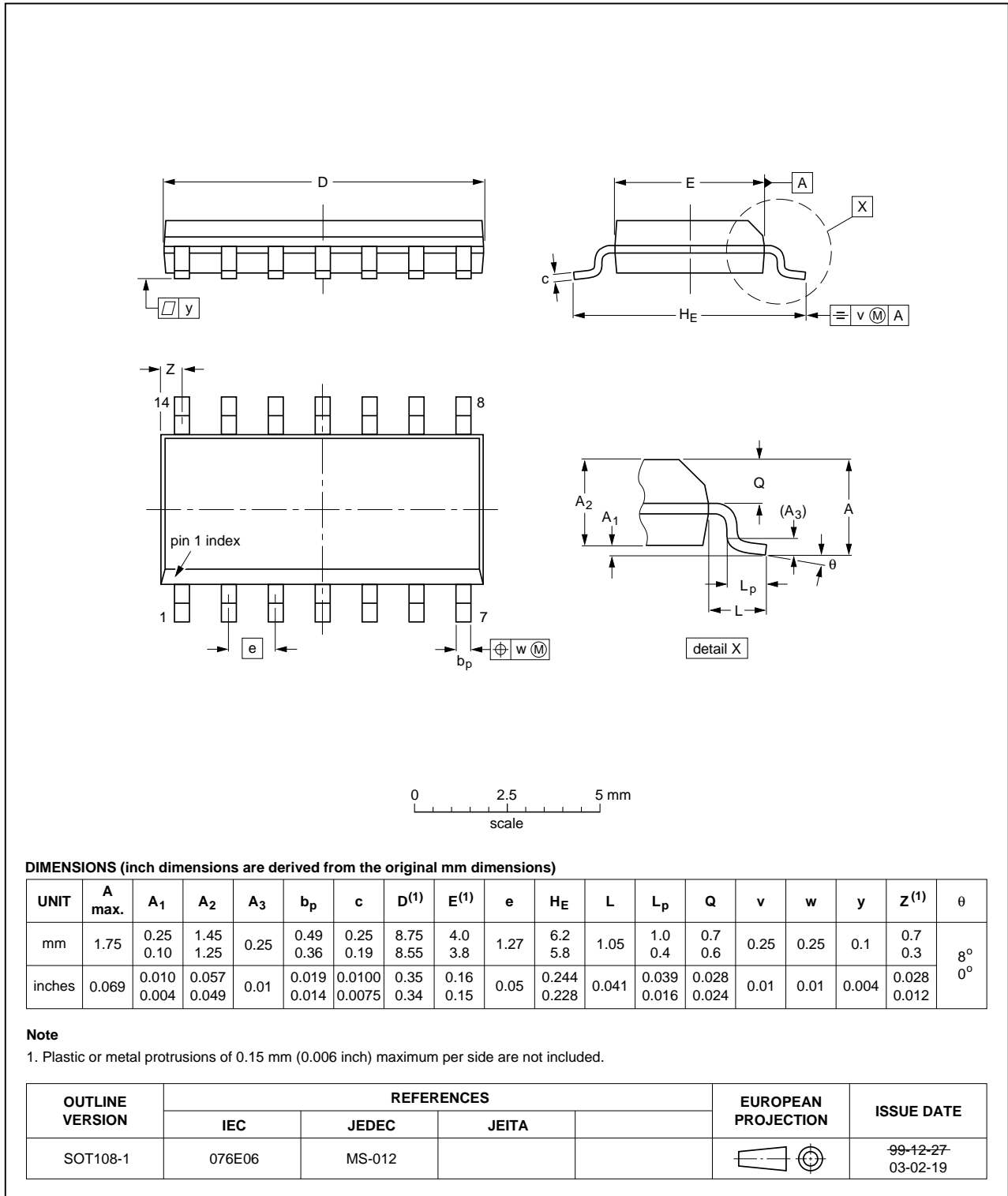


Fig 18. Package outline SOT108-1 (SO14)

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

SOT402-1

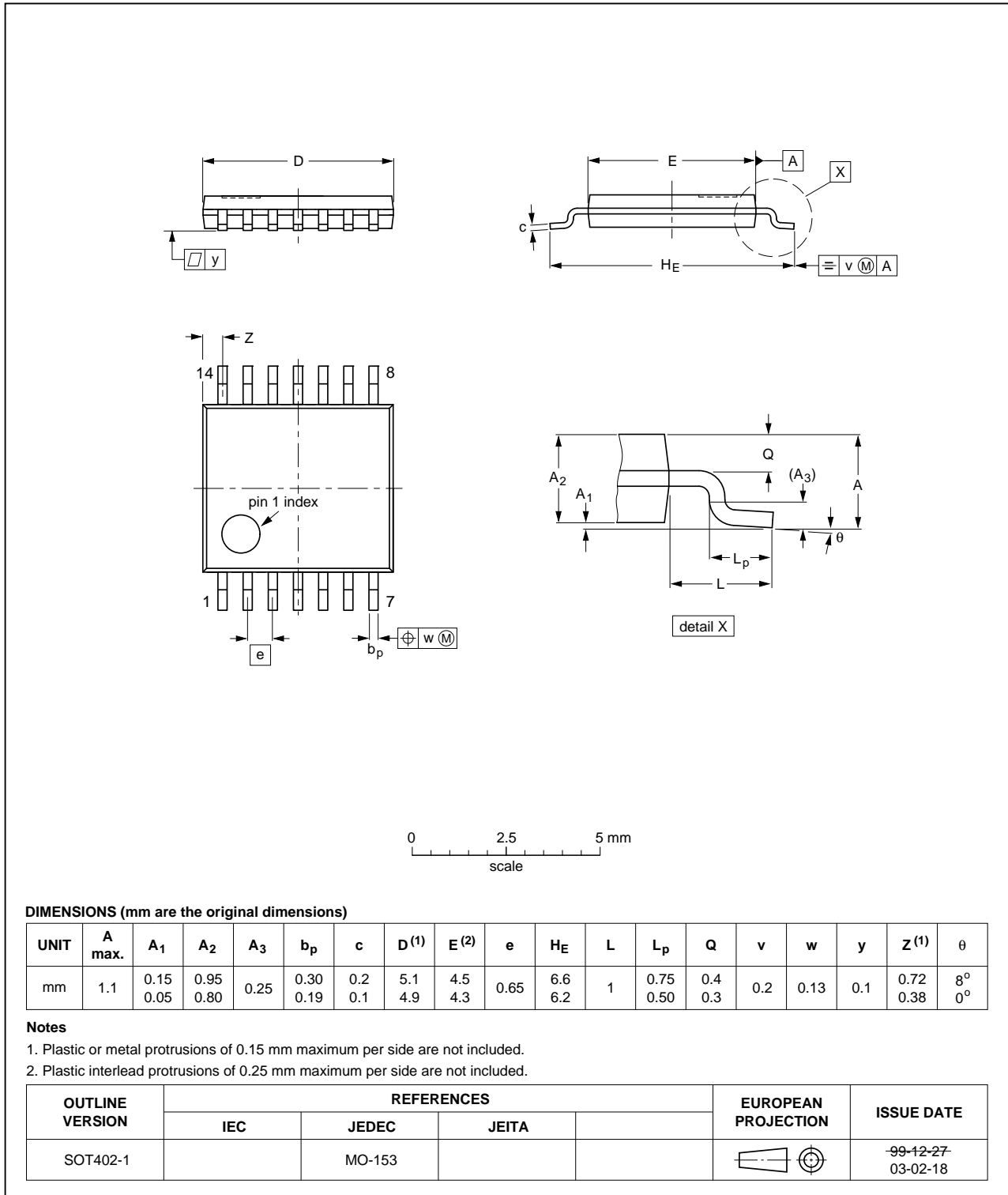
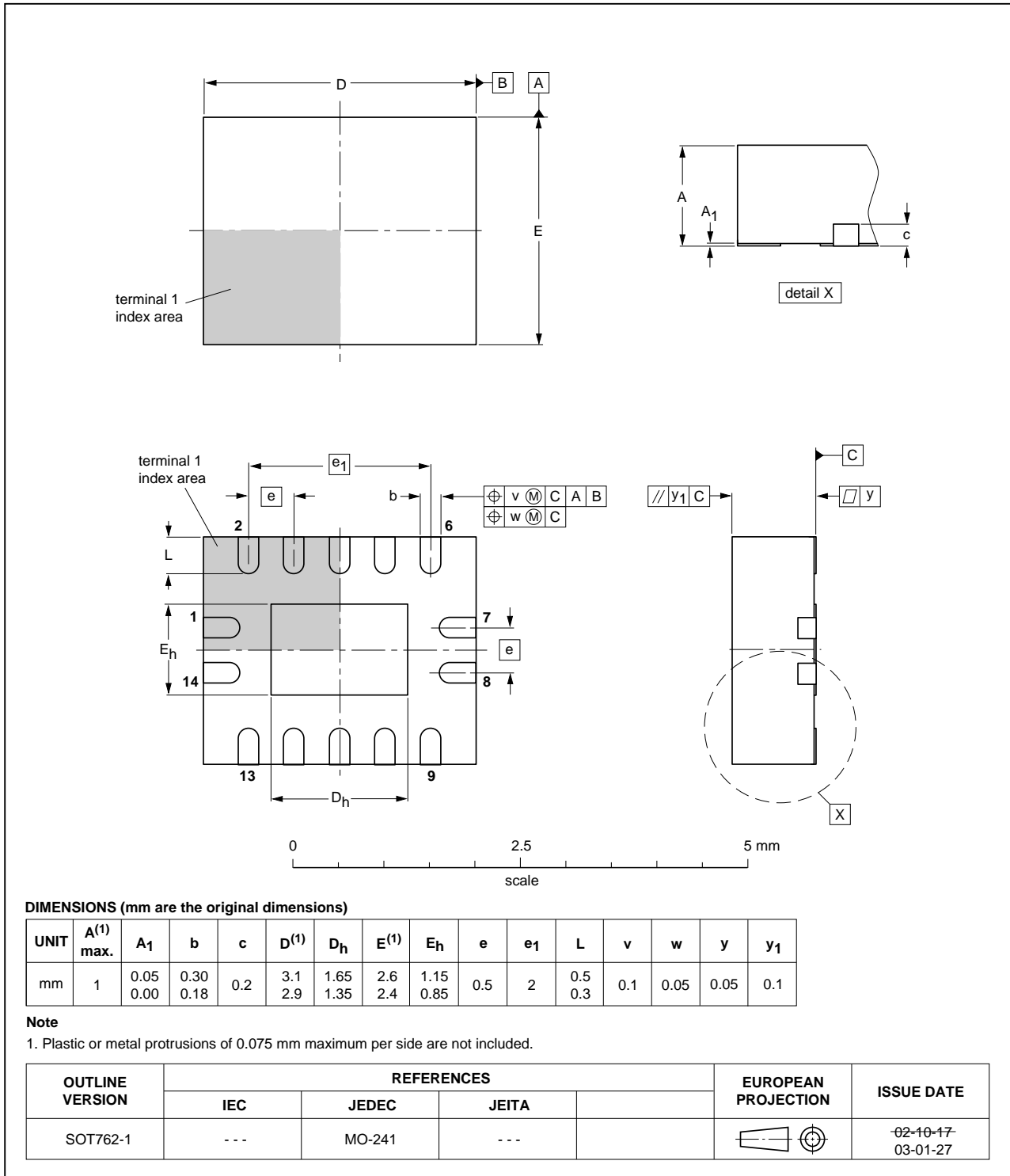


Fig 19. Package outline SOT402-1 (TSSOP14)

**DHVQFN14: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 x 3 x 0.85 mm**

**SOT762-1**



**Fig 20. Package outline SOT762-1 (DHVQFN14)**

## 14. Abbreviations

Table 14. Abbreviations

| Acronym | Description                             |
|---------|---|
| CMOS    | Complementary Metal Oxide Semiconductor |
| ESD     | ElectroStatic Discharge                 |
| HBM     | Human Body Model                        |
| MM      | Machine Model                           |
| CDM     | Charge-Device Model                     |
| MIL     | Military                                |

## 15. Revision history

Table 15. Revision history

| Document ID           | Release date   | Data sheet status  | Change notice | Supersedes            |
|-----------------------|--|--------------------|---------------|-----------------------|
| 74HC_HCT4066_Q100 v.3 | 20131216   | Product data sheet | -             | 74HC_HCT4066_Q100 v.2 |
| Modifications:        | <ul style="list-style-type: none"> <li>• Features and benefits updated (errata).</li> </ul>  |                    |               |                       |
| 74HC_HCT4066_Q100 v.2 | 20130404   | Product data sheet | -             | 74HC_HCT4066_Q100 v.1 |
| Modifications:        | <ul style="list-style-type: none"> <li>• Descriptive title corrected (errata).</li> <li>• New general description (errata).</li> </ul> |                    |               |                       |
| 74HC_HCT4066_Q100 v.1 | 20120712   | Product data sheet | -             | -                     |

## 16. Legal information

### 16.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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 in automotive applications** — This Nexperia product has been qualified for use in automotive applications. Unless otherwise agreed in writing, the product is 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.

**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](mailto:salesaddresses@nexperia.com)

**18. Contents**

---

|           |   |           |
|-----------|---|-----------|
| <b>1</b>  | <b>General description</b> . . . . .                | <b>1</b>  |
| <b>2</b>  | <b>Features and benefits</b> . . . . .              | <b>1</b>  |
| <b>3</b>  | <b>Ordering information</b> . . . . .               | <b>2</b>  |
| <b>4</b>  | <b>Functional diagram</b> . . . . .                 | <b>2</b>  |
| <b>5</b>  | <b>Pinning information</b> . . . . .                | <b>3</b>  |
| 5.1       | Pinning . . . . .                                   | 3         |
| 5.2       | Pin description . . . . .                           | 3         |
| <b>6</b>  | <b>Functional description</b> . . . . .             | <b>4</b>  |
| <b>7</b>  | <b>Limiting values</b> . . . . .                    | <b>4</b>  |
| <b>8</b>  | <b>Recommended operating conditions</b> . . . . .   | <b>4</b>  |
| <b>9</b>  | <b>Static characteristics</b> . . . . .             | <b>5</b>  |
| <b>10</b> | <b>Dynamic characteristics</b> . . . . .            | <b>9</b>  |
| <b>11</b> | <b>Waveforms</b> . . . . .                          | <b>11</b> |
| <b>12</b> | <b>Additional dynamic characteristics</b> . . . . . | <b>13</b> |
| <b>13</b> | <b>Package outline</b> . . . . .                    | <b>17</b> |
| <b>14</b> | <b>Abbreviations</b> . . . . .                      | <b>20</b> |
| <b>15</b> | <b>Revision history</b> . . . . .                   | <b>20</b> |
| <b>16</b> | <b>Legal information</b> . . . . .                  | <b>21</b> |
| 16.1      | Data sheet status . . . . .                         | 21        |
| 16.2      | Definitions . . . . .                               | 21        |
| 16.3      | Disclaimers . . . . .                               | 21        |
| 16.4      | Trademarks . . . . .                                | 22        |
| <b>17</b> | <b>Contact information</b> . . . . .                | <b>22</b> |
| <b>18</b> | <b>Contents</b> . . . . .                           | <b>23</b> |