

# 74HC4053-Q100; 74HCT4053-Q100

Triple 2-channel analog multiplexer/demultiplexer

Rev. 3 — 5 March 2020

Product data sheet

## 1. General description

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The 74HC4053-Q100; 74HCT4053-Q100 is a triple single-pole double-throw analog switch (3x SPDT) suitable for use in analog or digital 2:1 multiplexer/demultiplexer applications. Each switch features a digital select input (Sn), two independent inputs/outputs (nY0 and nY1) and a common input/output (nZ). A digital enable input (E) is common to all switches. When  $\bar{E}$  is HIGH, the switches are 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

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- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- Wide analog input voltage range from -5 V to +5 V
- Low ON resistance:
  - 80  $\Omega$  (typical) at  $V_{CC} - V_{EE} = 4.5$  V
  - 70  $\Omega$  (typical) at  $V_{CC} - V_{EE} = 6.0$  V
  - 60  $\Omega$  (typical) at  $V_{CC} - V_{EE} = 9.0$  V
- Logic level translation: to enable 5 V logic to communicate with  $\pm 5$  V analog signals
- Typical 'break before make' built-in
- 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 pF, R = 0  $\Omega$ )
  - CDM AEC-Q100-011 revision B exceeds 1000 V
- Multiple package options
- DHVQFN package with Side-Wettable Flanks enabling Automatic Optical Inspection (AOI) of solder joints

## 3. Applications

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

### 4. Ordering information

Table 1. Ordering information

| Type number      | Package           |          |  | Version  |
|------------------|-------------------|----------|--|----------|
|                  | Temperature range | Name     | Description  |          |
| 74HC4053D-Q100   | -40 °C to +125 °C | SO16     | plastic small outline package; 16 leads; body width 3.9 mm   | SOT109-1 |
| 74HCT4053D-Q100  |                   |          |  |          |
| 74HC4053PW-Q100  | -40 °C to +125 °C | TSSOP16  | plastic thin shrink small outline package; 16 leads; body width 4.4 mm   | SOT403-1 |
| 74HCT4053PW-Q100 |                   |          |  |          |
| 74HC4053BQ-Q100  | -40 °C to +125 °C | DHVQFN16 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 × 3.5 × 0.85 mm | SOT763-1 |
| 74HCT4053BQ-Q100 |                   |          |  |          |

### 5. Functional diagram

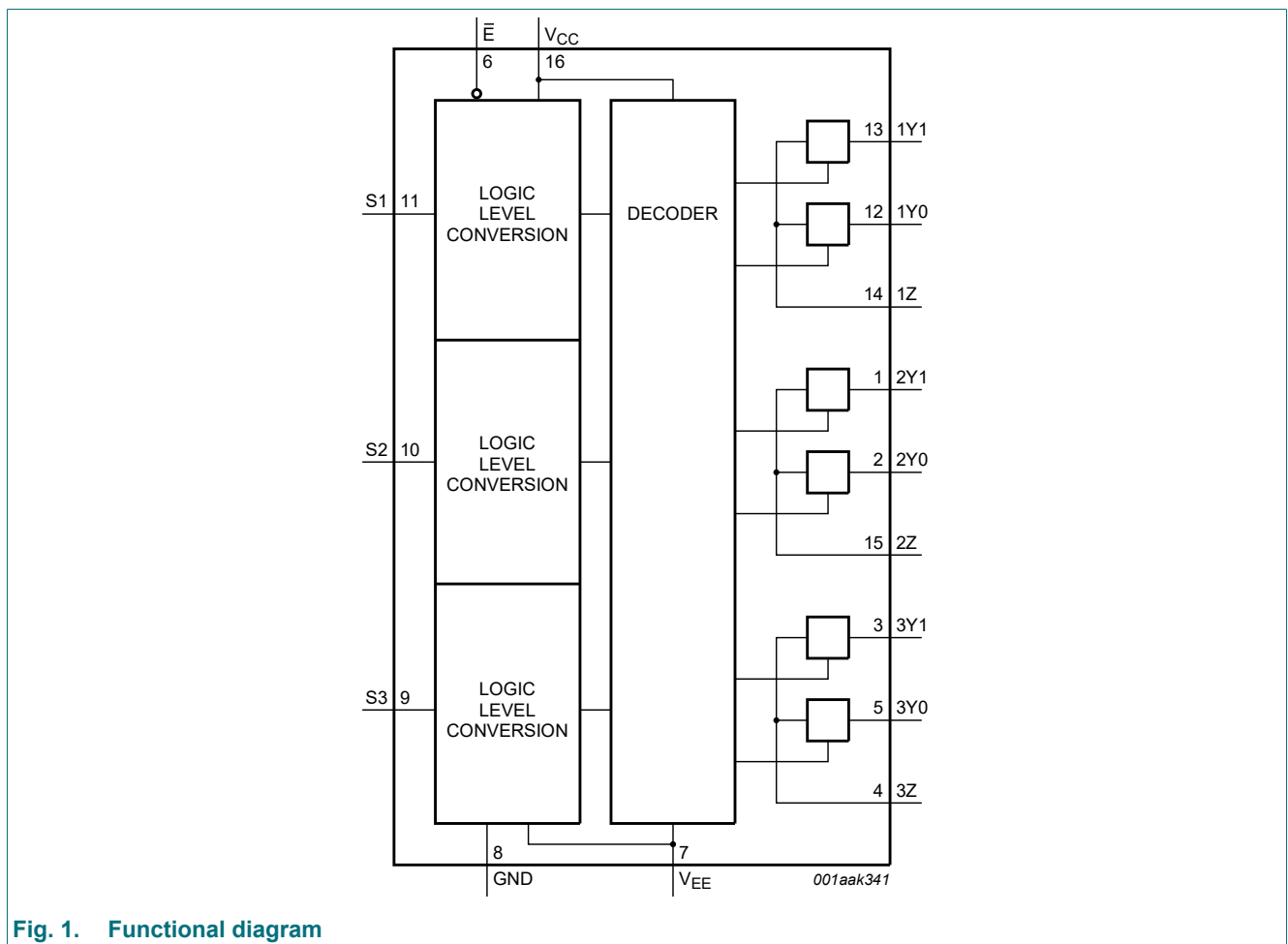


Fig. 1. Functional diagram

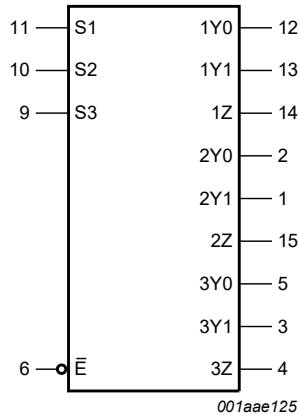


Fig. 2. Logic symbol

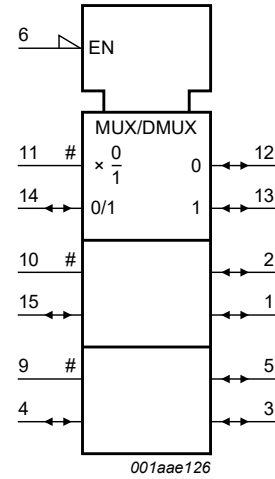


Fig. 3. IEC logic symbol

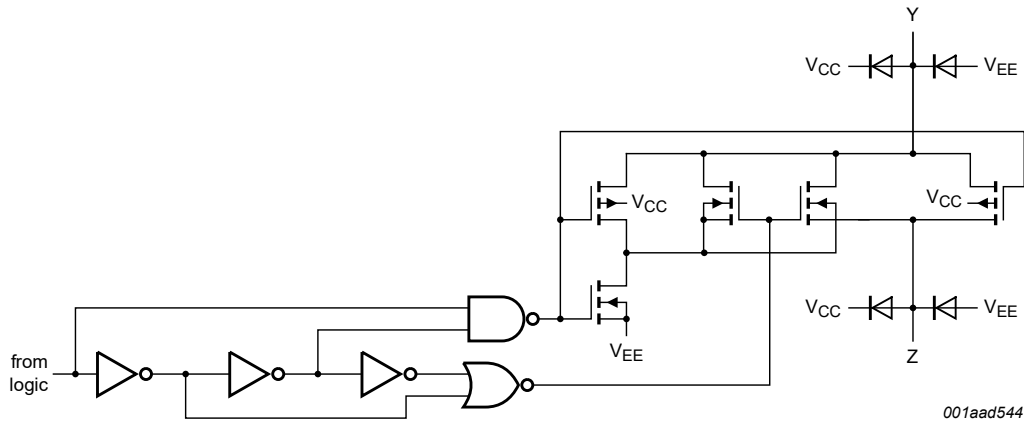
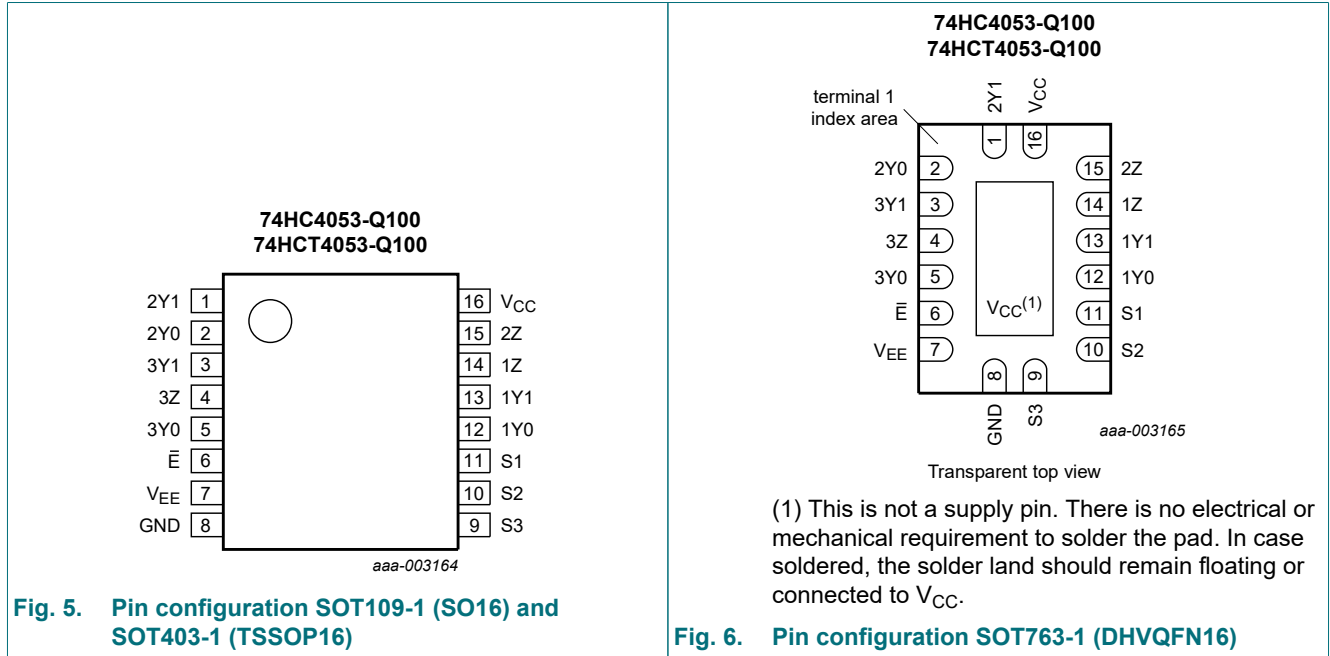


Fig. 4. Schematic diagram (one switch)

## 6. Pinning information

### 6.1. Pinning



### 6.2. Pin description

Table 2. Pin description

| Symbol          | Pin       | Description                 |
|-----------------|-----------|-----------------------------|
| $\bar{E}$       | 6         | enable input (active LOW)   |
| V <sub>EE</sub> | 7         | supply voltage              |
| GND             | 8         | ground supply voltage       |
| S1, S2, S3      | 11, 10, 9 | select input                |
| 1Y0, 2Y0, 3Y0   | 12, 2, 5  | independent input or output |
| 1Y1, 2Y1, 3Y1   | 13, 1, 3  | independent input or output |
| 1Z, 2Z, 3Z      | 14, 15, 4 | common output or input      |
| V <sub>CC</sub> | 16        | supply voltage              |

## 7. Functional description

Table 3. Function table

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

| Inputs    |                | Channel on   |
|-----------|----------------|--------------|
| $\bar{E}$ | S <sub>n</sub> |              |
| L         | L              | nY0 to nZ    |
| L         | H              | nY1 to nZ    |
| H         | X              | switches off |

## 8. Limiting values

**Table 4. Limiting values**

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to  $V_{SS} = 0$  V (ground).

| Symbol    | Parameter               | Conditions                                     | Min  | Max      | Unit |
|-----------|-------------------------|--|------|----------|------|
| $V_{CC}$  | supply voltage          | [1]  | -0.5 | +11.0    | V    |
| $I_{IK}$  | input clamping current  | $V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V       | -    | $\pm 20$ | mA   |
| $I_{SK}$  | switch clamping current | $V_{SW} < -0.5$ V or $V_{SW} > V_{CC} + 0.5$ V | -    | $\pm 20$ | mA   |
| $I_{SW}$  | switch current          | $-0.5$ V $< V_{SW} < V_{CC} + 0.5$ V           | -    | $\pm 25$ | mA   |
| $I_{EE}$  | supply current          |  | -    | $\pm 20$ | 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 | [2]  | -    | 500      | mW   |
| $P$       | power dissipation       | per switch                                     | -    | 100      | mW   |

- [1] To avoid drawing  $V_{CC}$  current out of terminal nZ, when switch current flows into terminals nYn, 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 nYn, and in this case there is no limit for the voltage drop across the switch, but the voltages at nYn and nZ may not exceed  $V_{CC}$  or  $V_{EE}$ .
- [2] For SOT109-1 (SO16) package:  $P_{tot}$  derates linearly with 12.4 mW/K above 110 °C.  
 For SOT403-1 (TSSOP16) package:  $P_{tot}$  derates linearly with 8.5 mW/K above 91 °C.  
 For SOT763-1 (DHVQFN16) package:  $P_{tot}$  derates linearly with 11.2 mW/K above 106 °C.

## 9. Recommended operating conditions

**Table 5. Recommended operating conditions**

| Symbol              | Parameter                           | Conditions  | 74HC4053-Q100 |      |          | 74HCT4053-Q100 |      |          | Unit |
|---------------------|-------------------------------------|---|---------------|------|----------|----------------|------|----------|------|
|                     |                                     |   | Min           | Typ  | Max      | Min            | Typ  | Max      |      |
| $V_{CC}$            | supply voltage                      | see <a href="#">Fig. 7</a> and <a href="#">Fig. 8</a> |               |      |          |                |      |          |      |
|                     |                                     | $V_{CC} - GND$  | 2.0           | 5.0  | 10.0     | 4.5            | 5.0  | 5.5      | V    |
|                     |                                     | $V_{CC} - V_{EE}$                                     | 2.0           | 5.0  | 10.0     | 2.0            | 5.0  | 10.0     | V    |
| $V_I$               | input voltage                       |   | GND           | -    | $V_{CC}$ | GND            | -    | $V_{CC}$ | V    |
| $V_{SW}$            | switch voltage                      |   | $V_{EE}$      | -    | $V_{CC}$ | $V_{EE}$       | -    | $V_{CC}$ | V    |
| $T_{amb}$           | ambient temperature                 |   | -40           | +25  | +125     | -40            | +25  | +125     | °C   |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 2.0$ V                                      | -             | -    | 625      | -              | -    | -        | ns/V |
|                     |                                     | $V_{CC} = 4.5$ V                                      | -             | 1.67 | 139      | -              | 1.67 | 139      | ns/V |
|                     |                                     | $V_{CC} = 6.0$ V                                      | -             | -    | 83       | -              | -    | -        | ns/V |
|                     |                                     | $V_{CC} = 10.0$ V                                     | -             | -    | 31       | -              | -    | -        | ns/V |

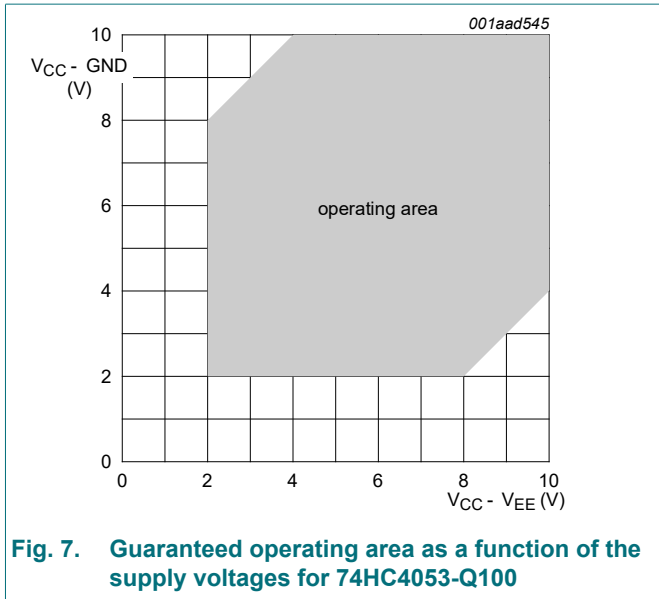


Fig. 7. Guaranteed operating area as a function of the supply voltages for 74HC4053-Q100

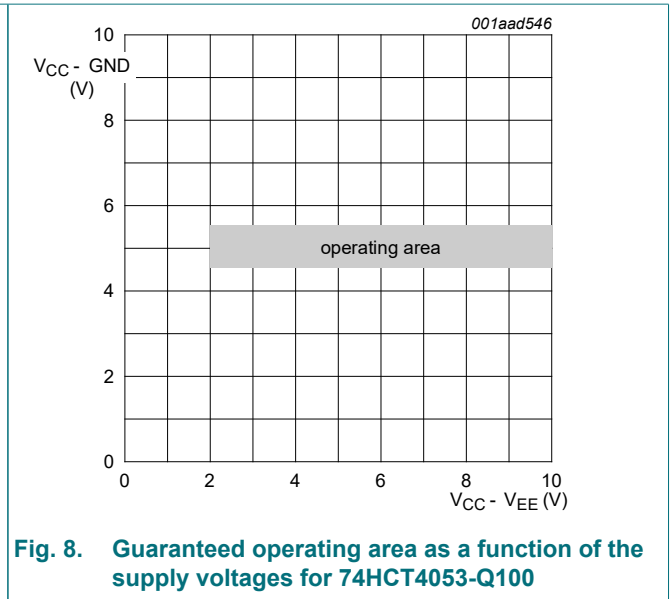


Fig. 8. Guaranteed operating area as a function of the supply voltages for 74HCT4053-Q100

## 10. Static characteristics

Table 6. R<sub>ON</sub> resistance per switch for 74HC4053-Q100 and 74HCT4053-Q100

$V_I = V_{IH}$  or  $V_{IL}$ ; for test circuit see Fig. 9.

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

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

For 74HC4053-Q100:  $V_{CC} - GND$  or  $V_{CC} - V_{EE} = 2.0\text{ V}$ ,  $4.5\text{ V}$ ,  $6.0\text{ V}$  and  $9.0\text{ V}$ .

For 74HCT4053-Q100:  $V_{CC} - GND = 4.5\text{ V}$  and  $5.5\text{ V}$ ,  $V_{CC} - V_{EE} = 2.0\text{ V}$ ,  $4.5\text{ V}$ ,  $6.0\text{ V}$  and  $9.0\text{ V}$ .

| Symbol                         | Parameter                               | Conditions  | Min | Typ | Max | Unit |          |
|--------------------------------|---|---|-----|-----|-----|------|----------|
| <b>T<sub>amb</sub> = 25 °C</b> |   |   |     |     |     |      |          |
| R <sub>ON(peak)</sub>          | ON resistance (peak)                    | $V_{is} = V_{CC}$ to $V_{EE}$   |     |     |     |      |          |
|                                |   | $V_{CC} = 2.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 100\text{ }\mu\text{A}$     | [1] | -   | -   | -    | $\Omega$ |
|                                |   | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 1000\text{ }\mu\text{A}$    |     | -   | 100 | 180  | $\Omega$ |
|                                |   | $V_{CC} = 6.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 1000\text{ }\mu\text{A}$    |     | -   | 90  | 160  | $\Omega$ |
| R <sub>ON(rail)</sub>          | ON resistance (rail)                    | $V_{is} = V_{EE}$   |     |     |     |      |          |
|                                |   | $V_{CC} = 2.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 100\text{ }\mu\text{A}$     | [1] | -   | 150 | -    | $\Omega$ |
|                                |   | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 1000\text{ }\mu\text{A}$    |     | -   | 80  | 140  | $\Omega$ |
|                                |   | $V_{CC} = 6.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 1000\text{ }\mu\text{A}$    |     | -   | 70  | 120  | $\Omega$ |
|                                |   | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$ ; $I_{SW} = 1000\text{ }\mu\text{A}$ |     | -   | 60  | 105  | $\Omega$ |
|                                |   | $V_{is} = V_{CC}$   |     |     |     |      |          |
|                                |   | $V_{CC} = 2.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 100\text{ }\mu\text{A}$     | [1] | -   | 150 | -    | $\Omega$ |
|                                |   | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 1000\text{ }\mu\text{A}$    |     | -   | 90  | 160  | $\Omega$ |
| $\Delta R_{ON}$                | ON resistance mismatch between channels | $V_{is} = V_{CC}$ to $V_{EE}$   |     |     |     |      |          |
|                                |   | $V_{CC} = 2.0\text{ V}$ ; $V_{EE} = 0\text{ V}$   | [1] | -   | -   | -    | $\Omega$ |
|                                |   | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$   |     | -   | 9   | -    | $\Omega$ |
|                                |   | $V_{CC} = 6.0\text{ V}$ ; $V_{EE} = 0\text{ V}$   |     | -   | 8   | -    | $\Omega$ |
|                                |   | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$                                      |     | -   | 6   | -    | $\Omega$ |

| Symbol                                    | Parameter            | Conditions   | Min | Typ | Max | Unit |
|---|----------------------|--|-----|-----|-----|------|
| <b>T<sub>amb</sub> = -40 °C to +85 °C</b> |                      |  |     |     |     |      |
| R <sub>ON(peak)</sub>                     | ON resistance (peak) | V <sub>is</sub> = V <sub>CC</sub> to V <sub>EE</sub>                         |     |     |     |      |
|   |                      | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 100 μA [1] | -   | -   | -   | Ω    |
|   |                      | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA    | -   | -   | 225 | Ω    |
|   |                      | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA    | -   | -   | 200 | Ω    |
|   |                      | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V; I <sub>SW</sub> = 1000 μA | -   | -   | 165 | Ω    |
| R <sub>ON(rail)</sub>                     | ON resistance (rail) | V <sub>is</sub> = V <sub>EE</sub>  |     |     |     |      |
|   |                      | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 100 μA [1] | -   | -   | -   | Ω    |
|   |                      | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA    | -   | -   | 175 | Ω    |
|   |                      | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA    | -   | -   | 150 | Ω    |
|   |                      | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V; I <sub>SW</sub> = 1000 μA | -   | -   | 130 | Ω    |
|   |                      | V <sub>is</sub> = V <sub>CC</sub>  |     |     |     |      |
|   |                      | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 100 μA [1] | -   | -   | -   | Ω    |
|   |                      | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA    | -   | -   | 200 | Ω    |
|   |                      | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA    | -   | -   | 175 | Ω    |
|   |                      | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V; I <sub>SW</sub> = 1000 μA | -   | -   | 150 | Ω    |
|   |                      | <b>T<sub>amb</sub> = -40 °C to +125 °C</b>                                   |     |     |     |      |
| R <sub>ON(peak)</sub>                     | ON resistance (peak) | V <sub>is</sub> = V <sub>CC</sub> to V <sub>EE</sub>                         |     |     |     |      |
|   |                      | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 100 μA [1] | -   | -   | -   | Ω    |
|   |                      | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA    | -   | -   | 270 | Ω    |
|   |                      | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA    | -   | -   | 240 | Ω    |
|   |                      | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V; I <sub>SW</sub> = 1000 μA | -   | -   | 195 | Ω    |
| R <sub>ON(rail)</sub>                     | ON resistance (rail) | V <sub>is</sub> = V <sub>EE</sub>  |     |     |     |      |
|   |                      | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 100 μA [1] | -   | -   | -   | Ω    |
|   |                      | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA    | -   | -   | 210 | Ω    |
|   |                      | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA    | -   | -   | 180 | Ω    |
|   |                      | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V; I <sub>SW</sub> = 1000 μA | -   | -   | 160 | Ω    |
|   |                      | V <sub>is</sub> = V <sub>CC</sub>  |     |     |     |      |
|   |                      | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 100 μA [1] | -   | -   | -   | Ω    |
|   |                      | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA    | -   | -   | 240 | Ω    |
|   |                      | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA    | -   | -   | 210 | Ω    |
|   |                      | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V; I <sub>SW</sub> = 1000 μA | -   | -   | 180 | Ω    |

[1] When supply voltages (V<sub>CC</sub> - V<sub>EE</sub>) near 2.0 V the analog switch ON resistance becomes extremely non-linear. When using a supply of 2 V, it is recommended to use these devices only for transmitting digital signals.

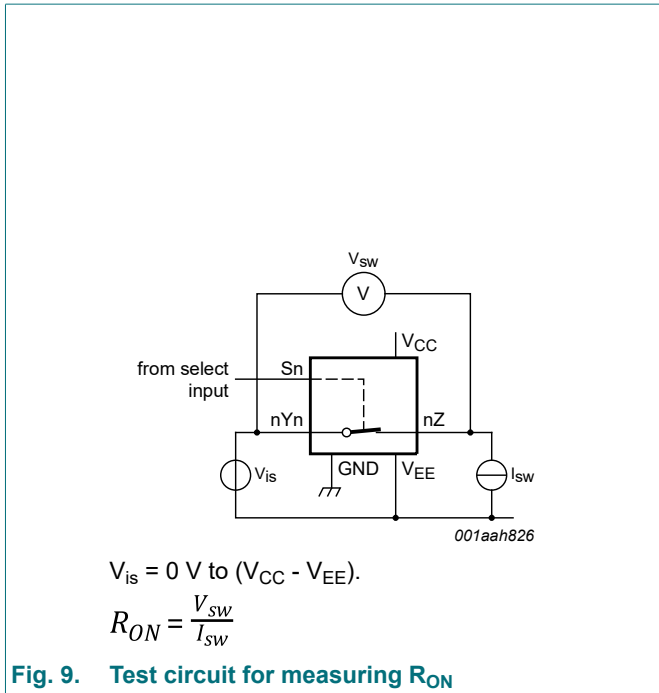


Fig. 9. Test circuit for measuring  $R_{ON}$

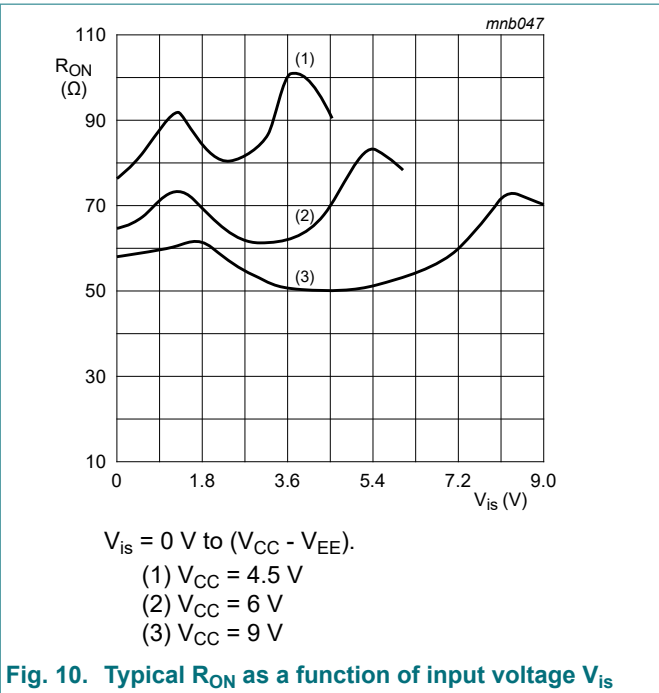


Fig. 10. Typical  $R_{ON}$  as a function of input voltage  $V_{is}$

Table 7. Static characteristics for 74HC4053-Q100

Voltages are referenced to GND (ground = 0 V).

$V_{is}$  is the input voltage at pins nYn or nZ, whichever is assigned as an input.

$V_{os}$  is the output voltage at pins nZ or nYn, whichever is assigned as an output.

| Symbol  | Parameter                 | Conditions  | Min  | Typ | Max       | Unit          |
|---|---------------------------|---|------|-----|-----------|---------------|
| <b><math>T_{amb} = 25 \text{ }^\circ\text{C}</math></b> |                           |   |      |     |           |               |
| $V_{IH}$  | 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 | 1.8       | V             |
|   |                           | $V_{CC} = 9.0 \text{ V}$  | -    | 4.3 | 2.7       | V             |
| $I_I$   | input leakage current     | $V_{EE} = 0 \text{ V}; V_I = V_{CC} \text{ or } \text{GND}$   |      |     |           |               |
|   |                           | $V_{CC} = 6.0 \text{ V}$  | -    | -   | $\pm 0.1$ | $\mu\text{A}$ |
|   |                           | $V_{CC} = 10.0 \text{ V}$   | -    | -   | $\pm 0.2$ | $\mu\text{A}$ |
| $I_{S(OFF)}$  | OFF-state leakage current | $V_{CC} = 10.0 \text{ V}; V_{EE} = 0 \text{ V}; V_I = V_{IH} \text{ or } V_{IL};  V_{SW}  = V_{CC} - V_{EE};$ see Fig. 11           |      |     |           |               |
|   |                           | per channel   | -    | -   | $\pm 0.1$ | $\mu\text{A}$ |
|   |                           | all channels  | -    | -   | $\pm 0.1$ | $\mu\text{A}$ |
| $I_{S(ON)}$   | ON-state leakage current  | $V_{CC} = 10.0 \text{ V}; V_{EE} = 0 \text{ V}; V_I = V_{IH} \text{ or } V_{IL};  V_{SW}  = V_{CC} - V_{EE};$ see Fig. 12           | -    | -   | $\pm 0.1$ | $\mu\text{A}$ |
| $I_{CC}$  | supply current            | $V_{EE} = 0 \text{ V}; V_I = V_{CC} \text{ or } \text{GND}; V_{is} = V_{EE} \text{ or } V_{CC}; V_{os} = V_{CC} \text{ or } V_{EE}$ |      |     |           |               |
|   |                           | $V_{CC} = 6.0 \text{ V}$  | -    | -   | 8.0       | $\mu\text{A}$ |
|   |                           | $V_{CC} = 10.0 \text{ V}$   | -    | -   | 16.0      | $\mu\text{A}$ |
| $C_I$   | input capacitance         |   | -    | 3.5 | -         | pF            |



## Triple 2-channel analog multiplexer/demultiplexer

| Symbol  | Parameter                 | Conditions  | Min  | Typ | Max       | Unit          |
|---|---------------------------|---|------|-----|-----------|---------------|
| $C_{sw}$  | switch capacitance        | independent pins nYn  | -    | 5   | -         | pF            |
|   |                           | common pins nZ  | -    | 8   | -         | pF            |
| <b><math>T_{amb} = -40\text{ °C to }+85\text{ °C}</math></b>  |                           |   |      |     |           |               |
| $V_{IH}$  | HIGH-level input voltage  | $V_{CC} = 2.0\text{ V}$   | 1.5  | -   | -         | V             |
|   |                           | $V_{CC} = 4.5\text{ V}$   | 3.15 | -   | -         | V             |
|   |                           | $V_{CC} = 6.0\text{ V}$   | 4.2  | -   | -         | V             |
|   |                           | $V_{CC} = 9.0\text{ V}$   | 6.3  | -   | -         | V             |
| $V_{IL}$  | LOW-level input voltage   | $V_{CC} = 2.0\text{ V}$   | -    | -   | 0.5       | V             |
|   |                           | $V_{CC} = 4.5\text{ V}$   | -    | -   | 1.35      | V             |
|   |                           | $V_{CC} = 6.0\text{ V}$   | -    | -   | 1.8       | V             |
|   |                           | $V_{CC} = 9.0\text{ V}$   | -    | -   | 2.7       | V             |
| $I_I$   | input leakage current     | $V_{EE} = 0\text{ V}; V_I = V_{CC}\text{ or GND}$   |      |     |           |               |
|   |                           | $V_{CC} = 6.0\text{ V}$   | -    | -   | $\pm 1.0$ | $\mu\text{A}$ |
|   |                           | $V_{CC} = 10.0\text{ V}$  | -    | -   | $\pm 2.0$ | $\mu\text{A}$ |
| $I_{S(OFF)}$  | OFF-state leakage current | $V_{CC} = 10.0\text{ V}; V_{EE} = 0\text{ V}; V_I = V_{IH}\text{ or }V_{IL};  V_{SW}  = V_{CC} - V_{EE}; \text{ Fig. 11}$     |      |     |           |               |
|   |                           | per channel   | -    | -   | $\pm 1.0$ | $\mu\text{A}$ |
|   |                           | all channels  | -    | -   | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{S(ON)}$   | ON-state leakage current  | $V_{CC} = 10.0\text{ V}; V_{EE} = 0\text{ V}; V_I = V_{IH}\text{ or }V_{IL};  V_{SW}  = V_{CC} - V_{EE}; \text{ see Fig. 12}$ | -    | -   | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{CC}$  | supply current            | $V_{EE} = 0\text{ V}; V_I = V_{CC}\text{ or GND}; V_{is} = V_{EE}\text{ or }V_{CC}; V_{os} = V_{CC}\text{ or }V_{EE}$         |      |     |           |               |
|   |                           | $V_{CC} = 6.0\text{ V}$   | -    | -   | 80.0      | $\mu\text{A}$ |
|   |                           | $V_{CC} = 10.0\text{ V}$  | -    | -   | 160.0     | $\mu\text{A}$ |
| <b><math>T_{amb} = -40\text{ °C to }+125\text{ °C}</math></b> |                           |   |      |     |           |               |
| $V_{IH}$  | HIGH-level input voltage  | $V_{CC} = 2.0\text{ V}$   | 1.5  | -   | -         | V             |
|   |                           | $V_{CC} = 4.5\text{ V}$   | 3.15 | -   | -         | V             |
|   |                           | $V_{CC} = 6.0\text{ V}$   | 4.2  | -   | -         | V             |
|   |                           | $V_{CC} = 9.0\text{ V}$   | 6.3  | -   | -         | V             |
| $V_{IL}$  | LOW-level input voltage   | $V_{CC} = 2.0\text{ V}$   | -    | -   | 0.5       | V             |
|   |                           | $V_{CC} = 4.5\text{ V}$   | -    | -   | 1.35      | V             |
|   |                           | $V_{CC} = 6.0\text{ V}$   | -    | -   | 1.8       | V             |
|   |                           | $V_{CC} = 9.0\text{ V}$   | -    | -   | 2.7       | V             |
| $I_I$   | input leakage current     | $V_{EE} = 0\text{ V}; V_I = V_{CC}\text{ or GND}$   |      |     |           |               |
|   |                           | $V_{CC} = 6.0\text{ V}$   | -    | -   | $\pm 1.0$ | $\mu\text{A}$ |
|   |                           | $V_{CC} = 10.0\text{ V}$  | -    | -   | $\pm 2.0$ | $\mu\text{A}$ |
| $I_{S(OFF)}$  | OFF-state leakage current | $V_{CC} = 10.0\text{ V}; V_{EE} = 0\text{ V}; V_I = V_{IH}\text{ or }V_{IL};  V_{SW}  = V_{CC} - V_{EE}; \text{ see Fig. 11}$ |      |     |           |               |
|   |                           | per channel   | -    | -   | $\pm 1.0$ | $\mu\text{A}$ |
|   |                           | all channels  | -    | -   | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{S(ON)}$   | ON-state leakage current  | $V_{CC} = 10.0\text{ V}; V_{EE} = 0\text{ V}; V_I = V_{IH}\text{ or }V_{IL};  V_{SW}  = V_{CC} - V_{EE}; \text{ see Fig. 12}$ | -    | -   | $\pm 1.0$ | $\mu\text{A}$ |

| Symbol          | Parameter      | Conditions   | Min | Typ | Max   | Unit |
|-----------------|----------------|--|-----|-----|-------|------|
| I <sub>CC</sub> | supply current | V <sub>EE</sub> = 0 V; V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>is</sub> = V <sub>EE</sub> or V <sub>CC</sub> ;<br>V <sub>os</sub> = V <sub>CC</sub> or V <sub>EE</sub> |     |     |       |      |
|                 |                | V <sub>CC</sub> = 6.0 V  | -   | -   | 160.0 | μA   |
|                 |                | V <sub>CC</sub> = 10.0 V   | -   | -   | 320.0 | μA   |

**Table 8. Static characteristics for 74HCT4053-Q100**

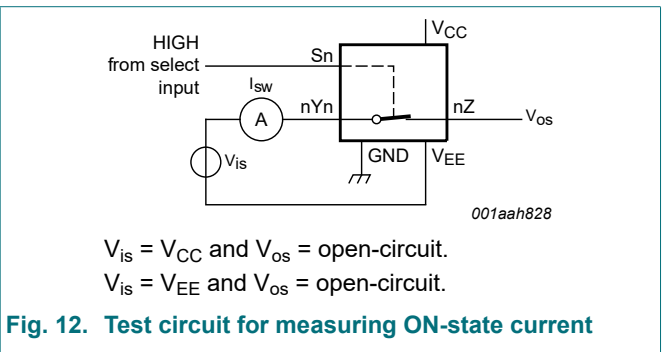
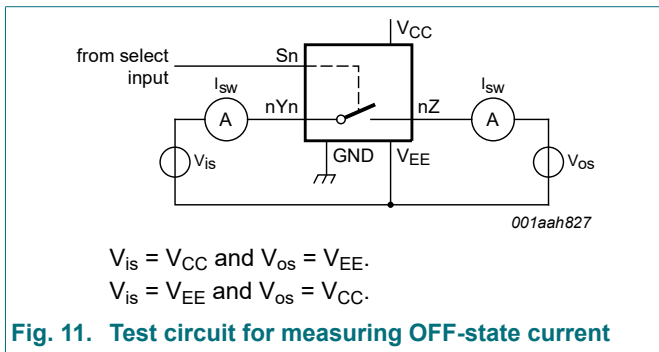
Voltages are referenced to GND (ground = 0 V).

V<sub>is</sub> is the input voltage at pins nYn or nZ, whichever is assigned as an input.

V<sub>os</sub> is the output voltage at pins nZ or nYn, whichever is assigned as an output.

| Symbol                                    | Parameter                 | Conditions   | Min | Typ | Max   | Unit |
|---|---------------------------|--|-----|-----|-------|------|
| <b>T<sub>amb</sub> = 25 °C</b>            |                           |  |     |     |       |      |
| V <sub>IH</sub>                           | HIGH-level input voltage  | V <sub>CC</sub> = 4.5 V to 5.5 V   | 2.0 | 1.6 | -     | V    |
| V <sub>IL</sub>                           | LOW-level input voltage   | V <sub>CC</sub> = 4.5 V to 5.5 V   | -   | 1.2 | 0.8   | V    |
| I <sub>I</sub>                            | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V; V <sub>EE</sub> = 0 V  | -   | -   | ±0.1  | μA   |
| I <sub>S(OFF)</sub>                       | OFF-state leakage current | V <sub>CC</sub> = 10.0 V; V <sub>EE</sub> = 0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br> V <sub>SW</sub>   = V <sub>CC</sub> - V <sub>EE</sub> ; see Fig. 11 |     |     |       |      |
|   |                           | per channel  | -   | -   | ±0.1  | μA   |
|   |                           | all channels   | -   | -   | ±0.1  | μA   |
| I <sub>S(ON)</sub>                        | ON-state leakage current  | V <sub>CC</sub> = 10.0 V; V <sub>EE</sub> = 0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br> V <sub>SW</sub>   = V <sub>CC</sub> - V <sub>EE</sub> ; see Fig. 12 | -   | -   | ±0.1  | μA   |
| I <sub>CC</sub>                           | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>is</sub> = V <sub>EE</sub> or V <sub>CC</sub> ; V <sub>os</sub> = V <sub>CC</sub> or V <sub>EE</sub>                           |     |     |       |      |
|   |                           | V <sub>CC</sub> = 5.5 V; V <sub>EE</sub> = 0 V   | -   | -   | 8.0   | μA   |
|   |                           | V <sub>CC</sub> = 5.0 V; V <sub>EE</sub> = -5.0 V  | -   | -   | 16.0  | μA   |
| ΔI <sub>CC</sub>                          | additional supply current | per input; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V;<br>other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V;<br>V <sub>EE</sub> = 0 V                     | -   | 50  | 180   | μA   |
| C <sub>I</sub>                            | input capacitance         |  | -   | 3.5 | -     | pF   |
| C <sub>sw</sub>                           | switch capacitance        | independent pins nYn   | -   | 5   | -     | pF   |
|   |                           | common pins nZ   | -   | 8   | -     | pF   |
| <b>T<sub>amb</sub> = -40 °C to +85 °C</b> |                           |  |     |     |       |      |
| V <sub>IH</sub>                           | HIGH-level input voltage  | V <sub>CC</sub> = 4.5 V to 5.5 V   | 2.0 | -   | -     | V    |
| V <sub>IL</sub>                           | LOW-level input voltage   | V <sub>CC</sub> = 4.5 V to 5.5 V   | -   | -   | 0.8   | V    |
| I <sub>I</sub>                            | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V; V <sub>EE</sub> = 0 V  | -   | -   | ±1.0  | μA   |
| I <sub>S(OFF)</sub>                       | OFF-state leakage current | V <sub>CC</sub> = 10.0 V; V <sub>EE</sub> = 0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br> V <sub>SW</sub>   = V <sub>CC</sub> - V <sub>EE</sub> ; see Fig. 11 |     |     |       |      |
|   |                           | per channel  | -   | -   | ±1.0  | μA   |
|   |                           | all channels   | -   | -   | ±1.0  | μA   |
| I <sub>S(ON)</sub>                        | ON-state leakage current  | V <sub>CC</sub> = 10.0 V; V <sub>EE</sub> = 0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br> V <sub>SW</sub>   = V <sub>CC</sub> - V <sub>EE</sub> ; see Fig. 12 | -   | -   | ±1.0  | μA   |
| I <sub>CC</sub>                           | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>is</sub> = V <sub>EE</sub> or V <sub>CC</sub> ; V <sub>os</sub> = V <sub>CC</sub> or V <sub>EE</sub>                           |     |     |       |      |
|   |                           | V <sub>CC</sub> = 5.5 V; V <sub>EE</sub> = 0 V   | -   | -   | 80.0  | μA   |
|   |                           | V <sub>CC</sub> = 5.0 V; V <sub>EE</sub> = -5.0 V  | -   | -   | 160.0 | μA   |

| Symbol   | Parameter                 | Conditions  | Min | Typ | Max       | Unit          |
|--|---------------------------|---|-----|-----|-----------|---------------|
| $\Delta I_{CC}$  | additional supply current | per input; $V_I = V_{CC} - 2.1\text{ V}$ ; other inputs at $V_{CC}$ or GND; $V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$ ; $V_{EE} = 0\text{ V}$ | -   | -   | 225       | $\mu\text{A}$ |
| <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; $V_{CC} = 5.5\text{ V}$ ; $V_{EE} = 0\text{ V}$  | -   | -   | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{S(OFF)}$   | OFF-state leakage current | $V_{CC} = 10.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $V_I = V_{IH}$ or $V_{IL}$ ; $ V_{SW}  = V_{CC} - V_{EE}$ ; see Fig. 11                    |     |     |           |               |
|  |                           | per channel   | -   | -   | $\pm 1.0$ | $\mu\text{A}$ |
|  |                           | all channels  | -   | -   | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{S(ON)}$  | ON-state leakage current  | $V_{CC} = 10.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $V_I = V_{IH}$ or $V_{IL}$ ; $ V_{SW}  = V_{CC} - V_{EE}$ ; see Fig. 12                    | -   | -   | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{CC}$   | supply current            | $V_I = V_{CC}$ or GND; $V_{is} = V_{EE}$ or $V_{CC}$ ; $V_{os} = V_{CC}$ or $V_{EE}$  |     |     |           |               |
|  |                           | $V_{CC} = 5.5\text{ V}$ ; $V_{EE} = 0\text{ V}$   | -   | -   | 160.0     | $\mu\text{A}$ |
|  |                           | $V_{CC} = 5.0\text{ V}$ ; $V_{EE} = -5.0\text{ V}$  | -   | -   | 320.0     | $\mu\text{A}$ |
| $\Delta I_{CC}$  | additional supply current | per input; $V_I = V_{CC} - 2.1\text{ V}$ ; other inputs at $V_{CC}$ or GND; $V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$ ; $V_{EE} = 0\text{ V}$ | -   | -   | 245       | $\mu\text{A}$ |



## 11. Dynamic characteristics

**Table 9. Dynamic characteristics for 74HC4053-Q100**

$GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; for test circuit see Fig. 15.

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

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

| Symbol   | Parameter         | Conditions  | Min | Typ | Max | Unit |
|--|-------------------|---|-----|-----|-----|------|
| <b><math>T_{amb} = 25\text{ }^\circ\text{C}</math></b> |                   |   |     |     |     |      |
| $t_{pd}$   | propagation delay | $V_{is}$ to $V_{os}$ ; $R_L = \infty\ \Omega$ ; see Fig. 13 | [1] |     |     |      |
|  |                   | $V_{CC} = 2.0\text{ V}$ ; $V_{EE} = 0\text{ V}$             | -   | 15  | 60  | ns   |
|  |                   | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$             | -   | 5   | 12  | ns   |
|  |                   | $V_{CC} = 6.0\text{ V}$ ; $V_{EE} = 0\text{ V}$             | -   | 4   | 10  | ns   |
|  |                   | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$          | -   | 4   | 8   | ns   |

| Symbol                                    | Parameter                     | Conditions   | Min | Typ | Max | Unit |
|---|-------------------------------|--|-----|-----|-----|------|
| t <sub>on</sub>                           | turn-on time                  | $\bar{E}$ to V <sub>os</sub> ; R <sub>L</sub> = ∞ Ω; see Fig. 14 [2]       |     |     |     |      |
|   |                               | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V                             | -   | 60  | 220 | ns   |
|   |                               | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | 20  | 44  | ns   |
|   |                               | V <sub>CC</sub> = 5.0 V; V <sub>EE</sub> = 0 V; C <sub>L</sub> = 15 pF     | -   | 17  | -   | ns   |
|   |                               | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V                             | -   | 16  | 37  | ns   |
|   |                               | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | 15  | 31  | ns   |
|   |                               | Sn to V <sub>os</sub> ; R <sub>L</sub> = ∞ Ω; see Fig. 14 [2]              |     |     |     |      |
|   |                               | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V                             | -   | 75  | 220 | ns   |
|   |                               | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | 25  | 44  | ns   |
|   |                               | V <sub>CC</sub> = 5.0 V; V <sub>EE</sub> = 0 V; C <sub>L</sub> = 15 pF     | -   | 21  | -   | ns   |
|   |                               | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V                             | -   | 20  | 37  | ns   |
|   |                               | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | 15  | 31  | ns   |
| t <sub>off</sub>                          | turn-off time                 | $\bar{E}$ to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see Fig. 14 [3]      |     |     |     |      |
|   |                               | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V                             | -   | 63  | 210 | ns   |
|   |                               | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | 21  | 42  | ns   |
|   |                               | V <sub>CC</sub> = 5.0 V; V <sub>EE</sub> = 0 V; C <sub>L</sub> = 15 pF     | -   | 18  | -   | ns   |
|   |                               | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V                             | -   | 17  | 36  | ns   |
|   |                               | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | 15  | 29  | ns   |
|   |                               | Sn to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see Fig. 14 [3]             |     |     |     |      |
|   |                               | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V                             | -   | 60  | 210 | ns   |
|   |                               | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | 20  | 42  | ns   |
|   |                               | V <sub>CC</sub> = 5.0 V; V <sub>EE</sub> = 0 V; C <sub>L</sub> = 15 pF     | -   | 17  | -   | ns   |
|   |                               | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V                             | -   | 16  | 36  | ns   |
|   |                               | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | 15  | 29  | ns   |
| C <sub>PD</sub>                           | power dissipation capacitance | per switch; V <sub>I</sub> = GND to V <sub>CC</sub> [4]                    | -   | 36  | -   | pF   |
| <b>T<sub>amb</sub> = -40 °C to +85 °C</b> |                               |  |     |     |     |      |
| t <sub>pd</sub>                           | propagation delay             | V <sub>is</sub> to V <sub>os</sub> ; R <sub>L</sub> = ∞ Ω; see Fig. 13 [1] |     |     |     |      |
|   |                               | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 75  | ns   |
|   |                               | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | -   | 15  | ns   |
|   |                               | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 13  | ns   |
|   |                               | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | -   | 10  | ns   |
| t <sub>on</sub>                           | turn-on time                  | $\bar{E}$ to V <sub>os</sub> ; R <sub>L</sub> = ∞ Ω; see Fig. 14 [2]       |     |     |     |      |
|   |                               | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 275 | ns   |
|   |                               | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | -   | 55  | ns   |
|   |                               | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 47  | ns   |
|   |                               | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | -   | 39  | ns   |
|   |                               | Sn to V <sub>os</sub> ; R <sub>L</sub> = ∞ Ω; see Fig. 14 [2]              |     |     |     |      |
|   |                               | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 275 | ns   |
|   |                               | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | -   | 55  | ns   |
|   |                               | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 47  | ns   |
|   |                               | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | -   | 39  | ns   |

| Symbol                                     | Parameter         | Conditions   | Min | Typ | Max | Unit |
|--|-------------------|--|-----|-----|-----|------|
| t <sub>off</sub>                           | turn-off time     | $\bar{E}$ to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see Fig. 14 [3]      |     |     |     |      |
|  |                   | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 265 | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | -   | 53  | ns   |
|  |                   | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 45  | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | -   | 36  | ns   |
|  |                   | Sn to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see Fig. 14 [3]             |     |     |     |      |
|  |                   | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 265 | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | -   | 53  | ns   |
|  |                   | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 45  | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | -   | 36  | ns   |
| <b>T<sub>amb</sub> = -40 °C to +125 °C</b> |                   |  |     |     |     |      |
| t <sub>pd</sub>                            | propagation delay | V <sub>is</sub> to V <sub>os</sub> ; R <sub>L</sub> = ∞ Ω; see Fig. 13 [1] |     |     |     |      |
|  |                   | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 90  | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | -   | 18  | ns   |
|  |                   | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 15  | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | -   | 12  | ns   |
| t <sub>on</sub>                            | turn-on time      | $\bar{E}$ to V <sub>os</sub> ; R <sub>L</sub> = ∞ Ω; see Fig. 14 [2]       |     |     |     |      |
|  |                   | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 330 | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | -   | 66  | ns   |
|  |                   | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 56  | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | -   | 47  | ns   |
|  |                   | Sn to V <sub>os</sub> ; R <sub>L</sub> = ∞ Ω; see Fig. 14 [2]              |     |     |     |      |
|  |                   | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 330 | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | -   | 66  | ns   |
|  |                   | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 56  | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | -   | 47  | ns   |
| t <sub>off</sub>                           | turn-off time     | $\bar{E}$ to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see Fig. 14 [3]      |     |     |     |      |
|  |                   | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 315 | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | -   | 63  | ns   |
|  |                   | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 54  | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | -   | 44  | ns   |
|  |                   | Sn to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see Fig. 14 [3]             |     |     |     |      |
|  |                   | V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 315 | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | -   | 63  | ns   |
|  |                   | V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V                             | -   | -   | 54  | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | -   | 44  | ns   |

- [1] t<sub>pd</sub> is the same as t<sub>PHL</sub> and t<sub>PLH</sub>.
- [2] t<sub>on</sub> is the same as t<sub>PZH</sub> and t<sub>PZL</sub>.
- [3] t<sub>off</sub> is the same as t<sub>PHZ</sub> and t<sub>PLZ</sub>.
- [4] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma\{(C_L + C_{sw}) \times V_{CC}^2 \times f_o\}$  where:  
 f<sub>i</sub> = input frequency in MHz; f<sub>o</sub> = output frequency in MHz;  
 N = number of inputs switching;  $\Sigma\{(C_L + C_{sw}) \times V_{CC}^2 \times f_o\}$  = sum of outputs;  
 C<sub>L</sub> = output load capacitance in pF; C<sub>sw</sub> = switch capacitance in pF;  
 V<sub>CC</sub> = supply voltage in V.

**Table 10. Dynamic characteristics for 74HCT4053-Q100**

$GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; for test circuit see Fig. 15.

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

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

| Symbol                                    | Parameter                     | Conditions   | Min | Typ | Max | Unit |
|---|-------------------------------|--|-----|-----|-----|------|
| <b>T<sub>amb</sub> = 25 °C</b>            |                               |  |     |     |     |      |
| t <sub>pd</sub>                           | propagation delay             | $V_{is}$ to $V_{os}$ ; $R_L = \infty\ \Omega$ ; see Fig. 13 [1]        |     |     |     |      |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$                        | -   | 5   | 12  | ns   |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$                     | -   | 4   | 8   | ns   |
| t <sub>on</sub>                           | turn-on time                  | $\bar{E}$ to $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see Fig. 14 [2]     |     |     |     |      |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$                        | -   | 27  | 48  | ns   |
|   |                               | $V_{CC} = 5.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $C_L = 15\text{ pF}$ | -   | 23  | -   | ns   |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$                     | -   | 16  | 34  | ns   |
|   |                               | Sn to $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see Fig. 14 [2]            |     |     |     |      |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$                        | -   | 25  | 48  | ns   |
|   |                               | $V_{CC} = 5.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $C_L = 15\text{ pF}$ | -   | 21  | -   | ns   |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$                     | -   | 16  | 34  | ns   |
| t <sub>off</sub>                          | turn-off time                 | $\bar{E}$ to $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see Fig. 14 [3]     |     |     |     |      |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$                        | -   | 24  | 44  | ns   |
|   |                               | $V_{CC} = 5.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $C_L = 15\text{ pF}$ | -   | 20  | -   | ns   |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$                     | -   | 15  | 31  | ns   |
|   |                               | Sn to $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see Fig. 14 [3]            |     |     |     |      |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$                        | -   | 22  | 44  | ns   |
|   |                               | $V_{CC} = 5.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $C_L = 15\text{ pF}$ | -   | 19  | -   | ns   |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$                     | -   | 15  | 31  | ns   |
| C <sub>PD</sub>                           | power dissipation capacitance | per switch; $V_I = GND$ to $V_{CC} - 1.5\text{ V}$ [4]                 | -   | 36  | -   | pF   |
| <b>T<sub>amb</sub> = -40 °C to +85 °C</b> |                               |  |     |     |     |      |
| t <sub>pd</sub>                           | propagation delay             | $V_{is}$ to $V_{os}$ ; $R_L = \infty\ \Omega$ ; see Fig. 13 [1]        |     |     |     |      |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$                        | -   | -   | 15  | ns   |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$                     | -   | -   | 10  | ns   |
| t <sub>on</sub>                           | turn-on time                  | $\bar{E}$ to $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see Fig. 14 [2]     |     |     |     |      |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$                        | -   | -   | 60  | ns   |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$                     | -   | -   | 43  | ns   |
|   |                               | Sn to $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see Fig. 14 [2]            |     |     |     |      |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$                        | -   | -   | 60  | ns   |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$                     | -   | -   | 43  | ns   |
| t <sub>off</sub>                          | turn-off time                 | $\bar{E}$ to $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see Fig. 14 [3]     |     |     |     |      |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$                        | -   | -   | 55  | ns   |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$                     | -   | -   | 39  | ns   |
|   |                               | Sn to $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see Fig. 14 [3]            |     |     |     |      |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$                        | -   | -   | 55  | ns   |
|   |                               | $V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$                     | -   | -   | 39  | ns   |

| Symbol                                     | Parameter         | Conditions   | Min | Typ | Max | Unit |
|--|-------------------|--|-----|-----|-----|------|
| <b>T<sub>amb</sub> = -40 °C to +125 °C</b> |                   |  |     |     |     |      |
| t <sub>pd</sub>                            | propagation delay | V <sub>is</sub> to V <sub>os</sub> ; R <sub>L</sub> = ∞ Ω; see Fig. 13 [1] |     |     |     |      |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | -   | 18  | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | -   | 12  | ns   |
| t <sub>on</sub>                            | turn-on time      | $\bar{E}$ to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see Fig. 14 [2]      |     |     |     |      |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | -   | 72  | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | -   | 51  | ns   |
|  |                   | Sn to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see Fig. 14 [2]             |     |     |     |      |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | -   | 72  | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | -   | 51  | ns   |
| t <sub>off</sub>                           | turn-off time     | $\bar{E}$ to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see Fig. 14 [3]      |     |     |     |      |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | -   | 66  | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | -   | 47  | ns   |
|  |                   | Sn to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see Fig. 14 [3]             |     |     |     |      |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V                             | -   | -   | 66  | ns   |
|  |                   | V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V                          | -   | -   | 47  | ns   |

- [1] t<sub>pd</sub> is the same as t<sub>PHL</sub> and t<sub>PLH</sub>.
- [2] t<sub>on</sub> is the same as t<sub>PZH</sub> and t<sub>PZL</sub>.
- [3] t<sub>off</sub> is the same as t<sub>PHZ</sub> and t<sub>PLZ</sub>.
- [4] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum\{(C_L + C_{sw}) \times V_{CC}^2 \times f_o\}$  where:  
 f<sub>i</sub> = input frequency in MHz; f<sub>o</sub> = output frequency in MHz;  
 N = number of inputs switching;  $\sum\{(C_L + C_{sw}) \times V_{CC}^2 \times f_o\}$  = sum of outputs;  
 C<sub>L</sub> = output load capacitance in pF; C<sub>sw</sub> = switch capacitance in pF;  
 V<sub>CC</sub> = supply voltage in V.

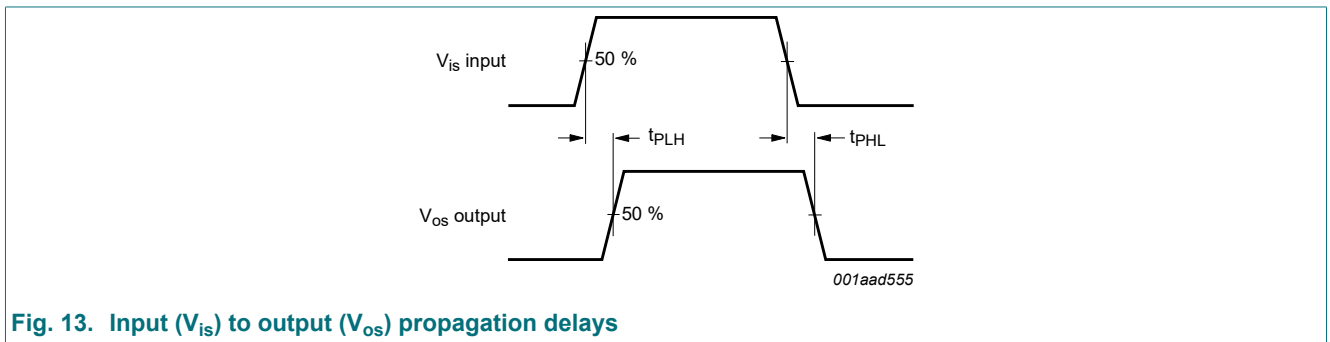
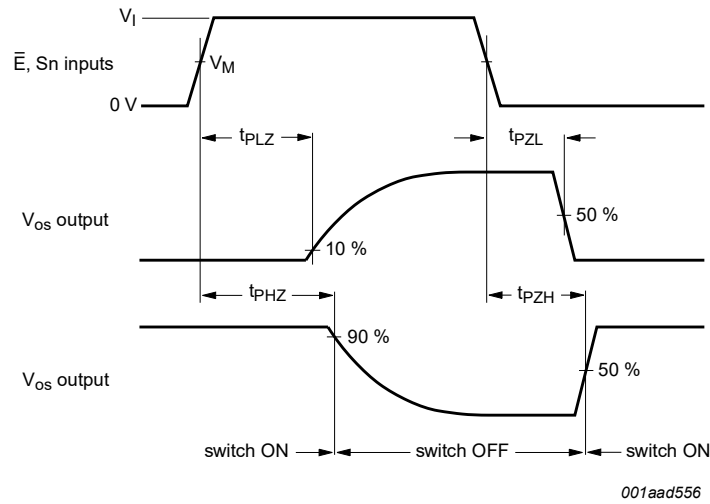
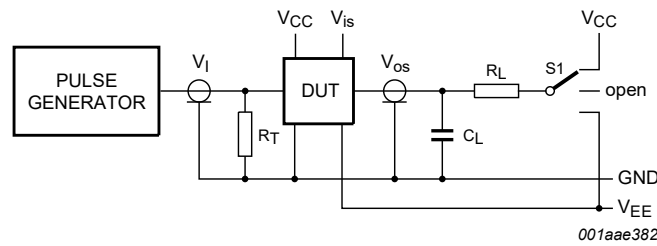
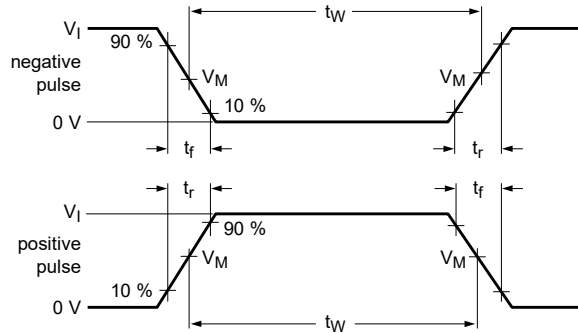


Fig. 13. Input (V<sub>is</sub>) to output (V<sub>os</sub>) propagation delays



For 74HC4053-Q100:  $V_M = 0.5 \times V_{CC}$ .  
 For 74HCT4053-Q100:  $V_M = 1.3 \text{ V}$ .

Fig. 14. Turn-on and turn-off times



Definitions for test circuit; see [Table 11](#):

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

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

$R_L$  = load resistance.

S1 = Test selection switch.

Fig. 15. Test circuit for measuring AC performance



Table 11. Test data

| Test               | Input     |          |              |           | Load  |              | S1 position |
|--------------------|-----------|----------|--------------|-----------|-------|--------------|-------------|
|                    | $V_I$ [1] | $V_{is}$ | $t_r, t_f$   |           | $C_L$ | $R_L$        |             |
|                    |           |          | at $f_{max}$ | other [2] |       |              |             |
| $t_{PHL}, t_{PLH}$ | $V_{CC}$  | pulse    | < 2 ns       | 6 ns      | 50 pF | 1 k $\Omega$ | open        |
| $t_{PZH}, t_{PHZ}$ | $V_{CC}$  | $V_{CC}$ | < 2 ns       | 6 ns      | 50 pF | 1 k $\Omega$ | $V_{EE}$    |
| $t_{PZL}, t_{PLZ}$ | $V_{CC}$  | $V_{EE}$ | < 2 ns       | 6 ns      | 50 pF | 1 k $\Omega$ | $V_{CC}$    |

[1] For 74HCT4053-Q100:  $V_I = 3$  V

[2]  $t_r = t_f = 6$  ns; when measuring  $f_{max}$ , there is no constraint to  $t_r$  and  $t_f$  with 50 % duty factor.

## 11.1. Additional dynamic characteristics

Table 12. Additional dynamic characteristics

Recommended conditions and typical values;  $GND = 0$  V;  $T_{amb} = 25$  °C;  $C_L = 50$  pF.

$V_{is}$  is the input voltage at pins nYn or nZ, whichever is assigned as an input.

$V_{os}$  is the output voltage at pins nYn or nZ, whichever is assigned as an output.

| Symbol         | Parameter                | Conditions  | Min | Typ  | Max | Unit |     |
|----------------|--------------------------|---|-----|------|-----|------|-----|
| $d_{sin}$      | sine-wave distortion     | $f_i = 1$ kHz; $R_L = 10$ k $\Omega$ ; see Fig. 16  |     |      |     |      |     |
|                |                          | $V_{is} = 4.0$ V (p-p); $V_{CC} = 2.25$ V; $V_{EE} = -2.25$ V   | -   | 0.04 | -   | %    |     |
|                |                          | $V_{is} = 8.0$ V (p-p); $V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V   | -   | 0.02 | -   | %    |     |
|                |                          | $f_i = 10$ kHz; $R_L = 10$ k $\Omega$ ; see Fig. 16   |     |      |     |      |     |
|                |                          | $V_{is} = 4.0$ V (p-p); $V_{CC} = 2.25$ V; $V_{EE} = -2.25$ V   | -   | 0.12 | -   | %    |     |
|                |                          | $V_{is} = 8.0$ V (p-p); $V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V   | -   | 0.06 | -   | %    |     |
| $\alpha_{iso}$ | isolation (OFF-state)    | $R_L = 600$ $\Omega$ ; $f_i = 1$ MHz; see Fig. 17   |     |      |     |      |     |
|                |                          | $V_{CC} = 2.25$ V; $V_{EE} = -2.25$ V   | [1] | -    | -50 | -    | dB  |
|                |                          | $V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V   | [1] | -    | -50 | -    | dB  |
| Xtalk          | crosstalk                | between two switches/multiplexers; $R_L = 600$ $\Omega$ ;<br>$f_i = 1$ MHz; see Fig. 18   |     |      |     |      |     |
|                |                          | $V_{CC} = 2.25$ V; $V_{EE} = -2.25$ V   | [1] | -    | -60 | -    | dB  |
|                |                          | $V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V   | [1] | -    | -60 | -    | dB  |
| $V_{ct}$       | crosstalk voltage        | peak-to-peak value;<br>between control and any switch;<br>$R_L = 600$ $\Omega$ ; $f_i = 1$ MHz; $\bar{E}$ or<br>Sn square wave between $V_{CC}$ and GND;<br>$t_r = t_f = 6$ ns; see Fig. 19 |     |      |     |      |     |
|                |                          | $V_{CC} = 4.5$ V; $V_{EE} = 0$ V  | -   | 110  | -   | mV   |     |
|                |                          | $V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V   | -   | 220  | -   | mV   |     |
| $f_{(-3dB)}$   | -3 dB frequency response | $R_L = 50$ $\Omega$ ; see Fig. 20   |     |      |     |      |     |
|                |                          | $V_{CC} = 2.25$ V; $V_{EE} = -2.25$ V   | [2] | -    | 160 | -    | MHz |
|                |                          | $V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V   | [2] | -    | 170 | -    | MHz |

[1] Adjust input voltage  $V_{is}$  to 0 dBm level (0 dBm = 1 mW into 600  $\Omega$ ).

[2] Adjust input voltage  $V_{is}$  to 0 dBm level at  $V_{os}$  for 1 MHz (0 dBm = 1 mW into 50  $\Omega$ ).

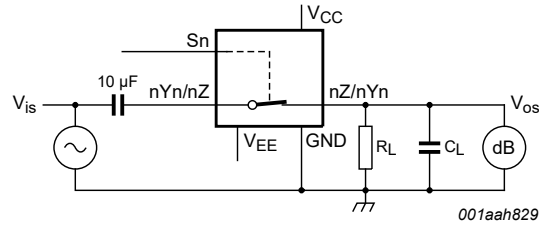
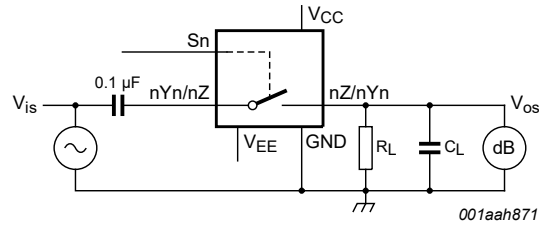
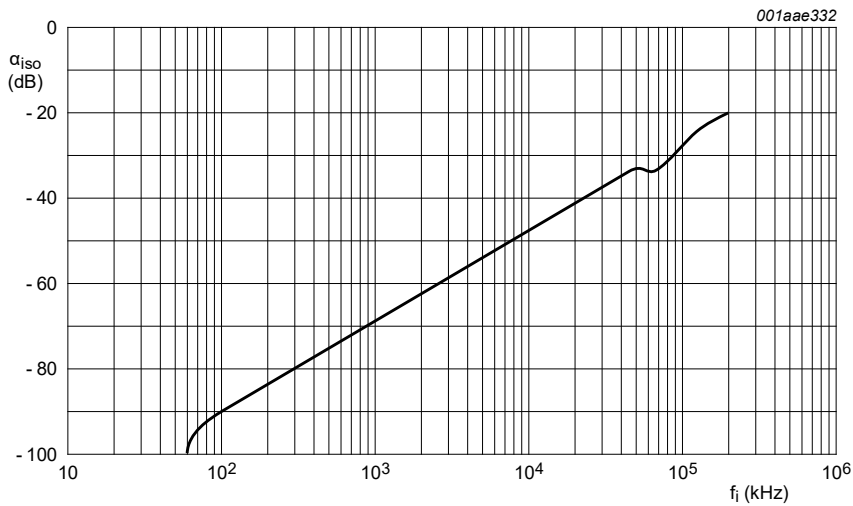


Fig. 16. Test circuit for measuring sine-wave distortion



$V_{CC} = 4.5\text{ V}$ ;  $GND = 0\text{ V}$ ;  $V_{EE} = -4.5\text{ V}$ ;  $R_L = 600\ \Omega$ ;  $R_S = 1\text{ k}\Omega$ .  
a. Test circuit



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

Fig. 17. Test circuit for measuring isolation (OFF-state)

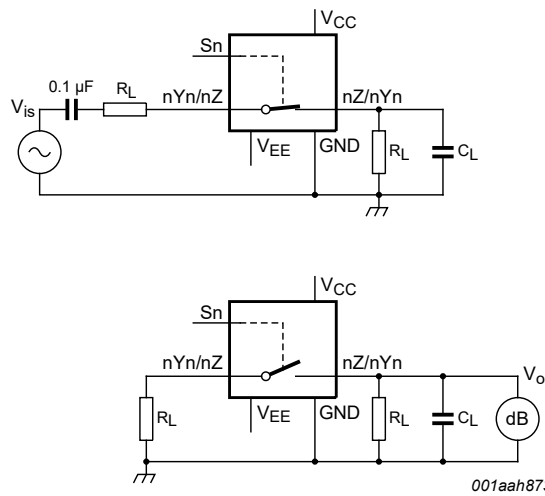


Fig. 18. Test circuits for measuring crosstalk between any two switches/multiplexers

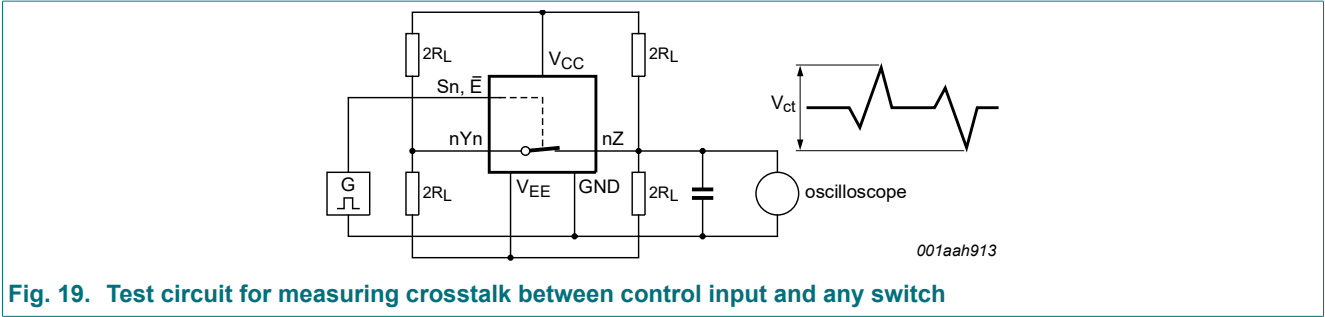


Fig. 19. Test circuit for measuring crosstalk between control input and any switch

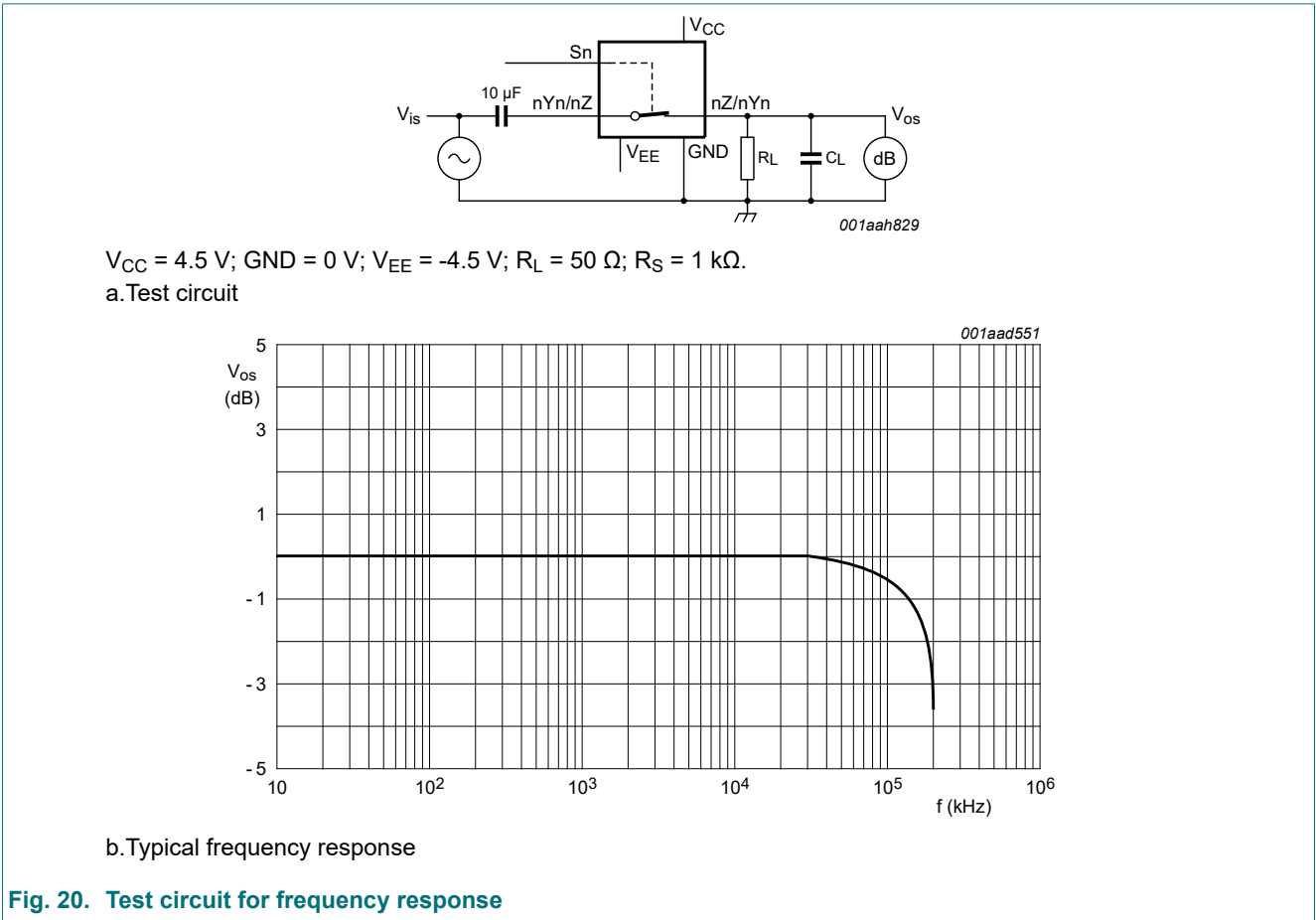


Fig. 20. Test circuit for frequency response

## 12. Package outline

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1

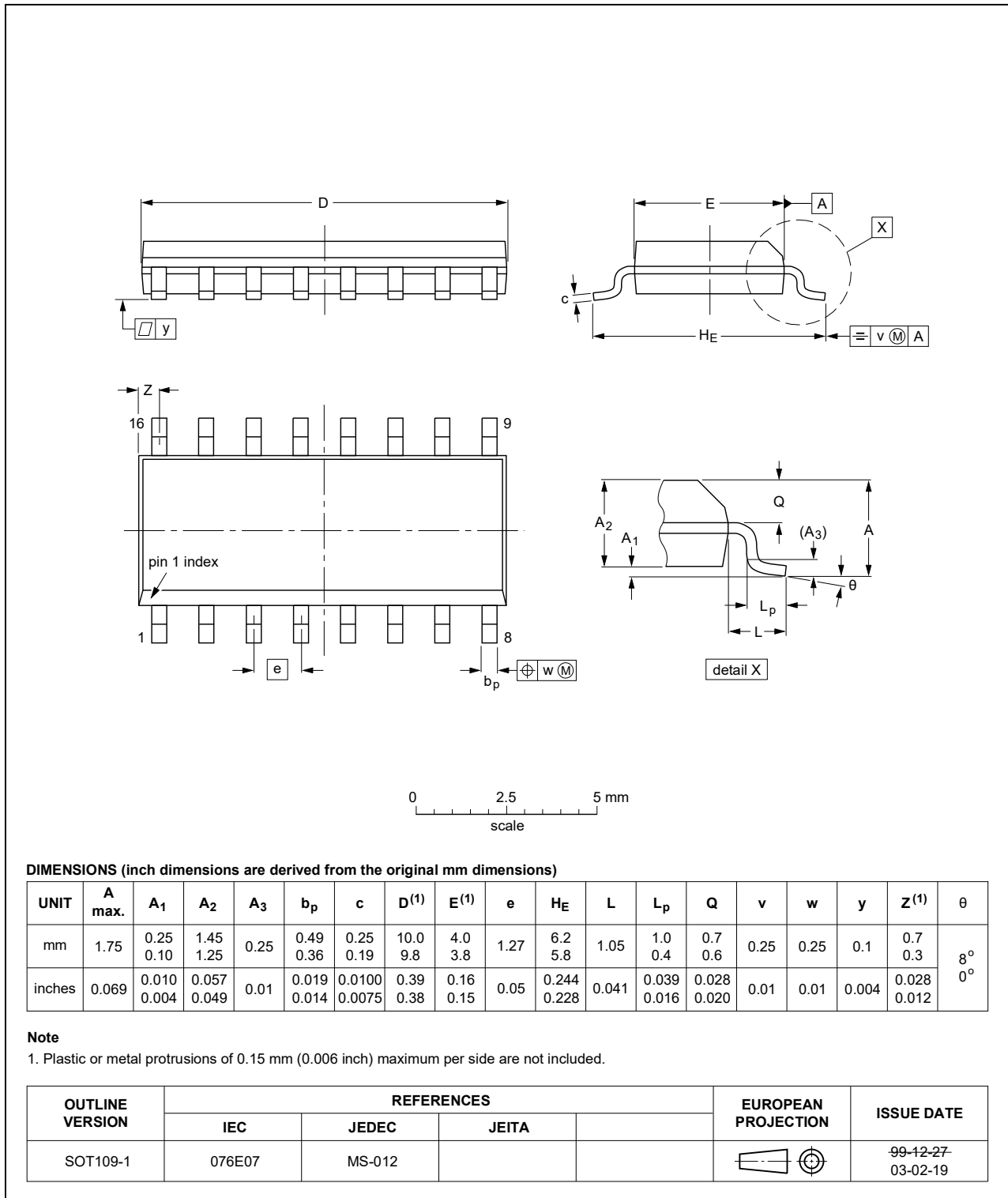


Fig. 21. Package outline SOT109-1 (SO16)

TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm

SOT403-1



Fig. 22. Package outline SOT403-1 (TSSOP16)

DHVQFN16: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 x 3.5 x 0.85 mm

SOT763-1



Fig. 23. Package outline SOT763-1 (DHVQFN16)

## 13. Abbreviations

Table 13. Abbreviations

| Acronym | Description             |
|---------|-------------------------|
| CDM     | Charged Device Model    |
| ESD     | ElectroStatic Discharge |
| HBM     | Human Body Model        |
| MIL     | Military                |
| MM      | Machine Model           |

## 14. Revision history

Table 14. Revision history

| Document ID           | Release date  | Data sheet status  | Change notice | Supersedes            |
|-----------------------|---|--------------------|---------------|-----------------------|
| 74HC_HCT4053_Q100 v.3 | 20200305  | Product data sheet | -             | 74HC_HCT4053_Q100 v.2 |
| Modifications:        | <ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li><a href="#">Section 1</a> updated.</li> <li><a href="#">Section 2</a> updated.</li> <li><a href="#">Table 4</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li> </ul> |                    |               |                       |
| 74HC_HCT4053_Q100 v.2 | 20121122  | Product data sheet | -             | 74HC_HCT4053_Q100 v.1 |
| Modifications:        | <ul style="list-style-type: none"> <li>CDM added to features.</li> </ul>  |                    |               |                       |
| 74HC_HCT4053_Q100 v.1 | 20120720  | Product data sheet | -             | -                     |

## 15. Legal information

### 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 <https://www.nexperia.com>.

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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)

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### Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: [info@moschip.ru](mailto:info@moschip.ru)

Skype отдела продаж:

moschip.ru

moschip.ru\_4

moschip.ru\_6

moschip.ru\_9