

# 74LV4053-Q100

## Triple single-pole double-throw analog switch

Rev. 1 — 25 March 2014

Product data sheet

### 1. General description

The 74LV4053-Q100 is a triple single-pole double-throw (SPDT) analog switch, suitable for use as an analog or digital multiplexer/demultiplexer. It is a low-voltage Si-gate CMOS device and is pin and function compatible with the 74HC4053-Q100 and 74HCT4053-Q100. Each switch has a digital select input ( $S_n$ ), two independent inputs/outputs ( $nY0$  and  $nY1$ ) and a common input/output ( $nZ$ ). All three switches share an enable input ( $\bar{E}$ ). A HIGH on  $\bar{E}$  causes all switches into the high-impedance OFF-state, independent of  $S_n$ .

$V_{CC}$  and GND are the supply voltage connections for the digital control inputs ( $S_n$  and  $\bar{E}$ ). The  $V_{CC}$  to GND range is 1 V to 6 V. The analog inputs/outputs ( $nY0$ ,  $nY1$  and  $nZ$ ) can swing between  $V_{CC}$  as a positive limit and  $V_{EE}$  as a negative limit.  $V_{CC} - V_{EE}$  may not exceed 6 V. For operation as a digital multiplexer/demultiplexer,  $V_{EE}$  is connected to GND (typically ground).  $V_{EE}$  and  $V_{SS}$  are the supply voltage connections for the switches.

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

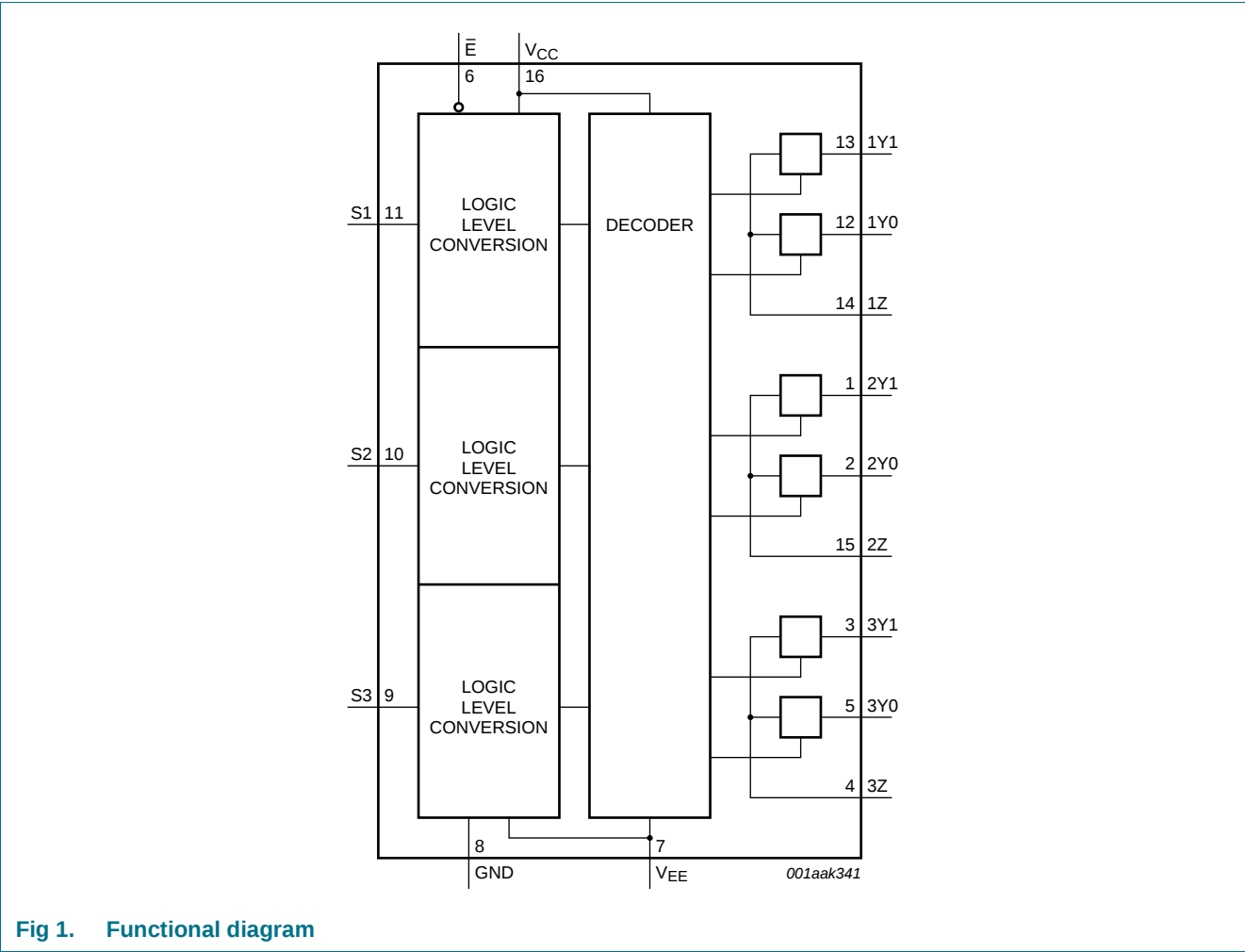
- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - ◆ Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$
- Optimized for low-voltage applications: 1.0 V to 3.6 V
- Accepts TTL input levels between  $V_{CC} = 2.7\text{ V}$  and  $V_{CC} = 3.6\text{ V}$
- Low ON resistance:
  - ◆  $180\text{ }\Omega$  (typical) at  $V_{CC} - V_{EE} = 2.0\text{ V}$
  - ◆  $100\text{ }\Omega$  (typical) at  $V_{CC} - V_{EE} = 3.0\text{ V}$
  - ◆  $75\text{ }\Omega$  (typical) at  $V_{CC} - V_{EE} = 4.5\text{ V}$
- Logic level translation:
  - ◆ To enable 3 V logic to communicate with  $\pm 3\text{ V}$  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 ( $C = 200\text{ pF}$ ,  $R = 0\text{ }\Omega$ )
- Multiple package options

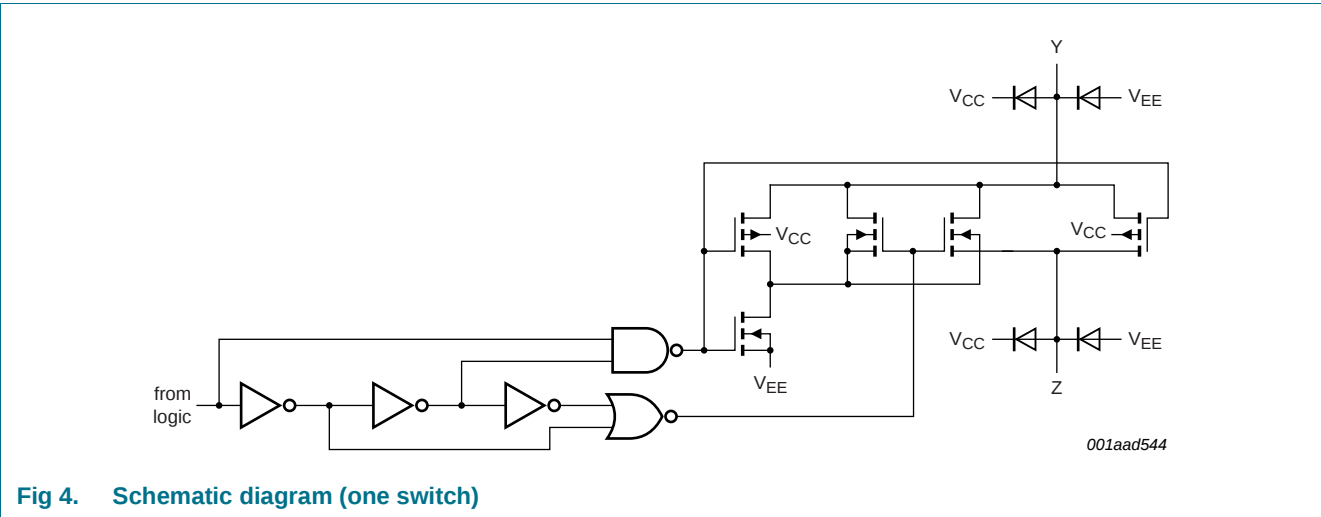
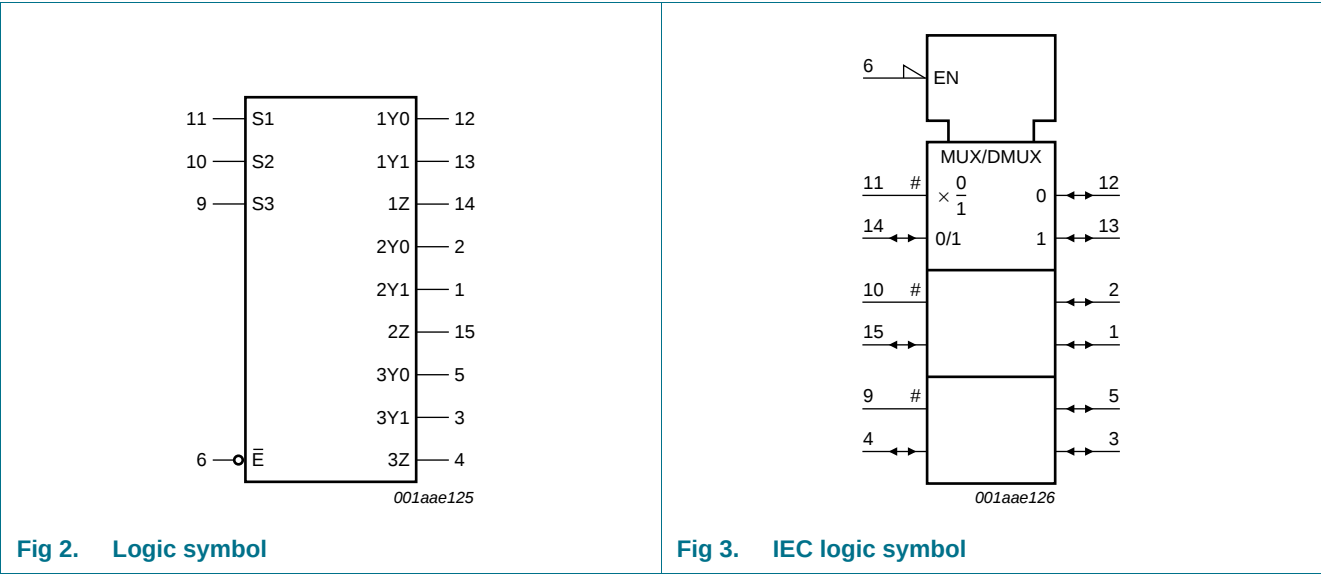
3. Ordering information

Table 1. Ordering information

| Type number     | Package           |          |                                                                                                                                |          |
|-----------------|-------------------|----------|--------------------------------------------------------------------------------------------------------------------------------|----------|
|                 | Temperature range | Name     | Description                                                                                                                    | Version  |
| 74LV4053D-Q100  | −40 °C to +125 °C | SO16     | plastic small outline package; 16 leads; body width 3.9 mm                                                                     | SOT109-1 |
| 74LV4053PW-Q100 | −40 °C to +125 °C | TSSOP16  | plastic thin shrink small outline package; 16 leads; body width 4.4 mm                                                         | SOT403-1 |
| 74LV4053BQ-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 |

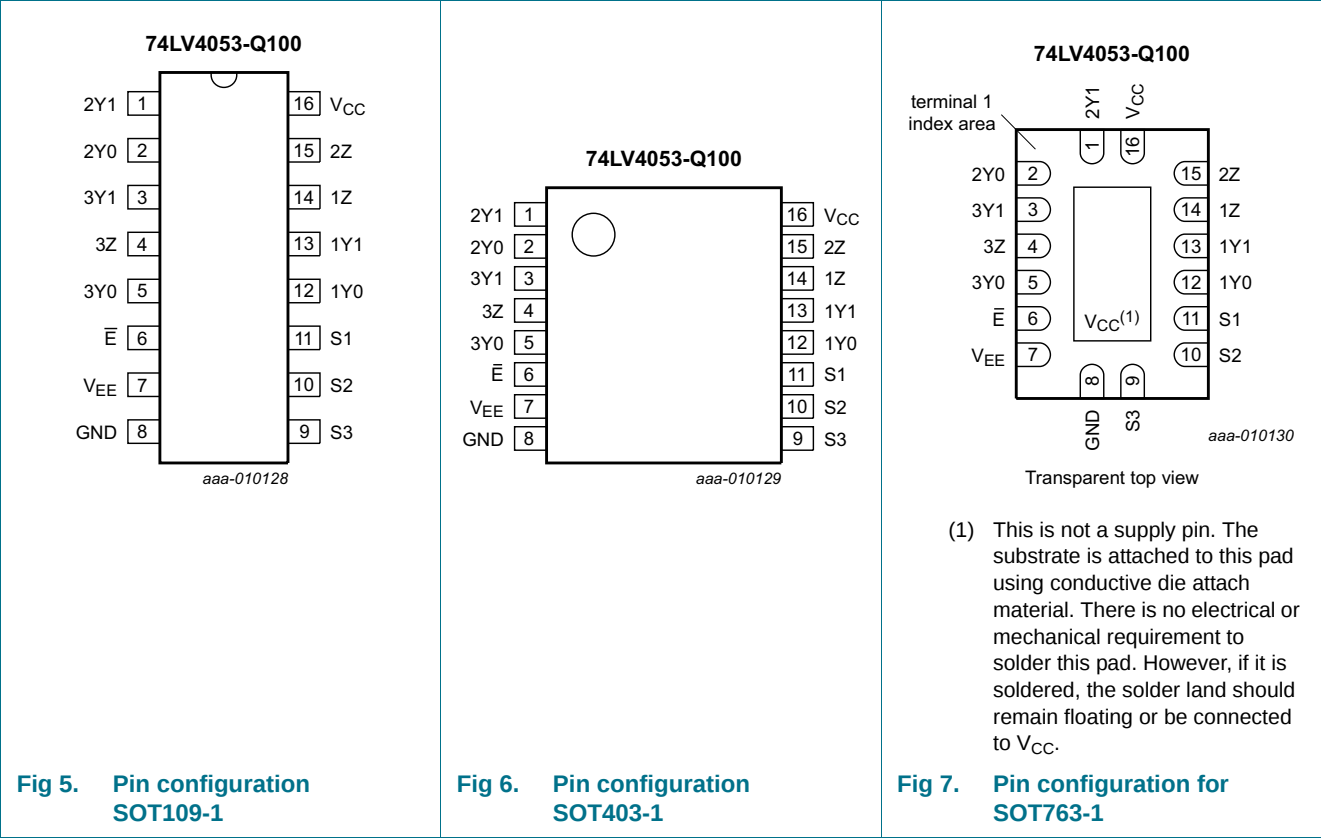
4. Functional diagram





5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

| Symbol          | Pin       | Description                 |
|-----------------|-----------|-----------------------------|
| $\overline{E}$  | 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              |

## 6. Functional description

Table 3. Function table [\[1\]](#)

| Inputs         |    | Channel on   |
|----------------|----|--------------|
| $\overline{E}$ | Sn |              |
| L              | L  | nY0 to nZ    |
| L              | H  | nY1 to nZ    |
| H              | X  | switches off |

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

## 7. 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          | <a href="#">[1]</a>                                                                        | -0.5 | +7.0     | V    |
| $I_{IK}$  | input clamping current  | $V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V <a href="#">[2]</a>                               | -    | $\pm 20$ | mA   |
| $I_{SK}$  | switch clamping current | $V_{SW} < -0.5$ V or $V_{SW} > V_{CC} + 0.5$ V <a href="#">[2]</a>                         | -    | $\pm 20$ | mA   |
| $I_{SW}$  | switch current          | $V_{SW} > -0.5$ V or $V_{SW} < V_{CC} + 0.5$ V; source or sink current <a href="#">[2]</a> | -    | $\pm 25$ | mA   |
| $T_{stg}$ | storage temperature     |                                                                                            | -65  | +150     | °C   |
| $P_{tot}$ | total power dissipation | $T_{amb} = -40$ °C to +125 °C <a href="#">[3]</a>                                          |      |          |      |
|           |                         | SO16 package                                                                               | -    | 500      | mW   |
|           |                         | TSSOP16 package                                                                            | -    | 500      | mW   |
|           |                         | DHVQFN16 package                                                                           | -    | 500      | mW   |

- [1] To avoid drawing  $V_{CC}$  current from 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 flows out of terminals nYn. In this case, there is no limit to the voltage drop across the switch. However, the voltages at nYn and nZ may not exceed  $V_{CC}$  or  $V_{EE}$ .
- [2] The minimum input voltage rating may be exceeded if the input current rating is observed.
- [3] For SO16 packages: above 70 °C the value of  $P_{tot}$  derates linearly with 8 mW/K.  
 For TSSOP16 packages: above 60 °C the value of  $P_{tot}$  derates linearly with 5.5 mW/K.  
 For DHVQFN16 packages: above 60 °C the value of  $P_{tot}$  derates linearly with 4.5 mW/K.

8. Recommended operating conditions

Table 5. Recommended operating conditions

| Symbol           | Parameter                           | Conditions                       | Min | Typ | Max             | Unit |
|------------------|-------------------------------------|----------------------------------|-----|-----|-----------------|------|
| V <sub>CC</sub>  | supply voltage                      | see <a href="#">Figure 8</a>     | 1   | 3.3 | 6               | V    |
| V <sub>I</sub>   | input voltage                       |                                  | 0   | -   | V <sub>CC</sub> | V    |
| V <sub>SW</sub>  | switch voltage                      |                                  | 0   | -   | V <sub>CC</sub> | V    |
| T <sub>amb</sub> | ambient temperature                 | in free air                      | −40 | -   | +125            | °C   |
| Δt/ΔV            | input transition rise and fall rate | V <sub>CC</sub> = 1.0 V to 2.0 V | -   | -   | 500             | ns/V |
|                  |                                     | V <sub>CC</sub> = 2.0 V to 2.7 V | -   | -   | 200             | ns/V |
|                  |                                     | V <sub>CC</sub> = 2.7 V to 3.6 V | -   | -   | 100             | ns/V |

[1] The static characteristics are guaranteed from V<sub>CC</sub> = 1.2 V to 6.0 V. However, LV devices are guaranteed to function down to V<sub>CC</sub> = 1.0 V (with input levels GND or V<sub>CC</sub>).

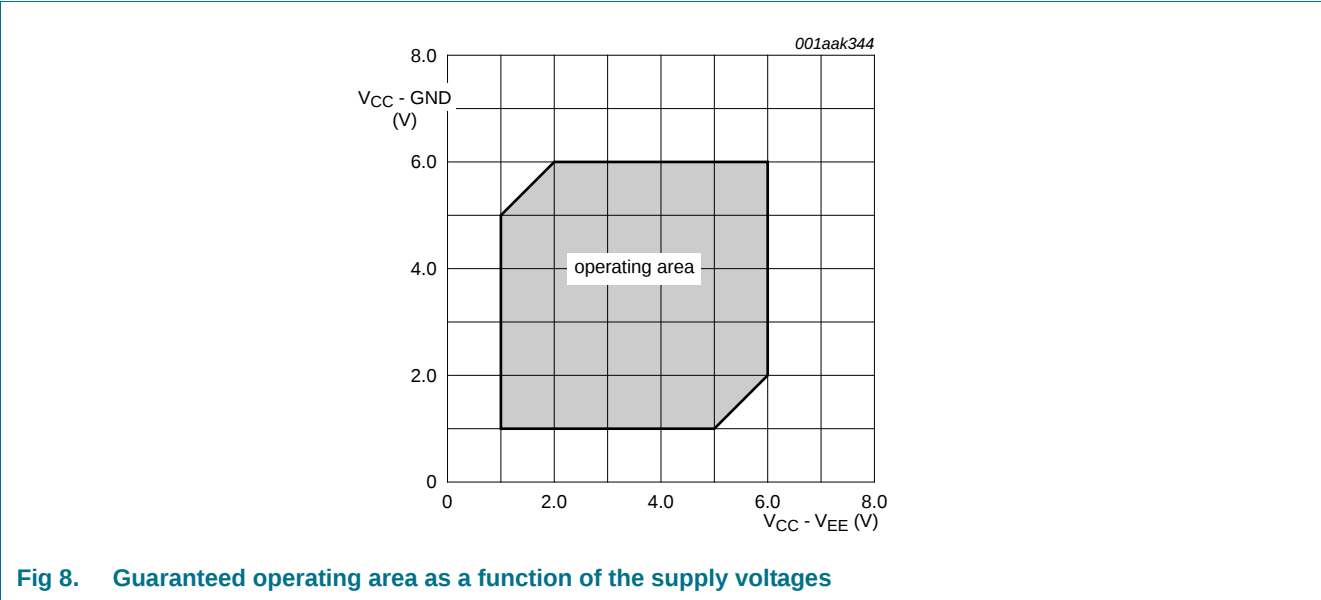


Fig 8. Guaranteed operating area as a function of the supply voltages

## 9. Static characteristics

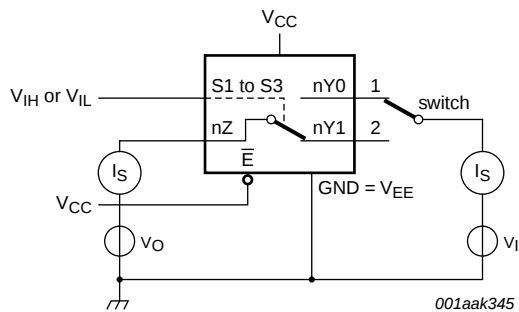
**Table 6. Static characteristics**

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

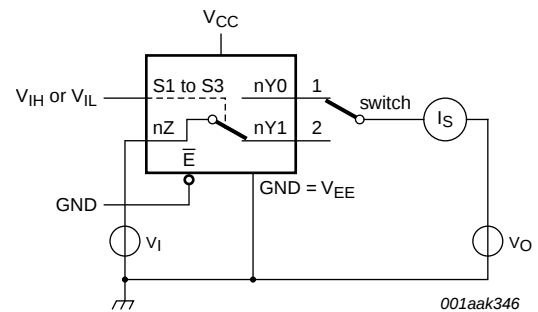
| Symbol              | Parameter                 | Conditions                                                                               | –40 °C to +85 °C |                    |      | –40 °C to +125 °C |      | Unit |
|---------------------|---------------------------|------------------------------------------------------------------------------------------|------------------|--------------------|------|-------------------|------|------|
|                     |                           |                                                                                          | Min              | Typ <sup>[1]</sup> | Max  | Min               | Max  |      |
| V <sub>IH</sub>     | HIGH-level input voltage  | V <sub>CC</sub> = 1.2 V                                                                  | 0.9              | -                  | -    | 0.9               | -    | V    |
|                     |                           | V <sub>CC</sub> = 2.0 V                                                                  | 1.4              | -                  | -    | 1.4               | -    | V    |
|                     |                           | V <sub>CC</sub> = 2.7 V to 3.6 V                                                         | 2.0              | -                  | -    | 2.0               | -    | V    |
|                     |                           | V <sub>CC</sub> = 4.5 V                                                                  | 3.15             | -                  | -    | 3.15              | -    | V    |
|                     |                           | V <sub>CC</sub> = 6.0 V                                                                  | 4.20             | -                  | -    | 4.20              | -    | V    |
| V <sub>IL</sub>     | LOW-level input voltage   | V <sub>CC</sub> = 1.2 V                                                                  | -                | -                  | 0.3  | -                 | 0.3  | V    |
|                     |                           | V <sub>CC</sub> = 2.0 V                                                                  | -                | -                  | 0.6  | -                 | 0.6  | V    |
|                     |                           | V <sub>CC</sub> = 2.7 V to 3.6 V                                                         | -                | -                  | 0.8  | -                 | 0.8  | V    |
|                     |                           | V <sub>CC</sub> = 4.5 V                                                                  | -                | -                  | 1.35 | -                 | 1.35 | V    |
|                     |                           | V <sub>CC</sub> = 6.0 V                                                                  | -                | -                  | 1.80 | -                 | 1.80 | V    |
| I <sub>I</sub>      | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND                                                  |                  |                    |      |                   |      |      |
|                     |                           | V <sub>CC</sub> = 3.6 V                                                                  | -                | -                  | 1.0  | -                 | 1.0  | μA   |
|                     |                           | V <sub>CC</sub> = 6.0 V                                                                  | -                | -                  | 2.0  | -                 | 2.0  | μA   |
| I <sub>S(OFF)</sub> | OFF-state leakage current | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; see <a href="#">Figure 9</a>       |                  |                    |      |                   |      |      |
|                     |                           | V <sub>CC</sub> = 3.6 V                                                                  | -                | -                  | 1.0  | -                 | 1.0  | μA   |
|                     |                           | V <sub>CC</sub> = 6.0 V                                                                  | -                | -                  | 2.0  | -                 | 2.0  | μA   |
| I <sub>S(ON)</sub>  | ON-state leakage current  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; see <a href="#">Figure 10</a>      |                  |                    |      |                   |      |      |
|                     |                           | V <sub>CC</sub> = 3.6 V                                                                  | -                | -                  | 1.0  | -                 | 1.0  | μA   |
|                     |                           | V <sub>CC</sub> = 6.0 V                                                                  | -                | -                  | 2.0  | -                 | 2.0  | μA   |
| I <sub>CC</sub>     | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A                            |                  |                    |      |                   |      |      |
|                     |                           | V <sub>CC</sub> = 3.6 V                                                                  | -                | -                  | 20   | -                 | 40   | μA   |
|                     |                           | V <sub>CC</sub> = 6.0 V                                                                  | -                | -                  | 40   | -                 | 80   | μA   |
| ΔI <sub>CC</sub>    | additional supply current | per input; V <sub>I</sub> = V <sub>CC</sub> – 0.6 V;<br>V <sub>CC</sub> = 2.7 V to 3.6 V | -                | -                  | 500  | -                 | 850  | 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   |

[1] Typical values are measured at T<sub>amb</sub> = 25 °C.

## 9.1 Test circuits


$$V_I = V_{CC} \text{ or } V_{EE} \text{ and } V_O = V_{EE} \text{ or } V_{CC}.$$

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



$V_I = V_{CC}$  or  $V_{EE}$  and  $V_O =$  open circuit.

**Fig 10. Test circuit for measuring ON-state leakage current**

## 9.2 ON resistance

### Table 7. ON resistance

*At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for graphs see [Figure 11](#) and [Figure 12](#).*

| Symbol                | Parameter                               | Conditions                                                       | –40 °C to +85 °C |                    |     | –40 °C to +125 °C |     | Unit |
|-----------------------|-----------------------------------------|------------------------------------------------------------------|------------------|--------------------|-----|-------------------|-----|------|
|                       |                                         |                                                                  | Min              | Typ <sup>[1]</sup> | Max | Min               | Max |      |
| R <sub>ON(peak)</sub> | ON resistance (peak)                    | V <sub>I</sub> = 0 V to V <sub>CC</sub> – V <sub>EE</sub>        |                  |                    |     |                   |     |      |
|                       |                                         | V <sub>CC</sub> = 1.2 V; I <sub>SW</sub> = 100 µA <sup>[2]</sup> | -                | -                  | -   | -                 | -   | Ω    |
|                       |                                         | V <sub>CC</sub> = 2.0 V; I <sub>SW</sub> = 1000 µA               | -                | 180                | 365 | -                 | 435 | Ω    |
|                       |                                         | V <sub>CC</sub> = 2.7 V; I <sub>SW</sub> = 1000 µA               | -                | 115                | 225 | -                 | 270 | Ω    |
|                       |                                         | V <sub>CC</sub> = 3.0 V to 3.6 V;<br>I <sub>SW</sub> = 1000 µA   | -                | 100                | 200 | -                 | 245 | Ω    |
|                       |                                         | V <sub>CC</sub> = 4.5 V; I <sub>SW</sub> = 1000 µA               | -                | 75                 | 150 | -                 | 180 | Ω    |
|                       |                                         | V <sub>CC</sub> = 6.0 V; I <sub>SW</sub> = 1000 µA               | -                | 70                 | 140 | -                 | 165 | Ω    |
| ΔR <sub>ON</sub>      | ON resistance mismatch between channels | V <sub>I</sub> = 0 V to V <sub>CC</sub> – V <sub>EE</sub>        |                  |                    |     |                   |     |      |
|                       |                                         | V <sub>CC</sub> = 1.2 V; I <sub>SW</sub> = 100 µA <sup>[2]</sup> | -                | -                  | -   | -                 | -   | Ω    |
|                       |                                         | V <sub>CC</sub> = 2.0 V; I <sub>SW</sub> = 1000 µA               | -                | 5                  | -   | -                 | -   | Ω    |
|                       |                                         | V <sub>CC</sub> = 2.7 V; I <sub>SW</sub> = 1000 µA               | -                | 4                  | -   | -                 | -   | Ω    |
|                       |                                         | V <sub>CC</sub> = 3.0 V to 3.6 V;<br>I <sub>SW</sub> = 1000 µA   | -                | 4                  | -   | -                 | -   | Ω    |
|                       |                                         | V <sub>CC</sub> = 4.5 V; I <sub>SW</sub> = 1000 µA               | -                | 3                  | -   | -                 | -   | Ω    |
|                       |                                         | V <sub>CC</sub> = 6.0 V; I <sub>SW</sub> = 1000 µA               | -                | 2                  | -   | -                 | -   | Ω    |

**Table 7.** ON resistance ...continued

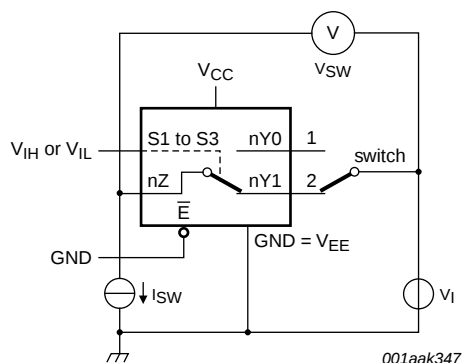
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for graphs see [Figure 11](#) and [Figure 12](#).

| Symbol                | Parameter            | Conditions                                                       | –40 °C to +85 °C |                    |     | –40 °C to +125 °C |     | Unit |
|-----------------------|----------------------|------------------------------------------------------------------|------------------|--------------------|-----|-------------------|-----|------|
|                       |                      |                                                                  | Min              | Typ <sup>[1]</sup> | Max | Min               | Max |      |
| R <sub>ON(rail)</sub> | ON resistance (rail) | V <sub>I</sub> = GND                                             |                  |                    |     |                   |     |      |
|                       |                      | V <sub>CC</sub> = 1.2 V; I <sub>SW</sub> = 100 µA <sup>[2]</sup> | -                | 250                | -   | -                 | -   | Ω    |
|                       |                      | V <sub>CC</sub> = 2.0 V; I <sub>SW</sub> = 1000 µA               | -                | 120                | 280 | -                 | 325 | Ω    |
|                       |                      | V <sub>CC</sub> = 2.7 V; I <sub>SW</sub> = 1000 µA               | -                | 75                 | 170 | -                 | 195 | Ω    |
|                       |                      | V <sub>CC</sub> = 3.0 V to 3.6 V;<br>I <sub>SW</sub> = 1000 µA   | -                | 70                 | 155 | -                 | 180 | Ω    |
|                       |                      | V <sub>CC</sub> = 4.5 V; I <sub>SW</sub> = 1000 µA               | -                | 50                 | 120 | -                 | 135 | Ω    |
|                       |                      | V <sub>CC</sub> = 6.0 V; I <sub>SW</sub> = 1000 µA               | -                | 45                 | 105 | -                 | 120 | Ω    |
| R <sub>ON(rail)</sub> | ON resistance (rail) | V <sub>I</sub> = V <sub>CC</sub> – V <sub>EE</sub>               |                  |                    |     |                   |     |      |
|                       |                      | V <sub>CC</sub> = 1.2 V; I <sub>SW</sub> = 100 µA <sup>[2]</sup> | -                | 350                | -   | -                 | -   | Ω    |
|                       |                      | V <sub>CC</sub> = 2.0 V; I <sub>SW</sub> = 1000 µA               | -                | 170                | 340 | -                 | 400 | Ω    |
|                       |                      | V <sub>CC</sub> = 2.7 V; I <sub>SW</sub> = 1000 µA               | -                | 105                | 210 | -                 | 250 | Ω    |
|                       |                      | V <sub>CC</sub> = 3.0 V to 3.6 V;<br>I <sub>SW</sub> = 1000 µA   | -                | 95                 | 190 | -                 | 225 | Ω    |
|                       |                      | V <sub>CC</sub> = 4.5 V; I <sub>SW</sub> = 1000 µA               | -                | 70                 | 140 | -                 | 165 | Ω    |
|                       |                      | V <sub>CC</sub> = 6.0 V; I <sub>SW</sub> = 1000 µA               | -                | 65                 | 125 | -                 | 150 | Ω    |

[1] Typical values are measured at T<sub>amb</sub> = 25 °C.

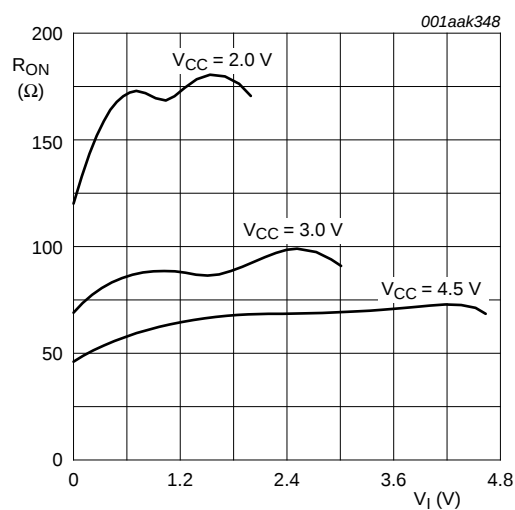
[2] When supply voltages (V<sub>CC</sub> – V<sub>EE</sub>) approach 1.2 V, the analog switch ON resistance becomes extremely non-linear. Use these devices only for transmitting digital signals, when using a supply of 1.2 V.

### 9.3 On resistance waveform and test circuit



$$R_{ON} = V_{SW} / I_{SW}.$$

**Fig 11. Test circuit for measuring  $R_{ON}$**



$$V_i = 0 \text{ V to } V_{CC} - V_{EE}$$

**Fig 12. Typical  $R_{ON}$  as a function of input voltage**

## 10. Dynamic characteristics

**Table 8. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V). For test circuit, see [Figure 15](#).

| Symbol          | Parameter         | Conditions                                                              | –40 °C to +85 °C |                    |     | –40 °C to +125 °C |     | Unit |
|-----------------|-------------------|-------------------------------------------------------------------------|------------------|--------------------|-----|-------------------|-----|------|
|                 |                   |                                                                         | Min              | Typ <sup>[1]</sup> | Max | Min               | Max |      |
| t <sub>pd</sub> | propagation delay | nYn, nZ to nZ, nYn; see <a href="#">Figure 13</a> <sup>[2]</sup>        |                  |                    |     |                   |     |      |
|                 |                   | V <sub>CC</sub> = 1.2 V                                                 | -                | 25                 | -   | -                 | -   | ns   |
|                 |                   | V <sub>CC</sub> = 2.0 V                                                 | -                | 9                  | 17  | -                 | 20  | ns   |
|                 |                   | V <sub>CC</sub> = 2.7 V                                                 | -                | 6                  | 13  | -                 | 15  | ns   |
|                 |                   | V <sub>CC</sub> = 3.0 V to 3.6 V <sup>[3]</sup>                         | -                | 5                  | 10  | -                 | 12  | ns   |
|                 |                   | V <sub>CC</sub> = 4.5 V                                                 | -                | 4                  | 9   | -                 | 10  | ns   |
|                 |                   | V <sub>CC</sub> = 6.0 V                                                 | -                | 3                  | 7   | -                 | 8   | ns   |
| t <sub>en</sub> | enable time       | $\overline{E}$ to nYn, nZ; see <a href="#">Figure 14</a> <sup>[2]</sup> |                  |                    |     |                   |     |      |
|                 |                   | V <sub>CC</sub> = 1.2 V                                                 | -                | 100                | -   | -                 | -   | ns   |
|                 |                   | V <sub>CC</sub> = 2.0 V                                                 | -                | 34                 | 65  | -                 | 77  | ns   |
|                 |                   | V <sub>CC</sub> = 2.7 V                                                 | -                | 25                 | 48  | -                 | 56  | ns   |
|                 |                   | V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 15 pF <sup>[3]</sup> | -                | 16                 | -   | -                 | -   | ns   |
|                 |                   | V <sub>CC</sub> = 3.0 V to 3.6 V <sup>[3]</sup>                         | -                | 19                 | 38  | -                 | 45  | ns   |
|                 |                   | V <sub>CC</sub> = 4.5 V                                                 | -                | 17                 | 32  | -                 | 38  | ns   |
|                 |                   | V <sub>CC</sub> = 6.0 V                                                 | -                | 13                 | 25  | -                 | 29  | ns   |
|                 |                   | Sn to nYn, nZ; see <a href="#">Figure 14</a> <sup>[2]</sup>             |                  |                    |     |                   |     |      |
|                 |                   | V <sub>CC</sub> = 1.2 V                                                 | -                | 125                | -   | -                 | -   | ns   |
|                 |                   | V <sub>CC</sub> = 2.0 V                                                 | -                | 43                 | 82  | -                 | 97  | ns   |
|                 |                   | V <sub>CC</sub> = 2.7 V                                                 | -                | 31                 | 60  | -                 | 71  | ns   |
|                 |                   | V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 15 pF <sup>[3]</sup> | -                | 20                 | -   | -                 | -   | ns   |
|                 |                   | V <sub>CC</sub> = 3.0 V to 3.6 V <sup>[3]</sup>                         | -                | 24                 | 48  | -                 | 57  | ns   |
|                 |                   | V <sub>CC</sub> = 4.5 V                                                 | -                | 21                 | 41  | -                 | 48  | ns   |
|                 |                   | V <sub>CC</sub> = 6.0 V                                                 | -                | 16                 | 31  | -                 | 37  | ns   |

**Table 8. Dynamic characteristics ...continued**Voltages are referenced to GND (ground = 0 V). For test circuit, see [Figure 15](#).

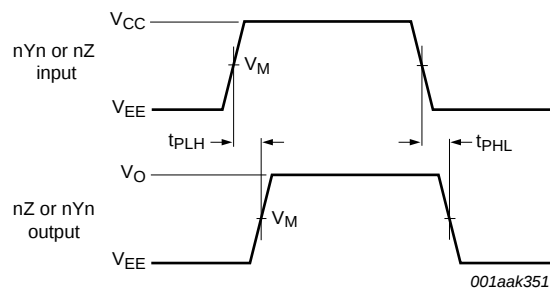
| Symbol           | Parameter                     | Conditions                                                                                                | –40 °C to +85 °C |                    |     | –40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------|------------------|--------------------|-----|-------------------|-----|------|
|                  |                               |                                                                                                           | Min              | Typ <sup>[1]</sup> | Max | Min               | Max |      |
| t <sub>dis</sub> | disable time                  | $\overline{E}$ to nYn, nZ; see <a href="#">Figure 14</a> <sup>[2]</sup>                                   |                  |                    |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 1.2 V                                                                                   | -                | 95                 | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 2.0 V                                                                                   | -                | 34                 | 61  | -                 | 73  | ns   |
|                  |                               | V <sub>CC</sub> = 2.7 V                                                                                   | -                | 26                 | 46  | -                 | 54  | ns   |
|                  |                               | V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 15 pF <sup>[3]</sup>                                   | -                | 17                 | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 3.0 V to 3.6 V <sup>[3]</sup>                                                           | -                | 20                 | 37  | -                 | 44  | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                                                   | -                | 18                 | 32  | -                 | 38  | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                                                                   | -                | 15                 | 25  | -                 | 30  | ns   |
|                  |                               | Sn to nYn, nZ; see <a href="#">Figure 14</a> <sup>[2]</sup>                                               |                  |                    |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 1.2 V                                                                                   | -                | 90                 | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 2.0 V                                                                                   | -                | 32                 | 59  | -                 | 70  | ns   |
|                  |                               | V <sub>CC</sub> = 2.7 V                                                                                   | -                | 24                 | 44  | -                 | 52  | ns   |
|                  |                               | V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 15 pF <sup>[3]</sup>                                   | -                | 16                 | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 3.0 V to 3.6 V <sup>[3]</sup>                                                           | -                | 19                 | 36  | -                 | 42  | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                                                   | -                | 17                 | 31  | -                 | 36  | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                                                                   | -                | 14                 | 24  | -                 | 28  | ns   |
| C <sub>PD</sub>  | power dissipation capacitance | C <sub>L</sub> = 50 pF; f <sub>i</sub> = 1 MHz; <sup>[4]</sup><br>V <sub>I</sub> = GND to V <sub>CC</sub> | -                | 36                 | -   | -                 | -   | pF   |

[1] All typical values are measured at T<sub>amb</sub> = 25 °C.[2] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.t<sub>en</sub> is the same as t<sub>PZL</sub> and t<sub>PZH</sub>.t<sub>dis</sub> is the same as t<sub>PLZ</sub> and t<sub>PHZ</sub>.[3] Typical values are measured at nominal supply voltage (V<sub>CC</sub> = 3.3 V).[4] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).P<sub>D</sub> = C<sub>PD</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>i</sub> × N + Σ((C<sub>L</sub> + C<sub>SW</sub>) × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) where:f<sub>i</sub> = input frequency in MHz, f<sub>o</sub> = output frequency in MHzC<sub>L</sub> = output load capacitance in pFC<sub>SW</sub> = maximum switch capacitance in pF;V<sub>CC</sub> = supply voltage in Volts

N = number of inputs switching

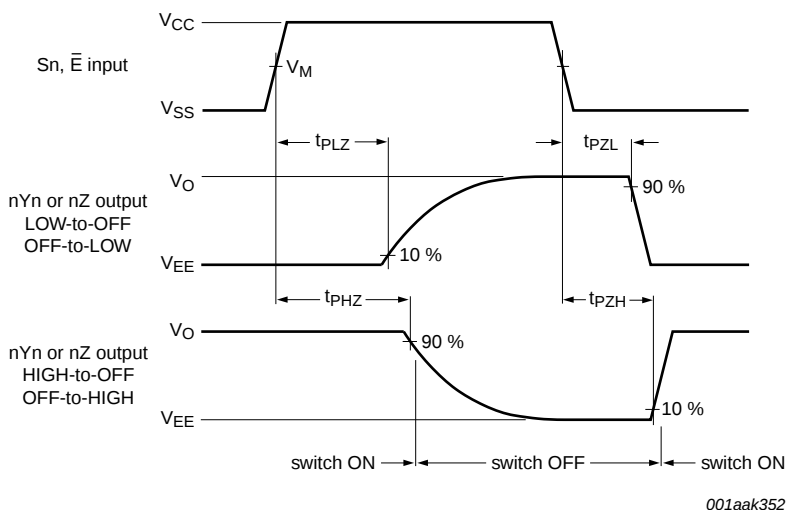
Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of the outputs.

10.1 Waveforms



Measurement points are given in [Table 9](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

Fig 13. nYn, nZ to nZ, nYn propagation delays

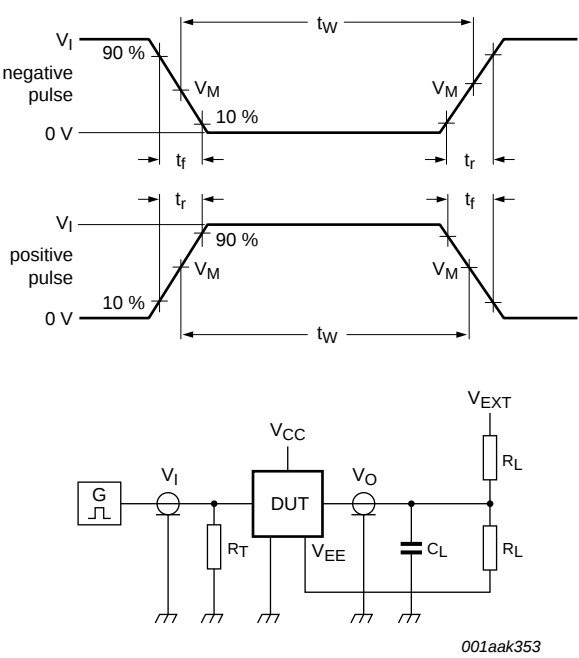


Measurement points are given in [Table 9](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

Fig 14. Enable and disable times

Table 9. Measurement points

| Supply voltage | Input       | Output      |                      |                      |
|----------------|-------------|-------------|----------------------|----------------------|
| $V_{CC}$       | $V_M$       | $V_M$       | $V_X$                | $V_Y$                |
| < 2.7 V        | $0.5V_{CC}$ | $0.5V_{CC}$ | $V_{OL} + 0.1V_{CC}$ | $V_{OH} - 0.1V_{CC}$ |
| 2.7 V to 3.6 V | 1.5 V       | 1.5 V       | $V_{OL} + 0.3 V$     | $V_{OH} - 0.3 V$     |
| > 3.6 V        | $0.5V_{CC}$ | $0.5V_{CC}$ | $V_{OL} + 0.1V_{CC}$ | $V_{OH} - 0.1V_{CC}$ |



Test data is given in [Table 10](#).  
Definitions for test circuit:  
 $R_L$  = Load resistance.  
 $C_L$  = Load capacitance including jig and probe capacitance.  
 $R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator.  
 $V_{EXT}$  = External voltage for measuring switching times.

Fig 15. Test circuit for measuring switching times

Table 10. Test data

| Supply voltage | Input    |             | Load         |              | $V_{EXT}$          |                    |                    |
|----------------|----------|-------------|--------------|--------------|--------------------|--------------------|--------------------|
| $V_{CC}$       | $V_I$    | $t_r, t_f$  | $C_L$        | $R_L$        | $t_{PHL}, t_{PLH}$ | $t_{PZH}, t_{PHZ}$ | $t_{PZL}, t_{PLZ}$ |
| < 2.7 V        | $V_{CC}$ | $\leq 6$ ns | 50 pF        | 1 k $\Omega$ | open               | $V_{EE}$           | $2V_{CC}$          |
| 2.7 V to 3.6 V | 2.7 V    | $\leq 6$ ns | 15 pF, 50 pF | 1 k $\Omega$ | open               | $V_{EE}$           | $2V_{CC}$          |
| > 3.6 V        | $V_{CC}$ | $\leq 6$ ns | 50 pF        | 1 k $\Omega$ | open               | $V_{EE}$           | $2V_{CC}$          |

## 10.2 Additional dynamic parameters

**Table 11. Additional dynamic characteristics**

At recommended operating conditions. Voltages are referenced to GND (ground = 0 V).  $V_I$  = GND or  $V_{CC}$  (unless otherwise specified).  $t_r = t_f \leq 6.0$  ns;  $T_{amb} = 25$  °C.

| Symbol         | Parameter                 | Conditions                                                                                                                              | Min | Typ  | Max | Unit |
|----------------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----|------|-----|------|
| THD            | total harmonic distortion | $f_i = 1$ kHz; $C_L = 50$ pF; $R_L = 10$ k $\Omega$ ; see <a href="#">Figure 20</a>                                                     |     |      |     |      |
|                |                           | $V_{CC} = 3.0$ V; $V_I = 2.75$ V (p-p)                                                                                                  | -   | 0.8  | -   | %    |
|                |                           | $V_{CC} = 6.0$ V; $V_I = 5.5$ V (p-p)                                                                                                   | -   | 0.4  | -   | %    |
|                |                           | $f_i = 10$ kHz; $C_L = 50$ pF; $R_L = 10$ k $\Omega$ ; see <a href="#">Figure 20</a>                                                    |     |      |     |      |
|                |                           | $V_{CC} = 3.0$ V; $V_I = 2.75$ V (p-p)                                                                                                  | -   | 2.4  | -   | %    |
|                |                           | $V_{CC} = 6.0$ V; $V_I = 5.5$ V (p-p)                                                                                                   | -   | 1.2  | -   | %    |
| $f_{(-3dB)}$   | –3 dB frequency response  | $C_L = 50$ pF; $R_L = 50$ $\Omega$ ; see <a href="#">Figure 16</a> <sup>[1]</sup>                                                       |     |      |     |      |
|                |                           | $V_{CC} = 3.0$ V                                                                                                                        | -   | 180  | -   | MHz  |
|                |                           | $V_{CC} = 6.0$ V                                                                                                                        | -   | 200  | -   | MHz  |
| $\alpha_{iso}$ | isolation (OFF-state)     | $f_i = 1$ MHz; $C_L = 50$ pF; $R_L = 600$ $\Omega$ ; see <a href="#">Figure 18</a> <sup>[2]</sup>                                       |     |      |     |      |
|                |                           | $V_{CC} = 3.0$ V                                                                                                                        | -   | –50  | -   | dB   |
|                |                           | $V_{CC} = 6.0$ V                                                                                                                        | -   | –50  | -   | dB   |
| $V_{ct}$       | crosstalk voltage         | between digital inputs and switch; <sup>[2]</sup><br>$f_i = 1$ MHz; $C_L = 50$ pF; $R_L = 600$ $\Omega$ ; see <a href="#">Figure 21</a> |     |      |     |      |
|                |                           | $V_{CC} = 3.0$ V                                                                                                                        | -   | 0.11 | -   | V    |
|                |                           | $V_{CC} = 6.0$ V                                                                                                                        | -   | 0.12 | -   | V    |
| Xtalk          | crosstalk                 | between switches; $f_i = 1$ MHz; $C_L = 50$ pF; $R_L = 600$ $\Omega$ ; see <a href="#">Figure 22</a>                                    |     |      |     |      |
|                |                           | $V_{CC} = 3.0$ V                                                                                                                        | -   | –60  | -   | dB   |
|                |                           | $V_{CC} = 6.0$ V                                                                                                                        | -   | –60  | -   | dB   |

[1] To obtain 0 dBm level at output for 1 MHz, adjust  $f_i$  voltage (0 dBm = 1 mW into 50  $\Omega$ ).

[2] To obtain 0 dBm level at output for 1 MHz, adjust  $f_i$  voltage (0 dBm = 1 mW into 600  $\Omega$ ).

10.2.1 Test circuits

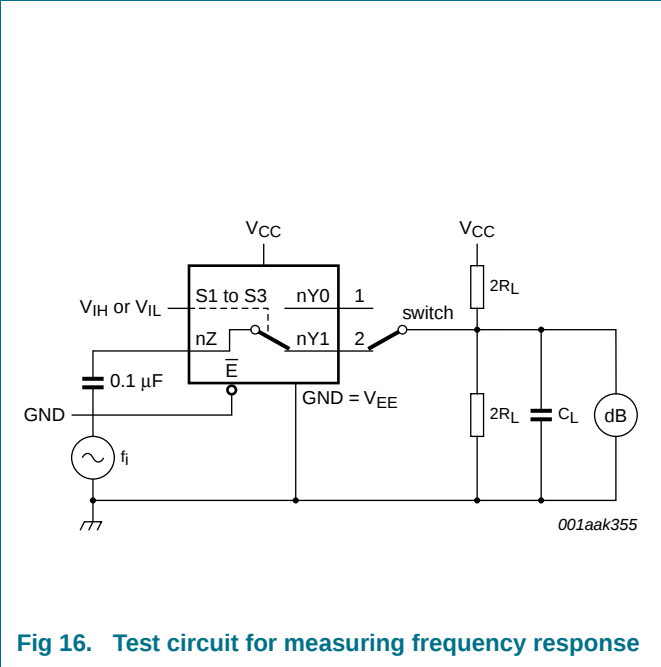


Fig 16. Test circuit for measuring frequency response

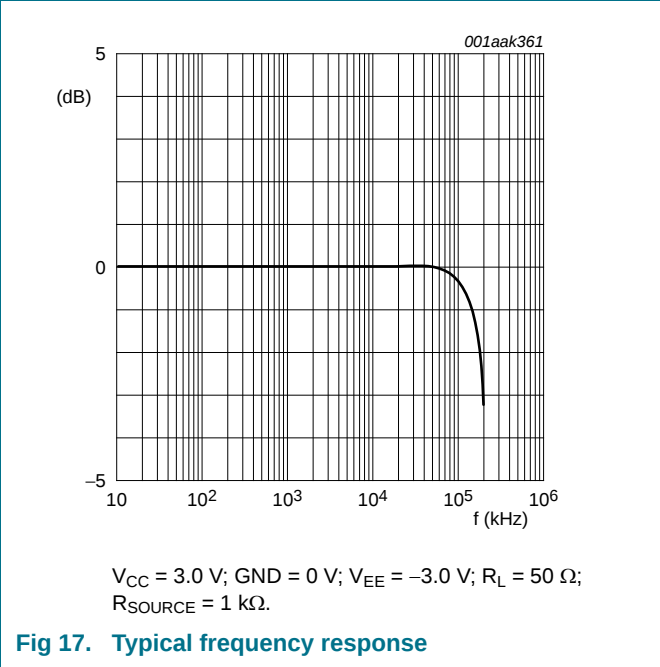


Fig 17. Typical frequency response

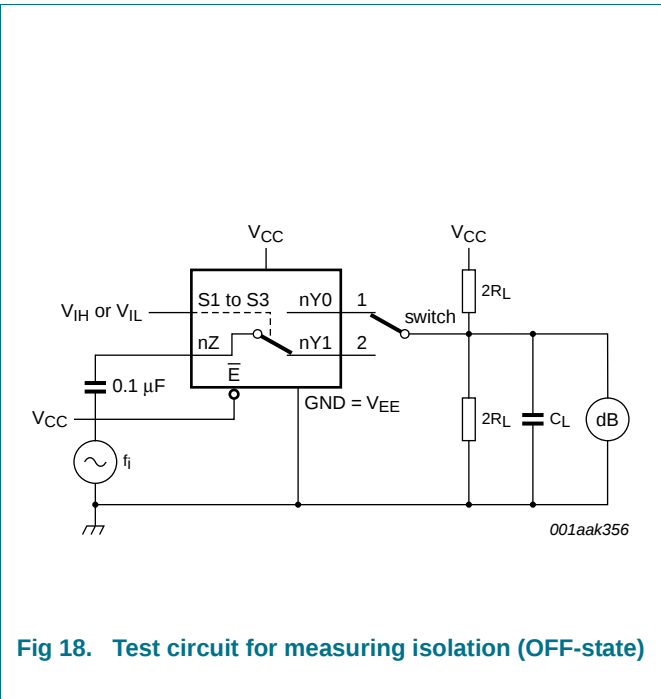


Fig 18. Test circuit for measuring isolation (OFF-state)

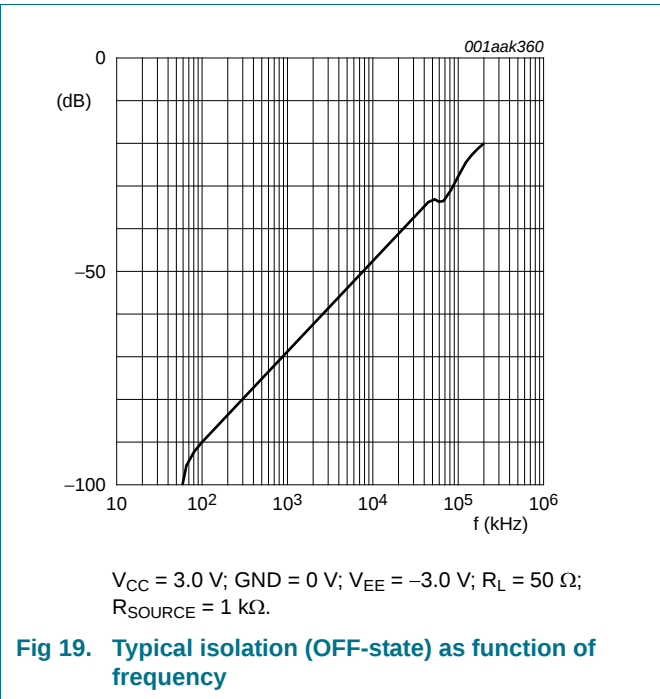


Fig 19. Typical isolation (OFF-state) as function of frequency

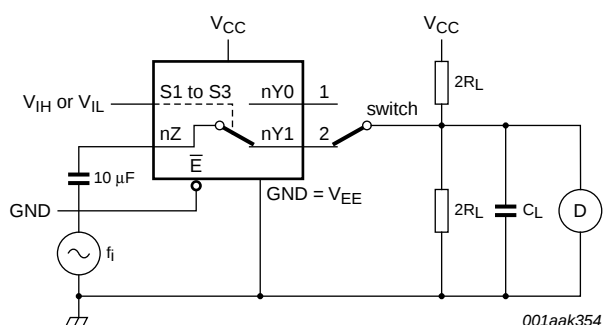
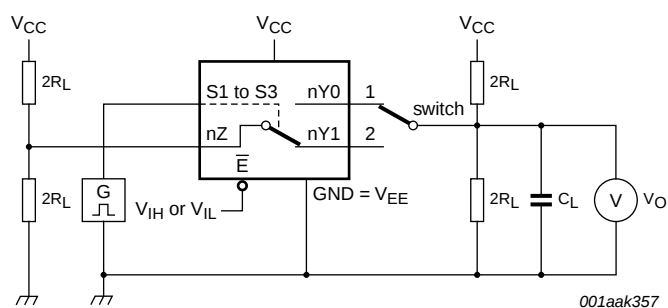
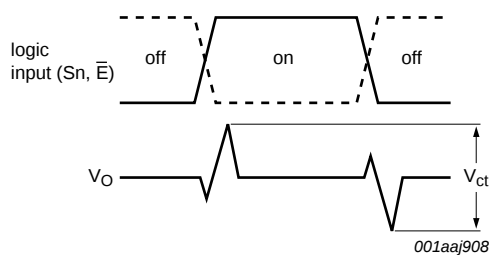


Fig 20. Test circuit for measuring total harmonic distortion



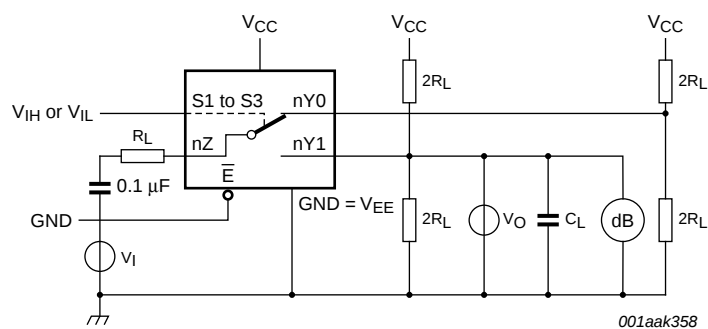
a. Test circuit



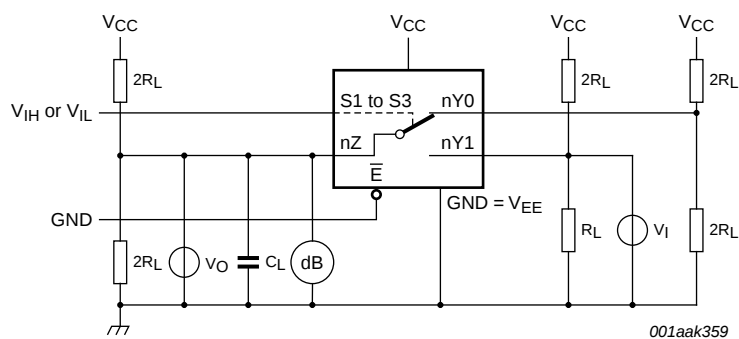
b. Input and output pulse definitions

$V_I$  may be connected to  $S_n$  or  $\bar{E}$ .

Fig 21. Test circuit for measuring crosstalk voltage between digital inputs and switch



a. Switch closed condition



b. Switch open condition

**Fig 22. Test circuit for measuring crosstalk between switches**

11. Package outline

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

SOT109-1

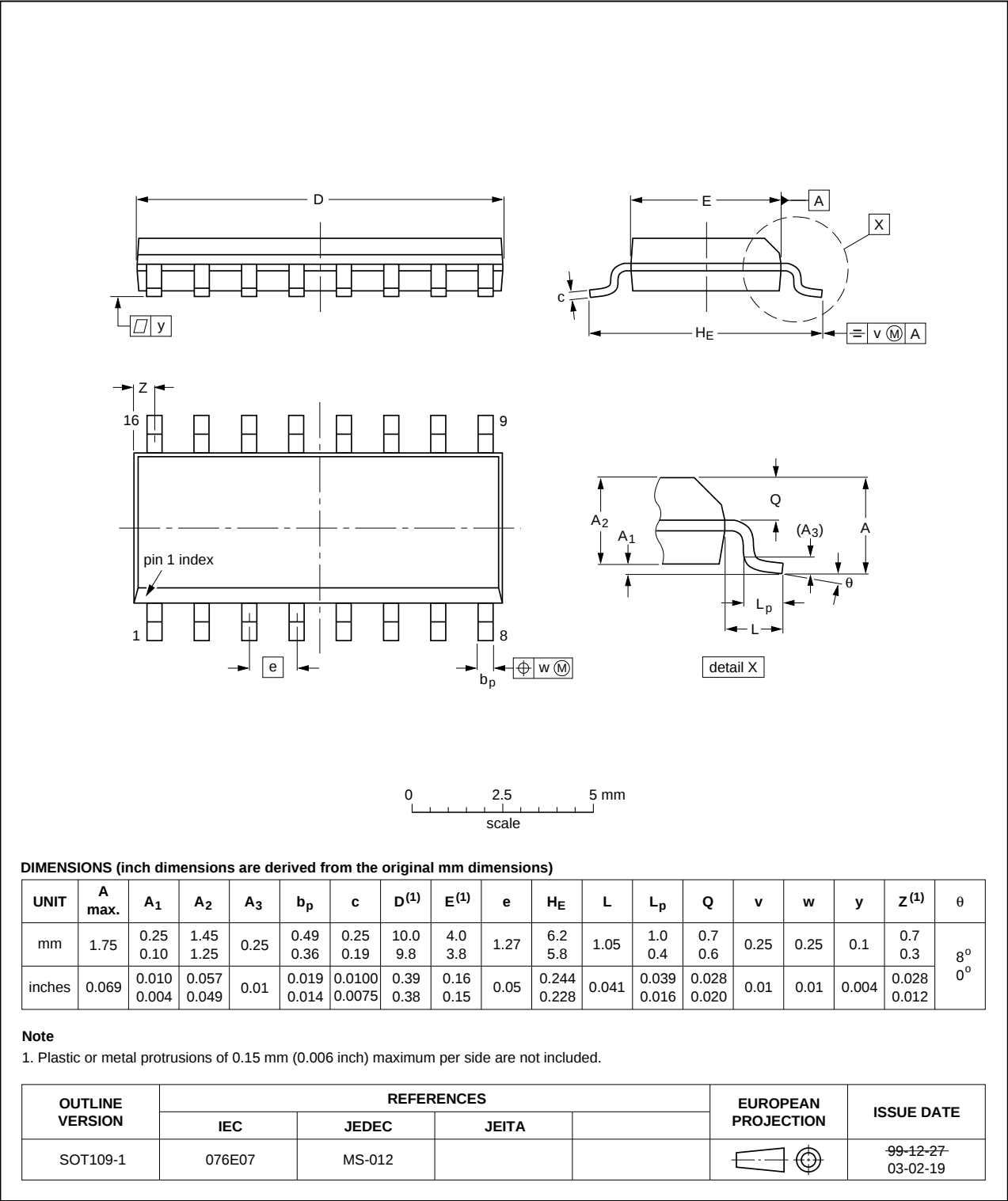
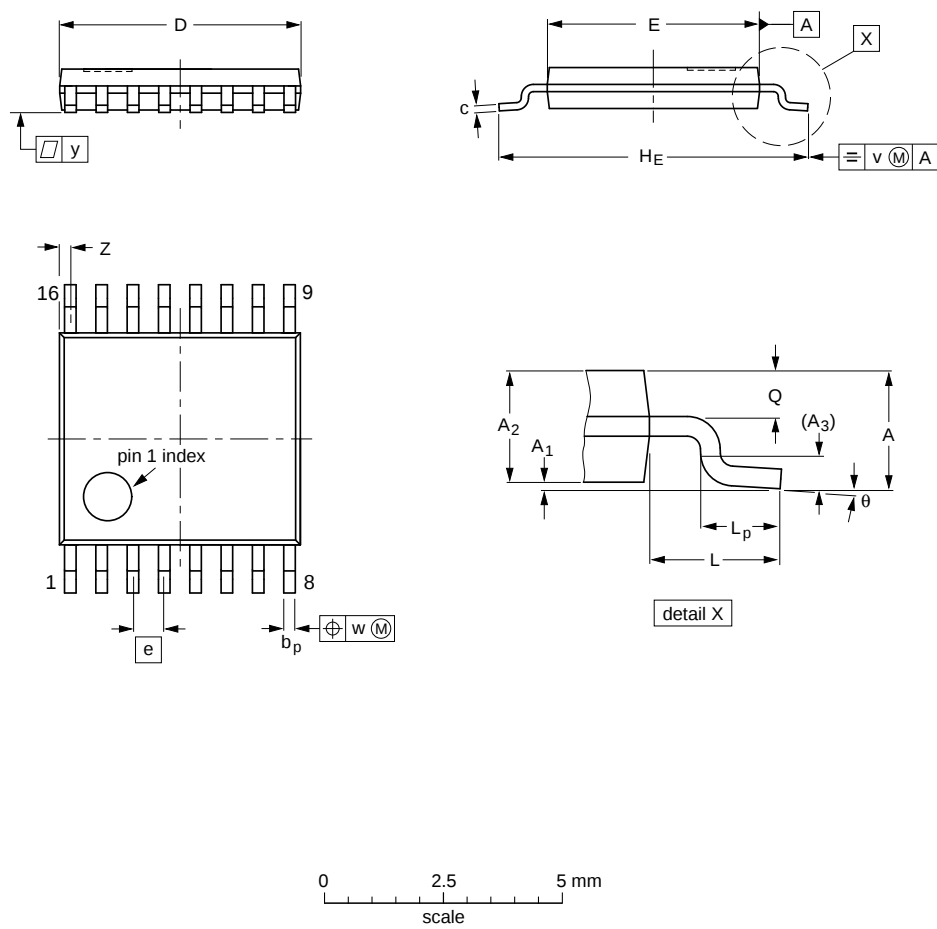


Fig 23. Package outline SOT109-1 (SO16)

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

SOT403-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A<br>max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c          | D <sup>(1)</sup> | E <sup>(2)</sup> | e    | H <sub>E</sub> | L | L <sub>p</sub> | Q          | v   | w    | y   | z <sup>(1)</sup> | θ        |
|------|-----------|----------------|----------------|----------------|----------------|------------|------------------|------------------|------|----------------|---|----------------|------------|-----|------|-----|------------------|----------|
| mm   | 1.1       | 0.15<br>0.05   | 0.95<br>0.80   | 0.25           | 0.30<br>0.19   | 0.2<br>0.1 | 5.1<br>4.9       | 4.5<br>4.3       | 0.65 | 6.6<br>6.2     | 1 | 0.75<br>0.50   | 0.4<br>0.3 | 0.2 | 0.13 | 0.1 | 0.40<br>0.06     | 8°<br>0° |

Notes

- 1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
- 2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |        |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE            |
|--------------------|------------|--------|-------|--|------------------------|-----------------------|
|                    | IEC        | JEDEC  | JEITA |  |                        |                       |
| SOT403-1           |            | MO-153 |       |  |                        | -99-12-27<br>03-02-18 |

Fig 24. 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

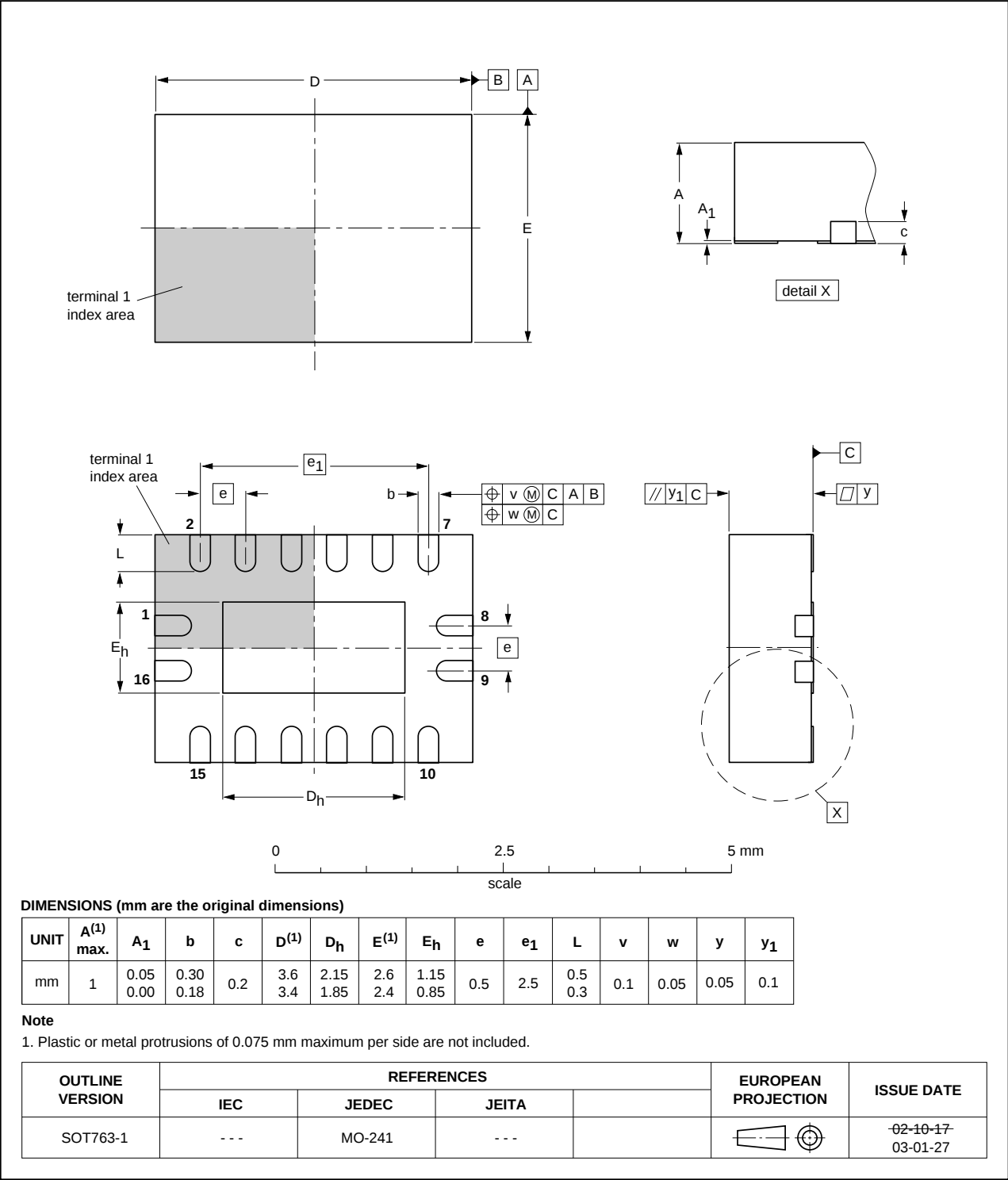


Fig 25. Package outline SOT763-1 (DHVQFN16)

## 12. Abbreviations

Table 12. Abbreviations

| Acronym | Description                             |
|---------|-----------------------------------------|
| CMOS    | Complementary Metal-Oxide Semiconductor |
| ESD     | ElectroStatic Discharge                 |
| HBM     | Human Body Model                        |
| MIL     | Military                                |
| MM      | Machine Model                           |
| TTL     | Transistor-Transistor Logic             |

## 13. Revision history

Table 13. Revision history

| Document ID       | Release date | Data sheet status  | Change notice | Supersedes |
|-------------------|--------------|--------------------|---------------|------------|
| 74LV4053_Q100 v.1 | 20140325     | Product data sheet | -             | -          |

## 14. Legal information

### 14.1 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".

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