



XS5A1T4157

Low-ohmic single-pole double-throw analog switch

Rev. 2.1 — 31 July 2024

Product data sheet

1. General description

The XS5A1T4157 is a low-ohmic single-pole double-throw analog switch suitable for use as an analog or digital 2:1 multiplexer/demultiplexer. It has a digital select input (S), two inputs/outputs (Y0 and Y1) and a common input/output (Z).

The XS5A1T4157 passes analog and digital voltages that may vary across the full voltage supply range (GND to V_{CC}).

2. Features and benefits

- Supply voltage range from $V_{CC} = 4.5\text{ V}$ to 5.5 V
- Very low ON resistance: $4\ \Omega$ (typical) at $V_{CC} = 5\text{ V}$
- Switch inputs voltage range: $V_{SW} = \text{GND to } V_{CC}$
- Control input voltage range: $V_{I(S)} = \text{GND to } V_{CC}$
- Latch-up performance exceeds 200 mA per JESD 78 Class II level A
- ESD protection:
 - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
 - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$

3. Ordering information

Table 1. Ordering information

| Type number | Package | | | |
|------------------------------|---|--------|--|--------------------------|
| | Temperature range | Name | Description | Version |
| XS5A1T4157GW | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | TSSOP6 | plastic thin shrink small outline package; 6 leads; body width 1.25 mm | SOT363-2 |

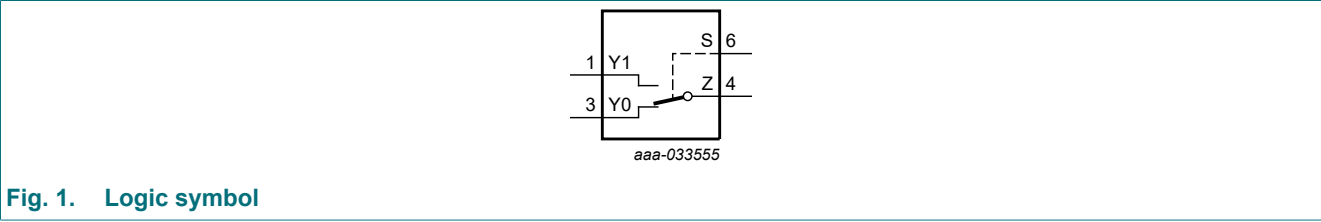
4. Marking

Table 2. Marking codes

| Type number | Marking code[1] |
|--------------|-----------------|
| XS5A1T4157GW | zb |

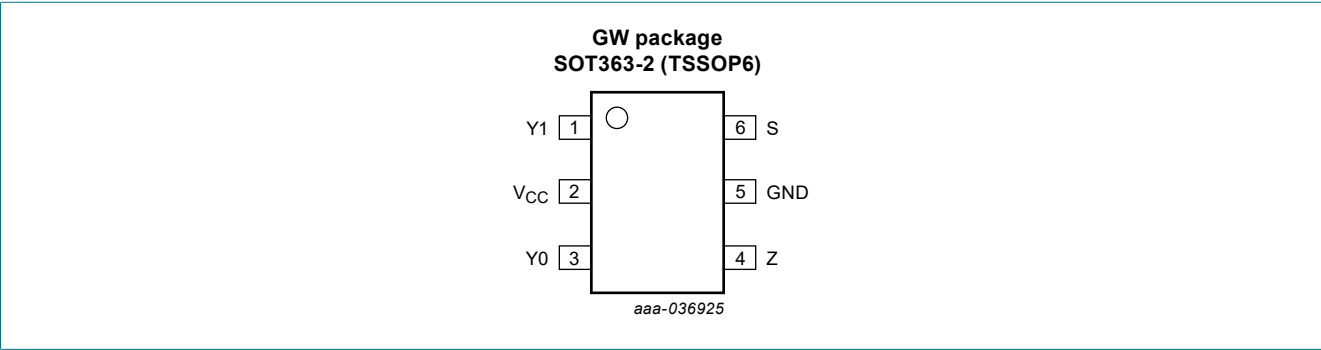
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

5. Functional diagram



6. Pinning information

6.1. Pinning



6.2. Pin description

Table 3. Pin description

| Symbol | Pin | Description |
|-----------------|-----|-----------------------------|
| Y1 | 1 | independent input or output |
| V _{CC} | 2 | supply voltage |
| Y0 | 3 | independent input or output |
| Z | 4 | common output or input |
| GND | 5 | ground (0 V) |
| S | 6 | select input |

7. Functional description

Table 4. Function table

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

| Input | Channel on |
|-------|------------|
| S | |
| L | Y0 |
| H | Y1 |

8. Limiting values

Table 5. Limiting values

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

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---------------------|------------------------------|---|-------|-----------------------|------|
| V _{CC} | supply voltage | | -0.5 | +6.5 | V |
| V _I | input voltage | S input [1] | -0.5 | +6.5 | V |
| I _{IK} | input clamping current | S input; V _I < -0.5 V | -50 | - | mA |
| I _{SK} | switch clamping current | Z, Y0 and Y1 inputs/outputs; V _{SW} < -0.5 V or V _{SW} > V _{CC} + 0.5 V | - | ±50 | mA |
| V _{SW} | switch voltage | Z, Y0 and Y1 inputs/outputs [2] | - 0.5 | V _{CC} + 0.5 | V |
| I _{SW} | switch current | Z, Y0 and Y1 inputs/outputs; -0.5 V < V _{SW} < V _{CC} + 0.5 V [3] | - | ±128 | mA |
| T _{j(max)} | maximum junction temperature | | - | +150 | °C |
| T _{stg} | storage temperature | | -65 | +150 | °C |
| P _{tot} | total power dissipation | T _{amb} = -40 °C to +125 °C [4] | - | 250 | mW |

- [1] The minimum input voltage rating may be exceeded if the input current rating is observed.
[2] The minimum and maximum switch voltage ratings may be exceeded if the switch clamping current rating is observed.
[3] Continuous current sustained maximum of 2 years.
[4] For SOT363-2 (TSSOP6) package: P_{tot} derates linearly with 3.7 mW/K above 83 °C.

9. Recommended operating conditions

Table 6. Recommended operating conditions

| Symbol | Parameter | Conditions | Min | Max | Unit |
|------------------|-------------------------------------|--|-----|-----------------|------|
| V _{CC} | supply voltage | | 4.5 | 5.5 | V |
| V _I | input voltage | S input | 0 | 5.5 | V |
| V _{SW} | switch voltage | Z, Y0 and Y1 inputs/outputs | 0 | V _{CC} | V |
| I _{SW} | switch current | Z, Y0 and Y1 inputs/outputs; -0.5 V < V _{SW} < V _{CC} + 0.5 V | - | ±64 | mA |
| T _{amb} | ambient temperature | | -40 | +125 | °C |
| Δt/ΔV | input transition rise and fall rate | S input | - | 100 | ns/V |

10. Static characteristics

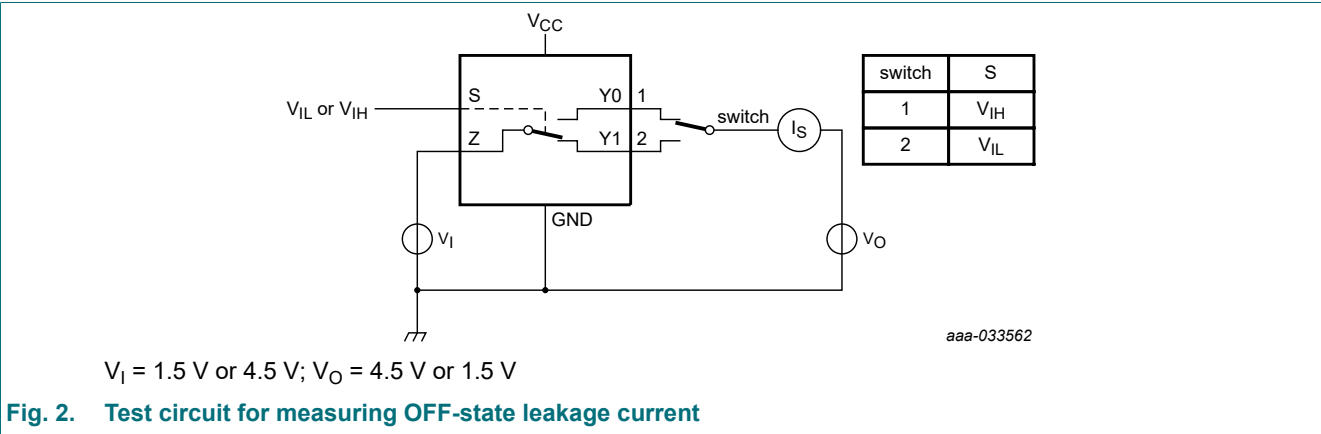
Table 7. Static characteristics

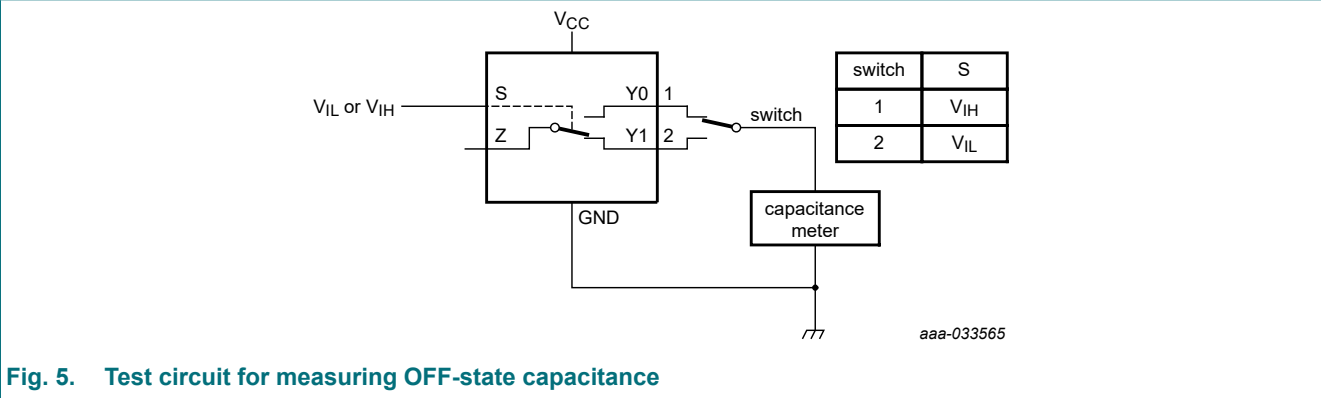
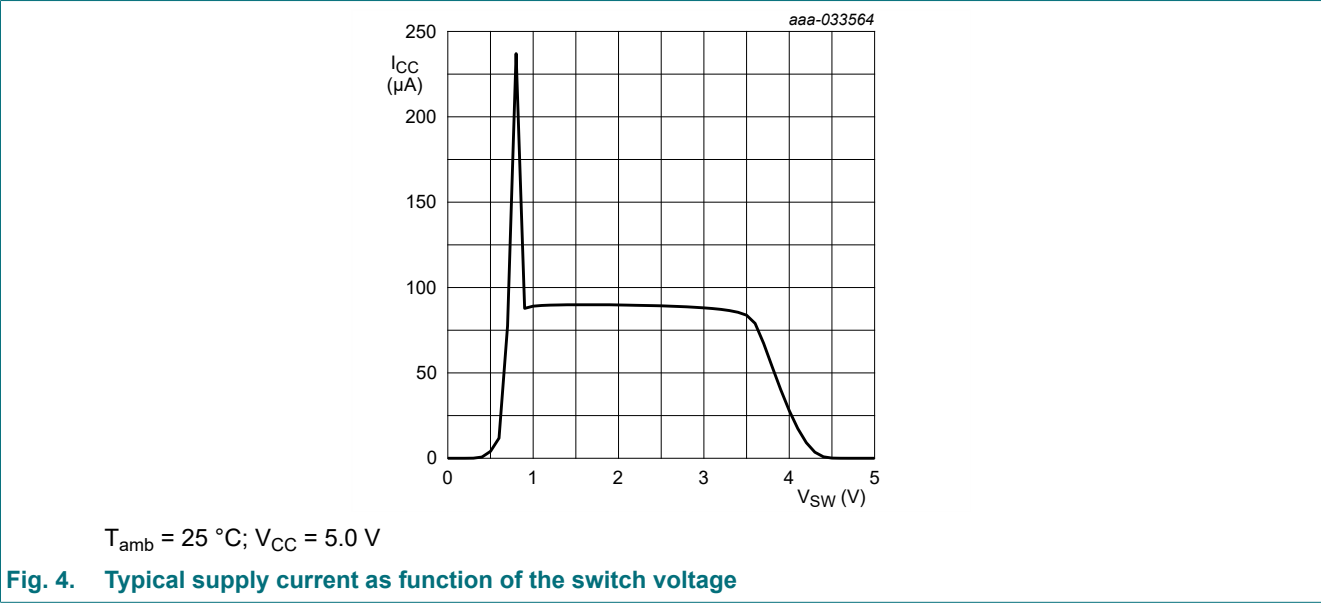
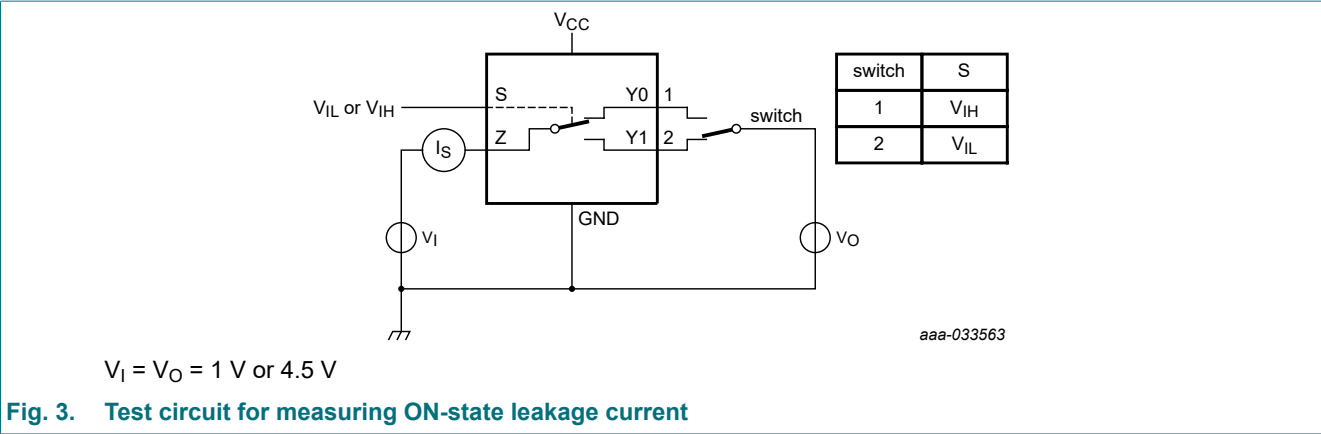
At recommended operating conditions; voltages are referenced to GND (ground 0 V).

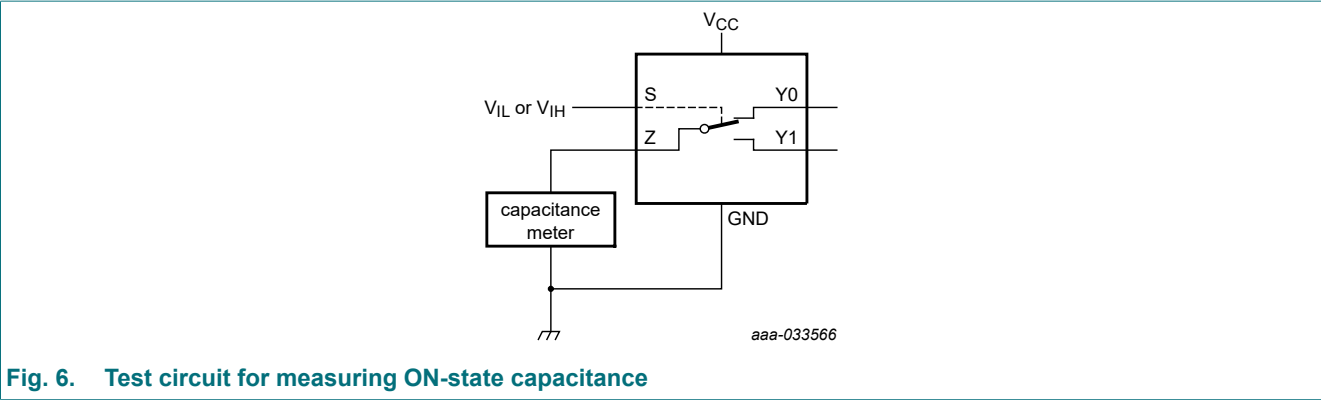
| Symbol | Parameter | Conditions | T _{amb} = -40 °C to +125 °C | | | Unit |
|---------------------|---------------------------|--|--------------------------------------|--------|------|------|
| | | | Min | Typ[1] | Max | |
| V _{IH} | HIGH-level input voltage | S input; V _{CC} = 4.5 V to 5.5 V | 1.4 | - | - | V |
| V _{IL} | LOW-level input voltage | S input; V _{CC} = 4.5 V to 5.5 V | - | - | 0.3 | V |
| I _I | input leakage current | S input; V _{I(S)} = 5.5 V | -50 | 0.2 | 50 | nA |
| I _{S(OFF)} | OFF-state leakage current | V _{I(S)} = V _{IL} or V _{IH} ; V _I = 1.5 V or 4.5 V; V _O = 4.5 V or 1.5 V; V _{CC} = 5.0 V; see Fig. 2 | -320 | ±0.02 | 320 | nA |
| I _{S(ON)} | ON-state leakage current | V _{I(S)} = V _{IL} or V _{IH} ; V _I = V _O = 1 V or 4.5 V; V _{CC} = 5.0 V; see Fig. 3 | -320 | ±0.02 | 320 | nA |
| I _{CC} | supply current | V _{I(S)} = GND or V _{CC} ; V _{SW} = GND or V _{CC} ; V _{CC} = 5.0 V | - | 0.6 | 8000 | nA |
| | | V _{I(S)} = 1.8 V; V _{SW} = GND or V _{CC} ; V _{CC} = 5.0 V; see Fig. 4 | - | 90 | - | µA |
| C _I | input capacitance | S input; V _{CC} = 5.0 V | - | 2 | - | pF |
| C _{S(OFF)} | OFF-state capacitance | Y0, Y1 input/output; V _{CC} = 5.0 V; see Fig. 5 | - | 11 | - | pF |
| C _{S(ON)} | ON-state capacitance | Z input/output; V _{CC} = 5.0 V; see Fig. 6 | - | 35 | - | pF |

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

10.1. Test circuits and graphs







10.2. ON resistance

Table 8. ON resistance
At recommended operating conditions; voltages are referenced to GND (ground 0 V);
For test circuit see Fig. 7; for graphs see Fig. 8 and Fig. 9.

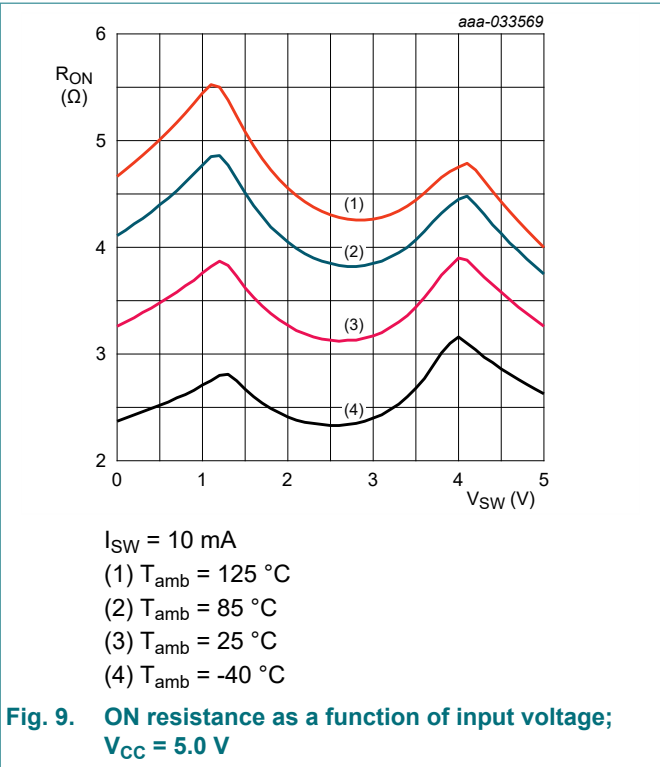
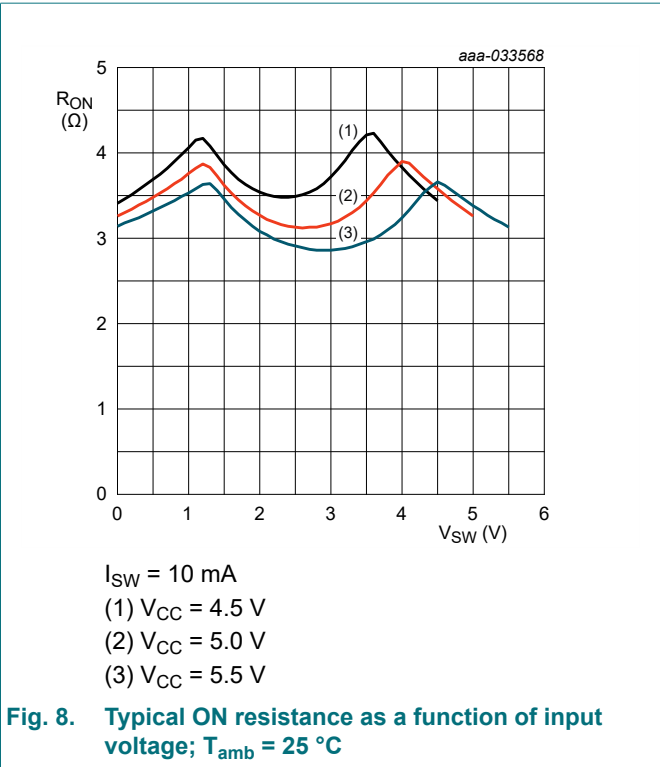
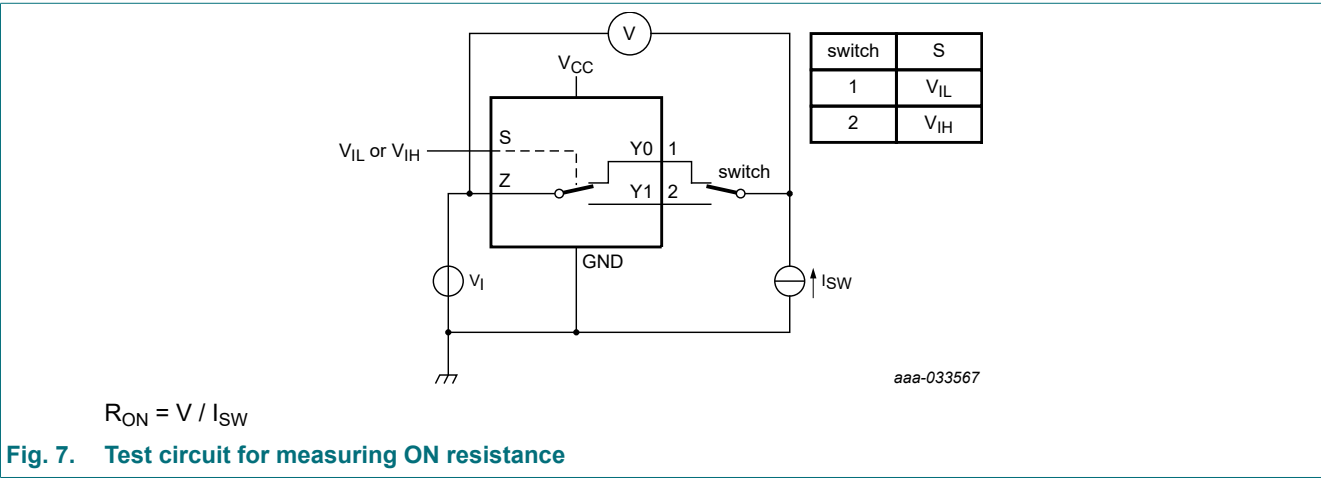
| Symbol | Parameter | Conditions | T _{amb} = -40 °C to +125 °C | | | Unit |
|-----------------------|---|--|--------------------------------------|--------|-----|------|
| | | | Min | Typ[1] | Max | |
| R _{ON(peak)} | ON resistance (peak) | V _{I(S)} = V _{IL} or V _{IH} ; V _{I(Z)} = GND to V _{CC} ; V _{CC} = 4.5 V to 5.5 V [2] | | | | |
| | | I _{SW} = 10 mA | 2.2 | 4.0 | 7.5 | Ω |
| | | I _{SW} = 32 mA | 2.2 | 4.0 | 7.7 | Ω |
| | | I _{SW} = 64 mA | 2.2 | 4.0 | 7.7 | Ω |
| ΔR _{ON} | ON resistance mismatch between channels | I _{SW} = 64 mA; V _{I(Z)} = GND to V _{CC} ; V _{CC} = 4.5 V to 5.0 V [2] | - | 90 | - | mΩ |
| R _{ON(flat)} | ON resistance (flatness) | V _{I(S)} = V _{IL} or V _{IH} ; V _{I(Z)} = GND to V _{CC} ; V _{CC} = 4.5 V to 5.0 V [2] [3] | | | | |
| | | I _{SW} = 10 mA | 0.2 | 0.8 | 3 | Ω |
| | | I _{SW} = 32 mA | 0.2 | 0.8 | 3 | Ω |
| | | I _{SW} = 64 mA | 0.2 | 0.9 | 3 | Ω |

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

[2] Measured by the voltage drop between Z and Yn pins at the indicated current through the switch. ON resistance is determined by the lower of the voltages on the two (Z or Yn pins).

[3] Flatness is defined as the difference between the maximum and minimum value of ON resistance over the specified range of conditions.

10.3. ON resistance test circuit and graphs



11. Dynamic characteristics

Table 9. Dynamic characteristics

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

| Symbol | Parameter | Conditions | T _{amb} = -40 °C to +125 °C | | | Unit |
|-------------------|----------------------------------|---|--------------------------------------|--------|-----|------|
| | | | Min | Typ[1] | Max | |
| t _{pd} | propagation delay | Z to Yn or Yn to Z; see Fig. 10 and Fig. 12; V _{CC} = 4.5 V to 5.5 V | - | 0.4 | 1.0 | ns |
| t _{TRAN} | transition time between channels | S to Z or Yn; see Fig. 11 and Fig. 13; V _{CC} = 4.5 V to 5.5 V | 10 | 23 | 40 | ns |
| t _{b-m} | break-before-make time | C _L = 15 pF; R _L = 200 Ω; see Fig. 14; V _{CC} = 4.5 V to 5.5 V | 1 | 7.5 | 17 | ns |

- [1] Typical values are measured at T_{amb} = 25 °C.
- [2] t_{pd} is the same as t_{PLH} and t_{PHL}

11.1. Waveforms and test circuits

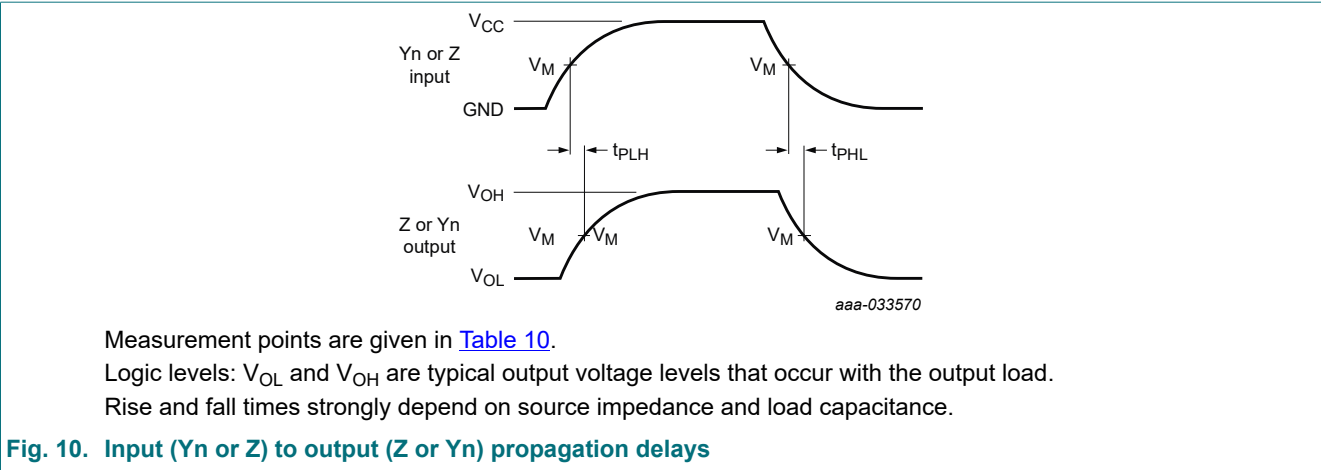


Fig. 10. Input (Yn or Z) to output (Z or Yn) propagation delays

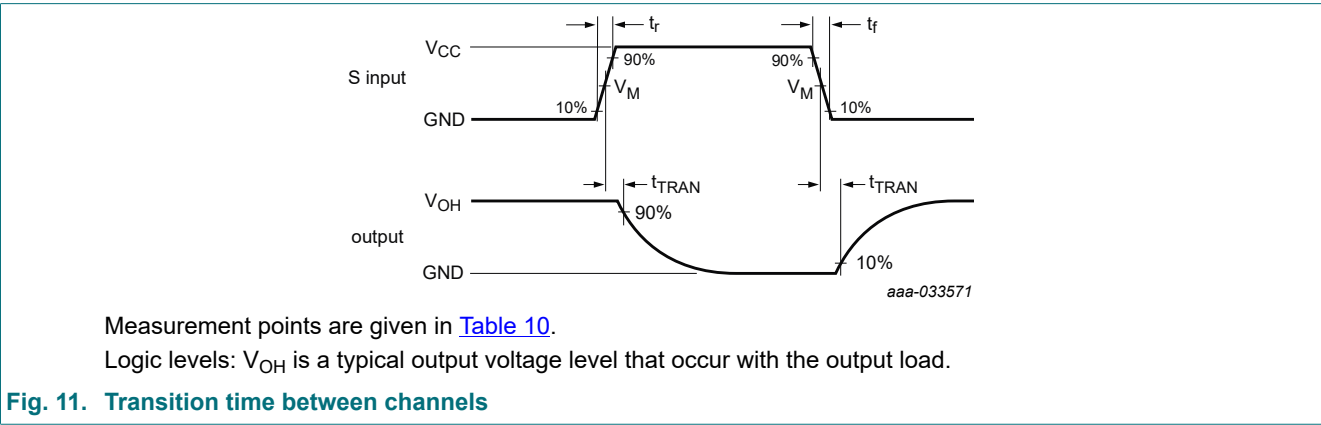
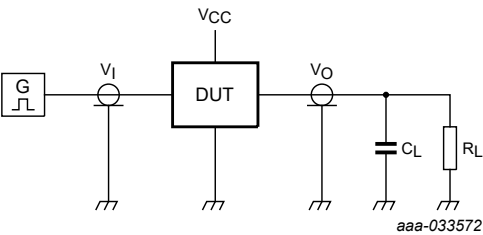


Fig. 11. Transition time between channels

Table 10. Measurement points

| Supply voltage | Input | Output |
|------------------------|----------------|----------------|
| V _{CC} | V _M | V _M |
| GND to V _{CC} | 50% | 50% |

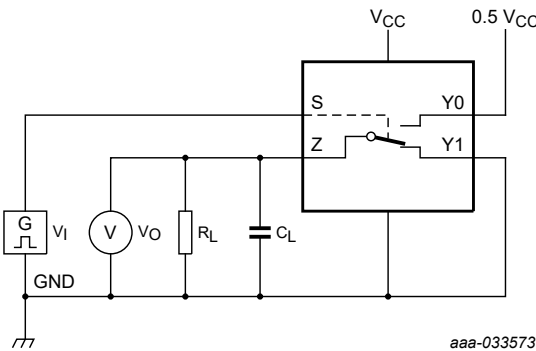


Test data is given in [Table 11](#).
All input pulses are supplied by generators having the following characteristics:
 $\text{PRR} \leq 10 \text{ MHz}$; $Z_O = 50 \text{ }\Omega$; $t_r, t_f = 2 \text{ ns}$.
Definitions test circuit:
 C_L = Load capacitance (including jig and probe capacitance);
 R_L = Load resistance.

Fig. 12. Test circuit for measuring propagation delay times

Table 11. Test data

| Load | |
|--------|--------------|
| C_L | R_L |
| 100 pF | 1 M Ω |



Test data is given in [Table 12](#).
All input pulses are supplied by generators having the following characteristics:
 $\text{PRR} \leq 10 \text{ MHz}$; $Z_O = 50 \text{ }\Omega$.
Definitions test circuit:
 C_L = Load capacitance (including jig and probe capacitance);
 R_L = Load resistance.

Fig. 13. Test circuit for measuring transition times between channels

Table 12. Test data

| Input S | Load | |
|---------------------|-------|--------------|
| t_r, t_f | C_L | R_L |
| $\leq 2 \text{ ns}$ | 15 pF | 1 M Ω |

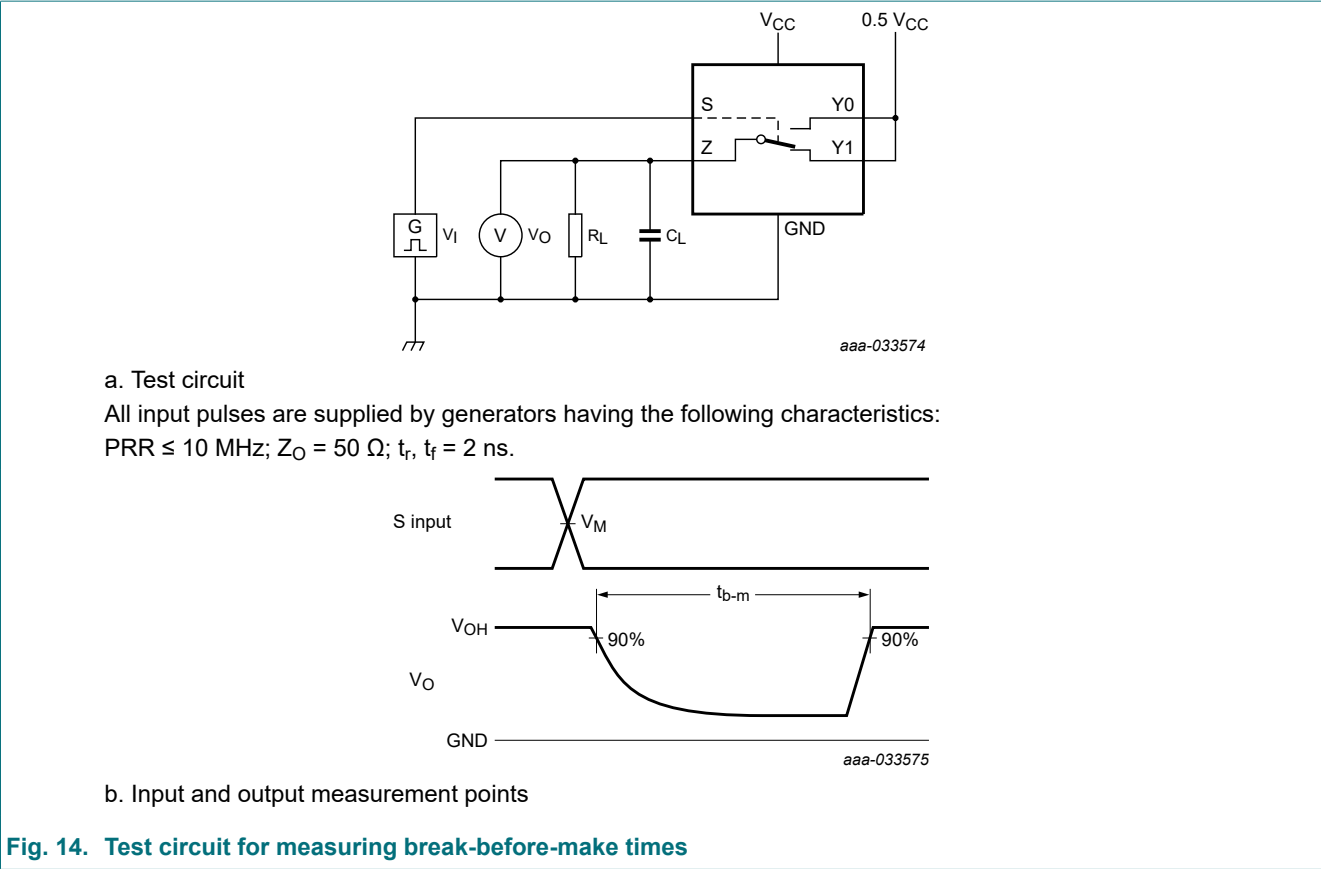


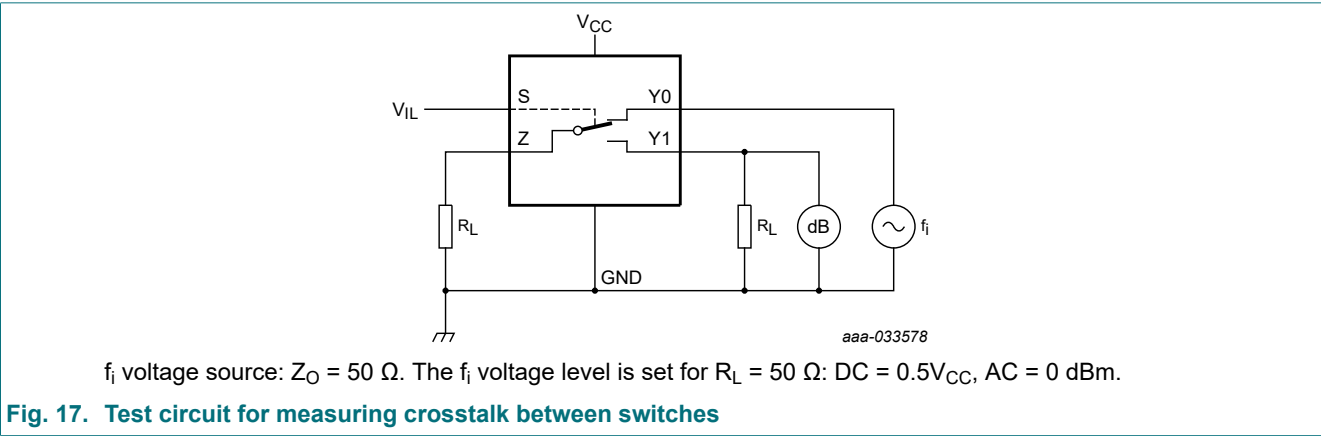
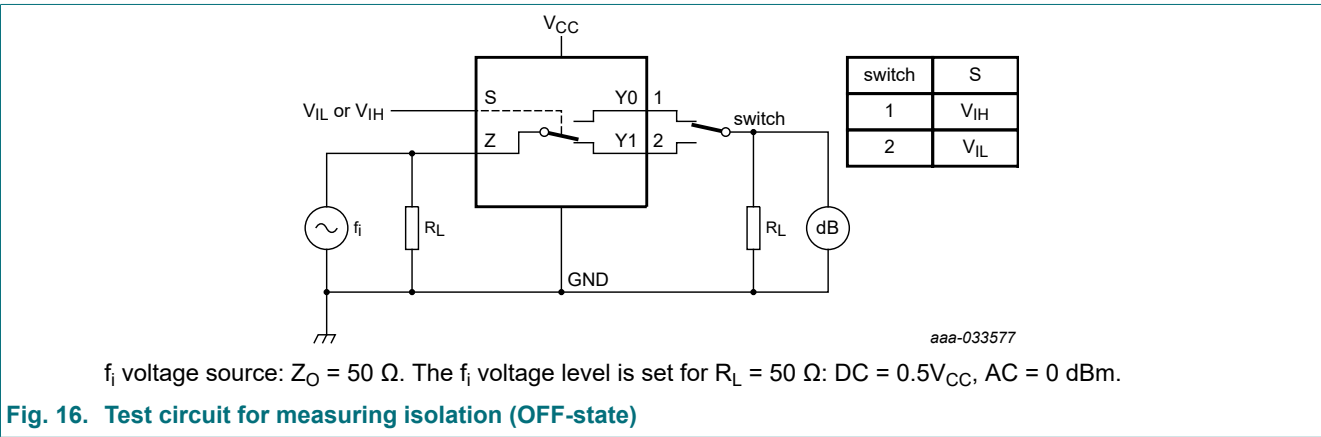
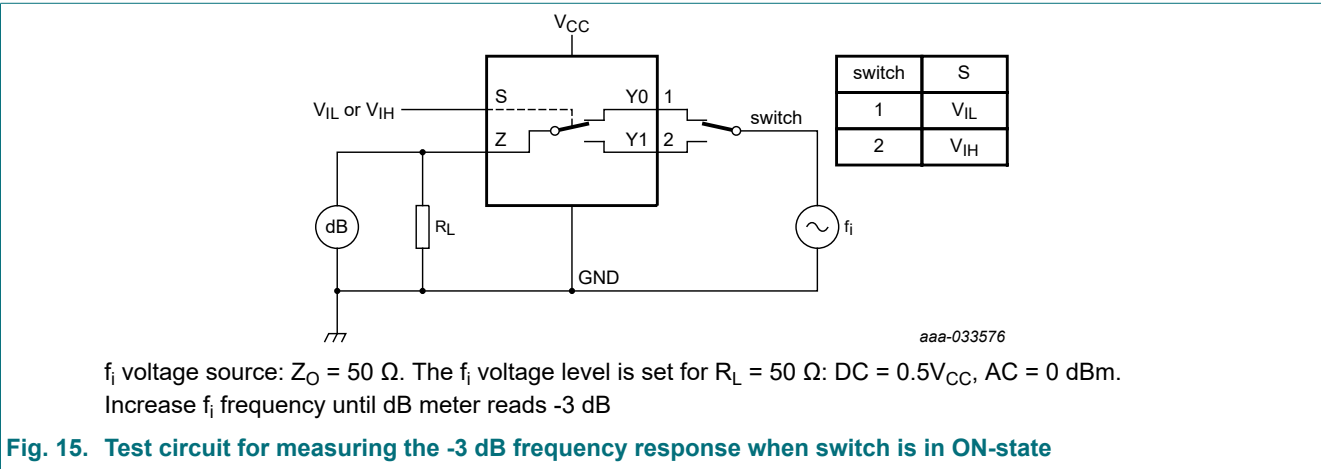
Fig. 14. Test circuit for measuring break-before-make times

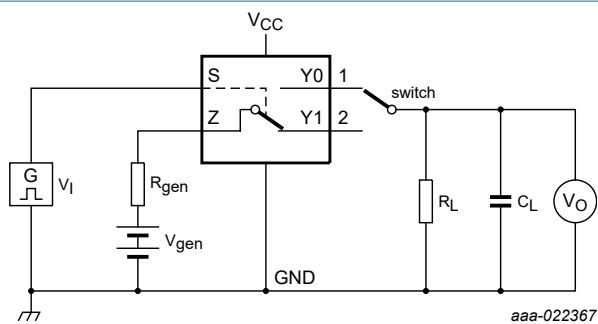
11.2. Additional dynamic characteristics

Table 13. Additional dynamic characteristics
At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

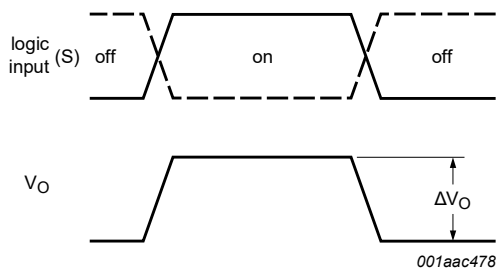
| Symbol | Parameter | Conditions | T _{amb} = 25 °C | | | Unit |
|---------------------|--------------------------|--|--------------------------|-----|-----|------|
| | | | Min | Typ | Max | |
| f _(-3dB) | -3 dB frequency response | R _L = 50 Ω; see Fig. 15; V _{CC} = 5.0 V | - | 190 | - | MHz |
| α _{iso} | isolation (OFF-state) | R _L = 50 Ω; f _i = 10 MHz; see Fig. 16; V _{CC} = 5.0 V | - | -56 | - | dB |
| Xtalk | crosstalk | between switches; R _L = 50 Ω; f _i = 1 MHz; V _{CC} = 5.0 V; see Fig. 17 | - | -76 | - | dB |
| Q _{inj} | charge injection | C _L = 1 nF; V _{gen} = 0.5V _{CC} ; R _{gen} = 0 Ω; f _i = 1 MHz; R _L = 1 MΩ; V _{CC} = 5.0 V; see Fig. 18 | - | 4.5 | - | pC |

11.3. Test circuits





a. Test circuit



b. Input and output pulse definitions

Definitions for test circuit:

$$Q_{inj} = \Delta V_O \times C_L;$$

ΔV_O = output voltage variation;

R_{gen} = generator resistance;

V_{gen} = generator voltage.

Fig. 18. Test circuit for measuring charge injection

12. Package outline

TSSOP6: plastic thin shrink small outline package; 6 leads; body width 1.25 mm

SOT363-2

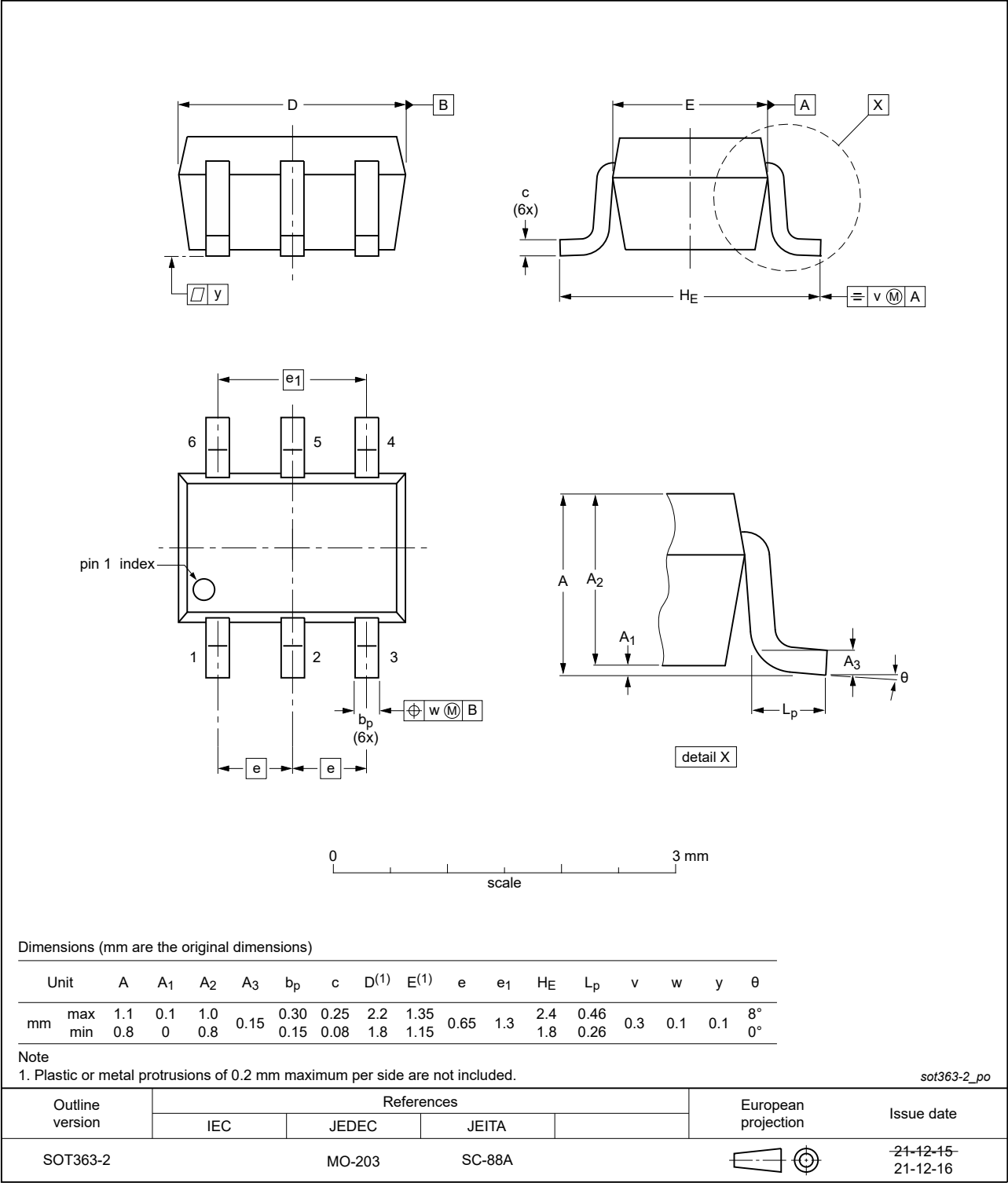


Fig. 19. Package outline SOT363-2 (TSSOP6)

13. Abbreviations

Table 14. Abbreviations

| Acronym | Description |
|---------|---|
| ANSI | American National Standards Institute |
| CDM | Charged Device Model |
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| ESDA | ElectroStatic Discharge Association |
| HBM | Human Body Model |
| JEDEC | Joint Electron Device Engineering Council |
| PRR | Pulse Rate Repetition |

14. Revision history

Table 15. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|------------------|--|--------------------|---------------|----------------|
| XS5A1T4157 v.2.1 | 20240731 | Product data sheet | - | XS5A1T4157 v.2 |
| XS5A1T4157 v.2 | 20220209 | Product data sheet | - | XS5A1T4157 v.1 |
| Modifications: | • Package SOT363 (SC-88) changed to SOT363-2 (TSSOP6). | | | |
| XS5A1T4157 v.1 | 20210716 | 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".
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Contents

1. General description..... 1

2. Features and benefits..... 1

3. Ordering information..... 1

4. Marking..... 1

5. Functional diagram.....2

6. Pinning information.....2

6.1. Pinning.....2

6.2. Pin description..... 2

7. Functional description..... 2

8. Limiting values..... 3

9. Recommended operating conditions.....3

10. Static characteristics.....4

10.1. Test circuits and graphs.....4

10.2. ON resistance.....6

10.3. ON resistance test circuit and graphs.....7

11. Dynamic characteristics.....8

11.1. Waveforms and test circuits.....8

11.2. Additional dynamic characteristics..... 10

11.3. Test circuits..... 11

12. Package outline..... 13

13. Abbreviations..... 14

14. Revision history.....14

15. Legal information.....15

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