

# NX3L1T5157

## Low-ohmic single-pole double-throw switch

Rev. 01 — 16 September 2008

Product data sheet

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## 1. General description

The NX3L1T5157 provides one low-ohmic single-pole double-throw analog switch, suitable for use as an analog or digital multiplexer/demultiplexer. It has a digital select input (S) with Schmitt trigger action, two independent inputs/outputs (Y0, Y1) and a common input/output (Z).

Schmitt trigger action at the select input (S) makes the circuit tolerant to slower input rise and fall times across the entire  $V_{CC}$  range from 1.4 V to 3.6 V.

A low input voltage threshold allows pin S to be driven by lower level logic signals without a significant increase in supply current  $I_{CC}$ . This makes it possible for the NX3L1T5157 to switch 3.6 V signals with a 1.8 V digital controller, eliminating the need for logic level translation.

The NX3L1T5157 allows signals with amplitude up to  $V_{CC}$  to be transmitted from Z to Y0 or Y1, or from Y0 or Y1 to Z. Its low ON resistance (0.5  $\Omega$ ) and flatness (0.13  $\Omega$ ) ensures minimal attenuation and distortion of transmitted signals.

## 2. Features

- Wide supply voltage range from 1.4 V to 3.6 V
- Very low ON resistance (peak):
  - ◆ 1.6  $\Omega$  (typical) at  $V_{CC} = 1.4$  V
  - ◆ 1.0  $\Omega$  (typical) at  $V_{CC} = 1.65$  V
  - ◆ 0.55  $\Omega$  (typical) at  $V_{CC} = 2.3$  V
  - ◆ 0.50  $\Omega$  (typical) at  $V_{CC} = 2.7$  V
- Break-before-make switching
- High noise immunity
- ESD protection:
  - ◆ HBM JESD22-A114E Class 3A exceeds 7500 V
  - ◆ MM JESD22-A115-A exceeds 200 V
  - ◆ CDM AEC-Q100-011 revision B exceeds 1000 V
- CMOS low-power consumption
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level A
- Direct interface with TTL levels at 3.0 V
- Control input accepts voltages above supply voltage
- Very low supply current, even when input is below  $V_{CC}$
- High current handling capability (350 mA continuous current under 3.3 V supply)
- Specified from  $-40$  °C to  $+85$  °C and from  $-40$  °C to  $+125$  °C

### 3. Applications

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- Cell phone
- PDA
- Portable media player

### 4. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
NX3L1T5157GM	-40 °C to +125 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm	SOT886

### 5. Marking

Table 2. Marking

Type number	Marking code
NX3L1T5157GM	DI

### 6. Functional diagram

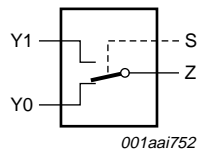


Fig 1. Logic symbol

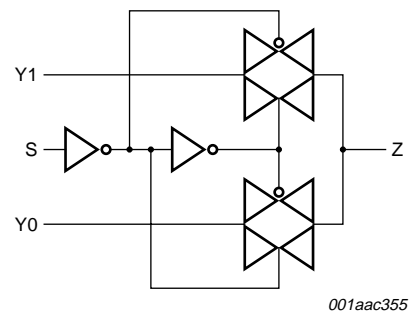
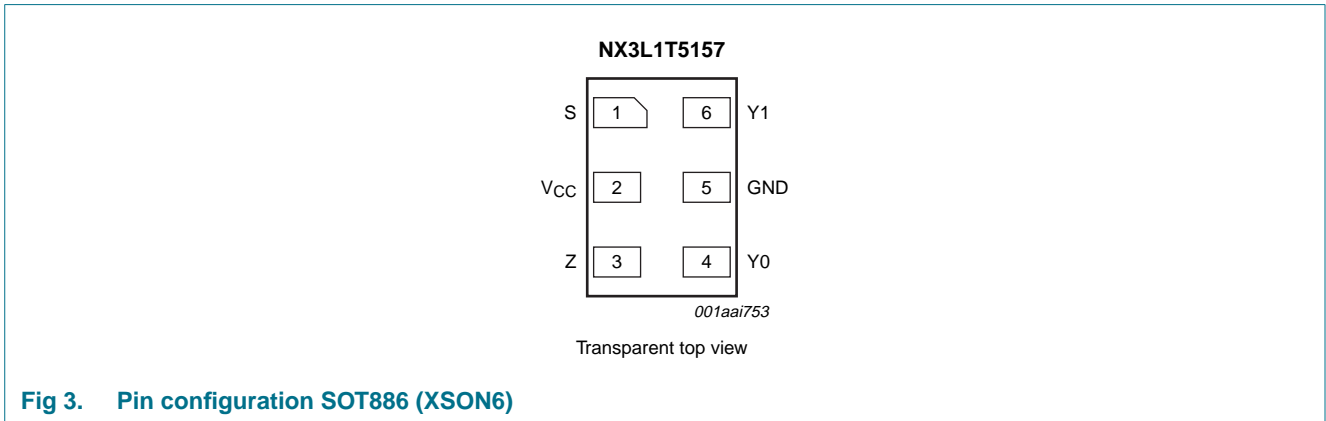


Fig 2. Logic diagram

## 7. Pinning information

W W W

### 7.1 Pinning



### 7.2 Pin description

**Table 3. Pin description**

Symbol	Pin	Description
S	1	select input
V <sub>CC</sub>	2	supply voltage
Z	3	common input or output
Y0	4	independent input or output
GND	5	ground (0 V)
Y1	6	independent input or output

## 8. Functional description

**Table 4. Function table<sup>[1]</sup>**

Input S	Channel on
L	Y0
H	Y1

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

## 9. Limiting values

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**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	+4.6	V
$V_I$	input voltage		[1] -0.5	+4.6	V
$V_{SW}$	switch voltage		[2] -0.5	$V_{CC} + 0.5$	V
$I_{IK}$	input clamping current	$V_I < -0.5$ V	-50	-	mA
$I_{SK}$	switch clamping current	$V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V	-	$\pm 50$	mA
$I_{SW}$	switch current	$V_{SW} > -0.5$ V or $V_{SW} < V_{CC} + 0.5$ V; source or sink current	-	$\pm 350$	mA
		$V_{SW} > -0.5$ V or $V_{SW} < V_{CC} + 0.5$ V; pulsed at 1 ms duration, < 10 % duty cycle; peak current	-	$\pm 500$	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40$ °C to +125 °C	[3] -	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] For XSON6 package: above 45 °C the value of  $P_{tot}$  derates linearly with 2.4 mW/K.

## 10. Recommended operating conditions

**Table 6. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		1.4	3.6	V
$V_I$	input voltage	select input S	0	3.6	V
$V_{SW}$	switch voltage		[1] 0	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 1.4$ V to 3.6 V	[2] -	200	ns/V

- [1] To avoid sinking GND current from terminal Z when switch current flows in terminal Yn, the voltage drop across the bidirectional switch must not exceed 0.4 V. If the switch current flows into terminal Z, no GND current will flow from terminal Yn. In this case, there is no limit for the voltage drop across the switch.
- [2] Applies to control signal levels.

### 11. Static characteristics

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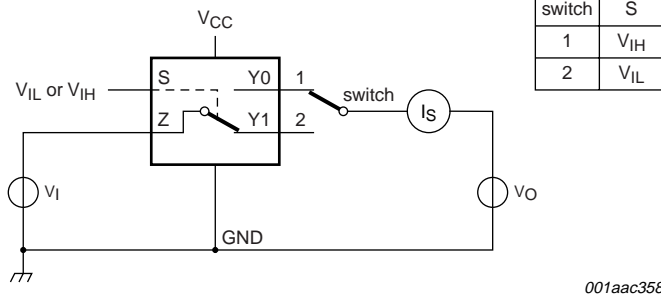
**Table 7. Static characteristics**

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

Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			T <sub>amb</sub> = -40 °C to +125 °C			Unit
			Min	Typ	Max	Min	Max (85 °C)	Max (125 °C)	
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 1.4 V to 1.6 V	0.9	-	-	0.9	-	-	V
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.9	-	-	0.9	-	-	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.1	-	-	1.1	-	-	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	1.3	-	-	1.3	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.4 V to 1.6 V	-	-	0.3	-	0.3	0.3	V
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	0.4	-	0.4	0.3	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.4	-	0.4	0.4	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	0.5	-	0.5	0.5	V
I <sub>I</sub>	input leakage current	select input S; V <sub>I</sub> = GND to 3.6 V; V <sub>CC</sub> = 1.4 V to 3.6 V	-	-	-	-	±0.5	±1	µA
I <sub>S(OFF)</sub>	OFF-state leakage current	Y0 and Y1 port; V <sub>CC</sub> = 1.4 V to 3.6 V; see <a href="#">Figure 4</a>	-	-	±5	-	±50	±500	nA
I <sub>S(ON)</sub>	ON-state leakage current	Z port; V <sub>CC</sub> = 1.4 V to 3.6 V; see <a href="#">Figure 5</a>	-	-	±5	-	±50	±500	nA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 3.6 V; V <sub>SW</sub> = GND or V <sub>CC</sub>	-	-	100	-	690	6000	nA
ΔI <sub>CC</sub>	additional supply current	V <sub>I</sub> = 2.6 V; V <sub>CC</sub> = 3.6 V; V <sub>SW</sub> = GND or V <sub>CC</sub>	-	0.35	0.7	-	1	1	µA
		V <sub>I</sub> = 1.8 V; V <sub>CC</sub> = 3.6 V; V <sub>SW</sub> = GND or V <sub>CC</sub>	-	2.5	4	-	5	5	µA
		V <sub>I</sub> = 1.8 V; V <sub>CC</sub> = 2.5 V; V <sub>SW</sub> = GND or V <sub>CC</sub>	-	50	200	-	300	500	nA
C <sub>I</sub>	input capacitance		-	1.0	-	-	-	-	pF
C <sub>S(OFF)</sub>	OFF-state capacitance		-	35	-	-	-	-	pF
C <sub>S(ON)</sub>	ON-state capacitance		-	130	-	-	-	-	pF

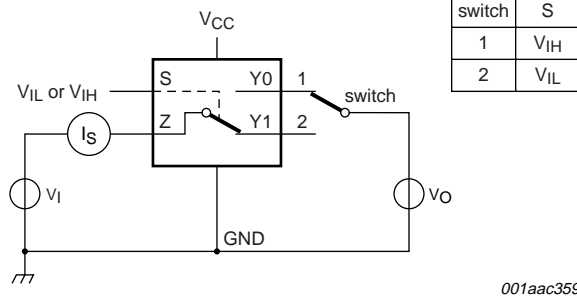
**11.1 Test circuits**

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$V_I = 0.3\text{ V or }V_{CC} - 0.3\text{ V}; V_O = V_{CC} - 0.3\text{ V or }0.3\text{ V}.$

**Fig 4. Test circuit for measuring OFF-state leakage current**



$V_I = 0.3\text{ V or }V_{CC} - 0.3\text{ V}; V_O = V_{CC} - 0.3\text{ V or }0.3\text{ V}.$

**Fig 5. Test circuit for measuring ON-state leakage current**

**11.2 ON resistance**

**Table 8. ON resistance**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for graphs see [Figure 7](#) to [Figure 12](#).

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			T <sub>amb</sub> = -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> = GND to V <sub>CC</sub> ; I <sub>SW</sub> = 100 mA; see <a href="#">Figure 6</a>	-	1.6	3.7	-	4.1	Ω	
			V <sub>CC</sub> = 1.4 V	-	1.0	1.6	-	1.7	Ω
			V <sub>CC</sub> = 1.65 V	-	0.55	0.8	-	0.9	Ω
			V <sub>CC</sub> = 2.3 V	-	0.5	0.75	-	0.9	Ω
ΔR <sub>ON</sub>	ON resistance mismatch between channels	V <sub>I</sub> = GND to V <sub>CC</sub> ; I <sub>SW</sub> = 100 mA	-	0.04	0.3	-	0.3	Ω	
			V <sub>CC</sub> = 1.4 V	-	0.04	0.2	-	0.3	Ω
			V <sub>CC</sub> = 1.65 V	-	0.02	0.08	-	0.1	Ω
			V <sub>CC</sub> = 2.3 V	-	0.02	0.075	-	0.1	Ω

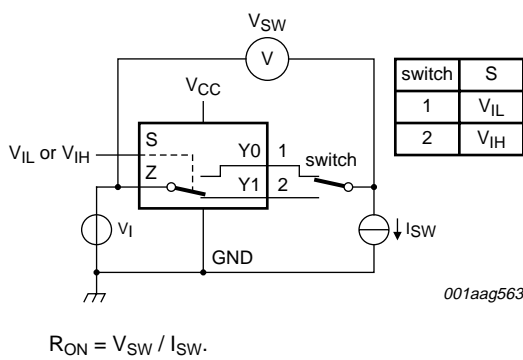
**Table 8. ON resistance ...continued**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for graphs see [Figure 7](#) to [Figure 12](#).

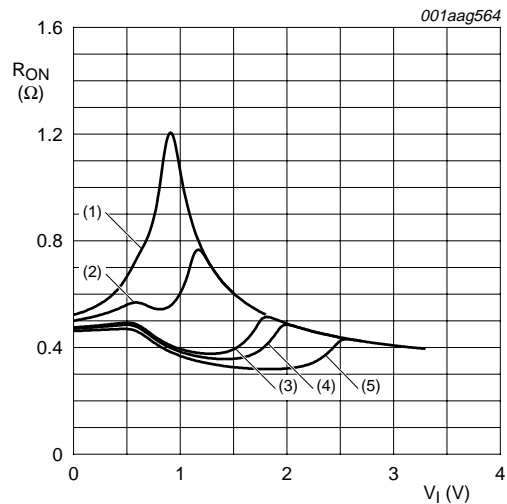
Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
R <sub>ON(flat)</sub>	ON resistance (flatness)	V <sub>I</sub> = GND to V <sub>CC</sub> ; I <sub>SW</sub> = 100 mA						
		V <sub>CC</sub> = 1.4 V	-	1.0	3.3	-	3.6	Ω
		V <sub>CC</sub> = 1.65 V	-	0.5	1.2	-	1.3	Ω
		V <sub>CC</sub> = 2.3 V	-	0.15	0.3	-	0.35	Ω
		V <sub>CC</sub> = 2.7 V	-	0.13	0.3	-	0.35	Ω

- [1] Typical values are measured at T<sub>amb</sub> = 25 °C.
- [2] Measured at identical V<sub>CC</sub>, temperature and input voltage.
- [3] Flatness is defined as the difference between the maximum and minimum value of ON resistance measured at identical V<sub>CC</sub> and temperature.

### 11.3 ON resistance test circuit and graphs

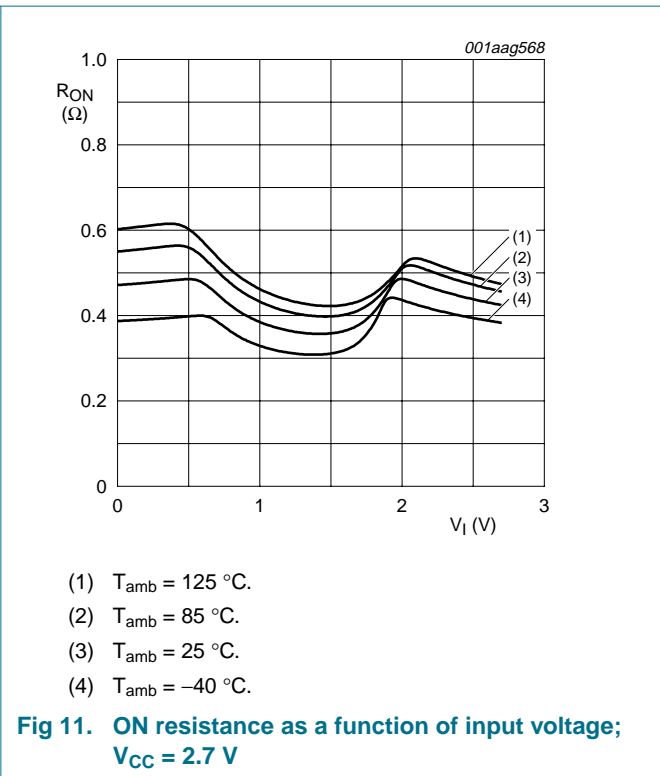
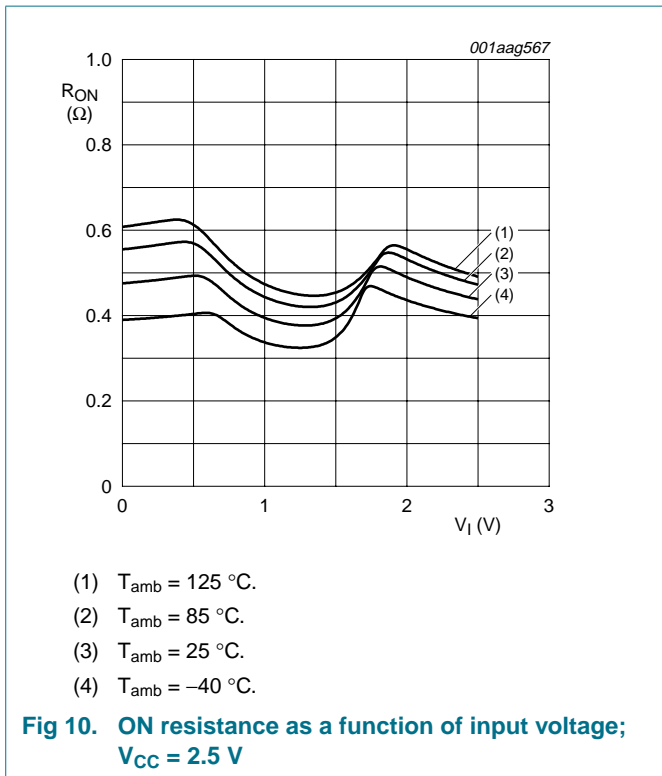
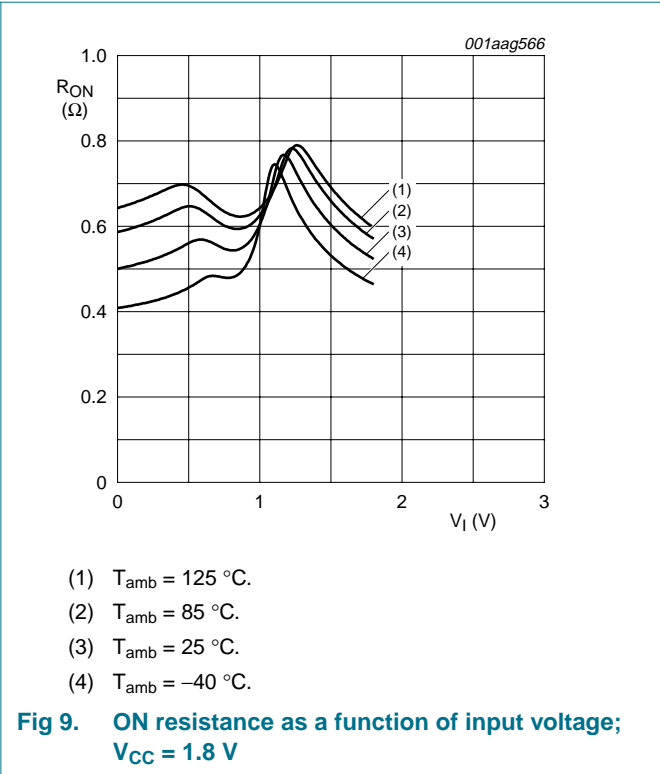
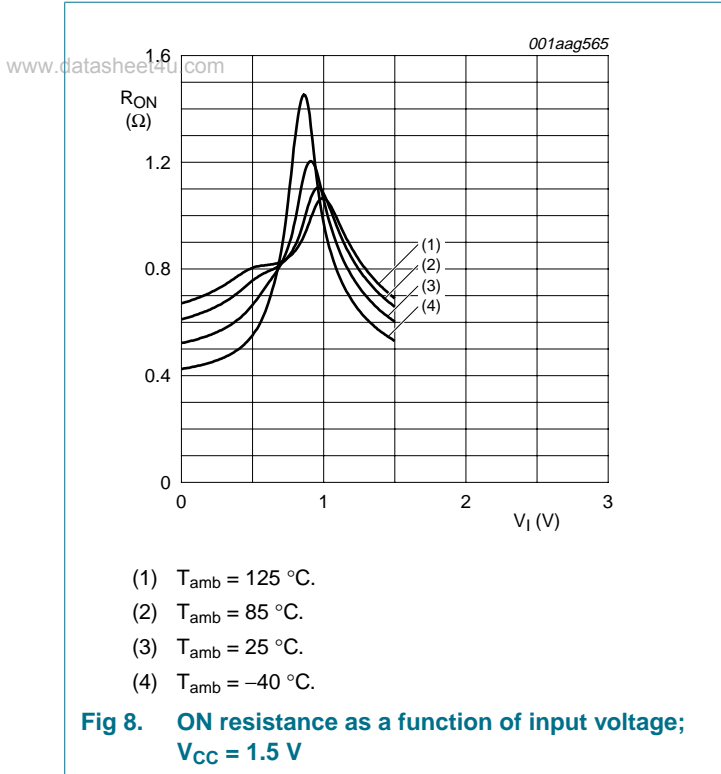


**Fig 6. Test circuit for measuring ON resistance**

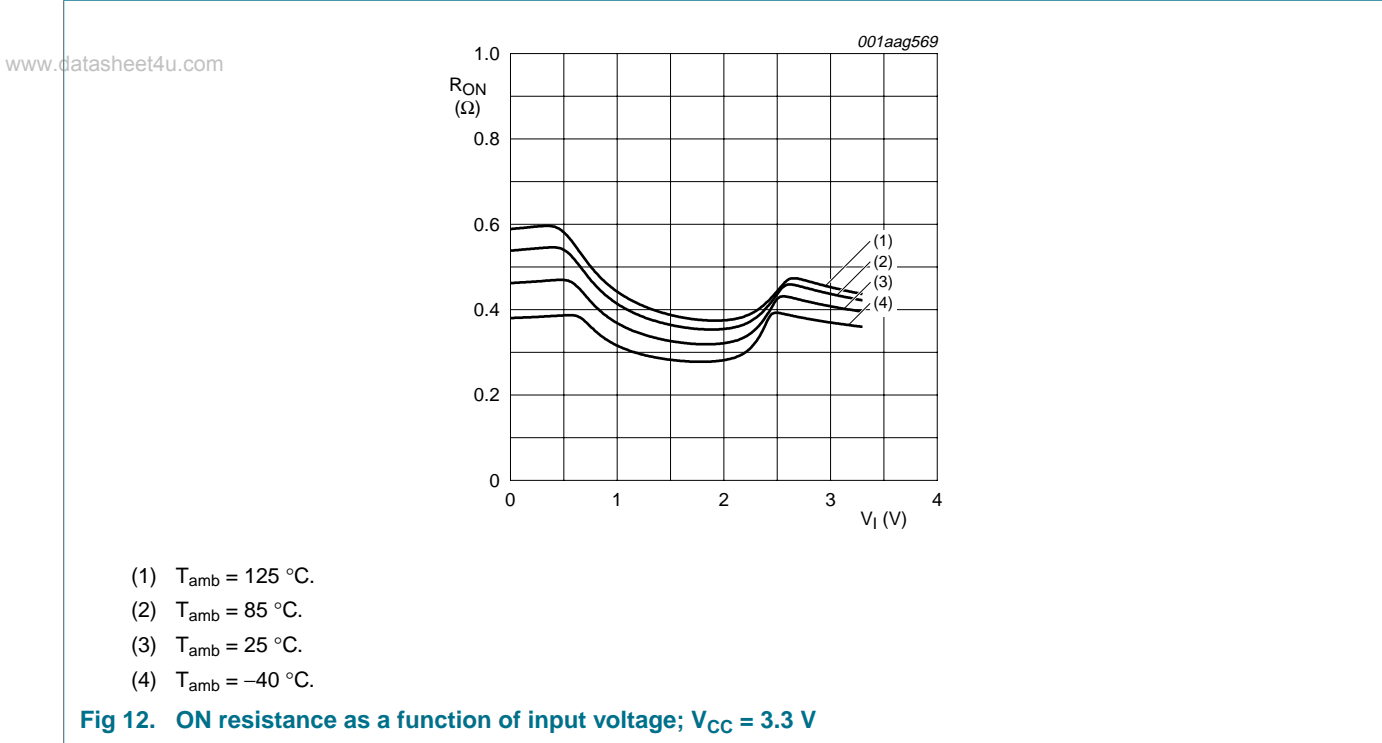


- (1) V<sub>CC</sub> = 1.5 V.
  - (2) V<sub>CC</sub> = 1.8 V.
  - (3) V<sub>CC</sub> = 2.5 V.
  - (4) V<sub>CC</sub> = 2.7 V.
  - (5) V<sub>CC</sub> = 3.3 V.
- Measured at T<sub>amb</sub> = 25 °C.

**Fig 7. Typical ON resistance as a function of input voltage**







## 12. Dynamic characteristics

**Table 9. Dynamic characteristics**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for load circuit see [Figure 15](#).

Symbol	Parameter	Conditions	25 °C			-40 °C to +125 °C			Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max (85 °C)	Max (125 °C)	
$t_{en}$	enable time	S to Z or Yn; see <a href="#">Figure 13</a>							
		$V_{CC} = 1.4\text{ V to }1.6\text{ V}$	-	50	90	-	120	120	ns
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	-	36	70	-	80	90	ns
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	-	24	45	-	50	55	ns
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	-	22	40	-	45	50	ns
$t_{dis}$	disable time	S to Z or Yn; see <a href="#">Figure 13</a>							
		$V_{CC} = 1.4\text{ V to }1.6\text{ V}$	-	32	70	-	80	90	ns
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	-	20	55	-	60	65	ns
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	-	12	25	-	30	35	ns
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	-	10	20	-	25	30	ns

**Table 9. Dynamic characteristics ...continued**

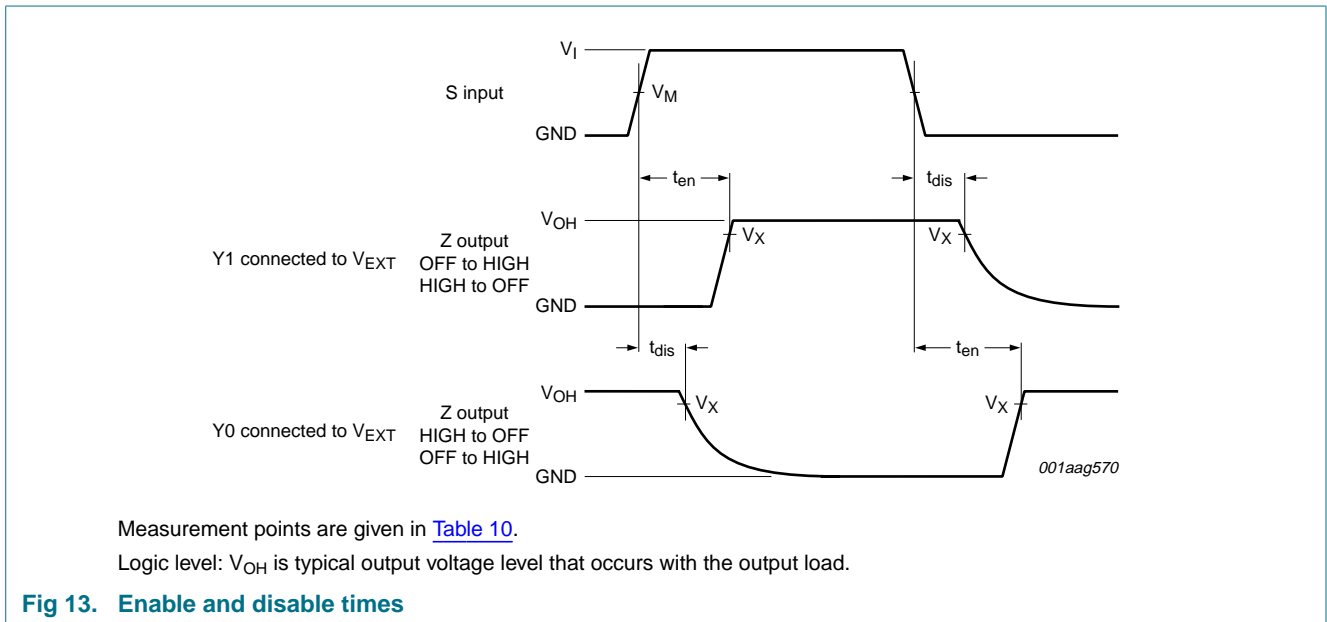
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for load circuit see [Figure 15](#).

Symbol	Parameter	Conditions	25 °C			-40 °C to +125 °C			Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max (85 °C)	Max (125 °C)	
t <sub>b-m</sub>	break-before-make time	see <a href="#">Figure 14</a>							
		V <sub>CC</sub> = 1.4 V to 1.6 V	-	19	-	9	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	17	-	7	-	-	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	13	-	4	-	-	ns
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	10	-	3	-	-	ns

[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 1.5 V, 1.8 V, 2.5 V and 3.3 V respectively.

[2] Break-before-make guaranteed by design.

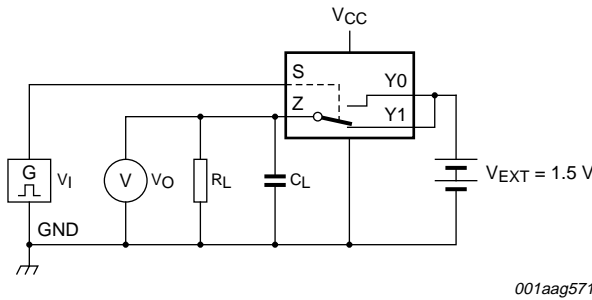
### 12.1 Waveform and test circuits



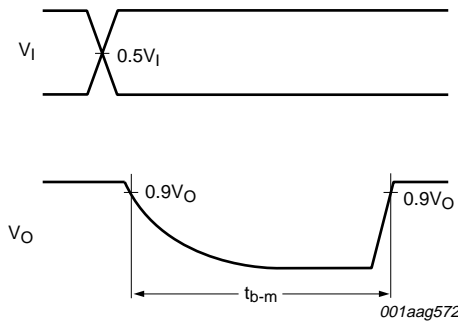
**Table 10. Measurement points**

Supply voltage	Input	Output
V <sub>CC</sub>	V <sub>M</sub>	V <sub>X</sub>
1.4 V to 3.6 V	0.5V <sub>CC</sub>	0.9V <sub>OH</sub>

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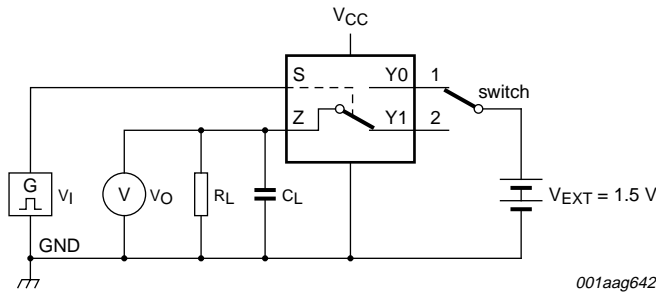


a. Test circuit



b. Input and output measurement points

**Fig 14. Test circuit for measuring break-before-make timing**



Test data is given in [Table 11](#).

Definitions test circuit:

$R_L$  = Load resistance.

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

$V_{EXT}$  = External voltage for measuring switching times.

**Fig 15. Load circuit for switching times**

**Table 11. Test data**

Supply voltage	Input		Load	
$V_{CC}$	$V_I$	$t_r, t_f$	$C_L$	$R_L$
1.4 V to 3.6 V	$V_{CC}$	$\leq 2.5$ ns	35 pF	50 $\Omega$

12.2 Additional dynamic characteristics

Table 12. Additional dynamic characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V);  $V_I = GND$  or  $V_{CC}$  (unless otherwise specified);  $t_r = t_f \leq 2.5$  ns;  $T_{amb} = 25^\circ C$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
THD	total harmonic distortion	$f_i = 20$ Hz to 20 kHz; $R_L = 32 \Omega$ ; see <a href="#">Figure 16</a>	[1]			
		$V_{CC} = 1.4$ V; $V_I = 1$ V (p-p)	-	0.15	-	%
		$V_{CC} = 1.65$ V; $V_I = 1.2$ V (p-p)	-	0.10	-	%
		$V_{CC} = 2.3$ V; $V_I = 1.5$ V (p-p)	-	0.015	-	%
		$V_{CC} = 2.7$ V; $V_I = 2$ V (p-p)	-	0.024	-	%
$f_{(-3dB)}$	-3 dB frequency response	$R_L = 50 \Omega$ ; see <a href="#">Figure 17</a>	[1]			
		$V_{CC} = 1.4$ V to 3.6 V	-	60	-	MHz
$\alpha_{iso}$	isolation (OFF-state)	$f_i = 100$ kHz; $R_L = 50 \Omega$ ; see <a href="#">Figure 18</a>	[1]			
		$V_{CC} = 1.4$ V to 3.6 V	-	-90	-	dB
$V_{ct}$	crosstalk voltage	between digital inputs and switch; $f_i = 1$ MHz; $C_L = 50$ pF; $R_L = 50 \Omega$ ; see <a href="#">Figure 19</a>				
		$V_{CC} = 1.4$ V to 3.6 V	-	0.21	-	V
$Q_{inj}$	charge injection	$f_i = 1$ MHz; $C_L = 0.1$ nF; $R_L = 1$ M $\Omega$ ; $V_{gen} = 0$ V; $R_{gen} = 0 \Omega$ ; see <a href="#">Figure 20</a>				
		$V_{CC} = 1.5$ V	-	3	-	pC
		$V_{CC} = 1.8$ V	-	4	-	pC
		$V_{CC} = 2.5$ V	-	6	-	pC
		$V_{CC} = 3.3$ V	-	9	-	pC

[1]  $f_i$  is biased at  $0.5V_{CC}$ .

12.3 Test circuits

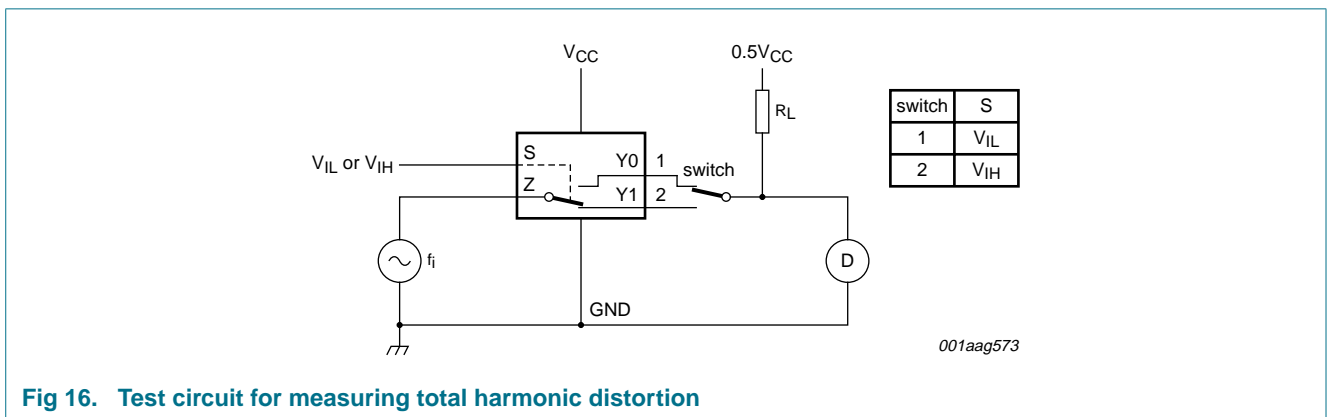
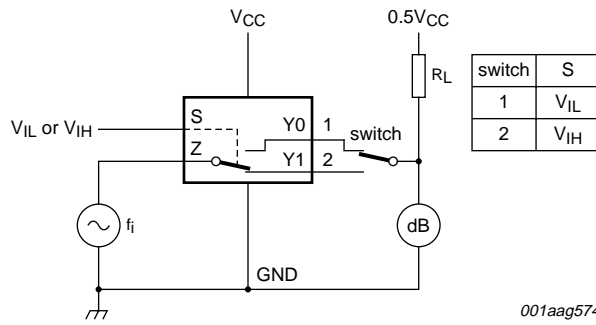


Fig 16. Test circuit for measuring total harmonic distortion

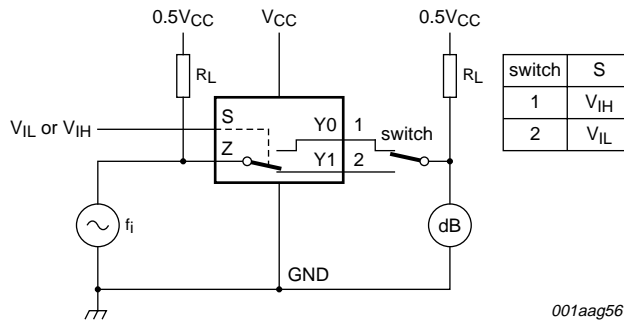
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Adjust  $f_i$  voltage to obtain 0 dBm level at output. Increase  $f_i$  frequency until dB meter reads -3 dB.

**Fig 17. Test circuit for measuring the frequency response when channel is in ON-state**

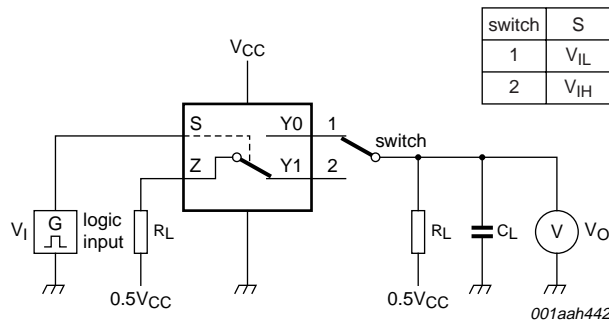


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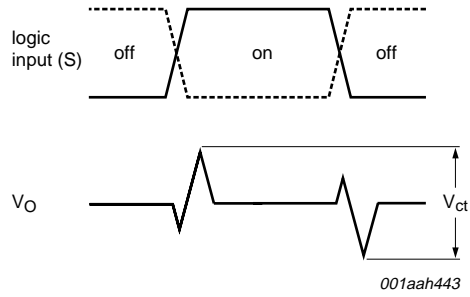
Adjust  $f_i$  voltage to obtain 0 dBm level at input.

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

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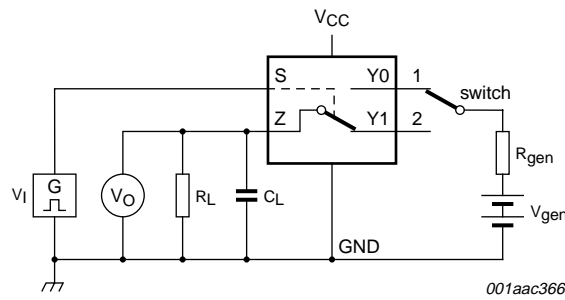
a. Test circuit



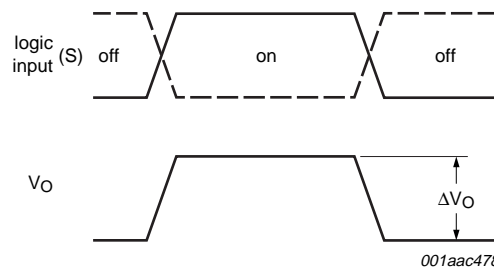
b. Input and output pulse definitions

**Fig 19. Test circuit for measuring crosstalk voltage between digital inputs and switch**

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a. Test circuit



b. Input and output pulse definitions

Definition:  $Q_{inj} = \Delta V_O \times C_L$ .

$\Delta V_O$  = output voltage variation.

$R_{gen}$  = generator resistance.

$V_{gen}$  = generator voltage.

**Fig 20. Test circuit for measuring charge injection**

13. Package outline

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XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm

SOT886

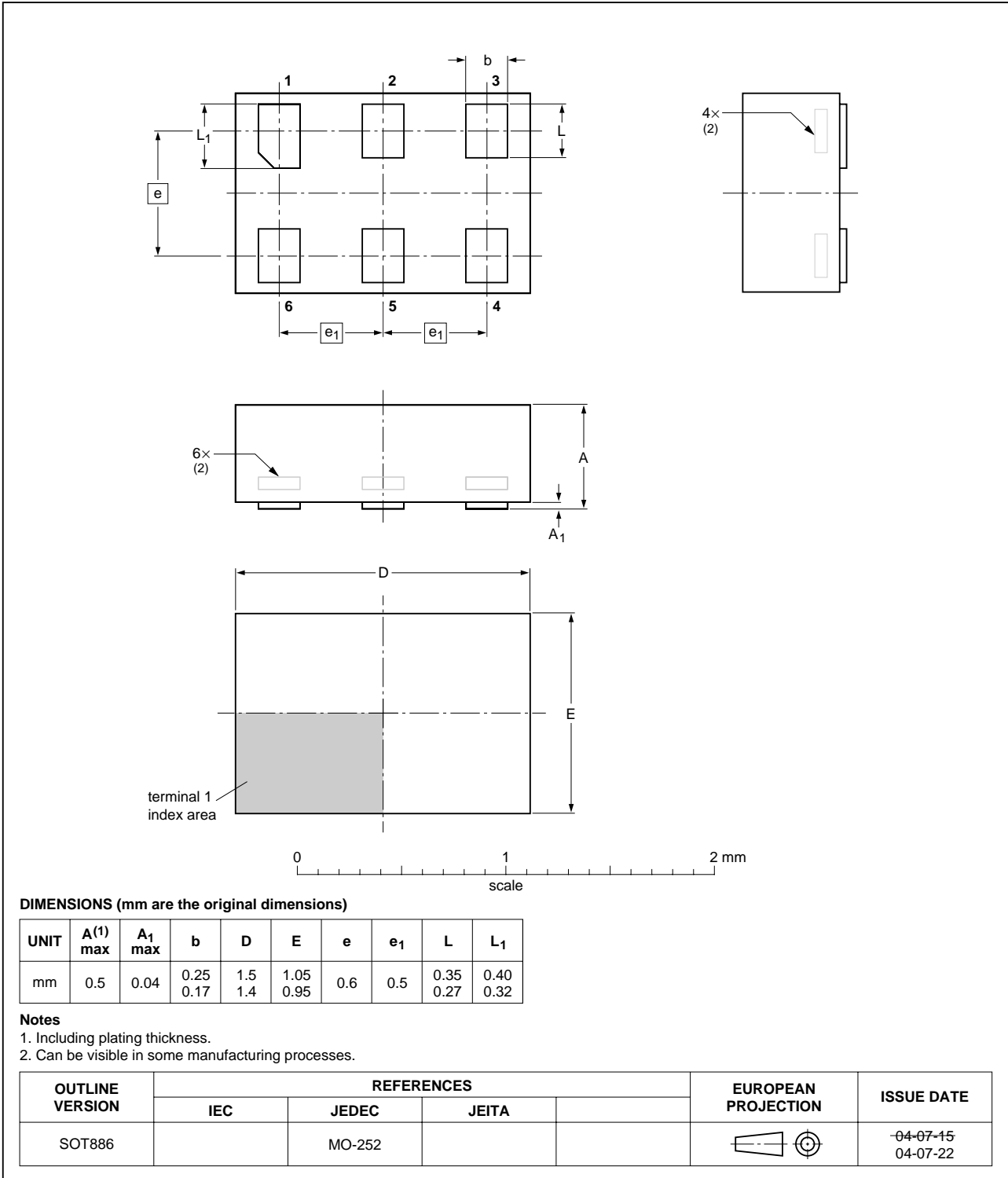


Fig 21. Package outline SOT886 (XSON6)



## 14. Abbreviations

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Table 13. Abbreviations

Acronym	Description
CDM	Charged Device Model
CMOS	Complementary Metal-Oxide Semiconductor
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
PDA	Personal Digital Assistant
TTL	Transistor-Transistor Logic

## 15. Revision history

Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NX3L1T5157_1	20080916	Product data sheet	-	-

## 16. Legal information

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### 16.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

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

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

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

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