

NX3L1T3157

Low-ohmic single-pole double-throw switch

Rev. 05 — 28 July 2008

Product data sheet

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1. General description

The NX3L1T3157 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 NX3L1T3157 to switch 3.6 V signals with a 1.8 V digital controller, eliminating the need for logic level translation.

The NX3L1T3157 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 Ω) and flatness (0.13 Ω) 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 Ω (typical) at $V_{CC} = 1.4$ V
 - ◆ 1.0 Ω (typical) at $V_{CC} = 1.65$ V
 - ◆ 0.55 Ω (typical) at $V_{CC} = 2.3$ V
 - ◆ 0.50 Ω (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	
NX3L1T3157GW	-40 °C to +125 °C	SC-88	plastic surface-mounted package; 6 leads	SOT363
NX3L1T3157GM	-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
NX3L1T3157GW	MI
NX3L1T3157GM	MI

6. Functional diagram

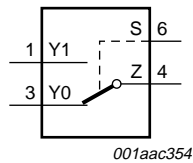


Fig 1. Logic symbol

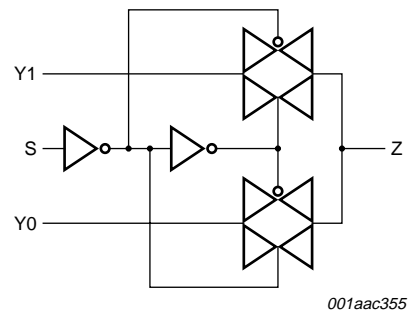
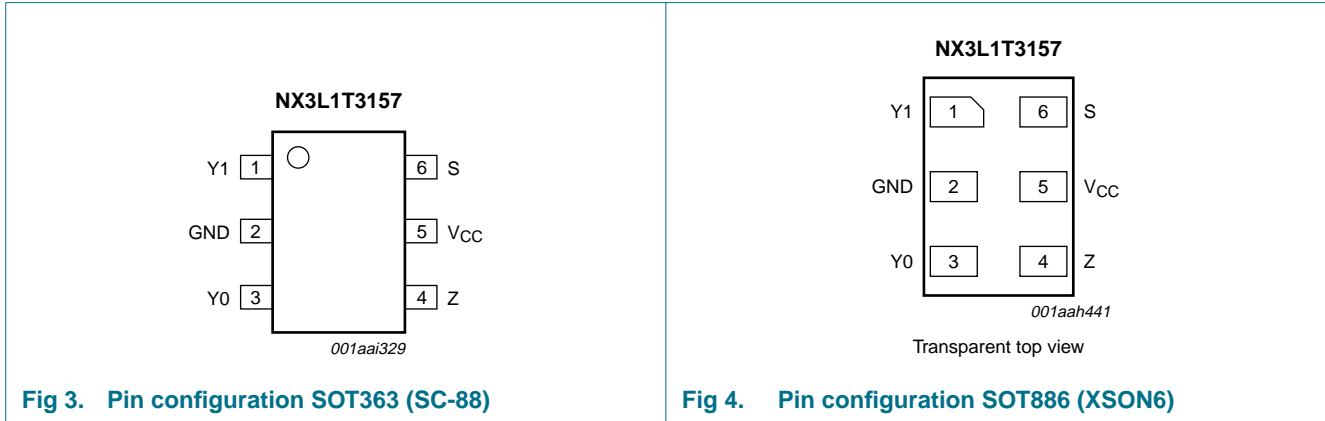


Fig 2. Logic diagram

7. Pinning information

W W W

7.1 Pinning



7.2 Pin description

Table 3. Pin description

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

8. Functional description

Table 4. Function table^[1]

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	-	± 50	mA
I_{SW}	switch current	$V_{SW} > -0.5$ V or $V_{SW} < V_{CC} + 0.5$ V; source or sink current	-	± 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	-	± 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 SC-88 package: above 87.5 °C the value of P_{tot} derates linearly with 4.0 mW/K.
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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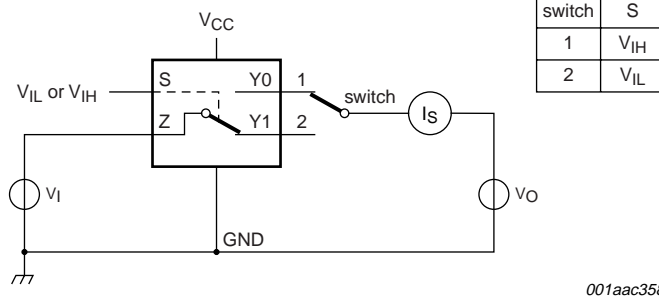
Table 7. Static characteristics

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

Symbol	Parameter	Conditions	T _{amb} = 25 °C			T _{amb} = -40 °C to +125 °C			Unit
			Min	Typ	Max	Min	Max (85 °C)	Max (125 °C)	
V _{IH}	HIGH-level input voltage	V _{CC} = 1.4 V to 1.6 V	0.9	-	-	0.9	-	-	V
		V _{CC} = 1.65 V to 1.95 V	0.9	-	-	0.9	-	-	V
		V _{CC} = 2.3 V to 2.7 V	1.1	-	-	1.1	-	-	V
		V _{CC} = 2.7 V to 3.6 V	1.3	-	-	1.3	-	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 1.4 V to 1.6 V	-	-	0.3	-	0.3	0.3	V
		V _{CC} = 1.65 V to 1.95 V	-	-	0.4	-	0.4	0.3	V
		V _{CC} = 2.3 V to 2.7 V	-	-	0.4	-	0.4	0.4	V
		V _{CC} = 2.7 V to 3.6 V	-	-	0.5	-	0.5	0.5	V
I _I	input leakage current	select input S; V _I = GND to 3.6 V; V _{CC} = 1.4 V to 3.6 V	-	-	-	-	±0.5	±1	μA
I _{S(OFF)}	OFF-state leakage current	Y0 and Y1 port; V _{CC} = 1.4 V to 3.6 V; see Figure 5	-	-	±5	-	±50	±500	nA
I _{S(ON)}	ON-state leakage current	Z port; V _{CC} = 1.4 V to 3.6 V; see Figure 6	-	-	±5	-	±50	±500	nA
I _{CC}	supply current	V _I = V _{CC} or GND; V _{CC} = 3.6 V; V _{SW} = GND or V _{CC}	-	-	100	-	690	6000	nA
ΔI _{CC}	additional supply current	V _I = 2.6 V; V _{CC} = 3.6 V; V _{SW} = GND or V _{CC}	-	0.35	0.7	-	1	1	μA
		V _I = 1.8 V; V _{CC} = 3.6 V; V _{SW} = GND or V _{CC}	-	2.5	4	-	5	5	μA
		V _I = 1.8 V; V _{CC} = 2.5 V; V _{SW} = GND or V _{CC}	-	50	200	-	300	500	nA
C _I	input capacitance		-	1.0	-	-	-	-	pF
C _{S(OFF)}	OFF-state capacitance		-	35	-	-	-	-	pF
C _{S(ON)}	ON-state capacitance		-	130	-	-	-	-	pF

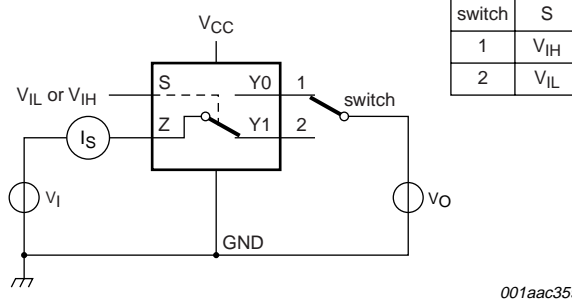
11.1 Test circuits

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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 5. 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 6. 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 8 to Figure 13.

Symbol	Parameter	Conditions	$T_{amb} = -40\text{ °C to }+85\text{ °C}$			$T_{amb} = -40\text{ °C to }+125\text{ °C}$		Unit	
			Min	Typ ^[1]	Max	Min	Max		
$R_{ON(peak)}$	ON resistance (peak)	$V_I = \text{GND to }V_{CC}; I_{SW} = 100\text{ mA};$ see Figure 7	$V_{CC} = 1.4\text{ V}$	-	1.6	3.7	-	4.1	Ω
			$V_{CC} = 1.65\text{ V}$	-	1.0	1.6	-	1.7	Ω
			$V_{CC} = 2.3\text{ V}$	-	0.55	0.8	-	0.9	Ω
			$V_{CC} = 2.7\text{ V}$	-	0.5	0.75	-	0.9	Ω
ΔR_{ON}	ON resistance mismatch between channels	$V_I = \text{GND to }V_{CC}; I_{SW} = 100\text{ mA}$ ^[2]	$V_{CC} = 1.4\text{ V}$	-	0.04	0.3	-	0.3	Ω
			$V_{CC} = 1.65\text{ V}$	-	0.04	0.2	-	0.3	Ω
			$V_{CC} = 2.3\text{ V}$	-	0.02	0.08	-	0.1	Ω
			$V_{CC} = 2.7\text{ V}$	-	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 8](#) to [Figure 13](#).

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

- [1] Typical values are measured at T_{amb} = 25 °C.
- [2] Measured at identical V_{CC}, temperature and input voltage.
- [3] Flatness is defined as the difference between the maximum and minimum value of ON resistance measured at identical V_{CC} and temperature.

11.3 ON resistance test circuit and graphs

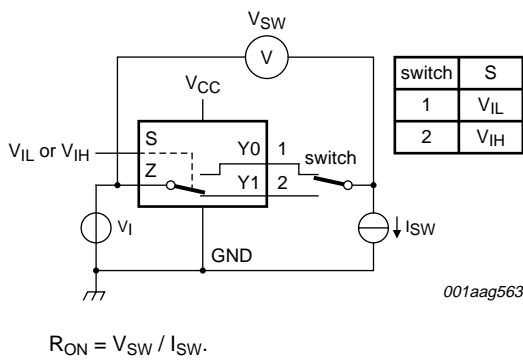
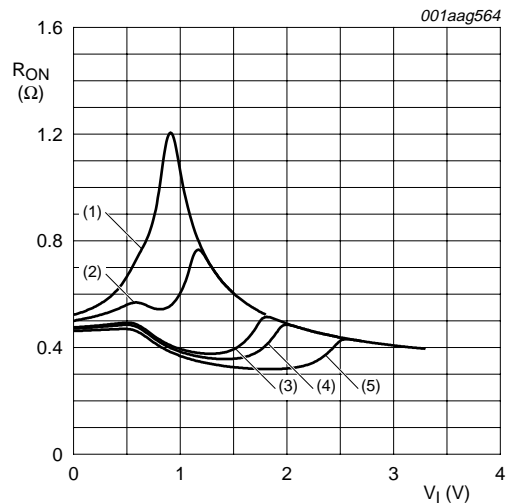
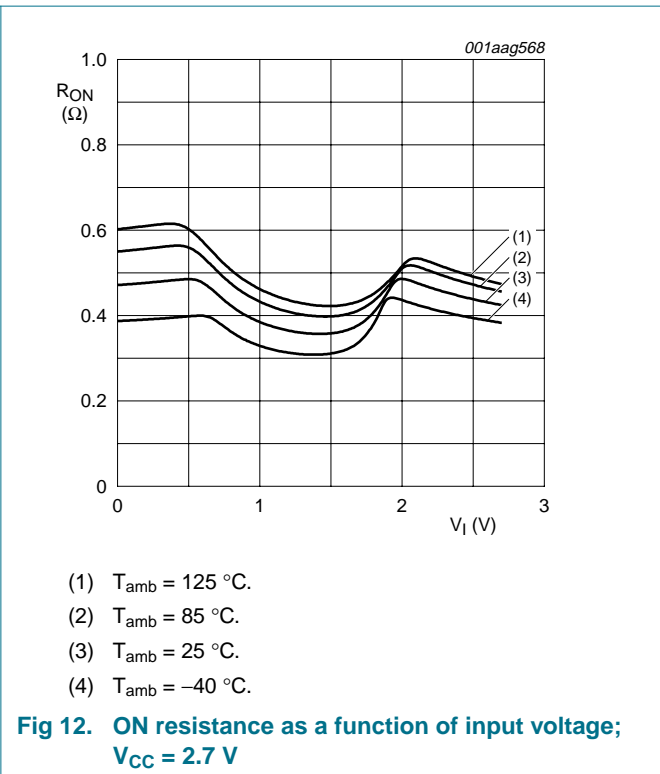
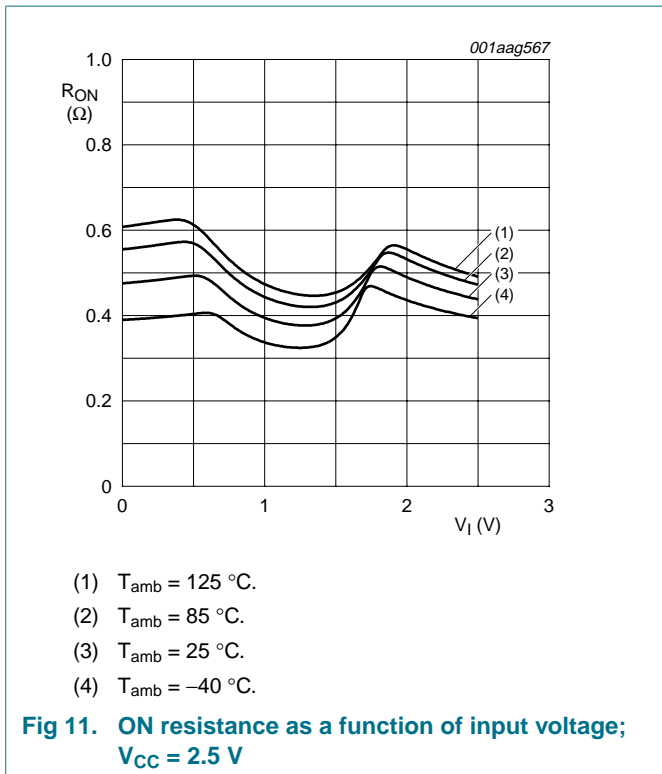
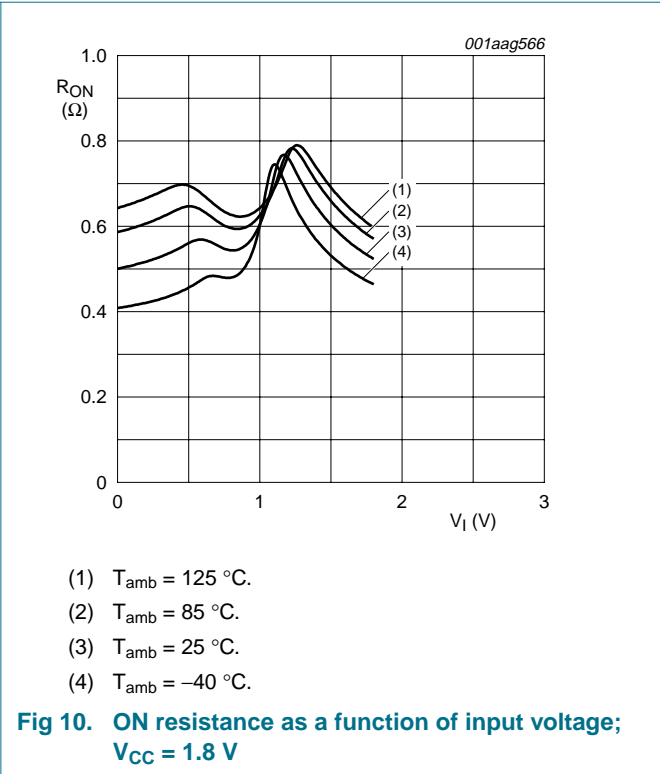
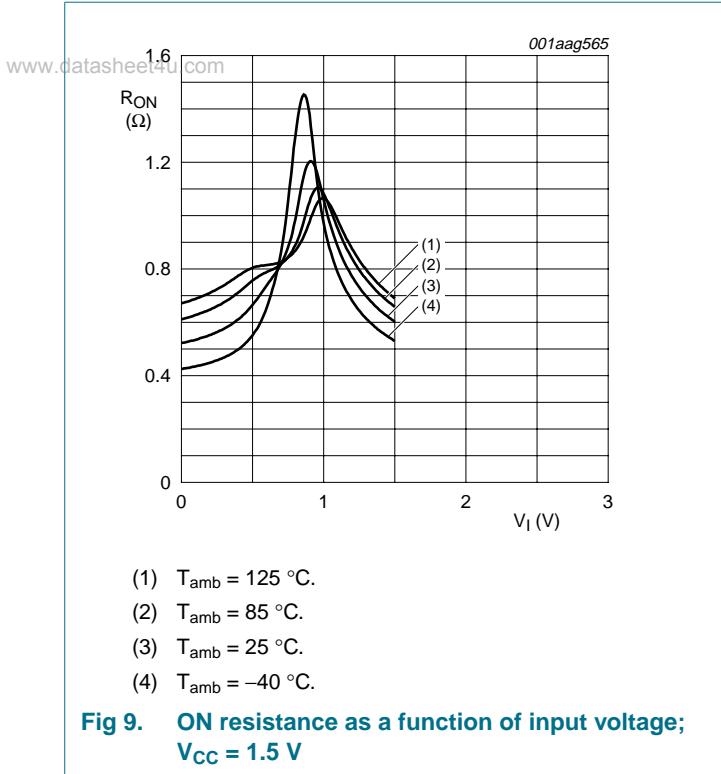


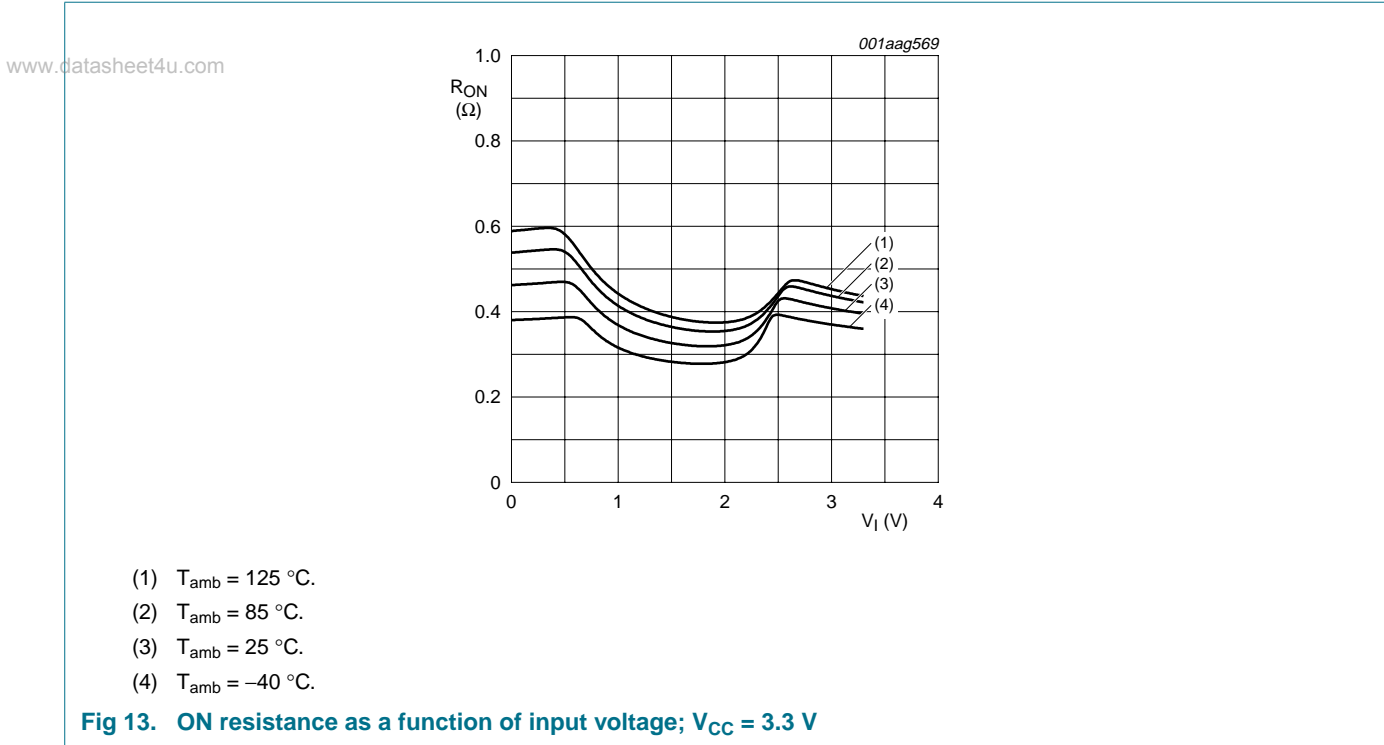
Fig 7. Test circuit for measuring ON resistance



- (1) V_{CC} = 1.5 V.
 - (2) V_{CC} = 1.8 V.
 - (3) V_{CC} = 2.5 V.
 - (4) V_{CC} = 2.7 V.
 - (5) V_{CC} = 3.3 V.
- Measured at T_{amb} = 25 °C.

Fig 8. 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 16](#).

Symbol	Parameter	Conditions	25 °C			-40 °C to +125 °C			Unit
			Min	Typ ^[1]	Max	Min	Max (85 °C)	Max (125 °C)	
t _{en}	enable time	S to Z or Yn; see Figure 14							
		V _{CC} = 1.4 V to 1.6 V	-	50	90	-	120	120	ns
		V _{CC} = 1.65 V to 1.95 V	-	36	70	-	80	90	ns
		V _{CC} = 2.3 V to 2.7 V	-	24	45	-	50	55	ns
		V _{CC} = 2.7 V to 3.6 V	-	22	40	-	45	50	ns
t _{dis}	disable time	S to Z or Yn; see Figure 14							
		V _{CC} = 1.4 V to 1.6 V	-	32	70	-	80	90	ns
		V _{CC} = 1.65 V to 1.95 V	-	20	55	-	60	65	ns
		V _{CC} = 2.3 V to 2.7 V	-	12	25	-	30	35	ns
		V _{CC} = 2.7 V to 3.6 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 16](#).

Symbol	Parameter	Conditions	25 °C			-40 °C to +125 °C			Unit
			Min	Typ ^[1]	Max	Min	Max (85 °C)	Max (125 °C)	
t_{b-m}	break-before-make time	see Figure 15 ^[2]							
		$V_{CC} = 1.4 \text{ V to } 1.6 \text{ V}$	-	19	-	9	-	-	ns
		$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	-	17	-	7	-	-	ns
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	-	13	-	4	-	-	ns
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	-	10	-	3	-	-	ns

[1] Typical values are measured at $T_{amb} = 25 \text{ °C}$ and $V_{CC} = 1.5 \text{ V}, 1.8 \text{ V}, 2.5 \text{ V}$ and 3.3 V respectively.

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

12.1 Waveform and test circuits

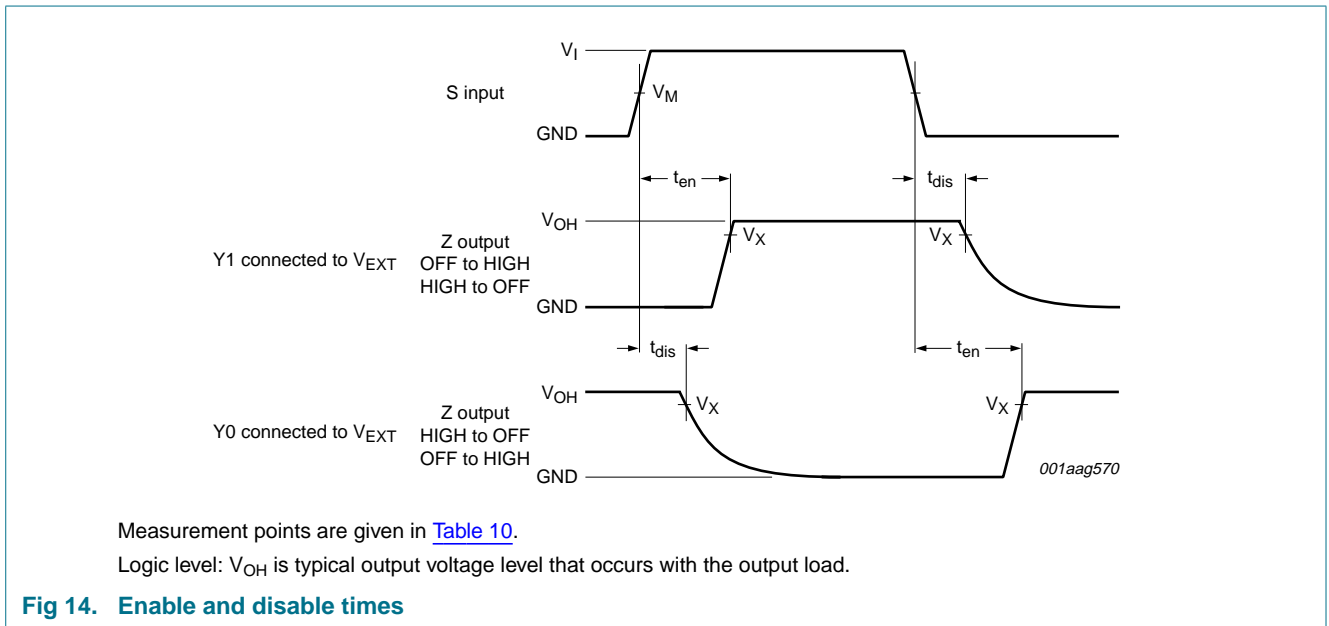
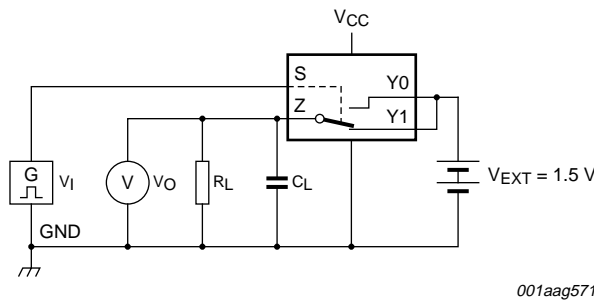


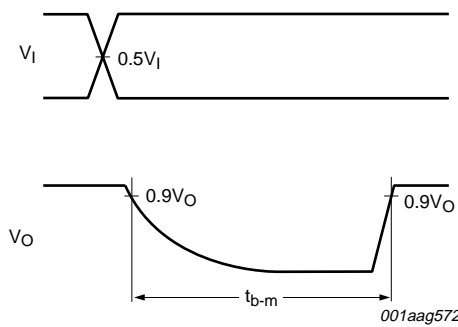
Table 10. Measurement points

Supply voltage	Input	Output
V_{CC}	V_M	V_X
1.4 V to 3.6 V	$0.5V_{CC}$	$0.9V_{OH}$

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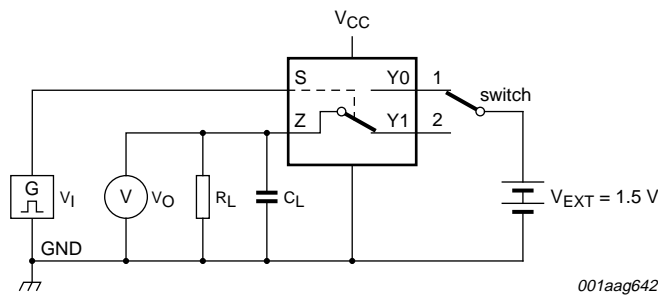


a. Test circuit



b. Input and output measurement points

Fig 15. 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 16. 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}	≤ 2.5 ns	35 pF	50 Ω

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 Figure 17	[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 Figure 18	[1]			
		$V_{CC} = 1.4$ V to 3.6 V	-	60	-	MHz
α_{iso}	isolation (OFF-state)	$f_i = 100$ kHz; $R_L = 50 \Omega$; see Figure 19	[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 Figure 20				
		$V_{CC} = 1.4$ 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 Ω ; $V_{gen} = 0$ V; $R_{gen} = 0 \Omega$; see Figure 21				
		$V_{CC} = 1.5$ 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

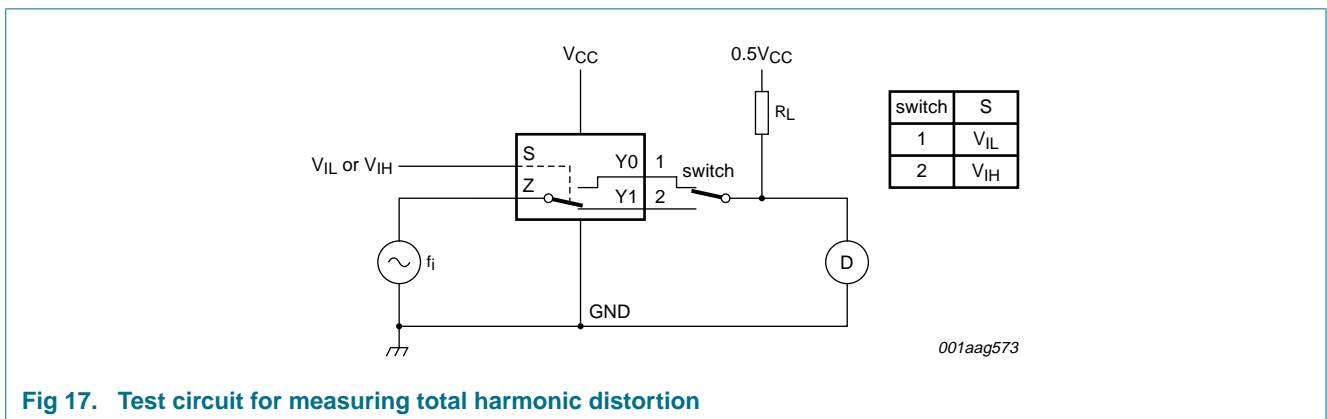
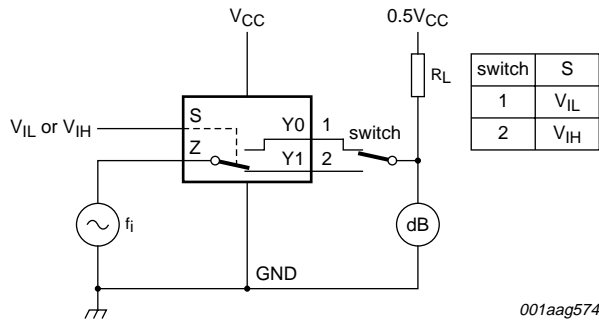


Fig 17. Test circuit for measuring total harmonic distortion

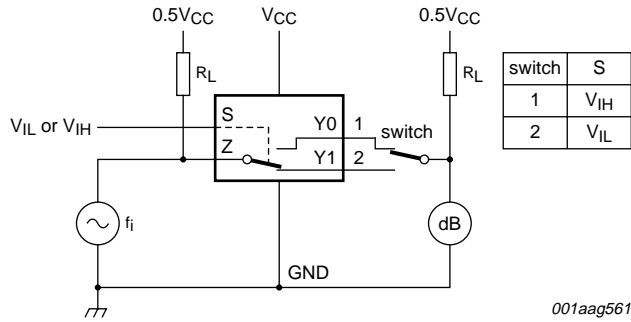
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Adjust f_i voltage to obtain 0 dBm level at output. Increase f_i frequency until dB meter reads -3 dB.

Fig 18. Test circuit for measuring the frequency response when channel is in ON-state

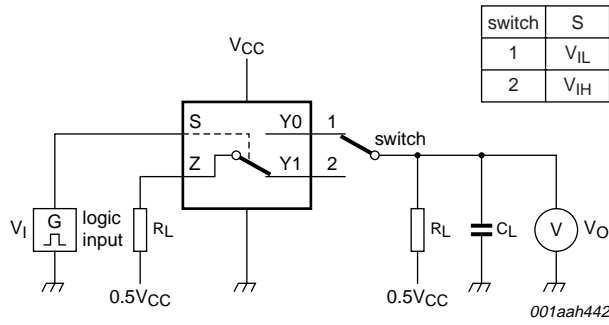


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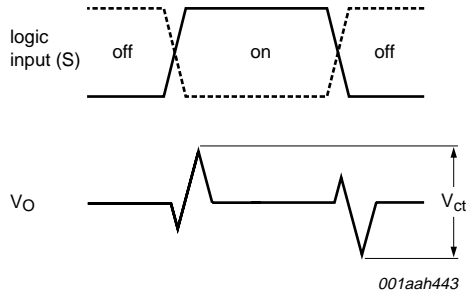
Adjust f_i voltage to obtain 0 dBm level at input.

Fig 19. Test circuit for measuring isolation (OFF-state)

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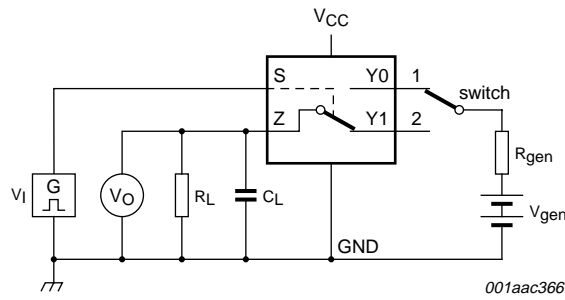
a. Test circuit



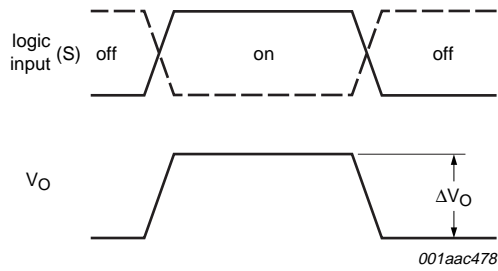
b. Input and output pulse definitions

Fig 20. 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: $Q_{inj} = \Delta V_O \times C_L$.

ΔV_O = output voltage variation.

R_{gen} = generator resistance.

V_{gen} = generator voltage.

Fig 21. Test circuit for measuring charge injection

13. Package outline

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Plastic surface-mounted package; 6 leads

SOT363

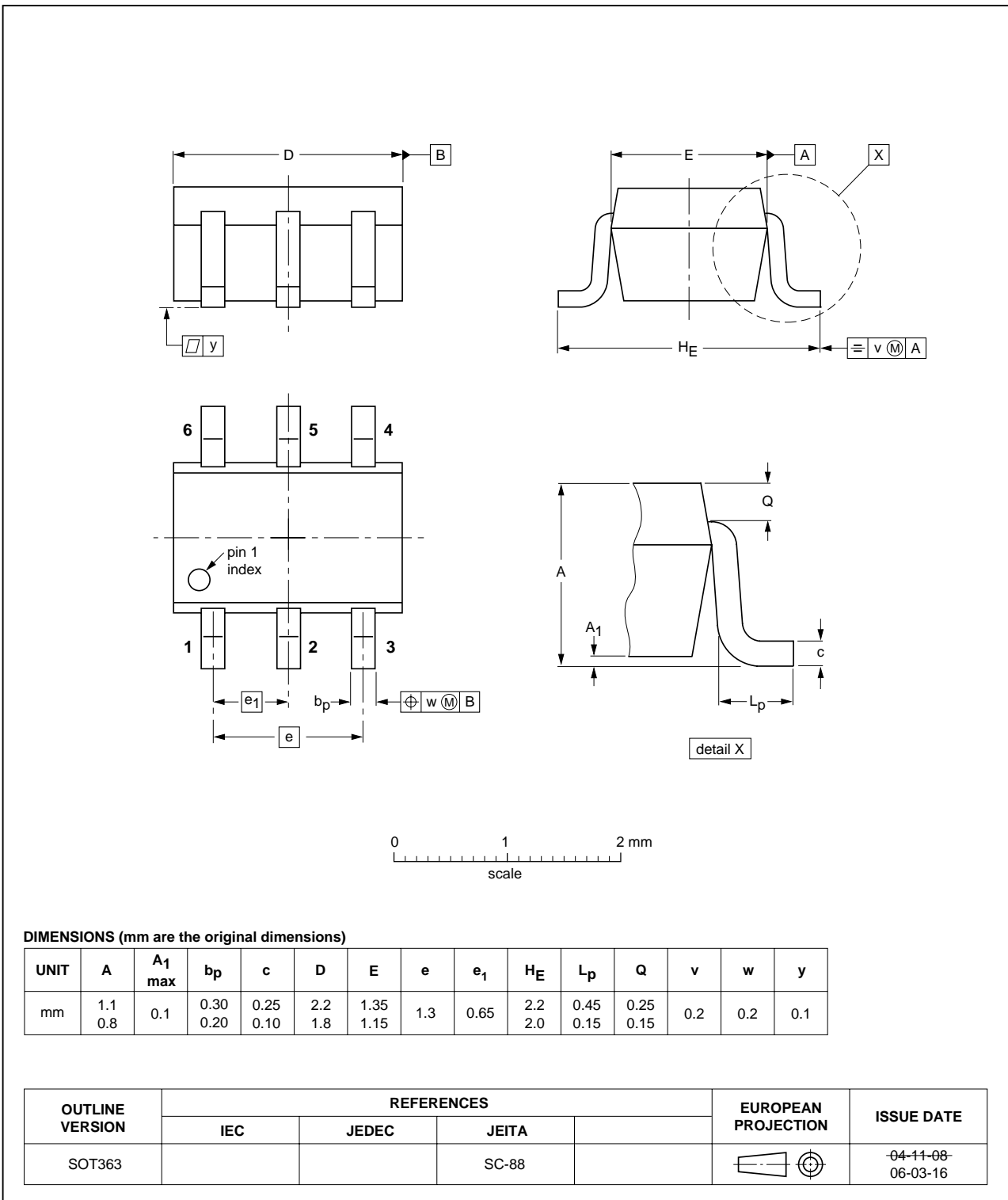


Fig 22. Package outline SOT363 (SC-88)

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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

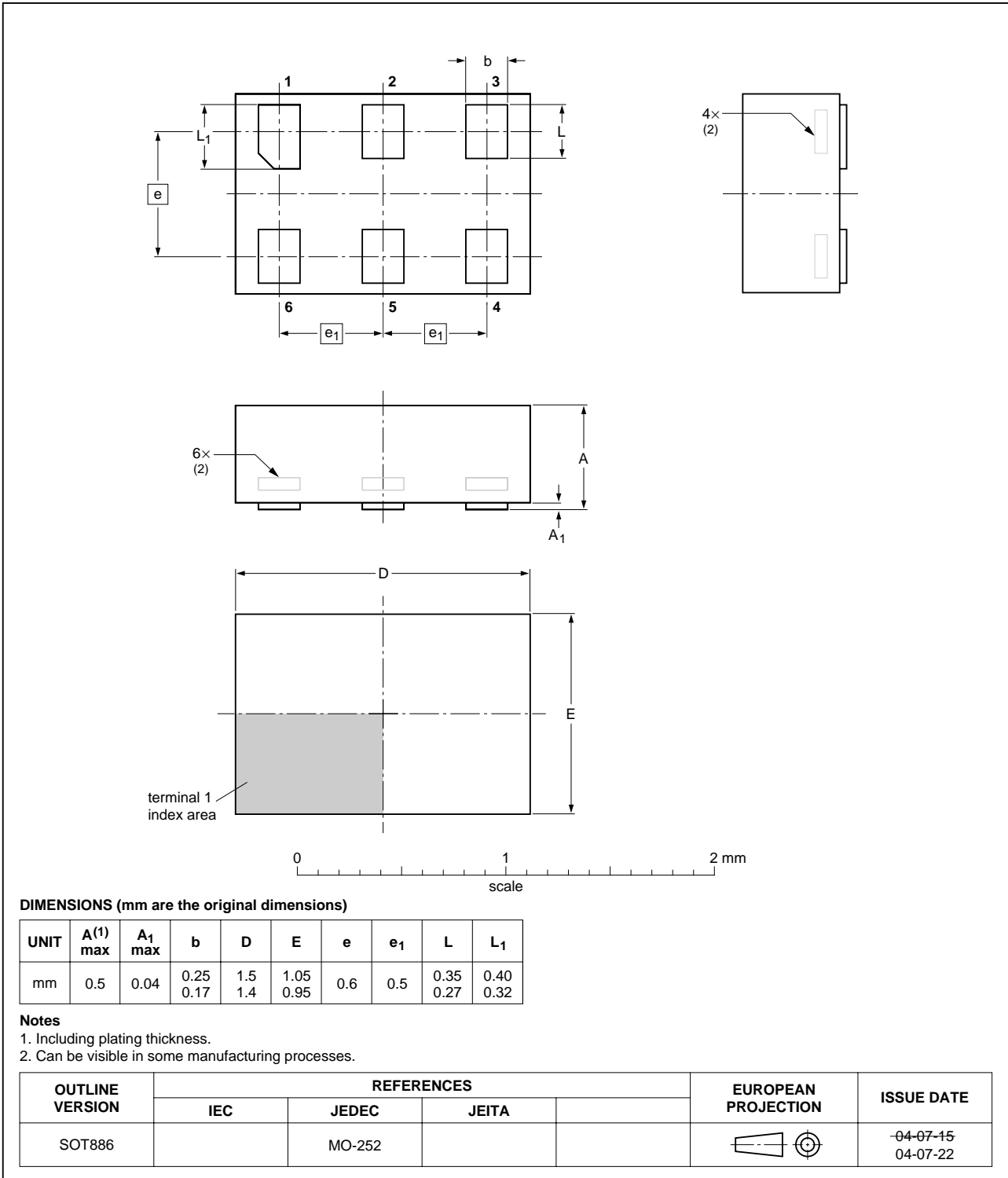


Fig 23. Package outline SOT886 (XSON6)

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
NX3L1T3157_5	20080728	Product data sheet	-	NX3L1T3157_4
Modifications:	<ul style="list-style-type: none"> Added type number NX3L1T3157GW (SC-88 / SOT363 package) 			
NX3L1T3157_4	20080718	Product data sheet	-	NX3L1T3157_3
NX3L1T3157_3	20080408	Product data sheet	-	NX3L1T3157_2
NX3L1T3157_2	20080306	Product data sheet	-	NX3L1T3157_1
NX3L1T3157_1	20080103	Product data sheet	-	-

16. Legal information

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Document status ^{[1][2]}	Product status ^[3]	Definition
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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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