NX3L1T5157

Low-ohmic single-pole double-throw analog switch

Rev. 6.2 — 3 December 2019 Product data sheet

1. General description

The NX3L1T5157 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 independent inputs/outputs (Y0 and Y1) and a common input/output (Z).

Schmitt trigger action at the digital input makes the circuit tolerant to slower input rise and fall times. Low threshold digital input allows this device to be driven by 1.8 V logic levels in 3.3 V applications without significant increase in supply current I_{CC}. This makes it possible for the NX3L1T5157 to switch 4.3 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 Ω) and flatness (0.13 Ω) ensures minimal attenuation and distortion of transmitted signals.

2. Features and benefits

- Wide supply voltage range from 1.4 V to 4.3 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
  - 0.50 Ω (typical) at V_{CC} = 4.3 V
- Break-before-make switching
- High noise immunity
- ESD protection:
  - HBM JESD22-A114F Class 3A exceeds 7500 V
  - MM JESD22-A115-A exceeds 200 V
  - CDM AEC-Q100-011 revision B exceeds 1000 V
  - IEC61000-4-2 contact discharge exceeds 8000 V for switch ports
- CMOS low-power consumption
- Latch-up performance exceeds 100 mA per JESD78 Class II Level A
- 1.8 V control logic at V_{CC} = 3.6 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

- Cell phone
- PDA
- Portable media player

4. Ordering information

Table 1. Ordering information

Type number	Topside marking[1]	Package		
		Name	Description	Version
NX3L1T5157GM	DI	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm	SOT886

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

4.1 Ordering options

Table 2. Ordering options

Type number	Orderable part number	Package	Packing method	Minimum order quantity	Temperature
NX3L1T5157GM	NX3L1T5157GM,115[1]	XSON6	REEL 7" Q1 NDP	5000	T_{amb} = –40 °C to +125 °C
NX3L1T5157GM	NX3L1T5157GM,132[1]	XSON6	REEL 7" Q3 NDP	5000	T_{amb} = –40 °C to +125 °C
NX3L1T5157GM	NX3L1T5157GMZ	XSON6	REEL 7" Q1 NDP SSB[2]	5000	T_{amb} = –40 °C to +125 °C
NX3L1T5157GM	NX3L1T5157GMAZ	XSON6	REEL 7" Q3 NDP SSB[2]	5000	T_{amb} = –40 °C to +125 °C

[1] Will go EOL - migrate to new leadframe orderable part number.

[2] This packing method uses a Static Shielding Bag (SSB) solution. Material is to be kept in the sealed bag between uses.

5. Functional diagram

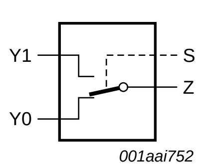


Fig 1. Logic symbol

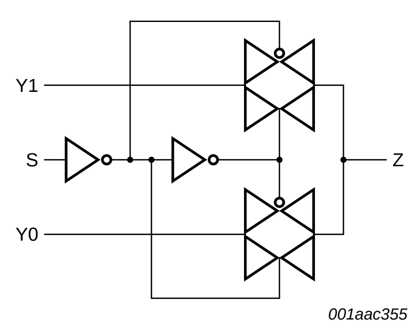


Fig 2. Logic diagram

6. Pinning information

6.1 Pinning

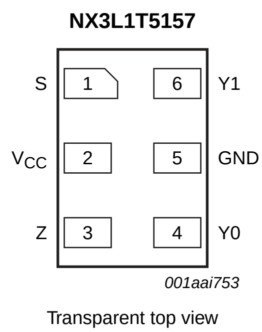


Fig 3. Pin configuration SOT886 (XSON6)

6.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
S	1	select input
V_{CC}	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

7. Functional description

Table 4. Function table[1]

Input S	Channel on
L	Y0
H	Y1

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

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	+4.6	V
V_I	input voltage	select input S	[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 but may not exceed 4.6 V.

[3] For XSON6 package: above 118 °C the value of P_{tot} derates linearly with 7.8 mW/K.

9. Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Conditions		Min	Max	Unit
V_{CC}	supply voltage			1.4	4.3	V
V_I	input voltage	select input S		0	4.3	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 4.3 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.

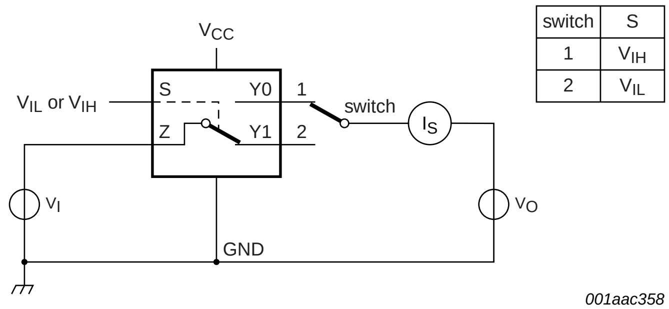
10. Static characteristics

Table 7. Static characteristics

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

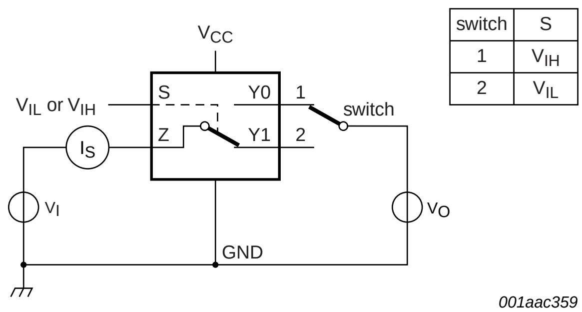
Symbol	Parameter	Conditions	T_{amb} = 25 °C			T_{amb} = −40 °C to +125 °C			Unit
			Min	Typ	Max	Min	Max (85 °C)	Max (125 °C)	
V_{IH}	HIGH-level input voltage	V_{CC} = 1.4 V to 1.6 V	0.9	-	-	0.9	-	-	V
		V_{CC} = 1.65 V to 1.95 V	0.9	-	-	0.9	-	-	V
		V_{CC} = 2.3 V to 2.7 V	1.1	-	-	1.1	-	-	V
		V_{CC} = 2.7 V to 3.6 V	1.3	-	-	1.3	-	-	V
		V_{CC} = 3.6 V to 4.3 V	1.4	-	-	1.4	-	-	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
		V_{CC} = 3.6 V to 4.3 V	-	-	0.6	-	0.6	0.6	V
I_I	input leakage current	select input S; V_I = GND to 4.3 V; V_{CC} = 1.4 V to 4.3 V	-	-	-	-	±0.5	±1	μA
$I_{S(OFF)}$	OFF-state leakage current	Y0 and Y1 port; see Figure 4							
		V_{CC} = 1.4 V to 3.6 V	-	-	±5	-	±50	±500	nA
		V_{CC} = 3.6 V to 4.3 V	-	-	±10	-	±50	±500	nA
$I_{S(ON)}$	ON-state leakage current	Z port; see Figure 5							
		V_{CC} = 1.4 V to 3.6 V	-	-	±5	-	±50	±500	nA
		V_{CC} = 3.6 V to 4.3 V	-	-	±10	-	±50	±500	nA
I_{CC}	supply current	V_I = V_{CC} or GND; V_{SW} = GND or V_{CC}							
		V_{CC} = 3.6 V	-	-	100	-	690	6000	nA
		V_{CC} = 4.3 V	-	-	150	-	800	7000	nA
ΔI_{CC}	additional supply current	V_{SW} = GND or V_{CC}							
		V_I = 2.6 V; V_{CC} = 4.3 V	-	2.0	4.0	-	7	7	μA
		V_I = 2.6 V; V_{CC} = 3.6 V	-	0.35	0.7	-	1	1	μA
		V_I = 1.8 V; V_{CC} = 4.3 V	-	7.0	10.0	-	15	15	μA
		V_I = 1.8 V; V_{CC} = 3.6 V	-	2.5	4.0	-	5	5	μA
		V_I = 1.8 V; V_{CC} = 2.5 V	-	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

10.1 Test circuits



V_I = 0.3 V or V_{CC} − 0.3 V; V_O = V_{CC} − 0.3 V or 0.3 V.

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



V_I = 0.3 V or V_{CC} − 0.3 V; V_O = V_{CC} − 0.3 V or 0.3 V.

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

10.2 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 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	
$R_{ON(peak)}$	ON resistance (peak)	V_I = GND to V_{CC}; I_{SW} = 100 mA; see Figure 6						
		V_{CC} = 1.4 V	-	1.6	3.7	-	4.1	Ω
		V_{CC} = 1.65 V	-	1.0	1.6	-	1.7	Ω
		V_{CC} = 2.3 V	-	0.55	0.8	-	0.9	Ω
		V_{CC} = 2.7 V	-	0.5	0.75	-	0.9	Ω
		V_{CC} = 4.3 V	-	0.5	0.75	-	0.9	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 13.

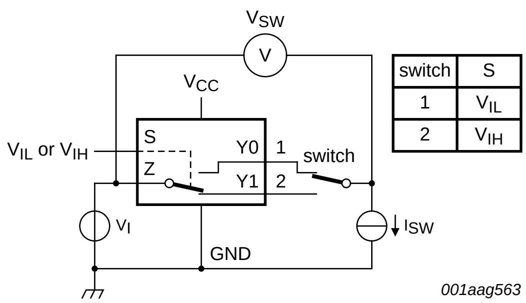
Symbol	Parameter	Conditions		T_{amb} = −40 °C to +85 °C			T_{amb} = −40 °C to +125 °C		Unit
				Min	Typ[1]	Max	Min	Max	
ΔR_{ON}	ON resistance mismatch between channels	V_I = GND to V_{CC}; I_{SW} = 100 mA	[2]						
		V_{CC} = 1.4 V		-	0.04	0.3	-	0.3	Ω
		V_{CC} = 1.65 V		-	0.04	0.2	-	0.3	Ω
		V_{CC} = 2.3 V		-	0.02	0.08	-	0.1	Ω
		V_{CC} = 2.7 V		-	0.02	0.075	-	0.1	Ω
		V_{CC} = 4.3 V		-	0.02	0.075	-	0.1	Ω
$R_{ON(flat)}$	ON resistance (flatness)	V_I = GND to V_{CC}; I_{SW} = 100 mA	[3]						
		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
		V_{CC} = 4.3 V		-	0.2	0.4	-	0.45	Ω

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

[2] Measured at identical V_{CC}, temperature and input voltage.

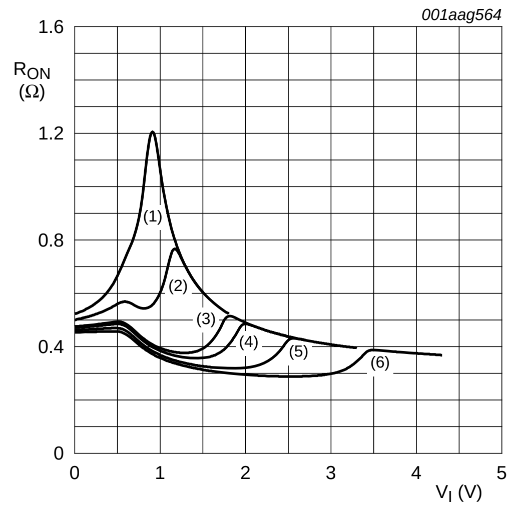
[3] Flatness is defined as the difference between the maximum and minimum value of ON resistance measured at identical V_{CC} and temperature.

10.3 ON resistance test circuit and graphs



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

Fig 6. Test circuit for measuring ON resistance



(1) V_{CC} = 1.5 V.

(2) V_{CC} = 1.8 V.

(3) V_{CC} = 2.5 V.

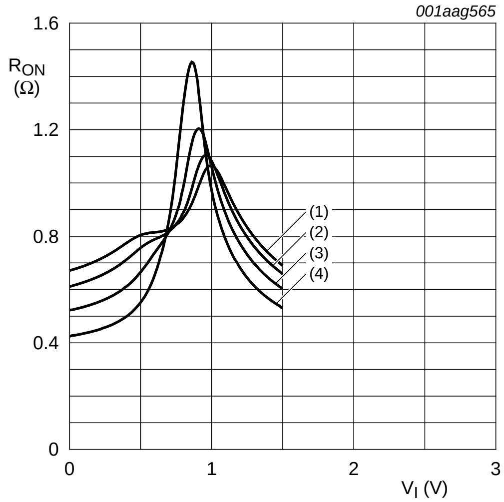
(4) V_{CC} = 2.7 V.

(5) V_{CC} = 3.3 V.

(6) V_{CC} = 4.3 V.

Measured at T_{amb} = 25 °C.

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



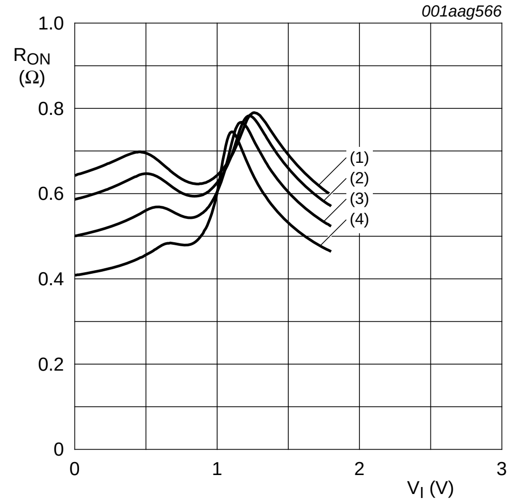
(1) T_{amb} = 125 °C.

(2) T_{amb} = 85 °C.

(3) T_{amb} = 25 °C.

(4) T_{amb} = −40 °C.

Fig 8. ON resistance as a function of input voltage; V_{CC} = 1.5 V



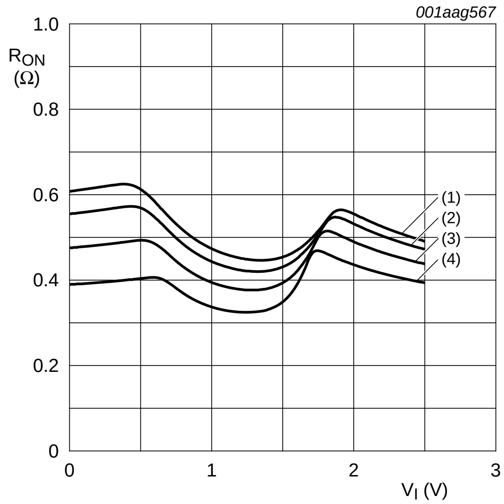
(1) T_{amb} = 125 °C.

(2) T_{amb} = 85 °C.

(3) T_{amb} = 25 °C.

(4) T_{amb} = −40 °C.

Fig 9. ON resistance as a function of input voltage; V_{CC} = 1.8 V



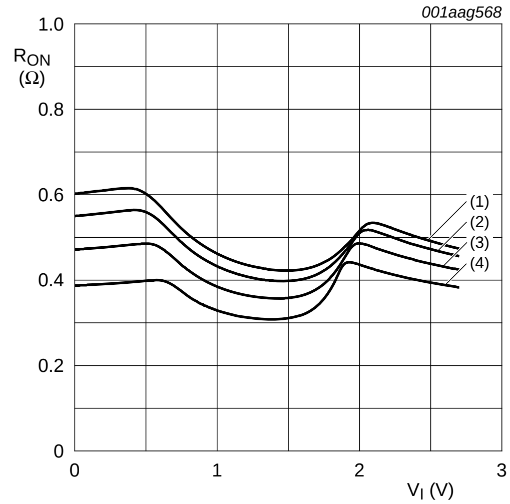
(1) T_{amb} = 125 °C.

(2) T_{amb} = 85 °C.

(3) T_{amb} = 25 °C.

(4) T_{amb} = −40 °C.

Fig 10. ON resistance as a function of input voltage; V_{CC} = 2.5 V



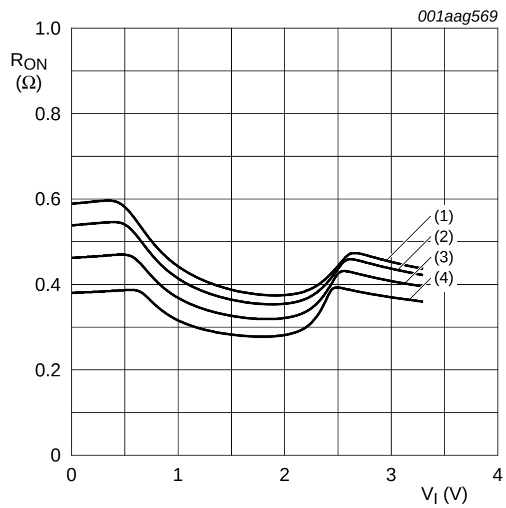
(1) T_{amb} = 125 °C.

(2) T_{amb} = 85 °C.

(3) T_{amb} = 25 °C.

(4) T_{amb} = −40 °C.

Fig 11. ON resistance as a function of input voltage; V_{CC} = 2.7 V



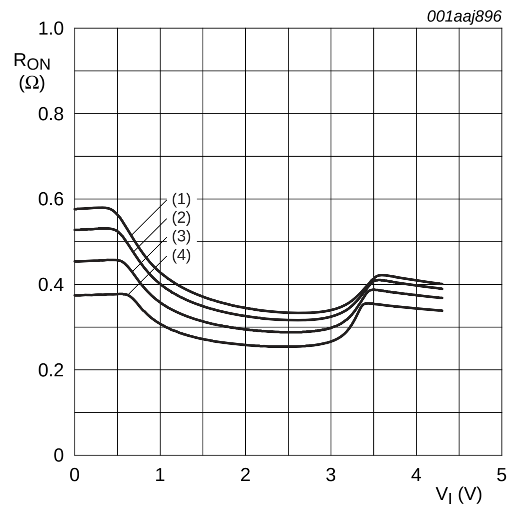
(1) T_{amb} = 125 °C.

(2) T_{amb} = 85 °C.

(3) T_{amb} = 25 °C.

(4) T_{amb} = −40 °C.

Fig 12. ON resistance as a function of input voltage; V_{CC} = 3.3 V



(1) T_{amb} = 125 °C.

(2) T_{amb} = 85 °C.

(3) T_{amb} = 25 °C.

(4) T_{amb} = −40 °C.

Fig 13. ON resistance as a function of input voltage; V_{CC} = 4.3 V

11. 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
		V_{CC} = 3.6 V to 4.3 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
		V_{CC} = 3.6 V to 4.3 V	-	10	20	-	25	30	ns

Table 9. Dynamic characteristics *...continued*

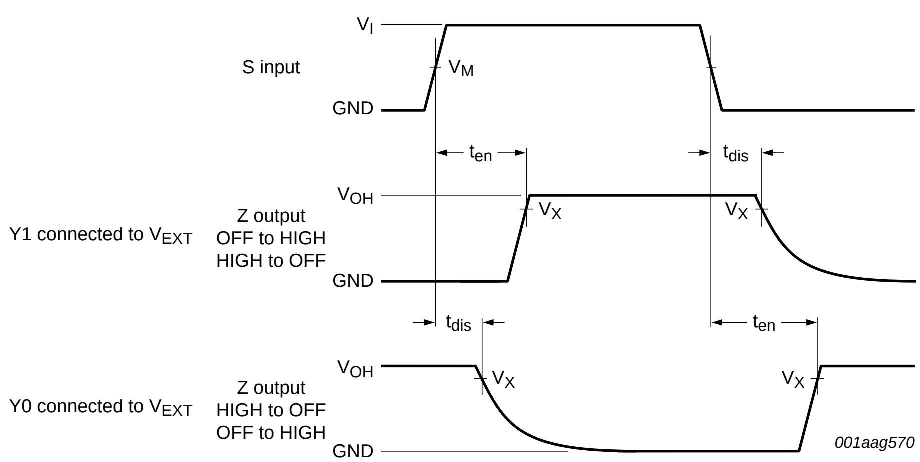
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for load circuit see Figure 16.

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 V to 1.6 V	-	19	-	9	-	-	ns
		V_{CC} = 1.65 V to 1.95 V	-	17	-	7	-	-	ns
		V_{CC} = 2.3 V to 2.7 V	-	13	-	4	-	-	ns
		V_{CC} = 2.7 V to 3.6 V	-	10	-	3	-	-	ns
		V_{CC} = 3.6 V to 4.3 V	-	10	-	2	-	-	ns

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 1.5 V, 1.8 V, 2.5 V, 3.3 V and 4.3 V respectively.

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

11.1 Waveform and test circuits



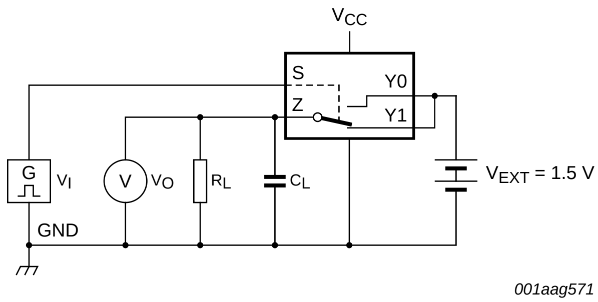
Measurement points are given in Table 10.

Logic level: V_{OH} is typical output voltage level that occurs with the output load.

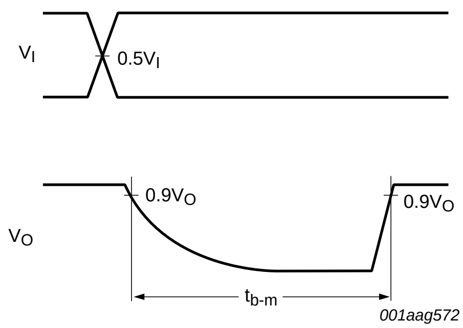
Fig 14. Enable and disable times

Table 10. Measurement points

Supply voltage	Input	Output
V_{CC}	V_M	V_X
1.4 V to 4.3 V	$0.5V_{CC}$	$0.9V_{OH}$

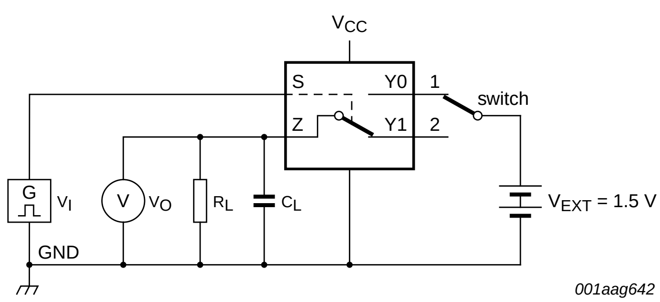


a. Test circuit



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 4.3 V	V_{CC}	≤ 2.5 ns	35 pF	50 Ω

11.2 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; $T_{amb} = 25$ °C.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
THD	total harmonic distortion	f_i = 20 Hz to 20 kHz; R_L = 32 Ω; 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)	-	0.02	-	%
		V_{CC} = 2.7 V; V_I = 2 V (p-p)	-	0.02	-	%
		V_{CC} = 4.3 V; V_I = 2 V (p-p)	-	0.02	-	%
$f_{(-3dB)}$	–3 dB frequency response	R_L = 50 Ω; see Figure 18 [1]				
		V_{CC} = 1.4 V to 4.3 V	-	60	-	MHz
α_{iso}	isolation (OFF-state)	f_i = 100 kHz; R_L = 50 Ω; see Figure 19 [1]				
		V_{CC} = 1.4 V to 4.3 V	-	–90	-	dB
V_{ct}	crosstalk voltage	between digital inputs and switch; f_i = 1 MHz; C_L = 50 pF; R_L = 50 Ω; see Figure 20				
		V_{CC} = 1.4 V to 3.6 V	-	0.2	-	V
		V_{CC} = 3.6 V to 4.3 V	-	0.3	-	V
Q_{inj}	charge injection	f_i = 1 MHz; C_L = 0.1 nF; R_L = 1 MΩ; V_{gen} = 0 V; R_{gen} = 0 Ω; 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
		V_{CC} = 4.3 V	-	15	-	pC

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

11.3 Test circuits

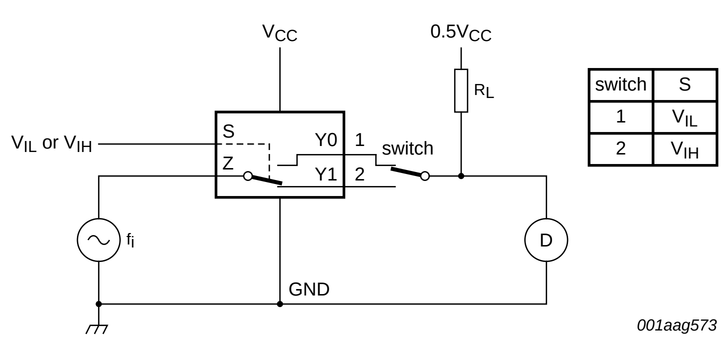
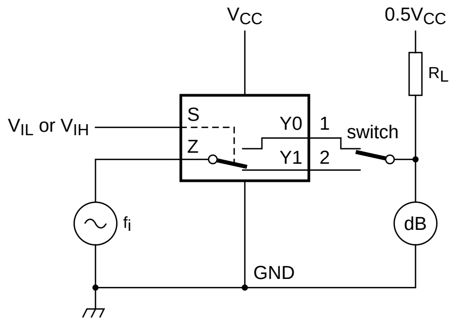


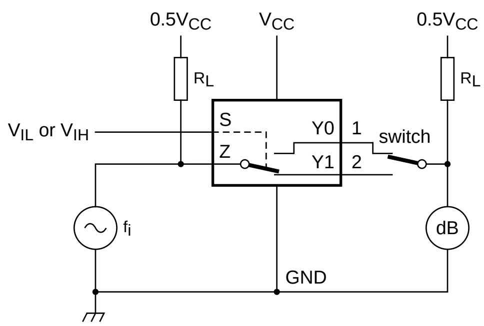
Fig 17. Test circuit for measuring total harmonic distortion



switch	S
1	V_{IL}
2	V_{IH}

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

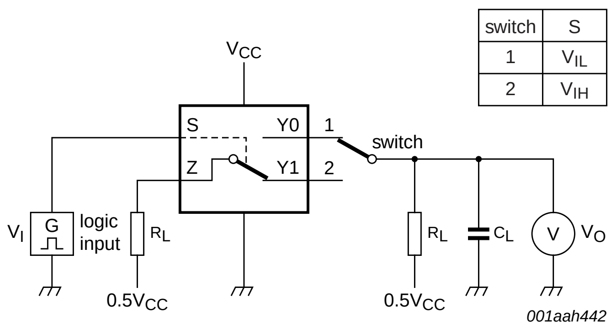
Fig 18. Test circuit for measuring the frequency response when channel is in ON-state



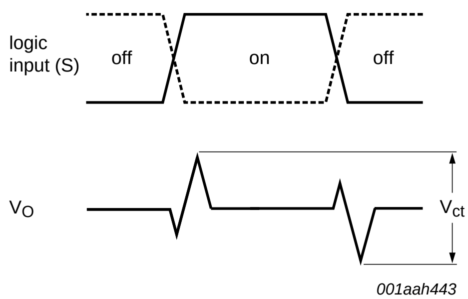
switch	S
1	V_{IH}
2	V_{IL}

Adjust f_i voltage to obtain 0 dBm level at input.

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

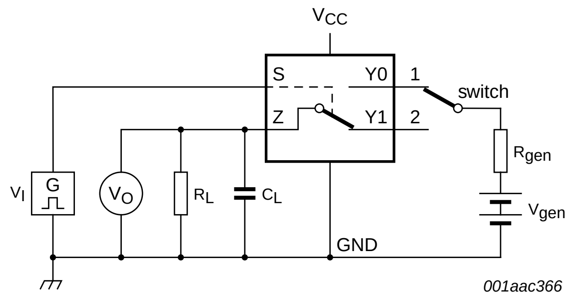


a. Test circuit

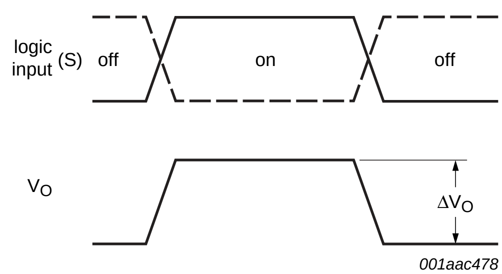


b. Input and output pulse definitions

Fig 20. Test circuit for measuring crosstalk voltage between digital inputs and switch



a. Test circuit



b. Input and output pulse definitions

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

ΔV_O = output voltage variation.

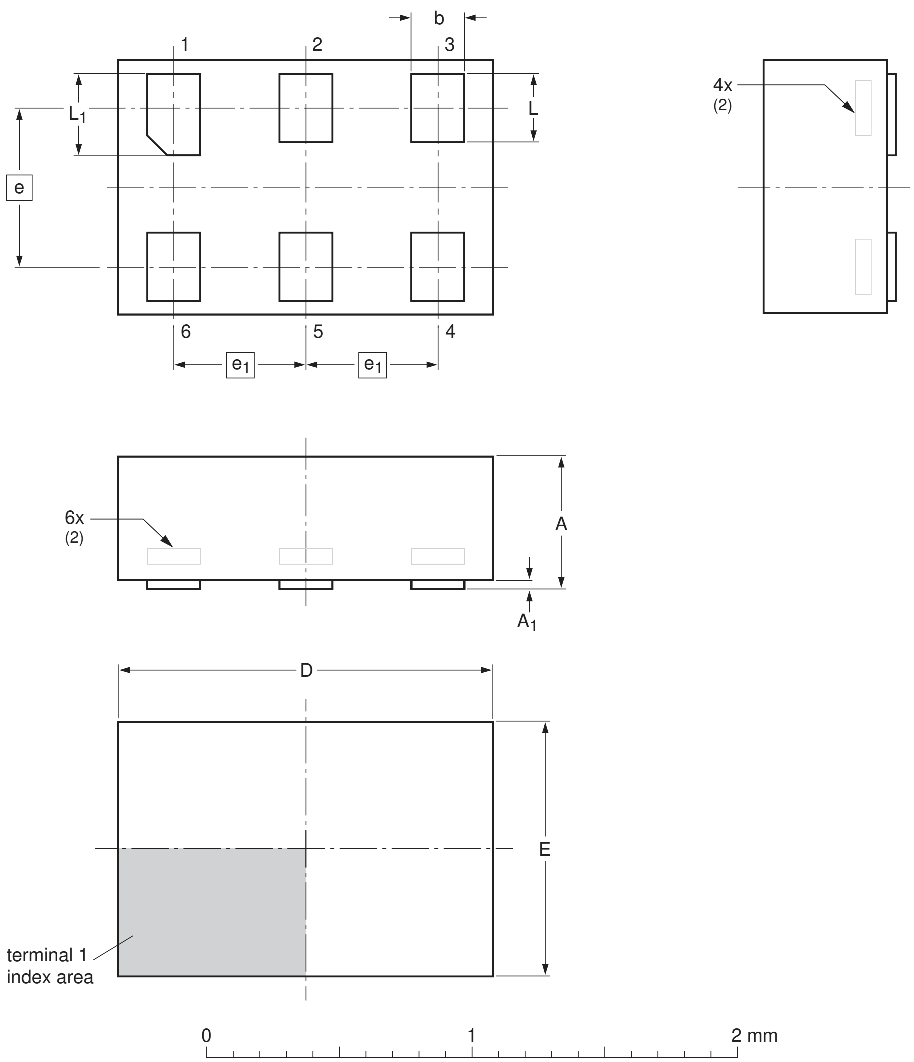
R_{gen} = generator resistance.

V_{gen} = generator voltage.

Fig 21. Test circuit for measuring charge injection

12. Package outline

XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm — SOT886



Dimensions (mm are the original dimensions)

Unit		A(1)	A_1	b	D	E	e	e_1	L	L_1
mm	max	0.5	0.04	0.25	1.50	1.05			0.35	0.40
	nom			0.20	1.45	1.00	0.6	0.5	0.30	0.35
	min			0.17	1.40	0.95			0.27	0.32

Notes
1. Including plating thickness.
2. Can be visible in some manufacturing processes.

sot886_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT886		MO-252				~~04-07-22~~ 12-01-05

Fig 22. Package outline SOT886 (XSON6)

13. Abbreviations

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

14. Revision history

Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NX3L1T5157 v.6.2	20191203	Product data sheet	-	NX3L1T5157 v.6.1
Modifications:	• Package SOT886 requiring SSB added. Refer to PCN number 201909001 XSON6 (SOT886) Assembly/Test Transfer from ATGD and ATSN to ATBK			
NX3L1T5157 v.6.1	20161130	Product data sheet	-	NX3L1T5157 v.6
Modifications:	• Added Section 13 “Packing information”			
NX3L1T5157 v.6	20111108	Product data sheet	-	NX3L1T5157 v.5
Modifications:	• Legal pages updated.			
NX3L1T5157 v.5	20110728	Product data sheet	-	NX3L1T5157 v.4
NX3L1T5157 v.4	20100324	Product data sheet	-	NX3L1T5157 v.3
NX3L1T5157 v.3	20100208	Product data sheet	-	NX3L1T5157 v.2
NX3L1T5157 v.2	20090417	Product data sheet	-	NX3L1T5157 v.1
NX3L1T5157 v.1	20080916	Product data sheet	-	-

15. Legal information

15.1 Data sheet status

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

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

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

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

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17. Contents

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