NX3L1T3157

Low-ohmic single-pole double-throw analog switch

Rev. 9.2 — 11 December 2019

Product data sheet

1. General description

The NX3L1T3157 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 NX3L1T3157 to switch 4.3 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 and benefits

- Wide supply voltage range from 1.4 V to 4.3 V
- Very low ON resistance (peak):
 - 1.6 Ω (typical) at $V_{CC} = 1.4 \text{ V}$
 - 1.0 Ω (typical) at $V_{CC} = 1.65 \text{ V}$
 - 0.55 Ω (typical) at $V_{CC} = 2.3 \text{ V}$
 - 0.50 Ω (typical) at V_{CC} = 2.7 V
 - 0.50 Ω (typical) at $V_{CC} = 4.3 \text{ V}$
- 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	Package		
	marking[1]	Name	Description	Version
NX3L1T3157GM	MI	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.

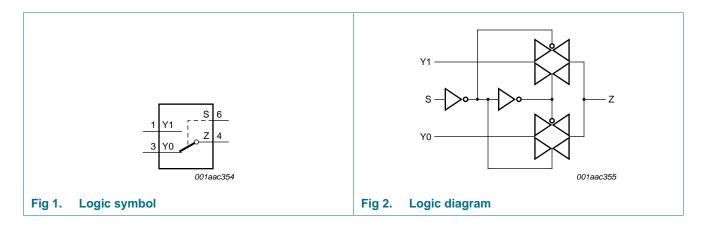
4.1 Ordering options

Table 2. Ordering options

Type number	Orderable part number	Package	J	Minimum order quantity	Temperature
NX3L1T3157GM	NX3L1T3157GM,115[1]	XSON6	REEL 7" Q1 NDP	5000	$T_{amb} = -40 ^{\circ}\text{C} \text{ to } +125 ^{\circ}\text{C}$
NX3L1T3157GM	NX3L1T3157GMZ	XSON6	REEL 7" Q1 NDP SSB[2]	5000	$T_{amb} = -40 ^{\circ}\text{C} \text{ to } +125 ^{\circ}\text{C}$

- [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

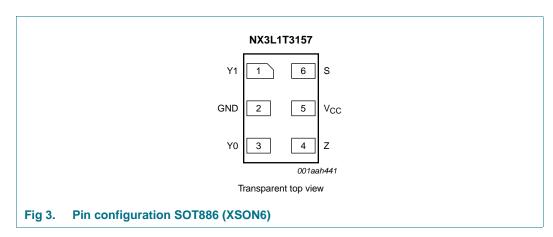


NX3L1T3157

Low-ohmic single-pole double-throw analog switch

6. Pinning information

6.1 Pinning



6.2 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

7. Functional description

Table 4. Function table [1]

Input S	Channel on
L	Y0
Н	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
VI	input voltage	select input S	<u>[1]</u>	-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	$V_{I} < -0.5 \text{ V or } V_{I} > V_{CC} + 0.5 \text{ V}$		-	±50	mA
I _{SW}	switch current	$V_{SW} > -0.5 \text{ V or } V_{SW} < V_{CC} + 0.5 \text{ V};$ 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	$T_{amb} = -40 ^{\circ}\text{C} \text{ to } +125 ^{\circ}\text{C}$	[3]	-	250	mW

^[1] The minimum input voltage rating may be exceeded if the input current rating is observed.

9. Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Conditions		Min	Max	Unit
V_{CC}	supply voltage			1.4	4.3	V
VI	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
Δt/ΔV	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] 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 Ptot derates linearly with 7.8 mW/K.

^[2] Applies to control signal levels.

10. Static characteristics

Table 7. Static characteristics

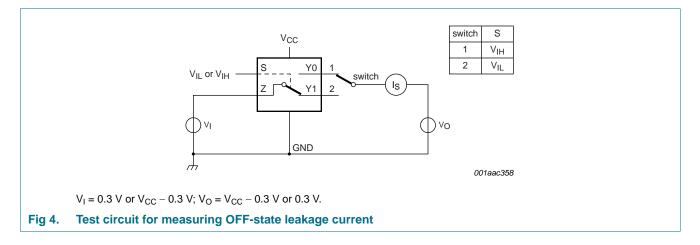
At recommended operating conditions; voltages are referenced to GND (ground 0 V).

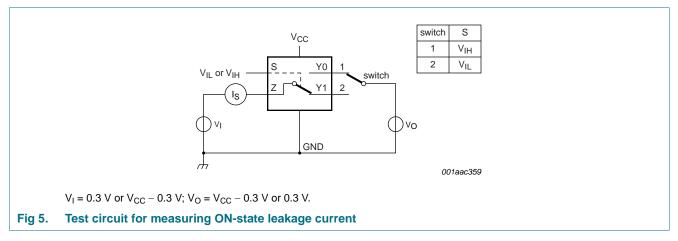
Symbol	Parameter	Conditions	T,	_{amb} = 25	°C	$T_{amb} = -40 ^{\circ}\text{C} \text{ to } +125 ^{\circ}\text{C}$			Unit
			Min	Тур	Max	Min	Max (85 °C)	Max (125 °C)	
V _{IH}	HIGH-level	V _{CC} = 1.4 V to 1.6 V	0.9	-	-	0.9	-	-	V
	input voltage	V _{CC} = 1.65 V to 1.95 V	0.9	-	-	0.9	-	-	V
		V _{CC} = 2.3 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	V _{CC} = 1.4 V to 1.6 V	-	-	0.3	-	0.3	0.3	V
	input voltage	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
l _l	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	μΑ
0(011)	OFF-state leakage	Y0 and Y1 port; see Figure 4							
	current	V _{CC} = 1.4 V to 3.6 V	-	-	±5	-	±50	±500	nΑ
		V _{CC} = 3.6 V to 4.3 V	-	-	±10	-	±50	±500	nΑ
I _{S(ON)}	ON-state	Z port; see Figure 5							
	leakage current	V _{CC} = 1.4 V to 3.6 V	-	-	±5	-	±50	±500	nΑ
	current	V _{CC} = 3.6 V to 4.3 V	-	-	±10	-	±50	±500	nΑ
I _{CC}	supply current	$V_I = V_{CC}$ or GND; $V_{SW} = GND$ or V_{CC}							
		V _{CC} = 3.6 V	-	-	100	-	690	6000	nΑ
		V _{CC} = 4.3 V	-	-	150	-	800	7000	nΑ
Δl _{CC}	additional	V _{SW} = GND or V _{CC}							
	supply current	V _I = 2.6 V; V _{CC} = 4.3 V	-	2.0	4.0	-	7	7	μΑ
		V _I = 2.6 V; V _{CC} = 3.6 V	-	0.35	0.7	-	1	1 1 μΑ 15 μΑ	μΑ
		$V_I = 1.8 \text{ V}; V_{CC} = 4.3 \text{ V}$	-	7.0	10.0	-	15		μΑ
		V _I = 1.8 V; V _{CC} = 3.6 V	-	2.5	4.0	-	5	5	μΑ
		V _I = 1.8 V; V _{CC} = 2.5 V	-	50	200	-	300	500	nΑ
Cı	input capacitance		-	1.0	-	-	-	-	pF
C _{S(OFF)}	OFF-state capacitance		-	35	-	-	-	-	pF
C _{S(ON)}	ON-state capacitance		-	130	-	-	-	-	pF

NX3L1T3157

Low-ohmic single-pole double-throw analog switch

10.1 Test circuits





Low-ohmic single-pole double-throw analog switch

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.

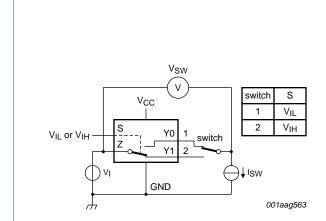
Symbol	Parameter	Conditions		T _{amb} =	-40 °C to	+85 °C	T _{amb} = -40 °	C to +125 °C	Unit
				Min	Typ[1]	Max	Min	Max	
R _{ON(peak)}	ON resistance (peak)	$V_I = GND$ to V_{CC} ; $I_{SW} = 100$ mA; see Figure 6							
		V _{CC} = 1.4 V		-	1.6	3.7	-	4.1	Ω
		V _{CC} = 1.65 V		-	1.0	1.6	-	1.7	Ω
		V _{CC} = 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
ΔR_{ON}	ON resistance mismatch between channels	$V_I = GND \text{ to } V_{CC};$ $I_{SW} = 100 \text{ mA}$	[2]						
		V _{CC} = 1.4 V		-	0.04	0.3	-	0.3	Ω
	Charmers	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)	$V_I = GND \text{ to } V_{CC};$ $I_{SW} = 100 \text{ mA}$	[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.

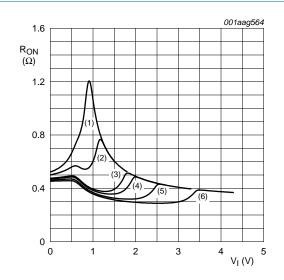
^[3] Flatness is defined as the difference between the maximum and minimum value of ON resistance measured at identical V_{CC} and temperature.

10.3 ON resistance test circuit and graphs



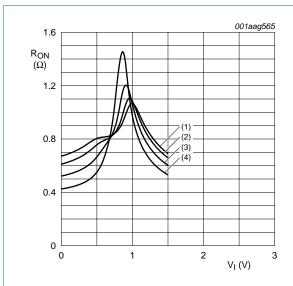
 $R_{ON} = V_{SW} / I_{SW}$.

Fig 6. Test circuit for measuring ON resistance



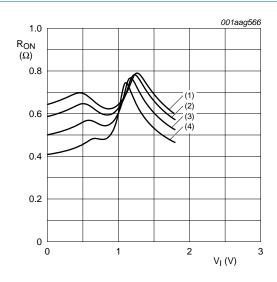
- (1) $V_{CC} = 1.5 \text{ V}.$
- (2) $V_{CC} = 1.8 \text{ V}.$
- (3) $V_{CC} = 2.5 \text{ V}.$
- (4) $V_{CC} = 2.7 \text{ V}.$
- (5) $V_{CC} = 3.3 \text{ V}.$
- (6) $V_{CC} = 4.3 \text{ V.}$ Measured at $T_{amb} = 25 \,^{\circ}\text{C.}$

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



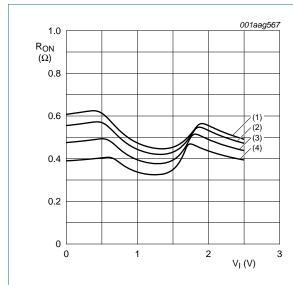
- (1) $T_{amb} = 125 \, ^{\circ}C$.
- (2) $T_{amb} = 85 \, ^{\circ}C$.
- (3) $T_{amb} = 25 \, ^{\circ}C$.
- (4) $T_{amb} = -40 \, ^{\circ}C$.

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



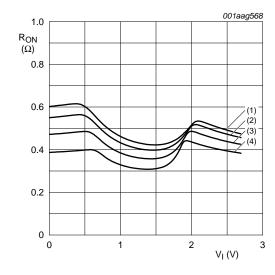
- (1) $T_{amb} = 125 \, ^{\circ}C$.
- (2) $T_{amb} = 85 \, ^{\circ}C$.
- (3) $T_{amb} = 25 \, ^{\circ}C$.
- (4) $T_{amb} = -40 \, ^{\circ}C$.

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



- (1) $T_{amb} = 125 \, ^{\circ}C$.
- (2) $T_{amb} = 85 \, ^{\circ}C$.
- (3) $T_{amb} = 25 \, ^{\circ}C$.
- (4) $T_{amb} = -40 \, ^{\circ}C$.

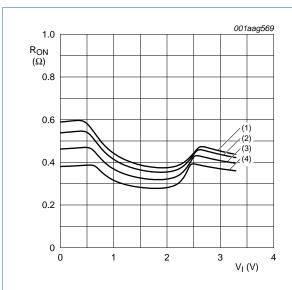
Fig 10. ON resistance as a function of input voltage; $V_{CC} = 2.5 \text{ V}$



- (1) $T_{amb} = 125 \, ^{\circ}C$.
- (2) $T_{amb} = 85 \, ^{\circ}C$.
- (3) $T_{amb} = 25 \, ^{\circ}C$.
- (4) $T_{amb} = -40 \, ^{\circ}C$.

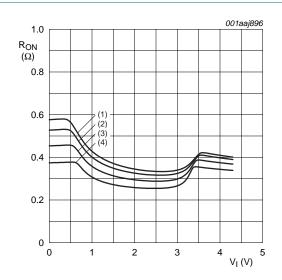
Fig 11. ON resistance as a function of input voltage; $V_{CC} = 2.7 \text{ V}$

Low-ohmic single-pole double-throw analog switch



- (1) $T_{amb} = 125 \, ^{\circ}C$.
- (2) $T_{amb} = 85 \, ^{\circ}C$.
- (3) $T_{amb} = 25 \, ^{\circ}C$.
- (4) $T_{amb} = -40 \, ^{\circ}C$.

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



- (1) $T_{amb} = 125 \, ^{\circ}C$.
- (2) $T_{amb} = 85 \, ^{\circ}C$.
- (3) $T_{amb} = 25 \, ^{\circ}C$.
- (4) $T_{amb} = -40 \, ^{\circ}C$.

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

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			ns ns ns ns ns ns
			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 +12	5 °C	Unit
				Min	Typ[1]	Max	Min	Max (85 °C)	Max (125 °C)	
t _{b-m}	break-before-make	see Figure 15	[2]							
	time	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.

11.1 Waveform and test circuits

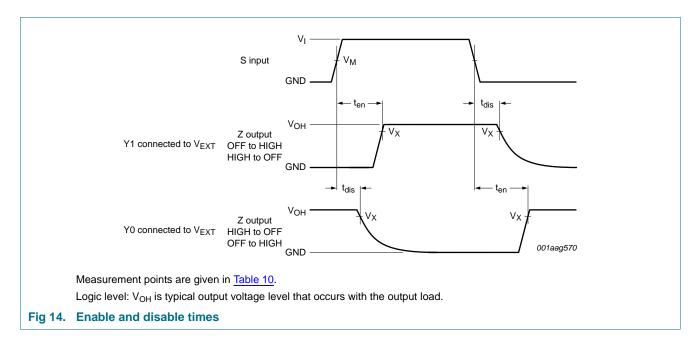
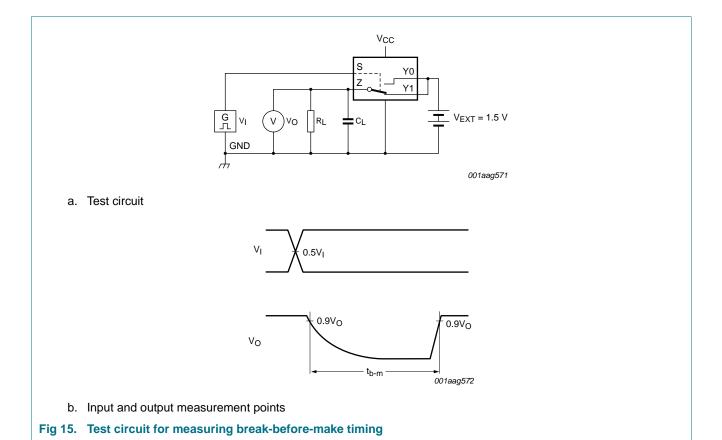


Table 10. Measurement points

Supply voltage	Input	Output
Vcc	V _M	V _X
1.4 V to 4.3 V	0.5V _{CC}	0.9V _{OH}

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

Low-ohmic single-pole double-throw analog switch



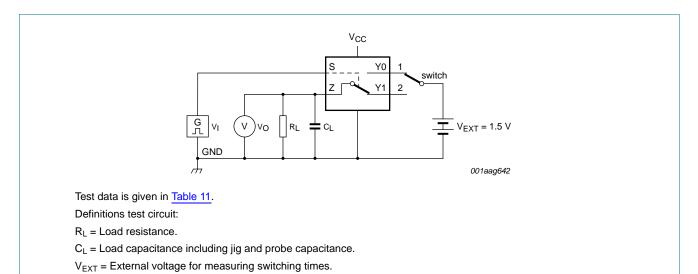


Table 11. Test data

Fig 16. Load circuit for switching times

Supply voltage	Input		Load		
V _{CC}	V _I	t _r , t _f	CL	R _L	
1.4 V to 4.3 V	V _{CC}	≤ 2.5 ns	35 pF	50 Ω	

11.2 Additional dynamic characteristics

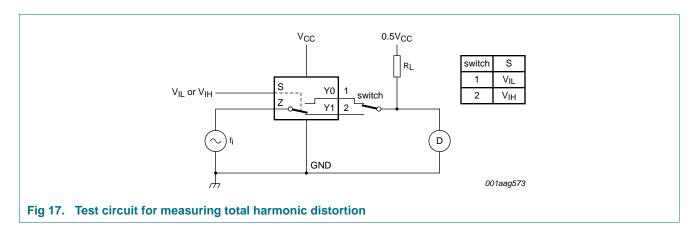
Table 12. Additional dynamic characteristics

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

Symbol	Parameter	Conditions	N	V lin	Тур	Max	Unit
THD	total harmonic distortion	f_i = 20 Hz to 20 kHz; R_L = 32 Ω ; see Figure 17	[1]				
		$V_{CC} = 1.4 \text{ V}; V_I = 1 \text{ V (p-p)}$		-	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	-	%
		$V_{CC} = 2.7 \text{ V}; V_{I} = 2 \text{ V (p-p)}$		-	0.02	-	%
		$V_{CC} = 4.3 \text{ V}; V_1 = 2 \text{ V (p-p)}$		-	0.02	-	%
f _(-3dB)	-3 dB frequency response	$R_L = 50 \Omega$; see Figure 18	<u>[1]</u>				
		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	<u>[1]</u>				
		V _{CC} = 1.4 V to 4.3 V		-	-90	-	dB
V _{ct}	crosstalk voltage	between digital inputs and switch; $f_i = 1 \text{ MHz}$; $C_L = 50 \text{ pF}$; $R_L = 50 \Omega$; 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 M Ω ; V_{gen} = 0 V; R_{gen} = 0 Ω ; see Figure 21					
		V _{CC} = 1.5 V		-	3	-	рС
		V _{CC} = 1.8 V		-	4	-	рС
		V _{CC} = 2.5 V		-	6	-	рС
		V _{CC} = 3.3 V		-	9	-	рС
		V _{CC} = 4.3 V		-	15	-	рC

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

11.3 Test circuits



Low-ohmic single-pole double-throw analog switch

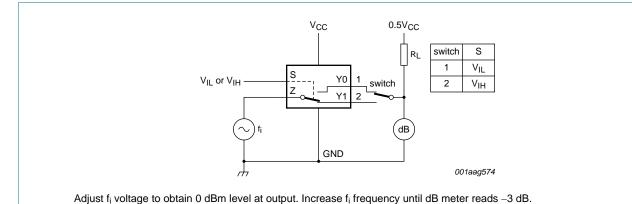
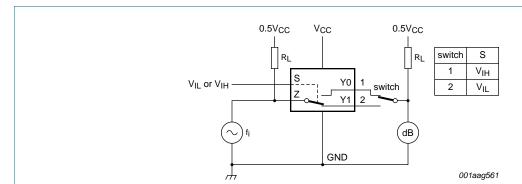


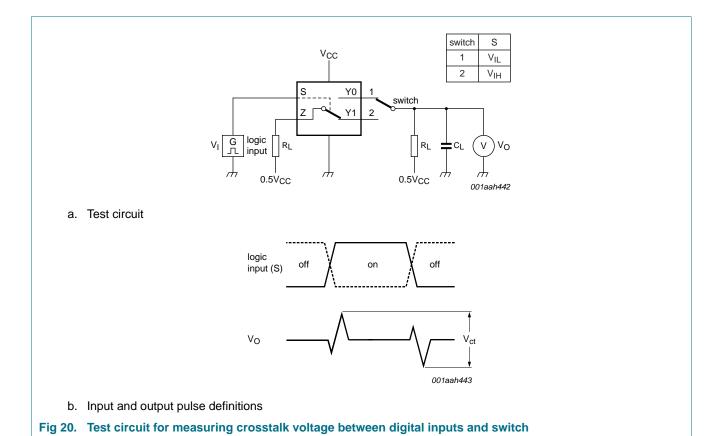
Fig 18. Test circuit for measuring the frequency response when channel is in ON-state



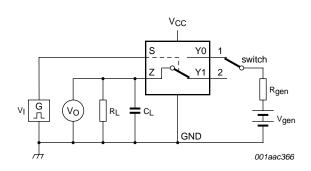
Adjust fi voltage to obtain 0 dBm level at input.

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

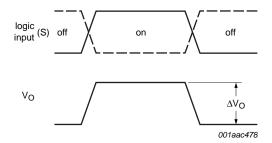
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a. Test circuit



b. Input and output pulse definitions

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

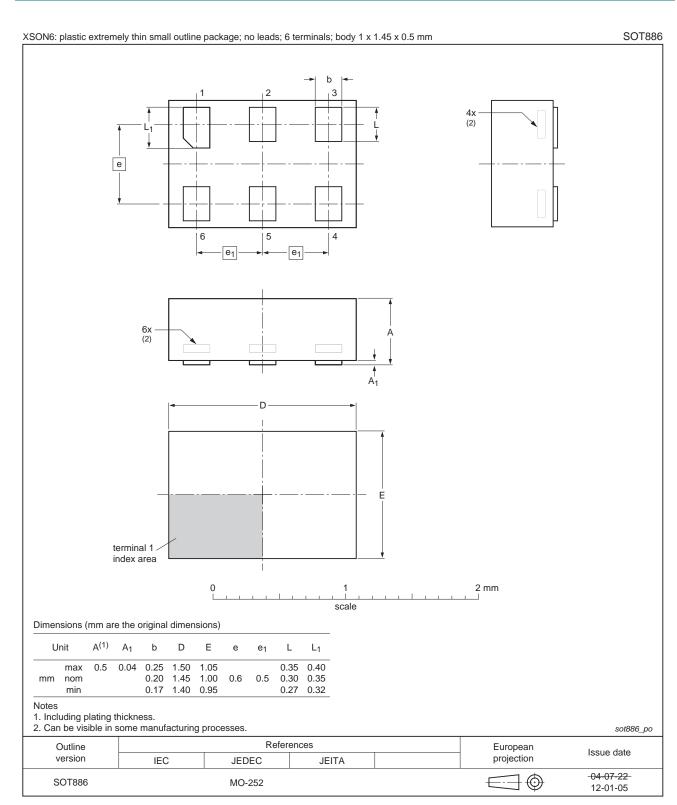


Fig 22. Package outline SOT886 (XSON6)

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		
NX3L1T3157 v.9.2	20191211	Product data sheet	-	NX3L1T3157 v.9.1		
Modifications:	 Corrected temperature range in <u>Table 2 "Ordering options"</u> from "-40 °C to +85 °C" to "-40 °C to +125 °C" 					
NX3L1T3157 v.9.1	20191203	Product data sheet	-	NX3L1T3157 v.9		
Modifications:	 Package SOT886 requiring SSB added. Refer to PCN number 201909001 XSON6 (SOT886) Assembly/Test Transfer from ATGD and ATSN to ATBK Removed NX3L1T3157GW,125 					
NX3L1T3157 v.9	20111109	Product data sheet	-	NX3L1T3157 v.8		
Modifications:	Legal pages i	updated.				
NX3L1T3157 v.8	20110727	Product data sheet	-	NX3L1T3157 v.7		
NX3L1T3157 v.7	20100121	Product data sheet	-	NX3L1T3157 v.6		
NX3L1T3157 v.6	20090415	Product data sheet	-	NX3L1T3157 v.5		
NX3L1T3157 v.5	20080728	Product data sheet	-	NX3L1T3157 v.4		
NX3L1T3157 v.4	20080718	Product data sheet	-	NX3L1T3157 v.3		
NX3L1T3157 v.3	20080408	Product data sheet	-	NX3L1T3157 v.2		
NX3L1T3157 v.2	20080306	Product data sheet	-	NX3L1T3157 v.1		
NX3L1T3157 v.1	20080103	Product data sheet	-	-		

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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".
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17. Contents

1	General description
2	Features and benefits
3	Applications
4	Ordering information
4.1	Ordering options
5	Functional diagram 2
6	Pinning information 3
6.1	Pinning
6.2	Pin description
7	Functional description 3
8	Limiting values 4
9	Recommended operating conditions 4
10	Static characteristics 5
10.1	Test circuits6
10.2	ON resistance
10.3	ON resistance test circuit and graphs 8
11	Dynamic characteristics
11.1	Waveform and test circuits 11
11.2	Additional dynamic characteristics 13
11.3	Test circuits
12	Package outline
13	Abbreviations
14	Revision history
15	Legal information
15.1	Data sheet status 19
15.2	Definitions
15.3	Disclaimers
15.4	Trademarks
16	Contact information
17	Contents 21

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