Low-ohmic single-pole double-throw analog switch

Rev. 7.1 — 15 November 2016

**Product data sheet** 

### 1. General description

The NX3L1G53 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), a common input/output (Z) and an active LOW enable input ( $\overline{E}$ ). When pin  $\overline{E}$  is HIGH, the switch is turned off. Schmitt trigger action at the digital inputs makes the circuit tolerant to slower input rise and fall times.

The NX3L1G53 allows signals with amplitude up to V<sub>CC</sub> 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 and benefits

- Wide supply voltage range from 1.4 V to 4.3 V
- Very low ON resistance (peak):
  - 1.6  $\Omega$  (typical) at V<sub>CC</sub> = 1.4 V
  - 1.0 Ω (typical) at V<sub>CC</sub> = 1.65 V
  - 0.55  $\Omega$  (typical) at V<sub>CC</sub> = 2.3 V
  - 0.50  $\Omega$  (typical) at V<sub>CC</sub> = 2.7 V
  - 0.50  $\Omega$  (typical) at V<sub>CC</sub> = 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 JESD 78 Class II Level A
- Direct interface with TTL levels at 3.0 V
- Control input accepts voltages above supply voltage
- 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	Package	Package							
	Temperature range	Name	Description	Version					
NX3L1G53GT	–40 °C to +125 °C	XSON8	plastic extremely thin small outline package; no leads; 8 terminals; body 1 $\times$ 1.95 $\times$ 0.5 mm	SOT833-1					
NX3L1G53GD	–40 °C to +125 °C	XSON8	plastic extremely thin small outline package; no leads; 8 terminals; body $3 \times 2 \times 0.5$ mm	SOT996-2					
NX3L1G53GM	–40 °C to +125 °C	XQFN8	plastic, extremely thin quad flat package; no leads; 8 terminals; body $1.6 \times 1.6 \times 0.5$ mm	SOT902-2					

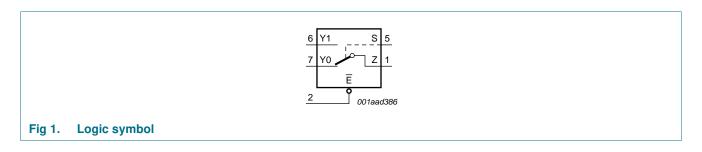
### 5. Marking

#### Table 2. Marking codes<sup>[1]</sup>

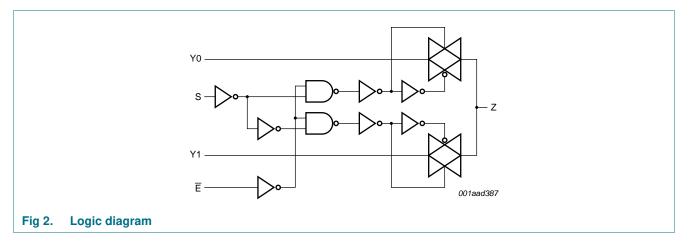
Type number	Marking code
NX3L1G53GT	D53
NX3L1G53GD	D53
NX3L1G53GM	D53

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

### 6. Functional diagram

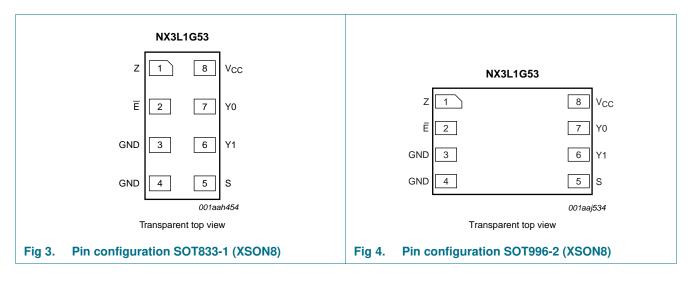


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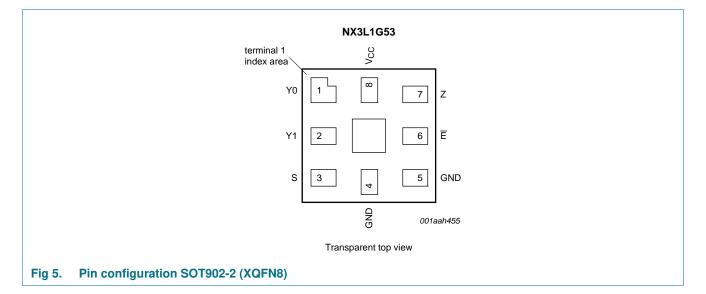
# 7. Pinning information

### 7.1 Pinning



# NX3L1G53

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### 7.2 Pin description

Table 3.	Pin description		
Symbol	Pin		Description
	SOT833-1 and SOT996-2	SOT902-2	
Z	1	7	common output or input
E	2	6	enable input (active LOW)
GND	3	5	ground (0 V)
GND	4	4	ground (0 V)
S	5	3	select input
Y1	6	2	independent input or output
Y0	7	1	independent input or output
V <sub>CC</sub>	8	8	supply voltage

# 8. Functional description

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

Input		Channel
S	Ē	
L	L	Y0 to Z or Z to Y0
Н	L	Y1 to Z or Z to Y1
Х	Н	switch off

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care.

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### 9. 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 <sub>CC</sub>	supply voltage		-0.5	+4.6	V
VI	input voltage	select input S and enable input $\overline{E}$	<u>[1]</u> –0.5	+4.6	V
V <sub>SW</sub>	switch voltage		<u>[2]</u> –0.5	$V_{CC} + 0.5$	V
I <sub>IK</sub>	input clamping current	$V_{l} < -0.5 V$	-50	-	mA
I <sub>SK</sub>	switch clamping current	$V_{l} < -0.5$ V or $V_{l} > V_{CC}$ + 0.5 V	-	±50	mA
I <sub>SW</sub>	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 <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	$T_{amb} = -40 \text{ °C to } +125 \text{ °C}$	[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 XSON8 and XQFN8 packages: above 118 °C the value of P<sub>tot</sub> derates linearly with 7.8 mW/K.

### **10. Recommended operating conditions**

#### Table 6. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CC</sub>	supply voltage		1.4	4.3	V
VI	input voltage	select input S and enable input $\overline{E}$	0	4.3	V
V <sub>SW</sub>	switch voltage		<u>[1]</u> 0	$V_{CC}$	V
T <sub>amb</sub>	ambient temperature		-40	+125	°C
$\Delta t / \Delta V$	input transition rise and fall rate	$V_{CC} = 1.4 \text{ V} \text{ to } 4.3 \text{ V}$	[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 signals.

# 11. Static characteristics

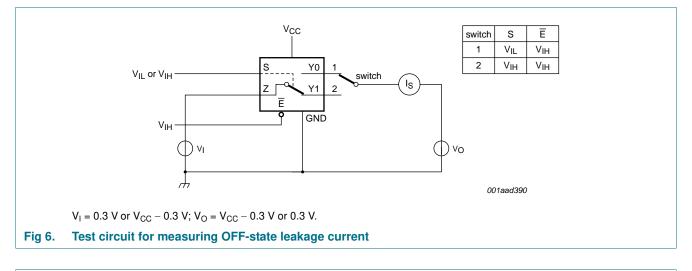
#### Table 7. Static characteristics

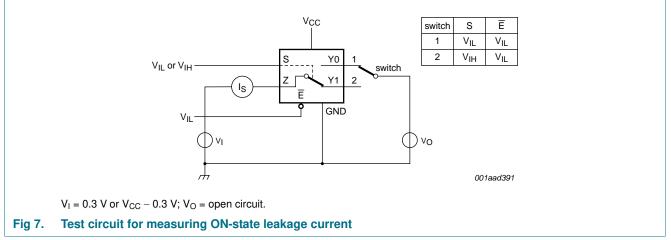
At recommended operating conditions; voltages are referenced to GND (ground 0 V).

Symbol	Parameter	Conditions		25 °C			–40 °C to +125 °C		
			Min	Тур	Max	Min	Max (85 °C)	Max (125 °C)	
V <sub>IH</sub>	HIGH-level	V <sub>CC</sub> = 1.4 V to 1.95 V	$0.65V_{CC}$	-	-	$0.65V_{CC}$	-	-	V
	input voltage	$V_{CC} = 2.3 \text{ V} \text{ to } 2.7 \text{ V}$	1.7	-	-	1.7	-	-	V
		$V_{CC} = 2.7 \text{ V} \text{ to } 3.6 \text{ V}$	2.0	-	-	2.0	-	-	V
		$V_{CC} = 3.6 \text{ V} \text{ to } 4.3 \text{ V}$	$0.7V_{CC}$	-	-	$0.7V_{CC}$	-	-	V
V <sub>IL</sub>	LOW-level	$V_{CC} = 1.4 \text{ V}$ to 1.95 V	-	-	$0.35V_{CC}$	-	$0.35V_{CC}$	$0.35V_{CC}$	V
	input voltage	$V_{CC} = 2.3 \text{ V} \text{ to } 2.7 \text{ V}$	-	-	0.7	-	0.7	0.7	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	0.8	-	0.8	0.8	V
		$V_{CC} = 3.6 \text{ V to } 4.3 \text{ V}$	-	-	$0.3V_{CC}$	-	$0.3V_{CC}$	$0.3V_{CC}$	V
I	input leakage current	select input S and enable input $\overline{E}$ ; V <sub>1</sub> = GND to 4.3 V; V <sub>CC</sub> = 1.4 V to 4.3 V	-	-	-	-	±0.5	±1	μA
$I_{S(OFF)}$	OFF-state leakage	Y0 and Y1 port; see <u>Figure 6</u>							
	current	$V_{CC} = 1.4 V \text{ to } 3.6 V$	-	-	±5	-	±50	±500	nA
		$V_{CC} = 3.6 \text{ V to } 4.3 \text{ V}$	-	-	±10	-	±50	±500	nA
I <sub>S(ON)</sub>	ON-state	Z port; see Figure 7							
	leakage current	$V_{CC} = 1.4 \text{ V} \text{ to } 3.6 \text{ V}$	-	-	±5	-	±50	±500	nA
	current	$V_{CC} = 3.6 V \text{ to } 4.3 V$	-	-	±10	-	±50	±500	nA
I <sub>CC</sub>	supply current	$V_I = V_{CC} \text{ or GND};$ $V_{SW} = GND \text{ or } V_{CC}$							
		$V_{CC} = 3.6 V$	-	-	100	-	690	6000	nA
		$V_{CC} = 4.3 V$	-	-	150	-	800	7000	nA
CI	input capacitance		-	1.0	-	-	-	-	pF
$C_{S(OFF)}$	OFF-state capacitance		-	35	-	-	-	-	pF
C <sub>S(ON)</sub>	ON-state capacitance		-	130	-	-	-	-	pF

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### 11.1 Test circuits





#### 11.2 ON resistance

#### Table 8. ON resistance

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for graphs see Figure 9 to Figure 15.

Symbol	Parameter	Conditions	-40	°C to +8	5 °C	–40 °C to +125 °C		Unit
			Min	Typ <mark>[1]</mark>	Max	Min	Max	
R <sub>ON(peak)</sub>	ON resistance (peak)	$V_I = GND$ to $V_{CC}$ ; $I_{SW} = 100 \text{ mA}$ ; see Figure 8						
		$V_{CC} = 1.4 V$	-	1.6	3.7	-	4.1	Ω
		V <sub>CC</sub> = 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
$\Delta R_{ON}$	ON resistance mismatch between channels	$V_{I} = \text{GND to } V_{\text{CC}}; \qquad \  \  \  \  \  \  \  \  \  \  \  \  \$						
		$V_{CC} = 1.4 V$	-	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 <sub>ON(flat)</sub>	ON resistance (flatness)	$V_{I} = \text{GND to } V_{\text{CC}}; \qquad [3] \\ I_{\text{SW}} = 100 \text{ mA}$						
		$V_{CC} = 1.4 V$	-	1.0	3.3	-	3.6	Ω
		V <sub>CC</sub> = 1.65 V	-	0.5	1.2	-	1.3	Ω
		$V_{CC} = 2.3 V$	-	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

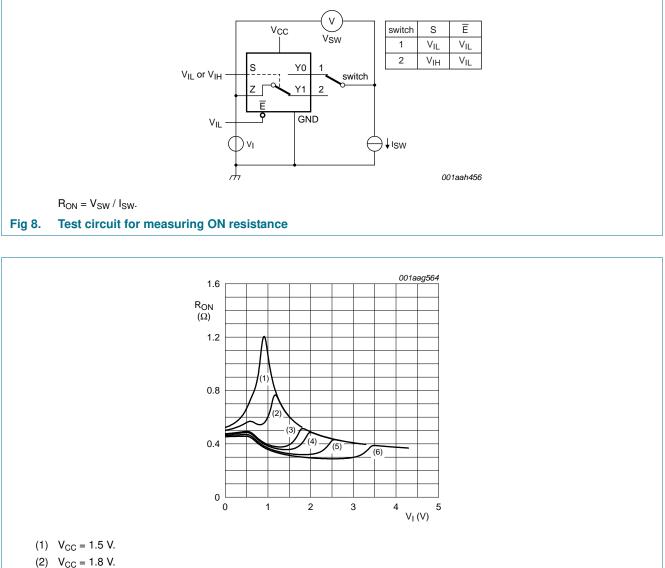
[1] Typical values are measured at  $T_{amb} = 25 \text{ °C}$ .

[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.

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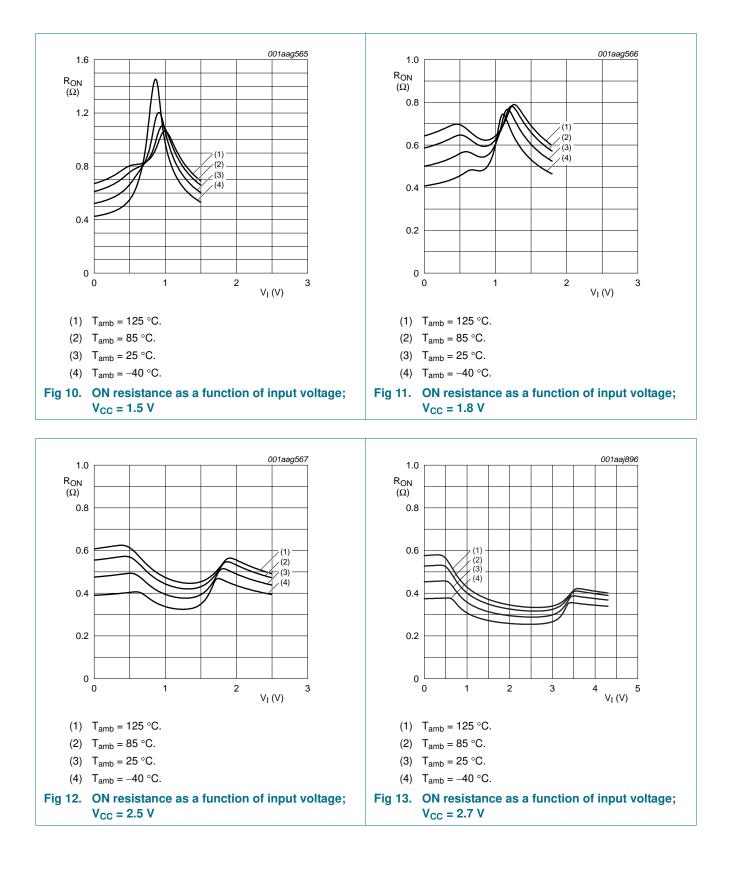
### 11.3 ON resistance test circuit and waveforms



- (2)  $V_{CC} = 1.0 V.$
- (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<sub>amb</sub> = 25 °C.
- Fig 9. ON resistance as a function of input voltage

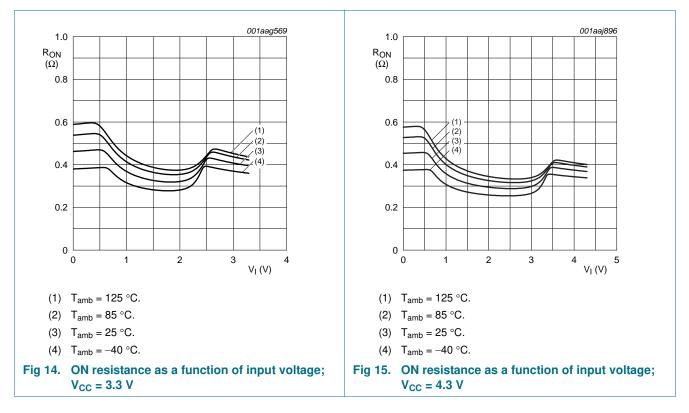
# NX3L1G53

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### 12. Dynamic characteristics

#### Table 9. Dynamic characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for load circuit see Figure 18.

Symbol	Parameter	Conditions		25 °C			–40 °C to +125 °C			
			Min	Typ[1]	Max	Min	Мах (85 °С)	Max (125 °C)		
t <sub>en</sub>	enable time	S or Ē to Z or Yn; see <u>Figure 16</u>								
		$V_{CC} = 1.4 \text{ V} \text{ to } 1.6 \text{ V}$	-	28	42	-	45	50	ns	
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	23	34	-	37	41	ns	
		$V_{CC}$ = 2.3 V to 2.7 V	-	17	27	-	29	31	ns	
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	-	15	24	-	26	28	ns	
		$V_{CC} = 3.6 \text{ V to } 4.3 \text{ V}$	-	15	24	-	26	28	ns	
t <sub>dis</sub>	disable time	S or Ē to Z or Yn; see <u>Figure 16</u>								
		$V_{CC} = 1.4 \text{ V} \text{ to } 1.6 \text{ V}$	-	10	19	-	21	23	ns	
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	7	14	-	16	17	ns	
		$V_{CC}$ = 2.3 V to 2.7 V	-	5	9	-	10	11	ns	
		$V_{CC} = 2.7 \text{ V} \text{ to } 3.6 \text{ V}$	-	4	8	-	9	9	ns	
		$V_{CC}$ = 2.7 V to 4.3 V	-	4	8	-	9	9	ns	

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#### –40 °C to +125 °C Symbol Parameter Conditions 25 °C Unit Min Typ[1] Max Min Max Max (85 °C) (125 °C) [2] break-before-make see Figure 17 t<sub>b-m</sub> time $V_{CC} = 1.4$ V to 1.6 V 9 \_ 19 \_ \_ \_ ns V<sub>CC</sub> = 1.65 V to 1.95 V 17 7 ns ---- $V_{CC} = 2.3 \text{ V}$ to 2.7 V 13 5 \_ \_ \_ ns \_ $V_{CC} = 2.7 \text{ V} \text{ to } 3.6 \text{ V}$ 10 3 \_ \_ \_ \_ ns $V_{CC} = 2.7 \text{ V} \text{ to } 4.3 \text{ V}$ 10 2 --ns -

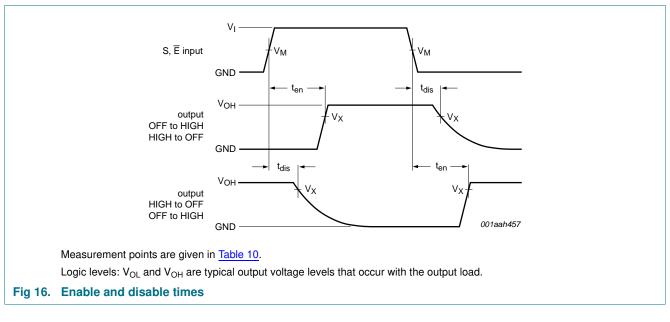
#### Table 9. Dynamic characteristics ...continued

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for load circuit see Figure 18.

[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.



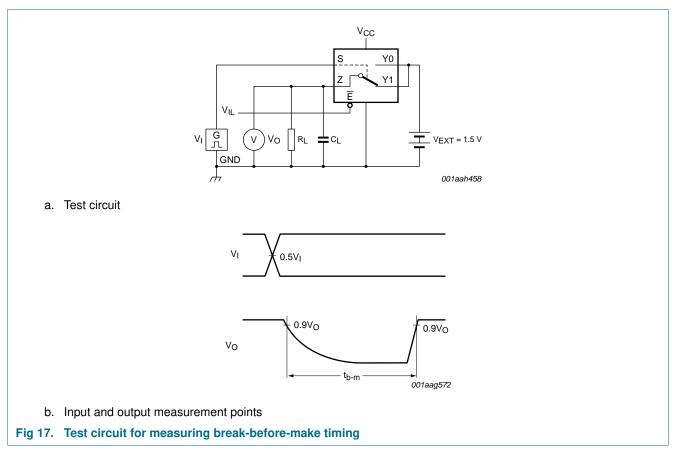


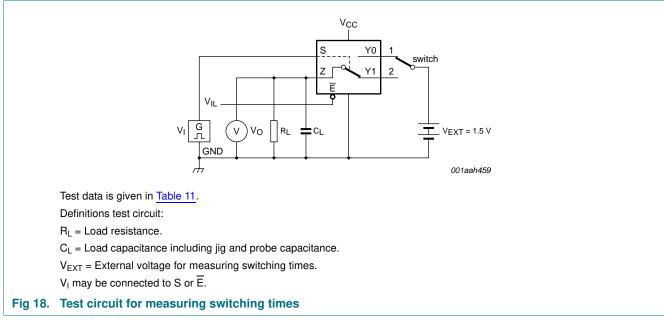
#### Table 10. Measurement points

Supply voltage	Input	Output
V <sub>cc</sub>	V <sub>M</sub>	V <sub>X</sub>
1.4 V to 4.3 V	0.5V <sub>CC</sub>	0.9V <sub>OH</sub>

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#### Table 11. Test data

Supply voltage	Input		Load		
V <sub>cc</sub>	VI	t <sub>r</sub> , t <sub>f</sub>	CL	RL	
1.4 V to 4.3 V	V <sub>CC</sub>	≤ 2.5 ns	35 pF	50 Ω	

### 12.2 Additional dynamic characteristics

#### Table 12. Additional dynamic characteristics

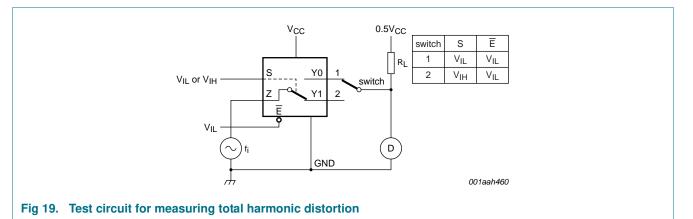
At recommended operating conditions; voltages are referenced to GND (ground = 0 V);  $V_I = GND$  or  $V_{CC}$  (unless otherwise specified);  $t_r = t_f \le 2.5$  ns;  $T_{amb} = 25$  °C.

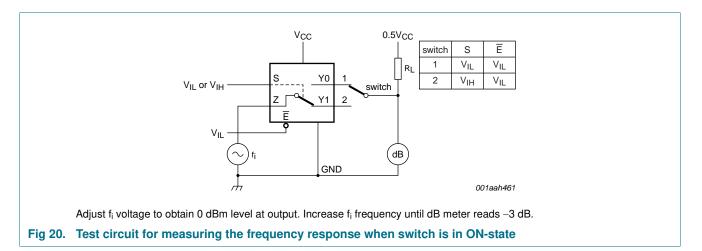
Symbol	Parameter	Conditions	Min	Тур	Мах	Unit
THD	total harmonic	$f_i$ = 20 Hz to 20 kHz; $R_L$ = 32 $\Omega$ ; see Figure 19	<u>[1]</u>			
	distortion	V <sub>CC</sub> = 1.4 V; V <sub>I</sub> = 1 V (p-p)	-	0.15	-	%
		V <sub>CC</sub> = 1.65 V; V <sub>I</sub> = 1.2 V (p-p)	-	0.10	-	%
		V <sub>CC</sub> = 2.3 V; V <sub>I</sub> = 1.5 V (p-p)	-	0.02	-	%
		V <sub>CC</sub> = 2.7 V; V <sub>I</sub> = 2 V (p-p)	-	0.02	-	%
		V <sub>CC</sub> = 4.3 V; V <sub>I</sub> = 2 V (p-p)	-	0.02	-	%
f <sub>(-3dB)</sub>	-3 dB frequency	$R_L = 50 \Omega$ ; see Figure 20	[1]			
	response	V <sub>CC</sub> = 1.4 V to 4.3 V	-	60	-	MHz
$\alpha_{\text{iso}}$	isolation (OFF-state)	$f_i = 100 \text{ kHz}; \text{ R}_L = 50 \Omega; \text{ see } \frac{\text{Figure 21}}{100 \text{ kHz}}$	[1]			
		V <sub>CC</sub> = 1.4 V to 4.3 V	-	-90	-	dB
V <sub>ct</sub>	crosstalk voltage	between digital inputs and switch; $f_i = 1 \text{ MHz}$ ; $C_L = 50 \text{ pF}$ ; $R_L = 50 \Omega$ ; see Figure 22				
		V <sub>CC</sub> = 1.4 V to 3.6 V	-	0.2	-	V
		V <sub>CC</sub> = 3.6 V to 4.3 V	-	0.3	-	V
Xtalk	crosstalk	between switches; $f_i = 100 \text{ kHz}$ ; $R_L = 50 \Omega$ ; see <u>Figure 23</u>	[1]			
		V <sub>CC</sub> = 1.4 V to 4.3 V	-	-90	-	dB
Q <sub>inj</sub>	charge injection	$      f_i = 1 \text{ MHz}; C_L = 0.1 \text{ nF}; R_L = 1 \text{ M}\Omega; V_{gen} = 0 \text{ V}; \\ R_{gen} = 0 \Omega; \text{ see } \frac{\text{Figure 24}}{2}      $				
		V <sub>CC</sub> = 1.5 V	-	3	-	рС
		V <sub>CC</sub> = 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	-	рС

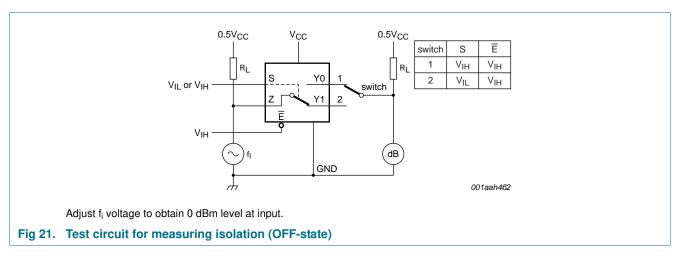
[1]  $f_i$  is biased at 0.5V<sub>CC</sub>.

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### 12.3 Test circuits

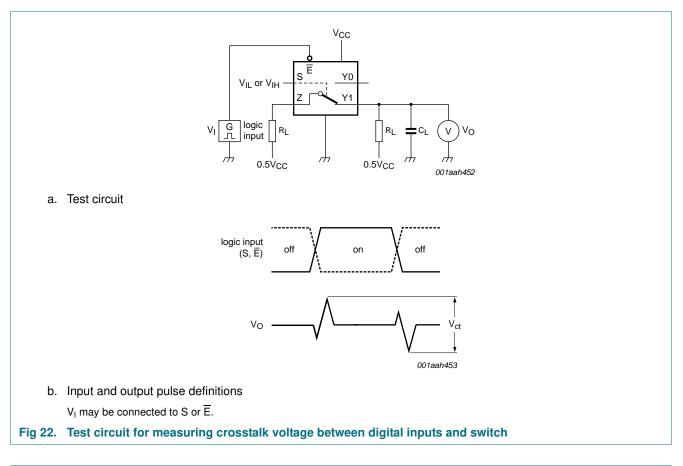


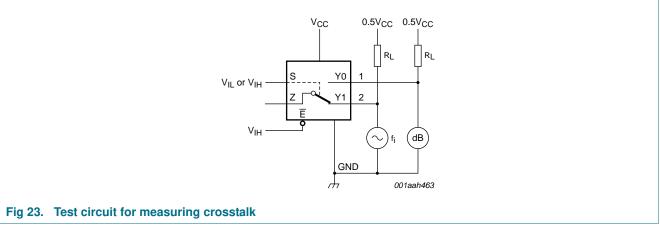




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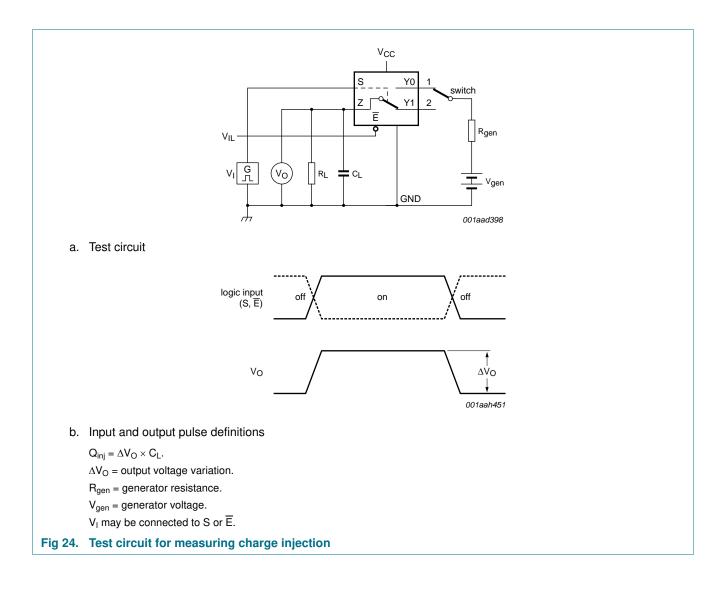
#### Low-ohmic single-pole double-throw analog switch





# NX3L1G53

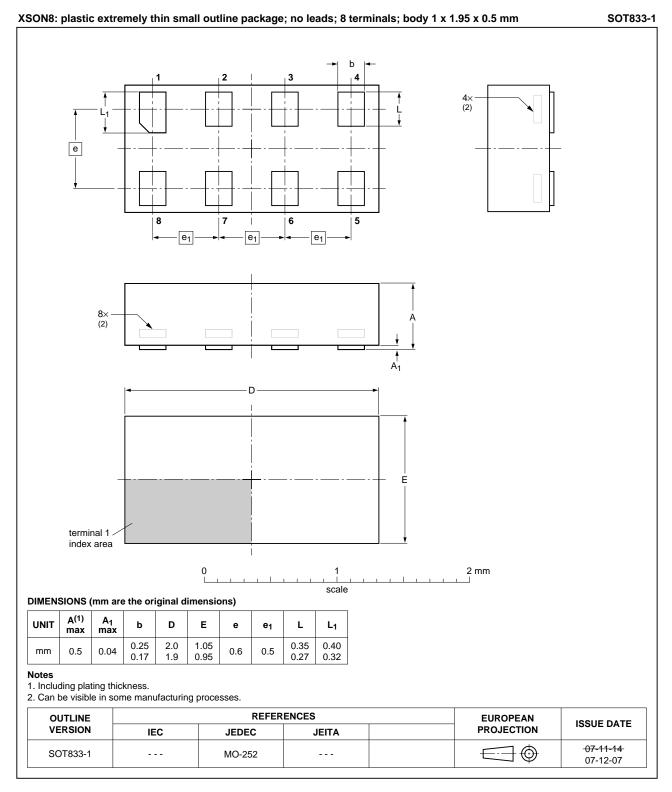
#### Low-ohmic single-pole double-throw analog switch



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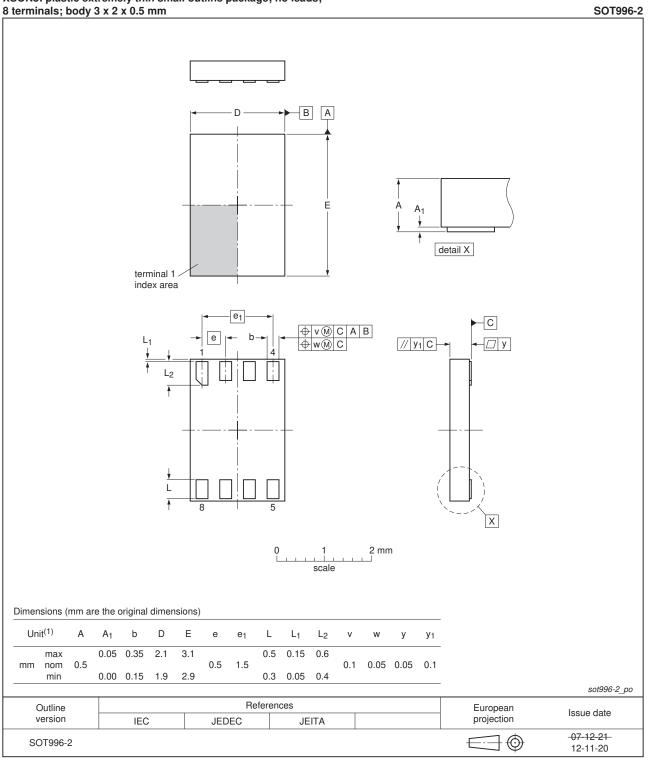
### 13. Package outline



#### Fig 25. Package outline SOT833-1 (XSON8)

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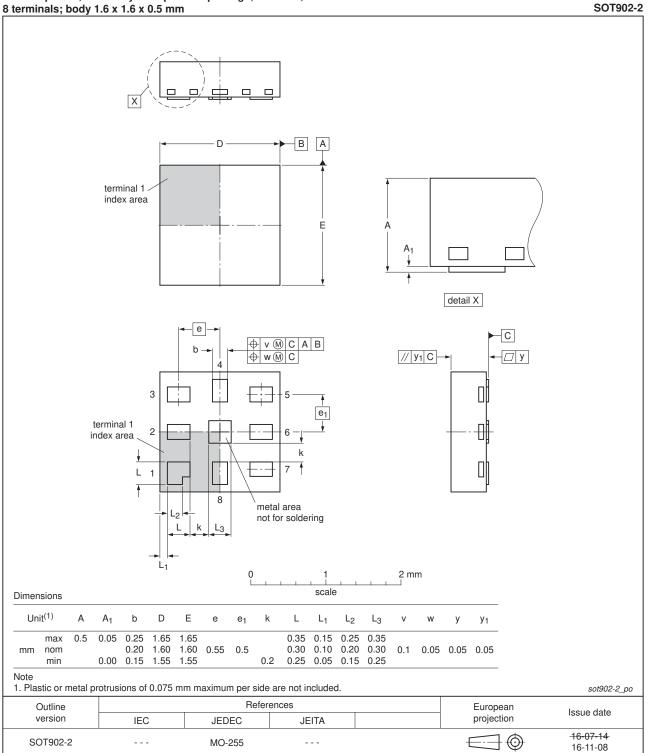


XSON8: plastic extremely thin small outline package; no leads;

Fig 26. Package outline SOT996-2 (XSON8)

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XQFN8: plastic, extremely thin quad flat package; no leads; 8 terminals; body 1.6 x 1.6 x 0.5 mm

#### Fig 27. Package outline SOT902-2 (XQFN8)

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# 14. 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			
TTL	Transistor-Transistor Logic			

# 15. Revision history

Table 14. Revision	history			
Document ID	Release date	Data sheet status	Change notice	Supersedes
NX3L1G53 v.7.1	20161115	Product data sheet	-	NX3L1G53 v.7
Modifications:	<ul> <li>Updated Fig</li> </ul>	jure 27 "Package outline So	OT902-2 (XQFN8)"	
NX3L1G53 v.7	20130208	Product data sheet	-	NX3L1G53 v.6
Modifications:	<ul> <li>For type nur</li> </ul>	mber NX3L1G53GD XSON	8U has changed to XSO	N8
NX3L1G53 v.6	20120613	Product data sheet	-	NX3L1G53 v.5
NX3L1G53 v.5	20111109	Product data sheet	-	NX3L1G53 v.4
NX3L1G53 v.4	20100127	Product data sheet	-	NX3L1G53 v.3
NX3L1G53 v.3	20090417	Product data sheet	-	NX3L1G53 v.2
NX3L1G53 v.2	20080718	Product data sheet	-	NX3L1G53 v.1
NX3L1G53 v.1	20080408	Product data sheet	-	-

### 16. Legal information

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Document status[1][2]	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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[2] The term 'short data sheet' is explained in section "Definitions".

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

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

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