

NX3L1T53

Low-ohmic single-pole double-throw analog switch

Rev. 8 — 23 January 2013

Product data sheet

1. General description

The NX3L1T53 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 ($\bar{E}$). When pin $\bar{E}$ 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. Low threshold digital inputs 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 NX3L1T53 to switch 4.3 V signals with a 1.8 V digital controller, eliminating the need for logic level translation. The NX3L1T53 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 JESD 78 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	Package			
	Temperature range	Name	Description	Version
NX3L1T53GT	–40 °C to +125 °C	XSON8	plastic extremely thin small outline package; no leads; 8 terminals; body 1 × 1.95 × 0.5 mm	SOT833-1
NX3L1T53GD	–40 °C to +125 °C	XSON8	plastic extremely thin small outline package; no leads; 8 terminals; body 3 × 2 × 0.5 mm	SOT996-2
NX3L1T53GM	–40 °C to +125 °C	XQFN8	plastic, extremely thin quad flat package; no leads; 8 terminals; body 1.6 × 1.6 × 0.5 mm	SOT902-2

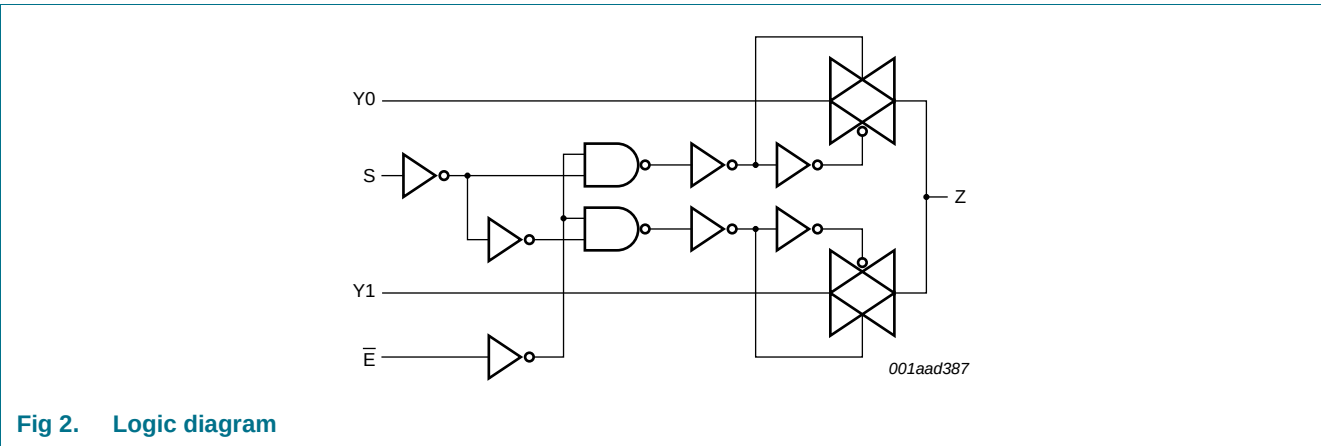
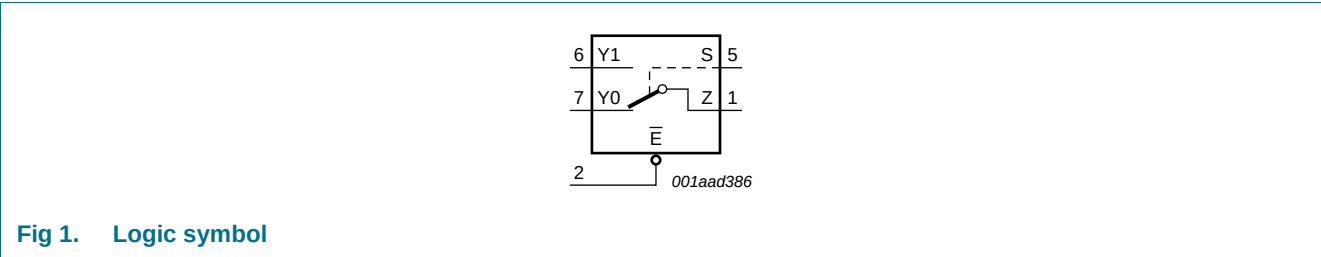
5. Marking

Table 2. Marking codes^[1]

Type number	Marking code
NX3L1T53GT	M53
NX3L1T53GD	M53
NX3L1T53GM	M53

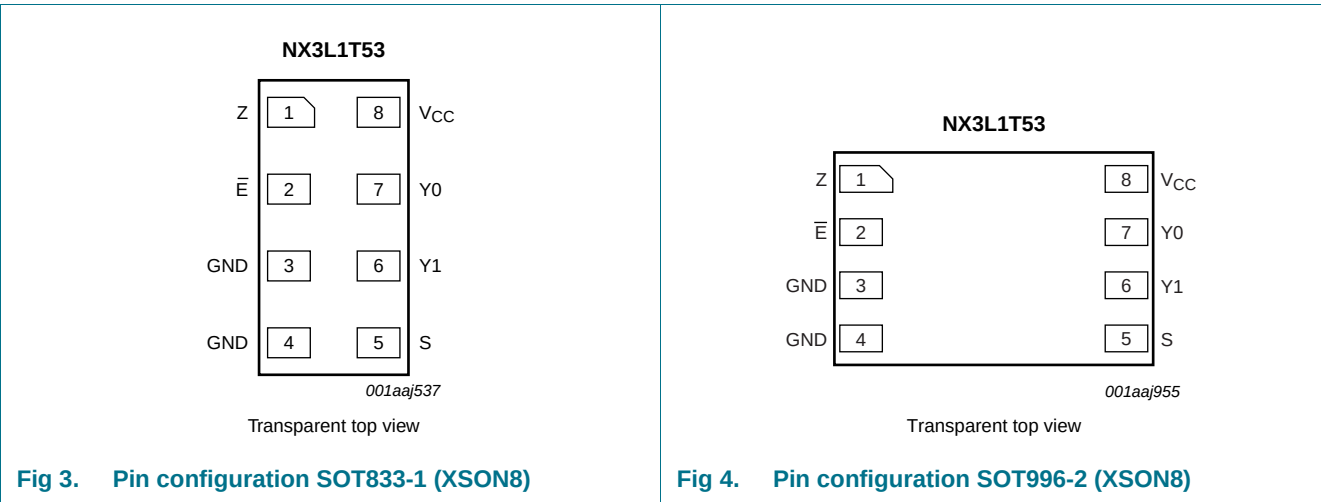
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

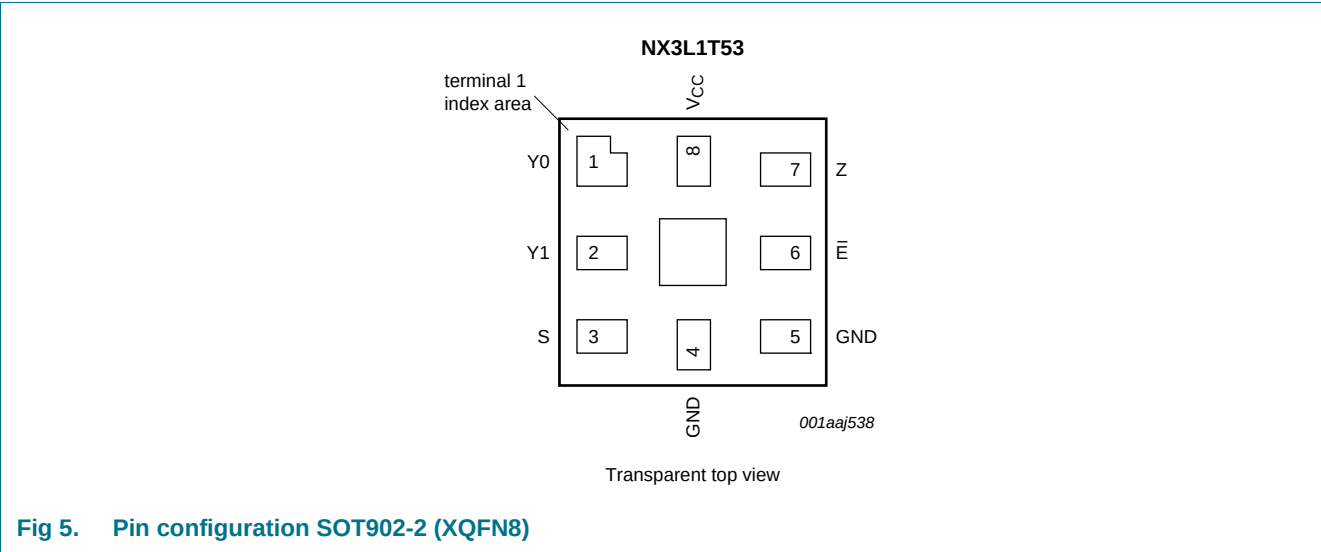
6. Functional diagram



7. Pinning information

7.1 Pinning





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
$\bar{E}$	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 _{CC}	8	8	supply voltage

8. Functional description

Table 4. Function table^[1]

Input		Channel on
S	$\bar{E}$	
L	L	Y0 to Z or Z to Y0
H	L	Y1 to Z or Z to Y1
X	H	switch off

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

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_{CC}	supply voltage		-0.5	+4.6	V
V_I	input voltage	select input S and enable input $\bar{E}$	[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 XSON8 and XQFN8 packages: above 118 °C the value of P_{tot} derates linearly with 7.8 mW/K.

10. Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		1.4	-	4.3	V
V_I	input voltage	select input S and enable input $\bar{E}$	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.

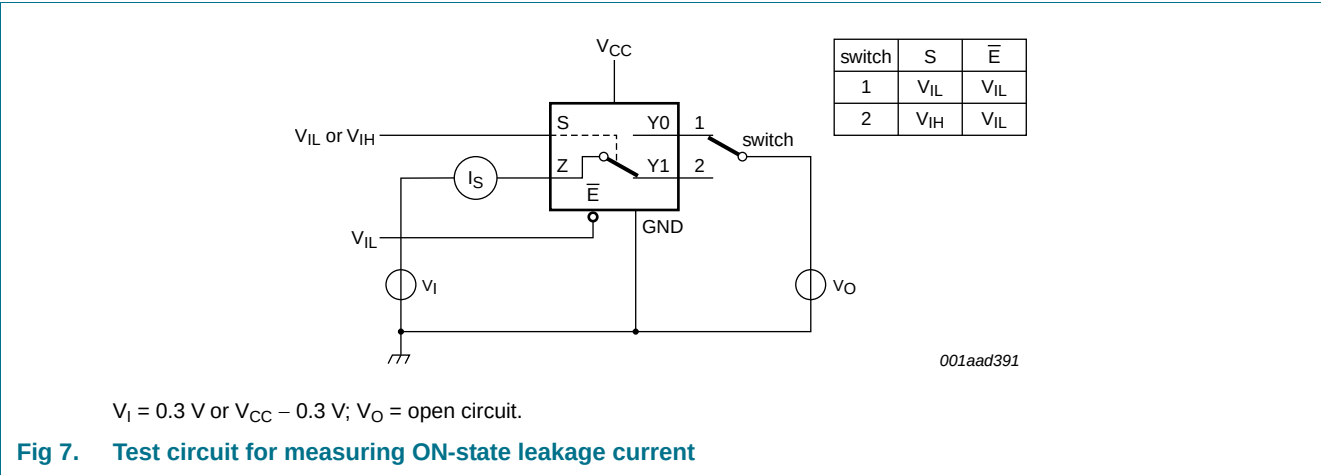
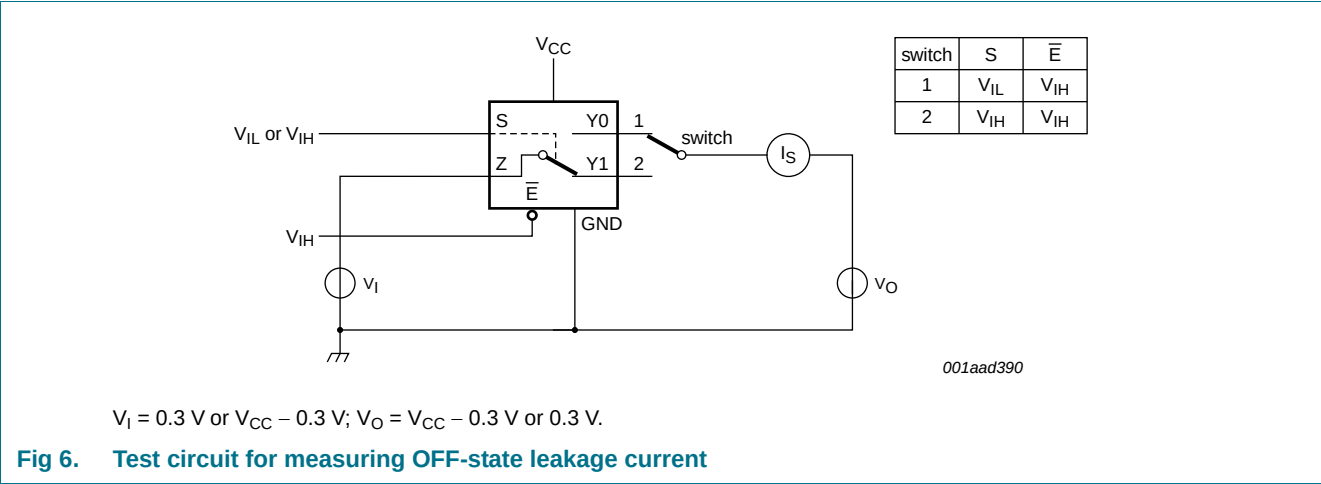
11. Static characteristics

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 and enable input $\bar{E}$; 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 6							
		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 7							
		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

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](#).

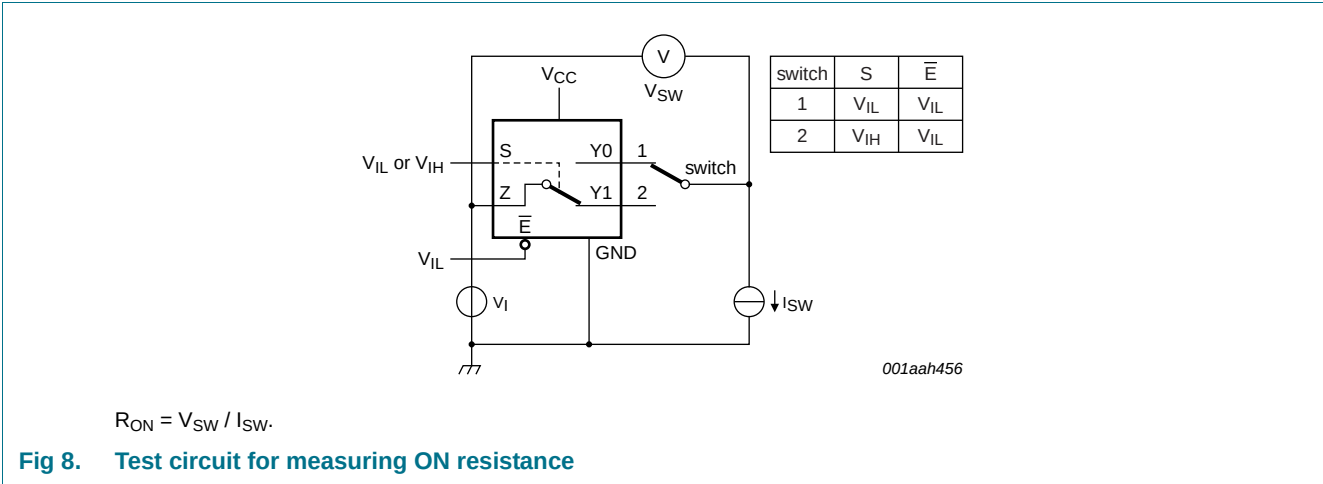
Symbol	Parameter	Conditions	−40 °C to +85 °C			−40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
$R_{ON(peak)}$	ON resistance (peak)	$V_I = \text{GND to } V_{CC};$ $I_{SW} = 100\text{ mA};$ see Figure 8						
		$V_{CC} = 1.4\text{ V}$	-	1.6	3.7	-	4.1	Ω
		$V_{CC} = 1.65\text{ V}$	-	1.0	1.6	-	1.7	Ω
		$V_{CC} = 2.3\text{ V}$	-	0.55	0.8	-	0.9	Ω
		$V_{CC} = 2.7\text{ V}$	-	0.5	0.75	-	0.9	Ω
		$V_{CC} = 4.3\text{ V}$	-	0.5	0.75	-	0.9	Ω

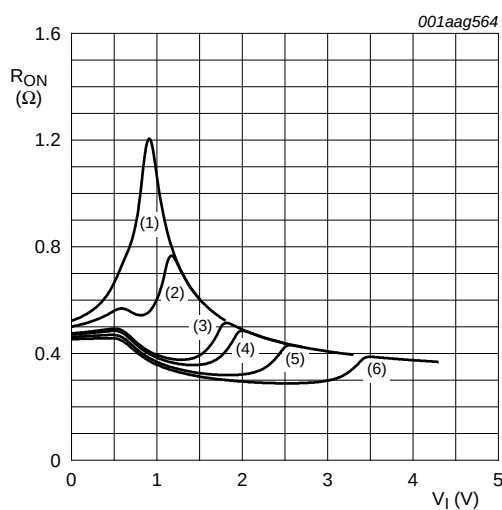
Table 8. ON resistance ...continued
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for graphs see [Figure 9](#) to [Figure 15](#).

Symbol	Parameter	Conditions	−40 °C to +85 °C			−40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	
ΔR_{ON}	ON resistance mismatch between channels	$V_I = \text{GND to } V_{CC};$ $I_{SW} = 100 \text{ mA}$						Ω
		$V_{CC} = 1.4 \text{ V}$	-	0.04	0.3	-	0.3	
		$V_{CC} = 1.65 \text{ V}$	-	0.04	0.2	-	0.3	
		$V_{CC} = 2.3 \text{ V}$	-	0.02	0.08	-	0.1	
		$V_{CC} = 2.7 \text{ V}$	-	0.02	0.075	-	0.1	
		$V_{CC} = 4.3 \text{ V}$	-	0.02	0.075	-	0.1	
$R_{ON(\text{flat})}$	ON resistance (flatness)	$V_I = \text{GND to } V_{CC};$ $I_{SW} = 100 \text{ mA}$						Ω
		$V_{CC} = 1.4 \text{ V}$	-	1.0	3.3	-	3.6	
		$V_{CC} = 1.65 \text{ V}$	-	0.5	1.2	-	1.3	
		$V_{CC} = 2.3 \text{ V}$	-	0.15	0.3	-	0.35	
		$V_{CC} = 2.7 \text{ V}$	-	0.13	0.3	-	0.35	
		$V_{CC} = 4.3 \text{ V}$	-	0.2	0.4	-	0.45	

- [1] Typical values are measured at $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$.
[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 waveforms

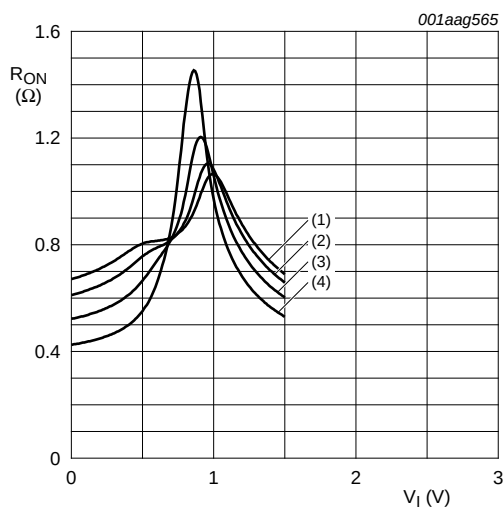




- (1) $V_{CC} = 1.5$ V.
- (2) $V_{CC} = 1.8$ V.
- (3) $V_{CC} = 2.5$ V.
- (4) $V_{CC} = 2.7$ V.
- (5) $V_{CC} = 3.3$ V.
- (6) $V_{CC} = 4.3$ V.

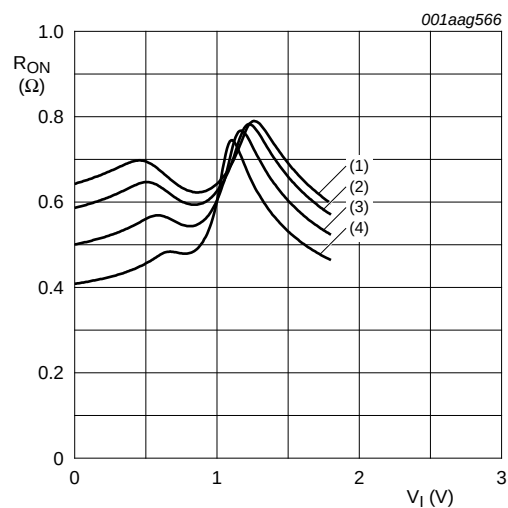
Measured at $T_{amb} = 25$ °C.

Fig 9. ON resistance as a function of input voltage



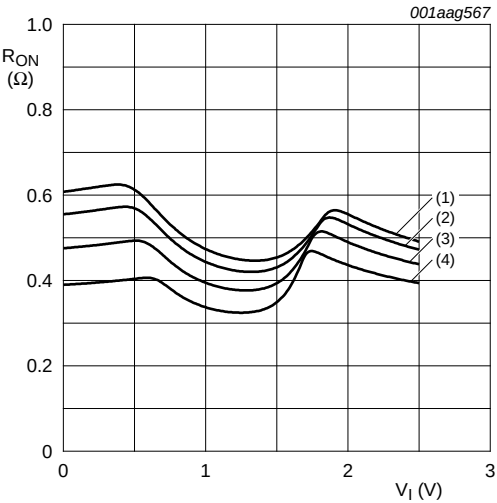
- (1) $T_{amb} = 125$ °C.
- (2) $T_{amb} = 85$ °C.
- (3) $T_{amb} = 25$ °C.
- (4) $T_{amb} = -40$ °C.

Fig 10. ON resistance as a function of input voltage; $V_{CC} = 1.5$ V



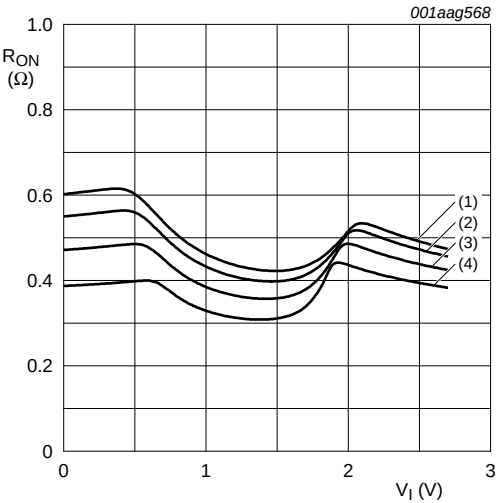
- (1) $T_{amb} = 125$ °C.
- (2) $T_{amb} = 85$ °C.
- (3) $T_{amb} = 25$ °C.
- (4) $T_{amb} = -40$ °C.

Fig 11. ON resistance as a function of input voltage; $V_{CC} = 1.8$ V



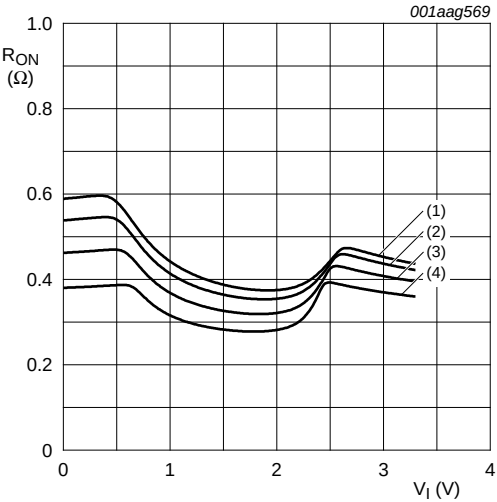
- (1) $T_{amb} = 125\text{ }^{\circ}\text{C}.$
- (2) $T_{amb} = 85\text{ }^{\circ}\text{C}.$
- (3) $T_{amb} = 25\text{ }^{\circ}\text{C}.$
- (4) $T_{amb} = -40\text{ }^{\circ}\text{C}.$

Fig 12. ON resistance as a function of input voltage;
 $V_{CC} = 2.5\text{ V}$



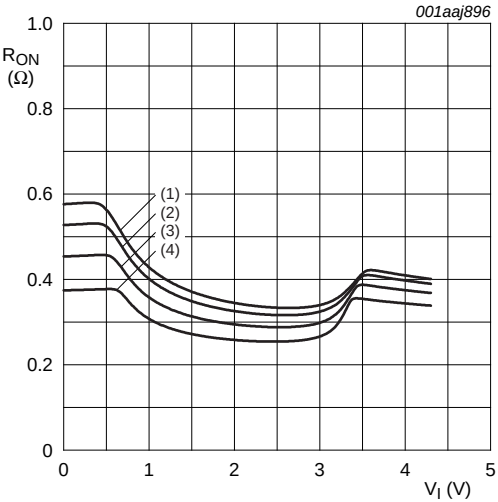
- (1) $T_{amb} = 125\text{ }^{\circ}\text{C}.$
- (2) $T_{amb} = 85\text{ }^{\circ}\text{C}.$
- (3) $T_{amb} = 25\text{ }^{\circ}\text{C}.$
- (4) $T_{amb} = -40\text{ }^{\circ}\text{C}.$

Fig 13. ON resistance as a function of input voltage;
 $V_{CC} = 2.7\text{ V}$



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

Fig 14. ON resistance as a function of input voltage;
 $V_{CC} = 3.3\text{ V}$



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

Fig 15. ON resistance as a function of input voltage;
 $V_{CC} = 4.3\text{ V}$

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			Unit
			Min	Typ ^[1]	Max	Min	Max (85 °C)	Max (125 °C)	
t _{en}	enable time	S or $\bar{E}$ to Z or Yn; see Figure 16							
		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 or $\bar{E}$ to Z or Yn; see Figure 16							
		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
t _{b-m}	break-before-make time	see Figure 17 ^[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.

12.1 Waveform and test circuits

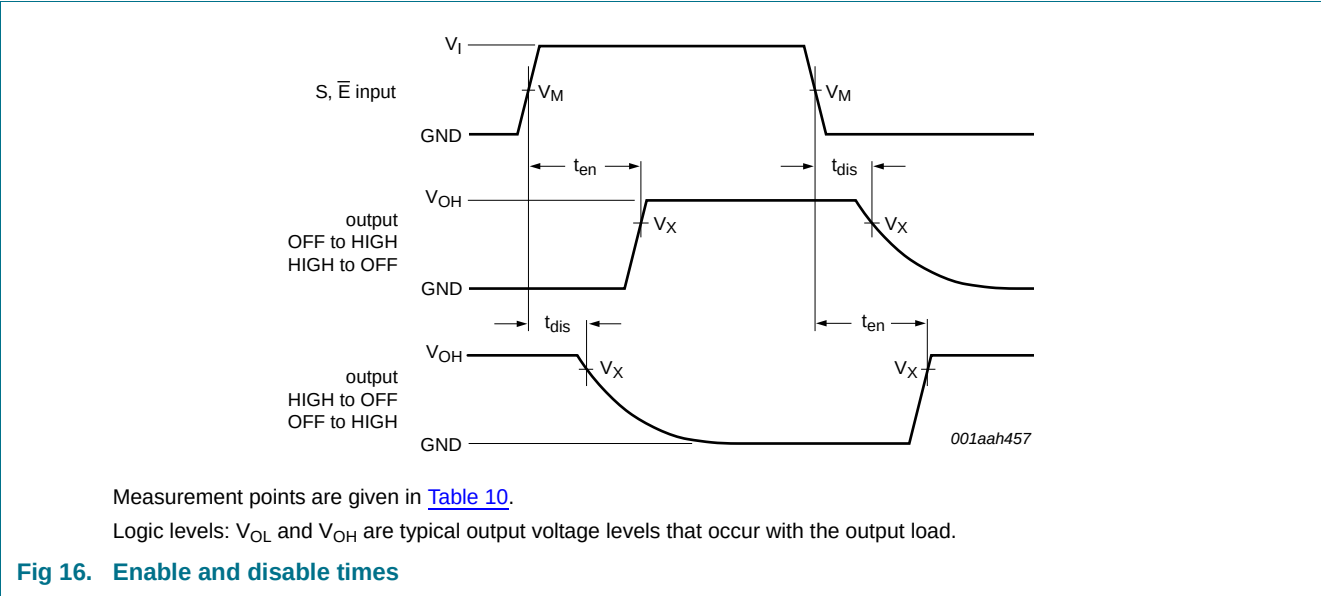


Table 10. Measurement points

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 17. 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.

V_I may be connected to S or $\bar{E}$.

Fig 18. Test circuit for measuring 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

12.2 Additional dynamic characteristics

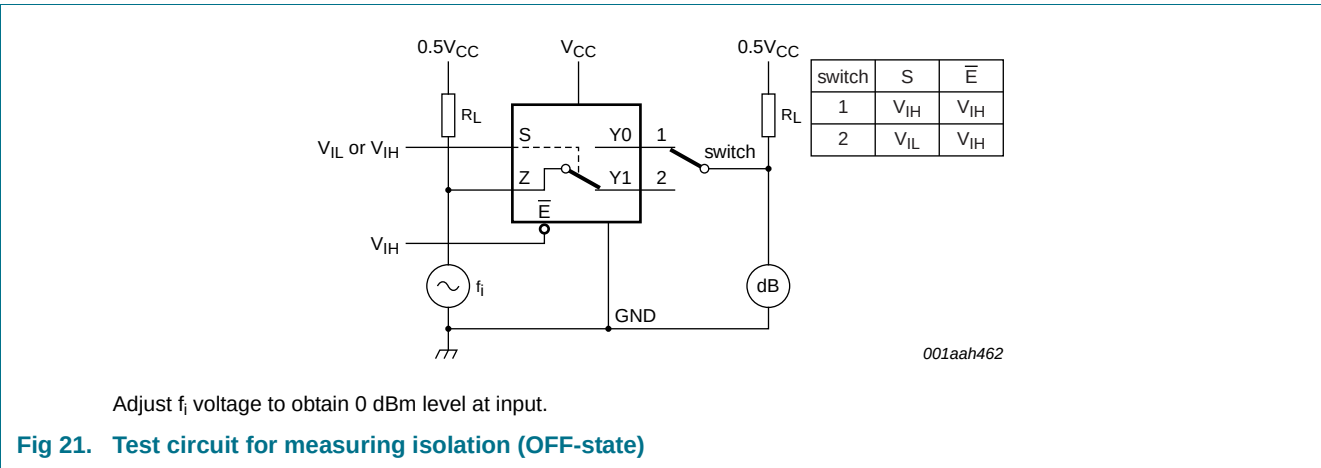
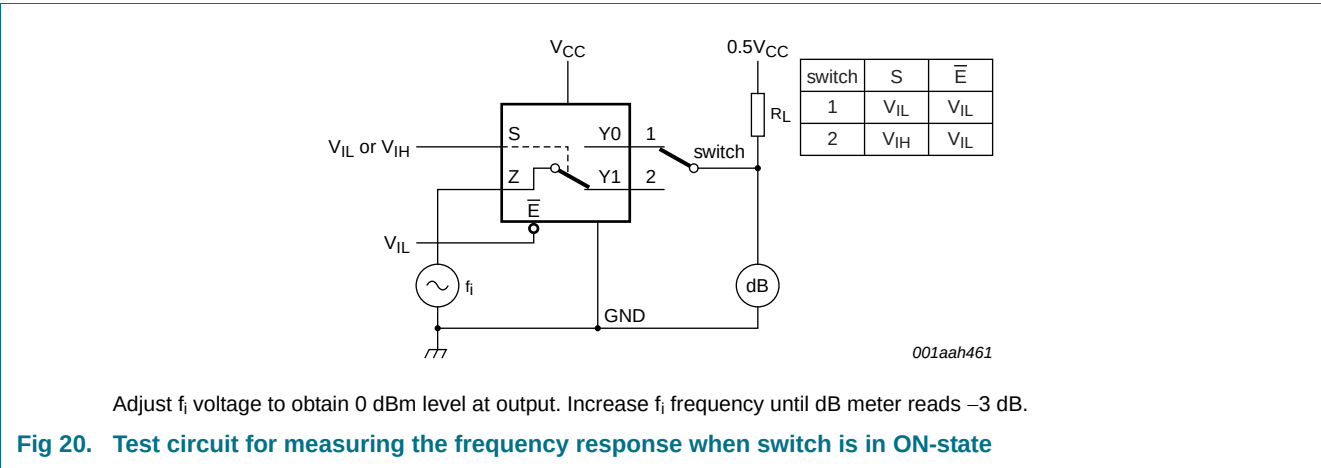
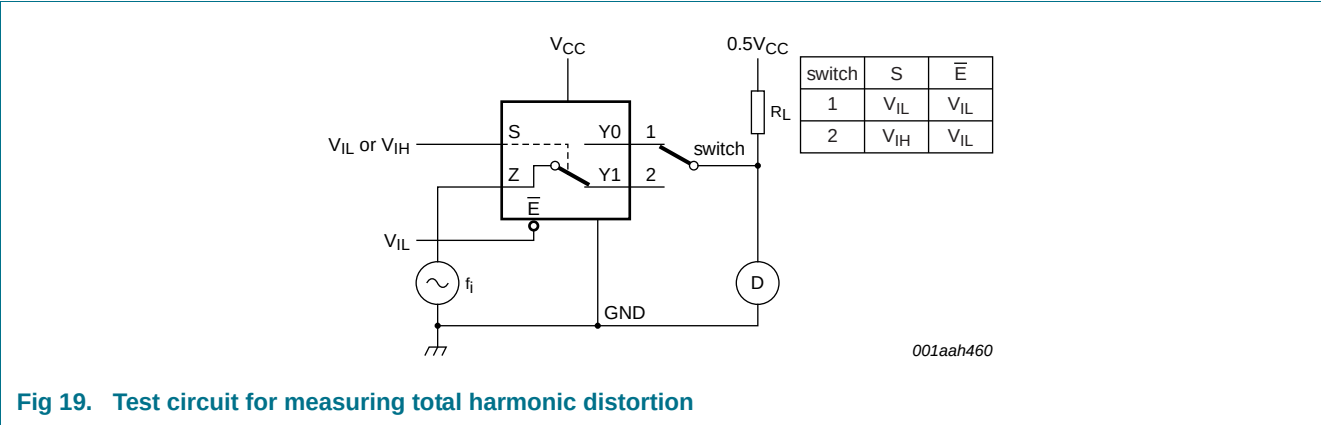
Table 12. Additional dynamic characteristics

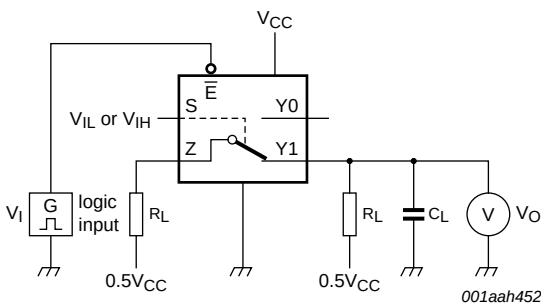
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); V_I = GND or V_{CC} (unless otherwise specified); t_r = t_f ≤ 2.5 ns; T_{amb} = 25 °C.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
THD	total harmonic distortion	f _i = 20 Hz to 20 kHz; R _L = 32 Ω; see Figure 19	[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	-	%
f _(-3dB)	-3 dB frequency response	V _{CC} = 4.3 V; V _I = 2 V (p-p)	-	0.02	-	%
		R _L = 50 Ω; see Figure 20	[1]			
α _{iso}	isolation (OFF-state)	V _{CC} = 1.4 V to 4.3 V	-	60	-	MHz
		f _i = 100 kHz; R _L = 50 Ω; see Figure 21	[1]			
V _{ct}	crosstalk voltage	V _{CC} = 1.4 V to 4.3 V	-	-90	-	dB
		between digital inputs and switch; f _i = 1 MHz; C _L = 50 pF; R _L = 50 Ω; see Figure 22				
		V _{CC} = 1.4 V to 3.6 V	-	0.2	-	V
Xtalk	crosstalk	V _{CC} = 3.6 V to 4.3 V	-	0.3	-	V
		between switches; f _i = 100 kHz; R _L = 50 Ω; see Figure 23	[1]			
		V _{CC} = 1.4 V to 4.3 V	-	-90	-	dB
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 24				
		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

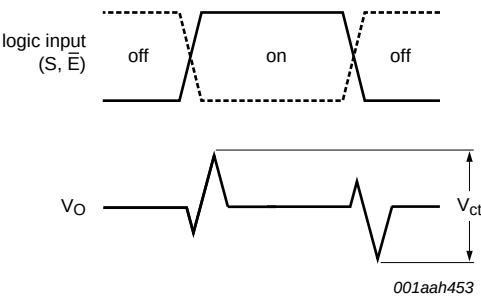
[1] f_i is biased at 0.5V_{CC}.

12.3 Test circuits





a. Test circuit



b. Input and output pulse definitions

V_I may be connected to S or $\bar{E}$.

Fig 22. Test circuit for measuring crosstalk voltage between digital inputs and switch

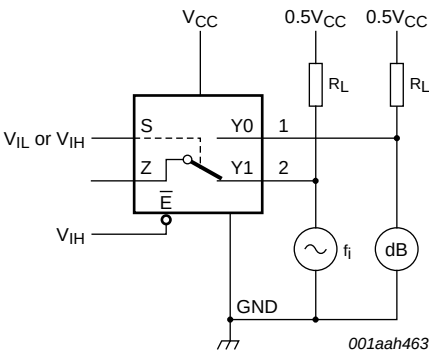
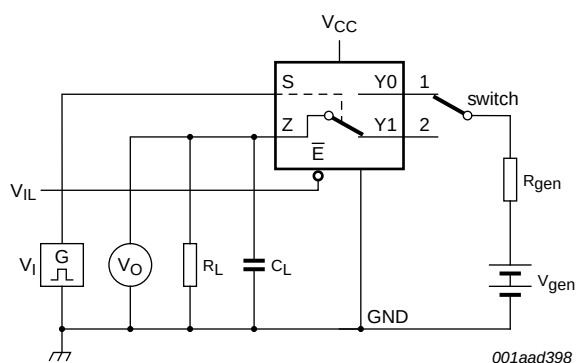
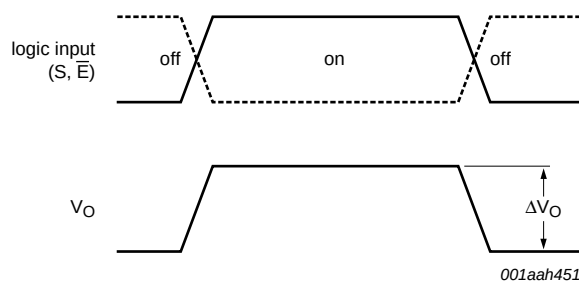


Fig 23. Test circuit for measuring crosstalk



a. Test circuit



b. Input and output pulse definitions

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

 ΔV_O = output voltage variation.

R_{gen} = generator resistance.

V_{gen} = generator voltage.

V_I may be connected to S or $\bar{E}$.

Fig 24. Test circuit for measuring charge injection

13. Package outline

XSON8: plastic extremely thin small outline package; no leads; 8 terminals; body 1 x 1.95 x 0.5 mm

SOT833-1

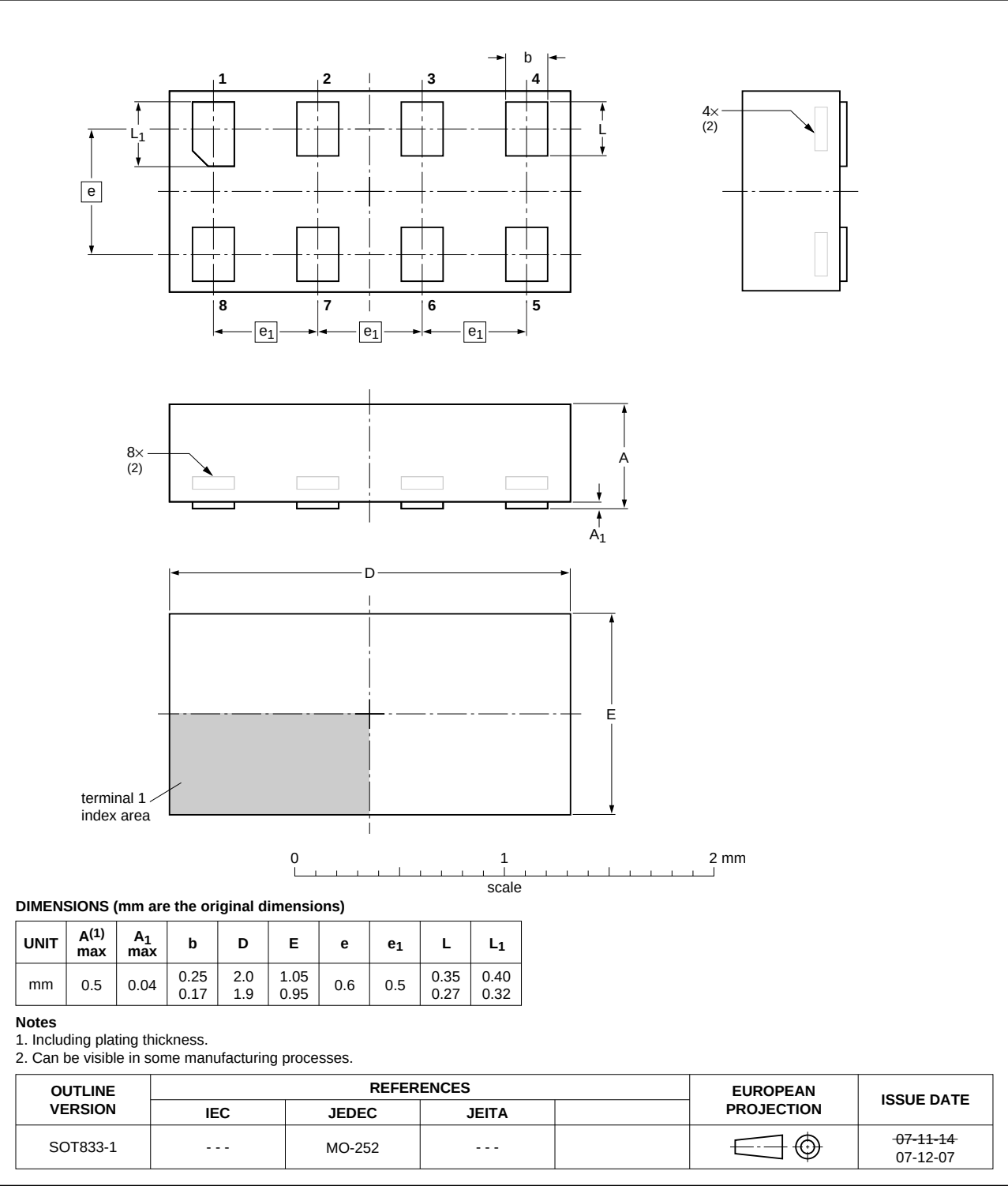


Fig 25. Package outline SOT833-1 (XSON8)

XSON8: plastic extremely thin small outline package; no leads;
8 terminals; body 3 x 2 x 0.5 mm

SOT996-2

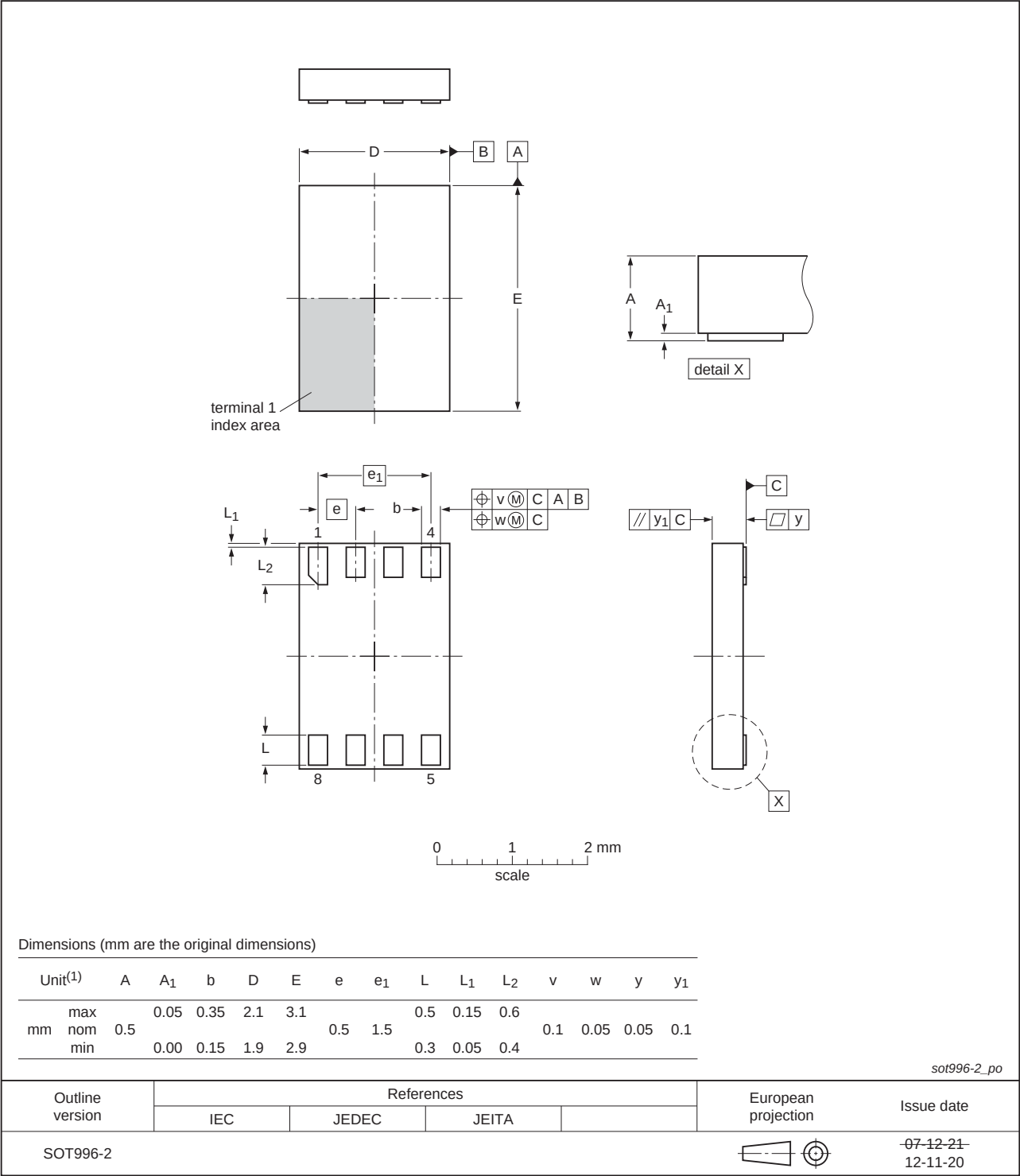


Fig 26. Package outline SOT996-2 (XSON8)

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

SOT902-2

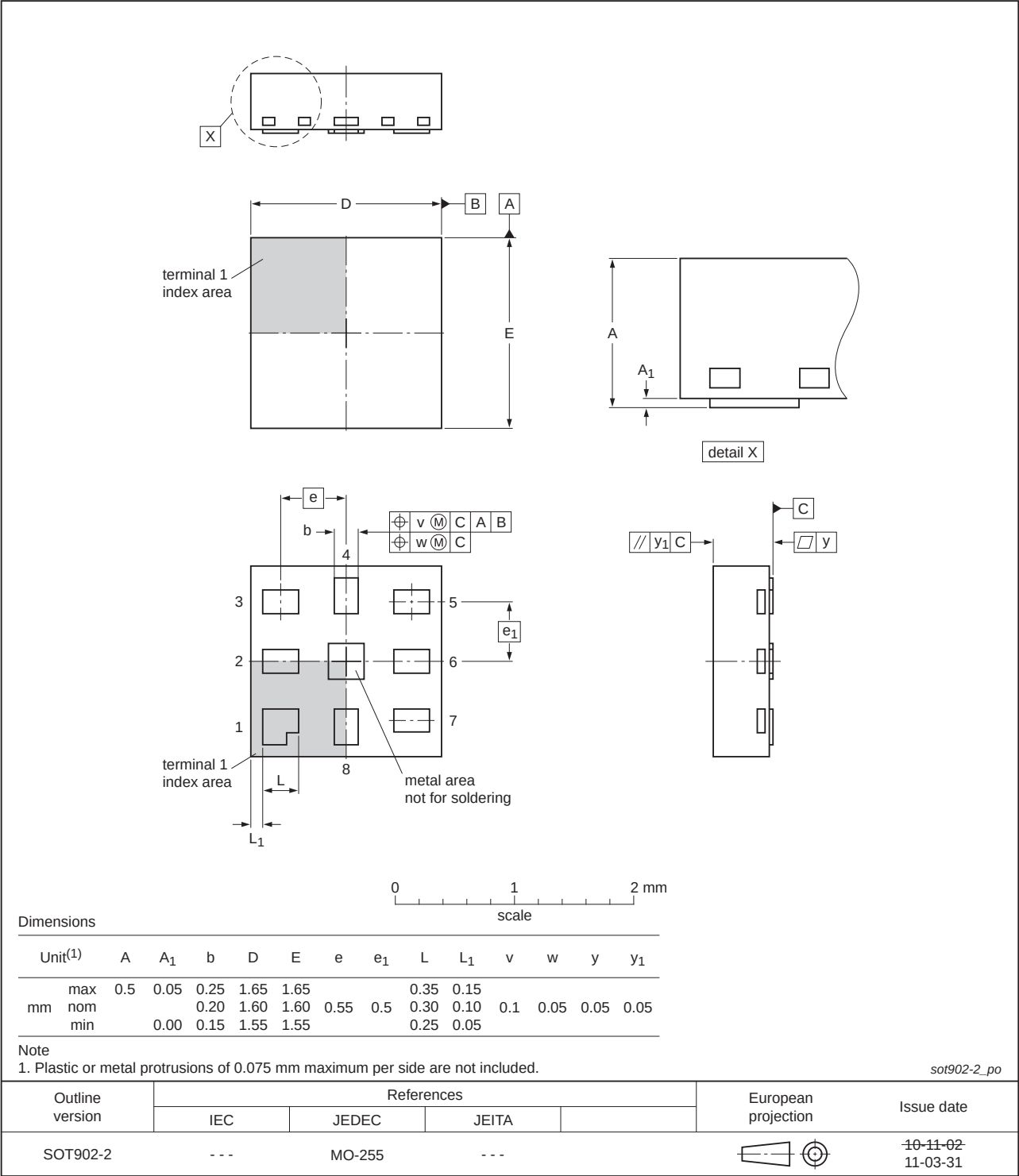


Fig 27. Package outline SOT902-2 (XQFN8)

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

15. Revision history

Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NX3L1T53 v.8	20130123	Product data sheet	-	NX3L1T53 v.7
Modifications:	• For type number NX3L1T53GD XSON8U has changed to XSON8.			
NX3L1T53 v.7	20120613	Product data sheet	-	NX3L1T53 v.6
NX3L1T53 v.6	20111108	Product data sheet	-	NX3L1T53 v.5
NX3L1T53 v.5	20110801	Product data sheet	-	NX3L1T53 v.4
NX3L1T53 v.4	20100324	Product data sheet	-	NX3L1T53 v.3
NX3L1T53 v.3	20100201	Product data sheet	-	NX3L1T53 v.2
NX3L1T53 v.2	20090414	Product data sheet	-	NX3L1T53 v.1
NX3L1T53 v.1	20090217	Product data sheet	-	-

16. Legal information

16.1 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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