

NX3L1G384

Low-ohmic single-pole single-throw analog switch

Rev. 6 — 3 July 2012

Product data sheet

1. General description

The NX3L1G384 is a low-ohmic single-pole single-throw analog switch. It has two input/output terminals (Y and Z) and an active LOW enable input pin (\bar{E}). When \bar{E} is HIGH, the analog switch is turned off.

Schmitt trigger action at the enable input (\bar{E}) makes the circuit tolerant to slower input rise and fall times. The NX3L1G384 allows signals with amplitude up to V_{CC} to be transmitted from Y to Z; or from Z to Y. 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 $V_{CC} = 1.4\ \text{V}$
 - ◆ $1.0\ \Omega$ (typical) at $V_{CC} = 1.65\ \text{V}$
 - ◆ $0.55\ \Omega$ (typical) at $V_{CC} = 2.3\ \text{V}$
 - ◆ $0.50\ \Omega$ (typical) at $V_{CC} = 2.7\ \text{V}$
 - ◆ $0.50\ \Omega$ (typical) at $V_{CC} = 4.3\ \text{V}$
- 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 4000 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 $-40\ ^\circ\text{C}$ to $+85\ ^\circ\text{C}$ and from $-40\ ^\circ\text{C}$ to $+125\ ^\circ\text{C}$

3. Applications

- Cell phone
- PDA
- Portable media player



4. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
NX3L1G384GW	-40 °C to +125 °C	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
NX3L1G384GM	-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 codes^[1]

Type number	Marking code
NX3L1G384GW	ML
NX3L1G384GM	ML

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

6. Functional diagram

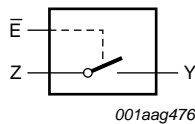


Fig 1. Logic symbol

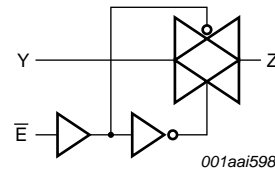


Fig 2. Logic diagram

7. Pinning information

7.1 Pinning

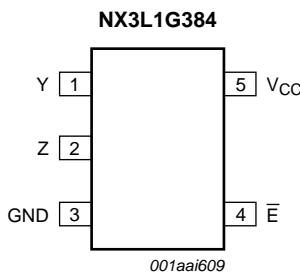


Fig 3. Pin configuration SOT353-1 (TSSOP5)

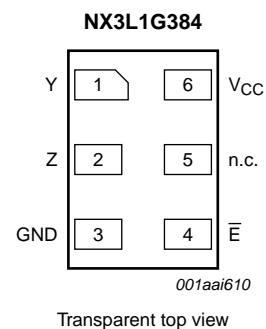


Fig 4. Pin configuration SOT886 (XSON6)

7.2 Pin description

Table 3. Pin description

Symbol	Pin		Description
	SOT353-1	SOT886	
Y	1	1	independent input or output
Z	2	2	independent output or input
GND	3	3	ground (0 V)
\bar{E}	4	4	enable input (active LOW)
n.c.	-	5	not connected
V _{CC}	5	6	supply voltage

8. Functional description

Table 4. Function table^[1]

Input \bar{E}	Switch
L	ON-state
H	OFF-state

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

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	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 TSSOP5 package: above 87.5 °C the value of P_{tot} derates linearly with 4.0 mW/K.
For XSON6 package: 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	Max	Unit
V_{CC}	supply voltage		1.4	4.3	V
V_I	input voltage	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	$V_{CC} = 1.4\text{ V to }4.3\text{ V}$	[2] -	200	ns/V

[1] To avoid sinking GND current from of terminal Z when switch current flows in terminal Y, 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 Y. 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	$T_{amb} = 25\text{ °C}$			$T_{amb} = -40\text{ °C to }+125\text{ °C}$			Unit
			Min	Typ	Max	Min	Max (85 °C)	Max (125 °C)	
V_{IH}	HIGH-level input voltage	$V_{CC} = 1.4\text{ V to }1.95\text{ V}$	$0.65V_{CC}$	-	-	$0.65V_{CC}$	-	-	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.7	-	-	1.7	-	-	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	2.0	-	-	2.0	-	-	V
		$V_{CC} = 3.6\text{ V to }4.3\text{ V}$	$0.7V_{CC}$	-	-	$0.7V_{CC}$	-	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 1.4\text{ V to }1.95\text{ V}$	-	-	$0.35V_{CC}$	-	$0.35V_{CC}$	$0.35V_{CC}$	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	-	-	0.7	-	0.7	0.7	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	-	-	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_I	input leakage current	enable input \bar{E} ; $V_I = \text{GND to }4.3\text{ V}$; $V_{CC} = 1.4\text{ V to }4.3\text{ V}$	-	-	-	-	± 0.5	± 1	μA
$I_{S(OFF)}$	OFF-state leakage current	Y port; see Figure 5							
		$V_{CC} = 1.4\text{ V to }3.6\text{ V}$	-	-	± 5	-	± 50	± 500	nA
		$V_{CC} = 3.6\text{ V to }4.3\text{ V}$	-	-	± 10	-	± 50	± 500	nA
$I_{S(ON)}$	ON-state leakage current	Z port; see Figure 6							
		$V_{CC} = 1.4\text{ V to }3.6\text{ V}$	-	-	± 5	-	± 50	± 500	nA
		$V_{CC} = 3.6\text{ V to }4.3\text{ V}$	-	-	± 10	-	± 50	± 500	nA
I_{CC}	supply current	$V_I = V_{CC}$ or GND; $V_{SW} = \text{GND or }V_{CC}$							
		$V_{CC} = 3.6\text{ V}$	-	-	100	-	690	6000	nA
		$V_{CC} = 4.3\text{ V}$	-	-	150	-	800	7000	nA

Table 7. Static characteristics ...continued

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)	
C _I	input capacitance		-	1.0	-	-	-	-	pF
C _{S(OFF)}	OFF-state capacitance		-	35	-	-	-	-	pF
C _{S(ON)}	ON-state capacitance		-	110	-	-	-	-	pF

11.1 Test circuits

$V_I = 0.3 \text{ V or } V_{CC} - 0.3 \text{ V}; V_O = V_{CC} - 0.3 \text{ V or } 0.3 \text{ V}.$

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

$V_I = 0.3 \text{ V or } V_{CC} - 0.3 \text{ V}; V_O = \text{open circuit}.$

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 14](#).

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 7						
		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

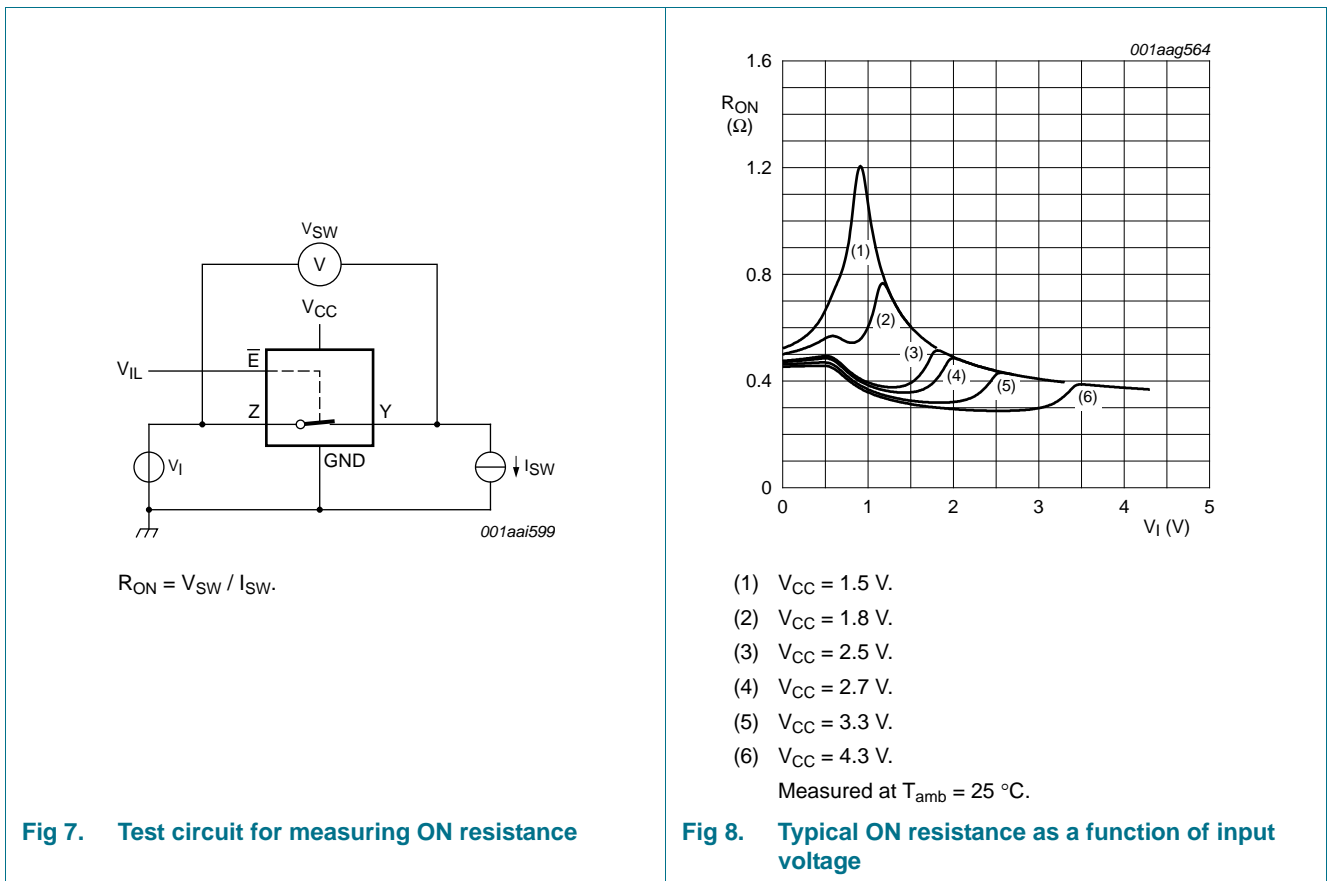
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for graphs see [Figure 8](#) to [Figure 14](#).

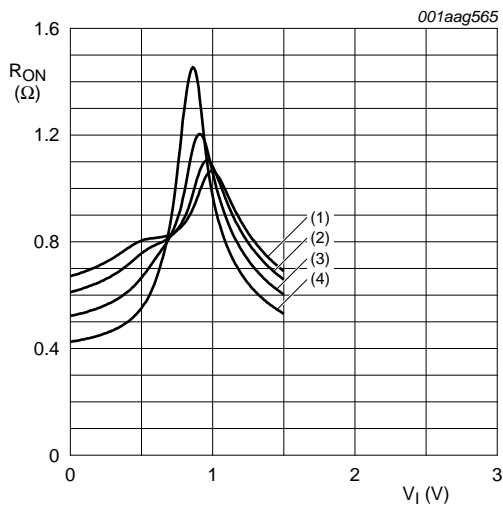
Symbol	Parameter	Conditions	T _{amb} = -40 °C to +85 °C			T _{amb} = -40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	
R _{ON(flat)}	ON resistance (flatness)	V _I = GND to V _{CC} ; I _{SW} = 100 mA						
		V _{CC} = 1.4 V	-	1.0	3.3	-	3.6	Ω
		V _{CC} = 1.65 V	-	0.5	1.2	-	1.3	Ω
		V _{CC} = 2.3 V	-	0.15	0.3	-	0.35	Ω
		V _{CC} = 2.7 V	-	0.13	0.3	-	0.35	Ω
		V _{CC} = 4.3 V	-	0.2	0.4	-	0.45	Ω

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

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

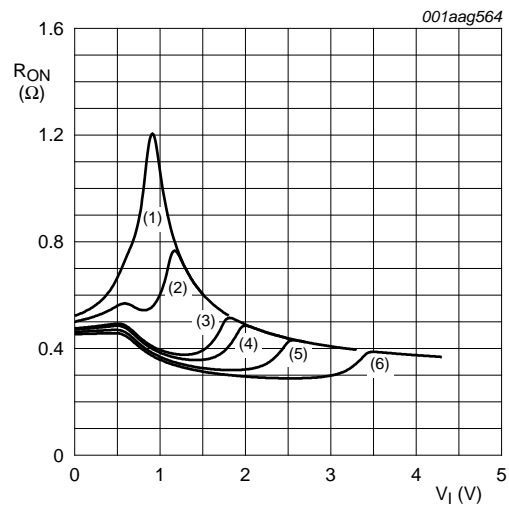
11.3 ON resistance test circuit and graphs





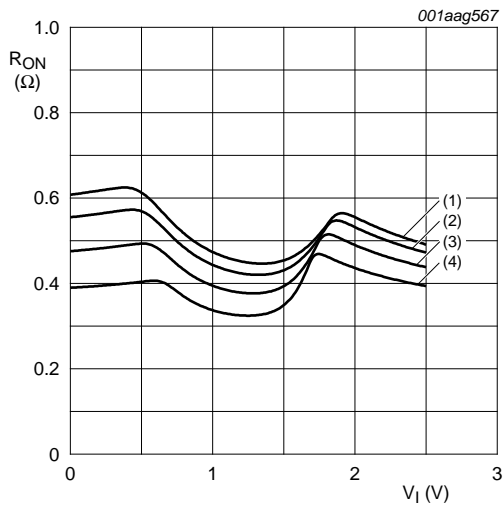
- (1) $T_{amb} = 125\text{ °C.}$
- (2) $T_{amb} = 85\text{ °C.}$
- (3) $T_{amb} = 25\text{ °C.}$
- (4) $T_{amb} = -40\text{ °C.}$

Fig 9. ON resistance as a function of input voltage;
 $V_{CC} = 1.5\text{ V}$



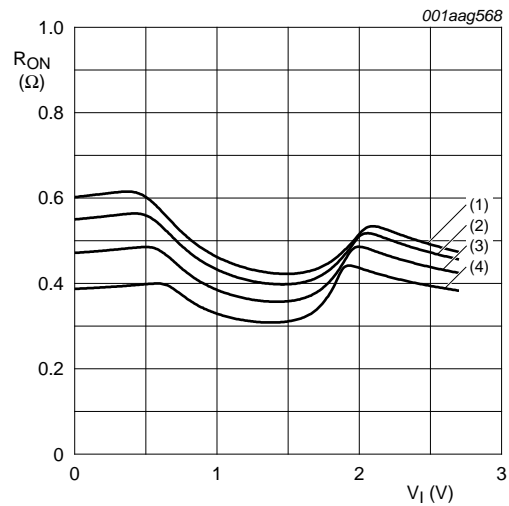
- (1) $T_{amb} = 125\text{ °C.}$
- (2) $T_{amb} = 85\text{ °C.}$
- (3) $T_{amb} = 25\text{ °C.}$
- (4) $T_{amb} = -40\text{ °C.}$

Fig 10. ON resistance as a function of input voltage;
 $V_{CC} = 1.8\text{ V}$



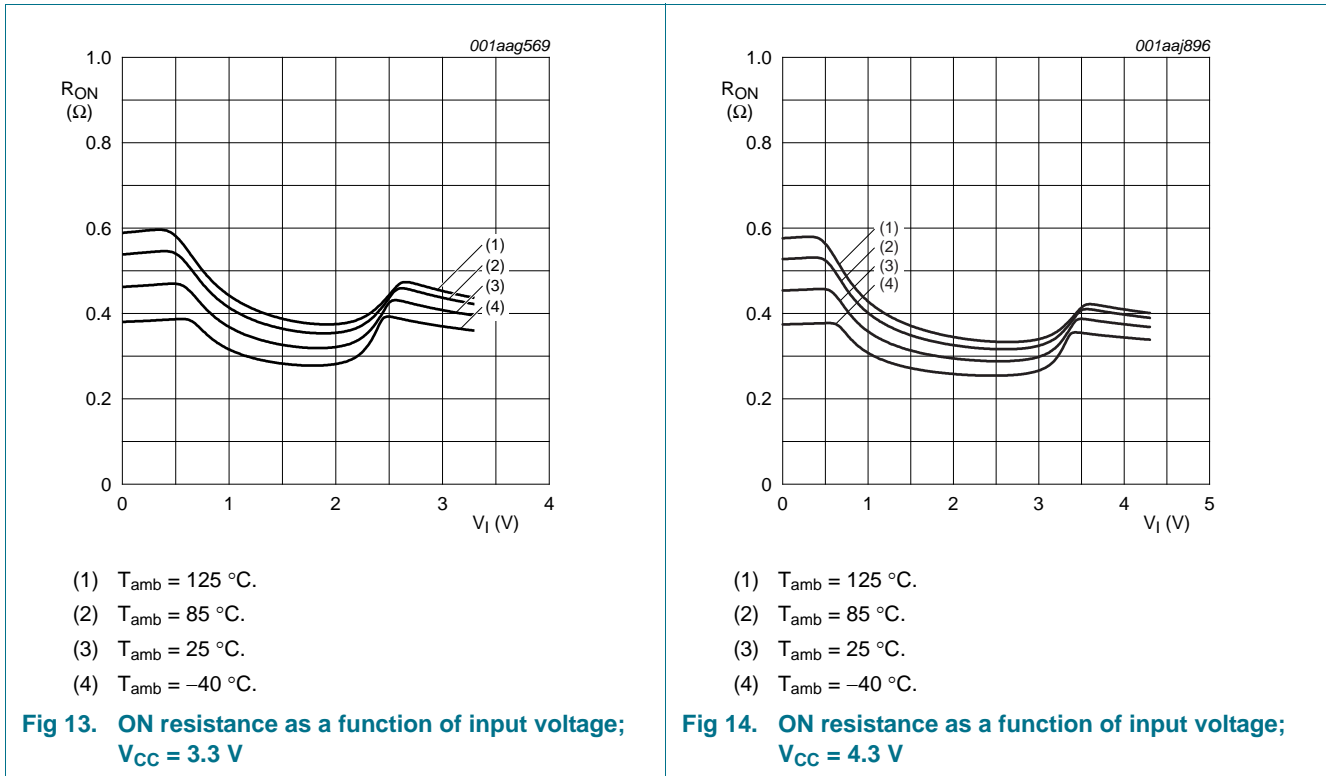
- (1) $T_{amb} = 125\text{ °C.}$
- (2) $T_{amb} = 85\text{ °C.}$
- (3) $T_{amb} = 25\text{ °C.}$
- (4) $T_{amb} = -40\text{ °C.}$

Fig 11. ON resistance as a function of input voltage;
 $V_{CC} = 2.5\text{ V}$



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

Fig 12. ON resistance as a function of input voltage;
 $V_{CC} = 2.7\text{ V}$



12. Dynamic characteristics

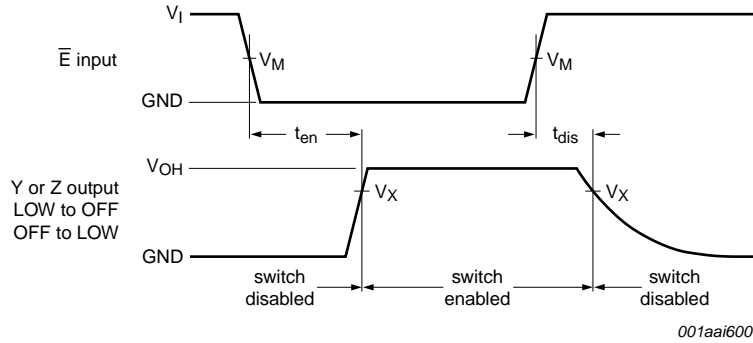
Table 9. Dynamic characteristics

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

Symbol	Parameter	Conditions	T _{amb} = 25 °C			T _{amb} = -40 °C to +125 °C			Unit
			Min	Typ ^[1]	Max	Min	Max (85 °C)	Max (125 °C)	
t _{en}	enable time	\bar{E} to Z or Y; see Figure 15							
		V _{CC} = 1.4 V to 1.6 V	-	27	41	-	44	48	ns
		V _{CC} = 1.65 V to 1.95 V	-	22	35	-	37	40	ns
		V _{CC} = 2.3 V to 2.7 V	-	17	26	-	28	31	ns
		V _{CC} = 2.7 V to 3.6 V	-	14	24	-	25	27	ns
t _{dis}	disable time	\bar{E} to Z or Y; see Figure 15							
		V _{CC} = 1.4 V to 1.6 V	-	9	17	-	19	21	ns
		V _{CC} = 1.65 V to 1.95 V	-	7	13	-	14	15	ns
		V _{CC} = 2.3 V to 2.7 V	-	4	8	-	9	10	ns
		V _{CC} = 2.7 V to 3.6 V	-	4	7	-	8	9	ns
		V _{CC} = 3.6 V to 4.3 V	-	4	7	-	8	9	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.

12.1 Waveform and test circuits

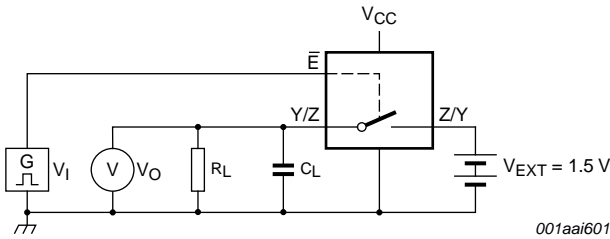


Measurement points are given in [Table 10](#).
 Logic level: V_{OH} is the typical output voltage that occurs with the output load.

Fig 15. 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	$0.5V_{CC}$	$0.9V_{OH}$



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}	$\leq 2.5 \text{ ns}$	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); $V_I = \text{GND}$ or V_{CC} (unless otherwise specified); $t_r = t_f \leq 2.5 \text{ ns}$.

Symbol	Parameter	Conditions	$T_{\text{amb}} = 25 \text{ }^\circ\text{C}$			Unit
			Min	Typ	Max	
THD	total harmonic distortion	$f_i = 20 \text{ Hz to } 20 \text{ kHz}; R_L = 32 \text{ } \Omega$; see Figure 17 ^[1]				
		$V_{CC} = 1.4 \text{ V}; V_I = 1 \text{ V (p-p)}$	-	0.15	-	%
		$V_{CC} = 1.65 \text{ V}; V_I = 1.2 \text{ V (p-p)}$	-	0.10	-	%
		$V_{CC} = 2.3 \text{ V}; V_I = 1.5 \text{ V (p-p)}$	-	0.02	-	%
		$V_{CC} = 2.7 \text{ V}; V_I = 2 \text{ V (p-p)}$	-	0.02	-	%
		$V_{CC} = 4.3 \text{ V}; V_I = 2 \text{ V (p-p)}$	-	0.02	-	%
$f_{(-3\text{dB})}$	-3 dB frequency response	$R_L = 50 \text{ } \Omega$; see Figure 18 ^[1]				
		$V_{CC} = 1.4 \text{ V to } 4.3 \text{ V}$	-	60	-	MHz
α_{iso}	isolation (OFF-state)	$f_i = 100 \text{ kHz}; R_L = 50 \text{ } \Omega$; see Figure 19 ^[1]				
		$V_{CC} = 1.4 \text{ V to } 4.3 \text{ V}$	-	-90	-	dB
V_{ct}	crosstalk voltage	between digital inputs and switch; $f_i = 1 \text{ MHz}; C_L = 50 \text{ pF}; R_L = 50 \text{ } \Omega$; see Figure 20				
		$V_{CC} = 1.4 \text{ V to } 3.6 \text{ V}$	-	0.2	-	V
		$V_{CC} = 3.6 \text{ V to } 4.3 \text{ V}$	-	0.2	-	V
Q_{inj}	charge injection	$f_i = 1 \text{ MHz}; C_L = 0.1 \text{ nF}; R_L = 1 \text{ M}\Omega; V_{\text{gen}} = 0 \text{ V}; R_{\text{gen}} = 0 \text{ } \Omega$; see Figure 21				
		$V_{CC} = 1.5 \text{ V}$	-	3	-	pC
		$V_{CC} = 1.8 \text{ V}$	-	3	-	pC
		$V_{CC} = 2.5 \text{ V}$	-	3	-	pC
		$V_{CC} = 3.3 \text{ V}$	-	3	-	pC
		$V_{CC} = 4.3 \text{ V}$	-	6	-	pC

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

12.3 Test circuits

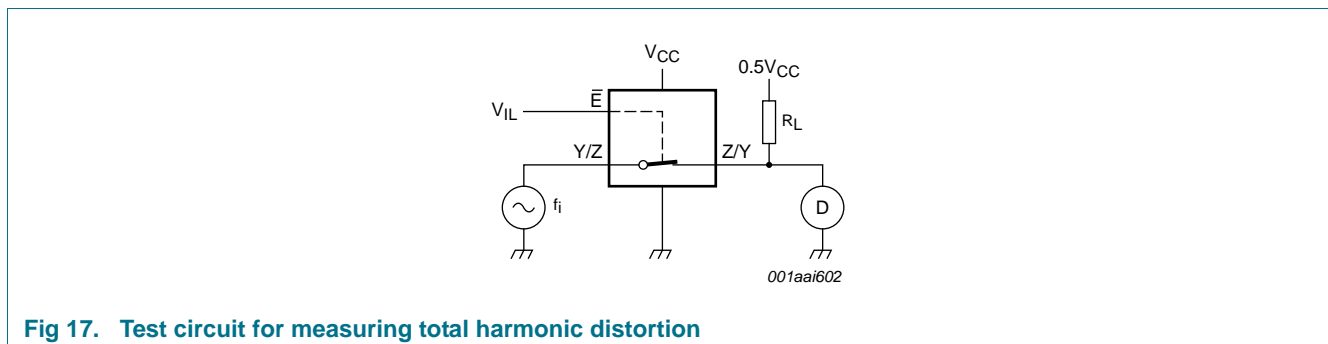
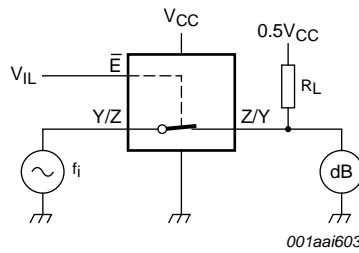
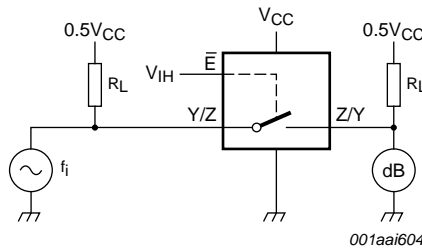


Fig 17. Test circuit for measuring total harmonic distortion



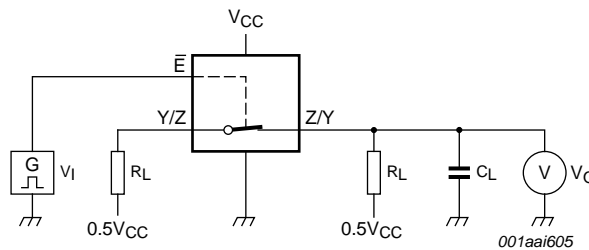
Adjust f_i voltage to obtain 0 dBm level at output. Increase f_i frequency until dB meter reads -3 dB.

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

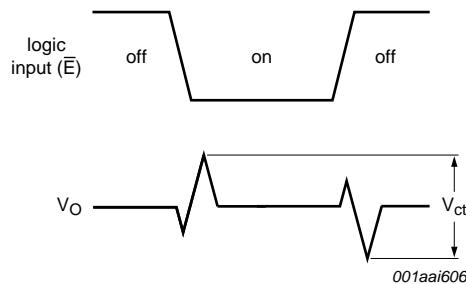


Adjust f_i voltage to obtain 0 dBm level at input.

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

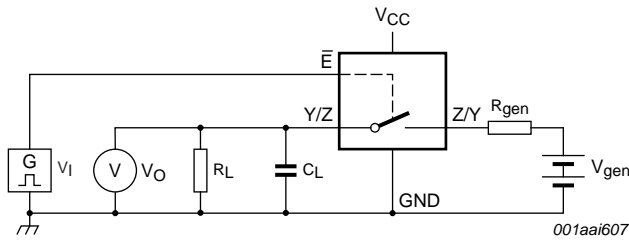


a. Test circuit

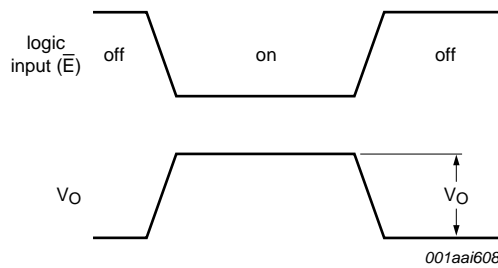


b. Input and output pulse definitions

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

13. Package outline

TSSOP5: plastic thin shrink small outline package; 5 leads; body width 1.25 mm

SOT353-1

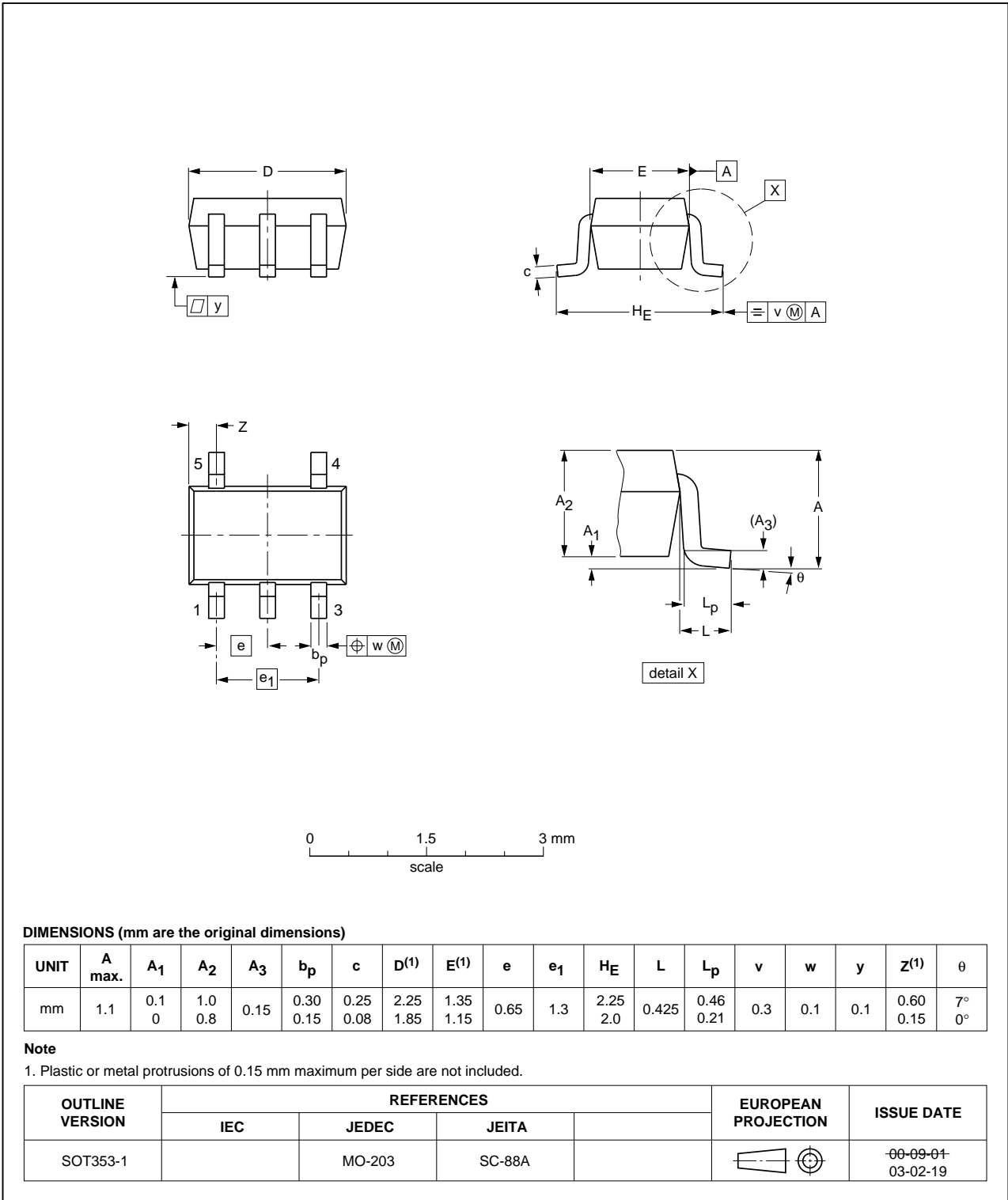


Fig 22. Package outline SOT353-1 (TSSOP5)

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

SOT886

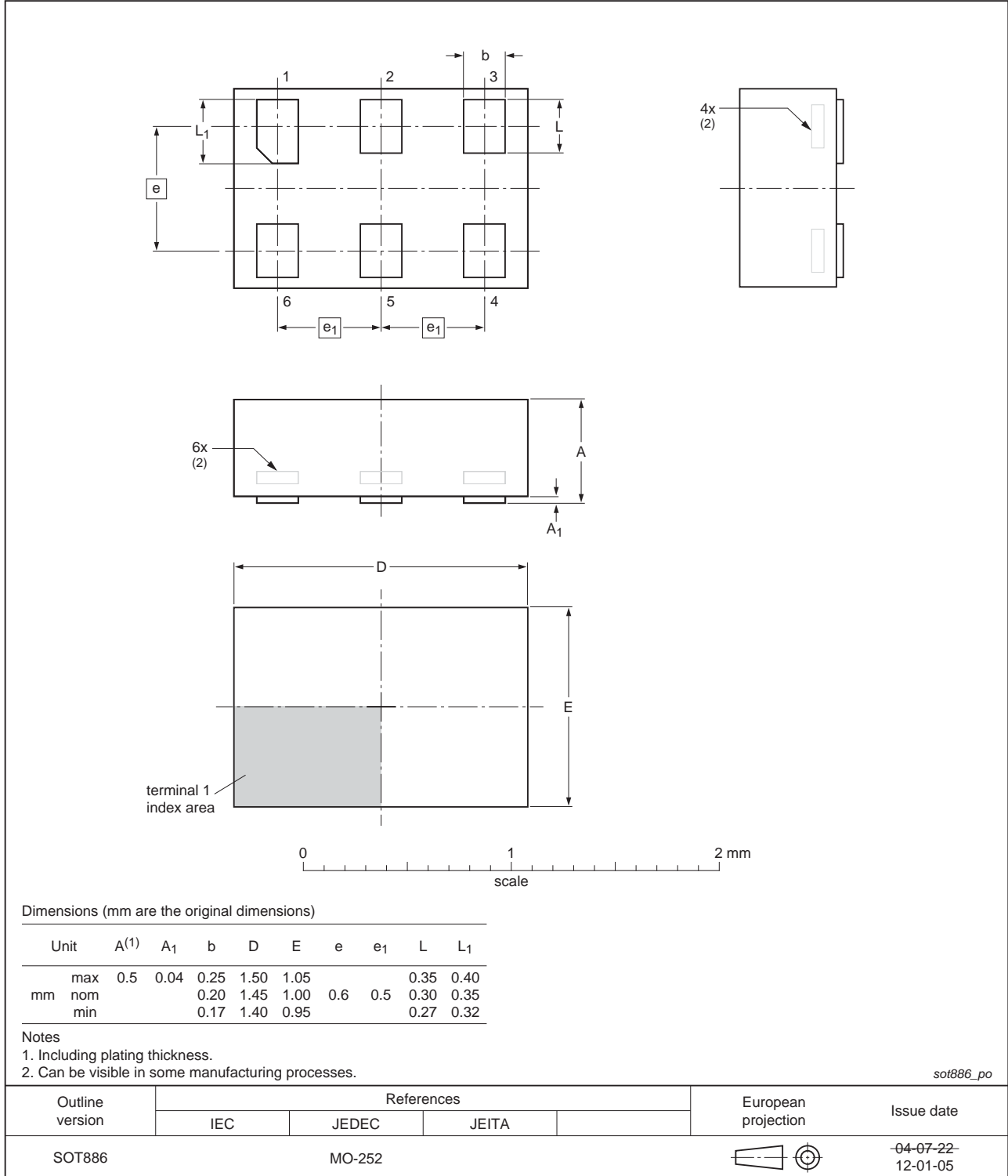


Fig 23. Package outline SOT886 (XSON6)

14. Abbreviations

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
NX3L1G384 v.6	20120703	Product data sheet	-	NX3L1G384 v.5
Modifications:	<ul style="list-style-type: none"> Package outline drawing of SOT886 (Figure 23) modified. 			
NX3L1G384 v.5	20111109	Product data sheet	-	NX3L1G384 v.4
Modifications:	<ul style="list-style-type: none"> Legal pages updated. 			
NX3L1G384 v.4	20110107	Product data sheet	-	NX3L1G384 v.3
NX3L1G384 v.3	20090817	Product data sheet	-	NX3L1G384 v.2
NX3L1G384 v.2	20090406	Product data sheet	-	NX3L1G384 v.1
NX3L1G384 v.1	20080908	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".

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