74LVC1GU04

Unbuffered inverter

Rev. 12 — 9 April 2013 Product data sheet

1. General description

The 74LVC1GU04 is a single unbuffered inverter.

The input can be driven from either 3.3 V or 5 V devices. This feature allows the use of this device in a mixed 3.3 V and 5 V environment.

2. Features and benefits

- Wide supply voltage range from 1.65 V to 5.5 V
- High noise immunity
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- ±24 mA output drive (V_{CC} = 3.0 V)
- CMOS low power consumption
- Latch-up performance exceeds 250 mA
- Input accepts voltages up to 5 V
- Multiple package options
- Specified from –40 °C to +85 °C and –40 °C to +125 °C

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LVC1GU04GW	–40 °C to +125 °C	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
74LVC1GU04GV	–40 °C to +125 °C	SC-74A	plastic surface-mounted package; 5 leads	SOT753
74LVC1GU04GM	–40 °C to +125 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm	SOT886
74LVC1GU04GF	–40 °C to +125 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1 × 0.5 mm	SOT891
74LVC1GU04GN	–40 °C to +125 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body 0.9 × 1.0 × 0.35 mm	SOT1115
74LVC1GU04GS	–40 °C to +125 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body 1.0 × 1.0 × 0.35 mm	SOT1202
74LVC1GU04GX	–40 °C to +125 °C	X2SON5	X2SON5: plastic thermal enhanced extremely thin small outline package; no leads; 5 terminals; body 0.8 × 0.8 × 0.35 mm	SOT1226

4. Marking

Table 2. Marking codes

Type number	Marking[1]
74LVC1GU04GW	VD
74LVC1GU04GV	VU4
74LVC1GU04GM	VD
74LVC1GU04GF	VD
74LVC1GU04GN	VD
74LVC1GU04GS	VD
74LVC1GU04GX	VD

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

5. Functional diagram

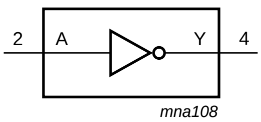


Fig 1. Logic symbol

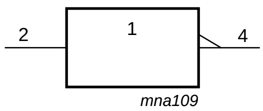


Fig 2. IEC logic symbol

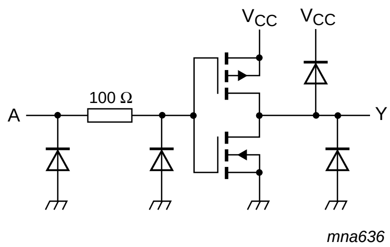


Fig 3. Logic diagram

6. Pinning information

6.1 Pinning

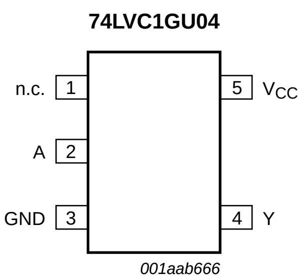
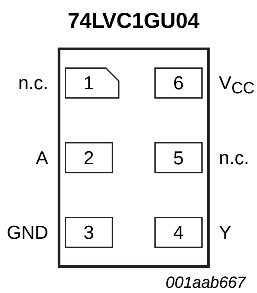


Fig 4. Pin configuration SOT353-1 and SOT753



Transparent top view

Fig 5. Pin configuration SOT886

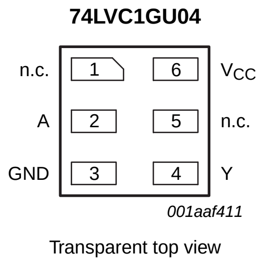


Fig 6. Pin configuration SOT891, SOT1115 and SOT1202

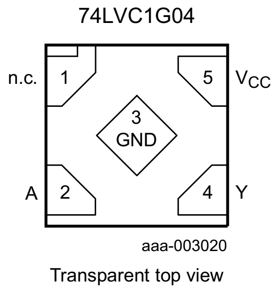


Fig 7. Pin configuration SOT1226 (X2SON5)

6.2 Pin description

Table 3. Pin description

Symbol	Pin		Description
	TSSOP5 and X2SON5	XSON6	
n.c.	1	1	not connected
A	2	2	data input
GND	3	3	ground (0 V)
Y	4	4	data output
n.c.	-	5	not connected
V_{CC}	5	6	supply voltage

7. Functional description

Table 4. Function table[1]

Input (A)	Output (Y)
L	H
H	L

[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	+6.5	V
I_{IK}	input clamping current	$V_I < 0$ V		-	–50	mA
V_I	input voltage		[1]	–0.5	+6.5	V
I_{OK}	output clamping current	$V_O > V_{CC}$ or $V_O < 0$ V		-	±50	mA
V_O	output voltage	Active mode	[1][2]	–0.5	V_{CC} + 0.5	V
I_O	output current	V_O = 0 V to V_{CC}		-	±50	mA
I_{CC}	supply current			-	+100	mA
I_{GND}	ground current			-	–100	mA
P_{tot}	total power dissipation	T_{amb} = –40 °C to +125 °C	[3]	-	250	mW
T_{stg}	storage temperature			–65	+150	°C

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

[2] When V_{CC} = 0 V (Power-down mode), the output voltage can be 5.5 V in normal operation.

[3] For TSSOP5 and SC-74A packages: above 87.5 °C the value of P_{tot} derates linearly with 4.0 mW/K.
For XSON6 and X2SON5 packages: above 118 °C the value of P_{tot} derates linearly with 7.8 mW/K.

9. Recommended operating conditions

Table 6. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		1.65	-	5.5	V
V_I	input voltage		0	-	5.5	V
V_O	output voltage	Active mode	0	-	V_{CC}	V
T_{amb}	ambient temperature		–40	-	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	V_{CC} = 1.65 V to 2.7 V	0	-	20	ns/V
		V_{CC} = 2.7 V to 5.5 V	0	-	10	ns/V

10. Static characteristics

Table 7. Static characteristics
At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ[1]	Max	Unit
T_{amb} = –40 °C to +85 °C						
V_{IH}	HIGH-level input voltage	V_{CC} = 1.65 V to 5.5 V	0.75 × V_{CC}	-	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 1.65 V to 5.5 V	-	-	0.25 × V_{CC}	V
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}				
		I_O = –100 μA; V_{CC} = 1.65 V to 5.5 V	V_{CC} – 0.1	-	-	V
		I_O = –4 mA; V_{CC} = 1.65 V	1.2	-	-	V
		I_O = –8 mA; V_{CC} = 2.3 V	1.9	-	-	V
		I_O = –12 mA; V_{CC} = 2.7 V	2.2	-	-	V
		I_O = –24 mA; V_{CC} = 3.0 V	2.3	-	-	V
		I_O = –32 mA; V_{CC} = 4.5 V	3.8	-	-	V
V_{OL}	LOW-level output voltage	V_I = V_{IH} or V_{IL}				
		I_O = 100 μA; V_{CC} = 1.65 V to 5.5 V	-	-	0.1	V
		I_O = 4 mA; V_{CC} = 1.65 V	-	-	0.45	V
		I_O = 8 mA; V_{CC} = 2.3 V	-	-	0.3	V
		I_O = 12 mA; V_{CC} = 2.7 V	-	-	0.4	V
		I_O = 24 mA; V_{CC} = 3.0 V	-	-	0.55	V
		I_O = 32 mA; V_{CC} = 4.5 V	-	-	0.55	V
I_I	input leakage current	V_I = 5.5 V or GND; V_{CC} = 0 V to 5.5 V	-	±0.1	±5	μA
I_{CC}	supply current	V_I = 5.5 V or GND; I_O = 0 A; V_{CC} = 1.65 V to 5.5 V	-	0.1	10	μA
C_I	input capacitance	V_{CC} = 3.3 V; V_I = GND to V_{CC}	-	6	-	pF
T_{amb} = –40 °C to +125 °C						
V_{IH}	HIGH-level input voltage	V_{CC} = 1.65 V to 5.5 V	0.8 × V_{CC}	-	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 1.65 V to 5.5 V	-	-	0.2 × V_{CC}	V
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}				
		I_O = –100 μA; V_{CC} = 1.65 V to 5.5 V	V_{CC} – 0.1	-	-	V
		I_O = –4 mA; V_{CC} = 1.65 V	0.95	-	-	V
		I_O = –8 mA; V_{CC} = 2.3 V	1.7	-	-	V
		I_O = –12 mA; V_{CC} = 2.7 V	1.9	-	-	V
		I_O = –24 mA; V_{CC} = 3.0 V	2.0	-	-	V
		I_O = –32 mA; V_{CC} = 4.5 V	3.4	-	-	V

Table 7. Static characteristics *...continued*

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

Symbol	Parameter	Conditions	Min	Typ[1]	Max	Unit
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}				
		$I_O = 100\ \mu A$; $V_{CC} = 1.65$ V to 5.5 V	-	-	0.1	V
		$I_O = 4$ mA; $V_{CC} = 1.65$ V	-	-	0.7	V
		$I_O = 8$ mA; $V_{CC} = 2.3$ V	-	-	0.45	V
		$I_O = 12$ mA; $V_{CC} = 2.7$ V	-	-	0.6	V
		$I_O = 24$ mA; $V_{CC} = 3.0$ V	-	-	0.80	V
		$I_O = 32$ mA; $V_{CC} = 4.5$ V	-	-	0.80	V
I_I	input leakage current	$V_I = 5.5$ V or GND; $V_{CC} = 0$ V to 5.5 V	-	±0.1	±5	μA
I_{CC}	supply current	$V_I = 5.5$ V or GND; $I_O = 0$ A; $V_{CC} = 1.65$ V to 5.5 V	-	-	200	μA

[1] All typical values are measured at $V_{CC} = 3.3$ V and $T_{amb} = 25$ °C.

11. Dynamic characteristics

Table 8. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit see Figure 11.

Symbol	Parameter	Conditions		–40 °C to +85 °C			–40 °C to +125 °C		Unit
				Min	Typ[1]	Max	Min	Max	
t_{pd}	propagation delay	A to Y; see Figure 8	[2]						
		$V_{CC} = 1.65$ V to 1.95 V		0.3	1.7	5.0	0.3	6.5	ns
		$V_{CC} = 2.3$ V to 2.7 V		0.3	1.3	4.0	0.3	5.5	ns
		$V_{CC} = 2.7$ V		0.5	1.7	5.0	0.5	6.5	ns
		$V_{CC} = 3.0$ V to 3.6 V		0.5	1.6	3.7	0.5	5.0	ns
		$V_{CC} = 4.5$ V to 5.5 V		0.5	1.3	3.0	0.5	4.0	ns
C_{PD}	power dissipation capacitance	$V_I = GND$ to V_{CC}; $V_{CC} = 3.3$ V	[3]	-	14.9	-	-	-	pF

[1] Typical values are measured at $T_{amb} = 25$ °C and $V_{CC} = 1.8$ V, 2.5 V, 2.7 V, 3.3 V and 5.0 V respectively.

[2] t_{pd} is the same as t_{PLH} and t_{PHL}.

[3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:

f_i = input frequency in MHz;

f_o = output frequency in MHz;

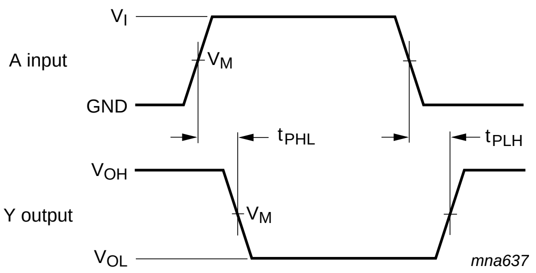
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

12. Waveforms



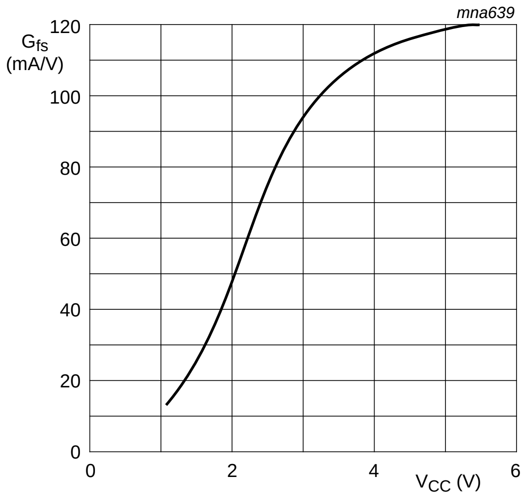
Measurement points are given in Table 9.

V_{OL} and V_{OH} are typical output voltage drop that occur with the output load.

Fig 8. The input A to output Y propagation delay times

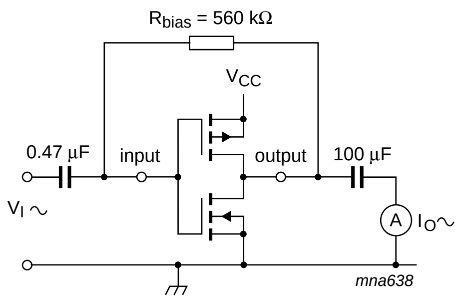
Table 9. Measurement points

Supply voltage	Input	Output
V_{CC}	V_M	V_M
1.65 V to 1.95 V	0.5 × V_{CC}	0.5 × V_{CC}
2.3 V to 2.7 V	0.5 × V_{CC}	0.5 × V_{CC}
2.7 V	1.5 V	1.5 V
3.0 V to 3.6 V	1.5 V	1.5 V
4.5 V to 5.5 V	0.5 × V_{CC}	0.5 × V_{CC}



T_{amb} = 25 °C.

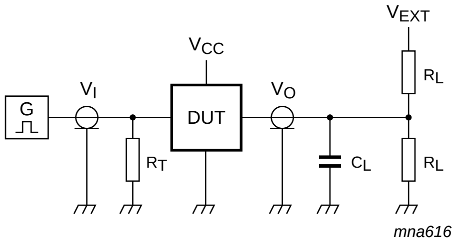
Fig 9. Typical forward transconductance as a function of supply voltage



$$G_{fs} = \frac{\Delta I_O}{\Delta V_I}$$

f_i = 1 kHz at V_O is constant

Fig 10. Test set-up for measuring forward transconductance



Test data is given in Table 10.

Definitions for test circuit:

R_L = Load resistance.

C_L = Load capacitance including jig and probe capacitance.

R_T = Termination resistance should be equal to the output impedance Z_o of the pulse generator.

V_{EXT} = External voltage for measuring switching times.

Fig 11. Test circuit for measuring switching times

Table 10. Test data

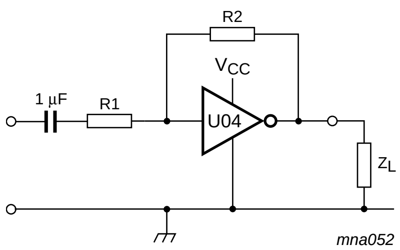
Supply voltage	Input		Load		V_{EXT}
V_{CC}	V_I	$t_r = t_f$	C_L	R_L	t_{PLH}, t_{PHL}
1.65 V to 1.95 V	V_{CC}	≤ 2.0 ns	30 pF	1 kΩ	open
2.3 V to 2.7 V	V_{CC}	≤ 2.0 ns	30 pF	500 Ω	open
2.7 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open
3.0 V to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open
4.5 V to 5.5 V	V_{CC}	≤ 2.5 ns	50 pF	500 Ω	open

13. Application information

Some applications are:

- Linear amplifier (see Figure 12)
- In crystal oscillator design (see Figure 13)

Remark: All values given are typical unless otherwise specified.



$V_{o(p-p)} = V_{CC} - 1.5$ V centered at $0.5V_{CC}$.

$$A_u = -\frac{G_{OL}}{1 + \frac{R1}{R2}(1 + G_{OL})}$$

G_{OL} = loop gain.

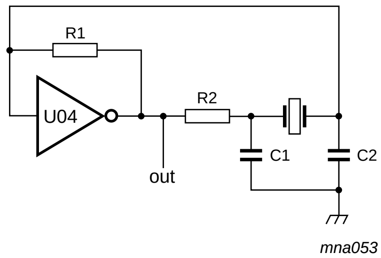
A_u = voltage amplification.

R1 ≥ 3 kΩ, R2 ≤ 1 MΩ

Z_L > 10 kΩ; A_{OL} = 20 (typ.)

Typical unity gain bandwidth product is 5 MHz.

Fig 12. Used as a linear amplifier



C1 = 47 pF (typ.)

C2 = 22 pF (typ.)

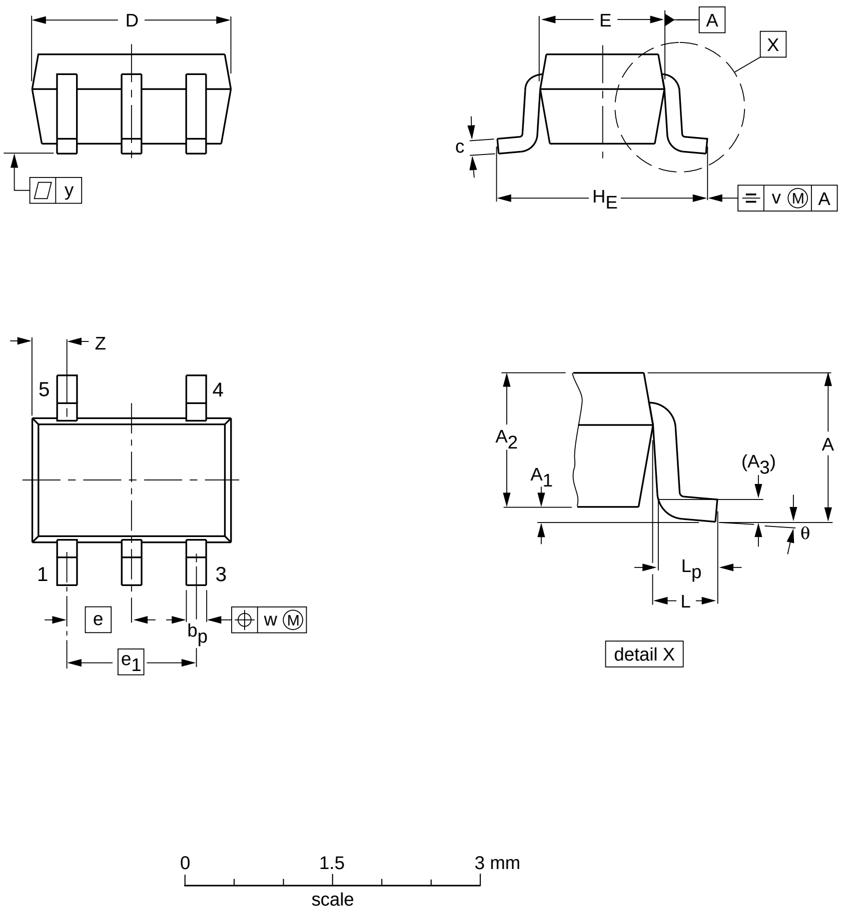
R1 = 1 MΩ to 10 MΩ (typ.)

R2 optimum value depends on the frequency and required stability against changes in V_{CC} or average minimum I_{CC} (I_{CC} is typically 2 mA at V_{CC} = 3.3 V and f = 10 MHz).

Fig 13. Crystal oscillator configuration

14. Package outline

TSSOP5: plastic thin shrink small outline package; 5 leads; body width 1.25 mm **SOT353-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(1)	e	e_1	H_E	L	L_p	v	w	y	Z(1)	θ
mm	1.1	0.1 0	1.0 0.8	0.15	0.30 0.15	0.25 0.08	2.25 1.85	1.35 1.15	0.65	1.3	2.25 2.0	0.425	0.46 0.21	0.3	0.1	0.1	0.60 0.15	7° 0°

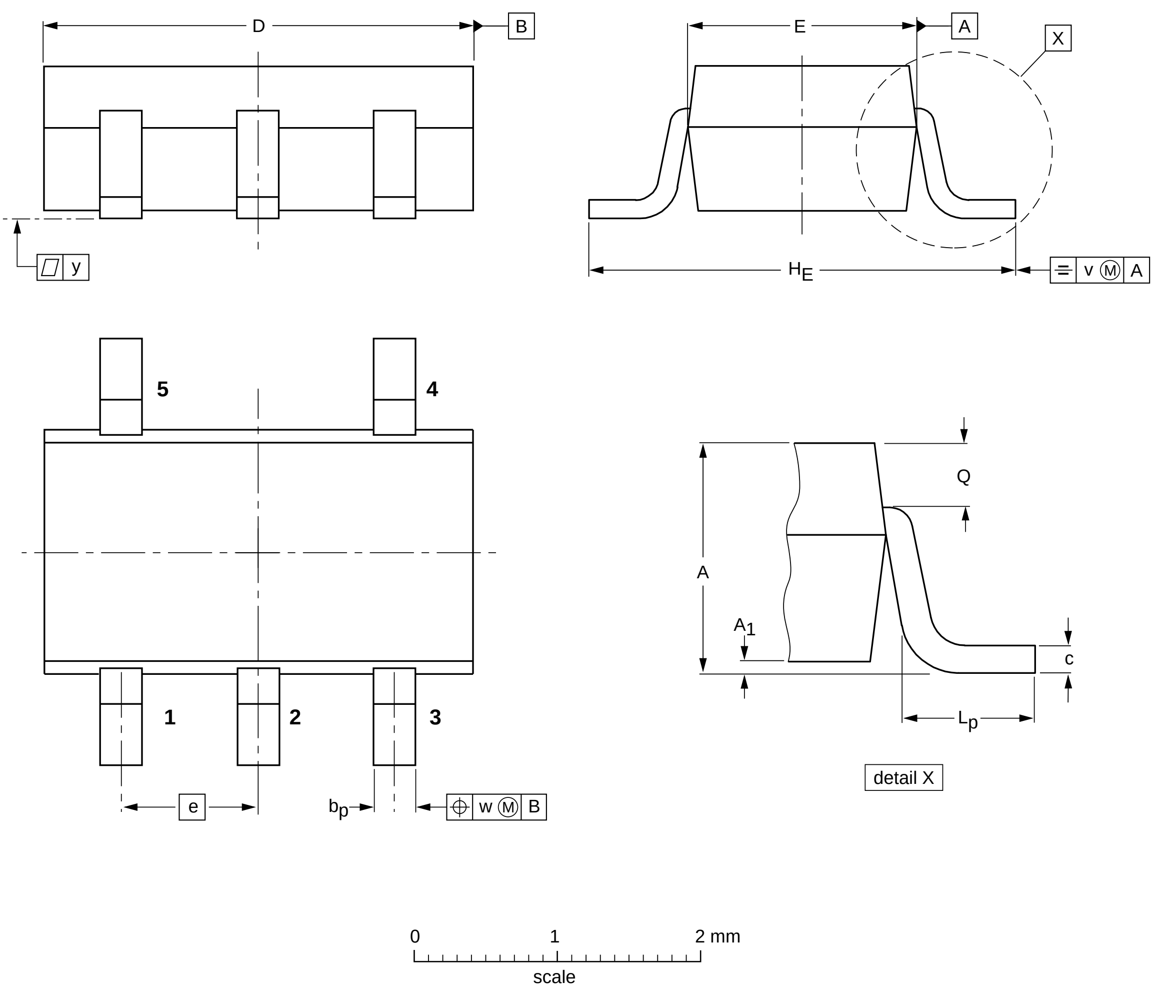
Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT353-1		MO-203	SC-88A			~~00-09-01~~ 03-02-19

Fig 14. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads **SOT753**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b_p	c	D	E	e	H_E	L_p	Q	v	w	y
mm	1.1 0.9	0.100 0.013	0.40 0.25	0.26 0.10	3.1 2.7	1.7 1.3	0.95	3.0 2.5	0.6 0.2	0.33 0.23	0.2	0.2	0.1

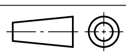
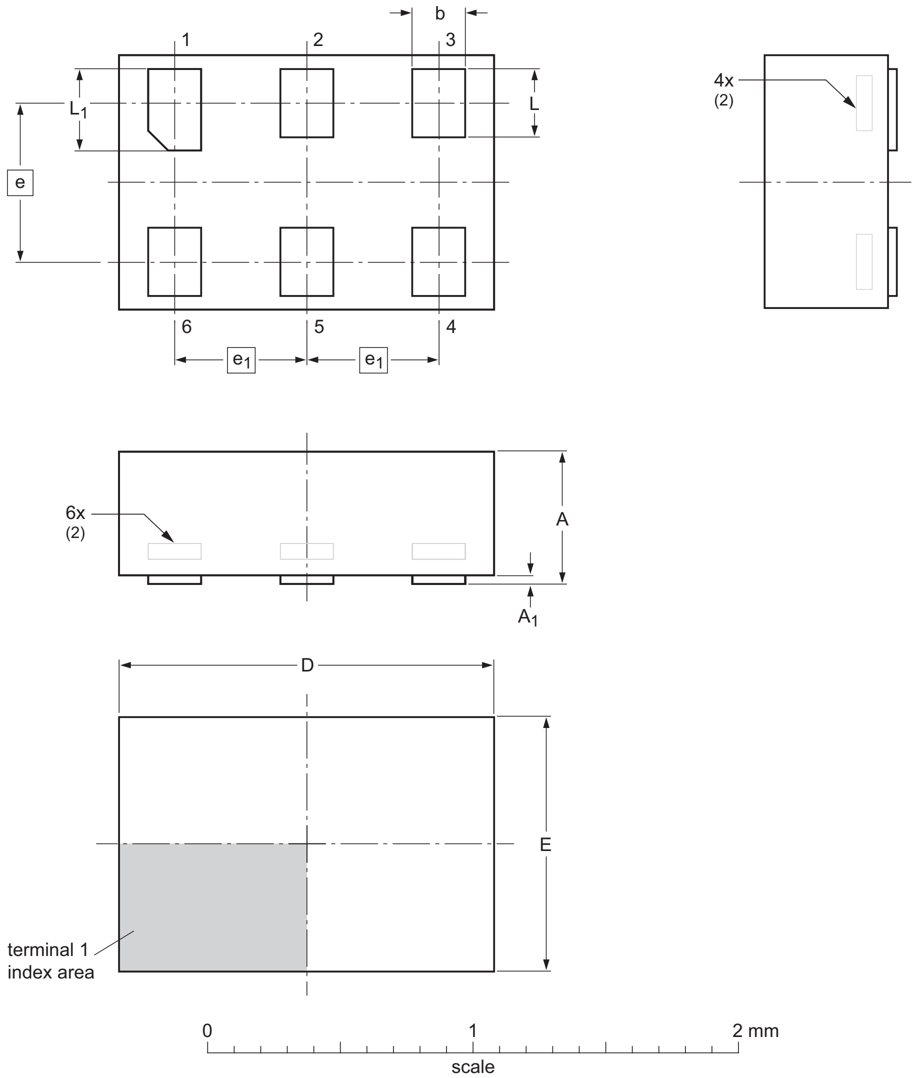
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT753			SC-74A			~~02-04-16~~ 06-03-16

Fig 15. Package outline SOT753 (SC-74A)

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

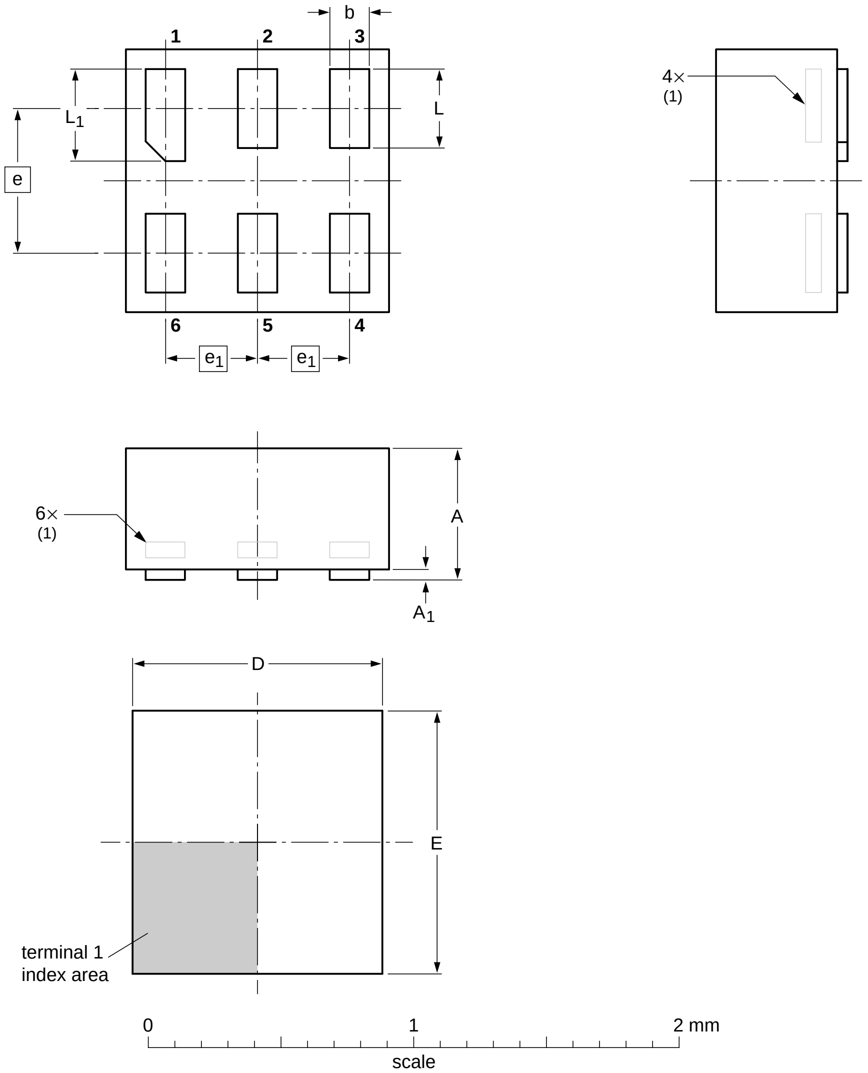
Notes
1. Including plating thickness.
2. Can be visible in some manufacturing processes.

sot886_po

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

Fig 16. Package outline SOT886 (XSON6)

XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1 x 0.5 mm **SOT891**



DIMENSIONS (mm are the original dimensions)

UNIT	A max	A_1 max	b	D	E	e	e_1	L	L_1
mm	0.5	0.04	0.20 0.12	1.05 0.95	1.05 0.95	0.55	0.35	0.35 0.27	0.40 0.32

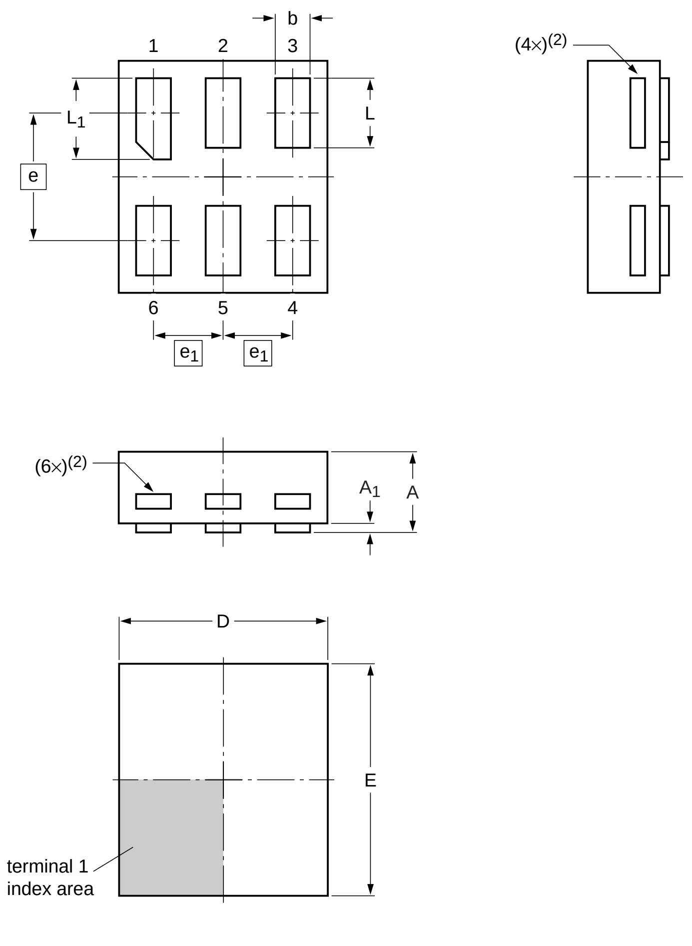
Note

1. Can be visible in some manufacturing processes.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT891						~~05-04-06~~ 07-05-15

Fig 17. Package outline SOT891 (XSON6)

XSON6: extremely thin small outline package; no leads; 6 terminals; body 0.9 x 1.0 x 0.35 mm **SOT1115**



Dimensions

Unit		A(1)	A_1	b	D	E	e	e_1	L	L_1
mm	max	0.35	0.04	0.20	0.95	1.05			0.35	0.40
	nom			0.15	0.90	1.00	0.55	0.3	0.30	0.35
	min			0.12	0.85	0.95			0.27	0.32

Note
1. Including plating thickness.
2. Visible depending upon used manufacturing technology.

sot1115_po

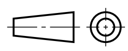
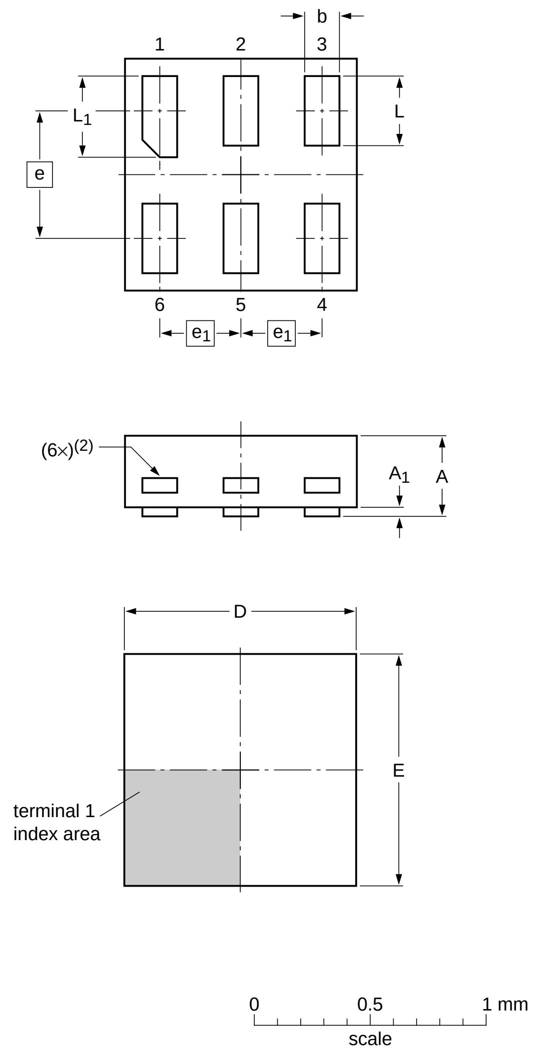
Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1115						~~10-04-02~~ 10-04-07

Fig 18. Package outline SOT1115 (XSON6)

XSON6: extremely thin small outline package; no leads; 6 terminals; body 1.0 x 1.0 x 0.35 mm **SOT1202**



Dimensions

Unit		A(1)	A_1	b	D	E	e	e_1	L	L_1
	max	0.35	0.04	0.20	1.05	1.05			0.35	0.40
mm	nom			0.15	1.00	1.00	0.55	0.35	0.30	0.35
	min			0.12	0.95	0.95			0.27	0.32

Note
1. Including plating thickness.
2. Visible depending upon used manufacturing technology.

sot1202_po

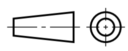
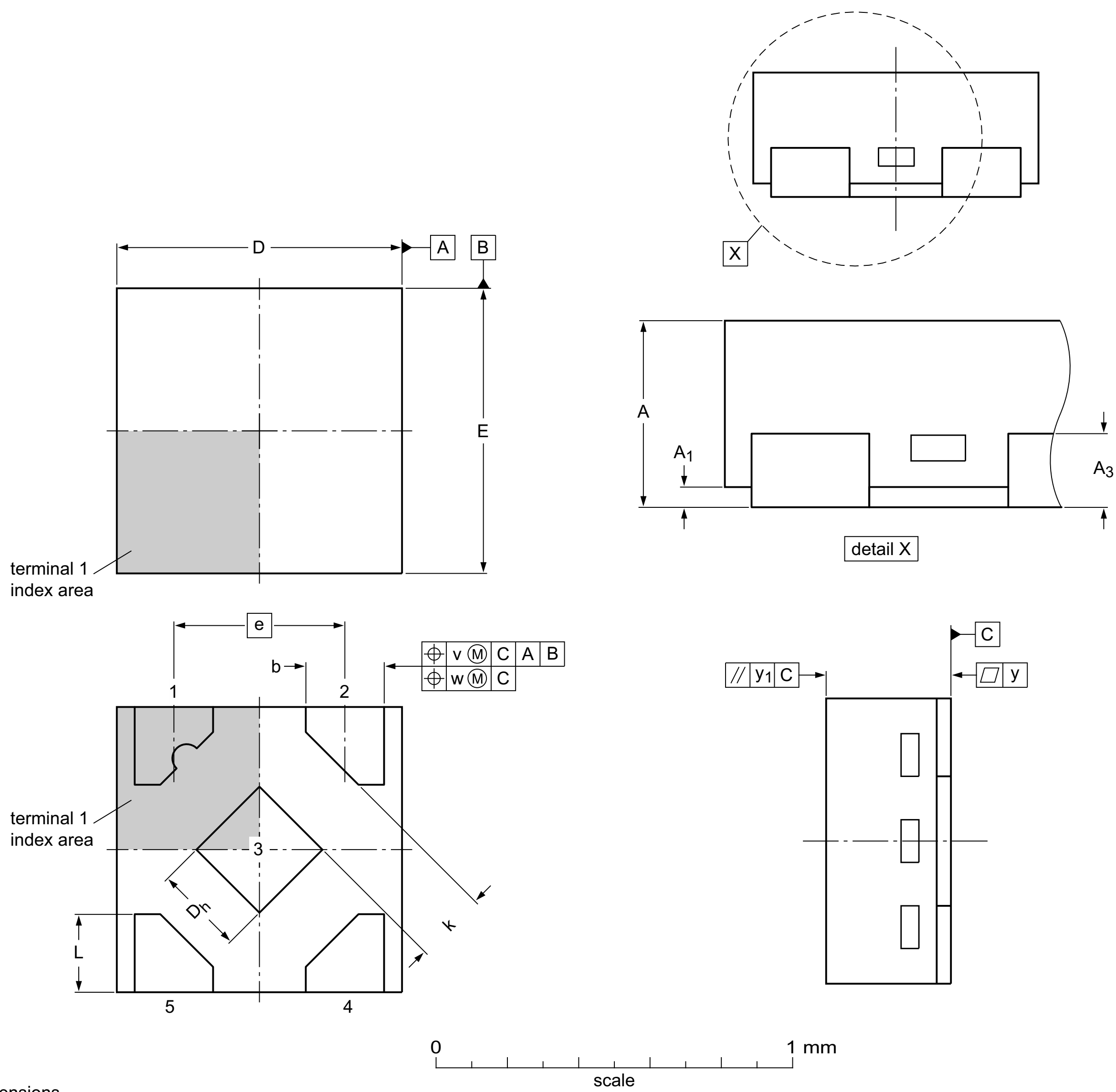
Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1202						~~10-04-02~~ 10-04-06

Fig 19. Package outline SOT1202 (XSON6)

X2SON5: plastic thermal enhanced extremely thin small outline package; no leads; 5 terminals; body 0.8 x 0.8 x 0.35 mm **SOT1226**



Dimensions

Unit		A(1)	A_1	A_3	D	D_h	E	b	e	k	L	v	w	y	y_1
	max	0.35	0.04	0.128	0.85	0.30	0.85	0.27			0.27				
mm	nom				0.80	0.25	0.80	0.22	0.48		0.22	0.1	0.05	0.05	0.05
	min			0.040	0.75	0.20	0.75	0.17		0.20	0.17				

Note
1. Dimension A is including plating thickness.
2. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

sot1226_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	EIAJ			
SOT1226						~~12-04-10~~ 12-04-25

Fig 20. Package outline SOT1226 (X2SON5)

15. Abbreviations

Table 11. Abbreviations

Acronym	Description
CMOS	Complementary Metal Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model

16. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC1GU04 v.12	20130409	Product data sheet	-	74LVC1GU04 v.11
Modifications:	• Descriptive title changed to Unbuffered inverter.			
74LVC1GU04 v.11	20120702	Product data sheet	-	74LVC1GU04 v.10
Modifications:	• Added type number 74LVC1GU04GX (SOT1226) • Package outline drawing of SOT886 (Figure 16) modified.			
74LVC1GU04 v.10	20111201	Product data sheet	-	74LVC1GU04 v.9
Modifications:	• Legal pages updated.			
74LVC1GU04 v.9	20101021	Product data sheet	-	74LVC1GU04 v.8
74LVC1GU04 v.8	20070612	Product data sheet	-	74LVC1GU04 v.7
74LVC1GU04 v.7	20061006	Product data sheet	-	74LVC1GU04 v.6
74LVC1GU04 v.6	20040921	Product specification	-	74LVC1GU04 v.5
74LVC1GU04 v.5	20040628	Product specification	-	74LVC1GU04 v.4
74LVC1GU04 v.4	20030630	Product specification	-	74LVC1GU04 v.3
74LVC1GU04 v.3	20030212	Product specification	-	74LVC1GU04 v.2
74LVC1GU04 v.2	20010406	Product specification	-	74LVC1GU04 v.1
74LVC1GU04 v.1	20001212	Product specification	-	-

17. Legal information

17.1 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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19. Contents

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