

# 74LVT16374A; 74LVTH16374A

3.3 V 16-bit edge-triggered D-type flip-flop; 3-state

Rev. 10 — 2 April 2012

Product data sheet

## 1. General description

---

The 74LVT16374A; 74LVTH16374A are high performance BiCMOS products designed for  $V_{CC}$  operation at 3.3 V.

This device is a 16-bit edge-triggered D-type flip-flop featuring non-inverting 3-state outputs. The device can be used as two 8-bit flip-flops or one 16-bit flip-flop. On the positive transition of the clock (nCP), the nQn outputs of the flip-flop take on the logic levels set up at the nDn inputs.

## 2. Features and benefits

---

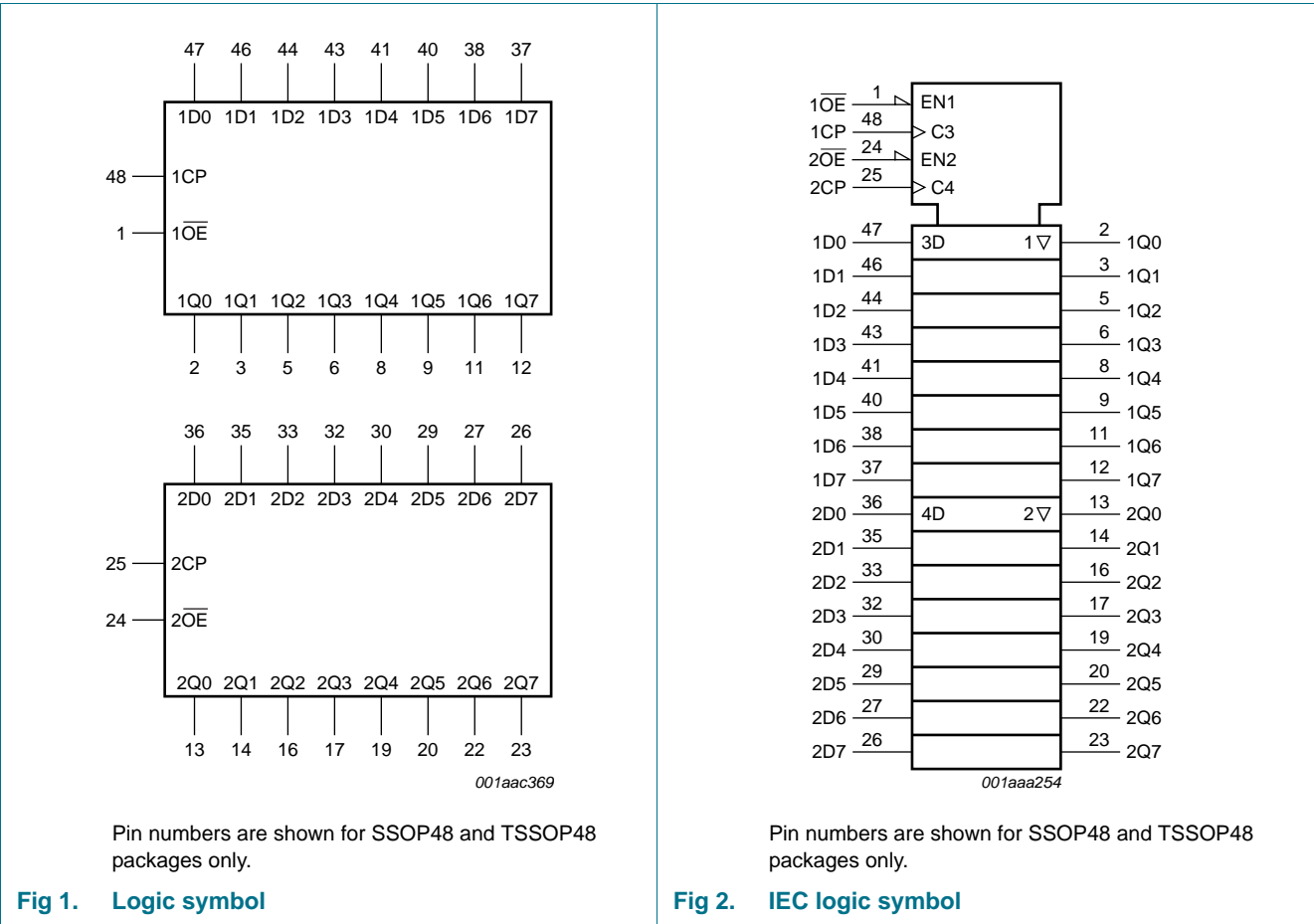
- 16-bit edge-triggered flip-flop
- 3-state buffers
- Output capability: +64 mA and –32 mA
- TTL input and output switching levels
- Input and output interface capability to systems at 5 V supply
- Bus-hold data inputs eliminate the need for external pull-up resistors to hold unused inputs
- Live insertion and extraction permitted
- Power-up reset
- Power-up 3-state
- No bus current loading when output is tied to 5 V bus
- Latch-up protection:
  - ◆ JESD78B Class II exceeds 500 mA
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LVT16374ADL	−40 °C to +85 °C	SSOP48	plastic shrink small outline package; 48 leads; body width 7.5 mm	SOT370-1
74LVT16374ADGG 74LVTH16374ADGG	−40 °C to +85 °C	TSSOP48	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	SOT362-1
74LVT16374AEV	−40 °C to +85 °C	VFBGA56	plastic very thin fine-pitch ball grid array package; 56 balls; body 4.5 × 7 × 0.65 mm	SOT702-1
74LVTH16374ABX	−40 °C to +125 °C	HXQFN60	plastic compatible thermal enhanced extremely thin quad flat package; no leads; 60 terminals; body 4 × 6 × 0.5 mm	SOT1134-2

4. Functional diagram



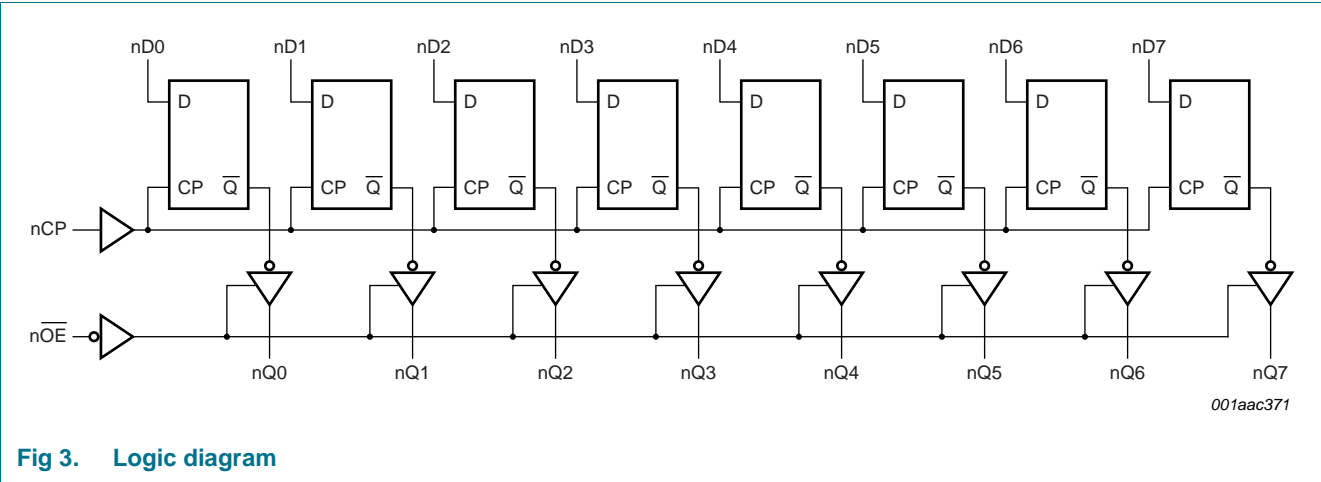


Fig 3. Logic diagram

5. Pinning information

5.1 Pinning

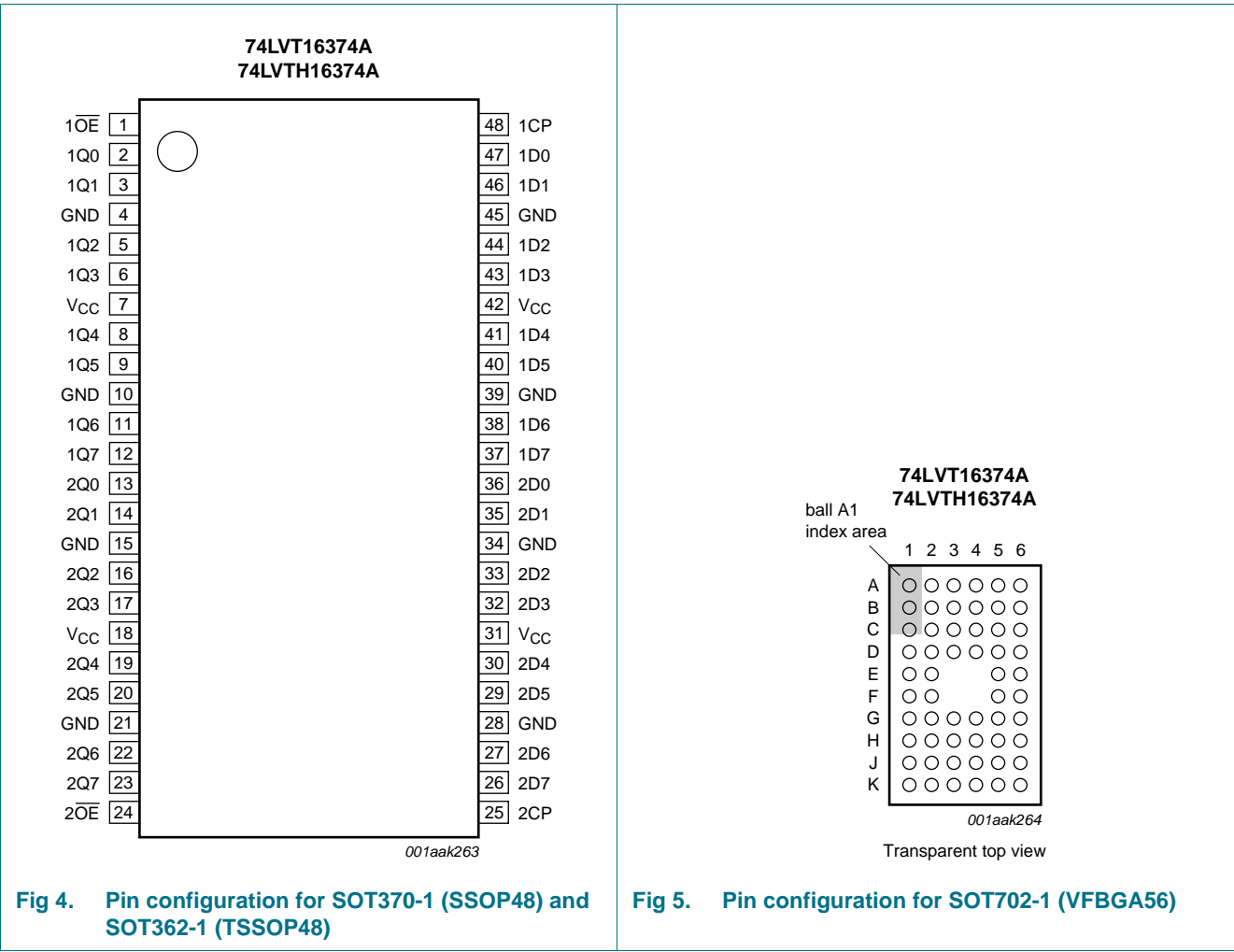
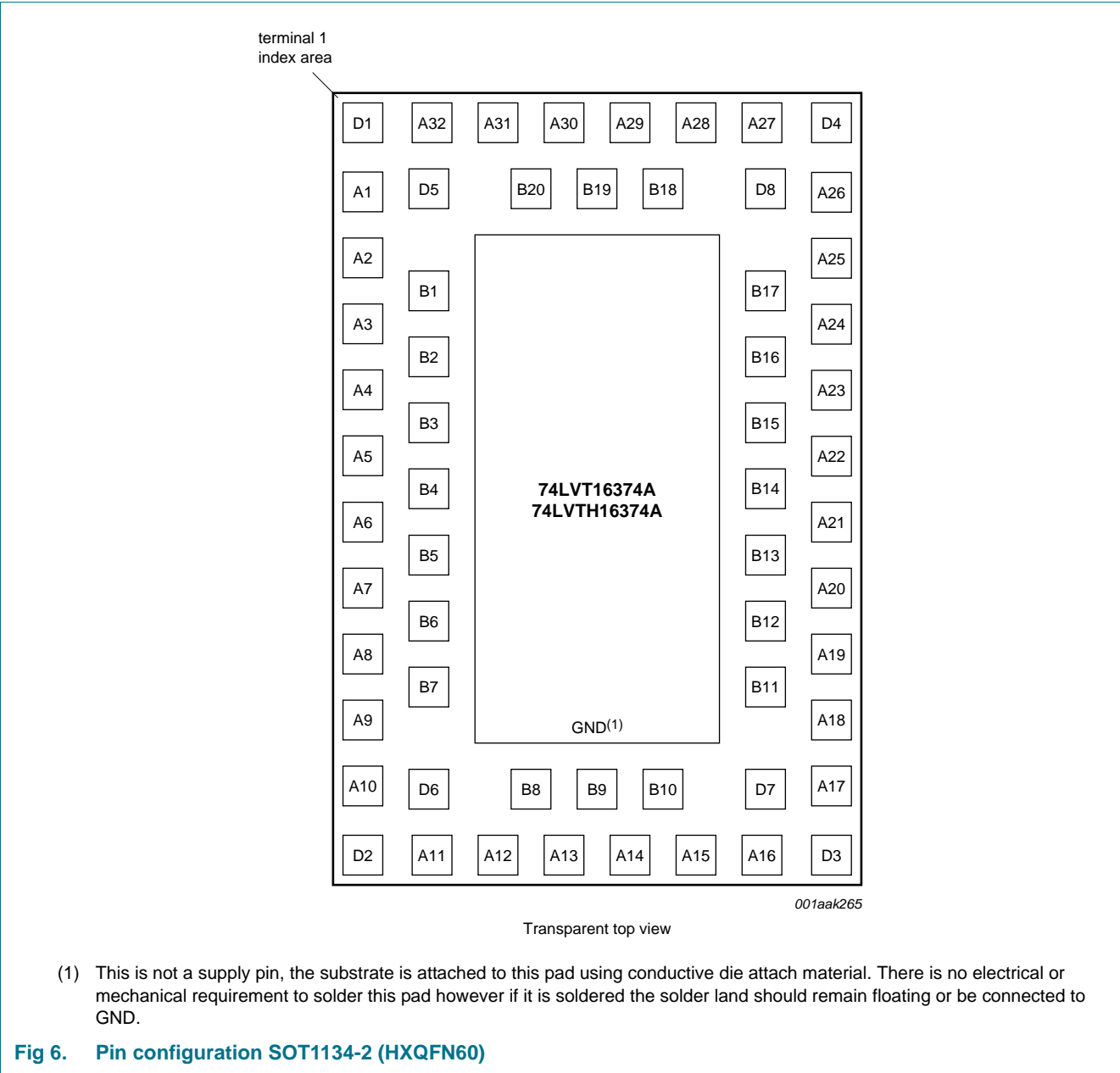


Fig 4. Pin configuration for SOT370-1 (SSOP48) and SOT362-1 (TSSOP48)

Fig 5. Pin configuration for SOT702-1 (VFBGA56)



## 5.2 Pin description

Table 2. Pin description

Symbol	Pin			Description
	SOT370-1 and SOT362-1	SOT702-1	SOT1134-2	
$\overline{1OE}, \overline{2OE}$	1, 24	A1, K1	A30, A13	output enable input (active LOW)
1CP, 2CP	48, 25	A6, K6	A29, A14	clock input
1Q0 to 1Q7	2, 3, 5, 6, 8, 9, 11, 12	B2, B1, C2, C1, D2, D1, E2, E1	B20, A31, D5, D1, A2, B2, B3, A5	data output
2Q0 to 2Q7	13, 14, 16, 17, 19, 20, 22, 23	F1, F2, G1, G2, H1, H2, J1, J2	A6, B5, B6, A9, D2, D6, A12, B8	data output
GND	4, 10, 15, 21, 28, 34, 39, 45	B3, D3, G3, J3, J4, G4, D4, B4	A32, A3, A8, A11, A16, A19, A24, A27	ground (0 V)
V <sub>CC</sub>	7, 18, 31, 42	C3, H3, H4, C4	A1, A10, A17, A26	supply voltage
1D0 to 1D7	47, 46, 44, 43, 41, 40, 38, 37	B5, B6, C5, C6, D5, D6, E5, E6	B18, A28, D8, D4, A25, B16, B15, A22	data input
2D0 to 2D7	36, 35, 33, 32, 30, 29, 27, 26	F6, F5, G6, G5, H6, H5, J6, J5	A21, B13, B12, A18, D3, D7, A15, B10	data input
n.c.	-	A2, A3, A4, A5, K2, K3, K4, K5	A4, A7, A20, A23, B1, B4, B7, B9, B11, B14, B17, B19	not connected

## 6. Functional description

Table 3. Function table<sup>[1]</sup>

Operating mode	Input			Internal register	Output nQ0 to nQ7
	nOE	nCP	nDn		
Load and read register	L	↑	l	L	L
	L	↑	h	H	H
Hold	L	NC	X	NC	NC
Disable outputs	H	NC	X	NC	Z
	H	↑	nDn	nDn	Z

- [1] H = HIGH voltage level;  
h = HIGH voltage level one set-up time prior to the HIGH-to-LOW clock transition;  
L = LOW voltage level;  
l = LOW voltage level one set-up time prior to the HIGH-to-LOW clock transition;  
NC = no change;  
X = don't care;  
Z = high-impedance OFF-state;  
↑ = LOW-to-HIGH clock transition.

## 7. Limiting values

**Table 4. 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		[1] -0.5	+7.0	V
$V_O$	output voltage	output in OFF-state or HIGH-state	[1] -0.5	+7.0	V
$I_{IK}$	input clamping current	$V_I < 0$ V	-50	-	mA
$I_{OK}$	output clamping current	$V_O < 0$ V	-50	-	mA
$I_O$	output current	output in LOW-state	-	128	mA
		output in HIGH-state	-64	-	mA
$T_{stg}$	storage temperature		-65	+150	°C
$T_j$	junction temperature		[2] -	150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40$ °C to $+85$ °C			
		(T)SSOP48 package	[3] -	500	mW
		VFBGA56 and HXQFN60 package	[4] -	1000	mW

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

[2] The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability.

[3] Above 60 °C the value of  $P_{tot}$  derates linearly with 5.5 mW/K.

[4] Above 70 °C the value of  $P_{tot}$  derates linearly with 1.8 mW/K.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage		2.7	-	3.6	V
$V_I$	input voltage		0	-	5.5	V
$V_{IH}$	HIGH-level input voltage		2.0	-	-	V
$V_{IL}$	LOW-level input voltage		-	-	0.8	V
$I_{OH}$	HIGH-level output current		-32	-	-	mA
$I_{OL}$	LOW-level output current	none	-	-	32	mA
		current duty cycle $\leq 50$ %; $f_i \geq 1$ kHz	-	-	64	mA
$T_{amb}$	ambient temperature	in free-air	-40	-	+85	°C
$\Delta t/\Delta V$	input transition rise and fall rate	outputs enabled	-	-	10	ns/V

## 9. Static characteristics

**Table 6. Static characteristics**

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

Symbol	Parameter	Conditions	Min	Typ <sup>[1]</sup>	Max	Unit
<b>T<sub>amb</sub> = –40 °C to +85 °C</b>						
V <sub>IK</sub>	input clamping voltage	V <sub>CC</sub> = 2.7 V; I <sub>IK</sub> = –18 mA	–1.2	–0.85	-	V
V <sub>OH</sub>	HIGH-level output voltage	I <sub>OH</sub> = –100 µA; V <sub>CC</sub> = 2.7 V to 3.6 V	V <sub>CC</sub> – 0.2	V <sub>CC</sub>	-	V
		I <sub>OH</sub> = –8 mA; V <sub>CC</sub> = 2.7 V	2.4	2.5	-	V
		I <sub>OH</sub> = –32 mA; V <sub>CC</sub> = 3.0 V	2.0	2.3	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>CC</sub> = 2.7 V				
		I <sub>OL</sub> = 100 µA	-	0.07	0.2	V
		I <sub>OL</sub> = 24 mA	-	0.3	0.5	V
		V <sub>CC</sub> = 3.0 V				
		I <sub>OL</sub> = 16 mA	-	0.25	0.4	V
		I <sub>OL</sub> = 32 mA	-	0.3	0.5	V
		I <sub>OL</sub> = 64 mA	-	0.4	0.55	V
V <sub>OL(pu)</sub>	power-up LOW-level output voltage	V <sub>CC</sub> = 3.6 V; I <sub>O</sub> = 1 mA; V <sub>I</sub> = V <sub>CC</sub> or GND	<sup>[2]</sup> -	0.1	0.55	V
I <sub>I</sub>	input leakage current	control pins				
		V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND	-	0.1	±1	µA
		V <sub>CC</sub> = 0 V or 3.6 V; V <sub>I</sub> = 5.5 V	-	0.4	10	µA
		input data pins	<sup>[3]</sup>			
		V <sub>CC</sub> = 0 V or 3.6 V; V <sub>I</sub> = 5.5 V	-	0.4	10	µA
		V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub>	-	0.1	1	µA
		V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 0 V	–5	–0.4	-	µA
I <sub>OFF</sub>	power-off leakage current	V <sub>CC</sub> = 0 V; V <sub>I</sub> or V <sub>O</sub> = 0 V to 4.5 V	-	0.1	±100	µA
I <sub>BHL</sub>	bus hold LOW current	V <sub>CC</sub> = 3 V; V <sub>I</sub> = 0.8 V	75	135	-	µA
I <sub>BHH</sub>	bus hold HIGH current	V <sub>CC</sub> = 3 V; V <sub>I</sub> = 2.0 V	-	–135	–75	µA
I <sub>BHLO</sub>	bus hold LOW overdrive current	input data pins; V <sub>I</sub> = 0 V to 3.6 V; V <sub>CC</sub> = 3.6 V	<sup>[4]</sup> 500	-	-	µA
I <sub>BHHO</sub>	bus hold HIGH overdrive current	input data pins; V <sub>I</sub> = 0 V to 3.6 V; V <sub>CC</sub> = 3.6 V	<sup>[4]</sup> -	-	–500	µA
I <sub>LO</sub>	output leakage current	output in HIGH-state when V <sub>O</sub> > V <sub>CC</sub> ; V <sub>O</sub> = 5.5 V; V <sub>CC</sub> = 3.0 V	-	50	125	µA
I <sub>O(pu/pd)</sub>	power-up/power-down output current	V <sub>CC</sub> ≤ 1.2 V; V <sub>O</sub> = 0.5 V to V <sub>CC</sub> ; V <sub>I</sub> = GND or V <sub>CC</sub> ; nOE = don't care	<sup>[5]</sup> -	1	±100	µA
I <sub>OZ</sub>	OFF-state output current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		output HIGH: V <sub>O</sub> = 3.0 V	-	0.5	5	µA
		output LOW: V <sub>O</sub> = 0.5 V	–5	0.5	-	µA
I <sub>CC</sub>	supply current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = GND or V <sub>CC</sub> ; I <sub>O</sub> = 0 A				
		outputs HIGH	-	0.07	0.12	mA
		outputs LOW	-	4.0	6.0	mA
		outputs disabled	<sup>[6]</sup> -	0.07	0.12	mA

**Table 6.** Static characteristics ...continued

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

Symbol	Parameter	Conditions	Min	Typ <sup>[1]</sup>	Max	Unit
$\Delta I_{CC}$	additional supply current	per input pin; $V_{CC} = 3.0\text{ V}$ to $3.6\text{ V}$ ; one input at $V_{CC} - 0.6\text{ V}$ , other inputs at $V_{CC}$ or GND	[7] -	0.1	0.2	mA
$C_I$	input capacitance	input pins; $V_I = 0\text{ V}$ or $3.0\text{ V}$	-	3	-	pF
$C_O$	output capacitance	output pins nQn; outputs disabled; $V_O = 0\text{ V}$ or $V_{CC}$	-	9	-	pF

- [1] Typical values are measured at  $V_{CC} = 3.3\text{ V}$  and at  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .
- [2] For valid test results, data must not be loaded into the flips-flops (or latches) after applying power.
- [3] Unused pins at  $V_{CC}$  or GND.
- [4] This is the bus hold overdrive current required to force the input to the opposite logic state.
- [5] This parameter is valid for any  $V_{CC}$  between  $0\text{ V}$  and  $1.2\text{ V}$  with a transition time of up to  $10\text{ ms}$ . From  $V_{CC} = 1.2\text{ V}$  to  $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$  a transition time of  $100\text{ }\mu\text{s}$  is permitted. This parameter is valid for  $T_{amb} = 25\text{ }^{\circ}\text{C}$  only.
- [6]  $I_{CC}$  is measured with outputs pulled to  $V_{CC}$  or GND.
- [7] This is the increase in supply current for each input at the specified voltage level other than  $V_{CC}$  or GND.

## 10. Dynamic characteristics

**Table 7.** Dynamic characteristicsVoltages are referenced to GND (ground = 0 V); for test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	Min	Typ <sup>[1]</sup>	Max	Unit
<b><math>T_{amb} = -40\text{ }^{\circ}\text{C}</math> to <math>+85\text{ }^{\circ}\text{C}</math></b>						
$f_{max}$	maximum frequency	nCP; $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ ; see <a href="#">Figure 7</a>	150	-	-	MHz
$t_{PLH}$	LOW to HIGH propagation delay	nCP to nQn; see <a href="#">Figure 7</a>				
		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$	1.5	2.9	5.0	ns
		$V_{CC} = 2.7\text{ V}$	-	-	5.6	ns
$t_{PHL}$	HIGH to LOW propagation delay	nCP to nQn; see <a href="#">Figure 7</a>				
		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$	1.5	3.0	5.0	ns
		$V_{CC} = 2.7\text{ V}$	-	-	5.6	ns
$t_{PZH}$	OFF-state to HIGH propagation delay	$\overline{nOE}$ to nQn; see <a href="#">Figure 8</a>				
		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$	1.5	3.2	4.8	ns
		$V_{CC} = 2.7\text{ V}$	-	-	6.0	ns
$t_{PZL}$	OFF-state to LOW propagation delay	$\overline{nOE}$ to nQn; see <a href="#">Figure 8</a>				
		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$	1.5	3.0	4.6	ns
		$V_{CC} = 2.7\text{ V}$	-	-	5.2	ns
$t_{PHZ}$	HIGH to OFF-state propagation delay	$\overline{nOE}$ to nQn; see <a href="#">Figure 8</a>				
		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$	1.5	3.9	5.4	ns
		$V_{CC} = 2.7\text{ V}$	-	-	6.0	ns
$t_{PLZ}$	LOW to OFF-state propagation delay	$\overline{nOE}$ to nQn; see <a href="#">Figure 8</a>				
		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$	1.5	3.4	4.6	ns
		$V_{CC} = 2.7\text{ V}$	-	-	5.0	ns



Table 7. Dynamic characteristics ...continued  
Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 10.

Symbol	Parameter	Conditions	Min	Typ <sup>[1]</sup>	Max	Unit
t <sub>su</sub>	set-up time	nDn to nCP; HIGH or LOW; see Figure 9	[2]			
		V <sub>CC</sub> = 3.3 V ± 0.3 V	2.0	0.7	-	ns
		V <sub>CC</sub> = 2.7 V	2.0	-	-	ns
t <sub>h</sub>	hold time	nDn to nCP; HIGH or LOW; see Figure 9	[3]			
		V <sub>CC</sub> = 3.3 V ± 0.3 V	0.8	0	-	ns
		V <sub>CC</sub> = 2.7 V	0.1	-	-	ns
t <sub>w</sub>	pulse width	nCP HIGH; see Figure 7	[4]			
		V <sub>CC</sub> = 3.3 V ± 0.3 V	1.5	0.6	-	ns
		V <sub>CC</sub> = 2.7 V	1.5	-	-	ns
		nCP LOW; see Figure 7				
		V <sub>CC</sub> = 3.3 V ± 0.3 V	3.0	1.6	-	ns
		V <sub>CC</sub> = 2.7 V	3.0	-	-	ns

- [1] All typical values are at V<sub>CC</sub> = 3.3 V and T<sub>amb</sub> = 25 °C.
- [2] t<sub>su</sub> is the same as t<sub>su(H)</sub> and t<sub>su(L)</sub>.
- [3] t<sub>h</sub> is the same as t<sub>h(H)</sub> and t<sub>h(L)</sub>.
- [4] t<sub>w</sub> is the same as t<sub>w(H)</sub> and t<sub>w(L)</sub>.

11. Waveforms

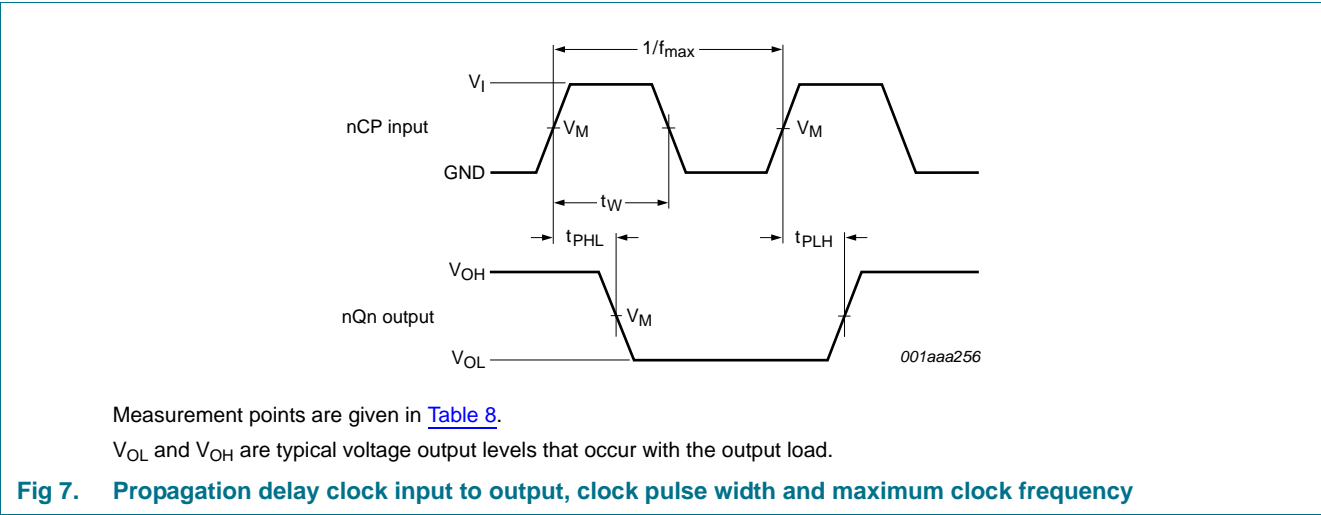
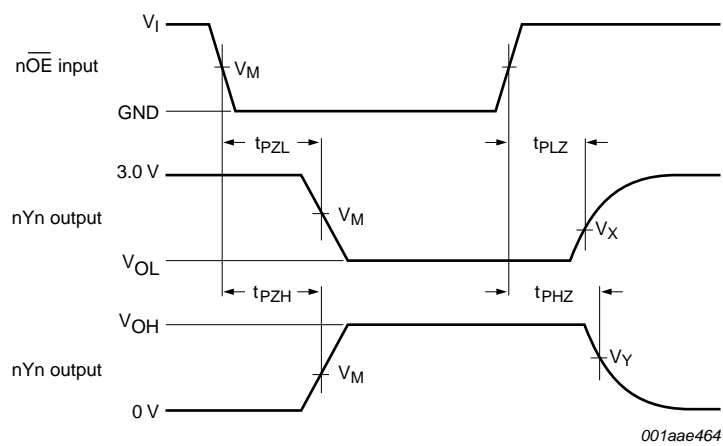


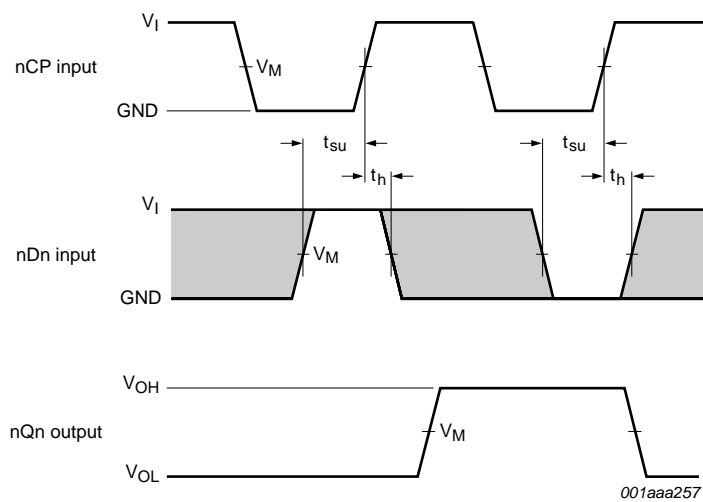
Table 8. Measurement points

Input	Output		
V <sub>M</sub>	V <sub>M</sub>	V <sub>X</sub>	V <sub>Y</sub>
1.5 V	1.5 V	V <sub>OL</sub> + 0.3 V	V <sub>OH</sub> - 0.3 V



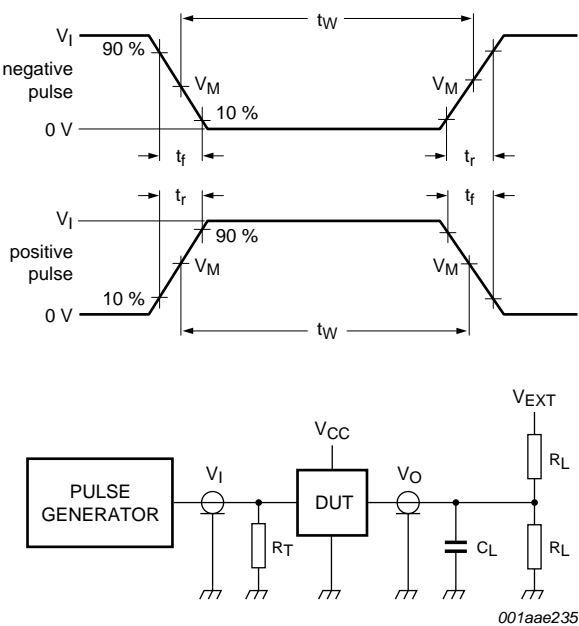
Measurements points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig 8.** Enable and disable times



Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.  
**Remark:** The shaded areas indicate when the input is permitted to change for predictable output performance.

**Fig 9.** Data set-up and hold times



Test data is given in [Table 9](#).

Definitions test circuit:

$R_L$  = Load resistance.

$C_L$  = Load capacitance including jig and probe capacitance.

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

$V_{EXT}$  = Test voltage for switching times.

Fig 10. Test circuit for measuring switching times

Table 9. Test data

Input				Load		$V_{EXT}$		
$V_I$	$f_i$	$t_W$	$t_r, t_f$	$C_L$	$R_L$	$t_{PHZ}, t_{PZH}$	$t_{PLZ}, t_{PZL}$	$t_{PLH}, t_{PHL}$
2.7 V	$\leq 10$ MHz	500 ns	$\leq 2.5$ ns	50 pF	500 $\Omega$	GND	6 V	open

12. Package outline

SSOP48: plastic shrink small outline package; 48 leads; body width 7.5 mm

SOT370-1

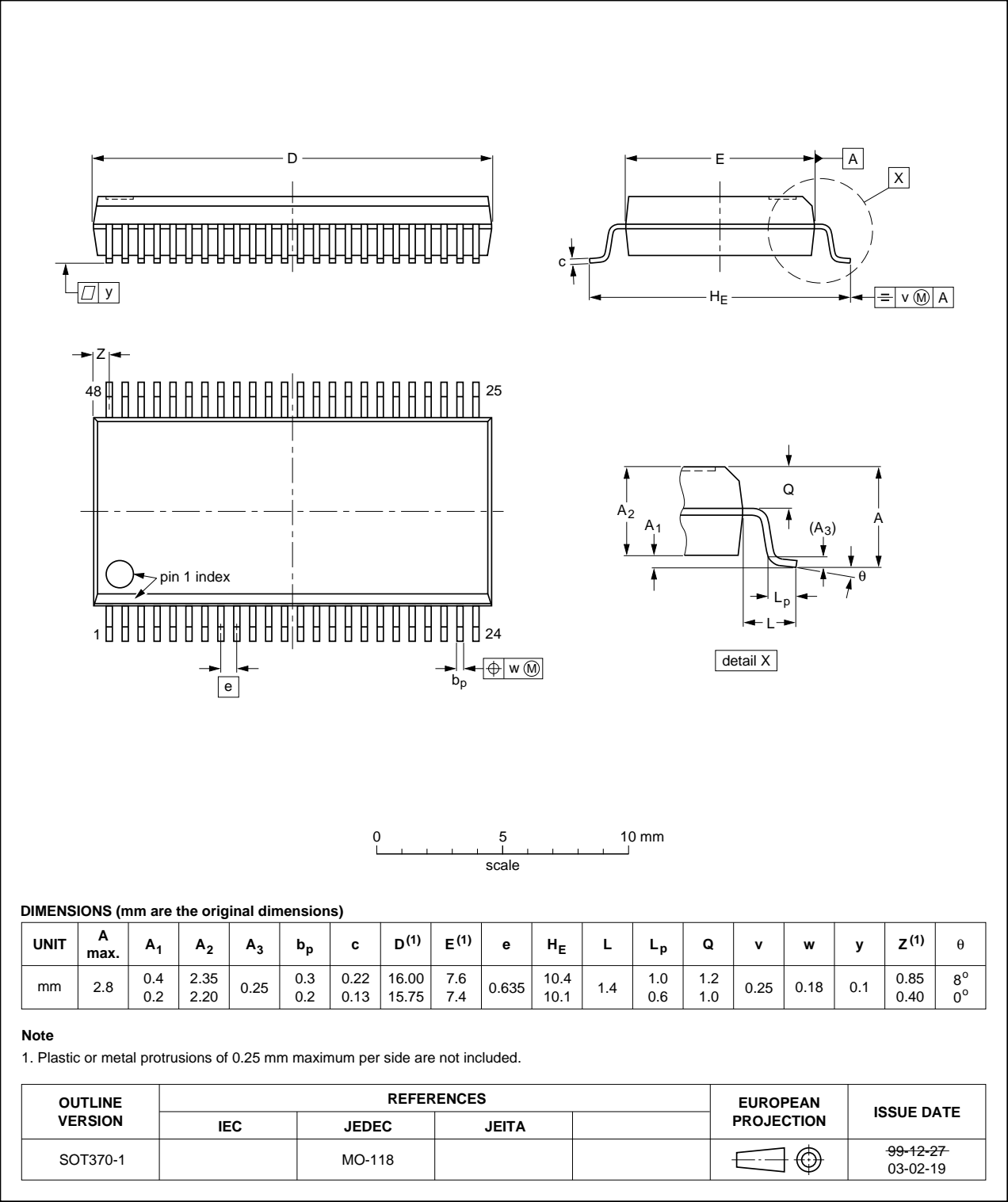


Fig 11. Package outline SOT370-1 (SSOP48)

TSSOP48: plastic thin shrink small outline package; 48 leads; body width 6.1 mm

SOT362-1

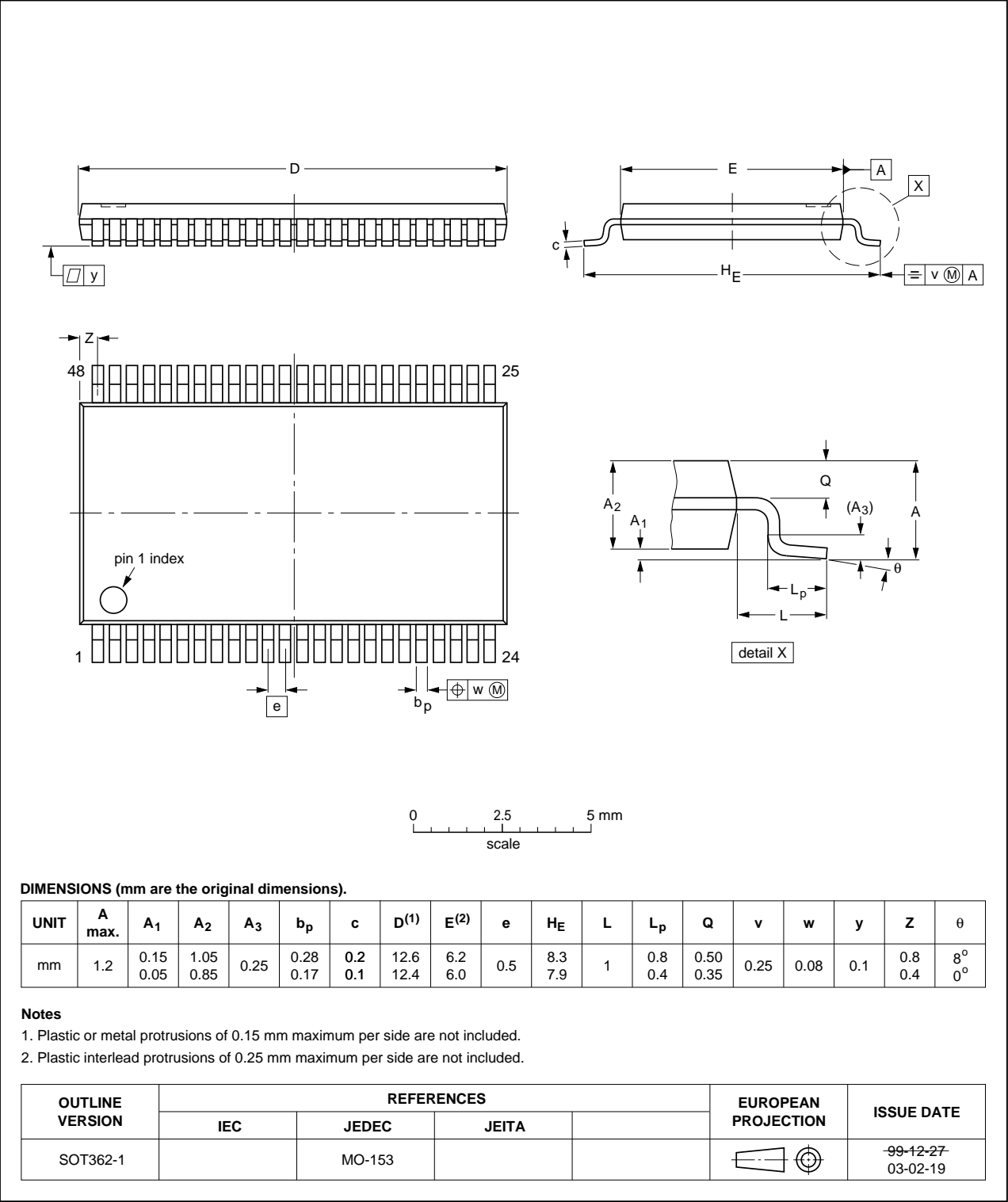


Fig 12. Package outline SOT362-1 (TSSOP48)

VFBGA56: plastic very thin fine-pitch ball grid array package; 56 balls; body 4.5 x 7 x 0.65 mm

SOT702-1

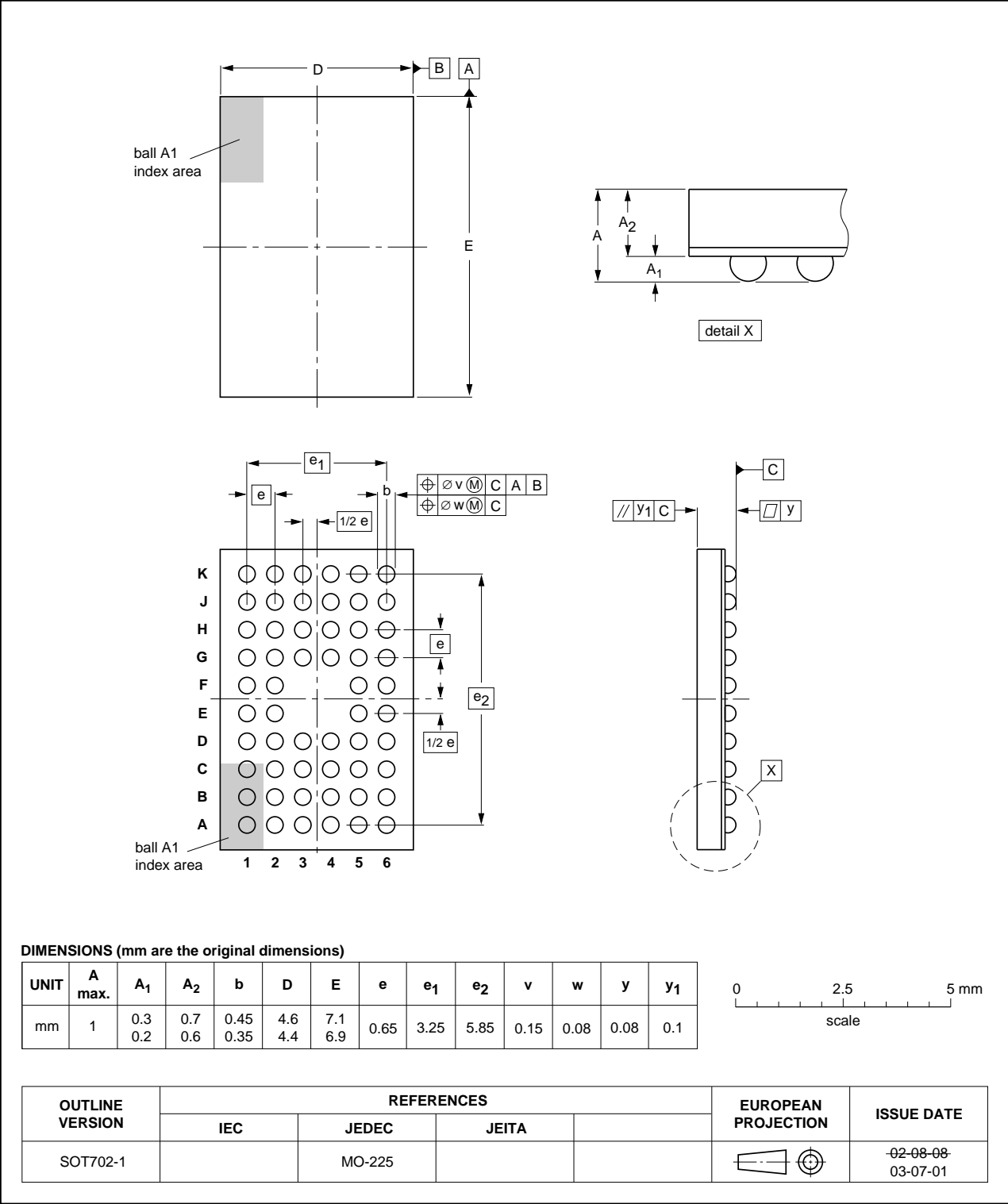


Fig 13. Package outline SOT702-1 (VFBGA56)

HXQFN60: plastic compatible thermal enhanced extremely thin quad flat package; no leads;  
 60 terminals; body 4 x 6 x 0.5 mm

SOT1134-2

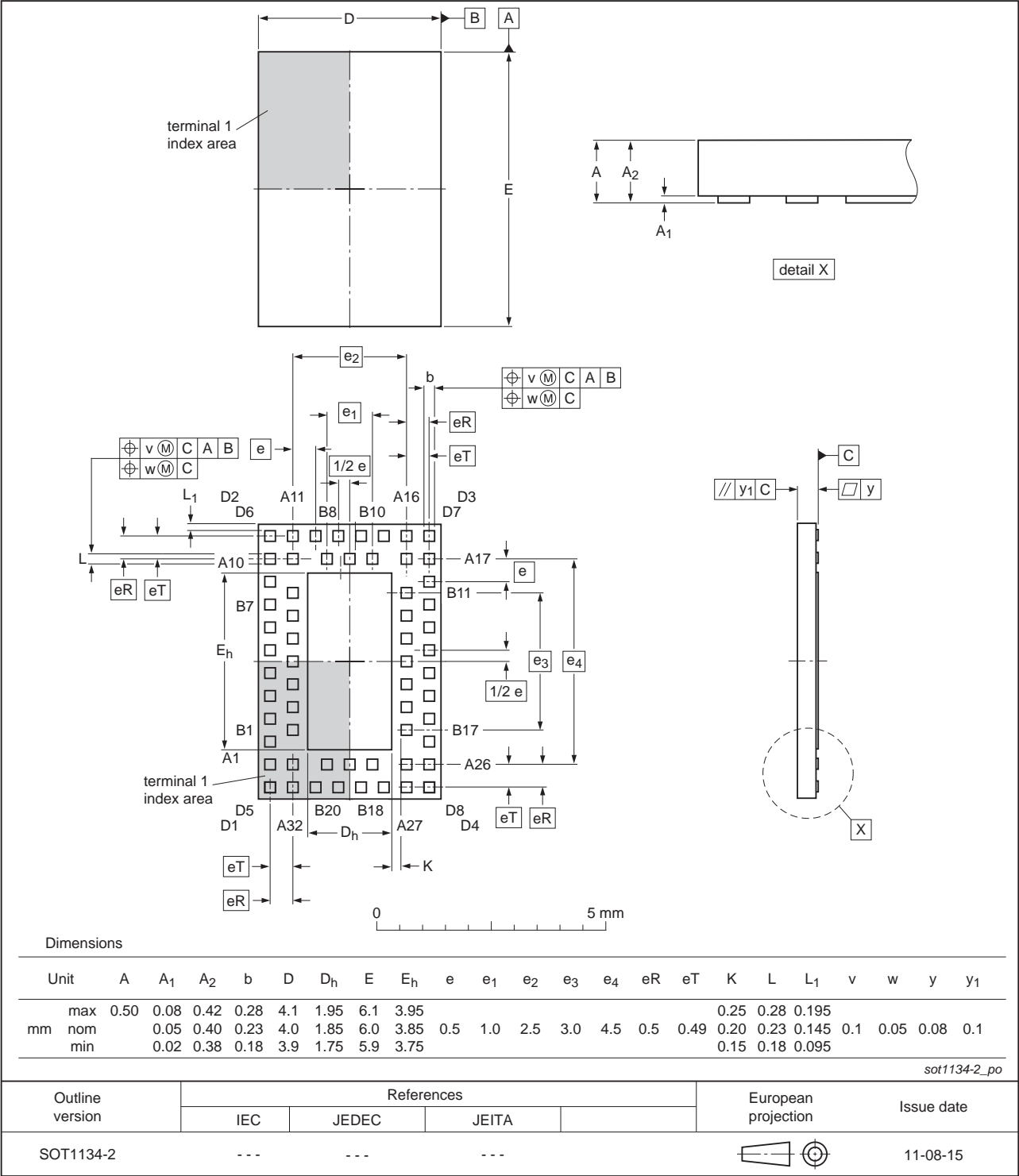


Fig 14. Package outline SOT1134-2 (HXQFN60)

## 13. Abbreviations

Table 10. Abbreviations

Acronym	Description
BiCMOS	Bipolar Complementary Metal Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
TTL	Transistor-Transistor Logic

## 14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVT_LVTH16374A v.10	20120402	Product data sheet	-	74LVT_LVTH16374A v.9
Modifications:	• For type number 74LVTH16374ABX the sot code has changed to SOT1134-2.			
74LVT_LVTH16374A v.9	20111122	Product data sheet	-	74LVT_LVTH16374A v.8
Modifications:	• Legal pages updated.			
74LVT_LVTH16374A v.8	20110620	Product data sheet	-	74LVT_LVTH16374A v.7
74LVT_LVTH16374A v.7	20100322	Product data sheet	-	74LVT_LVTH16374A v.6
74LVT_LVTH16374A v.6	20100118	product data sheet	-	74LVT16374A v.5
74LVT16374A v.5	20040916	product data sheet	-	74LVT16374A v.4
74LVT16374A v.4	20021101	product specification	-	74LVT16374A v.3
74LVT16374A v.3	19991018	product specification	-	74LVT16374A v.2
74LVT16374A v.2	19980219	product specification	-	-



## 15. Legal information

### 15.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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.nexperia.com>.

### 15.2 Definitions

**Draft** — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Nexperia does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

**Short data sheet** — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local Nexperia sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

**Product specification** — The information and data provided in a Product data sheet shall define the specification of the product as agreed between Nexperia and its customer, unless Nexperia and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the Nexperia product is deemed to offer functions and qualities beyond those described in the Product data sheet.

### 15.3 Disclaimers

**Limited warranty and liability** — Information in this document is believed to be accurate and reliable. However, Nexperia does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. Nexperia takes no responsibility for the content in this document if provided by an information source outside of Nexperia.

In no event shall Nexperia be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, Nexperia's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the *Terms and conditions of commercial sale* of Nexperia.

**Right to make changes** — Nexperia reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

**Suitability for use** — Nexperia products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of a Nexperia product can reasonably be expected to result in personal injury, death or severe property or environmental damage. Nexperia and its suppliers accept no liability for inclusion and/or use of Nexperia products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

**Applications** — Applications that are described herein for any of these products are for illustrative purposes only. Nexperia makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using Nexperia products, and Nexperia accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the Nexperia product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

Nexperia does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using Nexperia products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). Nexperia does not accept any liability in this respect.

**Limiting values** — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

**Terms and conditions of commercial sale** — Nexperia products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nexperia.com/profile/terms>, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. Nexperia hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of Nexperia products by customer.

**No offer to sell or license** — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

**Export control** — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

**Non-automotive qualified products** — Unless this data sheet expressly states that this specific Nexperia product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. Nexperia accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without Nexperia's warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond

Nexperia's specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies Nexperia for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond Nexperia's standard warranty and Nexperia's product specifications.

**Translations** — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

## 15.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

## 16. Contact information

For more information, please visit: <http://www.nexperia.com>

For sales office addresses, please send an email to: [salesaddresses@nexperia.com](mailto:salesaddresses@nexperia.com)

## 17. Contents

---

<b>1</b>	<b>General description</b> .....	<b>1</b>
<b>2</b>	<b>Features and benefits</b> .....	<b>1</b>
<b>3</b>	<b>Ordering information</b> .....	<b>2</b>
<b>4</b>	<b>Functional diagram</b> .....	<b>2</b>
<b>5</b>	<b>Pinning information</b> .....	<b>3</b>
5.1	Pinning .....	3
5.2	Pin description .....	5
<b>6</b>	<b>Functional description</b> .....	<b>5</b>
<b>7</b>	<b>Limiting values</b> .....	<b>6</b>
<b>8</b>	<b>Recommended operating conditions</b> .....	<b>6</b>
<b>9</b>	<b>Static characteristics</b> .....	<b>7</b>
<b>10</b>	<b>Dynamic characteristics</b> .....	<b>8</b>
<b>11</b>	<b>Waveforms</b> .....	<b>9</b>
<b>12</b>	<b>Package outline</b> .....	<b>12</b>
<b>13</b>	<b>Abbreviations</b> .....	<b>16</b>
<b>14</b>	<b>Revision history</b> .....	<b>16</b>
<b>15</b>	<b>Legal information</b> .....	<b>17</b>
15.1	Data sheet status .....	17
15.2	Definitions .....	17
15.3	Disclaimers .....	17
15.4	Trademarks .....	18
<b>16</b>	<b>Contact information</b> .....	<b>18</b>
<b>17</b>	<b>Contents</b> .....	<b>19</b>