

# 74CBTLV3125

## 4-bit bus switch

Rev. 3 — 15 December 2011

Product data sheet

## 1. General description

The 74CBTLV3125 provides a 4-bit high-speed bus switch with separate output enable inputs (1 $\overline{OE}$  to 4 $\overline{OE}$ ). The low on-state resistance of the switch allows connections to be made with minimal propagation delay. The switch is disabled (high-impedance OFF-state) when the output enable ( $n\overline{OE}$ ) input is HIGH.

To ensure the high-impedance OFF-state during power-up or power-down,  $n\overline{OE}$  should be tied to the  $V_{CC}$  through a pull-up resistor. The minimum value of the resistor is determined by the current-sinking capability of the driver.

Schmitt trigger action at control input makes the circuit tolerant to slower input rise and fall times across the entire  $V_{CC}$  range from 2.3 V to 3.6 V.

This device is fully specified for partial power-down applications using  $I_{OFF}$ . The  $I_{OFF}$  circuitry disables the output, preventing the damaging backflow current through the device when it is powered down.

## 2. Features and benefits

- Supply voltage range from 2.3 V to 3.6 V
- Standard '125'-type pinout
- High noise immunity
- Complies with JEDEC standard:
  - ◆ JESD8-5 (2.3 V to 2.7 V)
  - ◆ JESD8-B/JESD36 (2.7 V to 3.6 V)
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
  - ◆ CDM AEC-Q100-011 revision B exceeds 1000 V
- 5  $\Omega$  switch connection between two ports
- Rail to rail switching on data I/O ports
- CMOS low power consumption
- Latch-up performance exceeds 250 mA per JESD78B Class I level A
- $I_{OFF}$  circuitry provides partial Power-down mode operation
- Multiple package options
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$



### 3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74CBTLV3125DS	-40 °C to +125 °C	SSOP16 <sup>[1]</sup>	plastic shrink small outline package; 16 leads; body width 3.9 mm; lead pitch 0.635 mm	SOT519-1
74CBTLV3125PW	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74CBTLV3125BQ	-40 °C to +125 °C	DHVQFN14	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 × 3 × 0.85 mm	SOT762-1

[1] Also known as QSOP16.

### 4. Functional diagram

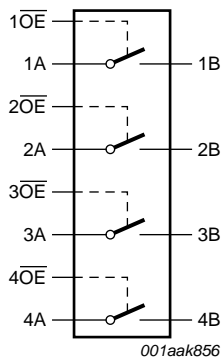


Fig 1. Logic symbol

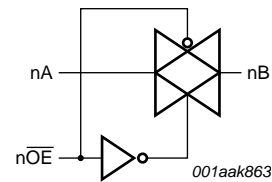
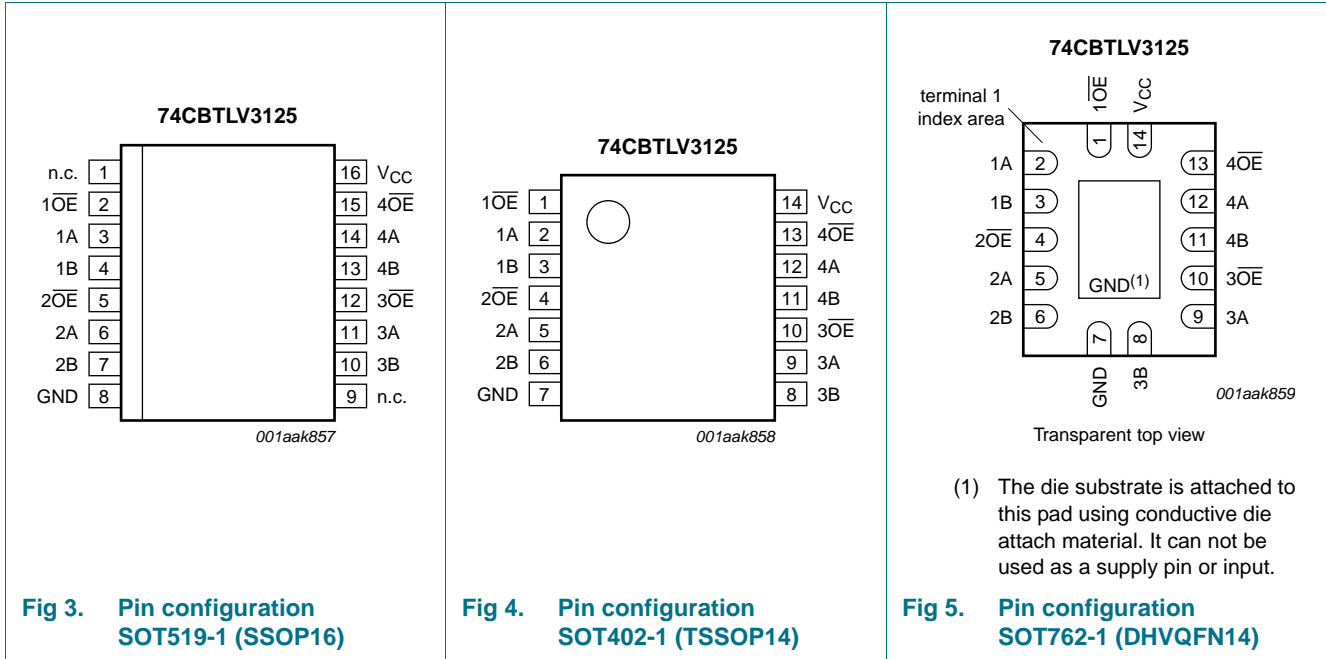


Fig 2. Logic diagram (one switch)

5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

Symbol	Pin		Description
	SOT519-1	SOT402-1 and SOT762-1	
1OE, 2OE, 3OE, 4OE	2, 5, 12, 15	1, 4, 10, 13	output enable input
1A, 2A, 3A, 4A,	3, 6, 11, 14	2, 5, 9, 12	A input/output
1B, 2B, 3B, 4B	4, 7, 10, 13	3, 6, 8, 11	B output/input
GND	8	7	ground (0 V)
VCC	16	14	positive supply voltage
n.c.	1, 9	-	not connected

6. Functional description

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

Output enable input OE	Function switch
L	ON-state
H	OFF-state

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

## 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 <sub>CC</sub>	supply voltage		-0.5	+4.6	V
V <sub>I</sub>	input voltage	control inputs	[1] -0.5	+4.6	V
V <sub>SW</sub>	switch voltage	enable and disable mode	[2] -0.5	V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < -0.5 V	-50	-	mA
I <sub>SK</sub>	switch clamping current	V <sub>I</sub> < -0.5 V	-50	-	mA
I <sub>SW</sub>	switch current	V <sub>SW</sub> = 0 V to V <sub>CC</sub>	-	±128	mA
I <sub>CC</sub>	supply current		-	+100	mA
I <sub>GND</sub>	ground current		-100	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -40 °C to +125 °C	[3] -	500	mW

[1] The minimum input voltage rating may be exceeded if the input clamping current ratings are observed.

[2] The switch voltage ratings may be exceeded if switch clamping current ratings are observed

[3] For SSOP16 and TSSOP14 packages: P<sub>tot</sub> derates linearly with 5.5 mW/K above 60 °C.  
For DHVQFN14 packages: P<sub>tot</sub> derates linearly with 4.5 mW/K above 60 °C.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CC</sub>	supply voltage		2.3	3.6	V
V <sub>I</sub>	input voltage	control inputs	0	3.6	V
V <sub>SW</sub>	switch voltage	enable and disable mode	0	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature		-40	+125	°C
Δt/ΔV	input transition rise and fall rate	pin n $\overline{OE}$ ; V <sub>CC</sub> = 2.3 V to 3.6 V	0	200	ns/V

## 9. Static characteristics

**Table 6. Static characteristics**

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

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	-	-	1.7	-	V
		V <sub>CC</sub> = 3.0 V to 3.6 V	2.0	-	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.7	-	0.7	V
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	-	0.9	-	0.9	V
I <sub>I</sub>	input leakage current	pin n $\overline{OE}$ ; V <sub>I</sub> = GND to V <sub>CC</sub> ; V <sub>CC</sub> = 3.6 V	-	-	±1.0	-	±20	μA
I <sub>S(OFF)</sub>	OFF-state leakage current	V <sub>CC</sub> = 3.6 V; see <a href="#">Figure 6</a>	-	-	±1	-	±20	μA

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

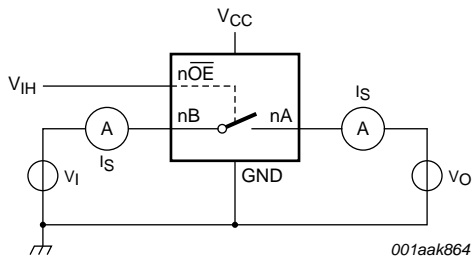
At recommended operating conditions voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
I <sub>S(ON)</sub>	ON-state leakage current	V <sub>CC</sub> = 3.6 V; see <a href="#">Figure 7</a>	-	-	±1	-	±20	μA
I <sub>OFF</sub>	power-off leakage current	V <sub>I</sub> or V <sub>O</sub> = 0 V to 3.6 V; V <sub>CC</sub> = 0 V	-	-	±10	-	±50	μA
I <sub>CC</sub>	supply current	V <sub>I</sub> = GND or V <sub>CC</sub> ; I <sub>O</sub> = 0 A; V <sub>SW</sub> = GND or V <sub>CC</sub> ; V <sub>CC</sub> = 3.6 V	-	-	10	-	50	μA
ΔI <sub>CC</sub>	additional supply current	pin n $\overline{\text{OE}}$ ; V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; <sup>[2]</sup> V <sub>SW</sub> = GND or V <sub>CC</sub> ; V <sub>CC</sub> = 3.6 V	-	-	300	-	2000	μA
C <sub>I</sub>	input capacitance	pin n $\overline{\text{OE}}$ ; V <sub>CC</sub> = 3.3 V; V <sub>I</sub> = 0 V to 3.3 V	-	0.9	-	-	-	pF
C <sub>S(OFF)</sub>	OFF-state capacitance	V <sub>CC</sub> = 3.3 V; V <sub>I</sub> = 0 V to 3.3 V	-	5.2	-	-	-	pF
C <sub>S(ON)</sub>	ON-state capacitance	V <sub>CC</sub> = 3.3 V; V <sub>I</sub> = 0 V to 3.3 V	-	14.3	-	-	-	pF

[1] All typical values are measured at T<sub>amb</sub> = 25 °C.

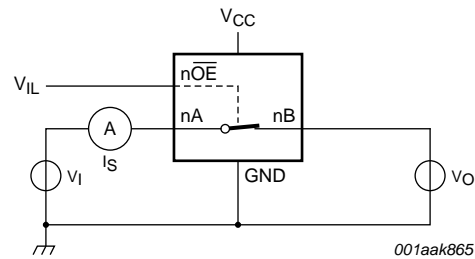
[2] One input at 3 V, other inputs at V<sub>CC</sub> or GND.

### 9.1 Test circuits



V<sub>I</sub> = V<sub>CC</sub> or GND and V<sub>O</sub> = GND or V<sub>CC</sub>.

**Fig 6. Test circuit for measuring OFF-state leakage current (one switch)**



V<sub>I</sub> = V<sub>CC</sub> or GND and V<sub>O</sub> = open circuit.

**Fig 7. Test circuit for measuring ON-state leakage current (one switch)**

9.2 ON resistance

Table 7. Resistance  $R_{ON}$

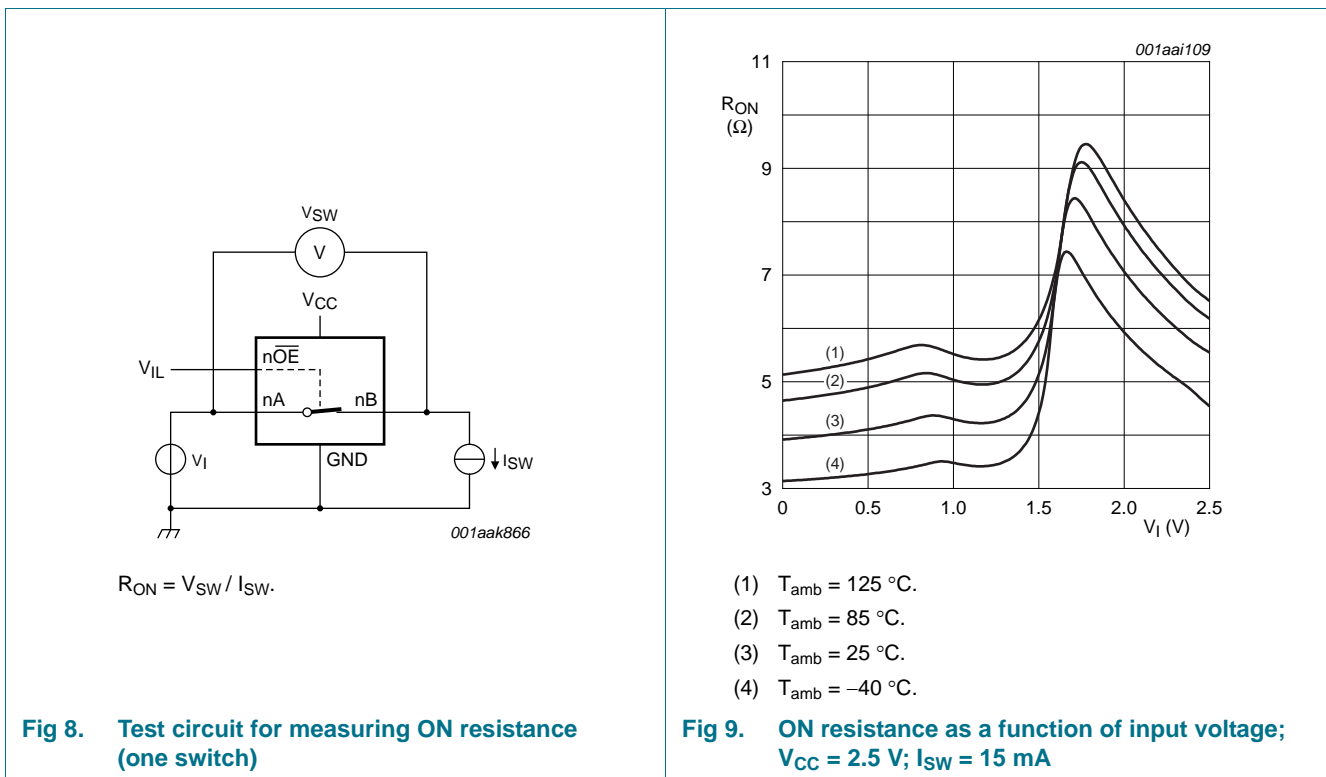
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for test circuit see Figure 8.

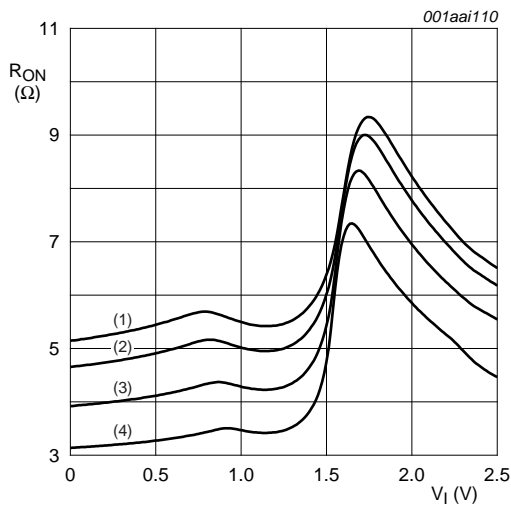
Symbol	Parameter	Conditions	$T_{amb} = -40\text{ }^{\circ}\text{C to }+85\text{ }^{\circ}\text{C}$			$T_{amb} = -40\text{ }^{\circ}\text{C to }+125\text{ }^{\circ}\text{C}$		Unit	
			Min	Typ <sup>[1]</sup>	Max	Min	Max		
$R_{ON}$	ON resistance	$V_{CC} = 2.3\text{ V to }2.7\text{ V};$ see Figure 9 to Figure 11	[2]						
			$I_{SW} = 64\text{ mA}; V_I = 0\text{ V}$	-	4.2	8.0	-	15.0	$\Omega$
			$I_{SW} = 24\text{ mA}; V_I = 0\text{ V}$	-	4.2	8.0	-	15.0	$\Omega$
		$I_{SW} = 15\text{ mA}; V_I = 1.7\text{ V}$	-	8.4	40.0	-	60.0	$\Omega$	
		$V_{CC} = 3.0\text{ V to }3.6\text{ V};$ see Figure 12 to Figure 14	$I_{SW} = 64\text{ mA}; V_I = 0\text{ V}$	-	4.0	7.0	-	11.0	$\Omega$
			$I_{SW} = 24\text{ mA}; V_I = 0\text{ V}$	-	4.0	7.0	-	11.0	$\Omega$
$I_{SW} = 15\text{ mA}; V_I = 2.4\text{ V}$	-		6.2	15.0	-	25.5	$\Omega$		

[1] Typical values are measured at  $T_{amb} = 25\text{ }^{\circ}\text{C}$  and nominal  $V_{CC}$ .

[2] Measured by the voltage drop between the A and B terminals at the indicated current through the switch. ON-state resistance is determined by the lower of the voltages of the two (A or B) terminals.

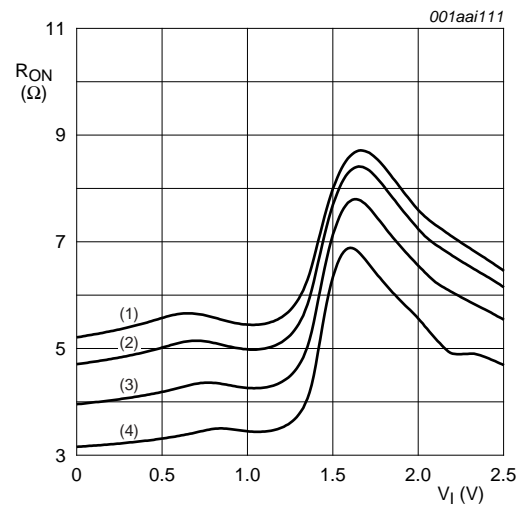
9.3 ON resistance test circuit and graphs





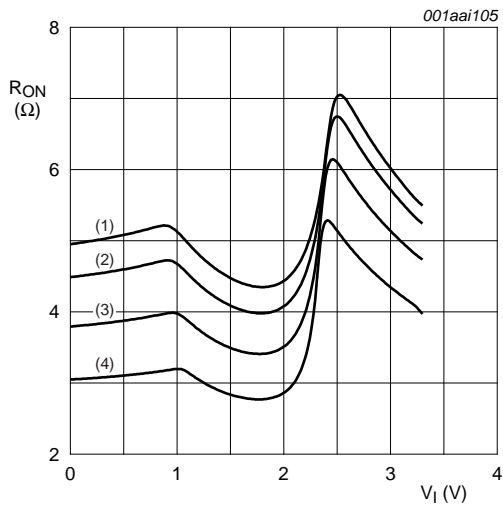
- (1)  $T_{amb} = 125\text{ }^{\circ}\text{C}.$
- (2)  $T_{amb} = 85\text{ }^{\circ}\text{C}.$
- (3)  $T_{amb} = 25\text{ }^{\circ}\text{C}.$
- (4)  $T_{amb} = -40\text{ }^{\circ}\text{C}.$

**Fig 10. ON resistance as a function of input voltage;**  
 $V_{CC} = 2.5\text{ V}; I_{SW} = 24\text{ mA}$



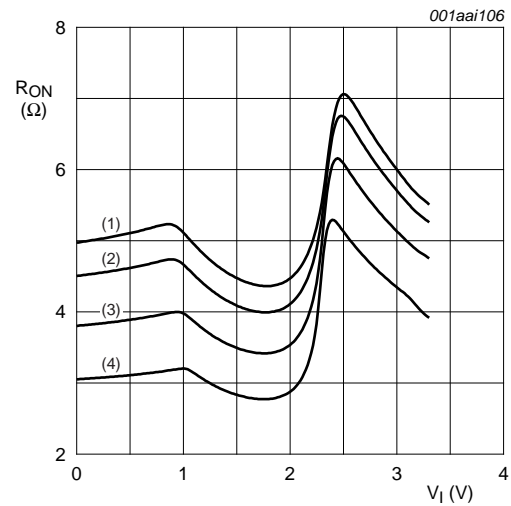
- (1)  $T_{amb} = 125\text{ }^{\circ}\text{C}.$
- (2)  $T_{amb} = 85\text{ }^{\circ}\text{C}.$
- (3)  $T_{amb} = 25\text{ }^{\circ}\text{C}.$
- (4)  $T_{amb} = -40\text{ }^{\circ}\text{C}.$

**Fig 11. ON resistance as a function of input voltage;**  
 $V_{CC} = 2.5\text{ V}; I_{SW} = 64\text{ mA}$



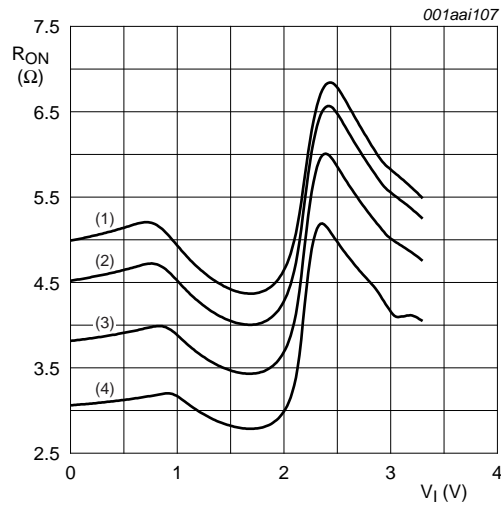
- (1)  $T_{amb} = 125\text{ }^{\circ}\text{C}.$
- (2)  $T_{amb} = 85\text{ }^{\circ}\text{C}.$
- (3)  $T_{amb} = 25\text{ }^{\circ}\text{C}.$
- (4)  $T_{amb} = -40\text{ }^{\circ}\text{C}.$

**Fig 12. ON resistance as a function of input voltage;**  
 $V_{CC} = 3.3\text{ V}; I_{SW} = 15\text{ mA}$



- (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;**  
 $V_{CC} = 3.3\text{ V}; I_{SW} = 24\text{ mA}$



- (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 14. ON resistance as a function of input voltage;  $V_{CC} = 3.3\text{ V}$ ;  $I_{SW} = 64\text{ mA}$

## 10. Dynamic characteristics

Table 8. Dynamic characteristics

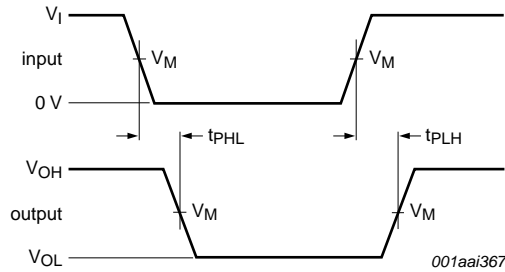
$GND = 0\text{ V}$ ; for test circuit see [Figure 17](#)

Symbol	Parameter	Conditions	$T_{amb} = -40\text{ °C to }+85\text{ °C}$			$T_{amb} = -40\text{ °C to }+125\text{ °C}$		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
$t_{pd}$	propagation delay	nA to nB or nB to nA; see <a href="#">Figure 15</a>	<a href="#">[2][3]</a>					
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	-	-	0.13	-	0.20	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	-	-	0.20	-	0.31	ns
$t_{en}$	enable time	$\overline{nOE}$ to nA or nB; see <a href="#">Figure 16</a>	<a href="#">[4]</a>					
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.0	2.7	4.6	1.0	6.0	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	2.4	4.4	1.0	6.0	ns
$t_{dis}$	disable time	$\overline{nOE}$ to nA or nB; see <a href="#">Figure 16</a>	<a href="#">[5]</a>					
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.0	2.2	3.9	1.0	5.5	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	2.9	4.2	1.0	5.5	ns

- [1] All typical values are measured at  $T_{amb} = 25\text{ °C}$  and at nominal  $V_{CC}$ .
- [2] The propagation delay is the calculated RC time constant of the on-state resistance of the switch and the load capacitance, when driven by an ideal voltage source (zero output impedance).
- [3]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .
- [4]  $t_{en}$  is the same as  $t_{PZH}$  and  $t_{PZL}$ .
- [5]  $t_{dis}$  is the same as  $t_{PHZ}$  and  $t_{PLZ}$ .



11. Waveforms

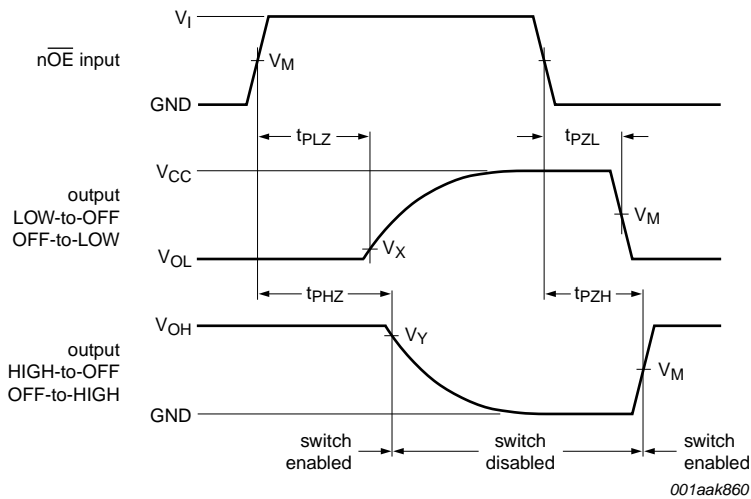


Measurement points are given in [Table 9](#).  
 Logic levels:  $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

Fig 15. The data input (nA or nB) to output (nB or nA) propagation delays

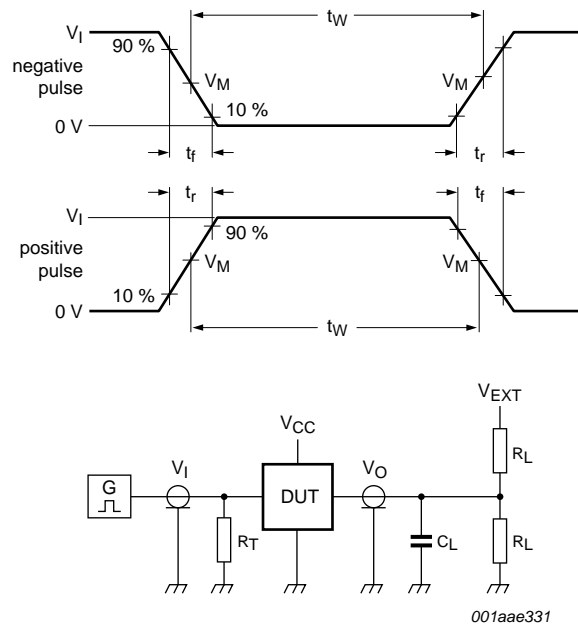
Table 9. Measurement points

Supply voltage	Input			Output		
$V_{CC}$	$V_M$	$V_I$	$t_r = t_f$	$V_M$	$V_X$	$V_Y$
2.3 V to 2.7 V	$0.5V_{CC}$	$V_{CC}$	$\leq 2.0$ ns	$0.5V_{CC}$	$V_{OL} + 0.15$ V	$V_{OH} - 0.15$ V
3.0 V to 3.6 V	$0.5V_{CC}$	$V_{CC}$	$\leq 2.0$ ns	$0.5V_{CC}$	$V_{OL} + 0.3$ V	$V_{OH} - 0.3$ V



Measurement points are given in [Table 9](#).  
 Logic levels:  $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

Fig 16. Enable and disable times



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 17. Test circuit for measuring switching times**

**Table 10. Test data**

Supply voltage	Load		$V_{EXT}$		
$V_{CC}$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PZH}, t_{PHZ}$	$t_{PZL}, t_{PLZ}$
2.3 V to 2.7 V	30 pF	500 $\Omega$	open	GND	$2V_{CC}$
3.0 V to 3.6 V	50 pF	500 $\Omega$	open	GND	$2V_{CC}$

12. Package outline

SSOP16: plastic shrink small outline package; 16 leads; body width 3.9 mm; lead pitch 0.635 mm SOT519-1

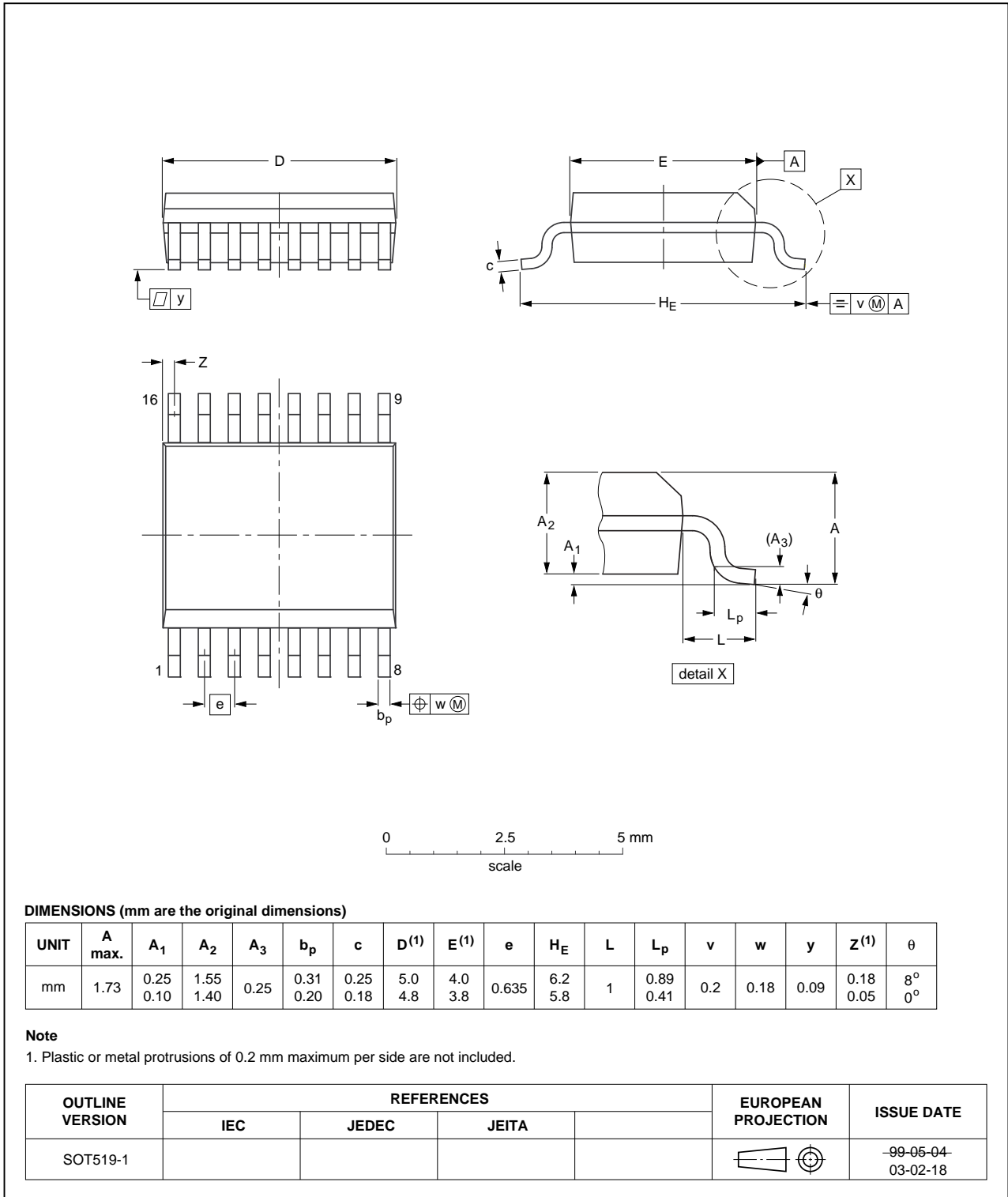


Fig 18. Package outline SOT519-1 (SSOP16)

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1

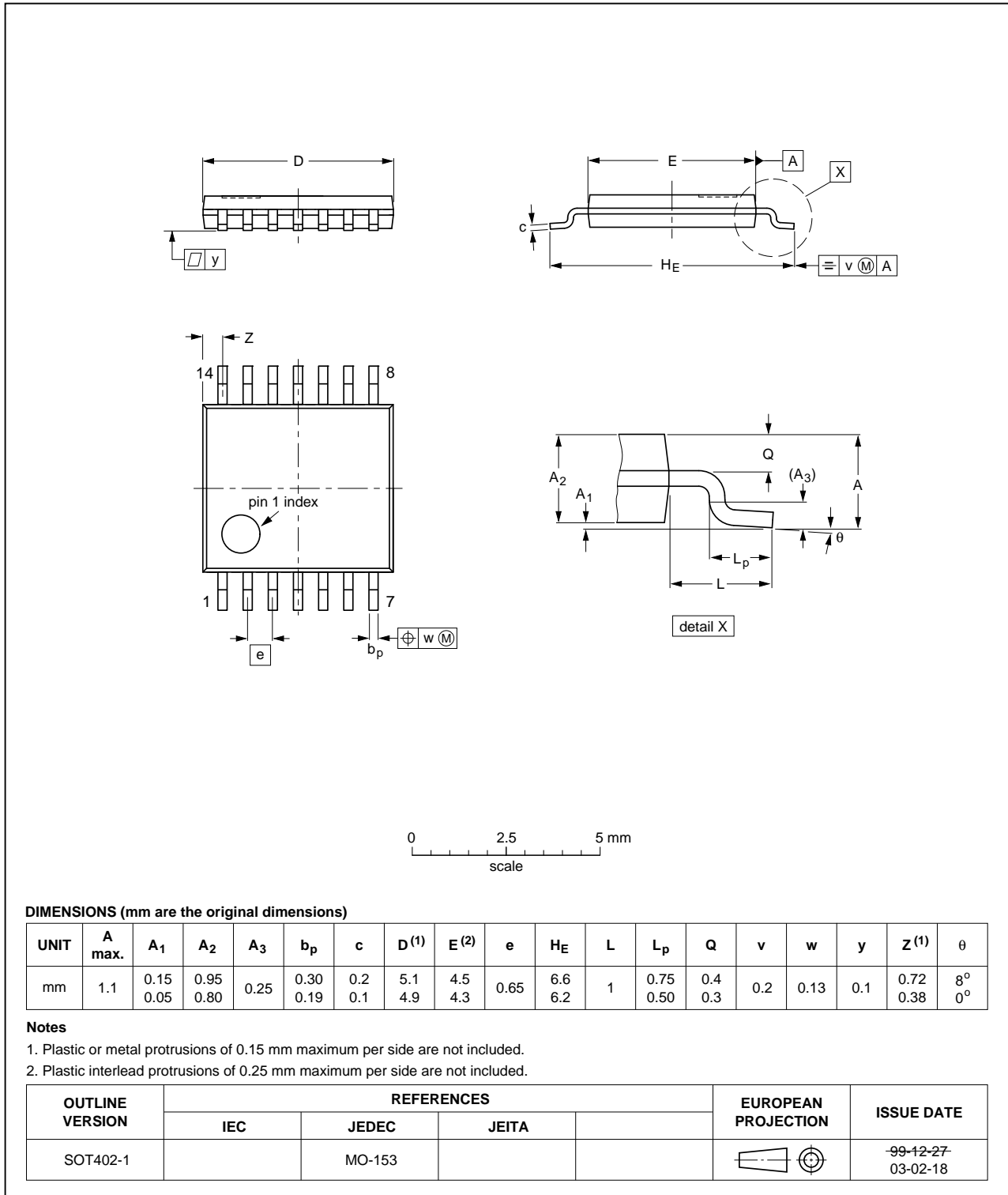


Fig 19. Package outline SOT402-1 (TSSOP14)

DHVQFN14: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 x 3 x 0.85 mm

SOT762-1

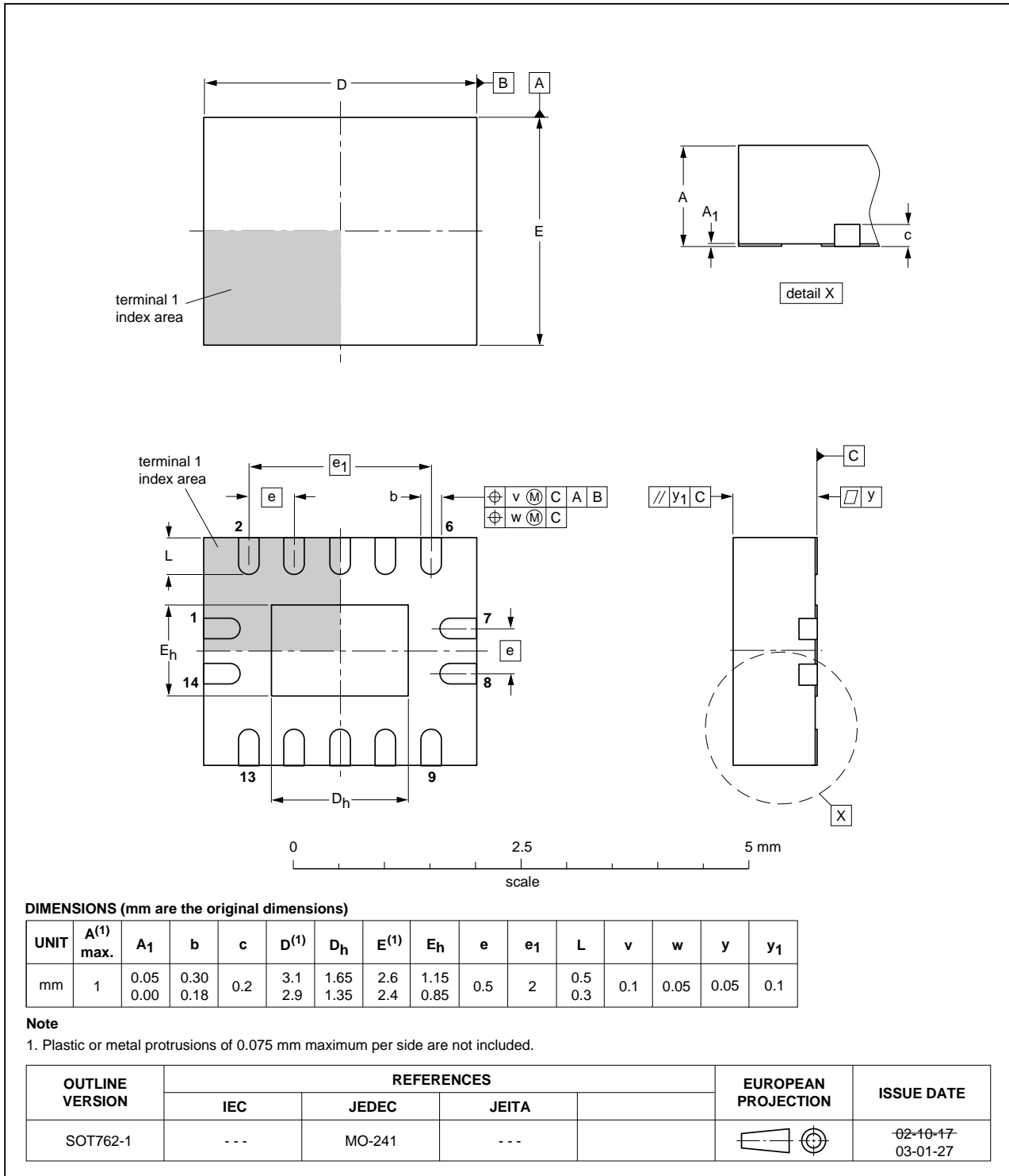


Fig 20. Package outline SOT762-1 (DHVQFN14)

## 13. Abbreviations

Table 11. Abbreviations

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

## 14. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74CBTLV3125 v.3	20111215	Product data sheet	-	74CBTLV3125 v.2
Modifications:	• Legal pages updated.			
74CBTLV3125 v.2	20110104	Product data sheet	-	74CBTLV3125 v.1
74CBTLV3125 v.1	20100108	Product data sheet	-	-

## 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.nxp.com>.

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