## 74CBTLV3306

2-bit bus switch

Rev. 1 — 7 December 2016

**Product data sheet** 

#### **General description** 1.

The 74CBTLV3306 is a 2-bit high-speed bus switch with separate output enable inputs (nOE). Each switch is disabled when the associated output enable (nOE) input is HIGH.

To ensure the high-impedance OFF-state during power-up or power-down, nOE should be tied to the V<sub>CC</sub> 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<sub>OFF</sub>. The I<sub>OFF</sub> 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
- 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
- $\blacksquare$  4  $\Omega$  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<sub>OFF</sub> circuitry provides partial Power-down mode operation
- 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	Temperature range Name Description								
74CBTLV3306DC	–40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm	SOT765-1						
74CBTLV3306GT	–40 °C to +125 °C	XSON8	plastic extremely thin small outline package; no leads; 8 terminals; body 1 $\times$ 1.95 $\times$ 0.5 mm	SOT833-1						

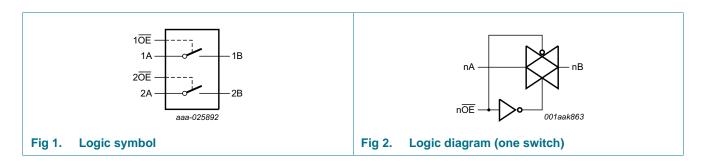
## 4. Marking

#### Table 2. Marking codes

Type number	Marking code <sup>[1]</sup>
74CBTLV3306DC	b6
74CBTLV3306GT	b6

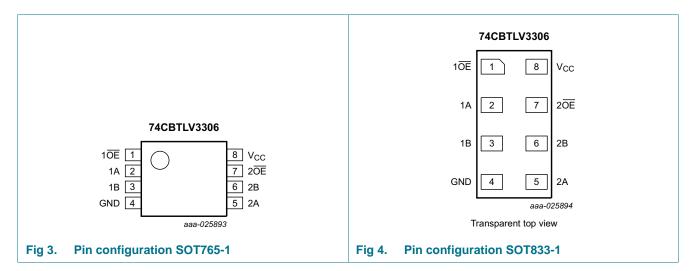
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

## 5. Functional diagram



## 6. Pinning information

#### 6.1 Pinning



#### 6.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
1 <del>OE</del> , 2 <del>OE</del>	1, 7	output enable input
1A, 2A	2, 5	data input/output (A port)
1B, 2B	3, 6	data input/output (B port)
GND	4	ground (0 V)
V <sub>CC</sub>	8	positive supply voltage

## 7. Functional description

Table 4. Function selection[1]

Input nOE	Input/output
nOE	nA, nB
L	nA = nB
Н	Z

[1] H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state.

## 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 <sub>CC</sub>	supply voltage		-0.5	+4.6	V
VI	input voltage	control inputs [1]	-0.5	+4.6	V
$V_{SW}$	switch voltage	enable and disable mode	-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	$V_{SW} = 0 V \text{ to } V_{CC}$	-	±128	mA
I <sub>CC</sub>	supply current		-	+100	mA
$I_{GND}$	ground current		-100	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	$T_{amb} = -40  ^{\circ}\text{C} \text{ to } +125  ^{\circ}\text{C}$	-	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 VSSOP8 packages: above 110 °C, the value of P<sub>tot</sub> derates linearly with 8.0 mW/K. For XSON8 packages: above 118 °C the value of P<sub>tot</sub> derates linearly with 7.8 mW/K.

## 9. Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CC</sub>	supply voltage		2.3	3.6	V
VI	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 $\overline{\text{OE}}$ ; V <sub>CC</sub> = 2.3 V to 3.6 V	0	200	ns/V

#### 10. Static characteristics

Table 7. Static characteristics

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

Symbol Parameter		Conditions	$T_{amb} = -40  ^{\circ}\text{C} \text{ to } +85  ^{\circ}\text{C}$			T <sub>amb</sub> = -40 °	Unit	
			Min	Typ[1]	Max	Min	Max	
$V_{IH}$	HIGH-level	V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	-	-	1.7	-	V
	input voltage	$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$	2.0	-	-	2.0	-	V
$V_{IL}$	LOW-level input	V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.7	-	0.7	V
	voltage	V <sub>CC</sub> = 3.0 V to 3.6 V	-	-	0.9	-	0.9	V
II	input leakage current	pin $\overline{OE}$ ; $V_I = GND$ to $V_{CC}$ ; $V_{CC} = 3.6 \text{ V}$	-	-	±1.0	-	±20	μА
I <sub>S(OFF)</sub>	OFF-state leakage current	V <sub>CC</sub> = 3.6 V; see <u>Figure 5</u>	-	-	±1	-	±20	μА

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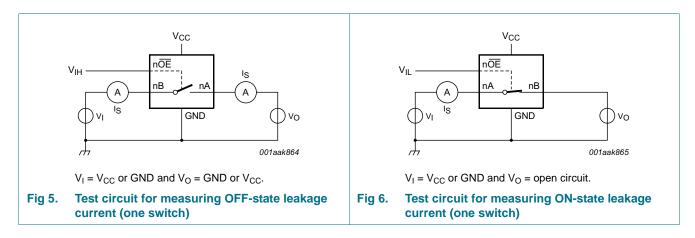
Table 7. Static characteristics ...continued

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

Symbol	Parameter	eter Conditions		–40 °C to +	-85 °C	T <sub>amb</sub> = -40 °C	Unit	
			Min	Typ[1]	Max	Min	Max	
I <sub>S(ON)</sub>	ON-state leakage current	V <sub>CC</sub> = 3.6 V; see <u>Figure 6</u>	-	-	±1	-	±20	μΑ
I <sub>OFF</sub>	power-off leakage current	$V_1 \text{ or } V_O = 0 \text{ V to } 3.6 \text{ V};$ $V_{CC} = 0 \text{ V}$	-	-	±10	-	±50	μΑ
I <sub>CC</sub>	supply current	$V_I = GND \text{ or } V_{CC}; I_O = 0 \text{ A};$ $V_{SW} = GND \text{ or } V_{CC};$ $V_{CC} = 3.6 \text{ V}$	-	-	10	-	50	μΑ
Δl <sub>CC</sub>	additional supply current	$\begin{aligned} &\text{pin } \overline{\text{OE}};  V_{\text{I}} = V_{\text{CC}} - 0.6  \text{V}; \\ &V_{\text{SW}} = \text{GND or } V_{\text{CC}}; \\ &V_{\text{CC}} = 3.6  \text{V} \end{aligned}$	-	-	300	-	2000	μΑ
Cı	input capacitance	pin n <del>OE</del> ; 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	$V_{CC} = 3.3 \text{ V}; V_{I} = 0 \text{ V to } 3.3 \text{ V}$	-	3.0	-	-	-	pF
C <sub>S(ON)</sub>	ON-state capacitance	$V_{CC} = 3.3 \text{ V}; V_{I} = 0 \text{ V to } 3.3 \text{ V}$	-	10.6	-	-	-	pF

- [1] All typical values are measured at  $T_{amb}$  = 25 °C.
- [2] One input at 3 V, other inputs at  $V_{CC}$  or GND.

#### 10.1 Test circuits



#### 10.2 ON resistance

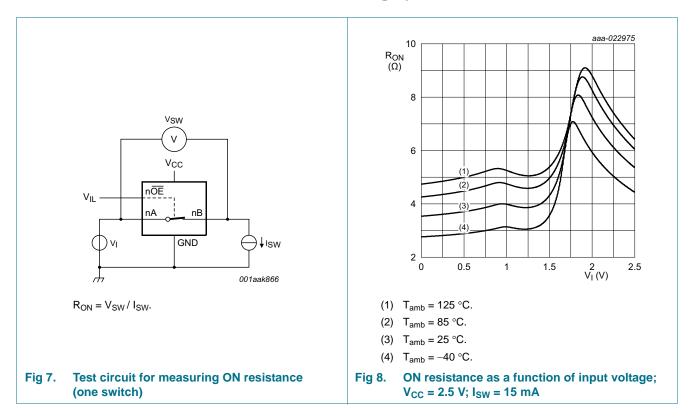
Table 8. Resistance RoN

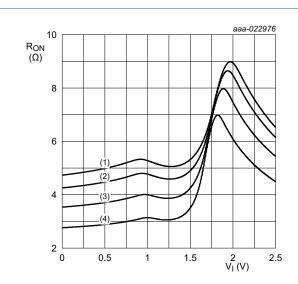
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for test circuit see Figure 7.

Symbol	Parameter	Conditions	T <sub>amb</sub> =	$T_{amb} = -40$ °C to +85 °C		T <sub>amb</sub> = -40 °	C to +125 °C	Unit
			Min	Typ[1]	Max	Min	Max	
R <sub>ON</sub>	ON resistance	$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V};$ see <u>Figure 8</u> to <u>Figure 10</u>						
		$I_{SW} = 64 \text{ mA}; V_I = 0 \text{ V}$	-	3.6	8.0	-	15.0	Ω
		$I_{SW} = 24 \text{ mA}; V_I = 0 \text{ V}$	-	3.6	8.0	-	15.0	Ω
		$I_{SW} = 15 \text{ mA}; V_I = 1.7 \text{ V}$	-	6.6	40.0	-	60.0	Ω
		V <sub>CC</sub> = 3.0 V to 3.6 V; see <u>Figure 11</u> to <u>Figure 13</u>						
		$I_{SW} = 64 \text{ mA}; V_I = 0 \text{ V}$	-	3.5	7.0	-	11.0	Ω
		$I_{SW} = 24 \text{ mA}; V_I = 0 \text{ V}$	-	3.5	7.0	-	11.0	Ω
		I <sub>SW</sub> = 15 mA; V <sub>I</sub> = 2.4 V	-	4.6	15.0	-	25.5	Ω

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

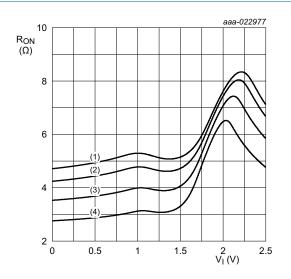
#### 10.3 ON resistance test circuit and graphs





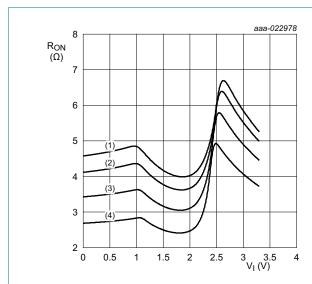
- (1)  $T_{amb} = 125 \, ^{\circ}C$ .
- (2)  $T_{amb} = 85 \, ^{\circ}C$ .
- (3)  $T_{amb} = 25 \, ^{\circ}C$ .
- (4)  $T_{amb} = -40 \, ^{\circ}C$ .

Fig 9. ON resistance as a function of input voltage;  $V_{CC} = 2.5 \text{ V}; I_{SW} = 24 \text{ mA}$ 



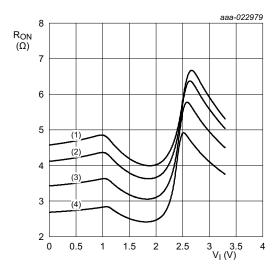
- (1)  $T_{amb} = 125 \, ^{\circ}C$ .
- (2)  $T_{amb} = 85 \, ^{\circ}C$ .
- (3)  $T_{amb} = 25 \, ^{\circ}C$ .
- (4)  $T_{amb} = -40 \, ^{\circ}C$ .

Fig 10. ON resistance as a function of input voltage;  $V_{CC} = 2.5 \text{ V}$ ;  $I_{SW} = 64 \text{ mA}$ 



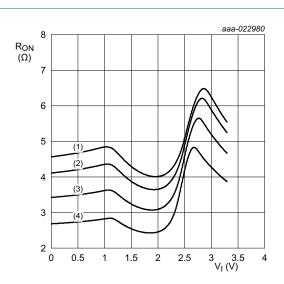
- (1)  $T_{amb} = 125 \, ^{\circ}C$ .
- (2)  $T_{amb} = 85 \, ^{\circ}C$ .
- (3)  $T_{amb} = 25 \, ^{\circ}C$ .
- (4)  $T_{amb} = -40 \, ^{\circ}C$ .

Fig 11. ON resistance as a function of input voltage;  $V_{CC} = 3.3 \text{ V}; I_{SW} = 15 \text{ mA}$ 



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

Fig 12. ON resistance as a function of input voltage;  $V_{CC} = 3.3 \text{ V}; I_{SW} = 24 \text{ mA}$ 



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

Fig 13. ON resistance as a function of input voltage;  $V_{CC} = 3.3 \text{ V}$ ;  $I_{SW} = 64 \text{ mA}$ 

## 11. Dynamic characteristics

**Table 9. Dynamic characteristics** GND = 0 *V; for test circuit see Figure 16* 

Symbol	Parameter	Conditions		T <sub>amb</sub> = -	-40 °C to	+85 °C	$T_{amb} = -40  ^{\circ}\text{C} \text{ to } +125  ^{\circ}\text{C}$		Unit
				Min	Typ[1]	Max	Min	Max	
t <sub>pd</sub>	propagation delay	nA to nB or nB to nA; see Figure 14	3]						
		V <sub>CC</sub> = 2.3 V to 2.7 V		-	-	0.13	-	0.20	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V		-	-	0.20	-	0.31	ns
t <sub>en</sub>	enable time	nOE to nA or nB; see Figure 15	<u>4]</u>						
		V <sub>CC</sub> = 2.3 V to 2.7 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 <sub>dis</sub>	disable time	nOE to nA or nB; see Figure 15	<u>5]</u>						
		V <sub>CC</sub> = 2.3 V to 2.7 V		1.0	2.2	3.9	1.0	5.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V		1.0	2.9	4.2	1.0	5.5	ns

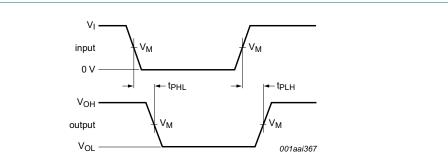
- [1] All typical values are measured at  $T_{amb}$  = 25 °C and at nominal  $V_{CC}$ .
- [2] The propagation delay is the calculated RC time constant of the typical ON resistance of the switch and the load capacitance, when driven by an ideal voltage source (zero output impedance).
- [3]  $t_{pd}$  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  $t_{PLZ}$ .

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#### 12. Waveforms



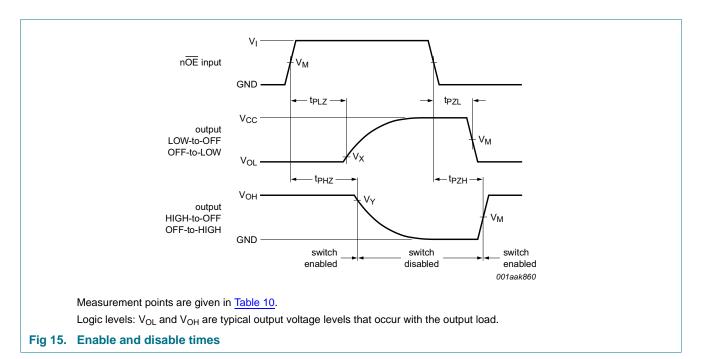
Measurement points are given in Table 10.

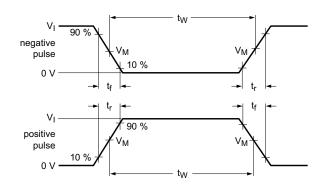
Logic levels:  $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

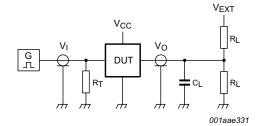
Fig 14. The data input (nA or nB) to output (nB or nA) propagation delays

Table 10. Measurement points

Supply voltage	Input			Output		
V <sub>CC</sub>	$V_{M}$ $V_{I}$ $t_{r} = t_{f}$		V <sub>M</sub>	V <sub>X</sub>	V <sub>Y</sub>	
2.3 V to 2.7 V	0.5V <sub>CC</sub>	V <sub>CC</sub>	≤ 2.0 ns	0.5V <sub>CC</sub>	V <sub>OL</sub> + 0.15 V	V <sub>OH</sub> – 0.15 V
3.0 V to 3.6 V	0.5V <sub>CC</sub>	V <sub>CC</sub>	≤ 2.0 ns	0.5V <sub>CC</sub>	V <sub>OL</sub> + 0.3 V	V <sub>OH</sub> – 0.3 V







Test data is given in Table 11.

Definitions for test circuit:

R<sub>L</sub> = Load resistance.

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

 $R_T$  = Termination resistance should be equal to the output impedance  $Z_0$  of the pulse generator.

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

Fig 16. Test circuit for measuring switching times

Table 11. Test data

Supply voltage	Load		V <sub>EXT</sub>				
V <sub>CC</sub>	C <sub>L</sub> R <sub>L</sub> t		t <sub>PLH</sub> , t <sub>PHL</sub> t <sub>PZH</sub> , t <sub>PHZ</sub>		$t_{PZL}, t_{PLZ}$		
2.3 V to 2.7 V	30 pF	500 Ω	open	GND	2V <sub>CC</sub>		
3.0 V to 3.6 V	50 pF	500 Ω	open	GND	2V <sub>CC</sub>		

## 12.1 Additional dynamic characteristics

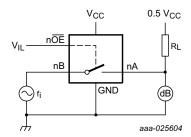
#### Table 12. Additional dynamic characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V);  $V_I = GND$  or  $V_{CC}$  (unless otherwise specified);  $t_r = t_f \le 2.5$  ns.

Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			Unit
			Min	Тур	Max	
f <sub>(-3dB)</sub>	-3 dB frequency response	$V_{CC} = 3.3 \text{ V}; R_L = 50 \Omega; \text{ see } \frac{\text{Figure 17}}{}$	-	423	-	MHz

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

#### 12.2 Test circuits



 $n\overline{OE}$  connected to GND; Adjust  $f_i$  voltage to obtain 0 dBm level at output. Increase  $f_i$  frequency until dB meter reads -3 dB.

Fig 17. Test circuit for measuring the frequency response when channel is in ON-state

## 13. Package outline

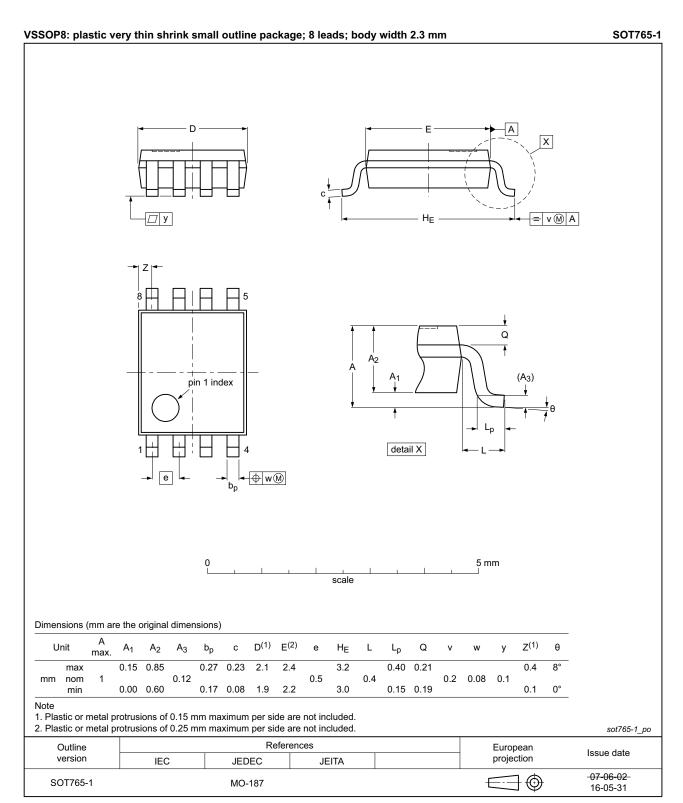


Fig 18. Package outline SOT765-1 (VSSOP8)

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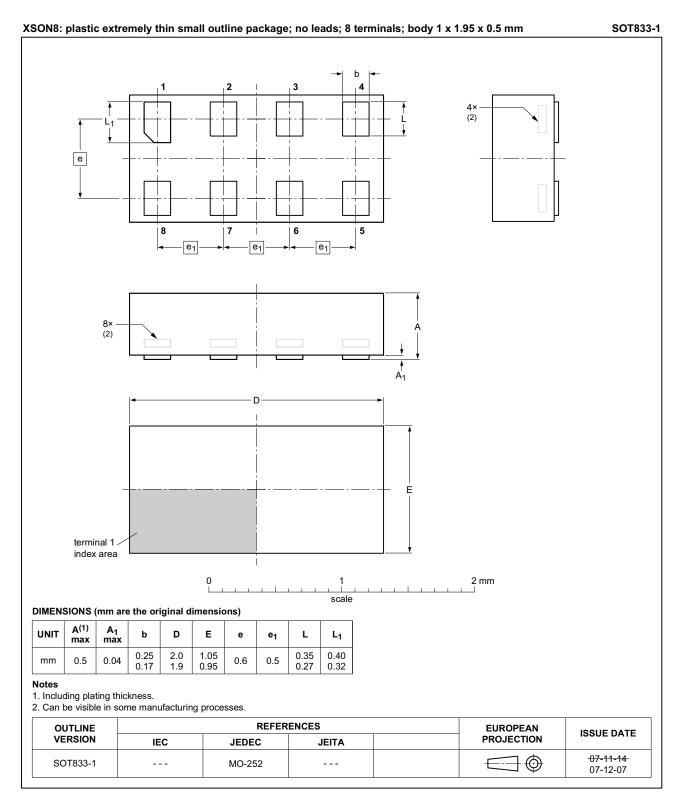


Fig 19. Package outline SOT833-1 (XSON8)

## 14. Abbreviations

#### Table 13. Abbreviations

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

## 15. Revision history

#### Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74CBTLV3306 v.1	20161207	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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2-bit bus switch

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### **ПОСТАВКА** ЭЛЕКТРОННЫХ КОМПОНЕНТОВ

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