

# 74CBTLV16211

## 24-bit low-voltage bus switch

Rev. 01 — 20 June 2008

Product data sheet

## 1. General description

The 74CBTLV16211 provides a dual 12-bit high-speed bus switch with separate output enable inputs ( $1\overline{OE}$ ,  $2\overline{OE}$ ). 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,  $1\overline{OE}$  and  $2\overline{OE}$  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

- 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-A114E 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 JESD78A Class I level A
- $I_{OFF}$  circuitry provides partial Power-down mode operation
- TSSOP56 packages: SOT364-1 and SOT481-2
- 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	
74CBTLV16211DGG	-40 °C to +125 °C	TSSOP56	plastic thin shrink small outline package; 56 leads; body width 6.1 mm	SOT364-1
74CBTLV16211DGV	-40 °C to +125 °C	TSSOP56	plastic thin shrink small outline package; 56 leads; body width 4.4 mm	SOT481-2

### 4. Functional diagram

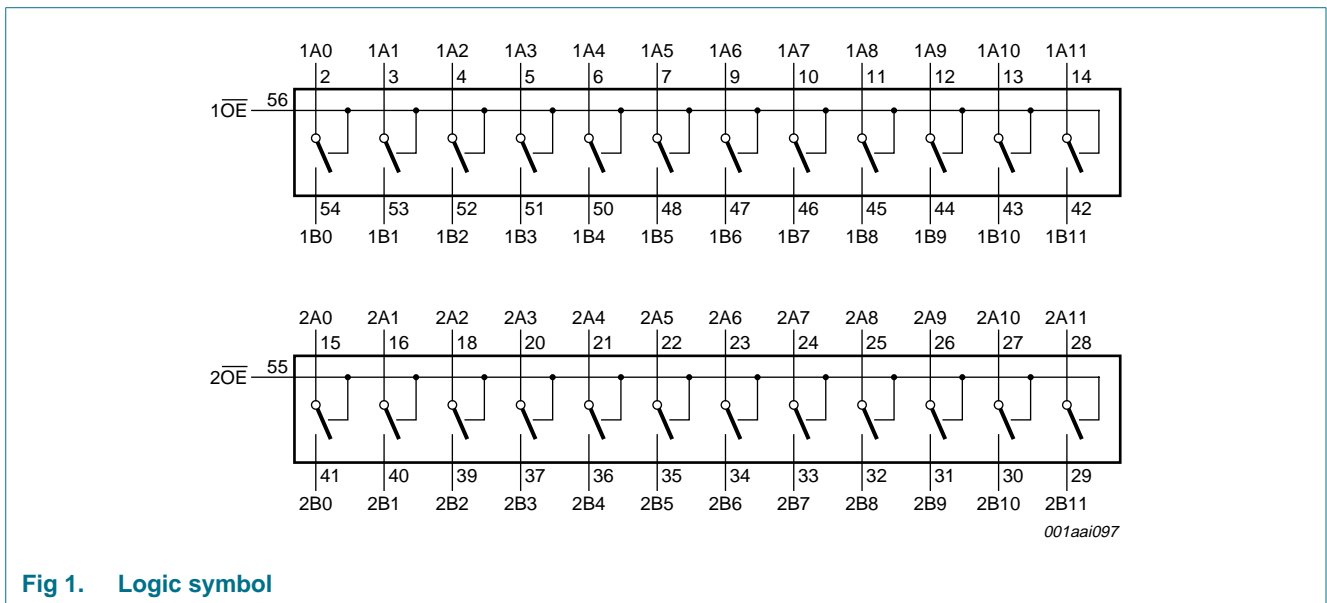


Fig 1. Logic symbol

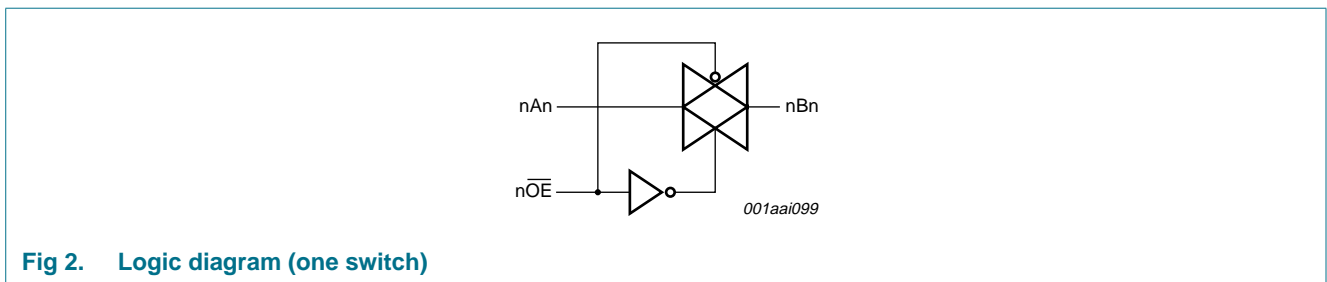


Fig 2. Logic diagram (one switch)

## 5. Pinning information

### 5.1 Pinning

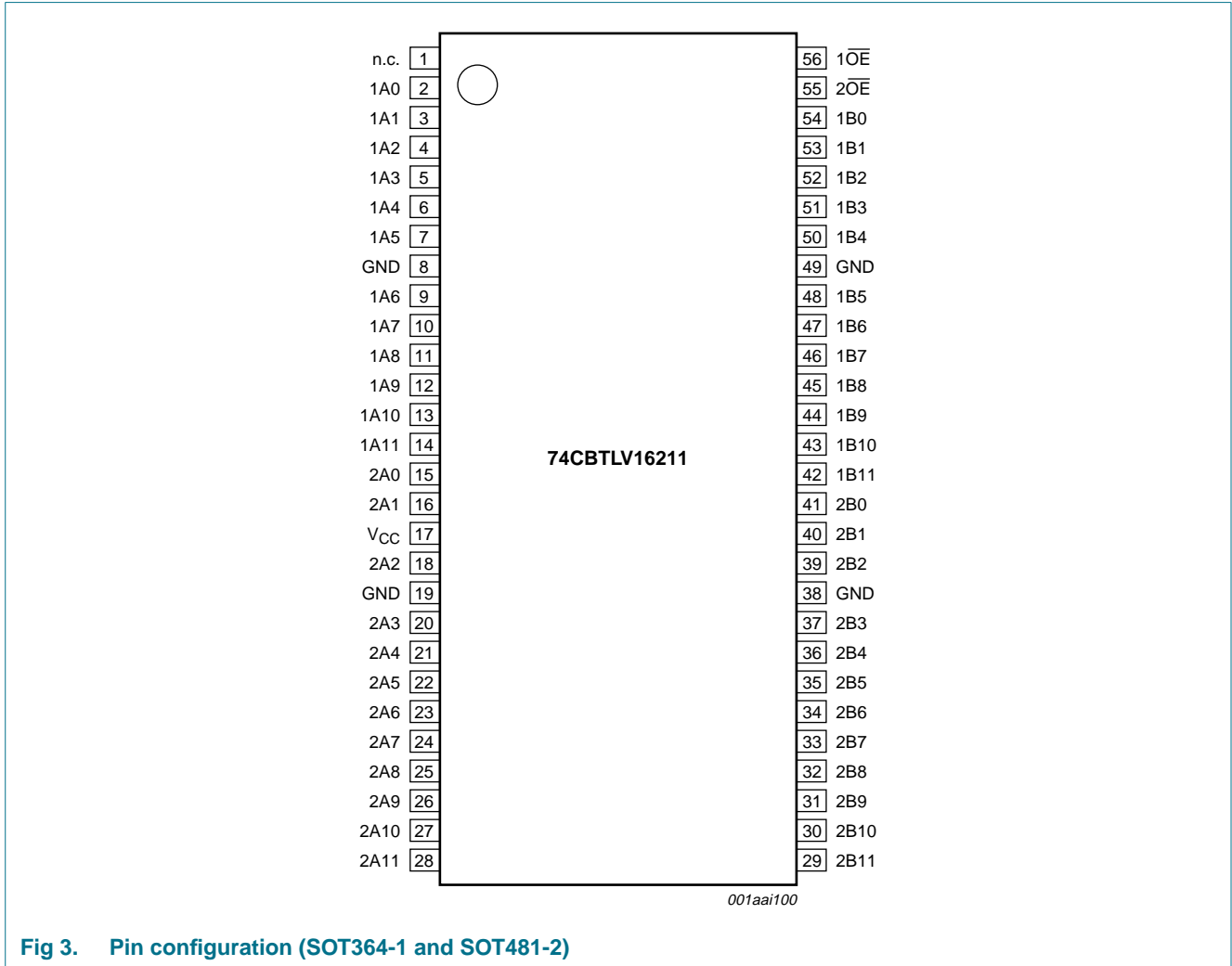


Fig 3. Pin configuration (SOT364-1 and SOT481-2)

### 5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
n.c.	1	not connected
1A0 to 1A11	2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14	independent input or output
2A0 to 2A11	15, 16, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28	independent input or output
GND	8, 19, 38, 49	ground (0 V)
V <sub>CC</sub>	17	supply voltage
2B0 to 2B11	41, 40, 39, 37, 36, 35, 34, 33, 32, 31, 30, 29	independent input or output

Table 2. Pin description ...continued

Symbol	Pin	Description
1B0 to 1B11	54, 53, 52, 51, 50, 48, 47, 46, 45, 44, 43, 42	independent input or output
$2\overline{OE}$	55	output enable input (active-LOW)
$1\overline{OE}$	56	output enable input (active-LOW)

## 6. Functional description

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

Output enable input $\overline{OE}$	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
$V_{CC}$	supply voltage		-0.5	+4.6	V
$V_I$	input voltage		<sup>[1]</sup> -0.5	+4.6	V
$V_{SW}$	switch voltage	enable and disable mode	<sup>[1]</sup> -0.5	$V_{CC} + 0.5$	V
$I_{IK}$	input clamping current	$V_{IO} < -0.5$ V	-	-50	mA
$I_{SK}$	switch clamping current	$V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V	-	$\pm 50$	mA
$I_{SW}$	switch current	$V_{SW} = 0$ V to $V_{CC}$	-	$\pm 128$	mA
$I_{CC}$	supply current		-	+100	mA
$I_{GND}$	ground current		-100	-	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40$ °C to +125 °C	<sup>[2]</sup> -	600	mW

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

[2] For TSSOP56 packages: above 55 °C the value of  $P_{tot}$  derates linearly with 8.0 mW/K.

## 8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		2.3	3.6	V
$V_I$	input voltage		0	3.6	V
$V_{SW}$	switch voltage	enable and disable mode	0	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 2.3$ V to 3.6 V	<sup>[1]</sup> 0	20	ns/V

[1] Applies to control signal levels.

## 9. Static characteristics

**Table 6. Static characteristics**

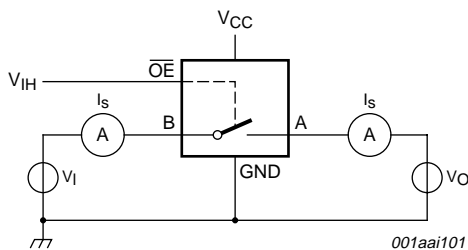
At recommended operating conditions voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	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>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 3.6 V; see <a href="#">Figure 4</a>	-	-	±1	-	±20	μA
I <sub>S(ON)</sub>	ON-state leakage current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 3.6 V; see <a href="#">Figure 5</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 $\overline{OE}$ ; V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; V <sub>SW</sub> = GND or V <sub>CC</sub> ; V <sub>CC</sub> = 3.6 V <sup>[2]</sup>	-	-	300	-	2000	μA
C <sub>I</sub>	input capacitance	pin n $\overline{OE}$ ; 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.

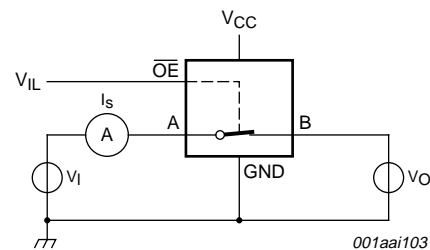
[2] One input at 3 V, other inputs at V<sub>CC</sub> or GND.

### 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 4. Test circuit for measuring OFF-state leakage current (one channel)**



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

**Fig 5. Test circuit for measuring ON-state leakage current (one channel)**

9.2 ON resistance

Table 7. Resistance  $R_{ON}$

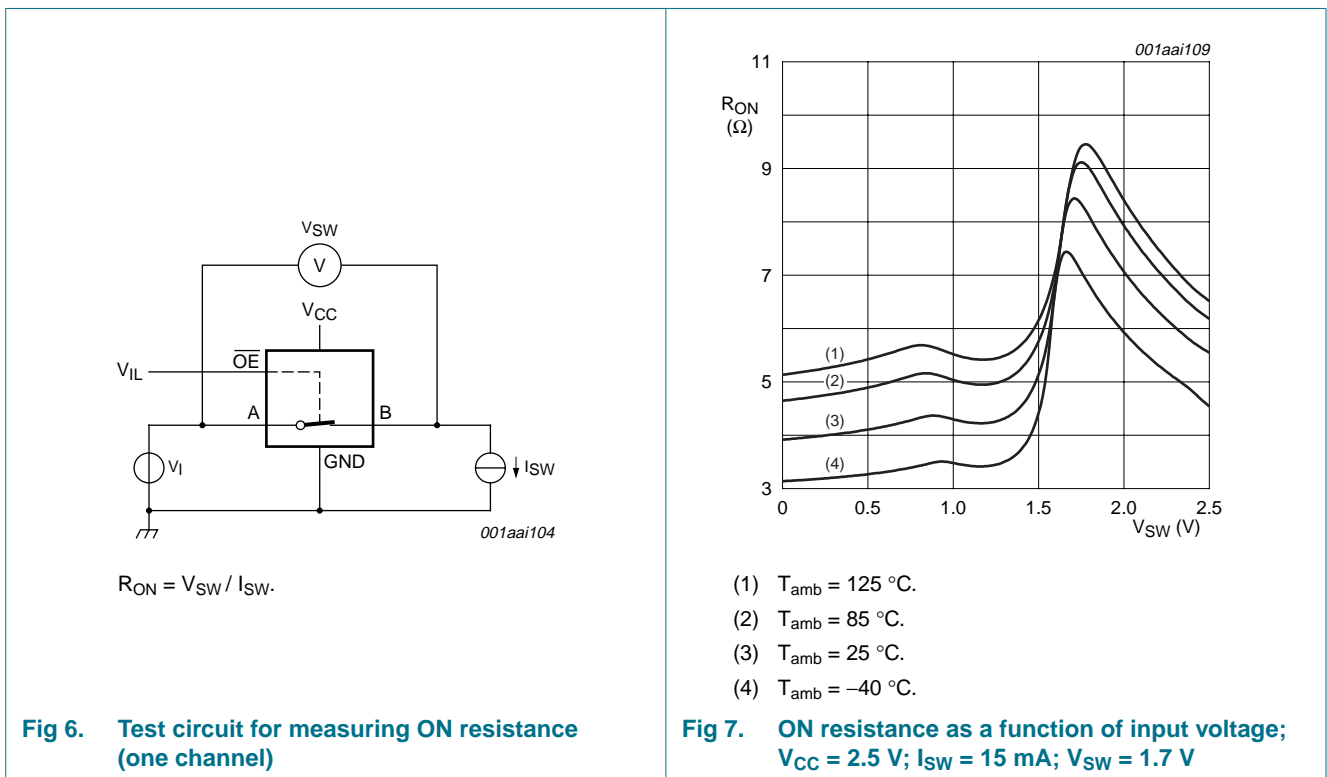
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for test circuit see Figure 6.

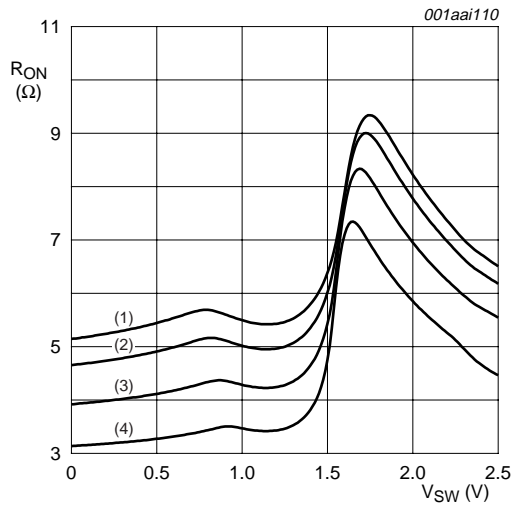
Symbol	Parameter	Conditions	$T_{amb} = -40\text{ }^{\circ}\text{C to }+85\text{ }^{\circ}\text{C}$			$T_{amb} = -40\text{ }^{\circ}\text{C to }+125\text{ }^{\circ}\text{C}$		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
$R_{ON}$	ON resistance	$V_{CC} = 2.3\text{ V to }2.7\text{ V};$ see Figure 7 to Figure 9						
		$I_{SW} = 64\text{ mA}; V_I = 0\text{ V}$	-	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	-	60.0	$\Omega$
		$V_{CC} = 3.0\text{ V to }3.6\text{ V};$ see Figure 10 to Figure 12						
		$I_{SW} = 64\text{ mA}; V_I = 0\text{ V}$	-	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	-	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.

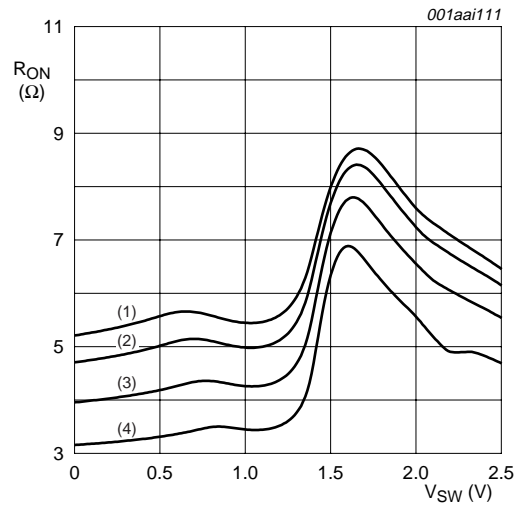
9.3 ON resistance test circuit and graphs





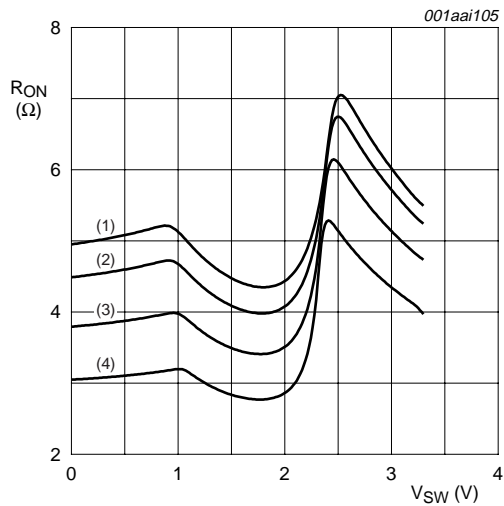
- (1)  $T_{amb} = 125\text{ }^{\circ}\text{C}.$
- (2)  $T_{amb} = 85\text{ }^{\circ}\text{C}.$
- (3)  $T_{amb} = 25\text{ }^{\circ}\text{C}.$
- (4)  $T_{amb} = -40\text{ }^{\circ}\text{C}.$

**Fig 8. ON resistance as a function of input voltage;**  
 $V_{CC} = 2.5\text{ V}; I_{SW} = 24\text{ mA}; V_{SW} = 0\text{ V}$



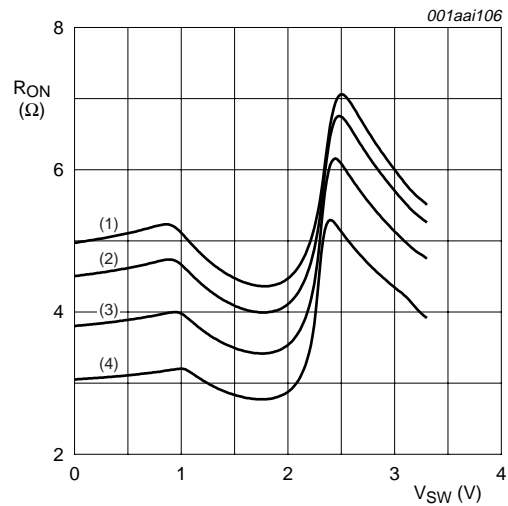
- (1)  $T_{amb} = 125\text{ }^{\circ}\text{C}.$
- (2)  $T_{amb} = 85\text{ }^{\circ}\text{C}.$
- (3)  $T_{amb} = 25\text{ }^{\circ}\text{C}.$
- (4)  $T_{amb} = -40\text{ }^{\circ}\text{C}.$

**Fig 9. ON resistance as a function of input voltage;**  
 $V_{CC} = 2.5\text{ V}; I_{SW} = 64\text{ mA}; V_{SW} = 1.7\text{ V}$



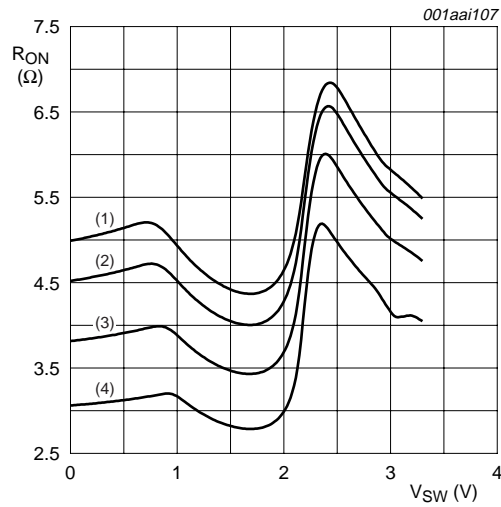
- (1)  $T_{amb} = 125\text{ }^{\circ}\text{C}.$
- (2)  $T_{amb} = 85\text{ }^{\circ}\text{C}.$
- (3)  $T_{amb} = 25\text{ }^{\circ}\text{C}.$
- (4)  $T_{amb} = -40\text{ }^{\circ}\text{C}.$

**Fig 10. ON resistance as a function of input voltage;**  
 $V_{CC} = 3.3\text{ V}; I_{SW} = 15\text{ mA}; V_{SW} = 2.4\text{ V}$



- (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;**  
 $V_{CC} = 3.3\text{ V}; I_{SW} = 24\text{ mA}; V_{SW} = 0\text{ V}$



- (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;  $V_{CC} = 3.3\text{ V}$ ;  $I_{SW} = 64\text{ mA}$ ;  $V_{SW} = 1.7\text{ V}$

## 10. Dynamic characteristics

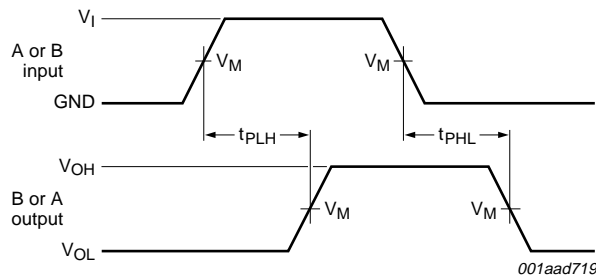
Table 8. Dynamic characteristics

$GND = 0\text{ V}$ ; see Figure 15

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	A to B or B to A; see Figure 13	[2][3]					
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	-	-	0.13	-	0.2	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	-	-	0.2	-	0.31	ns
$t_{en}$	enable time	$\overline{OE}$ to A or B; see Figure 14	[4]					
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.0	2.0	7.0	1.0	7.8	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	1.7	6.2	1.0	6.8	ns
$t_{dis}$	disable time	$\overline{OE}$ to A or B; see Figure 14	[5]					
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.0	2.6	7.2	1.0	8.1	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	3.0	7.7	1.0	8.8	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 maximum 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

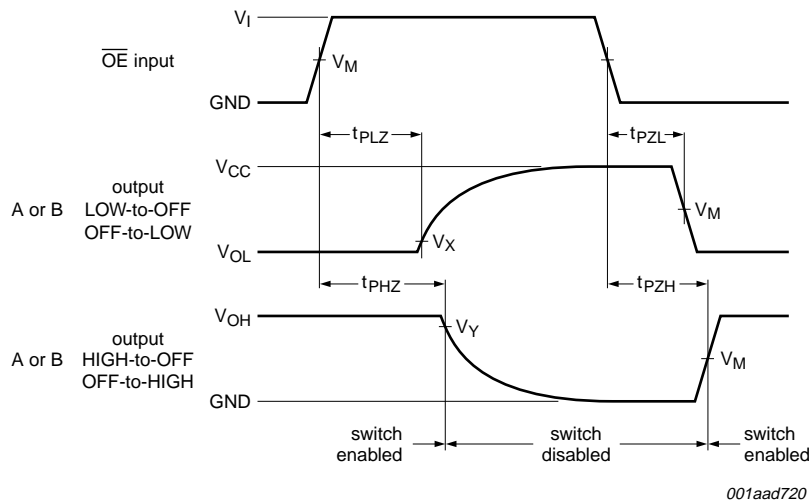


Measurement points are given in [Table 9](#).  
 Logic levels:  $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

Fig 13. The data input (A or B) to output (B or A) propagation delays

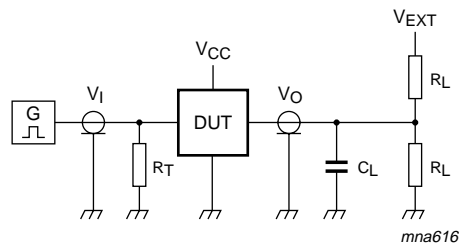
Table 9. Measurement points

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 14. 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.

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

**Fig 15. Test circuit for 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

TSSOP56: plastic thin shrink small outline package; 56 leads; body width 6.1 mm

SOT364-1

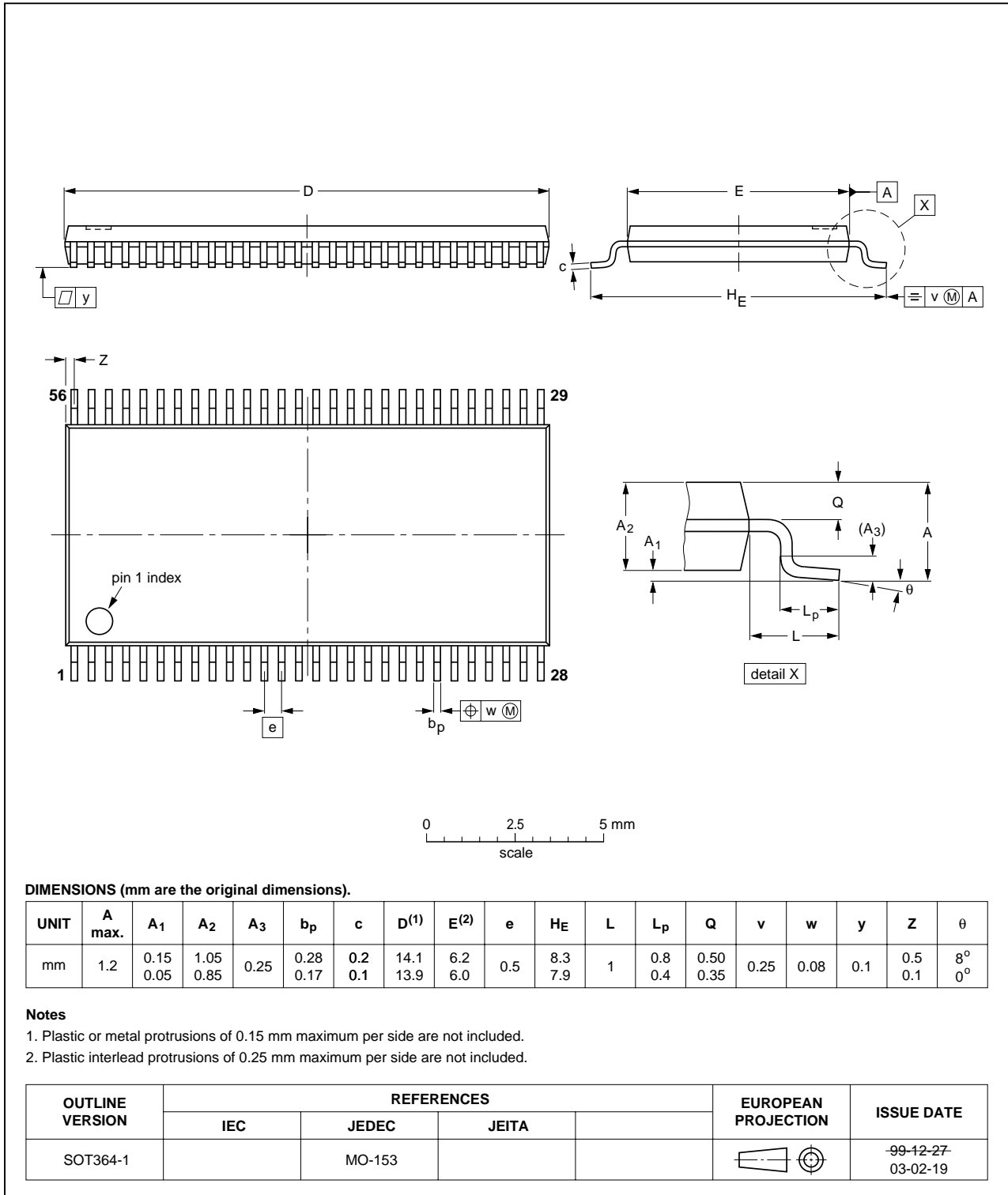


Fig 16. Package outline SOT364-1 (TSSOP56)

TSSOP56: plastic thin shrink small outline package; 56 leads; body width 4.4 mm

SOT481-2

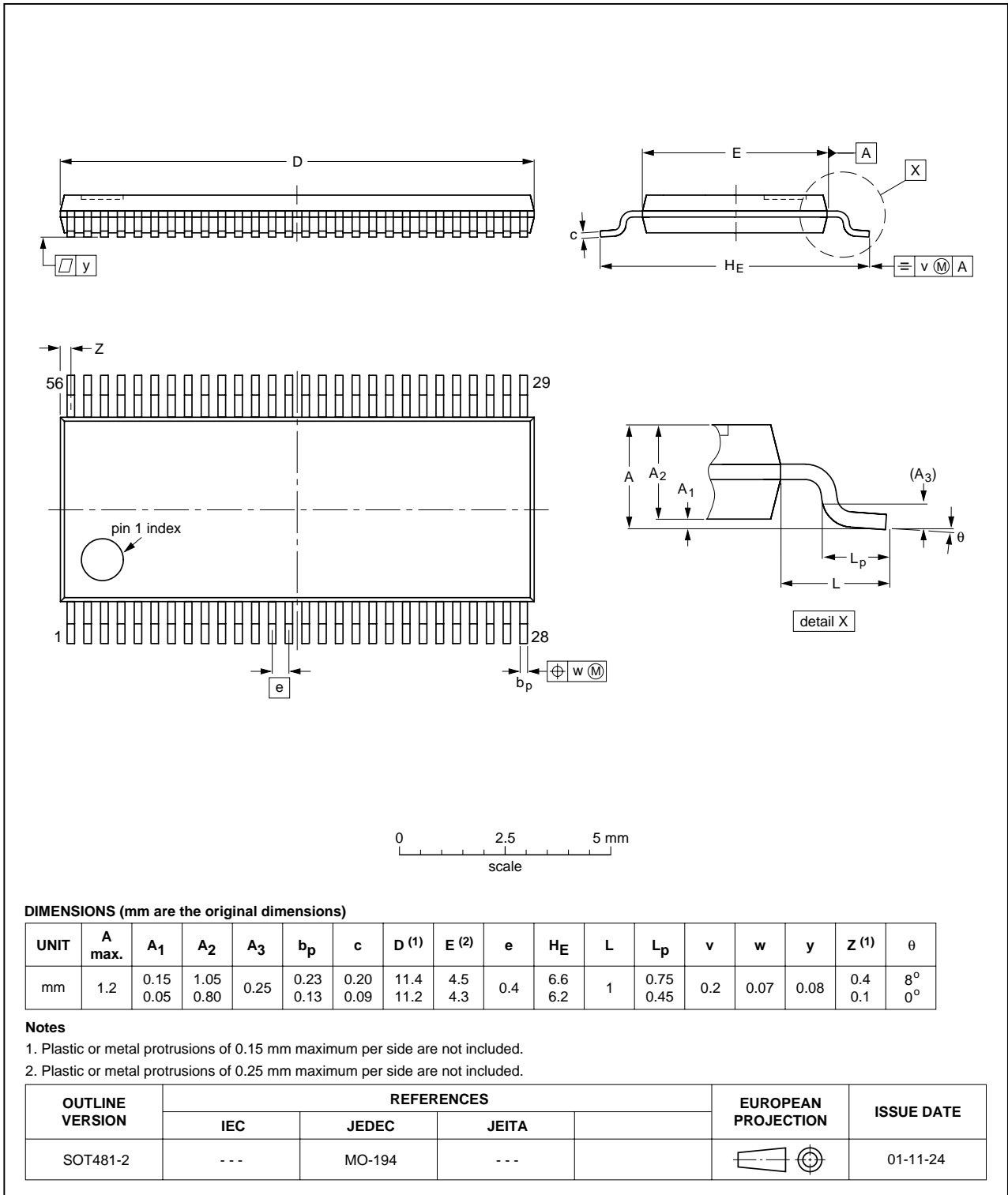


Fig 17. Package outline SOT481-2 (TSSOP56)

## 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
TTL	Transistor-Transistor Logic

## 14. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74CBTLV16211_1	20080620	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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