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Kind regards,

Team Nexperia

# 74AVC2T45

**Dual-bit, dual-supply voltage level translator/transceiver;  
3-state**

Rev. 7 — 8 February 2013

Product data sheet

## 1. General description

The 74AVC2T45 is a dual-bit, dual-supply transceiver that enables bidirectional level translation. It features two data input-output ports (nA and nB), a direction control input (DIR) and dual-supply pins ( $V_{CC(A)}$  and  $V_{CC(B)}$ ). Both  $V_{CC(A)}$  and  $V_{CC(B)}$  can be supplied at any voltage between 0.8 V and 3.6 V making the device suitable for translating between any of the low voltage nodes (0.8 V, 1.2 V, 1.5 V, 1.8 V, 2.5 V and 3.3 V). Pins nA and DIR are referenced to  $V_{CC(A)}$  and pins nB are referenced to  $V_{CC(B)}$ . A HIGH on DIR allows transmission from nA to nB and a LOW on DIR allows transmission from nB to nA.

The device is fully specified for partial power-down applications using  $I_{OFF}$ . The  $I_{OFF}$  circuitry disables the output, preventing any damaging backflow current through the device when it is powered down. In Suspend mode when either  $V_{CC(A)}$  or  $V_{CC(B)}$  are at GND level, both A and B are in the high-impedance OFF-state.

## 2. Features and benefits

- Wide supply voltage range:
  - ◆  $V_{CC(A)}$ : 0.8 V to 3.6 V
  - ◆  $V_{CC(B)}$ : 0.8 V to 3.6 V
- High noise immunity
- Complies with JEDEC standards:
  - ◆ JESD8-12 (0.8 V to 1.3 V)
  - ◆ JESD8-11 (0.9 V to 1.65 V)
  - ◆ JESD8-7 (1.2 V to 1.95 V)
  - ◆ JESD8-5 (1.8 V to 2.7 V)
  - ◆ JESD8-B (2.7 V to 3.6 V)
- ESD protection:
  - ◆ HBM JESD22-A114F Class 3B exceeds 8000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
  - ◆ CDM JESD22-C101C exceeds 1000 V
- Maximum data rates:
  - ◆ 500 Mbit/s (1.8 V to 3.3 V translation)
  - ◆ 320 Mbit/s (<1.8 V to 3.3 V translation)
  - ◆ 320 Mbit/s (translate to 2.5 V or 1.8 V)
  - ◆ 280 Mbit/s (translate to 1.5 V)
  - ◆ 240 Mbit/s (translate to 1.2 V)
- Suspend mode
- Latch-up performance exceeds 100 mA per JESD 78 Class II



- Inputs accept voltages up to 3.6 V
- Low noise overshoot and undershoot < 10 % of  $V_{CC}$
- $I_{OFF}$  circuitry provides partial Power-down mode operation
- Multiple package options
- Specified from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  and  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

### 3. Ordering information

Table 1. Ordering information

Type number	Package				Version
	Temperature range	Name	Description		
74AVC2T45DP	$-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	TSSOP8	plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm		SOT505-2
74AVC2T45DC	$-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm		SOT765-1
74AVC2T45GT	$-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	XSON8	plastic extremely thin small outline package; no leads; 8 terminals; body $1 \times 1.95 \times 0.5$ mm		SOT833-1
74AVC2T45GF	$-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	XSON8	extremely thin small outline package; no leads; 8 terminals; body $1.35 \times 1 \times 0.5$ mm		SOT1089
74AVC2T45GD	$-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	XSON8	plastic extremely thin small outline package; no leads; 8 terminals; body $3 \times 2 \times 0.5$ mm		SOT996-2
74AVC2T45GN	$-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	XSON8	extremely thin small outline package; no leads; 8 terminals; body $1.2 \times 1.0 \times 0.35$ mm		SOT1116
74AVC2T45GS	$-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	XSON8	extremely thin small outline package; no leads; 8 terminals; body $1.35 \times 1.0 \times 0.35$ mm		SOT1203

### 4. Marking

Table 2. Marking

Type number	Marking code <sup>[1]</sup>
74AVC2T45DP	B45
74AVC2T45DC	B45
74AVC2T45GT	B45
74AVC2T45GF	B5
74AVC2T45GD	B45
74AVC2T45GN	B5
74AVC2T45GS	B5

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

## 5. Functional diagram

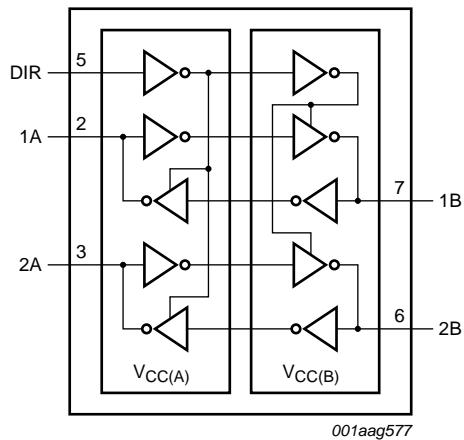


Fig 1. Logic symbol

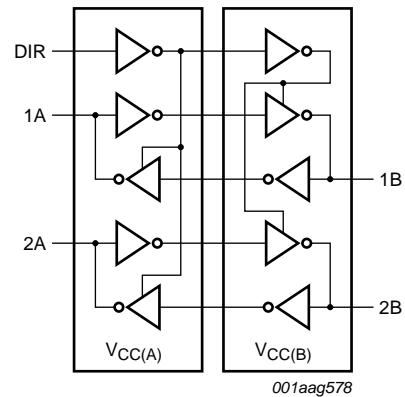


Fig 2. Logic diagram

## 6. Pinning information

### 6.1 Pinning

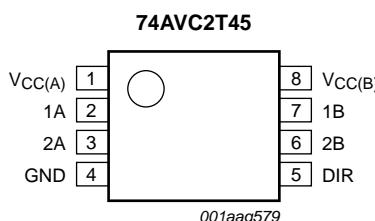


Fig 3. Pin configuration SOT505-2 and SOT765-1

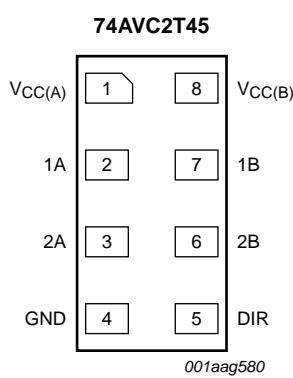


Fig 4. Pin configuration SOT833-1, SOT1089, SOT1116 and SOT1203

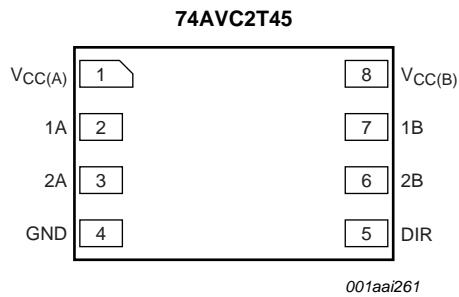


Fig 5. Pin configuration SOT996-2

## 6.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
$V_{CC(A)}$	1	supply voltage A (referenced to pins 1A, 2A and DIR)
1A	2	data input or output
2A	3	data input or output
GND	4	ground (0 V)
DIR	5	direction control
2B	6	data input or output
1B	7	data input or output
$V_{CC(B)}$	8	supply voltage B (referenced to pins 1B and 2B)

## 7. Functional description

Table 4. Function table<sup>[1]</sup>

Supply voltage	Input	Input/output <sup>[2]</sup>	
$V_{CC(A)}, V_{CC(B)}$	DIR <sup>[3]</sup>	$nA$	$nB$
0.8 V to 3.6 V	L	$nA = nB$	input
0.8 V to 3.6 V	H	input	$nB = nA$
GND <sup>[4]</sup>	X	Z	Z

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care; Z = high-impedance OFF-state.

[2] The input circuit of the data I/O is always active.

[3] The DIR input circuit is referenced to  $V_{CC(A)}$ .

[4] If at least one of  $V_{CC(A)}$  or  $V_{CC(B)}$  is at GND level, the device goes into Suspend mode.

## 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	
$V_{CC(A)}$	supply voltage A		-0.5	+4.6	V	
$V_{CC(B)}$	supply voltage B		-0.5	+4.6	V	
$I_{IK}$	input clamping current	$V_I < 0$ V	-50	-	mA	
$V_I$	input voltage		[1]	-0.5	+4.6	V
$I_{OK}$	output clamping current	$V_O < 0$ V	-50	-	mA	
$V_O$	output voltage	Active mode	[1][2][3]	-0.5	$V_{CCO} + 0.5$	V
		Suspend or 3-state mode	[1]	-0.5	+4.6	V
$I_O$	output current	$V_O = 0$ V to $V_{CCO}$	-	$\pm 50$	mA	
$I_{CC}$	supply current	$I_{CC(A)}$ or $I_{CC(B)}$	-	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	[4]	-	250	mW

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

[2]  $V_{CCO}$  is the supply voltage associated with the output port.

[3]  $V_{CCO} + 0.5$  V should not exceed 4.6 V.

[4] For TSSOP8 package: above 55 °C the value of  $P_{tot}$  derates linearly at 2.5 mW/K.

For VSSOP8 package: above 110 °C the value of  $P_{tot}$  derates linearly with 8 mW/K.

For XSON8 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**

Symbol	Parameter	Conditions	Min	Max	Unit	
$V_{CC(A)}$	supply voltage A		0.8	3.6	V	
$V_{CC(B)}$	supply voltage B		0.8	3.6	V	
$V_I$	input voltage		0	3.6	V	
$V_O$	output voltage	Active mode	[1]	0	$V_{CCO}$	V
		Suspend or 3-state mode	0	3.6	V	
$T_{amb}$	ambient temperature		-40	+125	°C	
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CCI} = 0.8$ V to 3.6 V	[2]	-	5	ns/V

[1]  $V_{CCO}$  is the supply voltage associated with the output port.

[2]  $V_{CCI}$  is the supply voltage associated with the input port.

## 10. Static characteristics

**Table 7. Typical static characteristics at  $T_{amb} = 25^{\circ}\text{C}$** <sup>[1][2]</sup>

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$ $I_O = -1.5 \text{ mA}$ ; $V_{CC(A)} = V_{CC(B)} = 0.8 \text{ V}$	-	0.69	-	V	
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}$ or $V_{IL}$ $I_O = 1.5 \text{ mA}$ ; $V_{CC(A)} = V_{CC(B)} = 0.8 \text{ V}$	-	0.07	-	V	
$I_I$	input leakage current	DIR input; $V_I = 0 \text{ V}$ or $3.6 \text{ V}$ ; $V_{CC(A)} = V_{CC(B)} = 0.8 \text{ V}$ to $3.6 \text{ V}$	-	$\pm 0.025$	$\pm 0.25$	$\mu\text{A}$	
$I_{OZ}$	OFF-state output current	A or B port; $V_O = 0 \text{ V}$ or $V_{CCO}$ ; $V_{CC(A)} = V_{CC(B)} = 0.8 \text{ V}$ to $3.6 \text{ V}$	[3]	-	$\pm 0.5$	$\pm 2.5$	$\mu\text{A}$
$I_{OFF}$	power-off leakage current	A port; $V_I$ or $V_O = 0 \text{ V}$ to $3.6 \text{ V}$ ; $V_{CC(A)} = 0 \text{ V}$ ; $V_{CC(B)} = 0.8 \text{ V}$ to $3.6 \text{ V}$		-	$\pm 0.1$	$\pm 1$	$\mu\text{A}$
$I_{OFF}$	power-off leakage current	B port; $V_I$ or $V_O = 0 \text{ V}$ to $3.6 \text{ V}$ ; $V_{CC(B)} = 0 \text{ V}$ ; $V_{CC(A)} = 0.8 \text{ V}$ to $3.6 \text{ V}$		-	$\pm 0.1$	$\pm 1$	$\mu\text{A}$
$C_I$	input capacitance	DIR input; $V_I = 0 \text{ V}$ or $3.3 \text{ V}$ ; $V_{CC(A)} = V_{CC(B)} = 3.3 \text{ V}$	-	1.0	-	pF	
$C_{I/O}$	input/output capacitance	A and B port; Suspend mode; $V_O = V_{CCO}$ or GND; $V_{CC(A)} = V_{CC(B)} = 3.3 \text{ V}$	-	4.0	-	pF	

[1]  $V_{CCO}$  is the supply voltage associated with the output port.

[2]  $V_{CCI}$  is the supply voltage associated with the data input port.

[3] For I/O ports, the parameter  $I_{OZ}$  includes the input leakage current.

**Table 8. Static characteristics**<sup>[1][2]</sup>

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

Symbol	Parameter	Conditions	-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Max	Min	Max	
$V_{IH}$	HIGH-level input voltage	data input					
		$V_{CCI} = 0.8 \text{ V}$	0.70 $V_{CCI}$	-	0.70 $V_{CCI}$	-	V
		$V_{CCI} = 1.1 \text{ V}$ to $1.95 \text{ V}$	0.65 $V_{CCI}$	-	0.65 $V_{CCI}$	-	V
		$V_{CCI} = 2.3 \text{ V}$ to $2.7 \text{ V}$	1.6	-	1.6	-	V
		$V_{CCI} = 3.0 \text{ V}$ to $3.6 \text{ V}$	2	-	2	-	V
	DIR input						
		$V_{CC(A)} = 0.8 \text{ V}$	0.70 $V_{CC(A)}$	-	0.70 $V_{CC(A)}$	-	V
		$V_{CC(A)} = 1.1 \text{ V}$ to $1.95 \text{ V}$	0.65 $V_{CC(A)}$	-	0.65 $V_{CC(A)}$	-	V
		$V_{CC(A)} = 2.3 \text{ V}$ to $2.7 \text{ V}$	1.6	-	1.6	-	V
		$V_{CC(A)} = 3.0 \text{ V}$ to $3.6 \text{ V}$	2	-	2	-	V

**Table 8. Static characteristics ...continued<sup>[1][2]</sup>**

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

Symbol	Parameter	Conditions	-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Max	Min	Max	
V <sub>IL</sub>	LOW-level input voltage	data input					
		V <sub>CCI</sub> = 0.8 V	-	0.30V <sub>CCI</sub>	-	0.30V <sub>CCI</sub>	V
		V <sub>CCI</sub> = 1.1 V to 1.95 V	-	0.35V <sub>CCI</sub>	-	0.35V <sub>CCI</sub>	V
		V <sub>CCI</sub> = 2.3 V to 2.7 V	-	0.7	-	0.7	V
		V <sub>CCI</sub> = 3.0 V to 3.6 V	-	0.9	-	0.9	V
		DIR input					
		V <sub>CC(A)</sub> = 0.8 V	-	0.30V <sub>CC(A)</sub>	-	0.30V <sub>CC(A)</sub>	V
		V <sub>CC(A)</sub> = 1.1 V to 1.95 V	-	0.35V <sub>CC(A)</sub>	-	0.35V <sub>CC(A)</sub>	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>					
		I <sub>O</sub> = -100 $\mu$ A; V <sub>CC(A)</sub> = V <sub>CC(B)</sub> = 0.8 V to 3.6 V	V <sub>CCO</sub> - 0.1	-	V <sub>CCO</sub> - 0.1	-	V
		I <sub>O</sub> = -3 mA; V <sub>CC(A)</sub> = V <sub>CC(B)</sub> = 1.1 V	0.85	-	0.85	-	V
		I <sub>O</sub> = -6 mA; V <sub>CC(A)</sub> = V <sub>CC(B)</sub> = 1.4 V	1.05	-	1.05	-	V
		I <sub>O</sub> = -8 mA; V <sub>CC(A)</sub> = V <sub>CC(B)</sub> = 1.65 V	1.2	-	1.2	-	V
		I <sub>O</sub> = -9 mA; V <sub>CC(A)</sub> = V <sub>CC(B)</sub> = 2.3 V	1.75	-	1.75	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC(A)</sub> = V <sub>CC(B)</sub> = 3.0 V	2.3	-	2.3	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>					
		I <sub>O</sub> = 100 $\mu$ A; V <sub>CC(A)</sub> = V <sub>CC(B)</sub> = 0.8 V to 3.6 V	-	0.1	-	0.1	V
		I <sub>O</sub> = 3 mA; V <sub>CC(A)</sub> = V <sub>CC(B)</sub> = 1.1 V	-	0.25	-	0.25	V
		I <sub>O</sub> = 6 mA; V <sub>CC(A)</sub> = V <sub>CC(B)</sub> = 1.4 V	-	0.35	-	0.35	V
		I <sub>O</sub> = 8 mA; V <sub>CC(A)</sub> = V <sub>CC(B)</sub> = 1.65 V	-	0.45	-	0.45	V
		I <sub>O</sub> = 9 mA; V <sub>CC(A)</sub> = V <sub>CC(B)</sub> = 2.3 V	-	0.55	-	0.55	V
		I <sub>O</sub> = 12 mA; V <sub>CC(A)</sub> = V <sub>CC(B)</sub> = 3.0 V	-	0.7	-	0.7	V
I <sub>I</sub>	input leakage current	DIR input; V <sub>I</sub> = 0 V or 3.6 V; V <sub>CC(A)</sub> = V <sub>CC(B)</sub> = 0.8 V to 3.6 V	-	$\pm$ 1	-	$\pm$ 1.5	$\mu$ A
I <sub>OZ</sub>	OFF-state output current	A or B port; V <sub>O</sub> = 0 V or V <sub>CCO</sub> ; V <sub>CC(A)</sub> = V <sub>CC(B)</sub> = 3.6 V	[3]	-	$\pm$ 5	-	$\pm$ 7.5 $\mu$ A
I <sub>OFF</sub>	power-off leakage current	A port; V <sub>I</sub> or V <sub>O</sub> = 0 V to 3.6 V; V <sub>CC(A)</sub> = 0 V; V <sub>CC(B)</sub> = 0.8 V to 3.6 V	-	$\pm$ 5	-	$\pm$ 35	$\mu$ A
		B port; V <sub>I</sub> or V <sub>O</sub> = 0 V to 3.6 V; V <sub>CC(B)</sub> = 0 V; V <sub>CC(A)</sub> = 0.8 V to 3.6 V	-	$\pm$ 5	-	$\pm$ 35	$\mu$ A

**Table 8. Static characteristics ...continued**<sup>[1][2]</sup>

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

Symbol	Parameter	Conditions	-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Max	Min	Max	
I <sub>CC</sub>	supply current	A port; V <sub>I</sub> = 0 V or V <sub>CCI</sub> ; I <sub>O</sub> = 0 A					
		V <sub>CC(A)</sub> = 0.8 V to 3.6 V; V <sub>CC(B)</sub> = 0.8 V to 3.6 V	-	8	-	11.5	µA
		V <sub>CC(A)</sub> = 3.6 V; V <sub>CC(B)</sub> = 0 V	-	8	-	11.5	µA
		V <sub>CC(A)</sub> = 0 V; V <sub>CC(B)</sub> = 3.6 V	-2	-	-8	-	µA
		B port; V <sub>I</sub> = 0 V or V <sub>CCI</sub> ; I <sub>O</sub> = 0 A					
		V <sub>CC(A)</sub> = 0.8 V to 3.6 V; V <sub>CC(B)</sub> = 0.8 V to 3.6 V	-	8	-	11.5	µA
		V <sub>CC(A)</sub> = 3.6 V; V <sub>CC(B)</sub> = 0 V	-2	-	-8	-	µA
		V <sub>CC(A)</sub> = 0 V; V <sub>CC(B)</sub> = 3.6 V	-	8	-	11.5	µA
		A plus B port (I <sub>CC(A)</sub> + I <sub>CC(B)</sub> ); I <sub>O</sub> = 0 A; V <sub>I</sub> = 0 V or V <sub>CCI</sub> ; V <sub>CC(A)</sub> = 0.8 V to 3.6 V; V <sub>CC(B)</sub> = 0.8 V to 3.6 V	-	16	-	23	µA

[1] V<sub>CCO</sub> is the supply voltage associated with the output port.[2] V<sub>CCI</sub> is the supply voltage associated with the data input port.[3] For I/O ports, the parameter I<sub>OZ</sub> includes the input leakage current.

## 11. Dynamic characteristics

**Table 9. Typical dynamic characteristics at  $V_{CC(A)} = 0.8$  V and  $T_{amb} = 25$  °C [1]**

Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 8](#); for wave forms see [Figure 6](#) and [Figure 7](#)

Symbol	Parameter	Conditions	$V_{CC(B)}$						Unit
			0.8 V	1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	
$t_{pd}$	propagation delay	A to B	15.5	8.1	7.6	7.7	8.4	9.2	ns
		B to A	15.5	12.7	12.3	12.2	12.0	11.8	ns
$t_{dis}$	disable time	DIR to A	12.2	12.2	12.2	12.2	12.2	12.2	ns
		DIR to B	11.7	7.9	7.6	8.2	8.7	10.2	ns
$t_{en}$	enable time	DIR to A	27.2	20.6	19.9	20.4	20.7	22.0	ns
		DIR to B	27.7	20.3	19.8	19.9	20.6	21.4	ns

[1]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ ;  $t_{dis}$  is the same as  $t_{PLZ}$  and  $t_{PHZ}$ ;  $t_{en}$  is the same as  $t_{PZL}$  and  $t_{PZH}$ .  
 $t_{en}$  is a calculated value using the formula shown in [Section 13.4 "Enable times"](#)

**Table 10. Typical dynamic characteristics at  $V_{CC(B)} = 0.8$  V and  $T_{amb} = 25$  °C [1]**

Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 8](#); for wave forms see [Figure 6](#) and [Figure 7](#)

Symbol	Parameter	Conditions	$V_{CC(A)}$						Unit
			0.8 V	1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	
$t_{pd}$	propagation delay	A to B	15.5	12.7	12.3	12.2	12.0	11.8	ns
		B to A	15.5	8.1	7.6	7.7	8.4	9.2	ns
$t_{dis}$	disable time	DIR to A	12.2	4.9	3.8	3.7	2.8	3.4	ns
		DIR to B	11.7	9.2	9.0	8.8	8.7	8.6	ns
$t_{en}$	enable time	DIR to A	27.2	17.3	16.6	16.5	17.1	17.8	ns
		DIR to B	27.7	17.6	16.1	15.9	14.8	15.2	ns

[1]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ ;  $t_{dis}$  is the same as  $t_{PLZ}$  and  $t_{PHZ}$ ;  $t_{en}$  is the same as  $t_{PZL}$  and  $t_{PZH}$ .  
 $t_{en}$  is a calculated value using the formula shown in [Section 13.4 "Enable times"](#)

**Table 11. Typical power dissipation capacitance at  $V_{CC(A)} = V_{CC(B)}$  and  $T_{amb} = 25$  °C [1][2]**

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

Symbol	Parameter	Conditions	$V_{CC(A)}$ and $V_{CC(B)}$						Unit
			0.8 V	1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	
$C_{PD}$	power dissipation capacitance	A port: (direction A to B); B port: (direction B to A)	1	2	2	2	2	2	pF
		A port: (direction B to A); B port: (direction A to B)	9	11	11	12	14	17	pF

[1]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu$ W).

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

$C_L$  = 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 the outputs.

[2]  $f_i = 10$  MHz;  $V_i = \text{GND to } V_{CC}$ ;  $t_r = t_f = 1$  ns;  $C_L = 0$  pF;  $R_L = \infty$   $\Omega$ .

Table 12. Dynamic characteristics for temperature range  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  [1]Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 8](#); for wave forms see [Figure 6](#) and [Figure 7](#).

Symbol	Parameter	Conditions	V <sub>CC(B)</sub>										Unit	
			1.2 V $\pm$ 0.1 V		1.5 V $\pm$ 0.1 V		1.8 V $\pm$ 0.15 V		2.5 V $\pm$ 0.2 V		3.3 V $\pm$ 0.3 V			
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
<b>V<sub>CC(A)</sub> = 1.1 V to 1.3 V</b>														
t <sub>pd</sub>	propagation delay	A to B	1.0	9.0	0.7	6.8	0.6	6.1	0.5	5.7	0.5	6.1	ns	
		B to A	1.0	9.0	0.8	8.0	0.7	7.7	0.6	7.2	0.5	7.1	ns	
t <sub>dis</sub>	disable time	DIR to A	2.2	8.8	2.2	8.8	2.2	8.8	2.2	8.8	2.2	8.8	ns	
		DIR to B	2.2	8.4	1.8	6.7	2.0	6.9	1.7	6.2	2.4	7.2	ns	
t <sub>en</sub>	enable time	DIR to A	-	17.4	-	14.7	-	14.6	-	13.4	-	14.3	ns	
		DIR to B	-	17.8	-	15.6	-	14.9	-	14.5	-	14.9	ns	
<b>V<sub>CC(A)</sub> = 1.4 V to 1.6 V</b>														
t <sub>pd</sub>	propagation delay	A to B	1.0	8.0	0.7	5.4	0.6	4.6	0.5	3.7	0.5	3.5	ns	
		B to A	1.0	6.8	0.8	5.4	0.7	5.1	0.6	4.7	0.5	4.5	ns	
t <sub>dis</sub>	disable time	DIR to A	1.6	6.3	1.6	6.3	1.6	6.3	1.6	6.3	1.6	6.3	ns	
		DIR to B	2.0	7.6	1.8	5.9	1.6	6.0	1.2	4.8	1.7	5.5	ns	
t <sub>en</sub>	enable time	DIR to A	-	14.4	-	11.3	-	11.1	-	9.5	-	10.0	ns	
		DIR to B	-	14.3	-	11.7	-	10.9	-	10.0	-	9.8	ns	
<b>V<sub>CC(A)</sub> = 1.65 V to 1.95 V</b>														
t <sub>pd</sub>	propagation delay	A to B	1.0	7.7	0.6	5.1	0.5	4.3	0.5	3.4	0.5	3.1	ns	
		B to A	1.0	6.1	0.7	4.6	0.5	4.4	0.5	3.9	0.5	3.7	ns	
t <sub>dis</sub>	disable time	DIR to A	1.6	5.5	1.6	5.5	1.6	5.5	1.6	5.5	1.6	5.5	ns	
		DIR to B	1.8	7.7	1.8	5.7	1.4	5.8	1.0	4.5	1.5	5.2	ns	
t <sub>en</sub>	enable time	DIR to A	-	13.8	-	10.3	-	10.2	-	8.4	-	8.9	ns	
		DIR to B	-	13.2	-	10.6	-	9.8	-	8.9	-	8.6	ns	
<b>V<sub>CC(A)</sub> = 2.3 V to 2.7 V</b>														
t <sub>pd</sub>	propagation delay	A to B	1.0	7.2	0.5	4.7	0.5	3.9	0.5	3.0	0.5	2.6	ns	
		B to A	1.0	5.7	0.6	3.8	0.5	3.4	0.5	3.0	0.5	2.8	ns	
t <sub>dis</sub>	disable time	DIR to A	1.5	4.2	1.5	4.2	1.5	4.2	1.5	4.2	1.5	4.2	ns	
		DIR to B	1.7	7.3	2.0	5.2	1.5	5.1	0.6	4.2	1.1	4.8	ns	
t <sub>en</sub>	enable time	DIR to A	-	13.0	-	9.0	-	8.5	-	7.2	-	7.6	ns	
		DIR to B	-	11.4	-	8.9	-	8.1	-	7.2	-	6.8	ns	
<b>V<sub>CC(A)</sub> = 3.0 V to 3.6 V</b>														
t <sub>pd</sub>	propagation delay	A to B	1.0	7.1	0.5	4.5	0.5	3.7	0.5	2.8	0.5	2.4	ns	
		B to A	1.0	6.1	0.6	3.6	0.5	3.1	0.5	2.6	0.5	2.4	ns	
t <sub>dis</sub>	disable time	DIR to A	1.5	4.7	1.5	4.7	1.5	4.7	1.5	4.7	1.5	4.7	ns	
		DIR to B	1.7	7.2	0.7	5.5	0.6	5.5	0.7	4.1	1.7	4.7	ns	
t <sub>en</sub>	enable time	DIR to A	-	13.3	-	9.1	-	8.6	-	6.7	-	7.1	ns	
		DIR to B	-	11.8	-	9.2	-	8.4	-	7.5	-	7.1	ns	

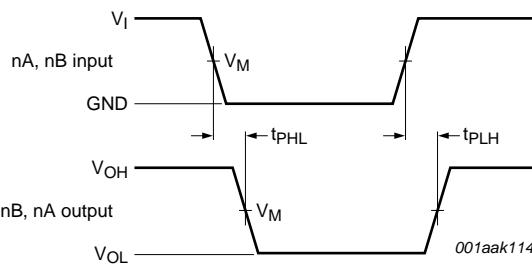
[1] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>; t<sub>dis</sub> is the same as t<sub>PLZ</sub> and t<sub>PHZ</sub>; t<sub>en</sub> is the same as t<sub>PZL</sub> and t<sub>PZH</sub>.  
t<sub>en</sub> is a calculated value using the formula shown in [Section 13.4 "Enable times"](#)

Table 13. Dynamic characteristics for temperature range  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  [1]Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 8](#); for wave forms see [Figure 6](#) and [Figure 7](#)

Symbol	Parameter	Conditions	V <sub>CC(B)</sub>										Unit	
			1.2 V $\pm$ 0.1 V		1.5 V $\pm$ 0.1 V		1.8 V $\pm$ 0.15 V		2.5 V $\pm$ 0.2 V		3.3 V $\pm$ 0.3 V			
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
<b>V<sub>CC(A)</sub> = 1.1 V to 1.3 V</b>														
t <sub>pd</sub>	propagation delay	A to B	1.0	9.9	0.7	7.5	0.6	6.8	0.5	6.3	0.5	6.8	ns	
		B to A	1.0	9.9	0.8	8.8	0.7	8.5	0.6	8.0	0.5	7.9	ns	
t <sub>dis</sub>	disable time	DIR to A	2.2	9.7	2.2	9.7	2.2	9.7	2.2	9.7	2.2	9.7	ns	
		DIR to B	2.2	9.2	1.8	7.4	2.0	7.6	1.7	6.9	2.4	8.0	ns	
t <sub>en</sub>	enable time	DIR to A	-	19.1	-	16.2	-	16.1	-	14.9	-	15.9	ns	
		DIR to B	-	19.6	-	17.2	-	16.5	-	16.0	-	16.5	ns	
<b>V<sub>CC(A)</sub> = 1.4 V to 1.6 V</b>														
t <sub>pd</sub>	propagation delay	A to B	1.0	8.8	0.7	6.0	0.6	5.1	0.5	4.1	0.5	3.9	ns	
		B to A	1.0	7.5	0.8	6.0	0.7	5.7	0.6	5.2	0.5	5.0	ns	
t <sub>dis</sub>	disable time	DIR to A	1.6	7.0	1.6	7.0	1.6	7.0	1.6	7.0	1.6	7.0	ns	
		DIR to B	2.0	8.3	1.8	6.5	1.6	6.6	1.2	5.3	1.7	6.1	ns	
t <sub>en</sub>	enable time	DIR to A	-	15.8	-	12.5	-	12.3	-	10.5	-	11.1	ns	
		DIR to B	-	15.8	-	13.0	-	12.1	-	11.1	-	10.9	ns	
<b>V<sub>CC(A)</sub> = 1.65 V to 1.95 V</b>														
t <sub>pd</sub>	propagation delay	A to B	1.0	8.5	0.6	5.7	0.5	4.8	0.5	3.8	0.5	3.5	ns	
		B to A	1.0	6.8	0.7	5.1	0.5	4.9	0.5	4.3	0.5	4.1	ns	
t <sub>dis</sub>	disable time	DIR to A	1.6	6.1	1.6	6.1	1.6	6.1	1.6	6.1	1.6	6.1	ns	
		DIR to B	1.8	8.5	1.8	6.3	1.4	6.4	1.0	5.0	1.5	5.8	ns	
t <sub>en</sub>	enable time	DIR to A	-	15.3	-	11.4	-	11.3	-	9.3	-	9.9	ns	
		DIR to B	-	14.6	-	11.8	-	10.9	-	9.9	-	9.6	ns	
<b>V<sub>CC(A)</sub> = 2.3 V to 2.7 V</b>														
t <sub>pd</sub>	propagation delay	A to B	1.0	8.0	0.5	5.2	0.5	4.3	0.5	3.3	0.5	2.9	ns	
		B to A	1.0	6.3	0.6	4.2	0.5	3.8	0.5	3.3	0.5	3.1	ns	
t <sub>dis</sub>	disable time	DIR to A	1.5	4.7	1.5	4.7	1.5	4.7	1.5	4.7	1.5	4.7	ns	
		DIR to B	1.7	8.0	2.0	5.8	1.5	5.7	0.6	4.7	1.1	5.3	ns	
t <sub>en</sub>	enable time	DIR to A	-	14.3	-	10.0	-	9.5	-	8.0	-	8.4	ns	
		DIR to B	-	12.7	-	9.9	-	9.0	-	8.0	-	7.6	ns	
<b>V<sub>CC(A)</sub> = 3.0 V to 3.6 V</b>														
t <sub>pd</sub>	propagation delay	A to B	1.0	7.9	0.5	5.0	0.5	4.1	0.5	3.1	0.5	2.7	ns	
		B to A	1.0	6.8	0.6	4.0	0.5	3.5	0.5	2.9	0.5	2.7	ns	
t <sub>dis</sub>	disable time	DIR to A	1.5	5.2	1.5	5.2	1.5	5.2	1.5	5.2	1.5	5.2	ns	
		DIR to B	1.7	7.9	0.7	6.1	0.6	6.1	0.7	4.6	1.7	5.2	ns	
t <sub>en</sub>	enable time	DIR to A	-	14.7	-	10.1	-	9.6	-	7.5	-	7.9	ns	
		DIR to B	-	13.1	-	10.2	-	9.3	-	8.3	-	7.9	ns	

[1] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>; t<sub>dis</sub> is the same as t<sub>PLZ</sub> and t<sub>PHZ</sub>; t<sub>en</sub> is the same as t<sub>PZL</sub> and t<sub>PZH</sub>.  
t<sub>en</sub> is a calculated value using the formula shown in [Section 13.4 "Enable times"](#)

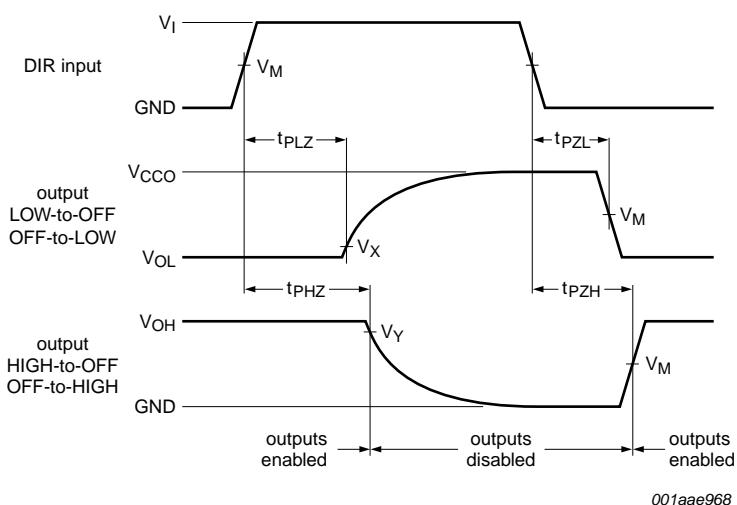
## 12. Waveforms



Measurement points are given in [Table 14](#).

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

**Fig 6. The data input (nA, nB) to output (nB, nA) propagation delay times**



Measurement points are given in [Table 14](#).

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

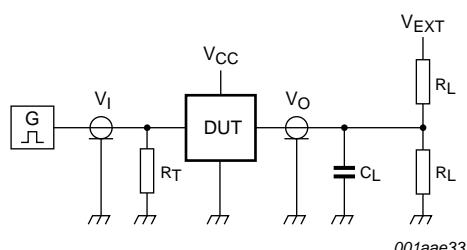
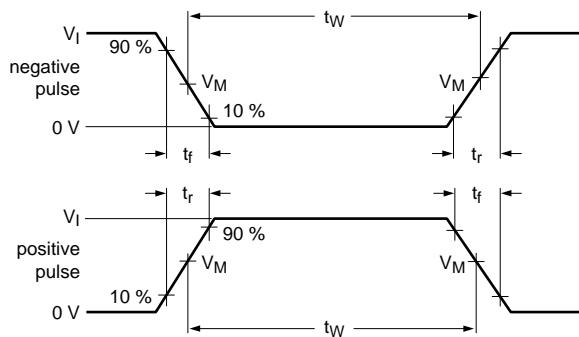
**Fig 7. Enable and disable times**

**Table 14. Measurement points**

Supply voltage	Input <sup>[1]</sup>	Output <sup>[2]</sup>		
$V_{CC(A)}, V_{CC(B)}$	$V_M$	$V_M$	$V_X$	$V_Y$
1.1 V to 1.6 V	$0.5V_{CCI}$	$0.5V_{CCO}$	$V_{OL} + 0.1$ V	$V_{OH} - 0.1$ V
1.65 V to 2.7 V	$0.5V_{CCI}$	$0.5V_{CCO}$	$V_{OL} + 0.15$ V	$V_{OH} - 0.15$ V
3.0 V to 3.6 V	$0.5V_{CCI}$	$0.5V_{CCO}$	$V_{OL} + 0.3$ V	$V_{OH} - 0.3$ V

[1]  $V_{CCI}$  is the supply voltage associated with the data input port.

[2]  $V_{CCO}$  is the supply voltage associated with the output port.



Test data is given in [Table 15](#).

$R_L$  = Load resistance.

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

$R_T$  = Termination resistance.

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

**Fig 8. Test circuit for measuring switching times**

**Table 15. Test data**

Supply voltage	Input	Load		$V_{EXT}$		
$V_{CC(A)}$ , $V_{CC(B)}$	$V_I^{[1]}$	$\Delta t/\Delta V^{[2]}$	$C_L$	$R_L$	$t_{PLH}$ , $t_{PHL}$	$t_{PZH}$ , $t_{PHZ}$
1.1 V to 1.6 V	$V_{CCI}$	$\leq 1.0 \text{ ns/V}$	15 pF	2 k $\Omega$	open	GND
1.65 V to 2.7 V	$V_{CCI}$	$\leq 1.0 \text{ ns/V}$	15 pF	2 k $\Omega$	open	GND
3.0 V to 3.6 V	$V_{CCI}$	$\leq 1.0 \text{ ns/V}$	15 pF	2 k $\Omega$	open	2 $V_{CCO}$

[1]  $V_{CCI}$  is the supply voltage associated with the data input port.

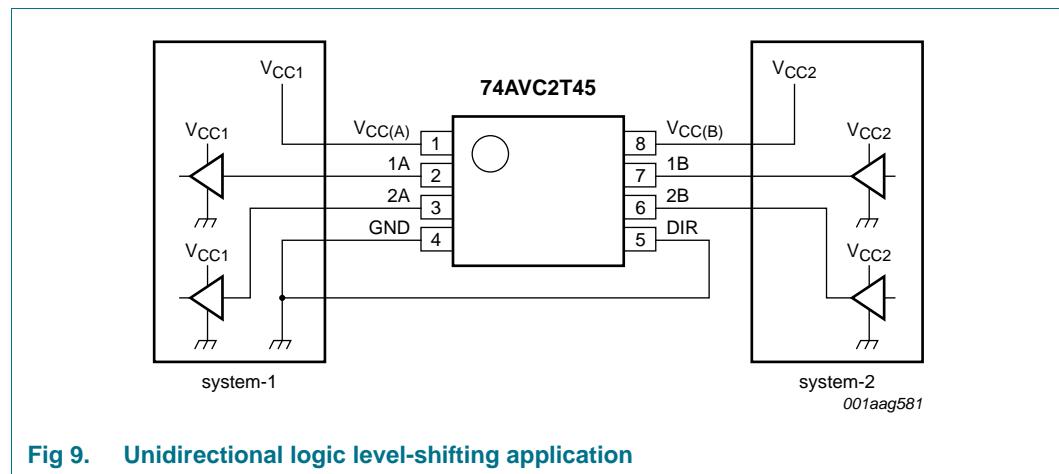
[2]  $dV/dt \geq 1.0 \text{ V/ns}$

[3]  $V_{CCO}$  is the supply voltage associated with the output port.

## 13. Application information

### 13.1 Unidirectional logic level-shifting application

The circuit given in [Figure 9](#) is an example of the 74AVC2T45 being used in an unidirectional logic level-shifting application.



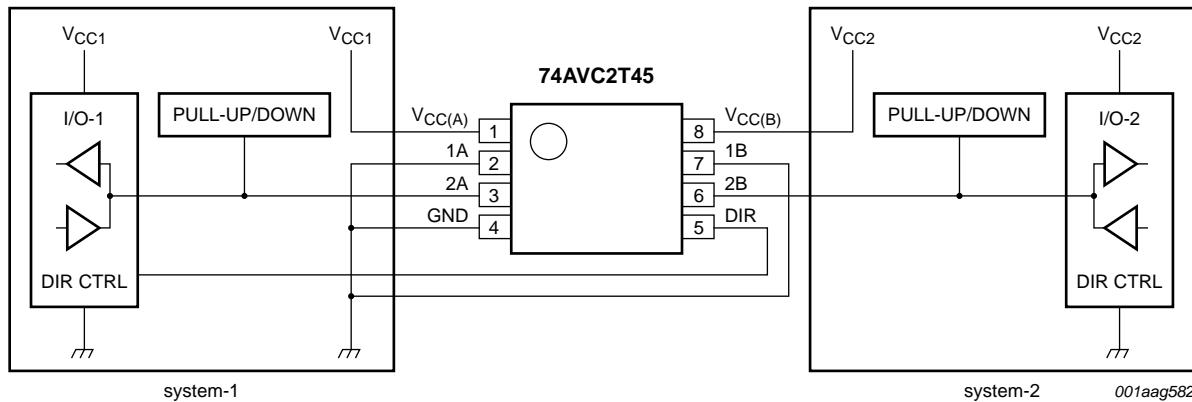
**Fig 9. Unidirectional logic level-shifting application**

**Table 16. Unidirectional logic level-shifting application**

Pin	Name	Function	Description
1	V <sub>CC(A)</sub>	V <sub>CC1</sub>	supply voltage of system-1 (0.8 V to 3.6 V)
2	1A	OUT1	output level depends on V <sub>CC1</sub> voltage
3	2A	OUT2	output level depends on V <sub>CC1</sub> voltage
4	GND	GND	device GND
5	DIR	DIR	the GND (LOW level) determines B port to A port direction
6	2B	IN2	input threshold value depends on V <sub>CC2</sub> voltage
7	1B	IN1	input threshold value depends on V <sub>CC2</sub> voltage
8	V <sub>CC(B)</sub>	V <sub>CC2</sub>	supply voltage of system-2 (0.8 V to 3.6 V)

### 13.2 Bidirectional logic level-shifting application

Figure 10 shows the 74AVC2T45 being used in a bidirectional logic level-shifting application. Since the device does not have an output enable (OE) pin, the system designer should take precautions to avoid bus contention between system-1 and system-2 when changing directions.



System-1 and system-2 must use the same conditions, i.e., both pull-up or both pull-down.

**Fig 10. Bidirectional logic level-shifting application**

Table 17 gives a sequence that will illustrate data transmission from system-1 to system-2 and then from system-2 to system-1.

**Table 17. Bidirectional logic level-shifting application<sup>[1][2]</sup>**

State	DIR CTRL	I/O-1	I/O-2	Description
1	H	output	input	system-1 data to system-2
2	H	Z	Z	system-2 is getting ready to send data to system-1. I/O-1 and I/O-2 are disabled. The bus-line state depends on the pull-up or pull-down.
3	L	Z	Z	DIR bit is set LOW. I/O-1 and I/O-2 still are disabled. The bus-line state depends on the pull-up or pull-down.
4	L	input	output	system-2 data to system-1

[1] System-1 and system-2 must use the same conditions, i.e., both pull-up or both pull-down.

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

### 13.3 Power-up considerations

The device is designed such that no special power-up sequence is required other than GND being applied first.

**Table 18. Typical total supply current ( $I_{CC(A)} + I_{CC(B)}$ )**

$V_{CC(A)}$	$V_{CC(B)}$							Unit
	0 V	0.8 V	1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	
0 V	0	0.1	0.1	0.1	0.1	0.1	0.1	$\mu A$
0.8 V	0.1	0.1	0.1	0.1	0.1	0.7	2.3	$\mu A$
1.2 V	0.1	0.1	0.1	0.1	0.1	0.3	1.4	$\mu A$
1.5 V	0.1	0.1	0.1	0.1	0.1	0.1	0.9	$\mu A$
1.8 V	0.1	0.1	0.1	0.1	0.1	0.1	0.5	$\mu A$
2.5 V	0.1	0.7	0.3	0.1	0.1	0.1	0.1	$\mu A$
3.3 V	0.1	2.3	1.4	0.9	0.5	0.1	0.1	$\mu A$

### 13.4 Enable times

The enable times for the 74AVC2T45 are calculated from the following formulas:

- $t_{en}$  (DIR to nA) =  $t_{dis}$  (DIR to nB) +  $t_{pd}$  (nB to nA)
- $t_{en}$  (DIR to nB) =  $t_{dis}$  (DIR to nA) +  $t_{pd}$  (nA to nB)

In a bidirectional application, these enable times provide the maximum delay from the time the DIR bit is switched until an output is expected. For example, if the 74AVC2T45 initially is transmitting from A to B, then the DIR bit is switched, the B port of the device must be disabled before presenting it with an input. After the B port has been disabled, an input signal applied to it appears on the corresponding A port after the specified propagation delay.

## 14. Package outline

TSSOP8: plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm SOT505-2

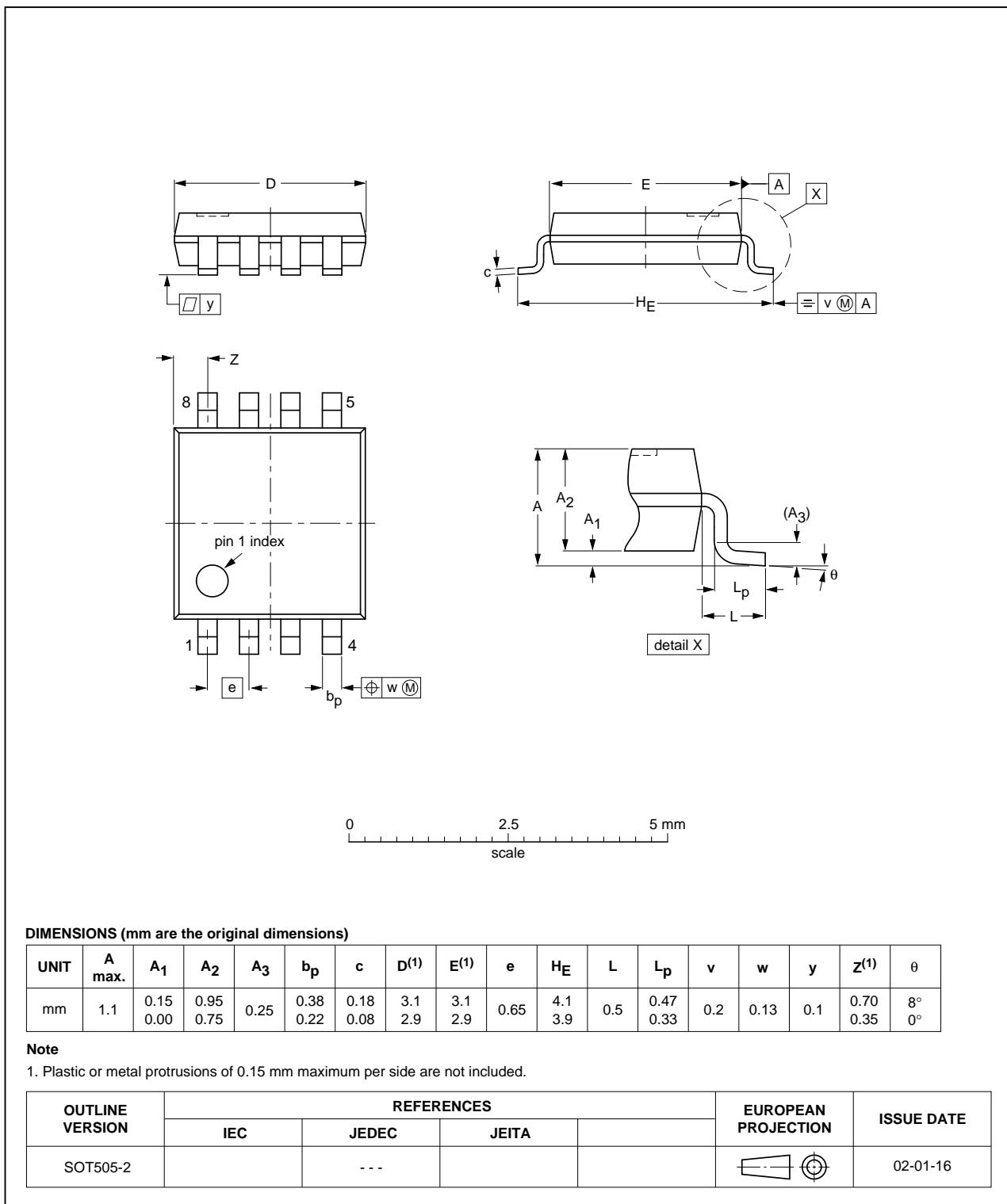
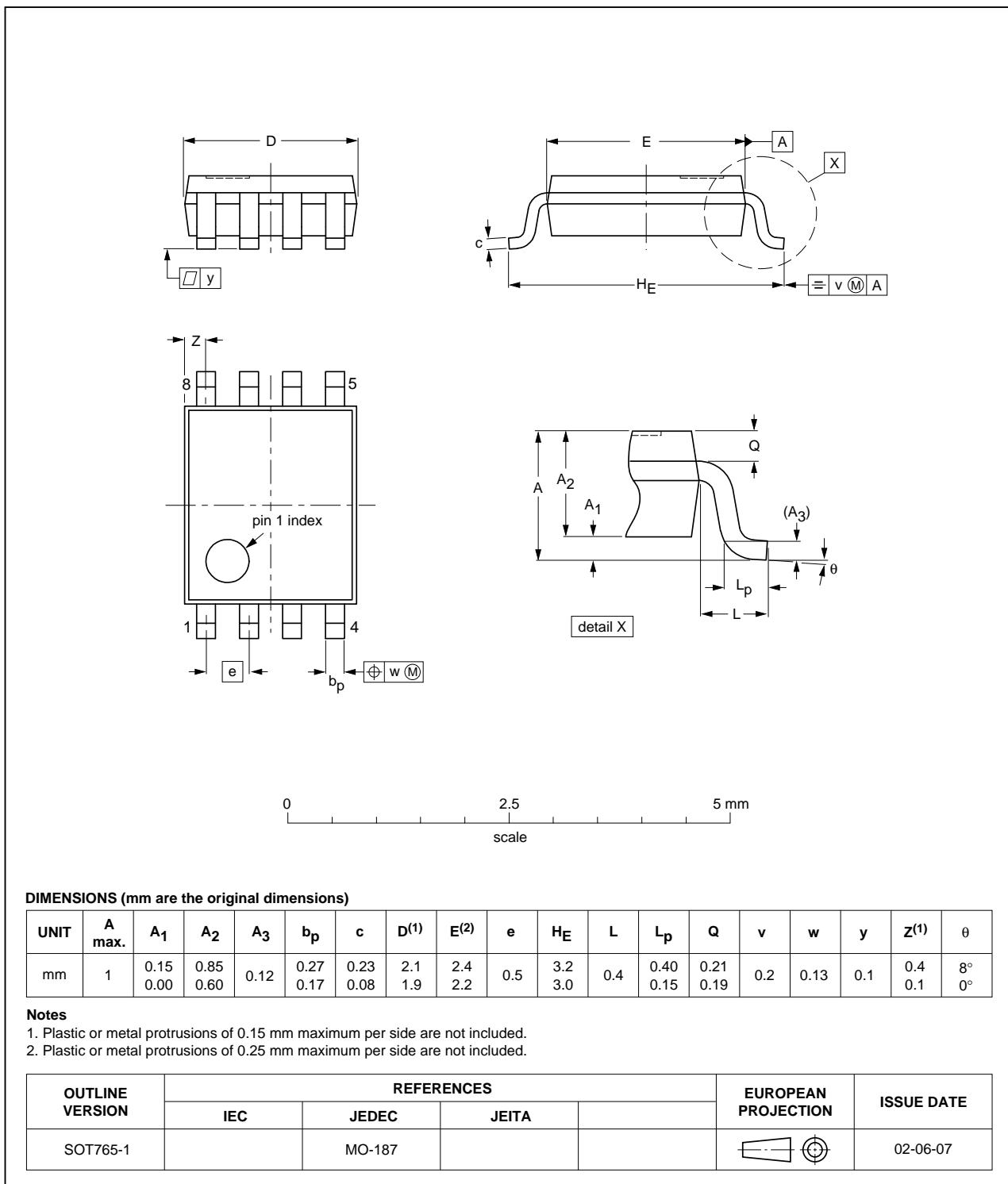


Fig 11. Package outline SOT505-2 (TSSOP8)

VSSOP8: plastic very thin shrink small outline package; 8 leads; body width 2.3 mm

SOT765-1



## DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(2)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	Z <sup>(1)</sup>	θ
mm	1	0.15	0.85	0.12	0.27	0.23	2.1	2.4	0.5	3.2	0.4	0.40	0.21	0.2	0.13	0.1	0.4	8°
	0.00	0.60	0.17	0.08	1.9	2.2	0.15	0.19		3.0	0.15	0.19	0.15	0.13	0.1	0.1	0.1	0°

## Notes

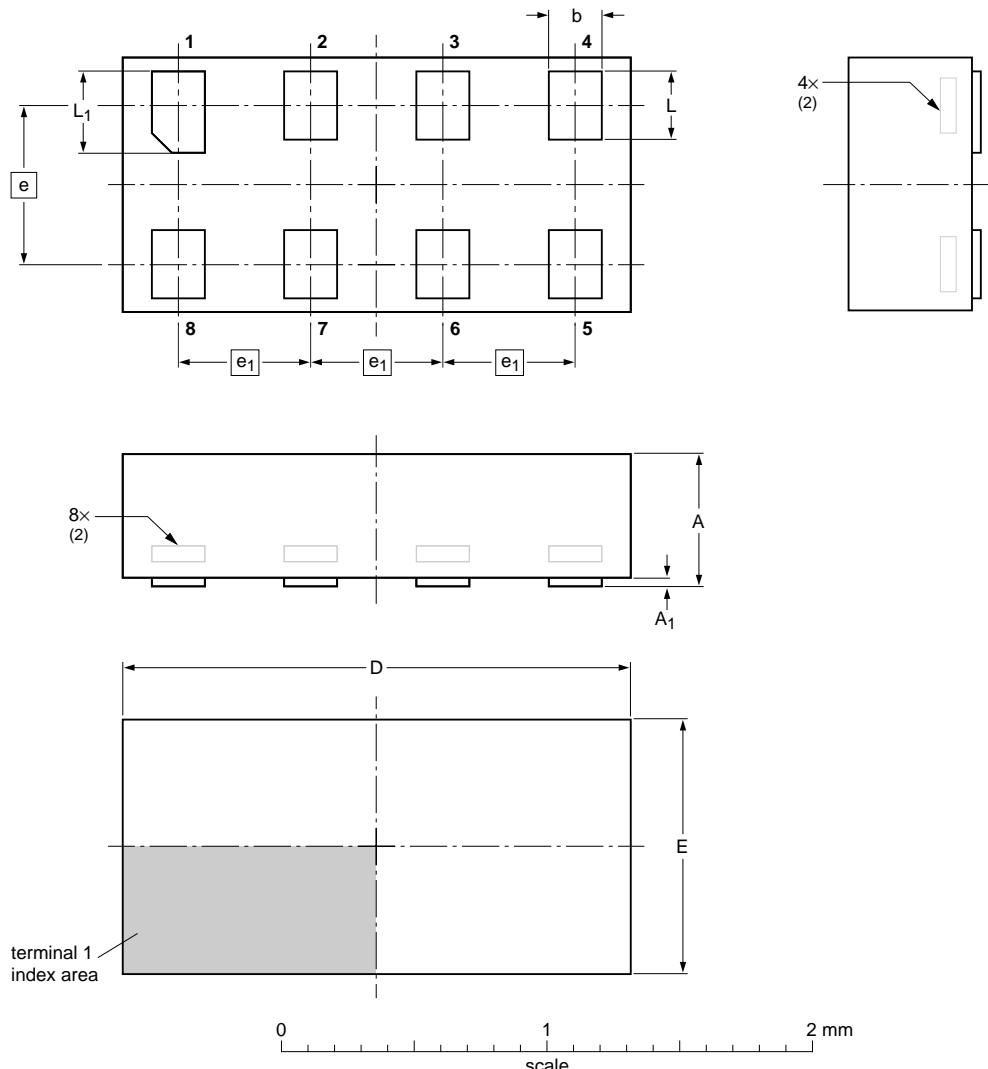
1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT765-1		MO-187				02-06-07

Fig 12. Package outline SOT765-1 (VSSOP8)

XSON8: plastic extremely thin small outline package; no leads; 8 terminals; body 1 x 1.95 x 0.5 mm

SOT833-1



## DIMENSIONS (mm are the original dimensions)

UNIT	$A^{(1)}$ max	$A_1$ max	b	D	E	e	$e_1$	L	$L_1$
mm	0.5	0.04	0.25 0.17	2.0 1.9	1.05 0.95	0.6	0.5	0.35 0.27	0.40 0.32

## Notes

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT833-1	---	MO-252	---			07-11-14 07-12-07

Fig 13. Package outline SOT833-1 (XSON8)

**XSON8: extremely thin small outline package; no leads;  
8 terminals; body 1.35 x 1 x 0.5 mm**

SOT1089

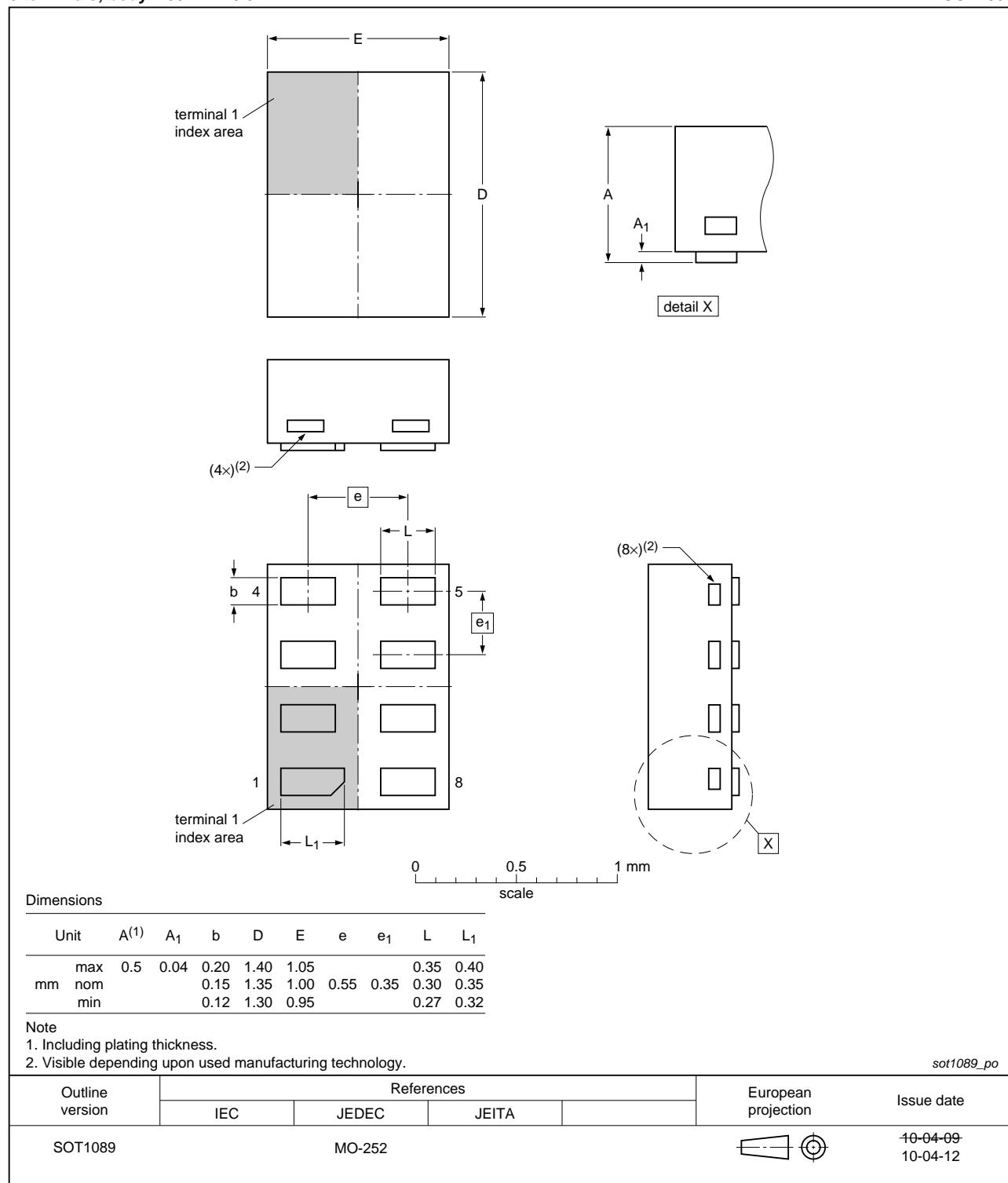


Fig 14. Package outline SOT1089 (XSON8)

XSON8: plastic extremely thin small outline package; no leads;  
8 terminals; body 3 x 2 x 0.5 mm

SOT996-2

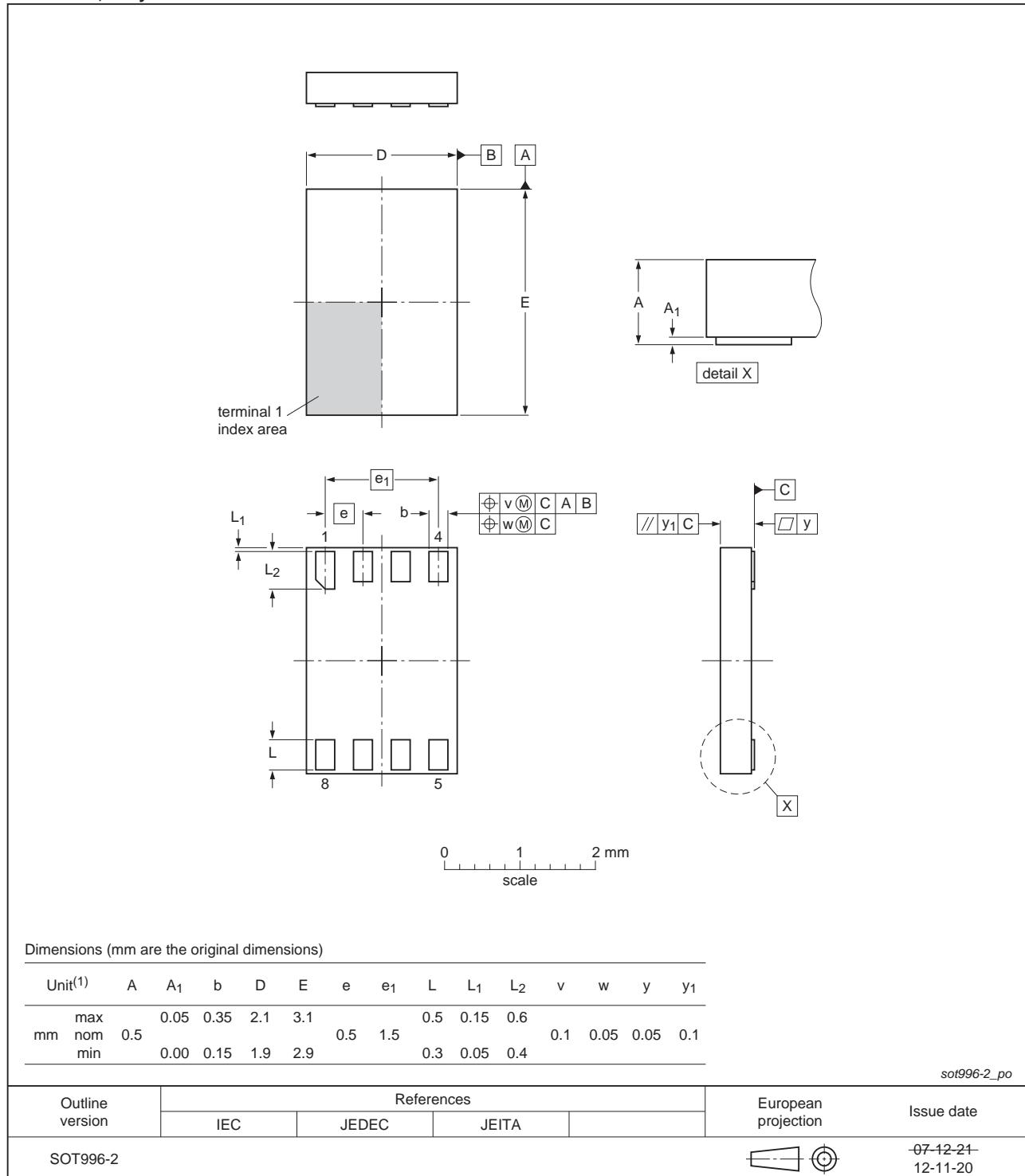
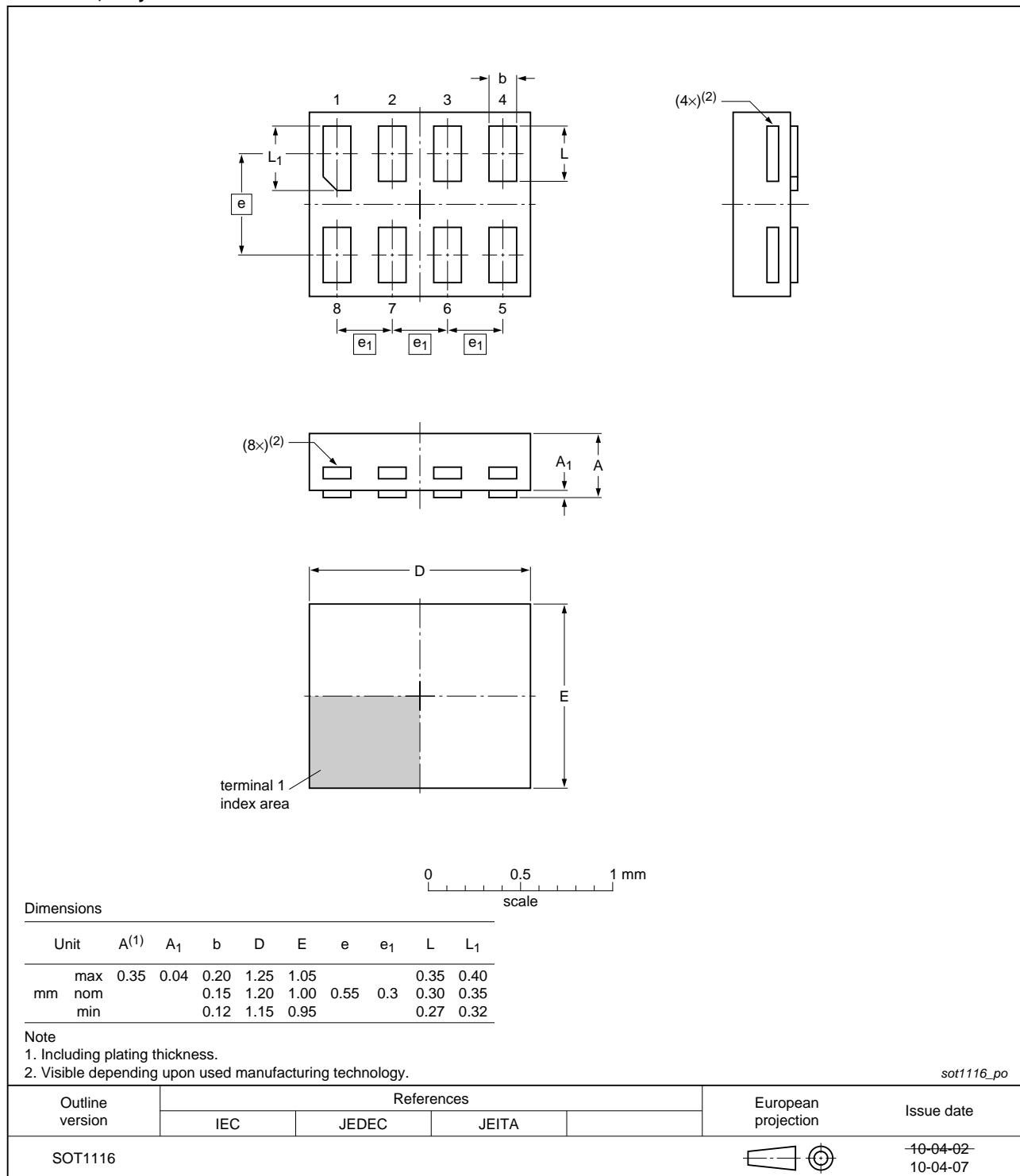


Fig 15. Package outline SOT996-2 (XSON8)

**XSON8: extremely thin small outline package; no leads;  
8 terminals; body 1.2 x 1.0 x 0.35 mm**

SOT1116



**Fig 16. Package outline SOT1116 (XSON8)**

**XSON8: extremely thin small outline package; no leads;  
8 terminals; body 1.35 x 1.0 x 0.35 mm**

SOT1203

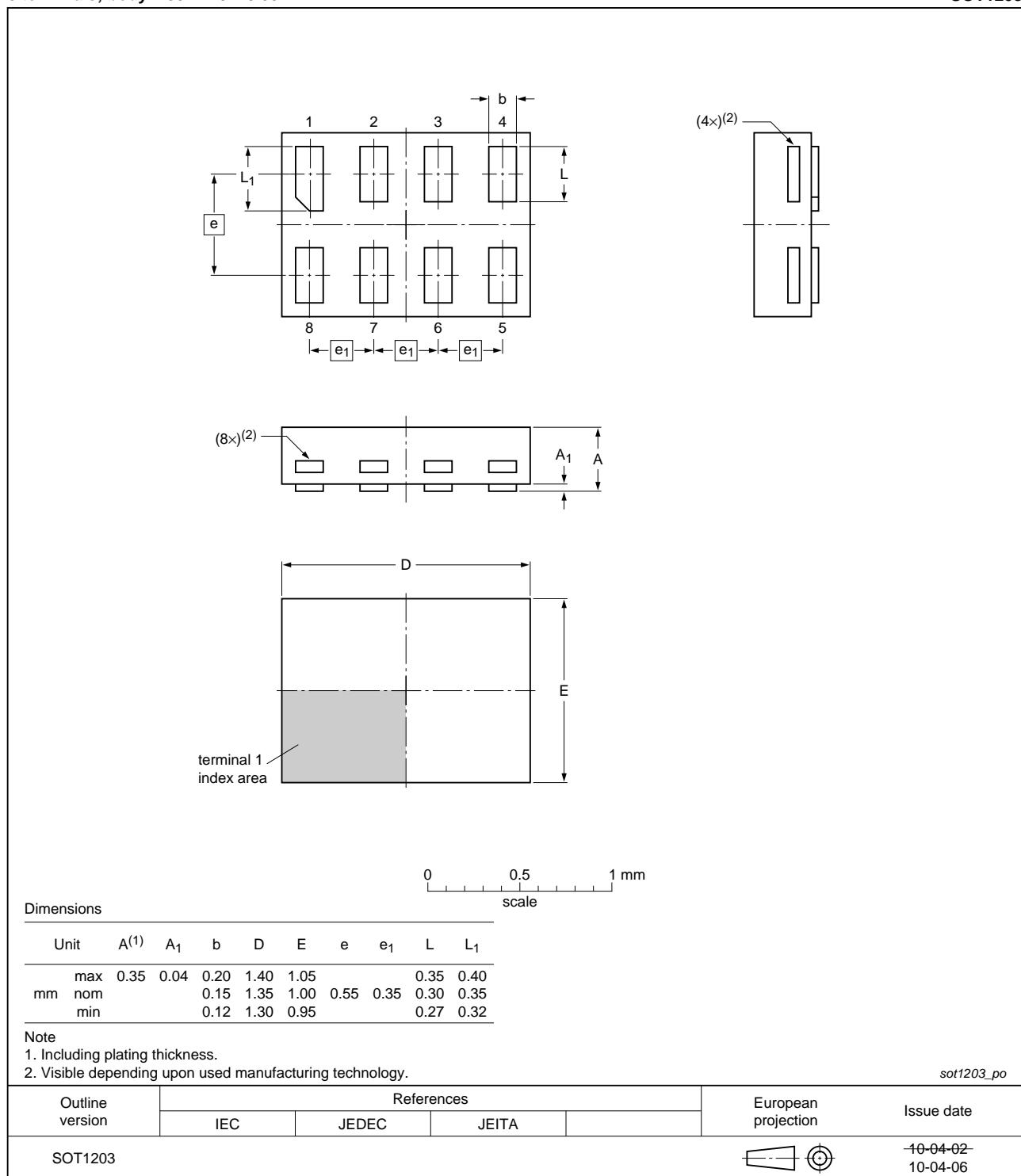


Fig 17. Package outline SOT1203 (XSON8)

## 15. Abbreviations

**Table 19. Abbreviations**

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model

## 16. Revision history

**Table 20. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AVC2T45 v.7	20130208	Product data sheet	-	74AVC2T45 v.6
Modifications:	<ul style="list-style-type: none"> <li>For type number 74AVC2T45GD XSON8U has changed to XSON8.</li> </ul>			
74AVC2T45 v.6	20111208	Product data sheet	-	74AVC2T45 v.5
74AVC2T45 v.5	20101130	Product data sheet	-	74AVC2T45 v.4
74AVC2T45 v.4	20090505	Product data sheet	-	74AVC2T45 v.3
74AVC2T45 v.3	20090129	Product data sheet	-	74AVC2T45 v.2
74AVC2T45 v.2	20080620	Product data sheet	-	74AVC2T45 v.1
74AVC2T45 v.1	20070703	Product data sheet	-	-

## 17. Legal information

### 17.1 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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