

# IP4251/52/53/54

Integrated 4-, 6- and 8-channel passive filter network with ESD protection to IEC 61000-4-2, level 4

Rev. 03 — 6 May 2009

Product data sheet

## 1. Product profile

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### 1.1 General description

The IP425x family consists of 4-, 6- and 8-channel RC low-pass filter arrays which are designed to provide filtering of undesired RF signals on the I/O ports of portable communication or computing devices. In addition, the IP425x family incorporates diodes to provide protection to downstream components from ElectroStatic Discharge (ESD) voltages as high as  $\pm 30$  kV.

The IP425x family is fabricated using monolithic silicon technology and integrates up to 8 resistors and 16 diodes in a 0.4 mm pitch 8-, 12- or 16-pin MicroPak (compatible with QFN) lead-free plastic package with a height of 0.5 mm only.

### 1.2 Features

- Pb-free, Restriction of the use of certain Hazardous Substances (RoHS) and dark green compliant
- 4-, 6- and 8-channel integrated  $\pi$ -type RC filter network
- IP4251CZ8/CZ12/CZ16: 100  $\Omega$  channel series resistance, 10 pF (at 2.5 V DC) channel capacitance
- IP4252CZ8/CZ12/CZ16: 40  $\Omega$  channel series resistance, 12 pF (at 2.5 V DC) channel capacitance
- IP4253CZ8/CZ12/CZ16: 200  $\Omega$  channel series resistance, 30 pF (at 2.5 V DC) channel capacitance
- IP4254CZ8/CZ12/CZ16: 100  $\Omega$  channel series resistance, 30 pF (at 2.5 V DC) channel capacitance
- ESD protection to  $\pm 30$  kV contact discharge according to IEC 61000-4-2 standard far exceeding level 4
- MicroPak (QFN compatible) plastic package with 0.4 mm pitch

### 1.3 Applications

- General purpose ElectroMagnetic Interference (EMI) and Radio-Frequency Interference (RFI) filtering and downstream ESD protection for:
  - ◆ Cellular and Personal Communication System (PCS) mobile handsets
  - ◆ Cordless telephones
  - ◆ Wireless data (WAN/LAN) systems
  - ◆ PDAs

## 2. Pinning information

Table 1. Pinning IP425xCZx

Pin	Description	Simplified outline	Symbol
<b>CZ8</b>			
1 and 8	filter channel 1	<p>Transparent top view</p>	<p>001aaf978</p>
2 and 7	filter channel 2		
3 and 6	filter channel 3		
4 and 5	filter channel 4		
ground pad	ground		
<b>CZ12</b>			
1 and 12	filter channel 1	<p>Transparent top view</p>	<p>001aaf979</p>
2 and 11	filter channel 2		
3 and 10	filter channel 3		
4 and 9	filter channel 4		
5 and 8	filter channel 5		
6 and 7	filter channel 6		
ground pad	ground		
<b>CZ16</b>			
1 and 16	filter channel 1	<p>Transparent top view</p>	<p>001aaf980</p>
2 and 15	filter channel 2		
3 and 14	filter channel 3		
4 and 13	filter channel 4		
5 and 12	filter channel 5		
6 and 11	filter channel 6		
7 and 10	filter channel 7		
8 and 9	filter channel 8		
ground pad	ground		

### 3. Ordering information

**Table 2. Ordering information**

Type number	Package		Version
	Name	Description	
IP4251CZ8-4	HXSON8U	plastic thermal enhanced extremely thin small outline package; no leads; 8 terminals; UTLP based; body 1.35 × 1.7 × 0.5 mm	SOT983-1
IP4251CZ12-6	HXSON12U	plastic thermal enhanced extremely thin small outline package; no leads; 12 terminals; UTLP based; body 1.35 × 2.5 × 0.5 mm	SOT984-1
IP4251CZ16-8	HXSON16U	plastic thermal enhanced extremely thin small outline package; no leads; 16 terminals; UTLP based; body 1.35 × 3.3 × 0.5 mm	SOT985-1
IP4252CZ8-4	HXSON8U	plastic thermal enhanced extremely thin small outline package; no leads; 8 terminals; UTLP based; body 1.35 × 1.7 × 0.5 mm	SOT983-1
IP4252CZ12-6	HXSON12U	plastic thermal enhanced extremely thin small outline package; no leads; 12 terminals; UTLP based; body 1.35 × 2.5 × 0.5 mm	SOT984-1
IP4252CZ16-8	HXSON16U	plastic thermal enhanced extremely thin small outline package; no leads; 16 terminals; UTLP based; body 1.35 × 3.3 × 0.5 mm	SOT985-1
IP4253CZ8-4	HXSON8U	plastic thermal enhanced extremely thin small outline package; no leads; 8 terminals; UTLP based; body 1.35 × 1.7 × 0.5 mm	SOT983-1
IP4253CZ12-6	HXSON12U	plastic thermal enhanced extremely thin small outline package; no leads; 12 terminals; UTLP based; body 1.35 × 2.5 × 0.5 mm	SOT984-1
IP4253CZ16-8	HXSON16U	plastic thermal enhanced extremely thin small outline package; no leads; 16 terminals; UTLP based; body 1.35 × 3.3 × 0.5 mm	SOT985-1
IP4254CZ8-4	HXSON8U	plastic thermal enhanced extremely thin small outline package; no leads; 8 terminals; UTLP based; body 1.35 × 1.7 × 0.5 mm	SOT983-1
IP4254CZ12-6	HXSON12U	plastic thermal enhanced extremely thin small outline package; no leads; 12 terminals; UTLP based; body 1.35 × 2.5 × 0.5 mm	SOT984-1
IP4254CZ16-8	HXSON16U	plastic thermal enhanced extremely thin small outline package; no leads; 16 terminals; UTLP based; body 1.35 × 3.3 × 0.5 mm	SOT985-1

## 4. Limiting values

**Table 3. Limiting values**

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		-0.5	+5.6	V
$V_{esd}$	electrostatic discharge voltage	all pins to ground			
		contact discharge			
		IP4251 and IP4252	[1][3] -15	+15	kV
		IP4253 and IP4254	[2][3] -30	+30	kV
		air discharge			
		IP4253 and IP4254	[2][3] -30	+30	kV
		IEC 61000-4-2, level 4; all pins to ground			
		contact discharge	-8	+8	kV
		air discharge	-15	+15	kV
$P_{ch}$	channel power dissipation	$T_{amb} = 85\text{ °C}$	-	60	mW
$P_{tot}$	total power dissipation	$T_{amb} = 85\text{ °C}$	-	200	mW
$T_{stg}$	storage temperature		-55	+150	°C
$T_{amb}$	ambient temperature		-40	+85	°C

[1] Device is qualified using contact discharges at  $\pm 15$  kV according IEC 61000-4-2 model, far exceeding level 4.

[2] Device is qualified using contact discharges at  $\pm 30$  kV according IEC 61000-4-2 model, far exceeding level 4.

[3] A special robust test is performed stressing the devices with  $\geq 1000$  contact discharges according IEC 61000-4-2 model. All devices far exceed IEC 61000-4-2, level 4.

## 5. Thermal characteristics

**Table 4. Thermal characteristics**

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-pcb)}$	thermal resistance from junction to printed-circuit board	2 layer printed-circuit board	120[1]	K/W

[1] Depends on layout details.

## 6. Characteristics

**Table 5. Channel resistance**

$T_{amb} = 25^{\circ}\text{C}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{s(\text{ch})}$	channel series resistance	IP4251CZ8/CZ12/CZ16	80	100	120	$\Omega$
		IP4252CZ8/CZ12/CZ16	32	40	48	$\Omega$
		IP4253CZ8/CZ12/CZ16	160	200	240	$\Omega$
		IP4254CZ8/CZ12/CZ16	80	100	120	$\Omega$

**Table 6. Channel characteristics**

$T_{amb} = 25^{\circ}\text{C}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{\text{ch}}$	channel capacitance	for the total channel; $f = 100\text{ kHz}$				
		$V_{\text{bias(DC)}} = 2.5\text{ V}$				
		IP4251	-	10	-	pF
		IP4252	-	12	-	pF
		IP4253 and IP4254	-	30	-	pF
		$V_{\text{bias(DC)}} = 0\text{ V}$				
		IP4251	[1] -	15	-	pF
		IP4252	[1] -	18	-	pF
		IP4253 and IP4254	[1] -	45	-	pF
		$I_{\text{LR}}$	reverse leakage current	per channel; $V_I = 3.5\text{ V}$	-	-
$V_{\text{BR}}$	breakdown voltage	positive clamp; $I_I = 1\text{ mA}$	5.8	-	9	V
$V_{\text{F}}$	forward voltage	negative clamp; $I_{\text{F}} = 1\text{ mA}$	0.4	-	1.5	V

[1] Guaranteed by design.

**Table 7. Frequency characteristics**

*T<sub>amb</sub> = 25 °C unless otherwise specified.*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>IP4251CZ8/CZ12/CZ16</b>						
$\alpha_{il}$	insertion loss	$R_{source} = 50 \Omega$ ; $R_L = 50 \Omega$				
		800 MHz < f < 3 GHz	-	16	-	dB
		f = 1 GHz	-	20	-	dB
$\alpha_{ct}$	crosstalk attenuation	$R_{source} = 50 \Omega$ ; $R_L = 50 \Omega$ ; 800 MHz < f < 3 GHz	-	30	-	dB
<b>IP4252CZ8/CZ12/CZ16</b>						
$\alpha_{il}$	insertion loss	$R_{source} = 50 \Omega$ ; $R_L = 50 \Omega$				
		800 MHz < f < 3 GHz	-	12	-	dB
		f = 1 GHz	-	14	-	dB
$\alpha_{ct}$	crosstalk attenuation	$R_{source} = 50 \Omega$ ; $R_L = 50 \Omega$ ; 800 MHz < f < 3 GHz	-	40	-	dB
<b>IP4253CZ8/CZ12/CZ16</b>						
$\alpha_{il}$	insertion loss	$R_{source} = 50 \Omega$ ; $R_L = 50 \Omega$				
		800 MHz < f < 3 GHz	-	33	-	dB
		f = 1 GHz	35	-	-	dB
$\alpha_{ct}$	crosstalk attenuation	$R_{source} = 50 \Omega$ ; $R_L = 50 \Omega$ ; 800 MHz < f < 3 GHz	-	30	-	dB
<b>IP4254CZ8/CZ12/CZ16</b>						
$\alpha_{il}$	insertion loss	$R_{source} = 50 \Omega$ ; $R_L = 50 \Omega$				
		800 MHz < f < 3 GHz	-	28	-	dB
		f = 1 GHz	30	-	-	dB
$\alpha_{ct}$	crosstalk attenuation	$R_{source} = 50 \Omega$ ; $R_L = 50 \Omega$ ; 800 MHz < f < 3 GHz	-	30	-	dB

## 7. Application information

### 7.1 Insertion loss

The IP425x family is mainly designed as EMI/RFI filters for multi-channel interfaces. The measured insertion loss in a 50  $\Omega$  system for IP4251, IP4253 and IP4254 and the simulated insertion loss for IP4252 is depicted in [Figure 2](#).

The insertion loss was measured using the test set-up as depicted in [Figure 1](#).

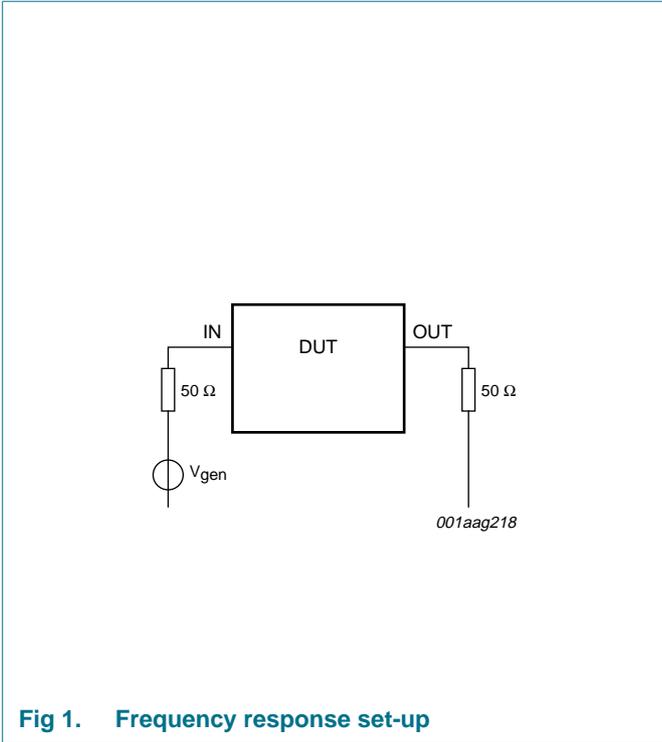


Fig 1. Frequency response set-up

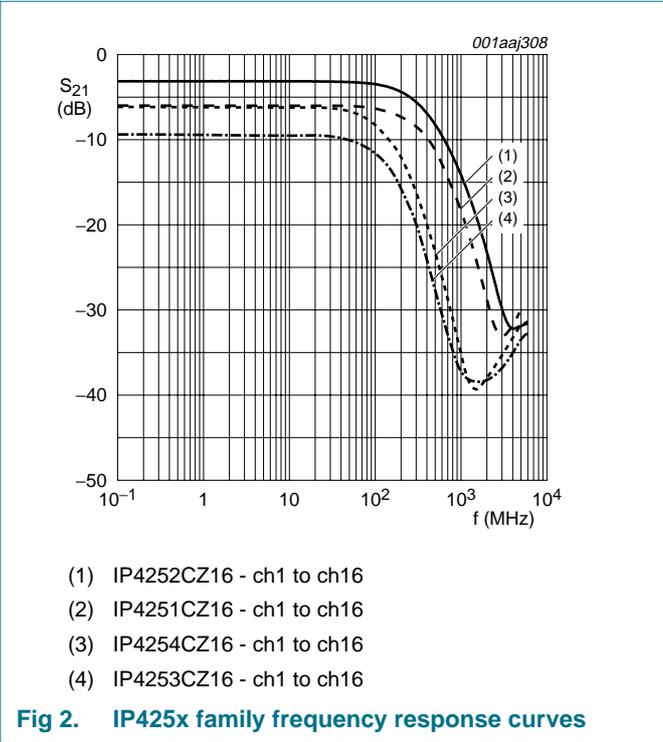


Fig 2. IP425x family frequency response curves

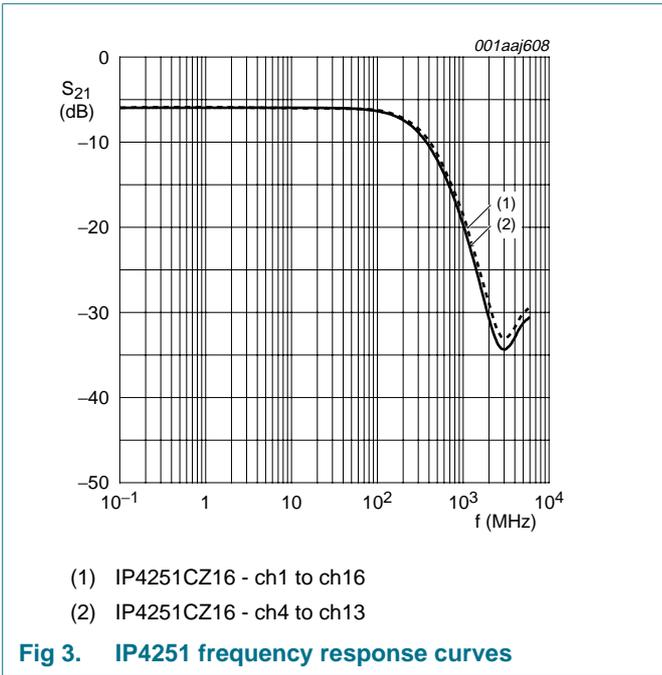


Fig 3. IP4251 frequency response curves

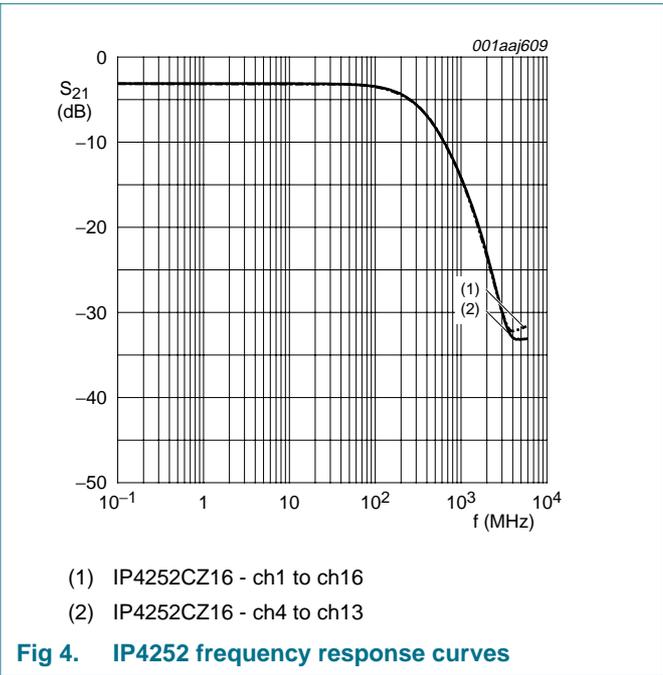
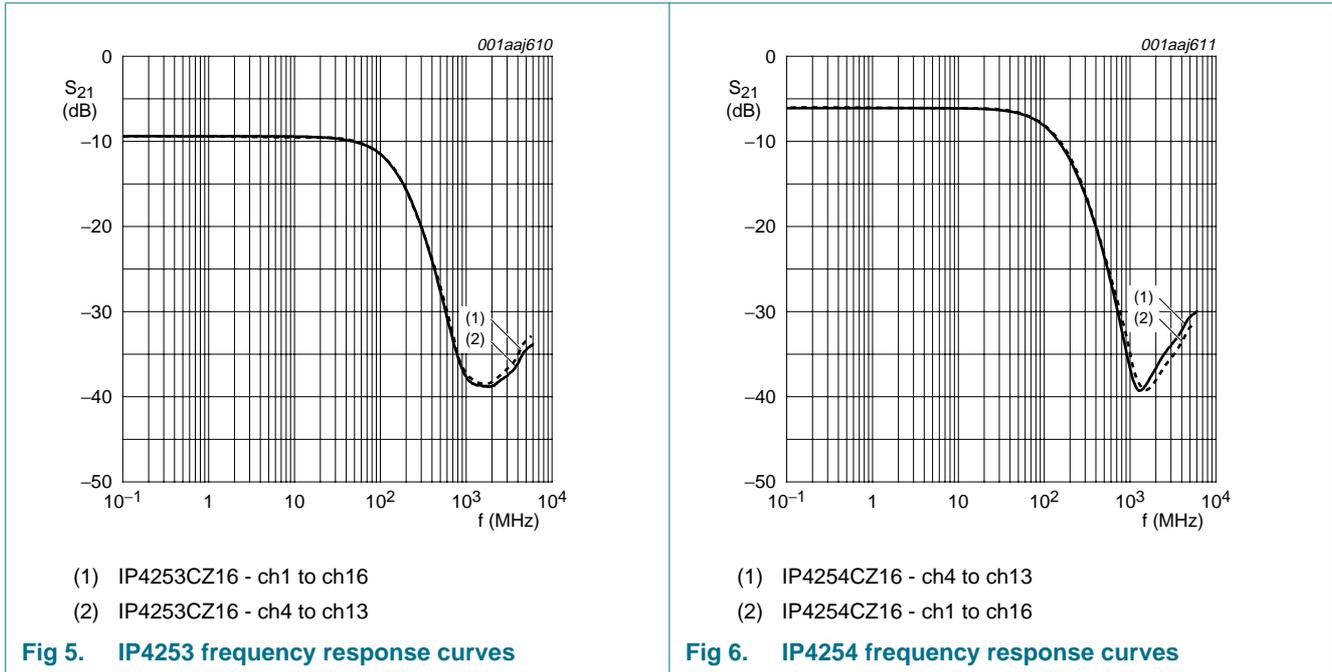


Fig 4. IP4252 frequency response curves



Due to the optimized silicon dice and package design, all channels in a single package show a very good matching performance as the insertion loss for a channel at the package side (e.g. ch1 to ch16) is nearly identical with the center channels (e.g. ch4 to ch13). Typical measurements results are shown in [Figure 3](#) to [Figure 6](#) for the different devices.

## 7.2 Selection

The IP425x family is mainly designed as EMI/RFI filters for multi-channel interfaces. The selection of one of the filter devices has to be performed dependent on the maximum clock frequency, driver strength, capacitive load of the sink, and also the maximum applicable rise and fall times.

### 7.2.1 SD(HC) and MMC memory interface

The Secure Digital High Capacity (SDHC) memory card interface standard specification and the MultiMediaCard (MMC) (JESD 84A43) standard specification recommend a rise and fall time of 25 % to 62.5 % (62.5 % to 25 % respectively) of 3 ns or less for the input signal of the receiving interface side.

Assuming a typical capacitance of about 20 pF for the SDHC memory card itself, and approximately 4 pF to 7 pF for the PCB and the card holder, IP4252CZ12-6 (6 channels,  $R_{s(ch)} = 40 \Omega$ ,  $C_{ch} = 12 \text{ pF}$  at  $V_{bias(DC)} = 2.5 \text{ V}$ ) is a matching selection to filter and protect all relevant interface pins such as CLK, CMD, and DAT0 to DAT3/CD. Please refer to [Figure 7](#) for a general example of the implementation of the IP4252 in an SD(HC) card interface.

In case additional channels such as write-protect or a mechanical card detection switch are used, the IP4252CZ16-8 (8 channels,  $R_{s(ch)} = 40 \Omega$ ,  $C_{ch} = 12 \text{ pF}$  at  $V_{bias(DC)} = 2.5 \text{ V}$ ) offers two additional channels.

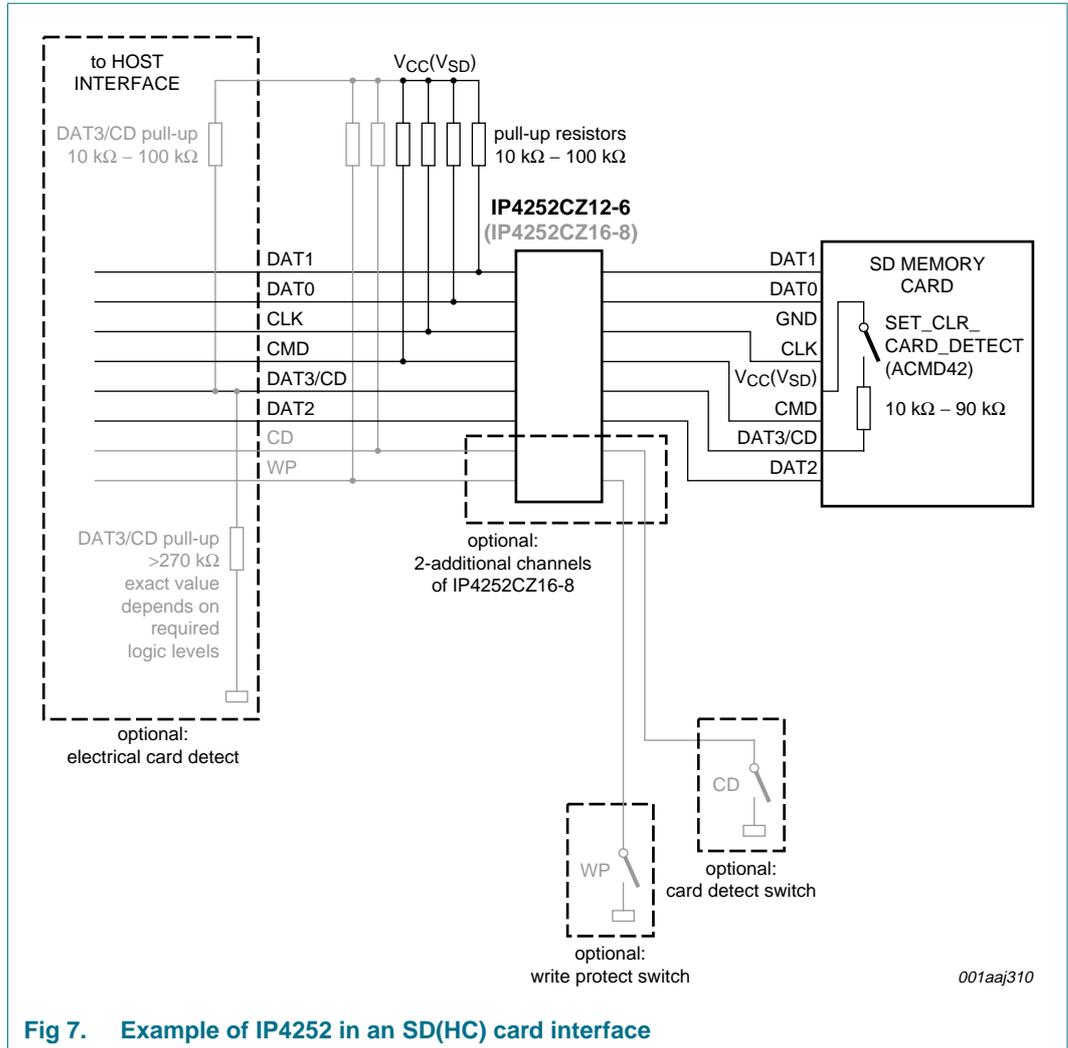


Fig 7. Example of IP4252 in an SD(HC) card interface

The capacitance values specified for the signal channels of the MMC interface differ from the SD(HC) specification. The MMC card side interface is specified to have an intrinsic capacitance of 12 pF to 18 pF and the total channel is limited according the specification to 30 pF only. Therefore, any filter device capacitance is limited to a maximum of up to 18 pF, including the card holder and PCB traces.

Please refer to [Figure 8](#) for a general example of the implementation of the IP4252 in a MultiMediaCard interface application.

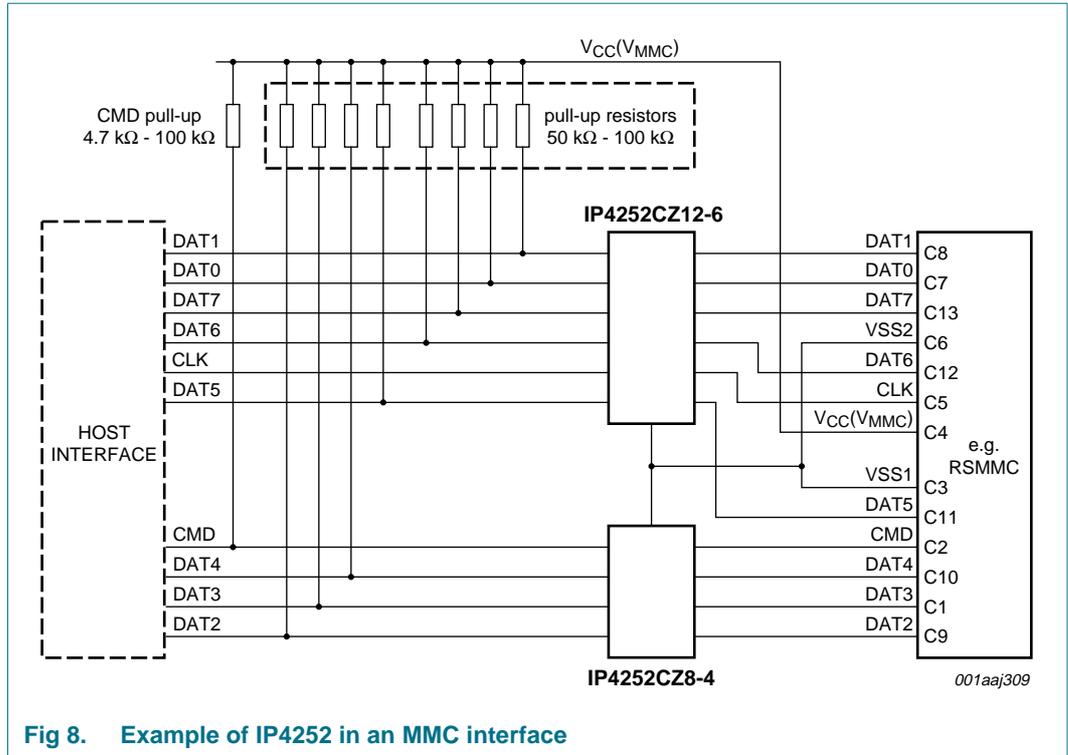


Fig 8. Example of IP4252 in an MMC interface

To generate SDHC- and MMC-compliant digital signals, the driver strength should not significantly undercut 8 mA.

7.2.2 LCD interfaces, medium-speed interfaces

For digital interfaces such as LCD display interfaces running at clock speeds between 10 MHz and 25 MHz or more, IP4251, IP4252, or IP4254 can be used in dependency of the sink load, clock speed, driver strength and rise and fall time requirements. Also the minimum EMI filter requirements may be a decision-making factor.

7.2.3 Keypad, low-speed interfaces

Especially for lower-speed interfaces such as keypads, low-speed serial interfaces (e.g. RS232) and low-speed control signals, IP4253 ( $R_{s(ch)} = 200 \Omega$ ,  $C_{ch} = 30 \text{ pF}$  at  $V_{bias(DC)} = 2.5 \text{ V}$ ) offers a very robust ESD protection and strong suppression of unwanted frequencies (EMI-filtering).

8. Package outline

HXSON8U: plastic thermal enhanced extremely thin small outline package; no leads; 8 terminals; UTLP based; body 1.35 x 1.7 x 0.5 mm

SOT983-1

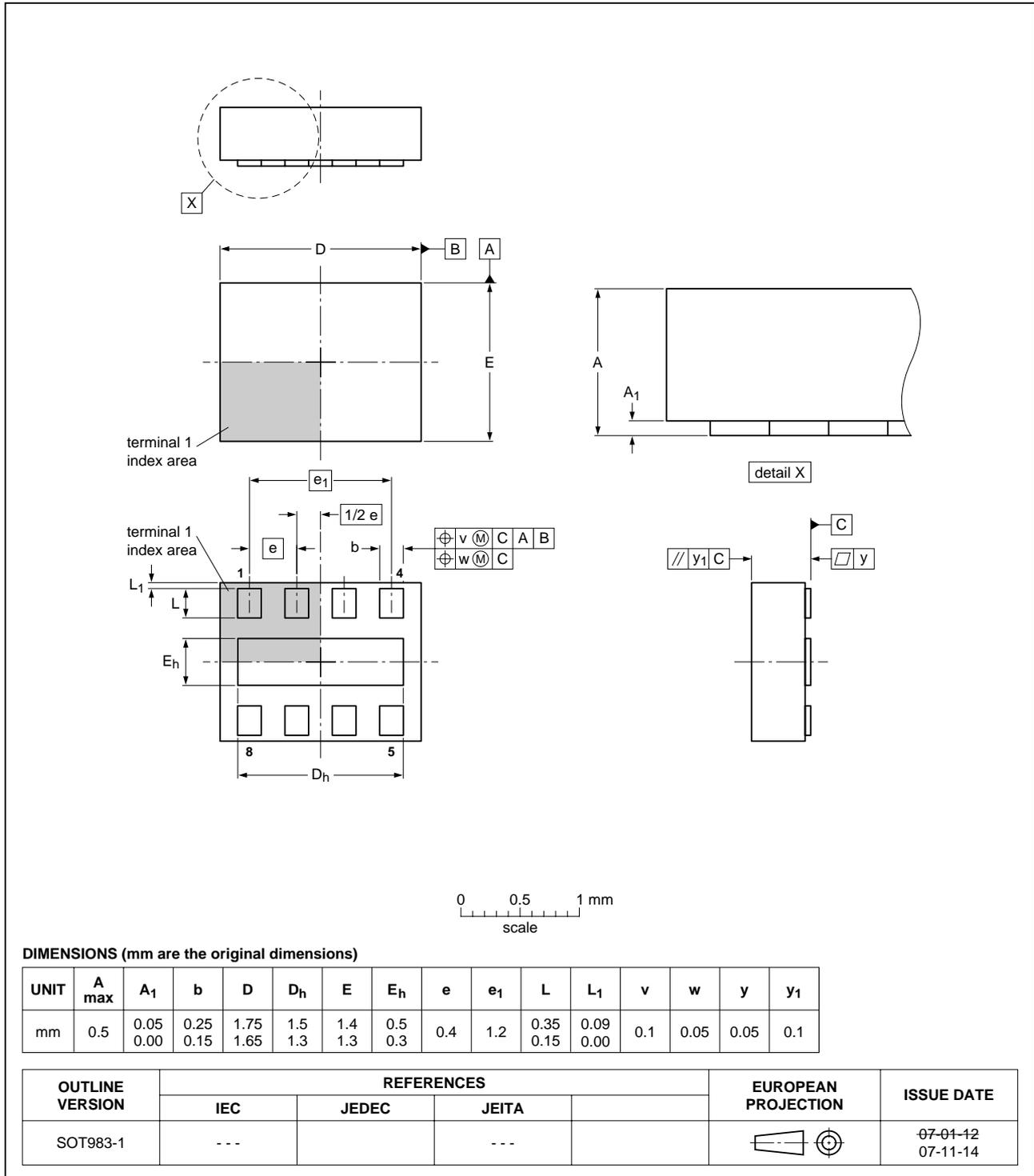


Fig 9. Package outline SOT983-1 (HXSON8U)

HXSON12U: plastic thermal enhanced extremely thin small outline package; no leads; 12 terminals; UTLP based; body 1.35 x 2.5 x 0.5 mm

SOT984-1

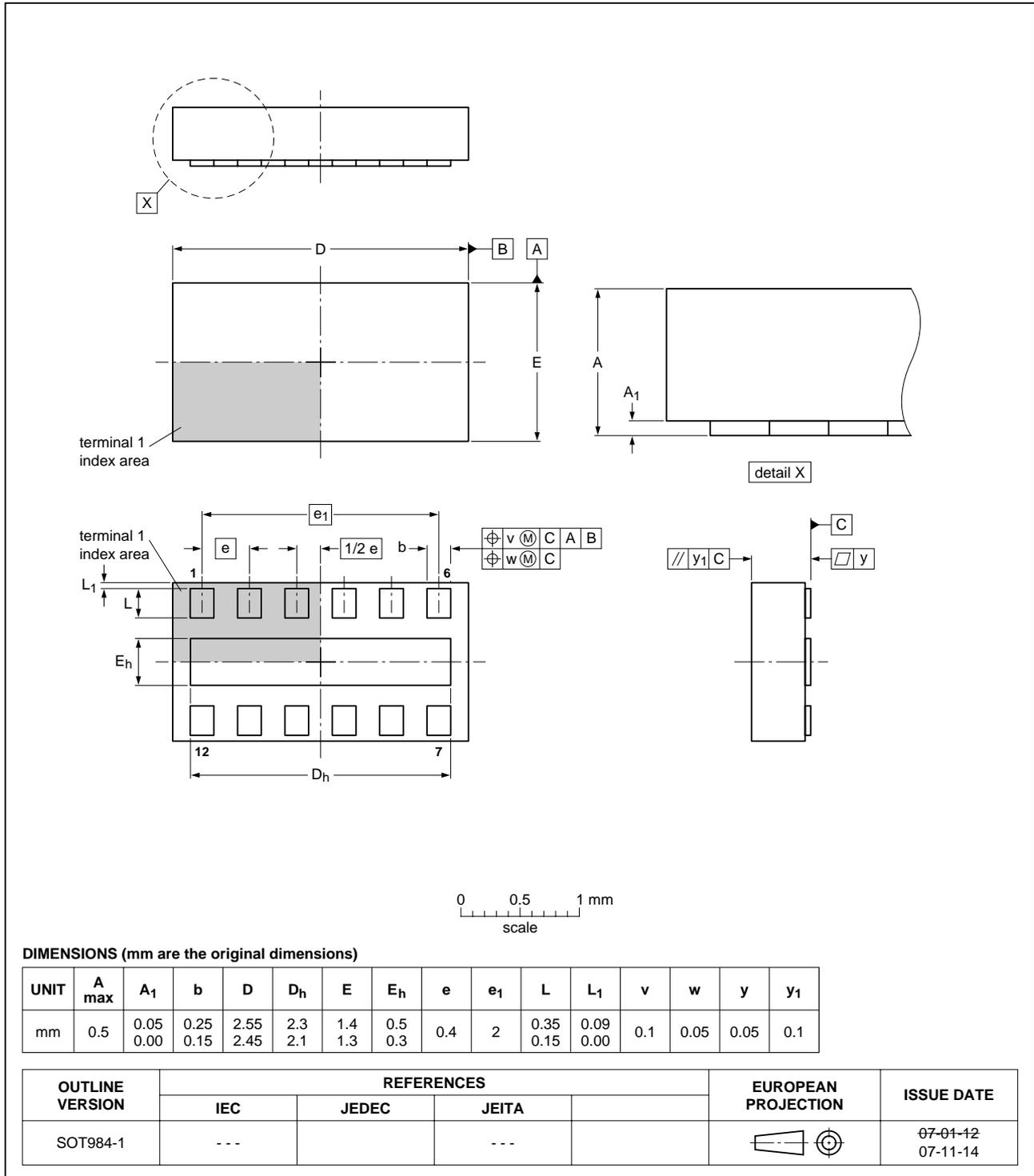


Fig 10. Package outline SOT984-1 (HXSON12U)

**HXSON16U: plastic thermal enhanced extremely thin small outline package; no leads; 16 terminals; UTLP based; body 1.35 x 3.3 x 0.5 mm**

**SOT985-1**

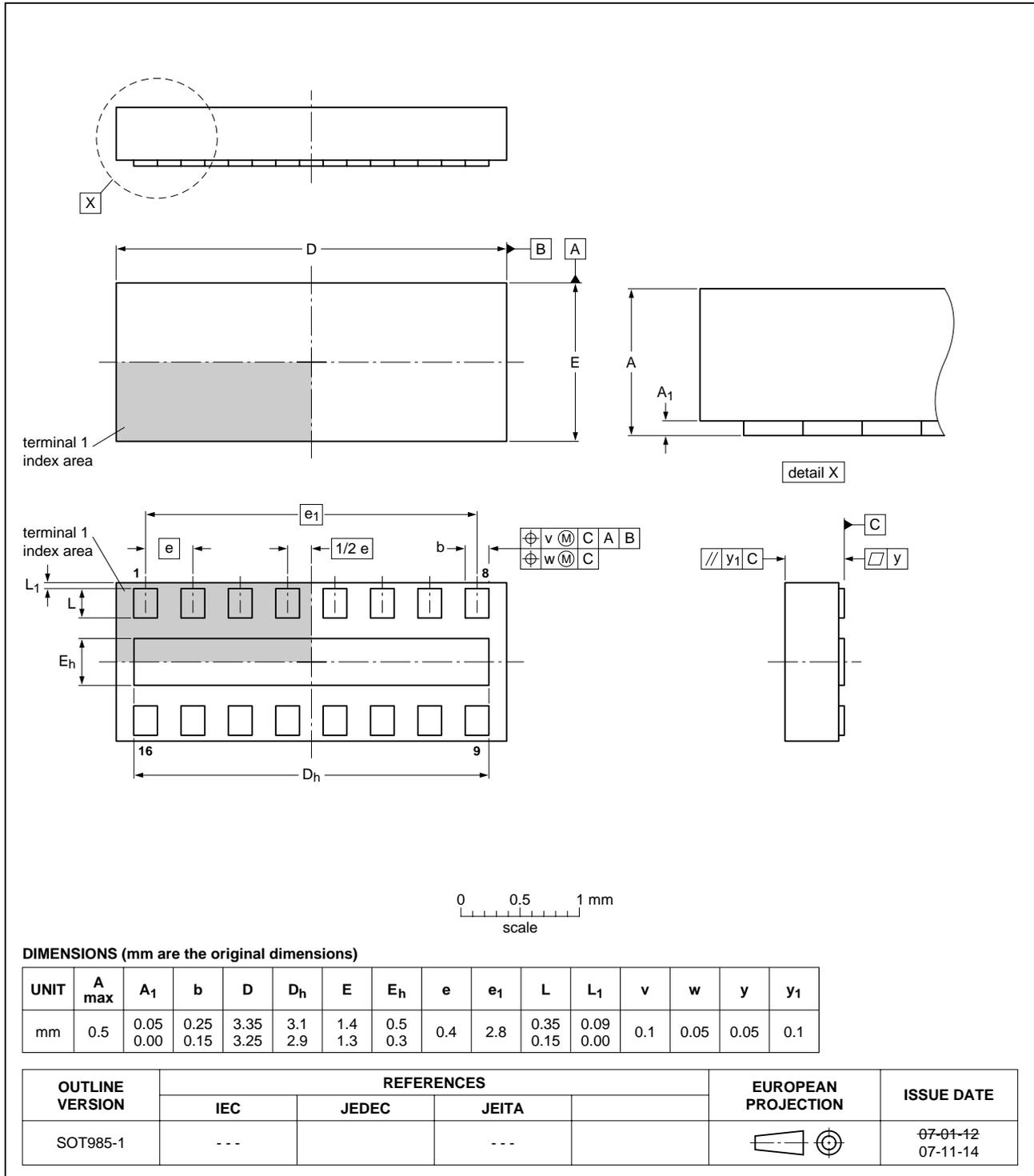


Fig 11. Package outline SOT985-1 (HXSON16U)

## 9. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
IP4251_52_53_54_3	20090506	Product data sheet	-	IP4253_54_CZ8_CZ12_CZ16_2
Modifications:			<ul style="list-style-type: none"><li>• Added product types IP4251x and IP4252x.</li><li>• Added chapter <a href="#">Section 7 “Application information”</a>.</li></ul>	
IP4253_54_CZ8_CZ12_CZ16_2	20071108	Product data sheet	-	IP4253_54_CZ8_CZ12_CZ16_1
IP4253_54_CZ8_CZ12_CZ16_1	20070209	Objective data sheet	-	-

## 10. Legal information

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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.

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[2] The term 'short data sheet' is explained in section "Definitions".

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