



# IP4292CZ10-TBR

ESD protection for ultra high-speed interfaces

Rev. 1 — 8 July 2011

Product data sheet

# HDMI

## 1. Product profile

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### 1.1 General description

The device is designed to protect high-speed interfaces such as SuperSpeed USB, High-Definition Multimedia Interface (HDMI), DisplayPort, external Serial Advanced Technology Attachment (eSATA) and Low Voltage Differential Signaling (LVDS) interfaces against ElectroStatic Discharge (ESD).

The device includes high-level ESD protection diodes for ultra high-speed signal lines and is encapsulated in an ultra small and leadless XSON10 plastic package.

All signal lines are protected by a special diode configuration offering ultra low line capacitance of only 0.55 pF. These diodes utilize a unique snap-back structure in order to provide protection to downstream components from ESD voltages up to  $\pm 8$  kV contact according to IEC 61000-4-2, level 4.

### 1.2 Features and benefits

- Pb-free, Restriction of Hazardous Substances (RoHS) compliant and free of halogen and antimony (Dark Green compliant)
- System ESD protection for USB 2.0 and USB SuperSpeed 3.0, HDMI 1.4, DisplayPort, eSATA and LVDS
- All signal lines with integrated rail-to-rail clamping diodes for downstream ESD protection of  $\pm 8$  kV according to IEC 61000-4-2, level 4
- Matched 0.5 mm trace spacing
- Signal lines with  $\leq 0.05$  pF matching capacitance between signal pairs
- Line capacitance of only 0.55 pF for each channel
- Design-friendly 'pass-thru' signal routing

### 1.3 Applications

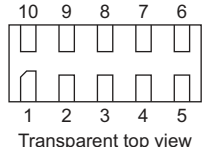
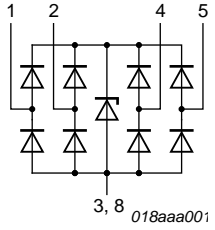
The devices are designed for high-speed receiver and transmitter port protection:

- TVs, monitors
- DVD recorders and players
- Notebooks, mother boards, graphic cards and ports
- Set-top boxes and game consoles



## 2. Pinning information

Table 1. Pinning

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	CH1	channel 1 ESD protection	 <p>Transparent top view</p> <p><b>XSON10</b></p>	 <p>018aaa001</p>
2	CH2	channel 2 ESD protection		
3	GND	ground		
4	CH3	channel 3 ESD protection		
5	CH4	channel 4 ESD protection		
6	n.c.	not connected		
7	n.c.	not connected		
8	GND	ground		
9	n.c.	not connected		
10	n.c.	not connected		

## 3. Ordering information

Table 2. Ordering information

Type number	Package		
	Name	Description	Version
IP4292CZ10-TBR	XSON10	plastic extremely thin small outline package; no leads; 10 terminals; body 1 × 2.5 × 0.5 mm	SOT1176-1

## 4. Marking

Table 3. Marking codes

Type number	Marking code
IP4292CZ10-TBR	92

## 5. Limiting values

Table 4. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
$V_I$	input voltage		-0.5	+5.5	V
$V_{ESD}$	electrostatic discharge voltage	IEC 61000-4-2, level 4; <a href="#">[1]</a> contact discharge	-	±8	kV
$T_{amb}$	ambient temperature		-40	+85	°C
$T_{stg}$	storage temperature		-55	+125	°C

[1] All pins to ground.

## 6. Characteristics

**Table 5. Characteristics**

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

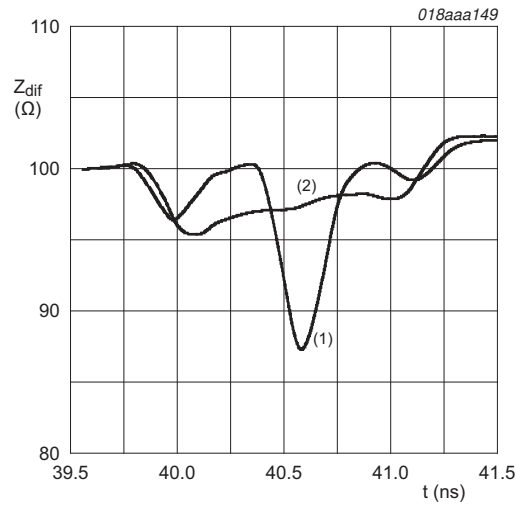
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{BR}$	breakdown voltage	$I_{test} = 1\text{ mA}$	6	-	-	V
$I_{LR}$	reverse leakage current	per TMDS channel; $V_I = 5\text{ V}$	-	-	1	$\mu\text{A}$
$V_F$	forward voltage		-	0.7	-	V
$C_{ch}$	channel capacitance	$f = 1\text{ MHz};$ $V_{bias} = 2.5\text{ V}$	[1] 0.45	0.55	0.65	pF
$\Delta C_{ch}$	channel capacitance difference	$f = 1\text{ MHz};$ $V_{bias} = 2.5\text{ V}$	[1] -	0.05	-	pF
$C_{ch(mutual)}$	mutual channel capacitance	$f = 1\text{ MHz};$ $V_{bias} = 2.5\text{ V}$	[1][2] -	0.07	-	pF
$r_{dyn}$	dynamic resistance	surge; $I = 1.0\text{ A}$	[3]			
		positive transient	-	0.4	-	$\Omega$
		negative transient	-	0.3	-	$\Omega$
		TLP	[4]			
		positive transient	-	0.45	-	$\Omega$
		negative transient	-	0.35	-	$\Omega$
$V_{CL(ch)trt(pos)}$	positive transient channel clamping voltage	$I_{PP} = 4\text{ A}$	[3] -	4	-	V

[1] This parameter is guaranteed by design.

[2] Between signal pin and pin n.c.

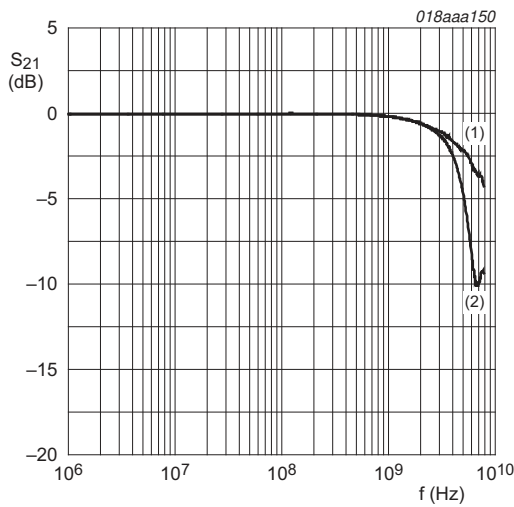
[3] According to IEC 61000-4-5 (8/20  $\mu\text{s}$ ).

[4] 100 ns Transmission Line Pulse (TLP); 50  $\Omega$ ; pulser at 80 ns.



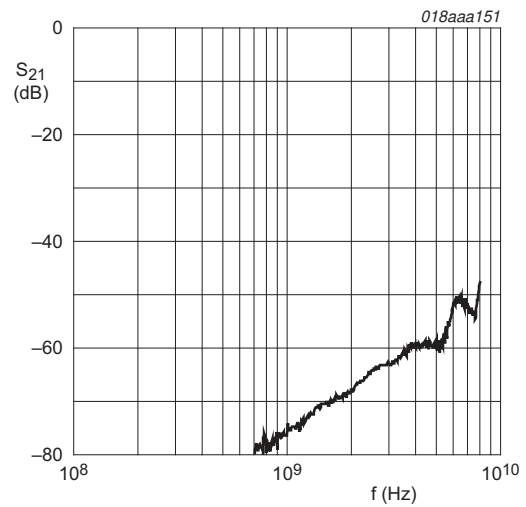
$t_r = 200$  ps; differential (CH1 + CH2)  
 (1) IP4292CZ10-TBR  
 (2) Reference board

**Fig 1. Differential TDR plot**



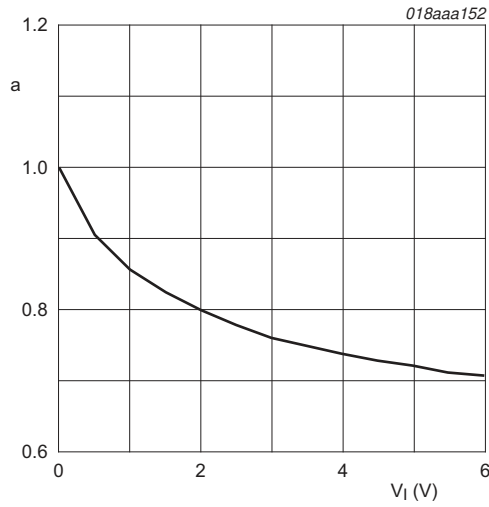
(1) Sdd21  
 (2) Scc21  
 normalized to 100 Ω;  
 differential pairs at CH1/CH2 or at CH3/CH4

**Fig 2. Mixed-mode differential and common-mode insertion loss; typical values**



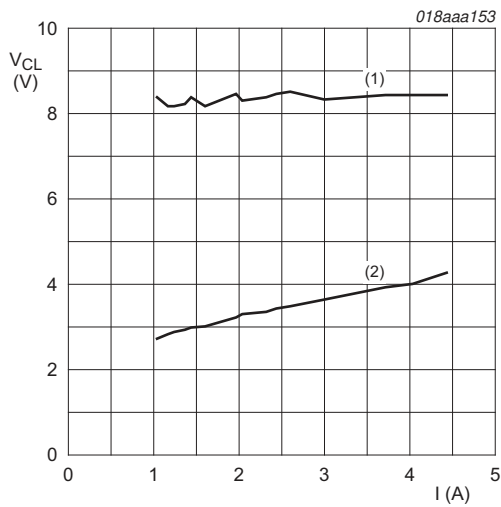
Sdd21  
 normalized to 100 Ω;  
 differential pairs CH1/CH2 versus CH3/CH4

**Fig 3. Mixed-mode differential NEXT; typical values**



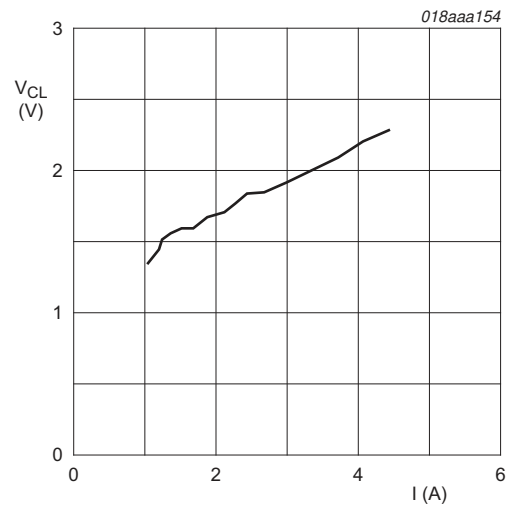
$$a = \frac{C_d}{C_{d(V_{bias} = 0 \text{ V})}}$$

Fig 4. Relative capacitance as a function of input voltage; typical values



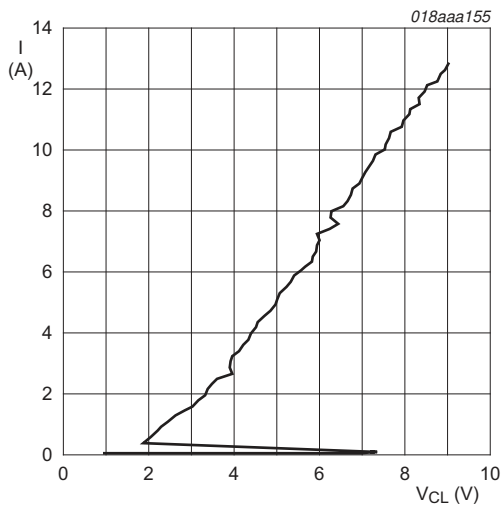
IEC 61000-4-5;  $t_p = 8/20 \mu\text{s}$ ; positive pulse  
 (1) overshoot voltage  
 (2) clamping voltage

Fig 5. Dynamic resistance with positive clamping



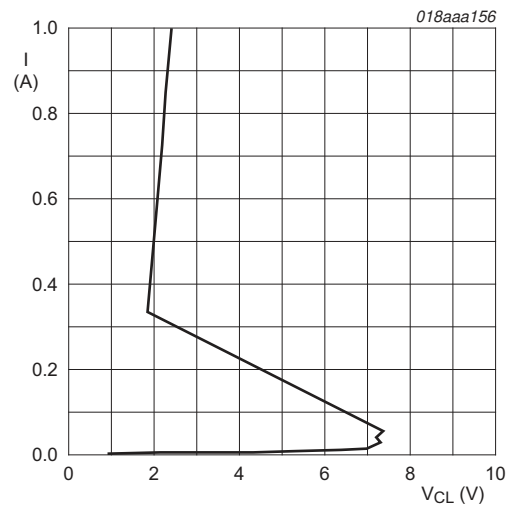
IEC 61000-4-5;  $t_p = 8/20 \mu\text{s}$ ; negative pulse

Fig 6. Dynamic resistance with negative clamping



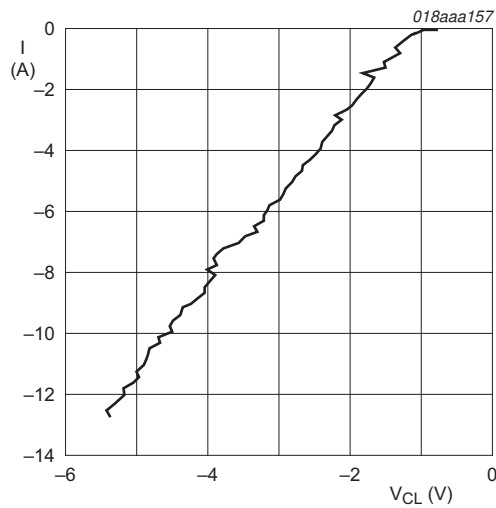
$t_p = 100 \text{ ns}$ ; TLP

Fig 7. Dynamic resistance with positive clamping



$t_p = 100 \text{ ns}$ ; TLP

Fig 8. Dynamic resistance with positive clamping



$t_p = 100 \text{ ns}$ ; TLP

Fig 9. Dynamic resistance with negative clamping

### 7. Application information

The device is designed to provide high-level ESD protection for high-speed serial data buses such as HDMI, DisplayPort, eSATA and LVDS data lines.

When designing the Printed-Circuit Board (PCB), give careful consideration to basic high-speed routing guidelines, impedance matching, and signal coupling. The signal lines must not be connected to unlimited current sources like for example, a battery.

A basic application diagram for the ESD protection of an HDMI interface is shown in [Figure 10](#).

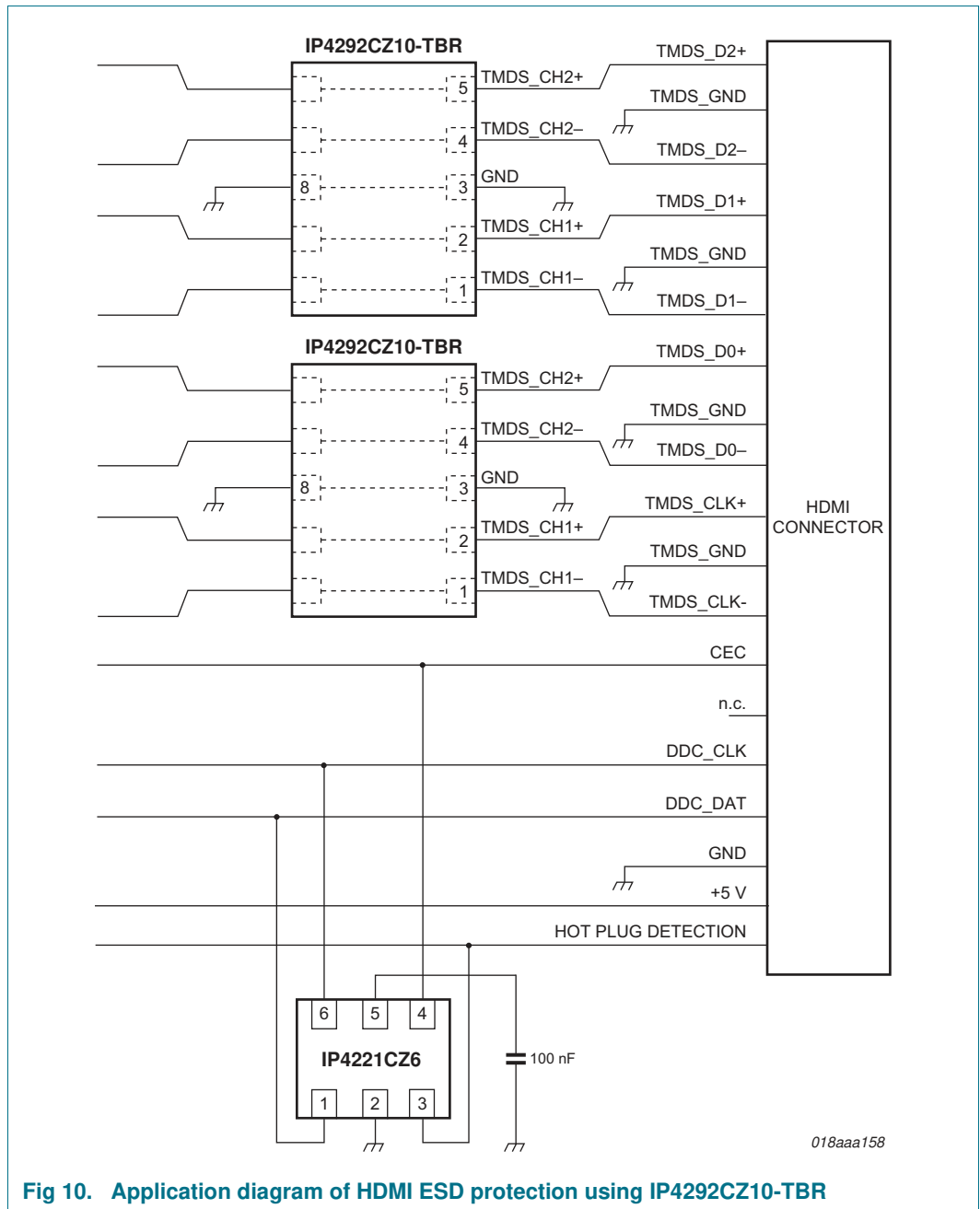


Fig 10. Application diagram of HDMI ESD protection using IP4292CZ10-TBR

8. Package outline

XSON10: plastic extremely thin small outline package; no leads;  
10 terminals; body 1 x 2.5 x 0.5 mm

SOT1176-1

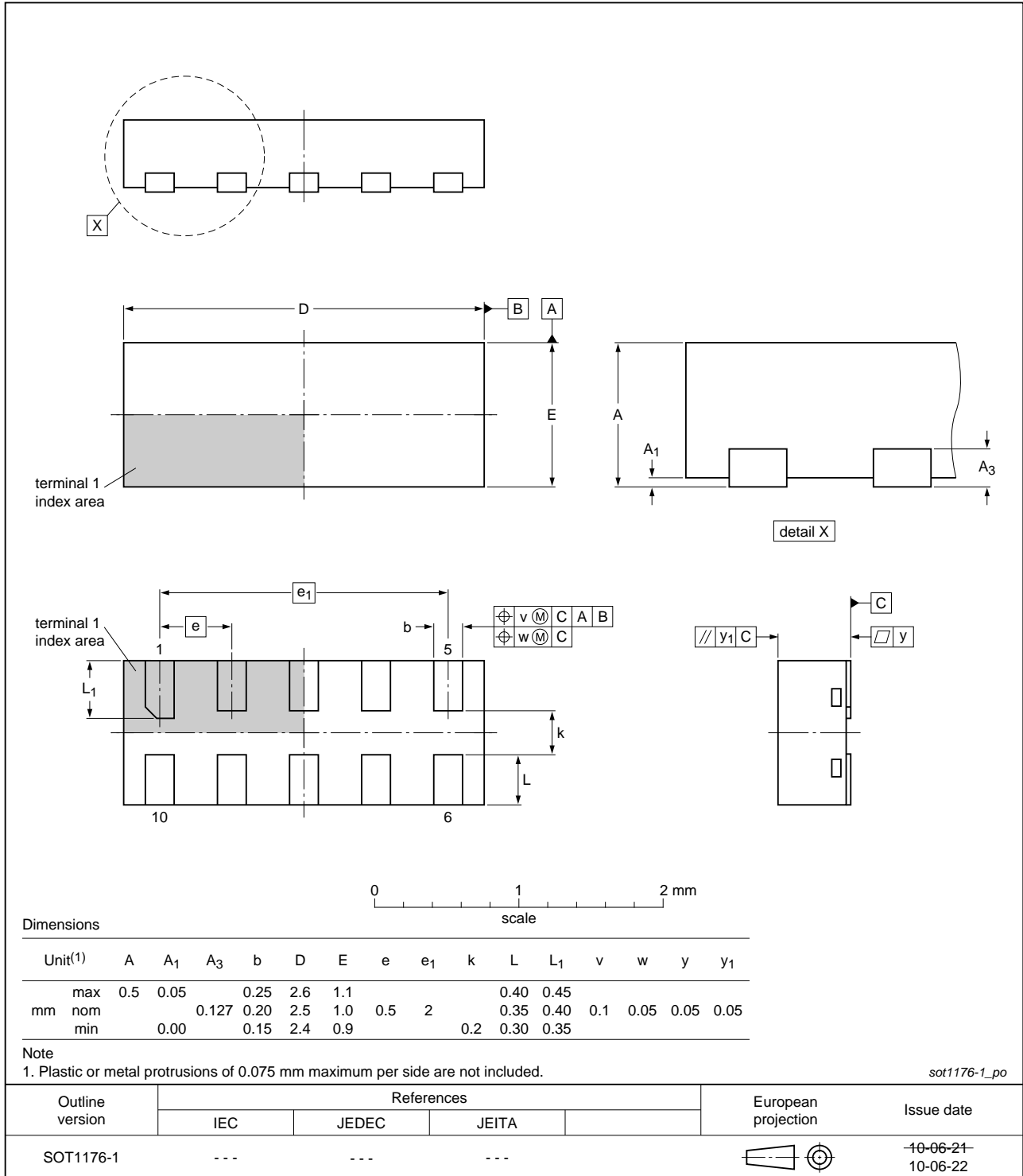
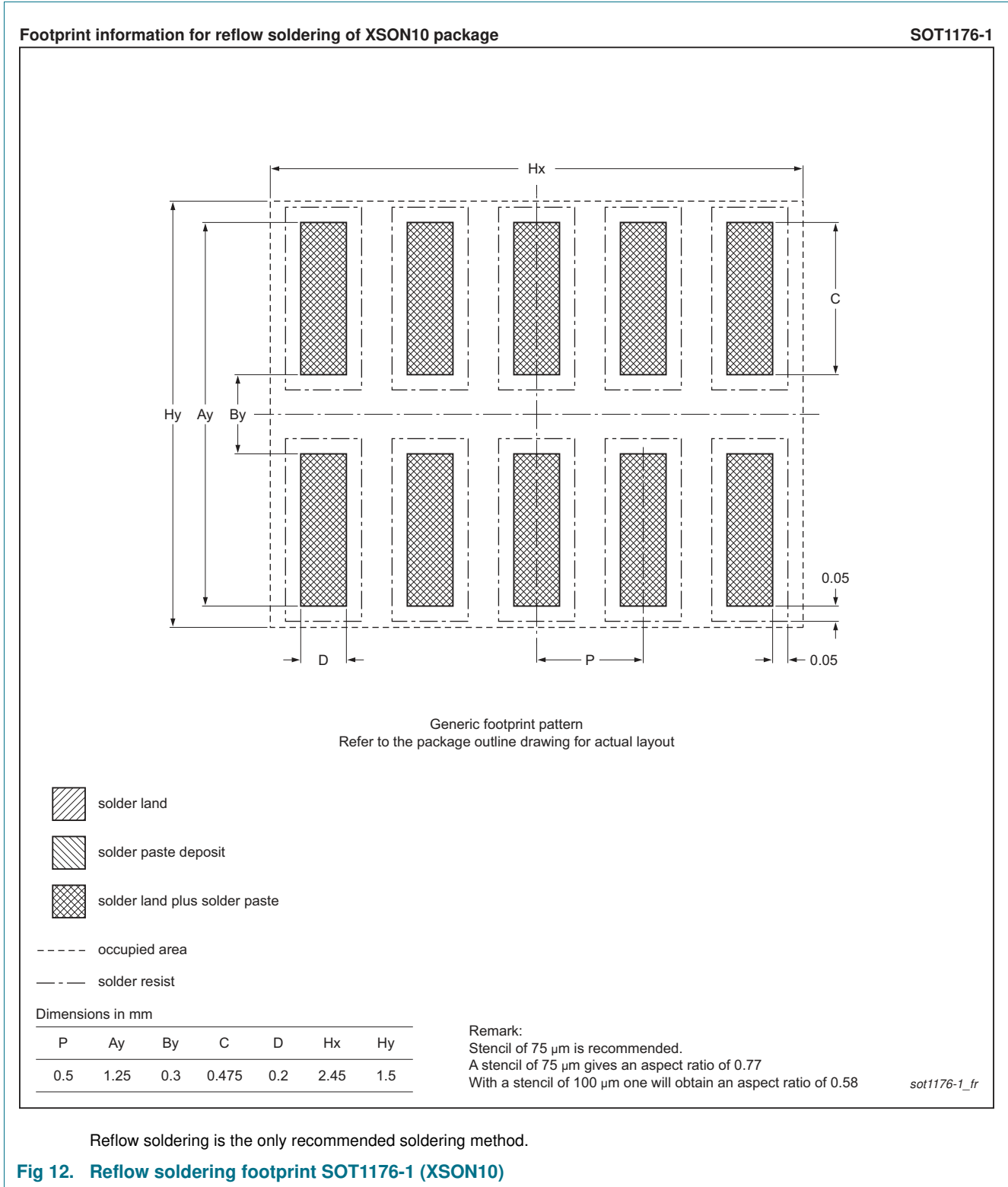


Fig 11. Package outline SOT1176-1 (XSON10)



9. Soldering



## 10. Abbreviations

Table 6. Abbreviations

Acronym	Description
NEXT	Near End Crosstalk
TDR	Time-Domain Reflectometer
TMDS	Transition Minimized Differential Signaling

## 11. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
IP4292CZ10-TBR v.1	20110708	Product data sheet	-	-

## 12. Legal information

### 12.1 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.

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

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