



IP4292CZ10-TBR

ESD protection for ultra high-speed interfaces

Rev. 1 — 8 July 2011

Product data sheet

HDMI

1. Product profile

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 ± 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 ± 8 kV according to IEC 61000-4-2, level 4
- Matched 0.5 mm trace spacing
- Signal lines with ≤ 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

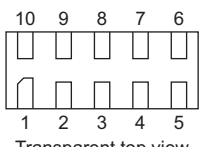
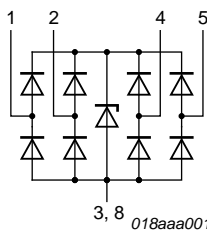
The devices are designed for high-speed receiver and transmitter port protection:

- 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>XSON10</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; [1] 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.

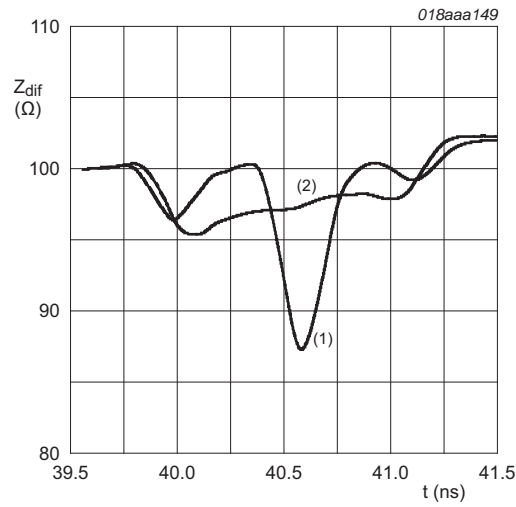
Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
V_{BR}	breakdown voltage	$I_{test} = 1\text{ mA}$	6	-	-	V	
I_{LR}	reverse leakage current	per TMDS channel; $V_I = 5\text{ V}$	-	-	1	μA	
V_F	forward voltage		-	0.7	-	V	
C_{ch}	channel capacitance	$f = 1\text{ MHz};$ $V_{bias} = 2.5\text{ V}$	[1]	0.45	0.55	0.65	pF
ΔC_{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	-	Ω	
		negative transient	-	0.3	-	Ω	
		TLP	[4]				
		positive transient	-	0.45	-	Ω	
	negative transient	-	0.35	-	Ω		
$V_{CL(ch)trt(pos)}$	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.

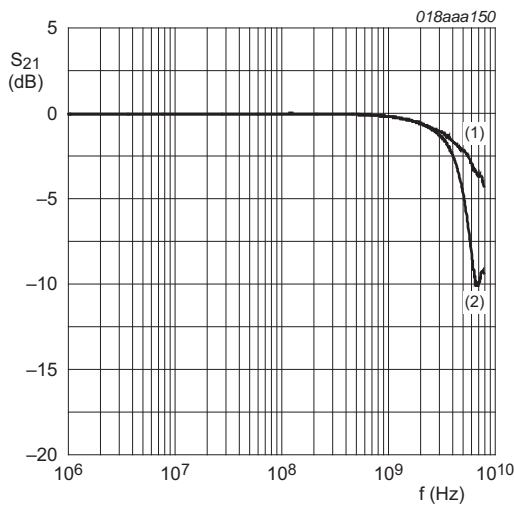
[3] According to IEC 61000-4-5 (8/20 μs).

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



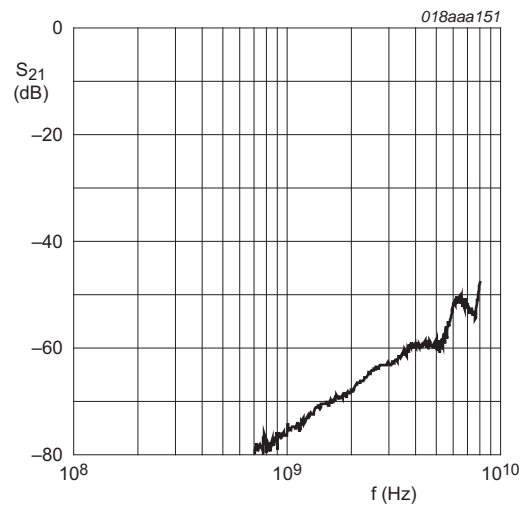
$t_r = 200$ ps; differential (CH1 + CH2)
 (1) IP4292CZ10-TBR
 (2) Reference board

Fig 1. Differential TDR plot



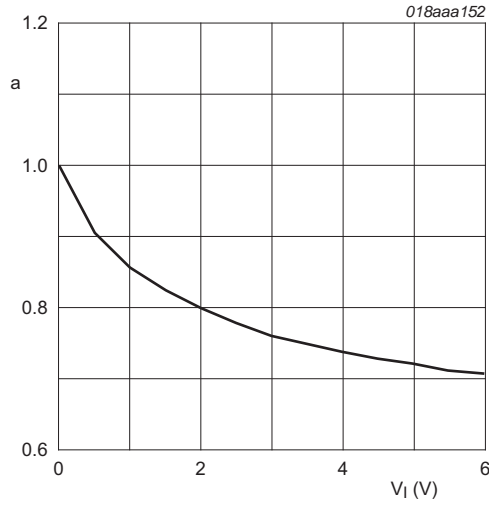
(1) Sdd21
 (2) Scc21
 normalized to 100 Ω;
 differential pairs at CH1/CH2 or at CH3/CH4

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



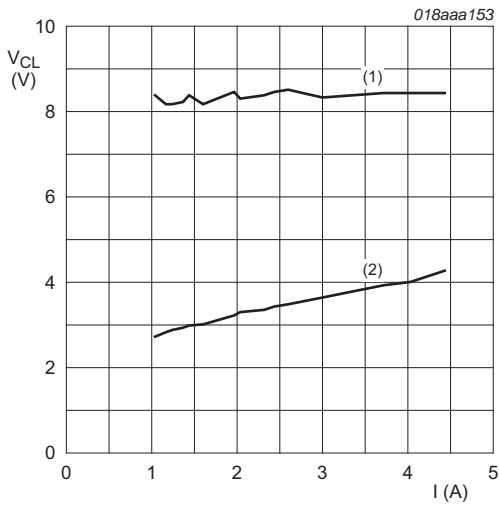
Sdd21
 normalized to 100 Ω;
 differential pairs CH1/CH2 versus CH3/CH4

Fig 3. Mixed-mode differential NEXT; typical values



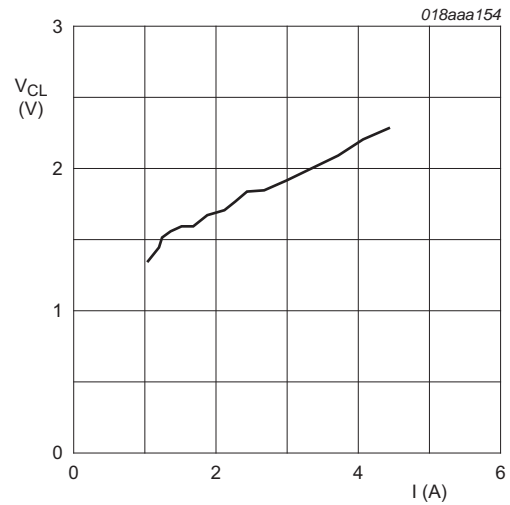
$$a = \frac{C_d}{C_{d(V_{bias} = 0\text{ V})}}$$

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



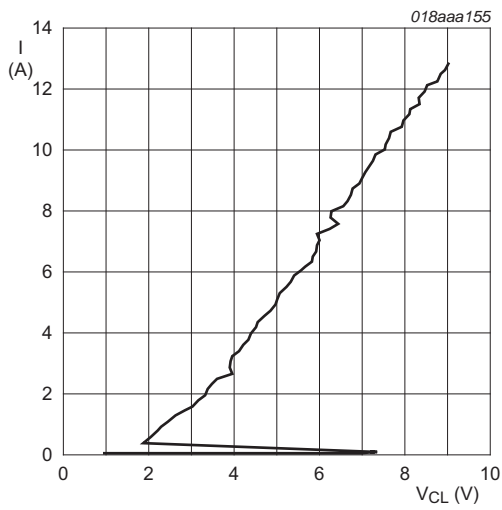
IEC 61000-4-5; t_p = 8/20 μs; positive pulse
 (1) overshoot voltage
 (2) clamping voltage

Fig 5. Dynamic resistance with positive clamping



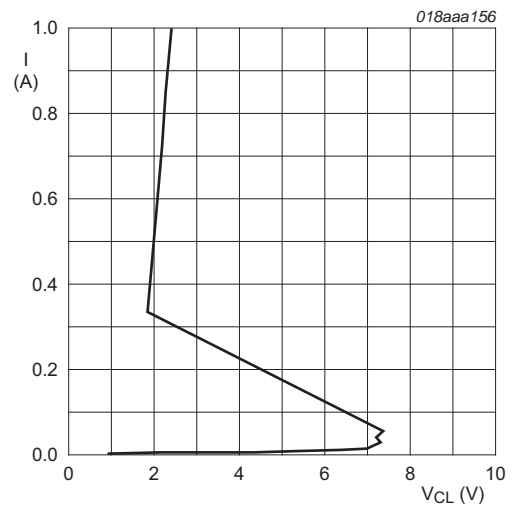
IEC 61000-4-5; t_p = 8/20 μs; negative pulse

Fig 6. Dynamic resistance with negative clamping



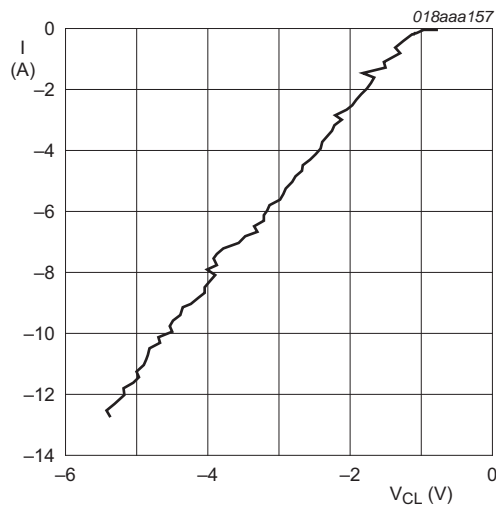
$t_p = 100$ ns; TLP

Fig 7. Dynamic resistance with positive clamping



$t_p = 100$ ns; TLP

Fig 8. Dynamic resistance with positive clamping



$t_p = 100$ 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](#).

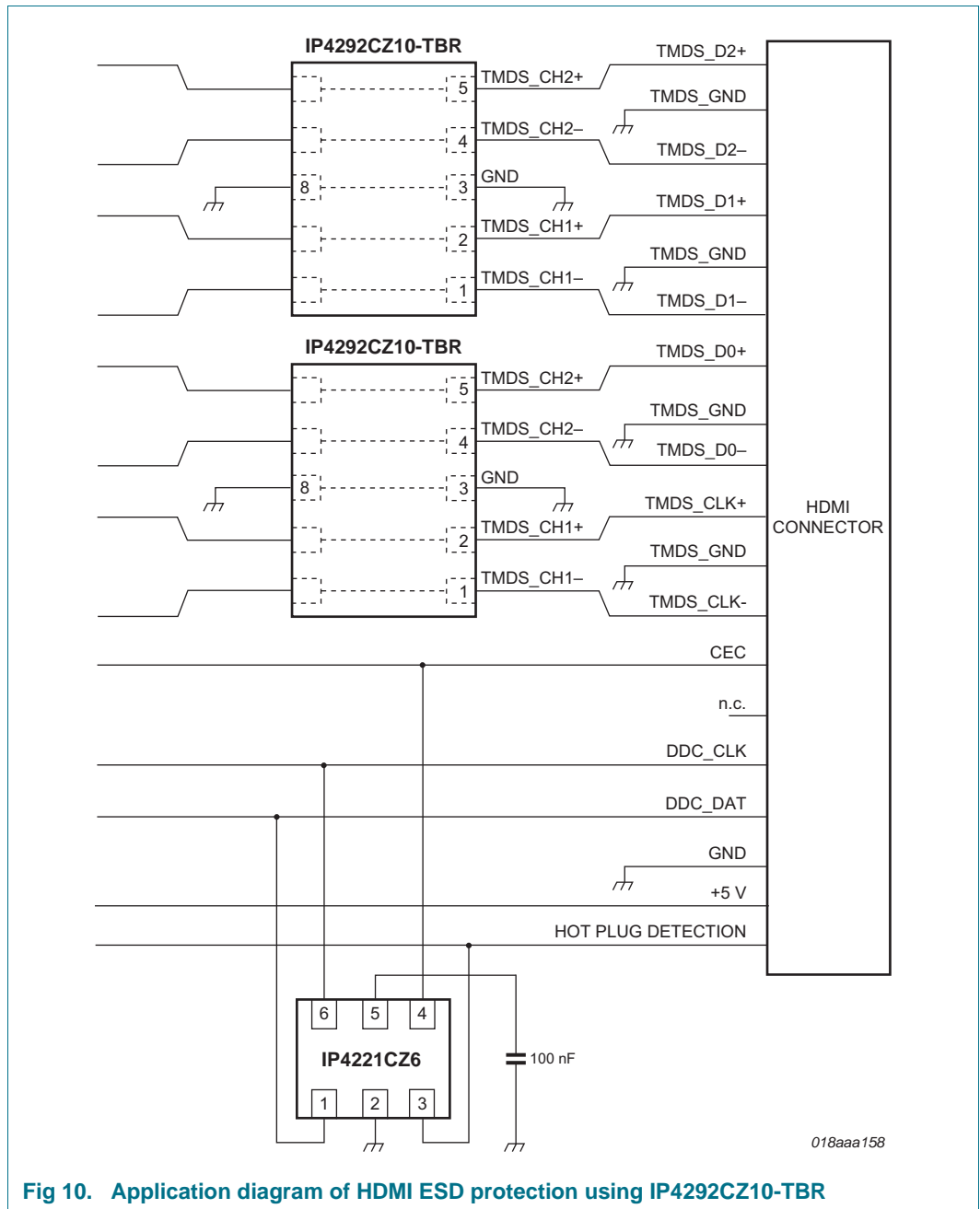


Fig 10. Application diagram of HDMI ESD protection using IP4292CZ10-TBR

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

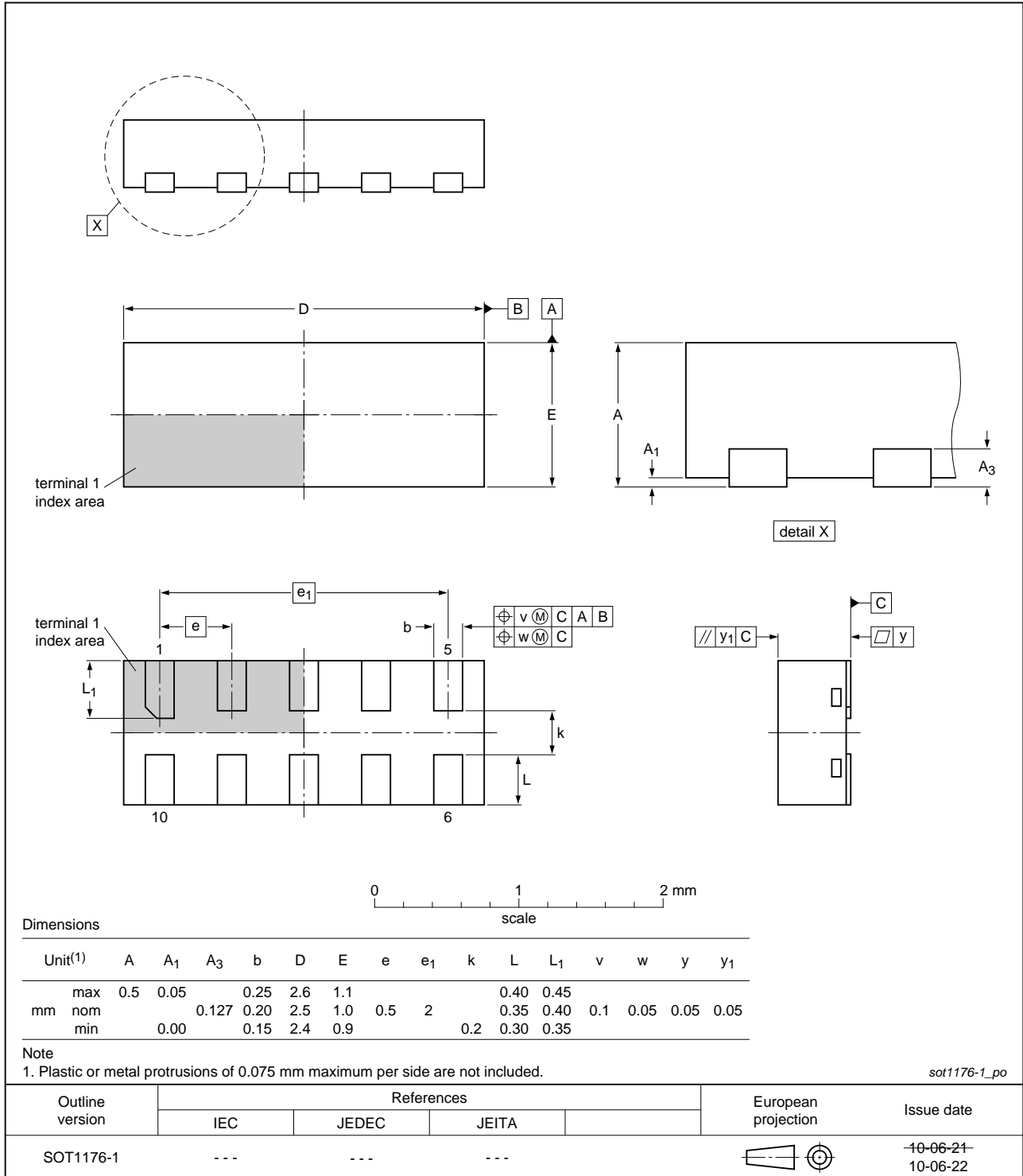
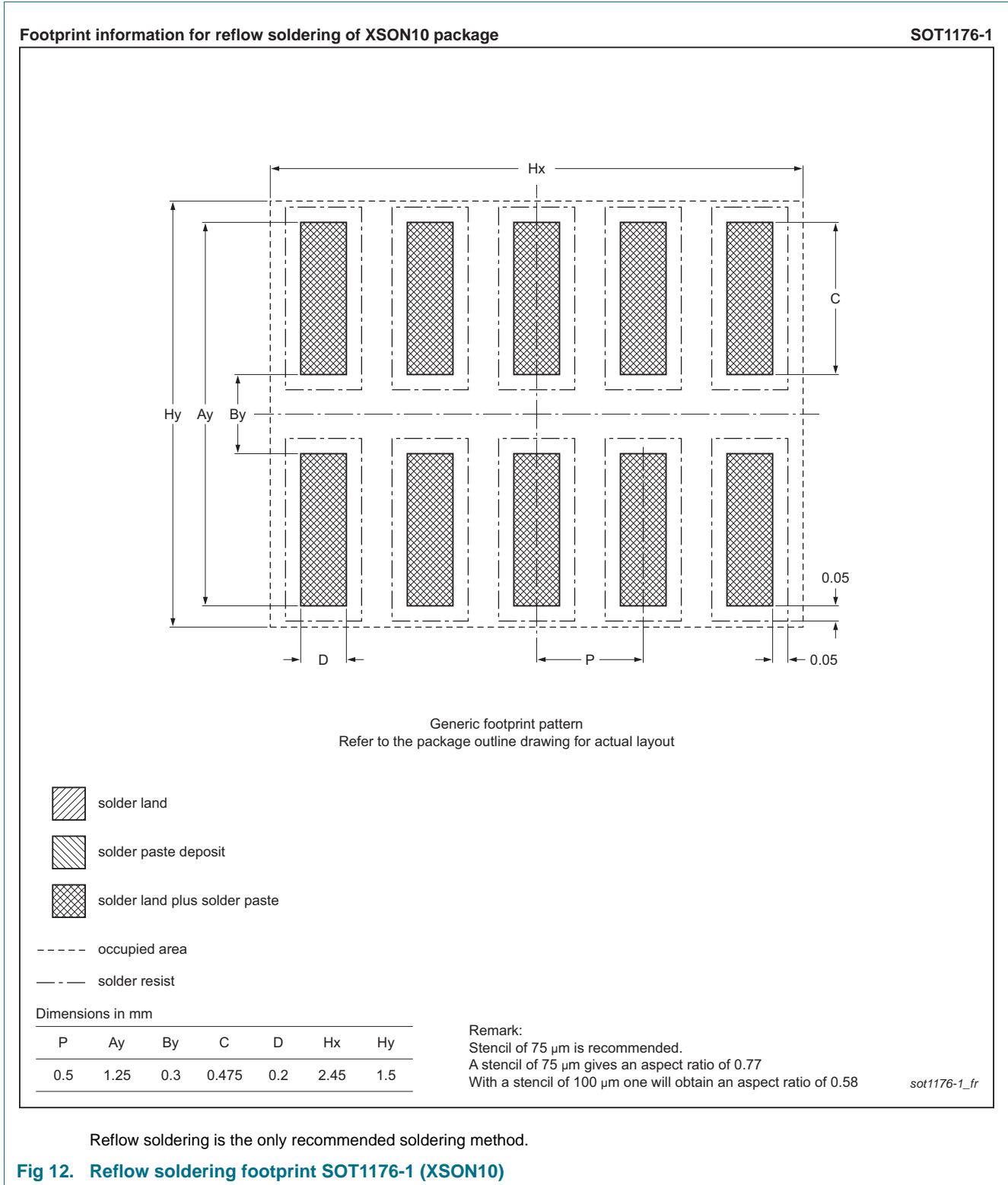


Fig 11. Package outline SOT1176-1 (XSON10)

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 ^{[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.

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

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14. Contents

1 Product profile 1

1.1 General description 1

1.2 Features and benefits 1

1.3 Applications 1

2 Pinning information 2

3 Ordering information 2

4 Marking 2

5 Limiting values 2

6 Characteristics 3

7 Application information 7

8 Package outline 8

9 Soldering 9

10 Abbreviations 10

11 Revision history 11

12 Legal information 12

12.1 Data sheet status 12

12.2 Definitions 12

12.3 Disclaimers 12

12.4 Trademarks 13

13 Contact information 13

14 Contents 14

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