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Kind regards,

Team Nexperia



# PUSB3F4-TBR

ESD protection for ultra high-speed interfaces

Rev. 1 — 6 October 2011

Product data sheet

## 1. Product profile

### 1.1 General description

The device is designed to protect high-speed interfaces such as High-Definition Multimedia Interface (HDMI), DisplayPort, SuperSpeed USB, 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 a 4-channel XSON10 Pb-free package.

All signal lines are protected by a special diode configuration offering ultra low line capacitance of only 0.5 pF. These diodes 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 1.3 and 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 0.5 pF for each channel
- 4-channel, XSON10 Pb-free package
- Design-friendly 'pass-thru' signal routing

### 1.3 Applications

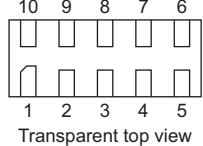
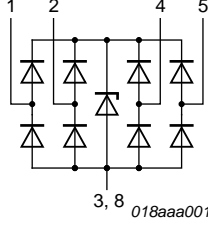
The device is designed for high-speed receiver and transmitter port protection:

- 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
PUSB3F4-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
PUSB3F4-TBR	F4

## 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
		air discharge	-	±15	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.

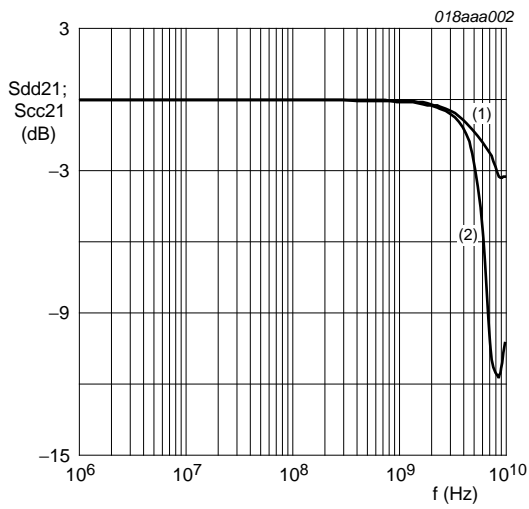
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{BRzd}$	Zener diode breakdown voltage	$I_{test} = 1\text{ mA}$	6	-	9	V
$I_{LRzd}$	Zener diode reverse leakage current	per TMDS channel; $V_I = 3.0\text{ V}$	-	-	1	$\mu\text{A}$
$V_F$	forward voltage		-	0.7	-	V
$C_{ch(TMDS)}$	TMDS channel capacitance	$f = 1\text{ MHz};$ $V_{bias} = 2.5\text{ V}$	[1] 0.4	0.5	0.7	pF
$\Delta C_{ch(TMDS)}$	TMDS 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	$I = 1\text{ A}$	[3]			
		positive transient	-	1	-	$\Omega$
		negative transient	-	1	-	$\Omega$
$V_{CL(ch)trt(pos)}$	positive transient channel clamping voltage	$V_{ESD} = 8\text{ kV}$	[4] -	8	-	V

[1] This parameter is guaranteed by design.

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

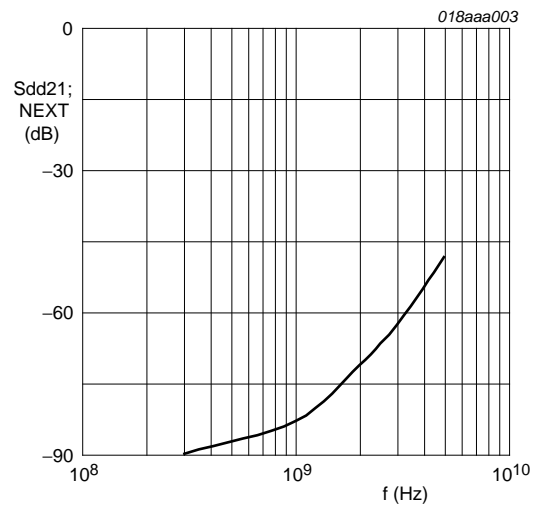
[3] According to IEC 61000-4-5 and IEC 61000-4-9.

[4] Human Body Model (HBM) according to JESD22-A-J114D.



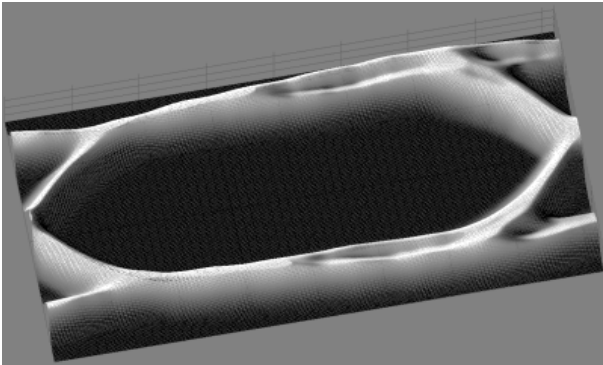
(1) Sdd21  
(2) Scc21  
Normalized to 100 Ω;  
differential pairs at CH1/CH2 or at CH3/CH4

**Fig 1. Mixed-mode differential and common-mode insertion loss; typical values**



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

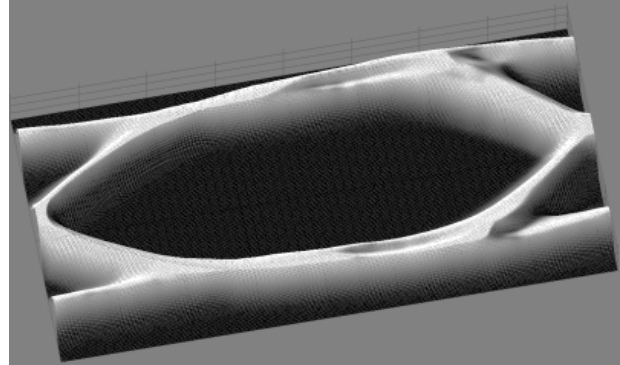
**Fig 2. Mixed-mode differential NEXT crosstalk; typical values**



018aaa004

5 Gbit/s; USB 3.0 CP0 pattern

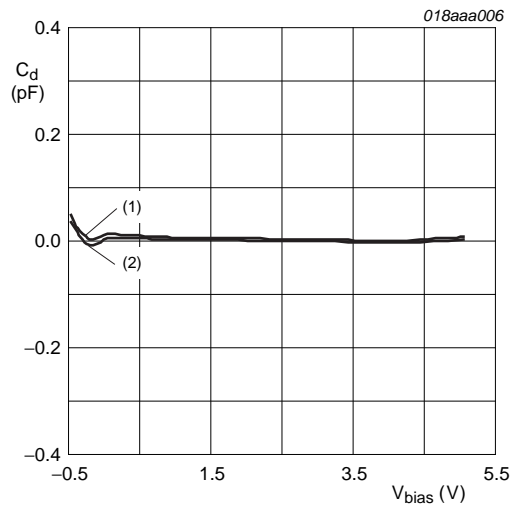
**Fig 3. Eye diagram using reference PCB**



018aaa005

5 Gbit/s; USB 3.0 CP0 pattern

**Fig 4. Typical eye diagram for PUSB3F4-TBR**

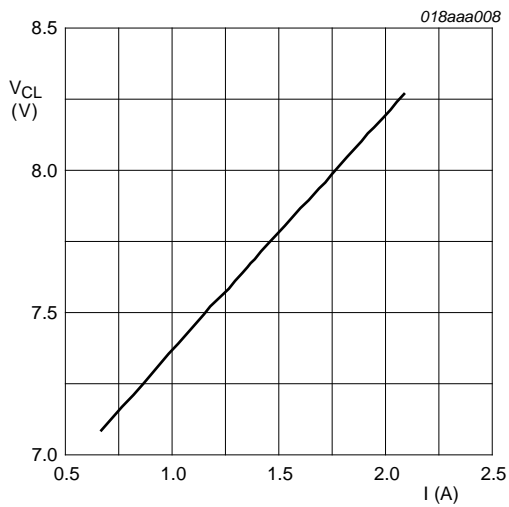


018aaa006

- (1) Pin 2
- (2) Pin 1

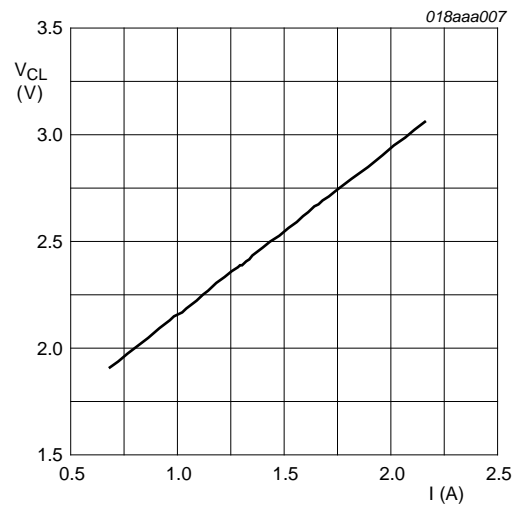
Deviation from typical capacitance normalized at  $V_{bias} = 2.5\text{ V}$

**Fig 5. Line capacitance as a function of bias voltage; typical values**



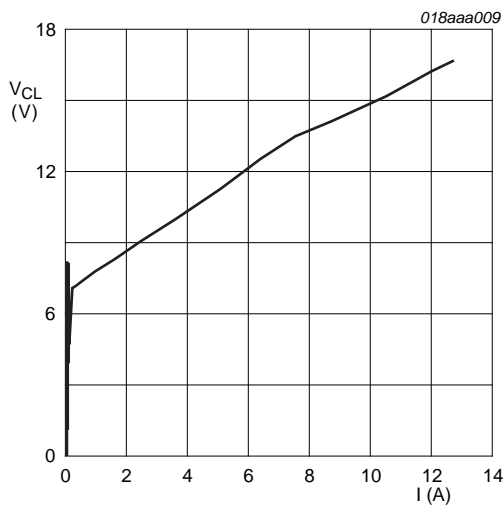
IEC 61000-4-5;  $t_p = 8/20 \mu s$ ; positive pulse

Fig 6. Dynamic resistance with positive clamping



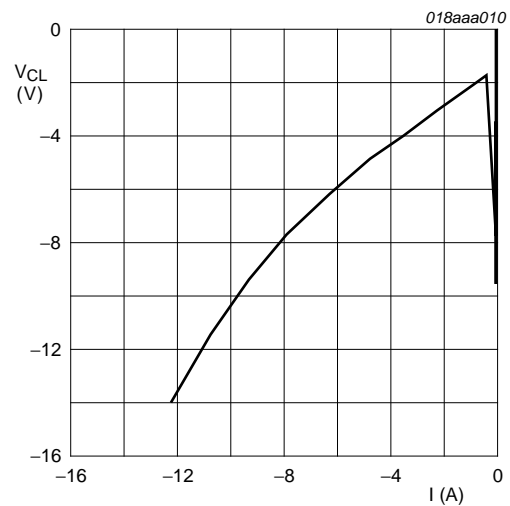
IEC 61000-4-5;  $t_p = 8/20 \mu s$ ; negative pulse

Fig 7. Dynamic resistance with negative clamping



$t_p = 100 ns$ ; Transmission Line Pulse (TLP)

Fig 8. Dynamic resistance with positive clamping



$t_p = 100 ns$ ; Transmission Line Pulse (TLP)

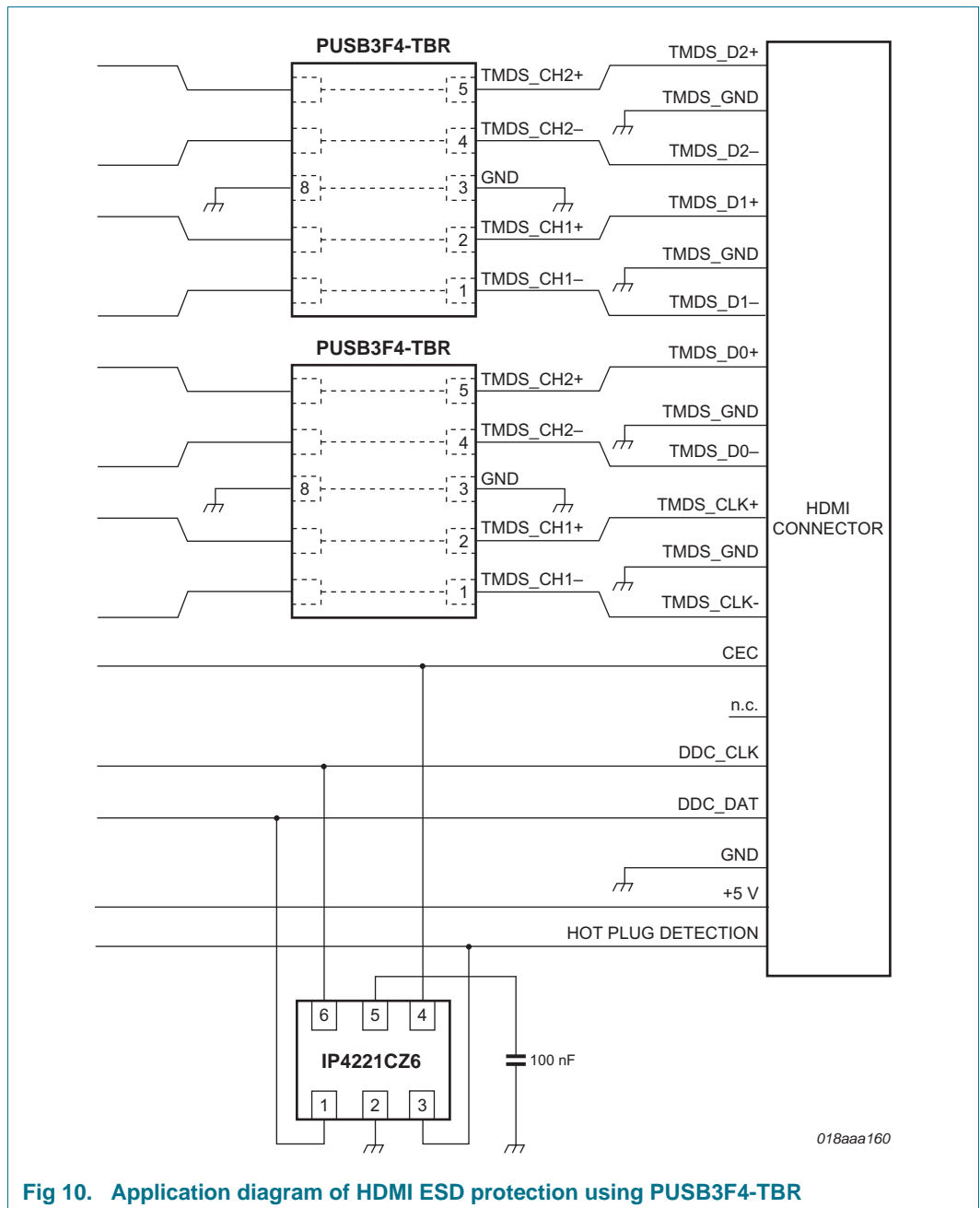
Fig 9. Dynamic resistance with negative clamping

## 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.

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 PUSB3F4-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

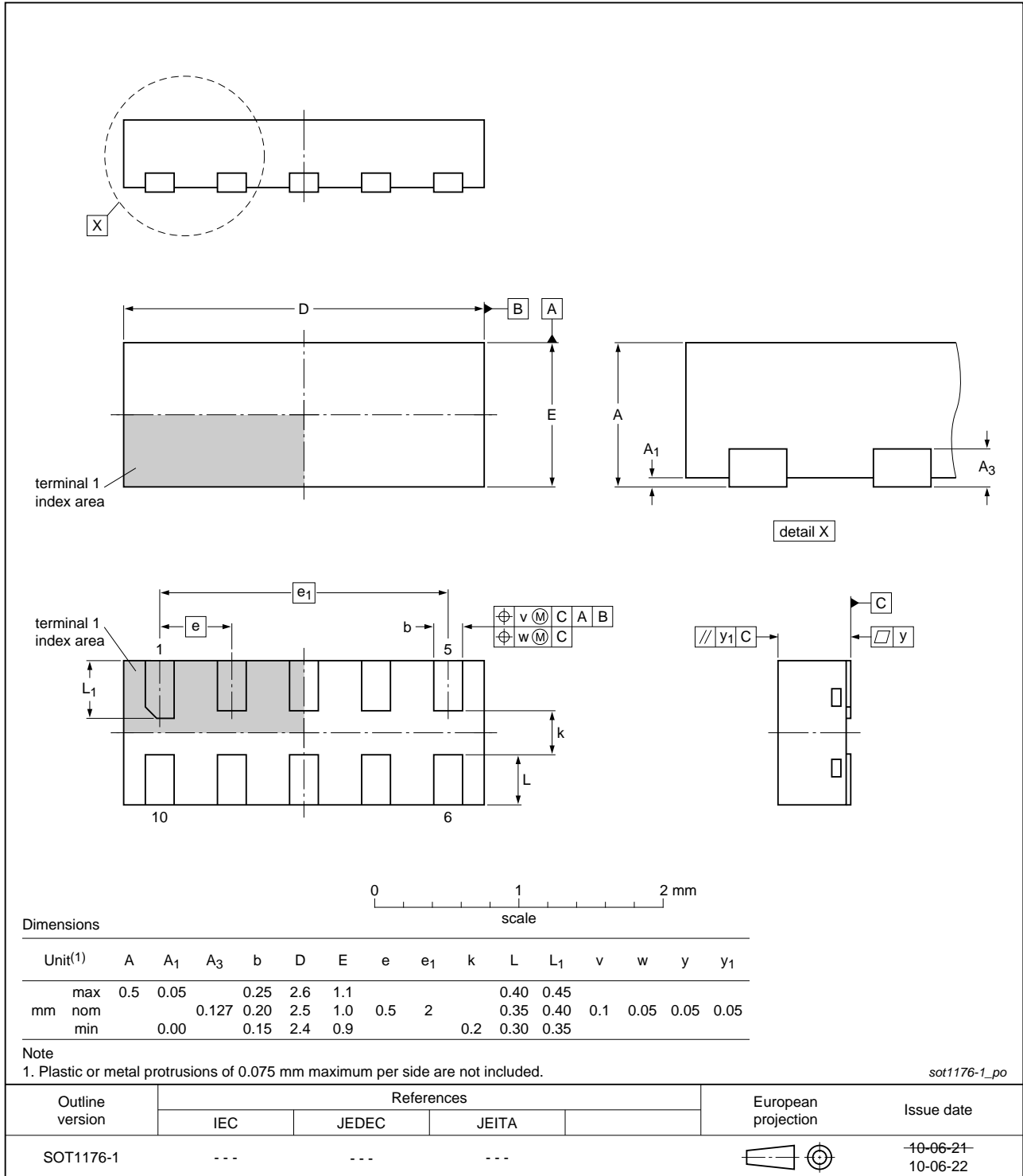
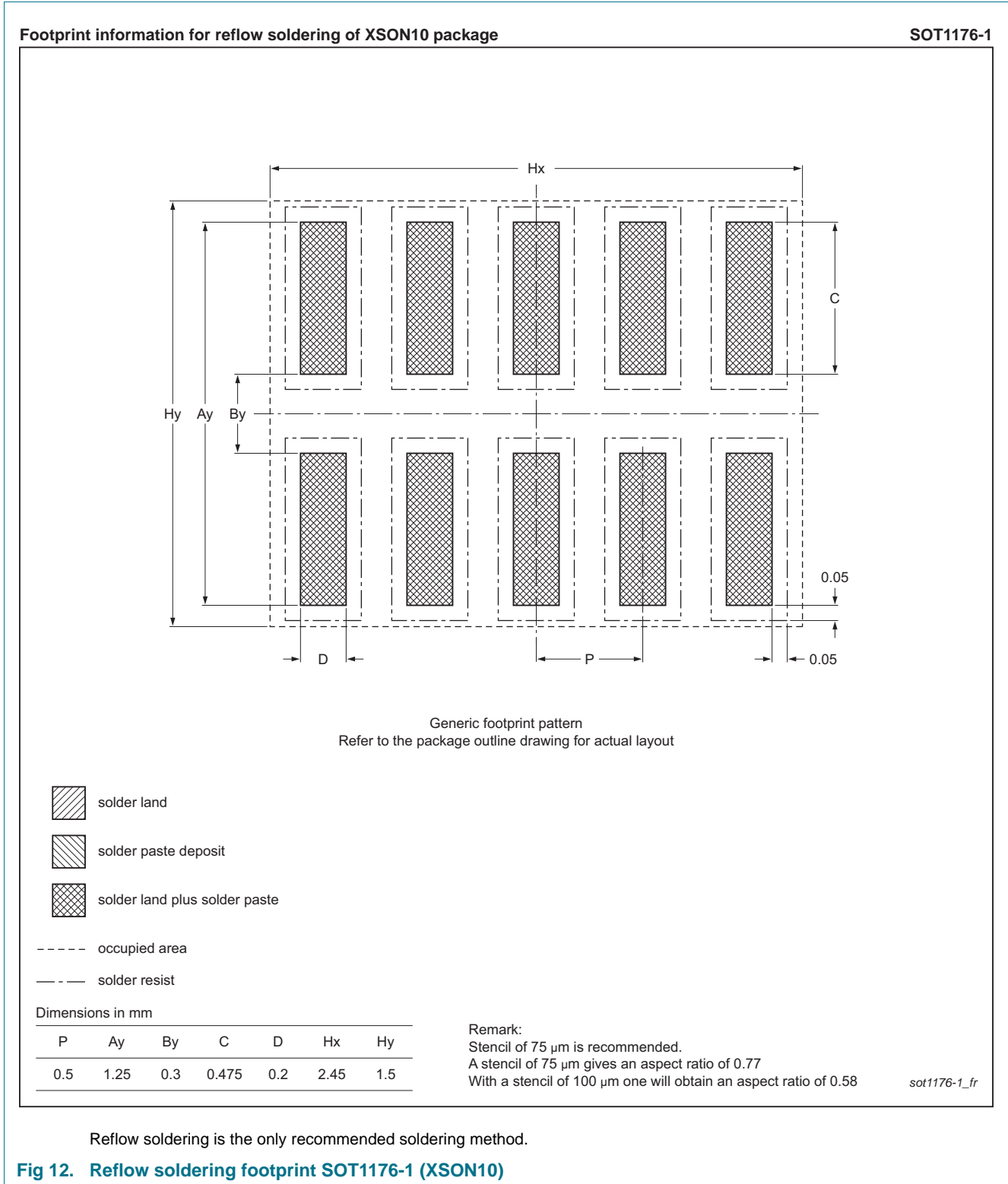


Fig 11. Package outline SOT1176-1 (XSON10)

9. Soldering



## 10. Abbreviations

**Table 6. Abbreviations**

<b>Acronym</b>	<b>Description</b>
eSATA	external Serial Advanced Technology Attachment
ESD	ElectroStatic Discharge
HBM	Human Body Model
HDMI	High-Definition Multimedia Interface
LVDS	Low Voltage Differential Signaling
NEXT	Near End Crosstalk
RoHS	Restriction of Hazardous Substances
TLP	Transmission Line Pulse
TMDS	Transition Minimized Differential Signaling

## 11. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PUSB3F4-TBR v.1	20111006	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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**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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