



# IP4284CZ10-TBR; IP4284CZ10-TT

ESD protection for ultra high-speed interfaces

Rev. 3 — 19 May 2011

Product data sheet

## 1. Product profile

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### 1.1 General description

The devices are 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 devices include high-level ESD protection diodes for ultra high-speed signal lines and are available in two package variants: XSON10 and TSSOP10.

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 or TSSOP10 Pb-free package
- Design-friendly 'pass-thru' signal routing

### 1.3 Applications

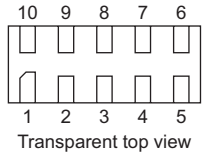
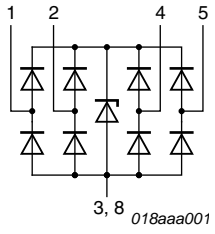
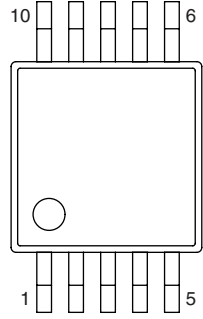
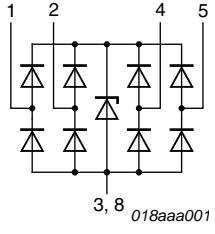
The devices are designed for high-speed receiver and transmitter port protection:

- 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  |
|-----------------------------------|--------|--------------------------|--|---|
| <b>IP4284CZ10-TBR (SOT1176-1)</b> |        |                          |  |   |
| 1                                 | CH1    | channel 1 ESD protection |  <p>Transparent top view<br/><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            |  |   |
| <b>IP4284CZ10-TT (SOT552-1)</b>   |        |                          |  |   |
| 1                                 | CH1    | channel 1 ESD protection |  <p><b>TSSOP10</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   |
| IP4284CZ10-TBR | XSON10  | plastic extremely thin small outline package; no leads; 10 terminals; body 1 × 2.5 × 0.5 mm | SOT1176-1 |
| IP4284CZ10-TT  | TSSOP10 | plastic thin shrink small outline package; 10 leads; body width 3 mm                        | SOT552-1  |

## 4. Marking

**Table 3. Marking codes**

| Type number    | Marking code |
|----------------|--------------|
| IP4284CZ10-TBR | 84           |
| IP4284CZ10-TT  | 4284         |

## 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   |
|           |                                 | 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**

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

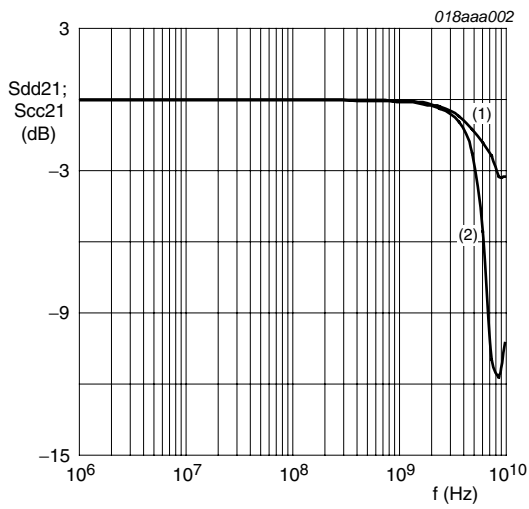
| Symbol                | Parameter                                   | Conditions                                       | Min      | Typ  | Max | Unit |
|-----------------------|---|--|----------|------|-----|------|
| $V_{BRzd}$            | Zener diode breakdown voltage               | $I_{test} = 1\text{ mA}$                         | 6        | -    | 9   | V    |
| $I_{LRzd}$            | Zener diode reverse leakage current         | per TMDS channel;<br>$V_I = 3.0\text{ V}$        | -        | -    | 1   | μA   |
| $V_F$                 | forward voltage                             |  | -        | 0.7  | -   | V    |
| $C_{ch(TMDS)}$        | TMDS channel capacitance                    | $f = 1\text{ MHz};$<br>$V_{bias} = 2.5\text{ V}$ | [1] 0.4  | 0.5  | 0.7 | pF   |
| $\Delta C_{ch(TMDS)}$ | TMDS channel capacitance difference         | $f = 1\text{ MHz};$<br>$V_{bias} = 2.5\text{ V}$ | [1] -    | 0.05 | -   | pF   |
| $C_{ch(mutual)}$      | mutual channel capacitance                  | $f = 1\text{ MHz};$<br>$V_{bias} = 2.5\text{ V}$ | [1][2] - | 0.07 | -   | pF   |
| $R_{dyn}$             | dynamic resistance                          | $I = 1\text{ A}$ [3]                             |          |      |     |      |
|                       |   | positive transient                               | -        | 1    | -   | Ω    |
|                       |   | negative transient                               | -        | 1    | -   | Ω    |
| $V_{CL(ch)trt(pos)}$  | 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.

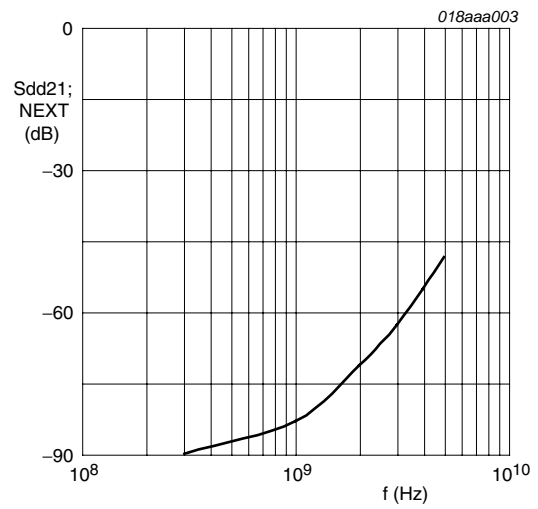
[3] According to IEC 61000-4-5 and IEC 61000-4-9.

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



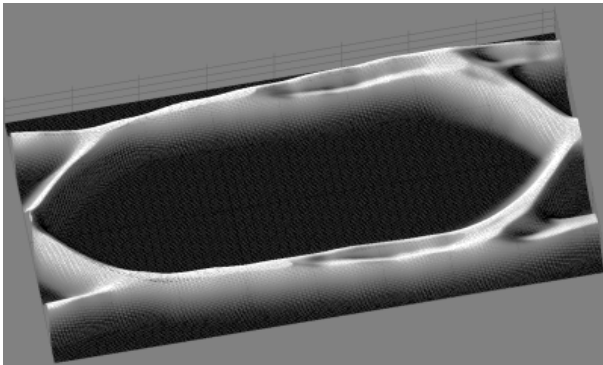
- (1) Sdd21
  - (2) Scc21
- normalized to 100 Ω;  
differential pairs at CH1/CH2 or at CH3/CH4

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



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

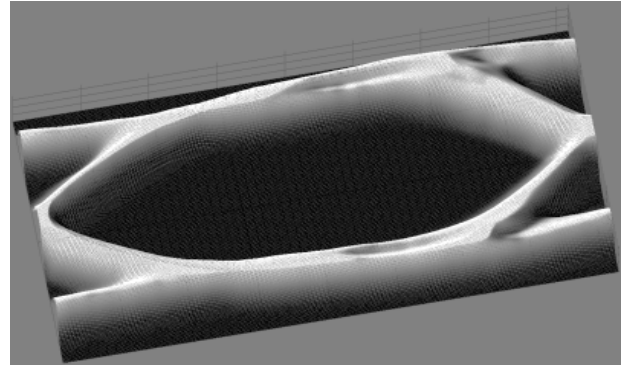
**Fig 2. Mixed-mode differential NEXT crosstalk; typical values**



018aaa004

5 Gbit/s; USB 3.0 CP0 pattern

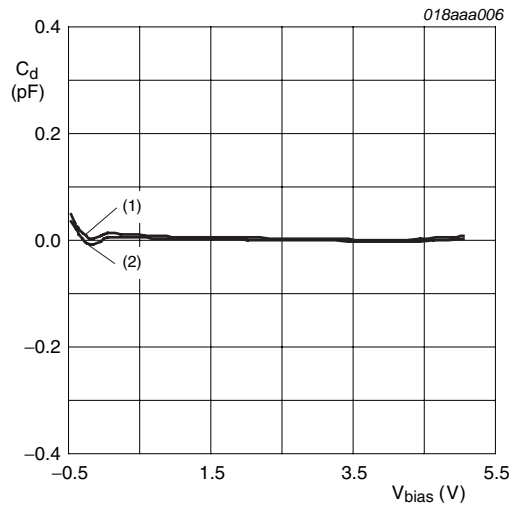
Fig 3. Eye diagram using reference PCB



018aaa005

5 Gbit/s; USB 3.0 CP0 pattern

Fig 4. Typical eye diagram for IP4284CZ10

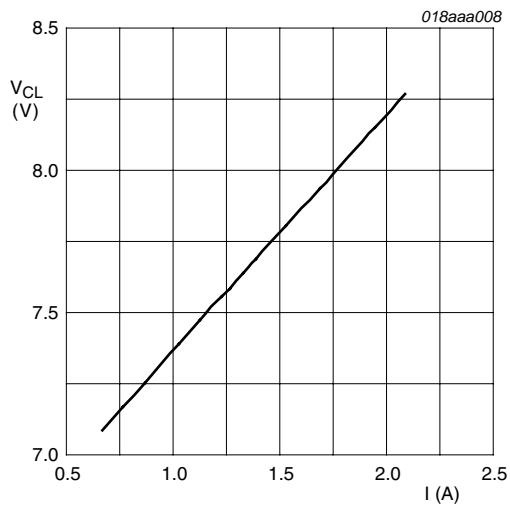


018aaa006

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

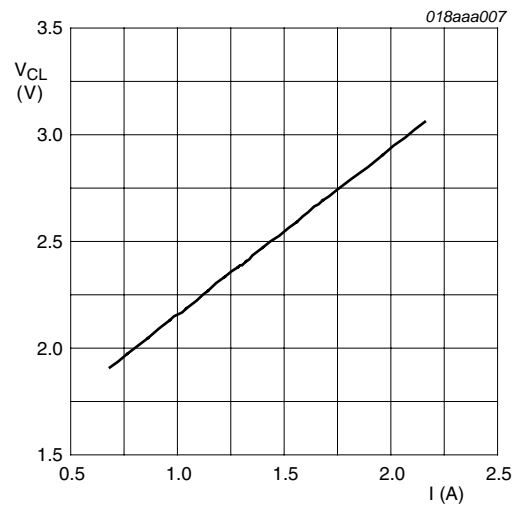
Deviation from typical capacitance normalized at  $V_{bias} = 2.5\text{ V}$

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



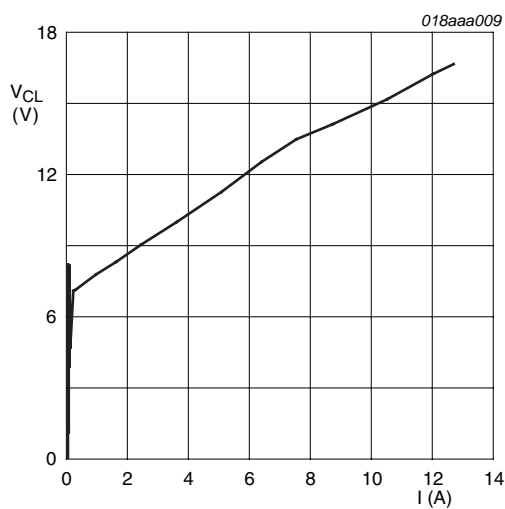
IEC 61000-4-5;  $t_p = 8/20 \mu s$ ; positive pulse

Fig 6. Dynamic resistance with positive clamping



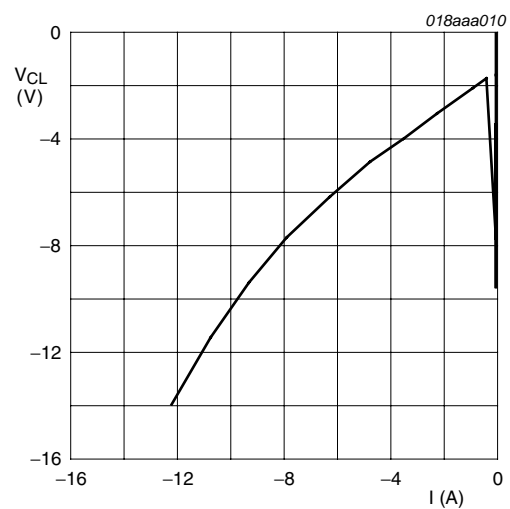
IEC 61000-4-5;  $t_p = 8/20 \mu s$ ; negative pulse

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 devices are 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), careful consideration should be given to basic high-speed routing guidelines, impedance matching, and signal coupling.

Basic application diagrams for the ESD protection of an HDMI interface are shown in [Figure 10](#) and [Figure 11](#).

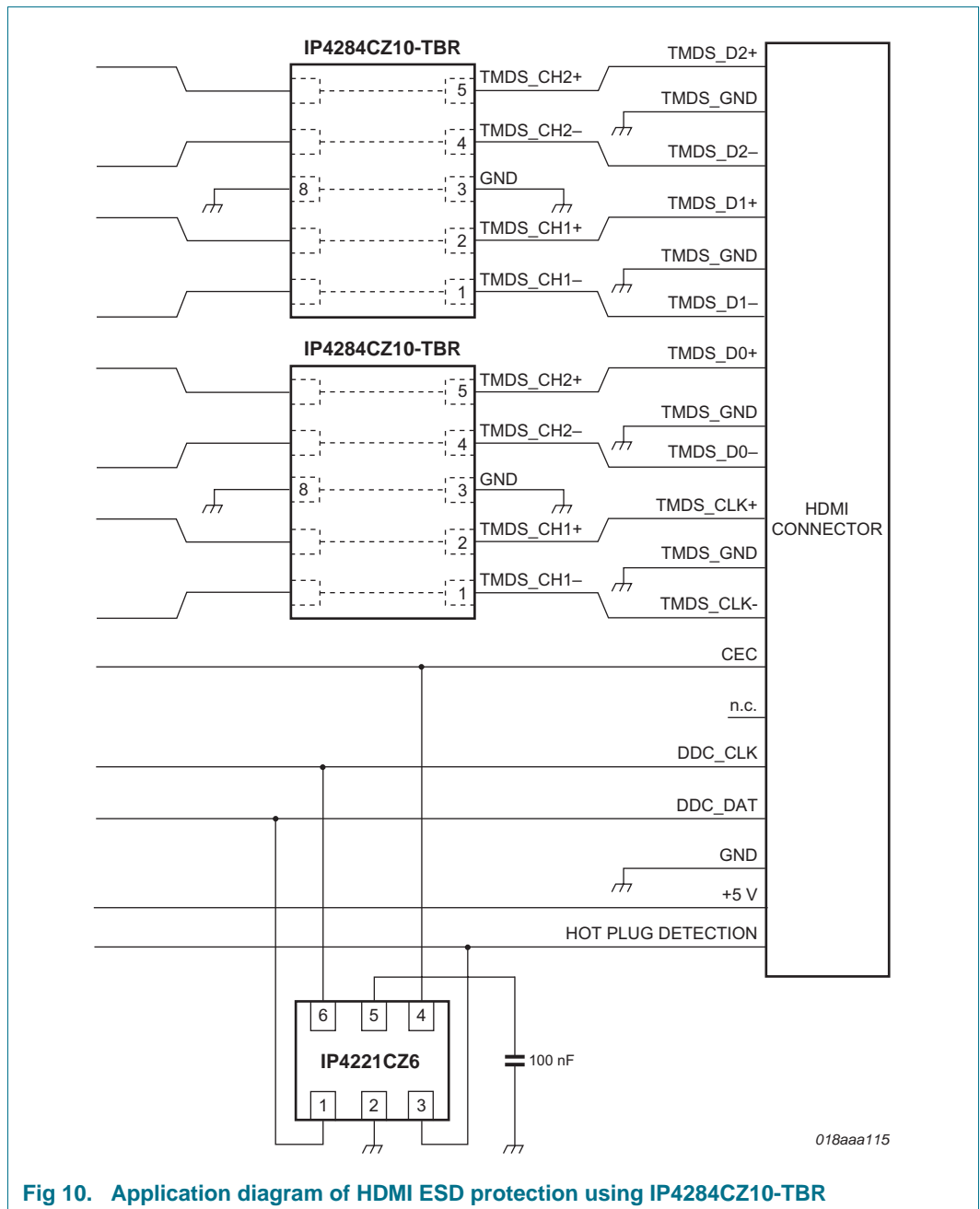


Fig 10. Application diagram of HDMI ESD protection using IP4284CZ10-TBR

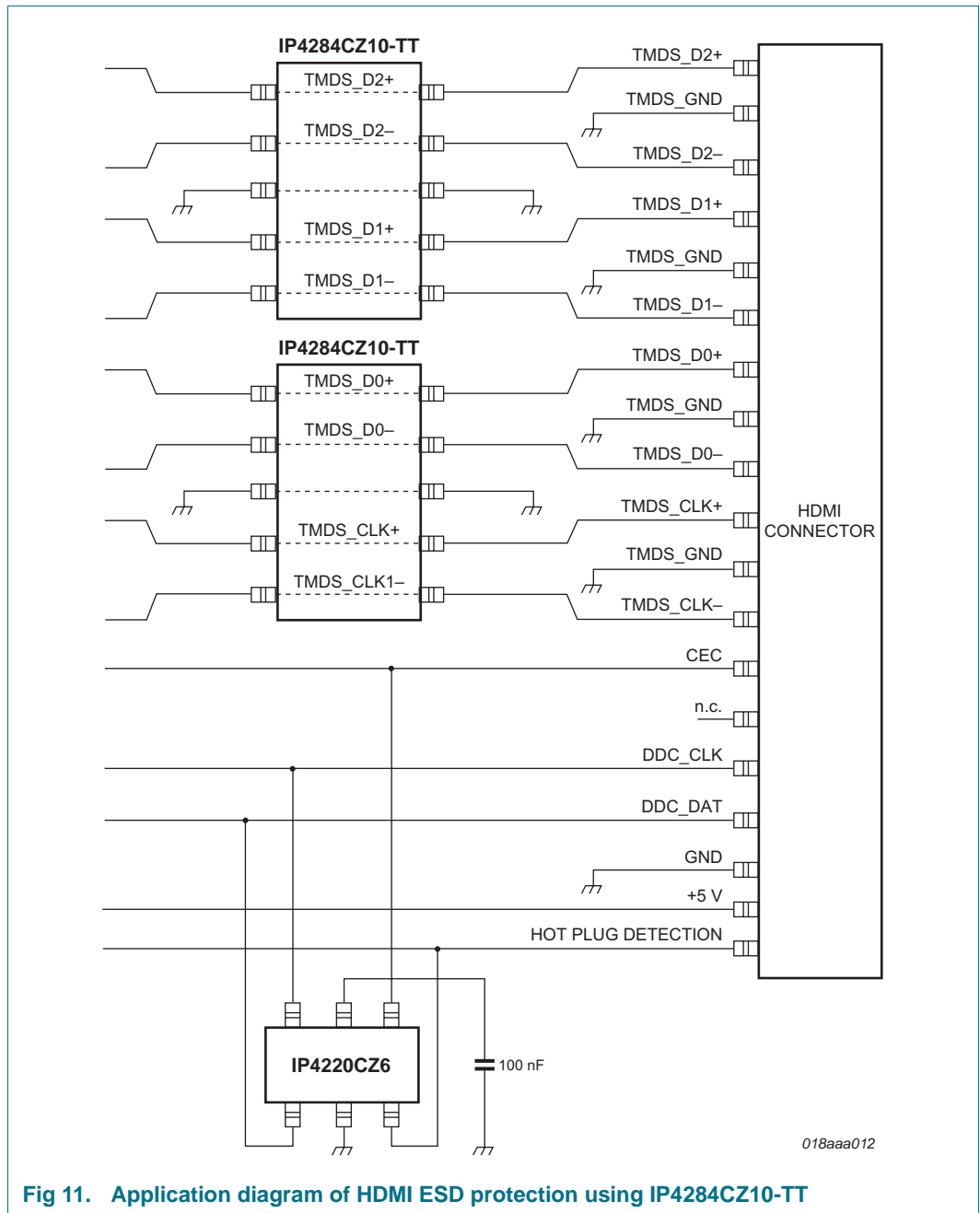


Fig 11. Application diagram of HDMI ESD protection using IP4284CZ10-TT



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

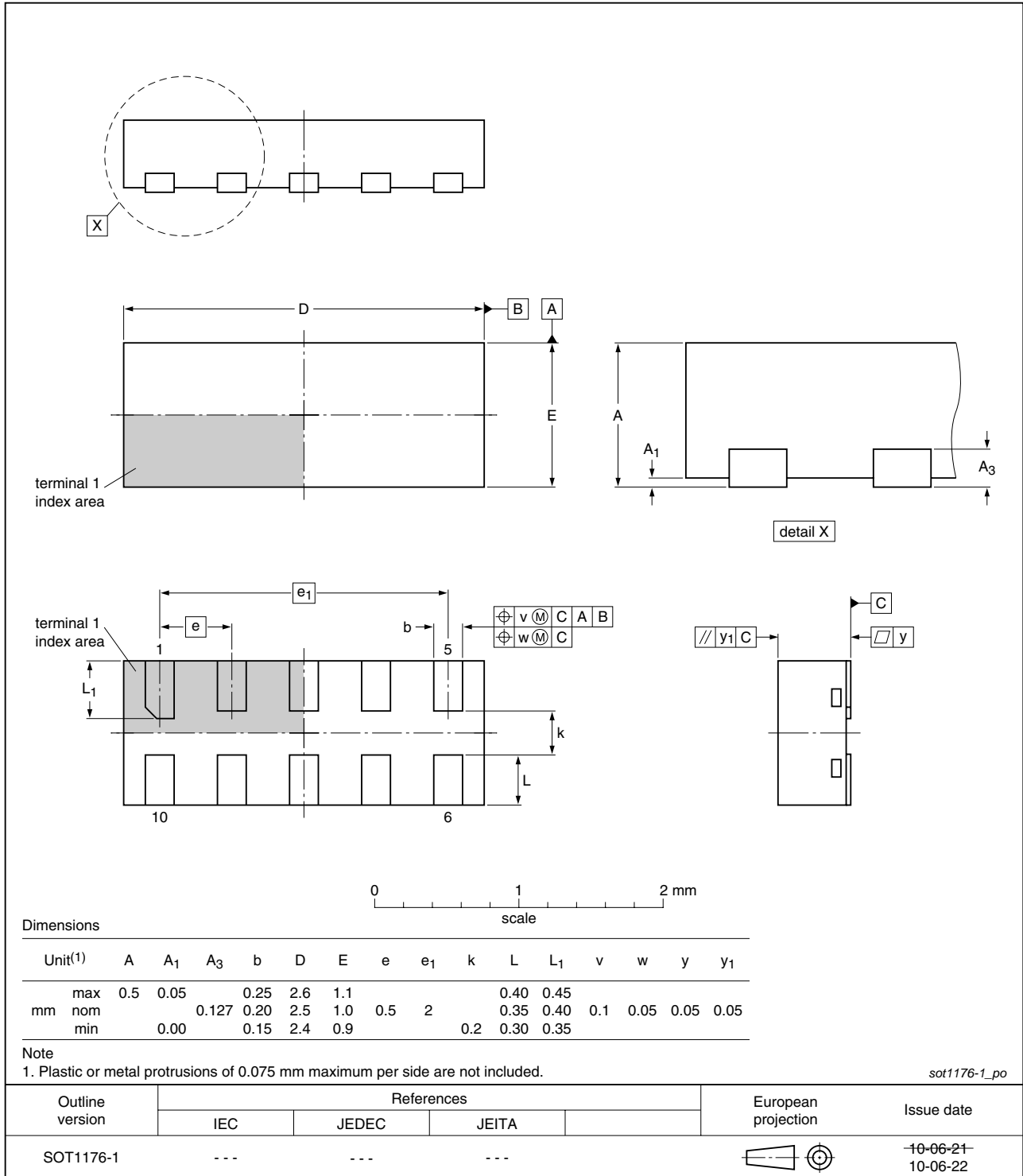


Fig 12. Package outline SOT1176-1 (XSON10)

TSSOP10: plastic thin shrink small outline package; 10 leads; body width 3 mm

SOT552-1

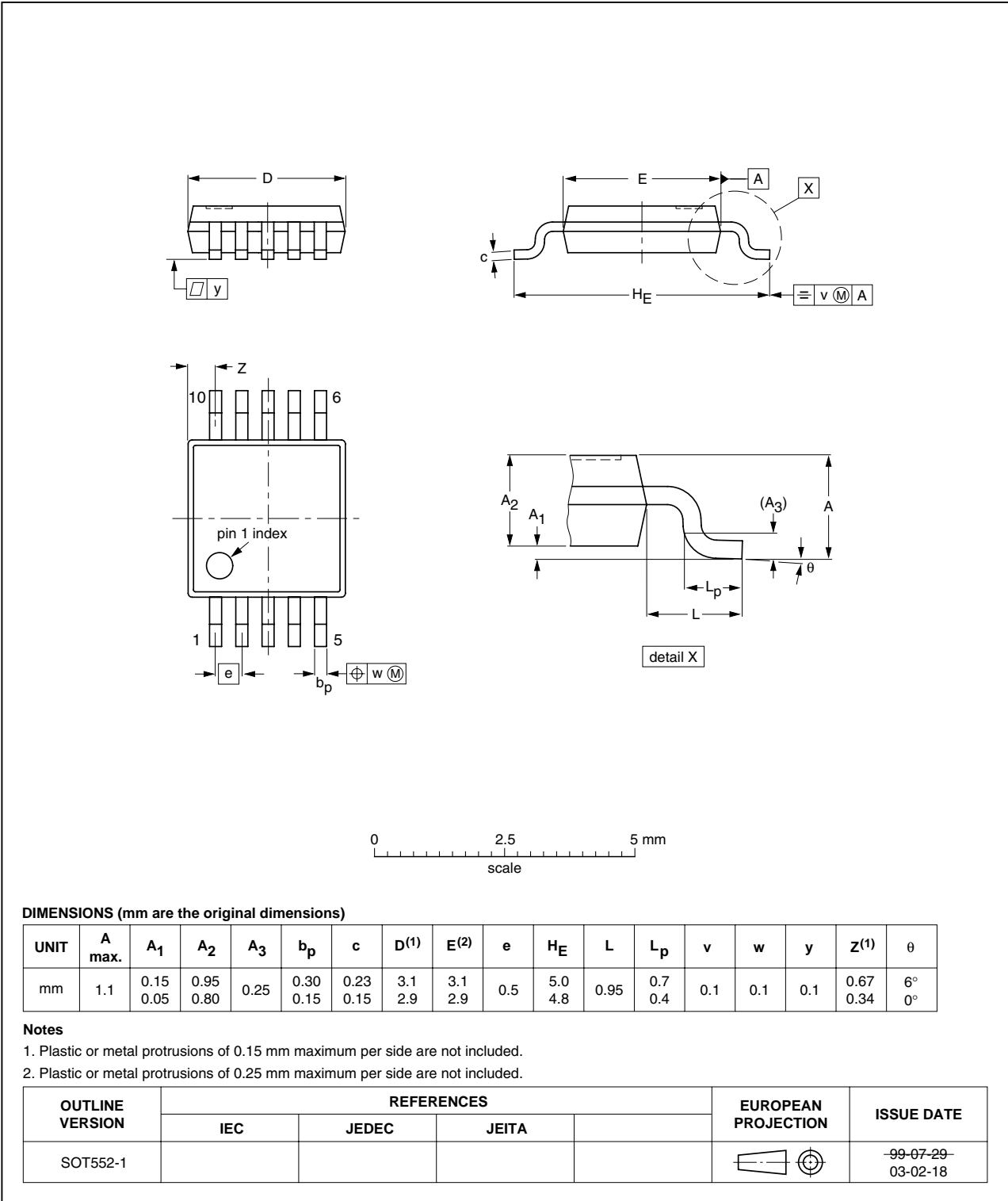
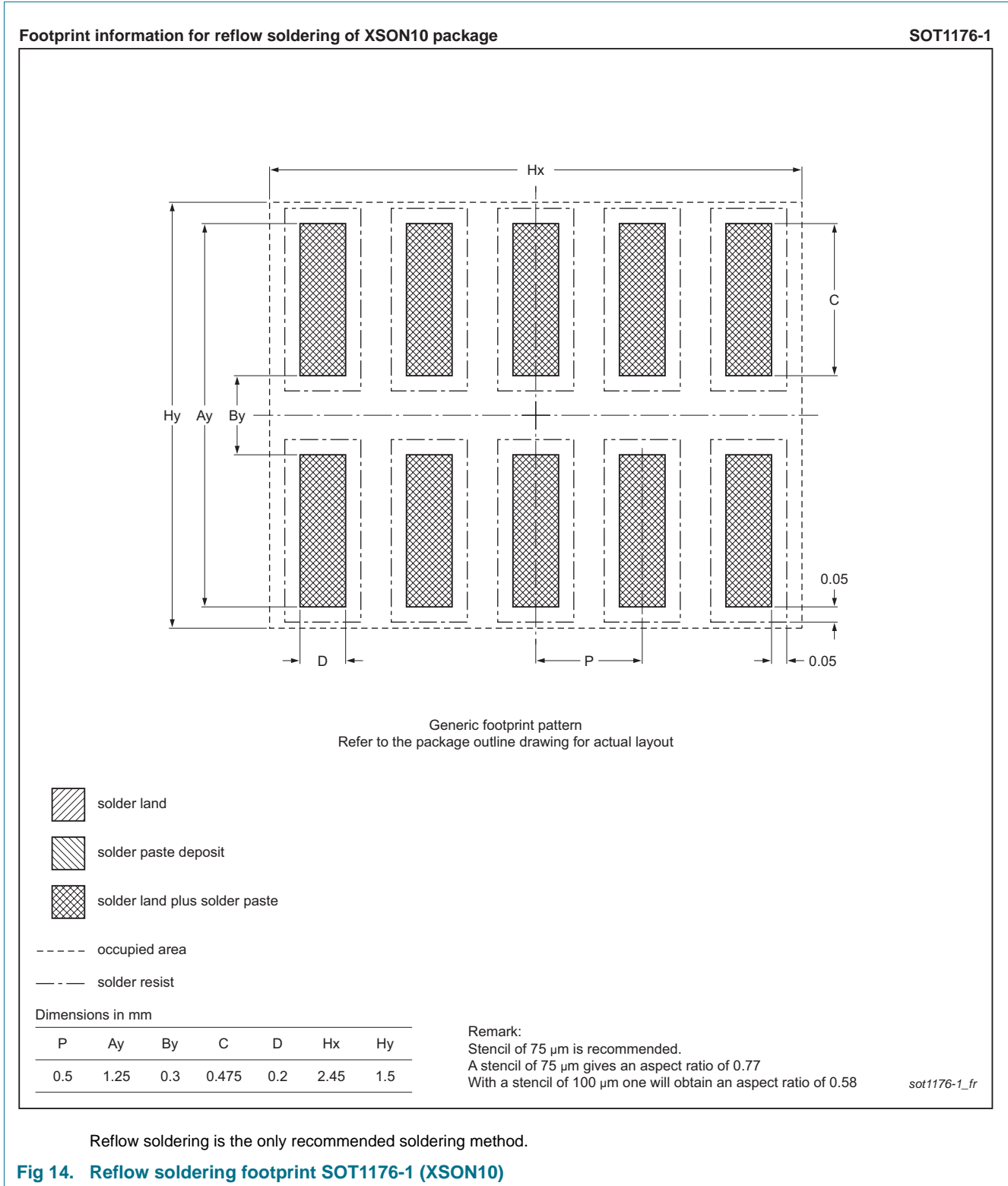


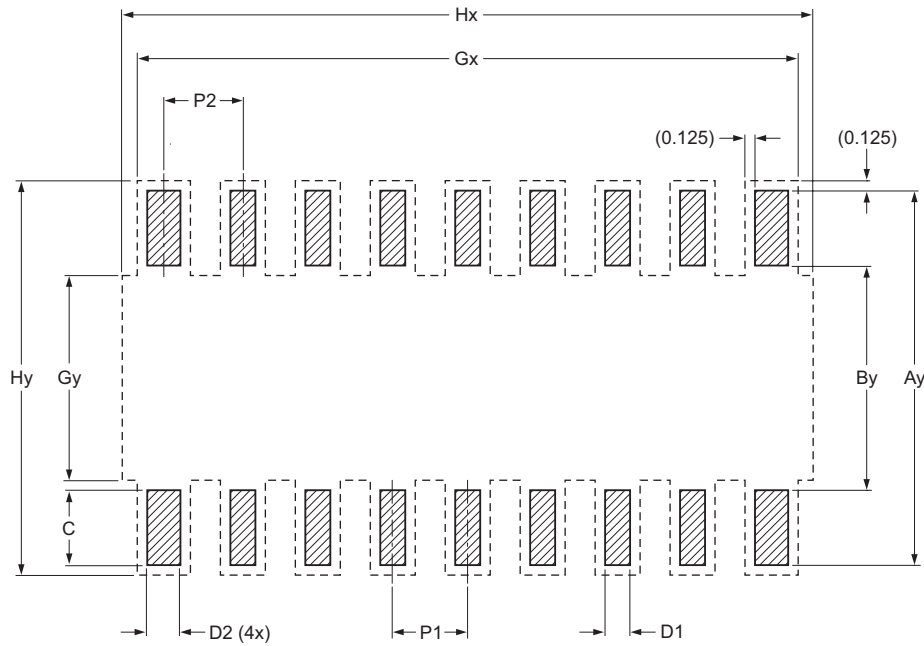
Fig 13. Package outline SOT552-1 (TSSOP10)

9. Soldering




Footprint information for reflow soldering of TSSOP10 package

SOT552-1



Generic footprint pattern  
Refer to the package outline drawing for actual layout

 solder land  
 - - - - occupied area

DIMENSIONS in mm

| P1    | P2    | Ay    | By    | C     | D1    | D2    | Gx    | Gy    | Hx    | Hy    |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0.500 | 0.550 | 5.400 | 3.200 | 1.100 | 0.300 | 0.400 | 2.750 | 3.900 | 3.700 | 5.650 |

sot552-1\_fr

Reflow soldering is the only recommended soldering method.

Fig 15. Reflow soldering footprint SOT552-1 (TSSOP10)

## 10. Abbreviations

**Table 6. Abbreviations**

| <b>Acronym</b> | <b>Description</b>                             |
|----------------|--|
| DVD            | Digital Versatile Disc                         |
| 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    |
| UTLP           | Ultra Thin Leadless Package                    |

## 11. Revision history

Table 7. Revision history

| Document ID           | Release date | Data sheet status   | Change notice | Supersedes           |
|-----------------------|--------------|---|---------------|----------------------|
| IP4284CZ10-TBR_TT v.3 | 20110519     | Product data sheet  | -             | IP4284CZ10-TB_TT v.2 |
| Modifications:        |              | <ul style="list-style-type: none"><li>Deleted type number IP4284CZ10-TB.</li><li>Added type number IP4284CZ10-TBR.</li><li><a href="#">Section 4 "Marking"</a>: added.</li><li><a href="#">Table 4 "Limiting values"</a>: updated <math>V_{ESD}</math> values.</li><li><a href="#">Section 9 "Soldering"</a>: added.</li><li><a href="#">Section 12 "Legal information"</a>: updated.</li></ul> |               |                      |
| IP4284CZ10-TB_TT v.2  | 20100401     | Product data sheet  | -             | IP4284CZ10-TB_TT v.1 |
| IP4284CZ10-TB_TT v.1  | 20100304     | Preliminary data sheet  | -             | -                    |

## 12. 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.                                     |

[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".

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