



IP4284CZ10-TBR; IP4284CZ10-TT

ESD protection for ultra high-speed interfaces

Rev. 3 — 19 May 2011

Product data sheet

1. Product profile

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 ± 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 ± 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 0.5 pF for each channel
- 4-channel, XSON10 or TSSOP10 Pb-free package
- Design-friendly 'pass-thru' signal routing

1.3 Applications

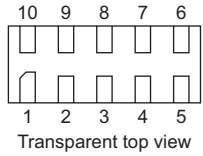
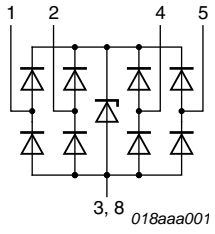
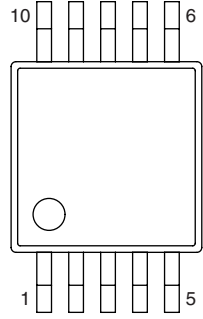
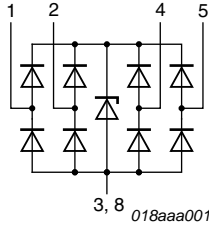
The devices are designed for high-speed receiver and transmitter port protection:

- 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 |
|-----------------------------------|--------|--------------------------|--|---|
| IP4284CZ10-TBR (SOT1176-1) | | | | |
| 1 | CH1 | channel 1 ESD protection |  <p>Transparent top view 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 | | |
| IP4284CZ10-TT (SOT552-1) | | | | |
| 1 | CH1 | channel 1 ESD protection |  <p>TSSOP10</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.

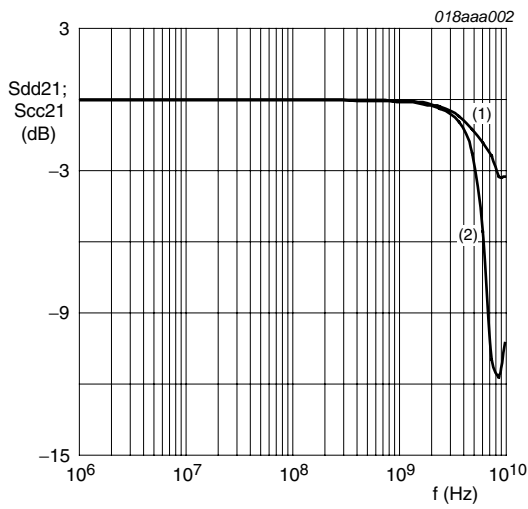
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------------------|---|--|----------|------|-----|------|
| V_{BRzd} | Zener diode breakdown voltage | $I_{test} = 1\text{ mA}$ | 6 | - | 9 | V |
| I_{LRzd} | Zener diode reverse leakage current | per TMDS channel; $V_I = 3.0\text{ V}$ | - | - | 1 | μA |
| V_F | forward voltage | | - | 0.7 | - | V |
| $C_{ch(TMDS)}$ | TMDS channel capacitance | $f = 1\text{ MHz};$ $V_{bias} = 2.5\text{ V}$ | [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 | - | 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.

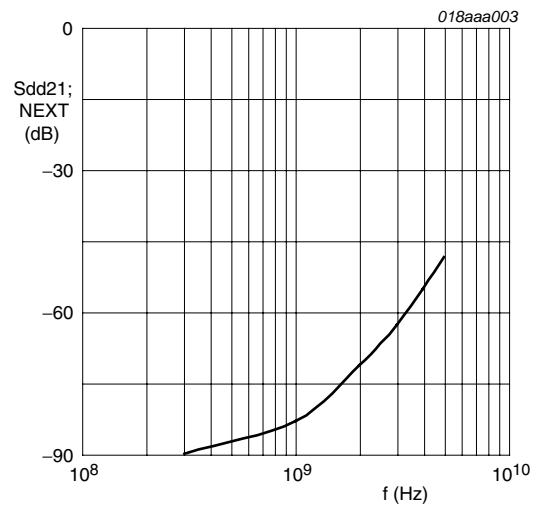
[3] According to IEC 61000-4-5 and IEC 61000-4-9.

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



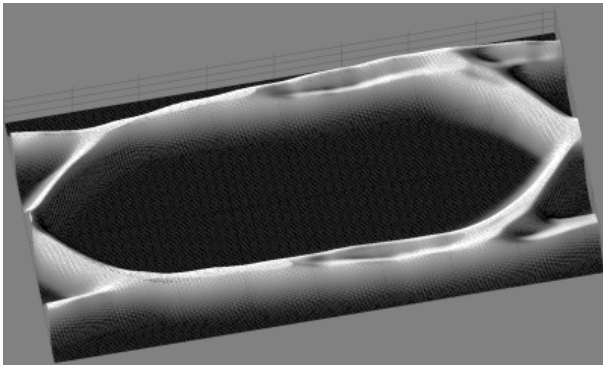
- (1) Sdd21
 - (2) Scc21
- normalized to 100 Ω;
differential pairs at CH1/CH2 or at CH3/CH4

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



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

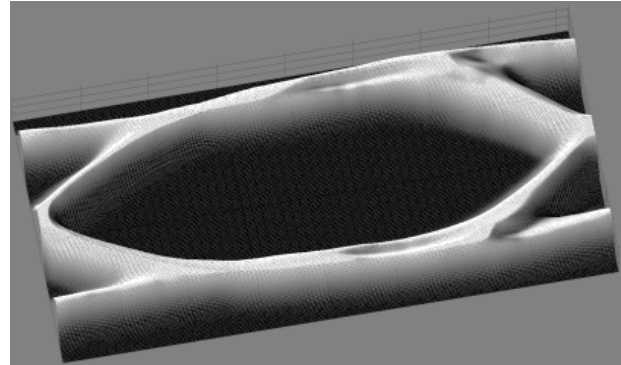
Fig 2. Mixed-mode differential NEXT crosstalk; typical values



018aaa004

5 Gbit/s; USB 3.0 CP0 pattern

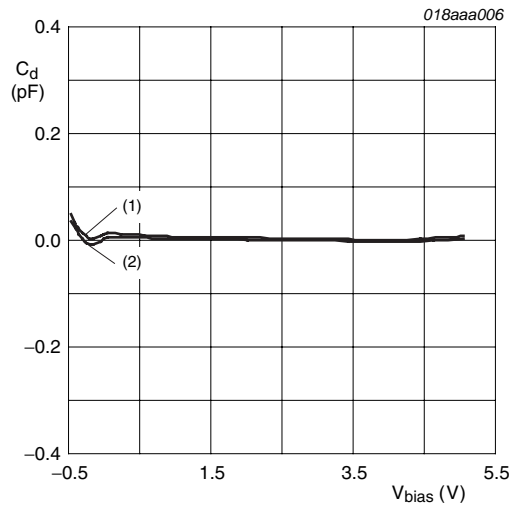
Fig 3. Eye diagram using reference PCB



018aaa005

5 Gbit/s; USB 3.0 CP0 pattern

Fig 4. Typical eye diagram for IP4284CZ10

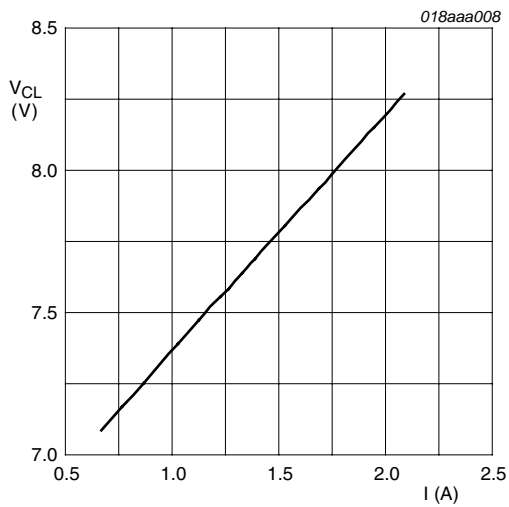


018aaa006

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

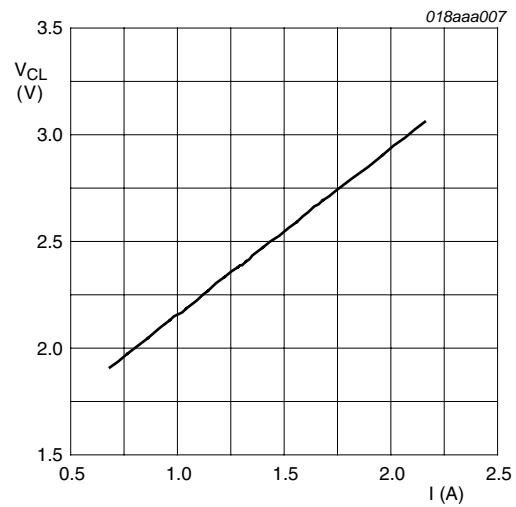
Deviation from typical capacitance normalized at $V_{bias} = 2.5\text{ V}$

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



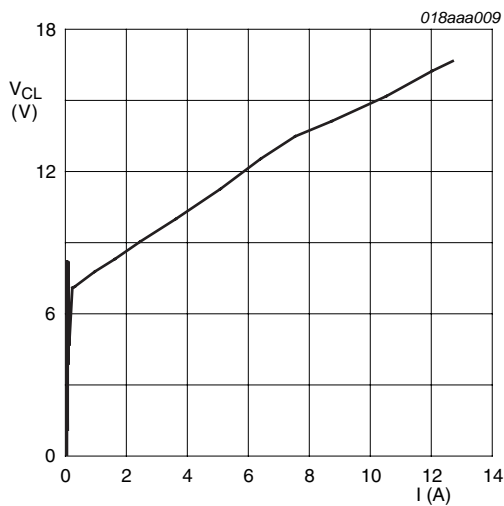
IEC 61000-4-5; $t_p = 8/20 \mu s$; positive pulse

Fig 6. Dynamic resistance with positive clamping



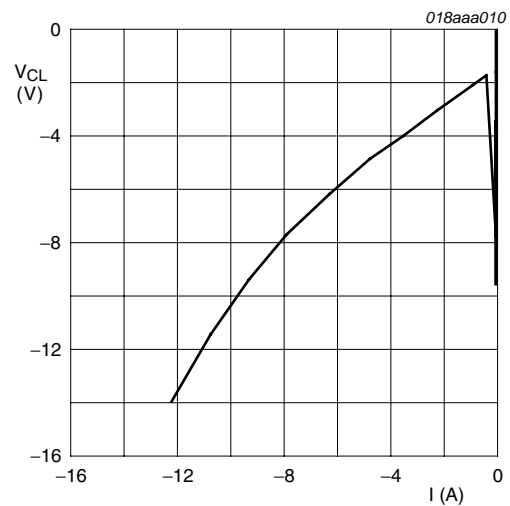
IEC 61000-4-5; $t_p = 8/20 \mu s$; negative pulse

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](#).

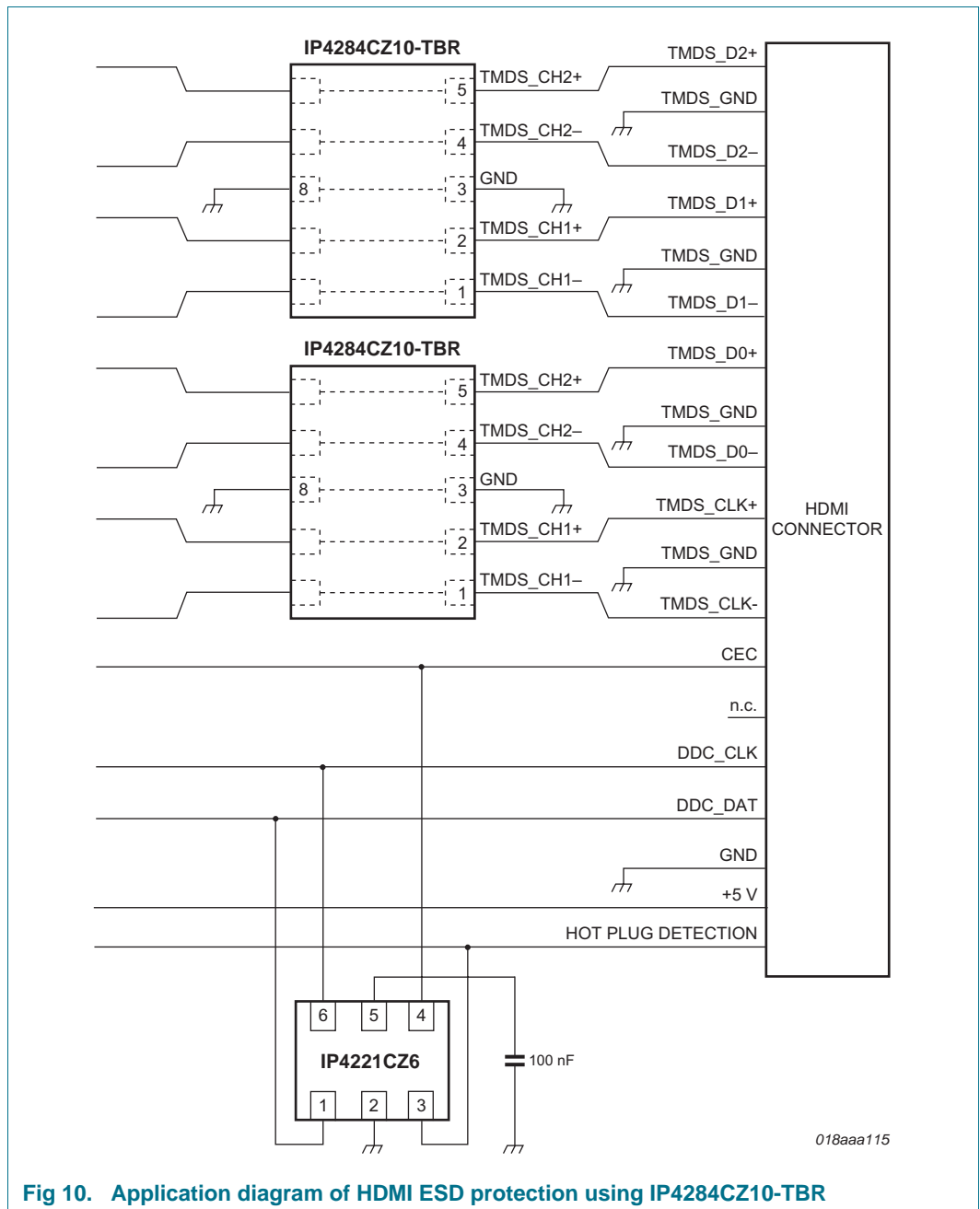


Fig 10. Application diagram of HDMI ESD protection using IP4284CZ10-TBR

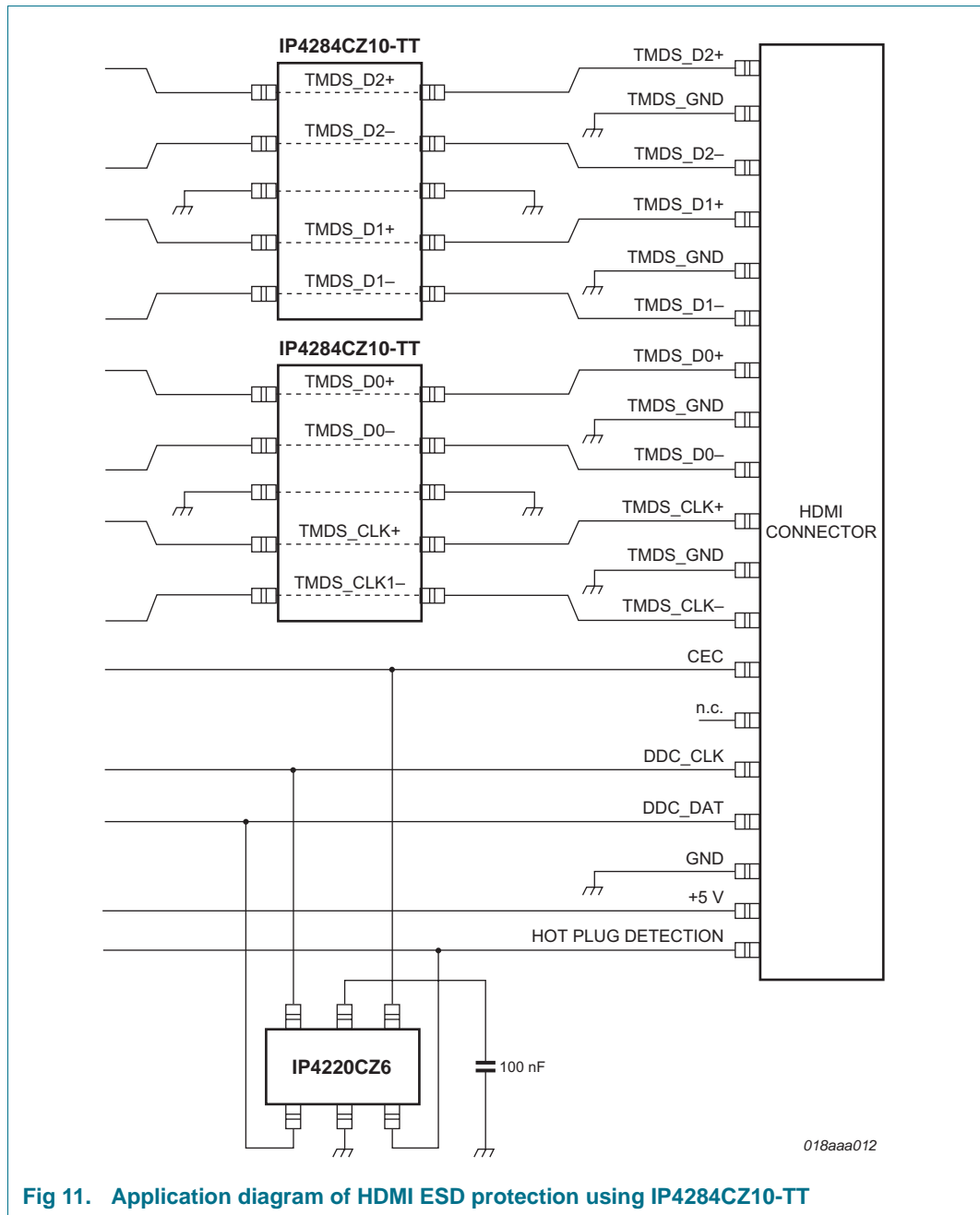


Fig 11. Application diagram of HDMI ESD protection using IP4284CZ10-TT

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

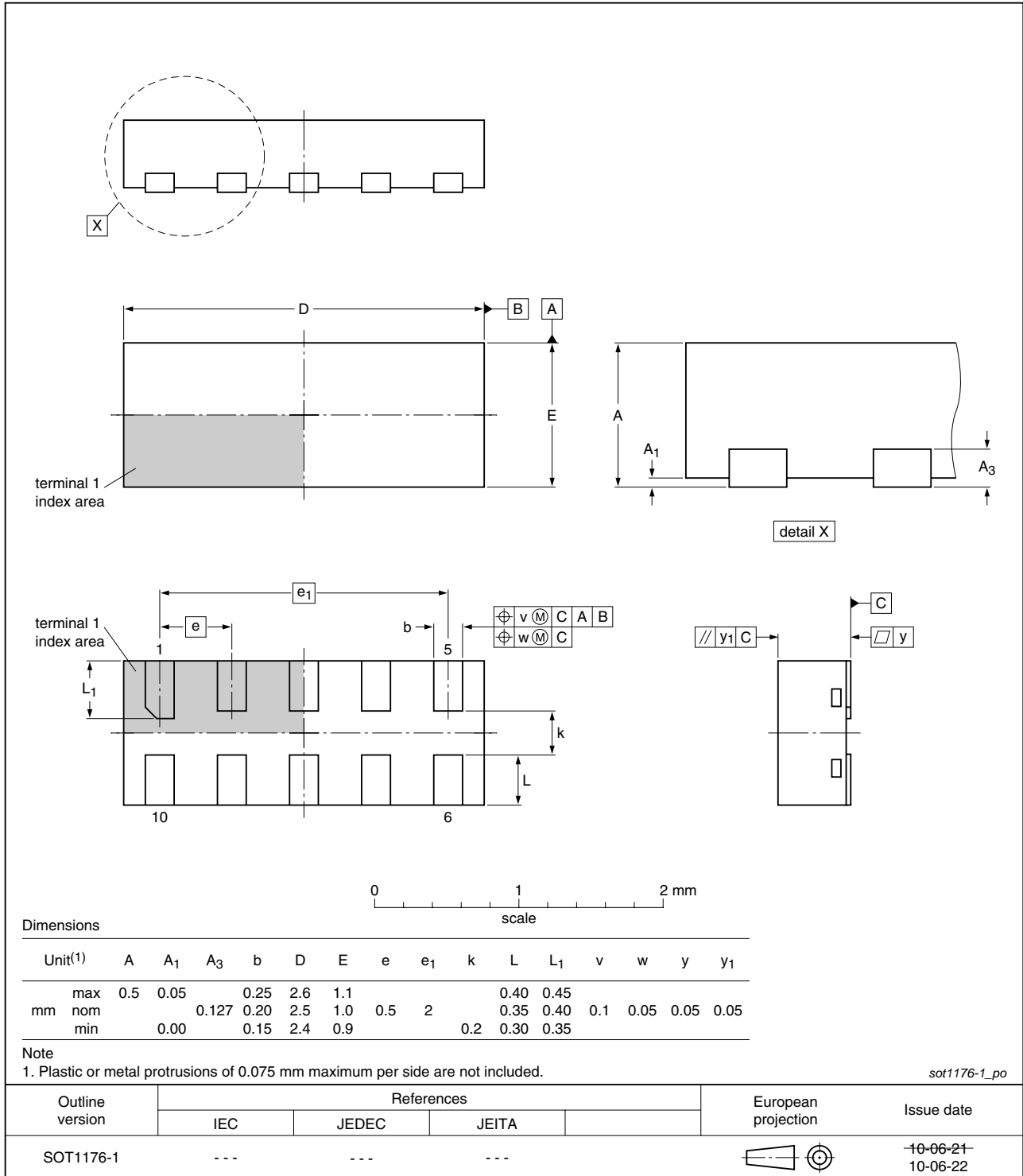


Fig 12. Package outline SOT1176-1 (XSON10)

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

SOT552-1

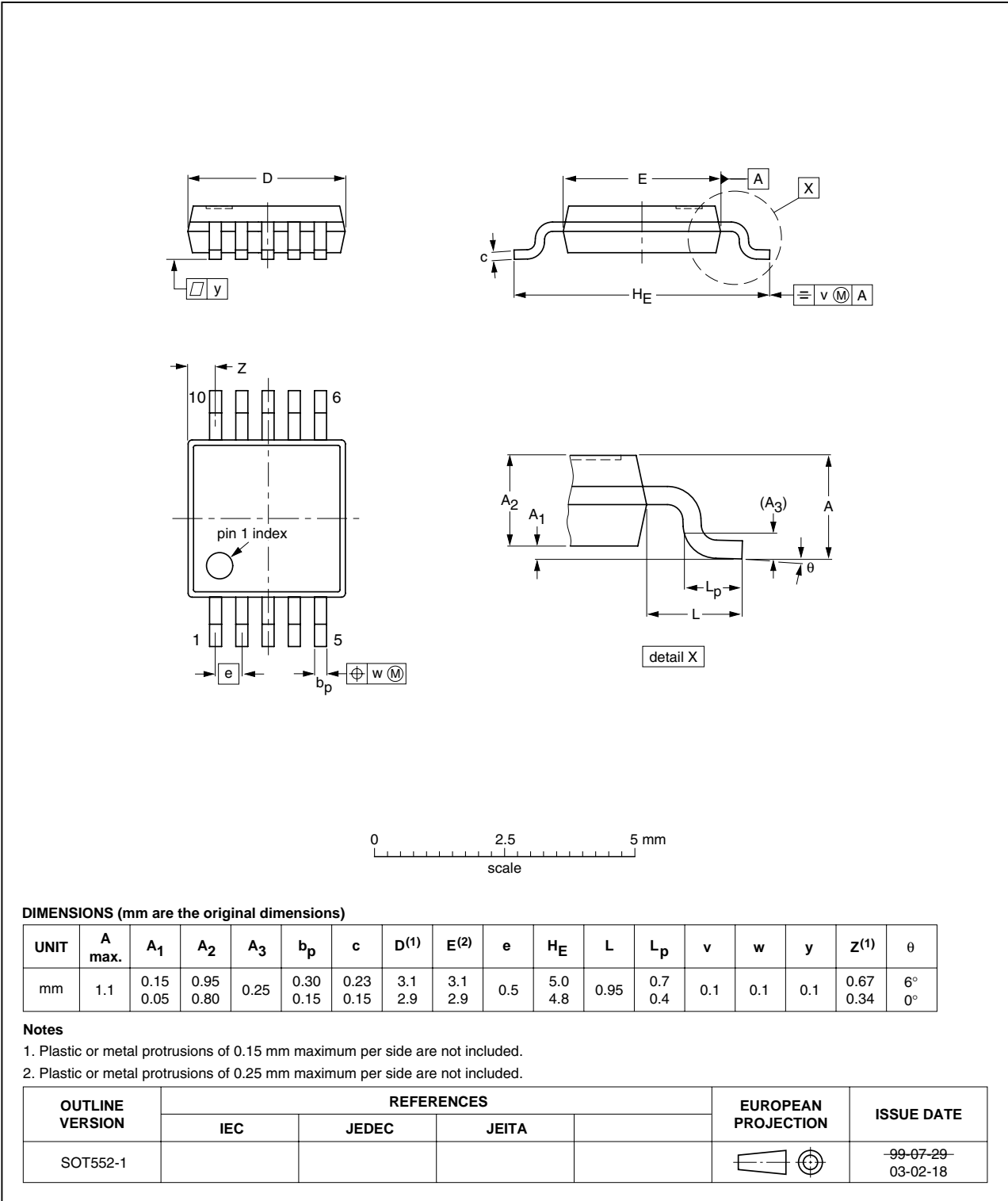
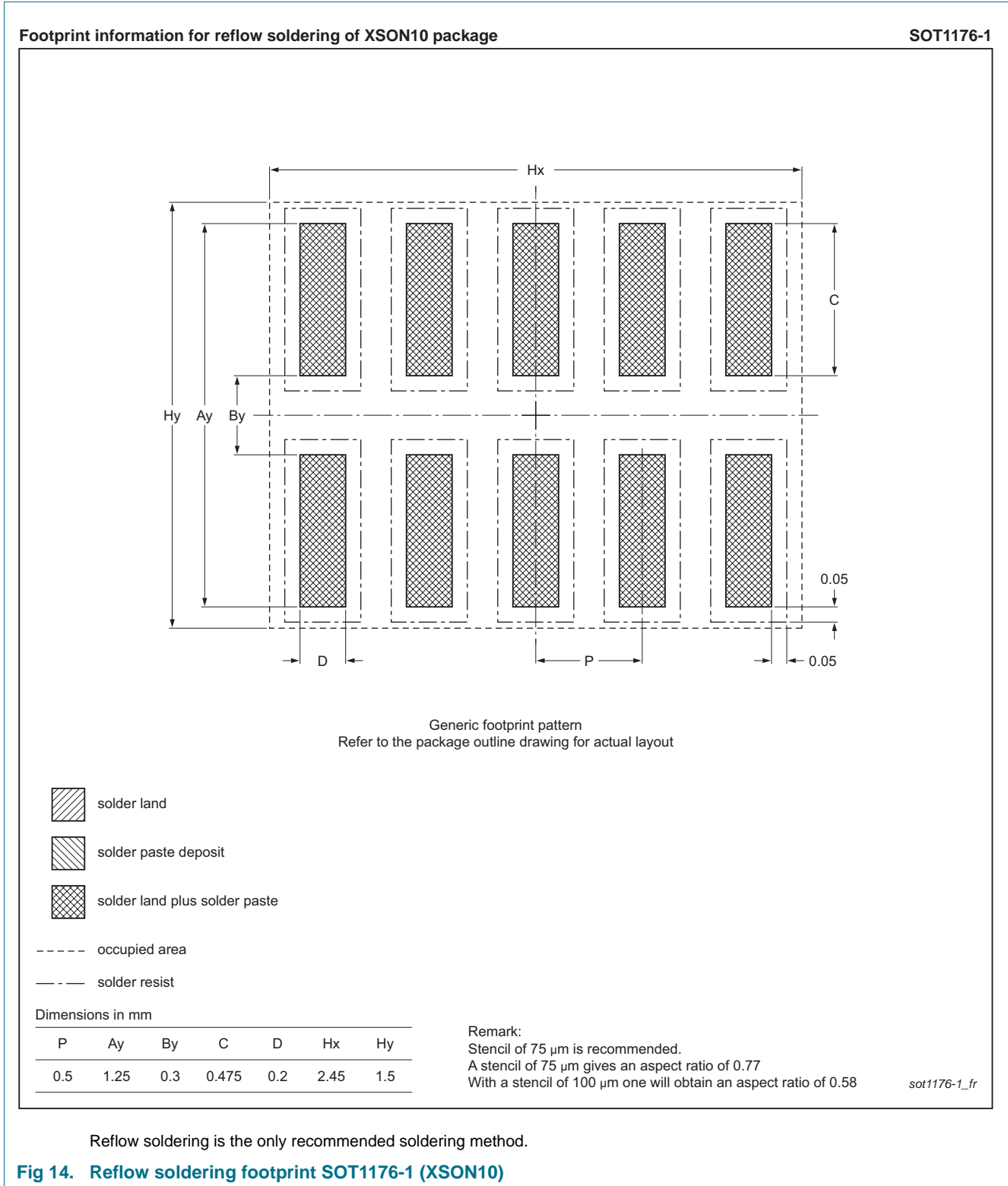


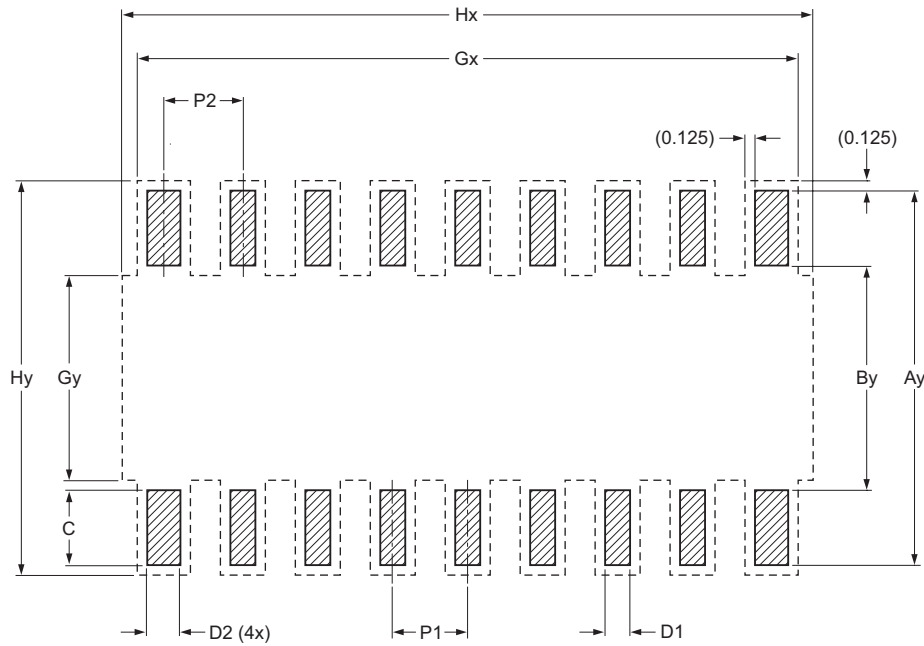
Fig 13. Package outline SOT552-1 (TSSOP10)

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

| Acronym | Description |
|---------|--|
| 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">Deleted type number IP4284CZ10-TB.Added type number IP4284CZ10-TBR.Section 4 "Marking": added.Table 4 "Limiting values": updated V_{ESD} values.Section 9 "Soldering": added.Section 12 "Legal information": updated. | | |
| 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

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. |

[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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