

# PRTR5V0U2F; PRTR5V0U2K

Ultra low capacitance double rail-to-rail ESD protection

Rev. 02 — 19 February 2009

Product data sheet

## 1. Product profile

### 1.1 General description

Ultra low capacitance double rail-to-rail ElectroStatic Discharge (ESD) protection devices in leadless ultra small Surface-Mounted Device (SMD) plastic packages.

The devices are designed to protect two Hi-Speed data lines or high-frequency signal lines from the damage caused by ESD and other transients.

PRTR5V0U2F and PRTR5V0U2K integrate two ultra low capacitance rail-to-rail ESD protection channels and one additional ESD protection diode each to ensure signal line protection even if no supply voltage is available.

Table 1. Product overview

Type number	Package		Package configuration
	Nexperia	JEDEC	
PRTR5V0U2F	SOT886	MO-252	leadless ultra small
PRTR5V0U2K	SOT891	-	leadless ultra small

### 1.2 Features

- ESD protection of two Hi-Speed data lines or high-frequency signal lines
- Ultra low input/output to ground capacitance:  $C_{(I/O-GND)} = 1 \text{ pF}$
- ESD protection up to 8 kV
- IEC 61000-4-2, level 4 (ESD)
- Very low clamping voltage due to an integrated additional ESD protection diode
- Very low reverse current
- AEC-Q101 qualified
- Leadless ultra small SMD plastic packages

### 1.3 Applications

- USB 2.0 interfaces
- Digital Video Interface (DVI) / High Definition Multimedia Interface (HDMI) interfaces
- Mobile and cordless phones
- Personal Digital Assistants (PDA)
- Digital cameras
- Wide Area Network (WAN) / Local Area Network (LAN) systems
- PCs, notebooks, printers and other PC peripherals

## 1.4 Quick reference data

**Table 2. Quick reference data**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per channel</b>						
$C_{(I/O-GND)}$	input/output to ground capacitance	$f = 1\text{ MHz}$ ; $V_{(I/O-GND)} = 0\text{ V}$	[1] -	1.0	1.5	pF
$C_{(I/O-I/O)}$	input/output to input/output capacitance	$f = 1\text{ MHz}$ ; $V_{(I/O-I/O)} = 0\text{ V}$	[2] -	0.6	-	pF
<b>Zener diode</b>						
$V_{RWM}$	reverse standoff voltage		[3] -	-	5.5	V
$C_{sup}$	supply pin to ground capacitance	$f = 1\text{ MHz}$ ; $V_{CC} = 0\text{ V}$	[3] -	16	-	pF

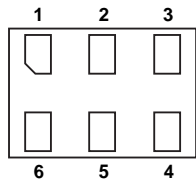
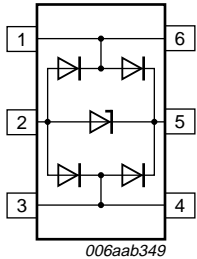
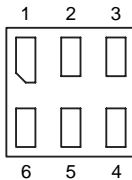
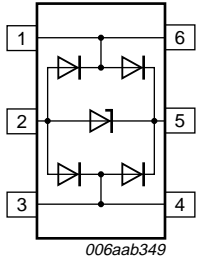
[1] Measured from pin 1, 3, 4 or 6 to ground.

[2] Measured from pin 1 or 6 to pin 3 or 4.

[3] Measured from pin 5 to ground.

## 2. Pinning information

**Table 3. Pinning**

Pin	Symbol	Description	Simplified outline	Graphic symbol
<b>PRTR5V0U2F (SOT886)</b>				
1	I/O1	input/output 1	 <p>bottom view</p>	 <p>006aab349</p>
2	GND	ground		
3	I/O2	input/output 2		
4	I/O2	input/output 2		
5	$V_{CC}$	supply voltage		
6	I/O1	input/output 1		
<b>PRTR5V0U2K (SOT891)</b>				
1	I/O1	input/output 1	 <p>bottom view</p>	 <p>006aab349</p>
2	GND	ground		
3	I/O2	input/output 2		
4	I/O2	input/output 2		
5	$V_{CC}$	supply voltage		
6	I/O1	input/output 1		

### 3. Ordering information

**Table 4. Ordering information**

Type number	Package		
	Name	Description	Version
PRTR5V0U2F	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm	SOT886
PRTR5V0U2K	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1 × 0.5 mm	SOT891

### 4. Marking

**Table 5. Marking codes**

Type number	Marking code
PRTR5V0U2F	PF
PRTR5V0U2K	PK

### 5. Limiting values

**Table 6. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit
<b>Per device</b>					
T <sub>amb</sub>	ambient temperature		-40	+85	°C
T <sub>stg</sub>	storage temperature		-55	+125	°C

**Table 7. ESD maximum ratings**

*T<sub>amb</sub> = 25 °C unless otherwise specified.*

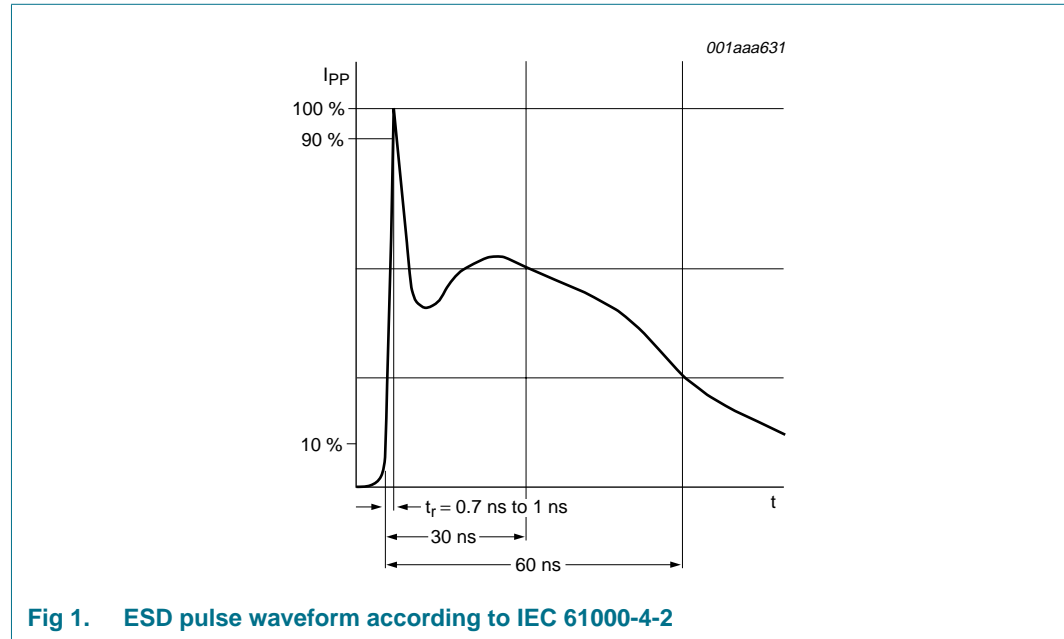
Symbol	Parameter	Conditions	Min	Max	Unit
<b>Per channel</b>					
V <sub>ESD</sub>	electrostatic discharge voltage	IEC 61000-4-2 (contact discharge)	[1][2] -	8	kV
		MIL-STD-883 (human body model)	[2] -	10	kV

[1] Device stressed with ten non-repetitive ESD pulses.

[2] Measured from pin 1, 3, 4 or 6 to pin 2 or 5.

**Table 8. ESD standards compliance**

Standard	Conditions
<b>Per channel</b>	
IEC 61000-4-2; level 4 (ESD)	> 8 kV (contact)
MIL-STD-883; class 3 (human body model)	> 4 kV



**Fig 1. ESD pulse waveform according to IEC 61000-4-2**

## 6. Characteristics

**Table 9. Characteristics**

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

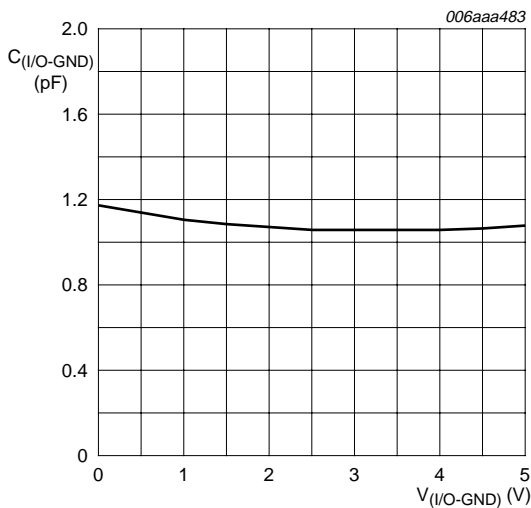
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per channel</b>						
$I_R$	reverse current	$V_R = 5\text{ V}$	[1] -	< 1	100	nA
$C_{(I/O-GND)}$	input/output to ground capacitance	$f = 1\text{ MHz};$ $V_{(I/O-GND)} = 0\text{ V}$	[1] -	1.0	1.5	pF
$C_{(I/O-I/O)}$	input/output to input/output capacitance	$f = 1\text{ MHz};$ $V_{(I/O-I/O)} = 0\text{ V}$	[2] -	0.6	-	pF
$V_F$	forward voltage	$I_F = 1\text{ mA}$	[3] -	0.7	-	V
<b>Zener diode</b>						
$V_{RWM}$	reverse standoff voltage		[4] -	-	5.5	V
$V_{BR}$	breakdown voltage		[4] 6	-	9	V
$C_{sup}$	supply pin to ground capacitance	$f = 1\text{ MHz};$ $V_{CC} = 0\text{ V}$	[4] -	16	-	pF

[1] Measured from pin 1, 3, 4 or 6 to ground.

[2] Measured from pin 1 or 6 to pin 3 or 4.

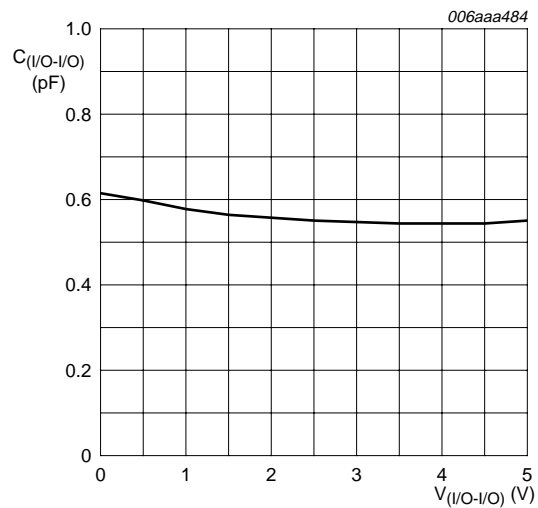
[3] Measured from pin 1, 3, 4 or 6 to pin 5.

[4] Measured from pin 5 to ground.



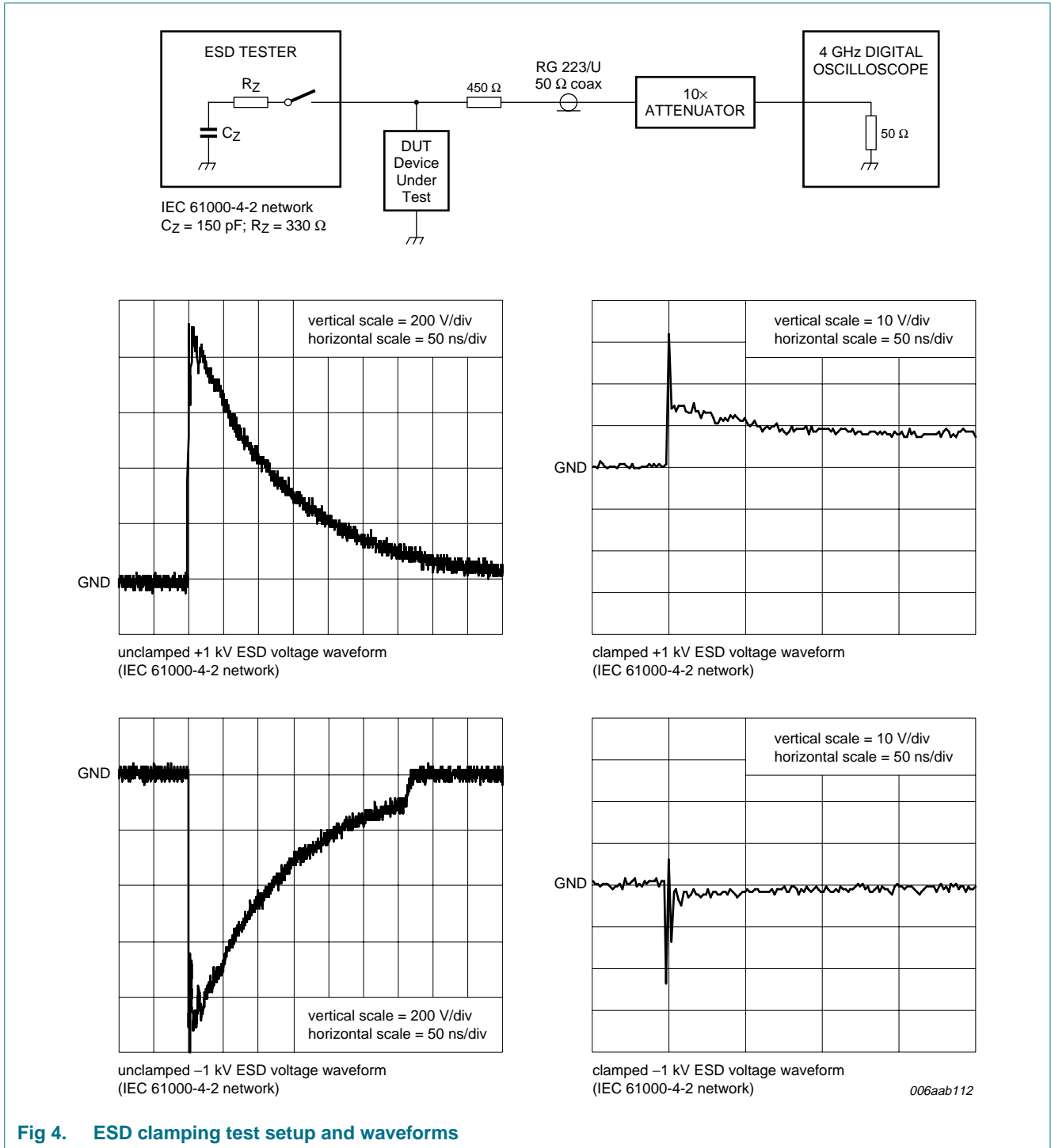
$f = 1\text{ MHz}; T_{amb} = 25\text{ °C}$

**Fig 2. Input/output to ground capacitance as a function of input/output to ground voltage; typical values**



$f = 1\text{ MHz}; T_{amb} = 25\text{ °C}$

**Fig 3. Input/output to input/output capacitance as a function of input/output to input/output voltage; typical values**



**Fig 4. ESD clamping test setup and waveforms**

## 7. Application information

Handling data rates up to 480 Mbit/s, USB 2.0 interfaces require ESD protection devices with an extremely low line capacitance in order to avoid signal distortion.

With a capacitance of only 1 pF, the PRTR5V0U2F and the PRTR5V0U2K offer IEC 61000-4-2, level 4 compliant ESD protection.

PRTR5V0U2F and PRTR5V0U2K integrate two pairs of ultra low capacitance rail-to-rail ESD protection channels and one additional ESD protection diode each.

The additional ESD protection diode connected between ground and  $V_{CC}$  prevents charging of the supply.

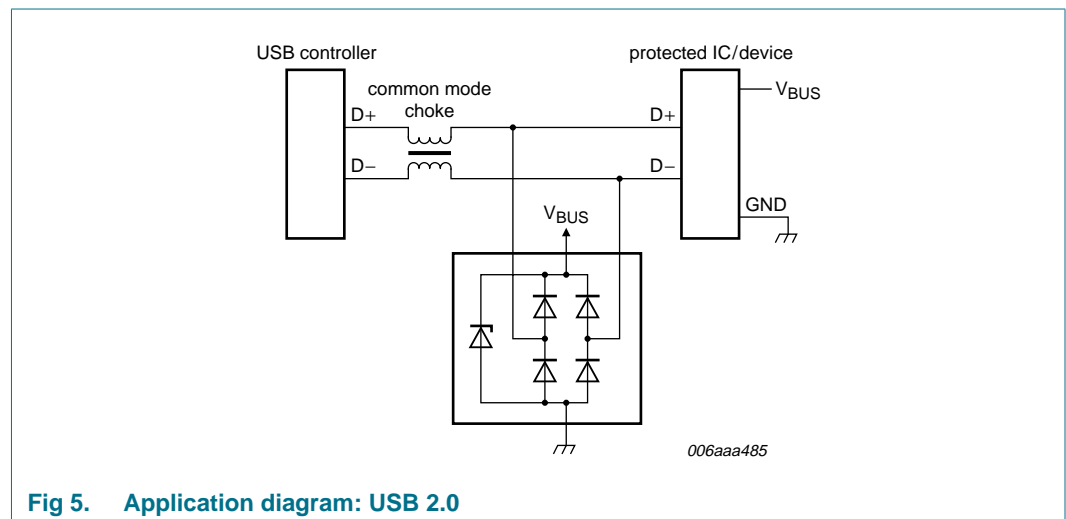


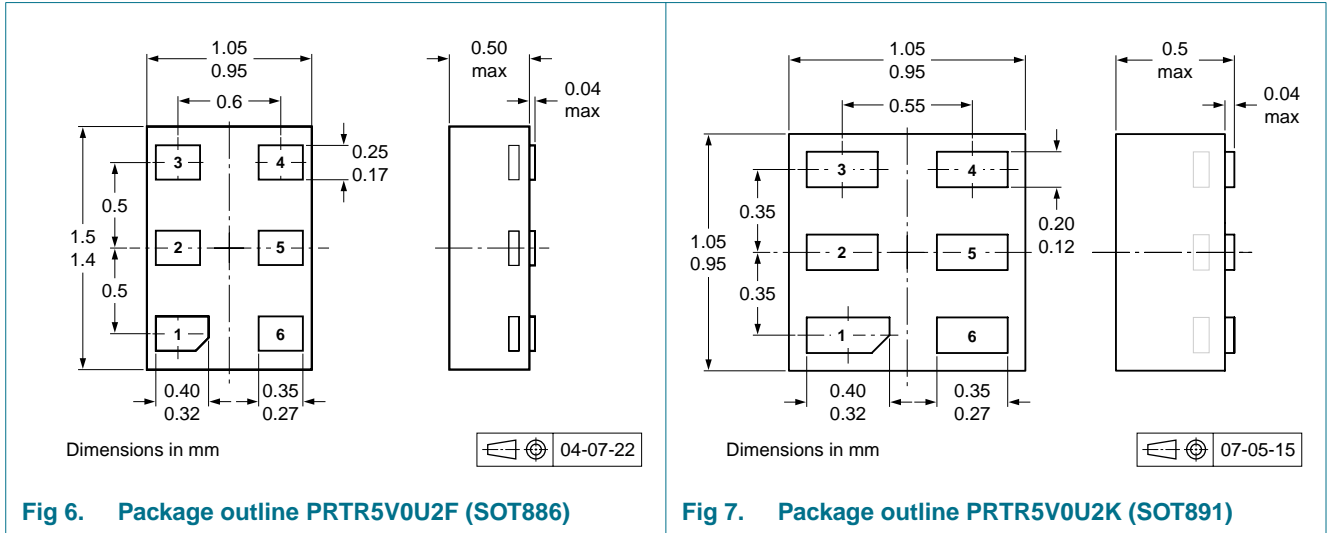
Fig 5. Application diagram: USB 2.0

### Circuit board layout and protection device placement

Circuit board layout is critical for the suppression of ESD, Electrical Fast Transient (EFT) and surge transients. The following guidelines are recommended:

1. Place the PRTR5V0U2F and the PRTR5V0U2K as close to the input terminal or connector as possible.
2. The path length between the PRTR5V0U2F or the PRTR5V0U2K and the protected line should be minimized.
3. Keep parallel signal paths to a minimum.
4. Avoid running protected conductors in parallel with unprotected conductors.
5. Minimize all Printed-Circuit Board (PCB) conductive loops including power and ground loops.
6. Minimize the length of the transient return path to ground.
7. Avoid using shared transient return paths to a common ground point.
8. Ground planes should be used whenever possible. For multilayer PCBs, use ground vias.

## 8. Package outline



## 9. Packing information

**Table 10. Packing methods**

The indicated -xxx are the last three digits of the 12NC ordering code.<sup>[1]</sup>

Type number	Package	Description	Packing quantity	
				5000
PRTR5V0U2F	SOT886	4 mm pitch, 8 mm tape and reel; T1	<sup>[2]</sup>	-115
		4 mm pitch, 8 mm tape and reel; T4	<sup>[3]</sup>	-132
PRTR5V0U2K	SOT891	4 mm pitch, 8 mm tape and reel		-132

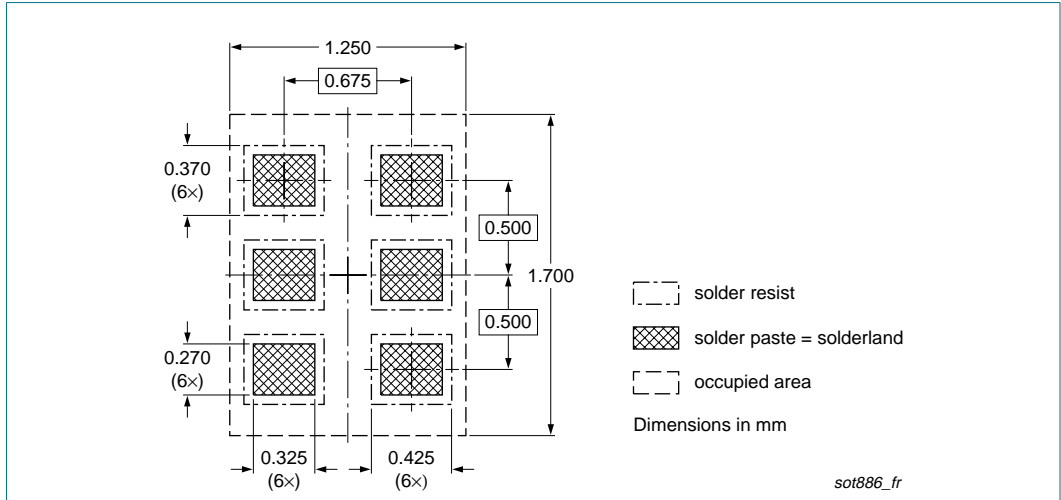
[1] For further information and the availability of packing methods, see [Section 13](#).

[2] T1: normal taping

[3] T4: 90° rotated reverse taping

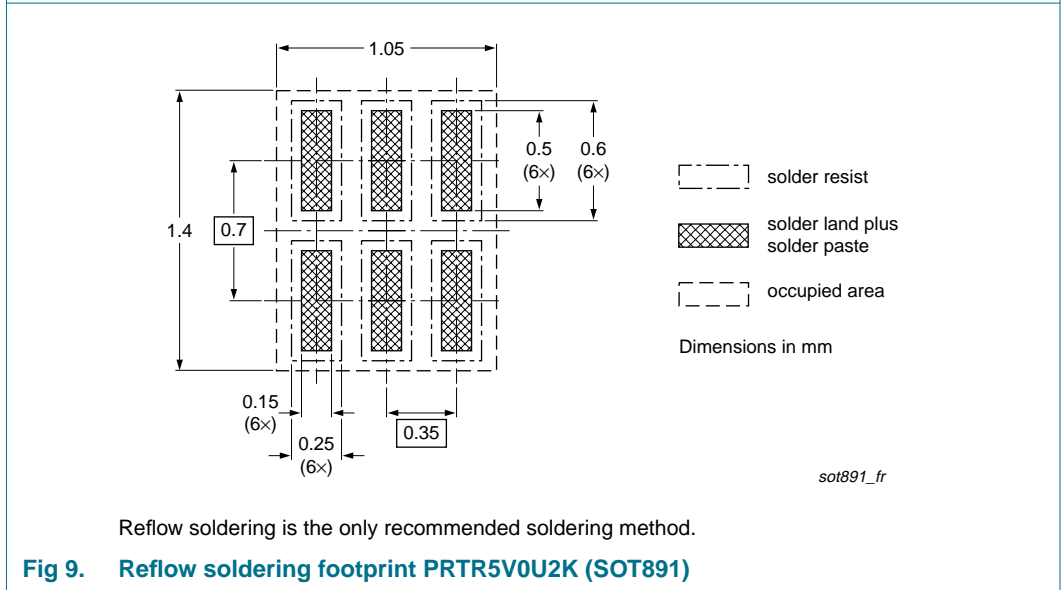


10. Soldering



Reflow soldering is the only recommended soldering method.

Fig 8. Reflow soldering footprint PRTR5V0U2F (SOT886)



Reflow soldering is the only recommended soldering method.

Fig 9. Reflow soldering footprint PRTR5V0U2K (SOT891)

## 11. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PRTR5V0U2F_PRTR5V0U2K_2	20090219	Product data sheet	-	PRTR5V0U2F_PRTR5V0U2K_1
Modifications:		• <a href="#">Table 3 "Pinning"</a> : graphic symbol amended		
PRTR5V0U2F_PRTR5V0U2K_1	20081106	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.

[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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