

# PNE20010EXD

200 V, 1 A hyperfast recovery rectifier

1 April 2022

Product data sheet

## 1. General description

High power density, hyperfast recovery rectifier with high-efficiency planar technology, encapsulated in a CFP2-HP (SOD323HP) power and flat lead Surface-Mounted Device (SMD) plastic package.

## 2. Features and benefits

- Reverse voltage:  $V_R \leq 200$  V
- Forward current:  $I_F \leq 1$  A
- Hyperfast recovery time:  $t_{rr} \leq 25$  ns
- Planar die design with Pt doped life time control
- Low inductance
- Small and flat lead SMD plastic package, typical height 0.68 mm
- High power capability due to clip-bond technology

## 3. Applications

- General-purpose rectification
- Reverse polarity protection
- Hyperfast switching
- Freewheeling applications


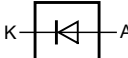
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{F(AV)}$	average forward current	$\delta = 0.5$ ; $f = 20$ kHz; square wave; $T_{sp} \leq 170$ °C	-	-	1	A
$V_R$	reverse voltage	$T_j = 25$ °C	-	-	200	V
$V_F$	forward voltage	$I_F = 1$ A; pulsed; $T_j = 25$ °C	-	880	1020	mV
$I_R$	reverse current	$V_R = 200$ V; pulsed; $T_j = 25$ °C	-	-	75	nA
		$V_R = 200$ V; pulsed; $T_j = 125$ °C	-	0.6	5	$\mu$ A

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	K	cathode	 <p>Transparent top view CFP2-HP (SOD323HP)</p>	 <p>006aab040</p>
2	A	anode		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
<a href="#">PNE20010EXD</a>	CFP2-HP	SOD323HP: plastic surface-mounted package with solderable lead ends; 2.2 mm x 1.3 mm x 0.68 mm body	<a href="#">SOD323HP</a>

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PNE20010EXD	2K

## 8. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
$V_R$	reverse voltage	$T_j = 25\text{ °C}$		-	200	V
$I_F$	forward current	$\delta = 1; T_{sp} \leq 169\text{ °C}$		-	1.4	A
$I_{F(AV)}$	average forward current	$\delta = 0.5; f = 20\text{ kHz}$ ; square wave; $T_{sp} \leq 170\text{ °C}$		-	1	A
$I_{FSM}$	non-repetitive peak forward current	$t_p = 8.3\text{ ms}$ ; single half sine wave (applied at rated load condition); $T_{j(\text{init})} = 25\text{ °C}$		-	25	A
$P_{tot}$	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[1]	-	0.65	W
			[2]	-	1.2	W
$T_j$	junction temperature			-	175	°C
$T_{amb}$	ambient temperature			-55	175	°C
$T_{stg}$	storage temperature			-65	175	°C

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for cathode 1 cm<sup>2</sup>.

## 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1] [2]	-	-	230	K/W
			[1] [3]	-	-	125	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		[4]	-	-	6	K/W

- [1] For Schottky barrier diodes thermal runaway has to be considered, as in some applications the reverse power losses PR are a significant part of the total power losses.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
- [3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for cathode 1 cm<sup>2</sup>.
- [4] Soldering point of cathode tab.

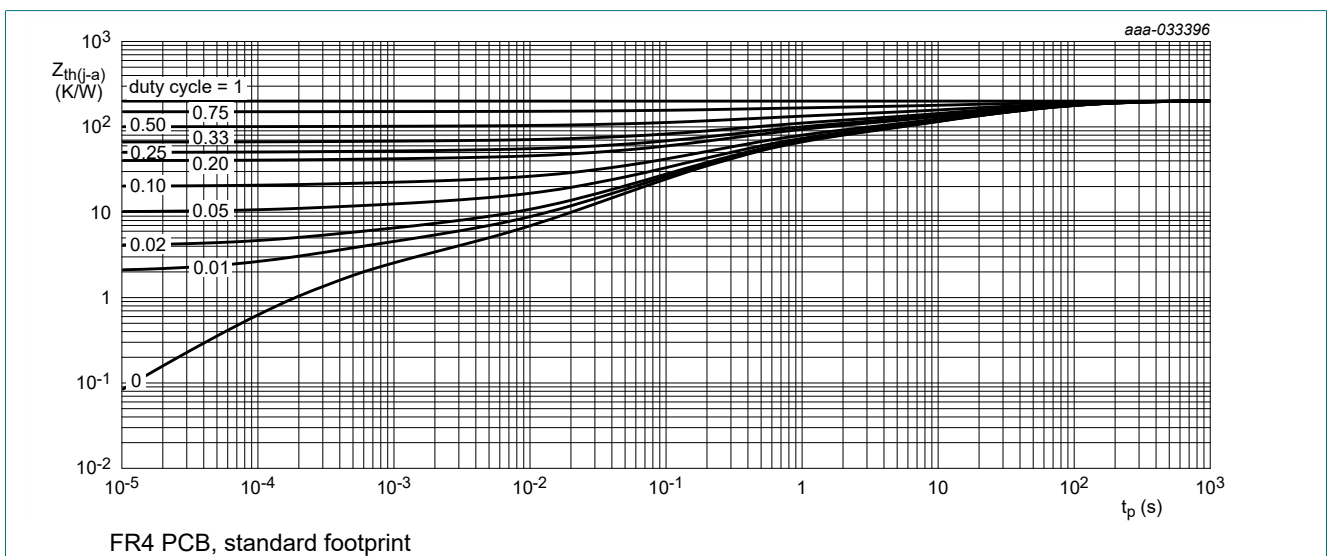


Fig. 1. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

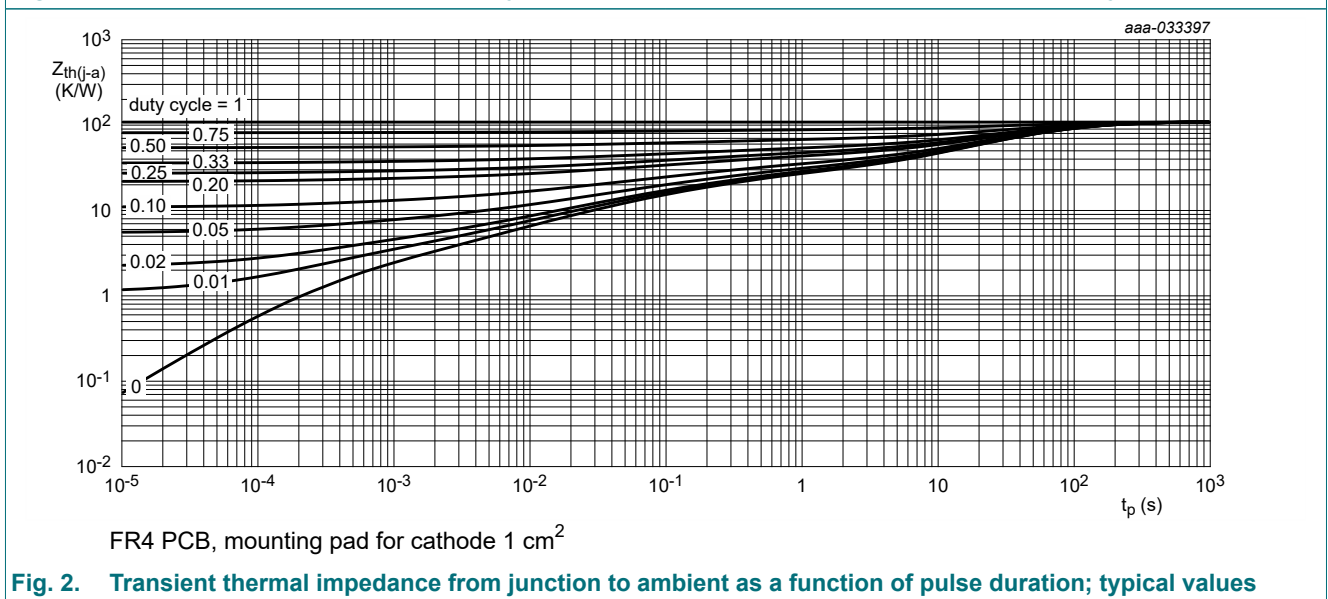


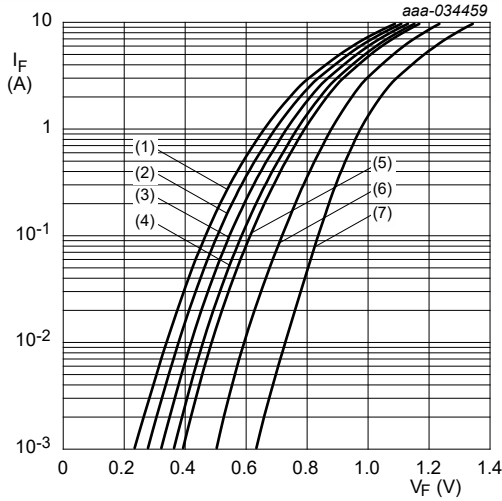
Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 10. Characteristics

Table 7. Characteristics

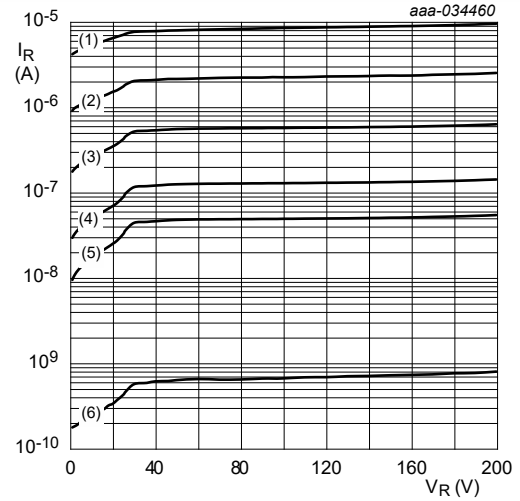
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$V_{(BR)R}$	reverse breakdown voltage	$I_R = 0.1 \text{ mA}$ ; pulsed; $T_j = 25 \text{ }^\circ\text{C}$	[1]	200	-	-	V
$V_F$	forward voltage	$I_F = 0.1 \text{ A}$ ; pulsed; $T_j = 25 \text{ }^\circ\text{C}$	[1]	-	720	840	mV
		$I_F = 0.5 \text{ A}$ ; pulsed; $T_j = 25 \text{ }^\circ\text{C}$	[1]	-	825	935	mV
		$I_F = 1 \text{ A}$ ; pulsed; $T_j = 25 \text{ }^\circ\text{C}$		-	880	1020	mV
		$I_F = 1 \text{ A}$ ; pulsed; $T_j = -40 \text{ }^\circ\text{C}$		-	975	1100	mV
		$I_F = 1 \text{ A}$ ; pulsed; $T_j = 125 \text{ }^\circ\text{C}$		-	730	870	mV
$I_R$	reverse current	$V_R = 200 \text{ V}$ ; pulsed; $T_j = 25 \text{ }^\circ\text{C}$		-	-	75	nA
		$V_R = 200 \text{ V}$ ; pulsed; $T_j = 125 \text{ }^\circ\text{C}$		-	0.6	5	$\mu\text{A}$
		$V_R = 200 \text{ V}$ ; pulsed; $T_j = 150 \text{ }^\circ\text{C}$		-	2.5	15	$\mu\text{A}$
$C_d$	diode capacitance	$V_R = 4 \text{ V}$ ; $f = 1 \text{ MHz}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	10	-	pF
		$V_R = 10 \text{ V}$ ; $f = 1 \text{ MHz}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	8	-	pF
$t_{rr}$	reverse recovery time ; step recovery	$I_F = 0.5 \text{ A}$ ; $I_R = 1 \text{ A}$ ; $I_{R(\text{meas})} = 0.25 \text{ A}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	9	25	ns
	reverse recovery time ; ramp recovery	$I_F = 1 \text{ A}$ ; $dI_F/dt = 50 \text{ A}/\mu\text{s}$ ; $V_R = 30 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	15	-	ns
$I_{RM}$	peak reverse recovery current			-	0.45	-	A
$Q_{rr}$	reverse recovery charge			-	4	-	nC
$V_{FRM}$	peak forward recovery voltage	$I_F = 1 \text{ A}$ ; $dI_F/dt = 50 \text{ A}/\mu\text{s}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	1	-	V

[1] Very short pulse, in order to maintain a stable junction temperature.



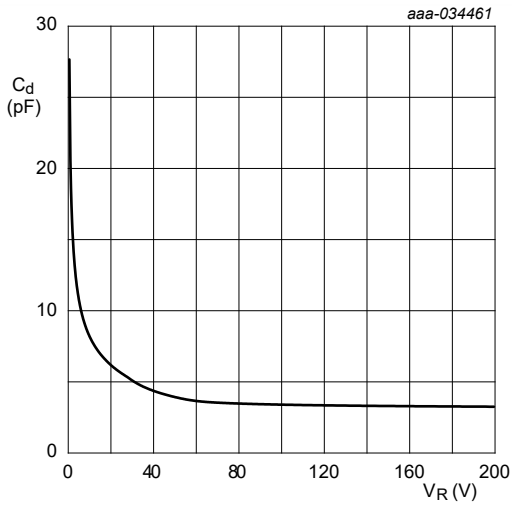
pulsed condition  
 (1)  $T_j = 175\text{ }^\circ\text{C}$   
 (2)  $T_j = 150\text{ }^\circ\text{C}$   
 (3)  $T_j = 125\text{ }^\circ\text{C}$   
 (4)  $T_j = 100\text{ }^\circ\text{C}$   
 (5)  $T_j = 85\text{ }^\circ\text{C}$   
 (6)  $T_j = 25\text{ }^\circ\text{C}$   
 (7)  $T_j = -40\text{ }^\circ\text{C}$

**Fig. 3. Forward current as a function of forward voltage; typical values**



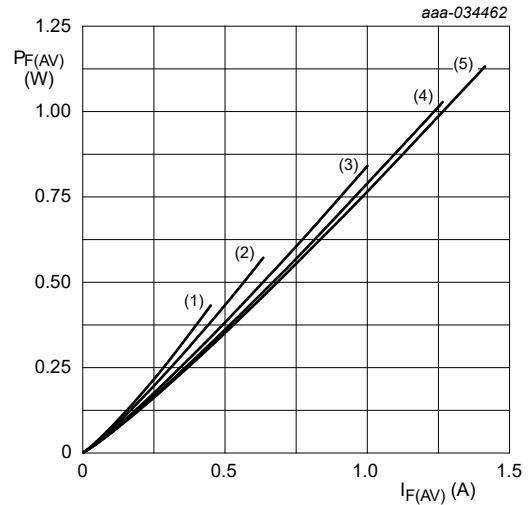
pulsed condition  
 (1)  $T_j = 175\text{ }^\circ\text{C}$   
 (2)  $T_j = 150\text{ }^\circ\text{C}$   
 (3)  $T_j = 125\text{ }^\circ\text{C}$   
 (4)  $T_j = 100\text{ }^\circ\text{C}$   
 (5)  $T_j = 85\text{ }^\circ\text{C}$   
 (6)  $T_j = 25\text{ }^\circ\text{C}$

**Fig. 4. Reverse current as a function of reverse voltage; typical values**



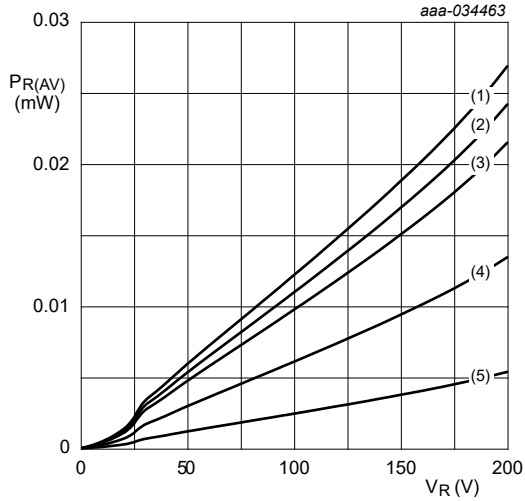
$f = 1\text{ MHz}; T_{amb} = 25\text{ }^\circ\text{C}$

**Fig. 5. Diode capacitance as a function of reverse voltage; typical values**



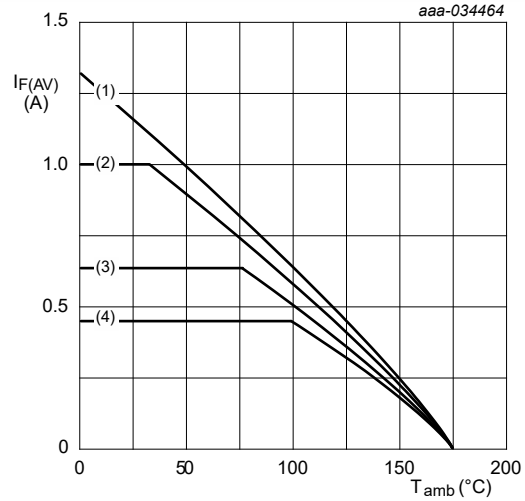
$T_j = 100\text{ }^\circ\text{C}$   
 (1)  $\delta = 0.1$   
 (2)  $\delta = 0.2$   
 (3)  $\delta = 0.5$   
 (4)  $\delta = 0.8$   
 (5)  $\delta = 1$ ; DC

**Fig. 6. Average forward power dissipation as a function of average forward current; typical values**



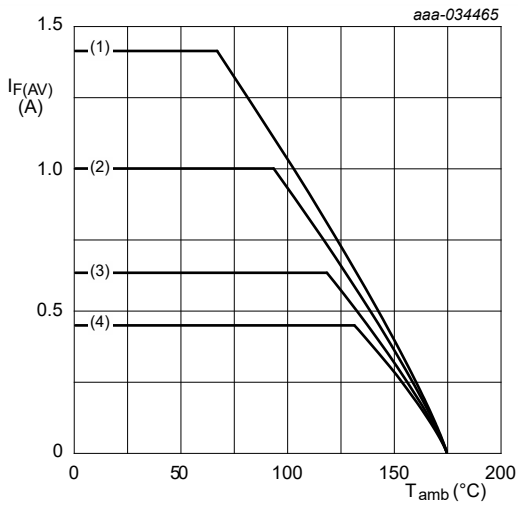
$T_j = 100\text{ }^\circ\text{C}$   
 (1)  $\delta = 1$ ; DC  
 (2)  $\delta = 0.9$   
 (3)  $\delta = 0.8$   
 (4)  $\delta = 0.5$   
 (5)  $\delta = 0.2$

**Fig. 7. Average reverse power dissipation as a function of reverse voltage; typical values**



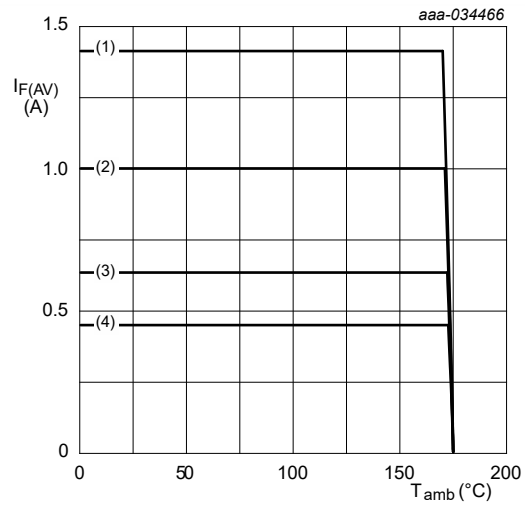
FR4 PCB, standard footprint  
 $T_j = 175\text{ }^\circ\text{C}$   
 (1)  $\delta = 1$ ; DC  
 (2)  $\delta = 0.5$ ;  $f = 20\text{ kHz}$   
 (3)  $\delta = 0.2$ ;  $f = 20\text{ kHz}$   
 (4)  $\delta = 0.1$ ;  $f = 20\text{ kHz}$

**Fig. 8. Average forward current as a function of ambient temperature; typical values**



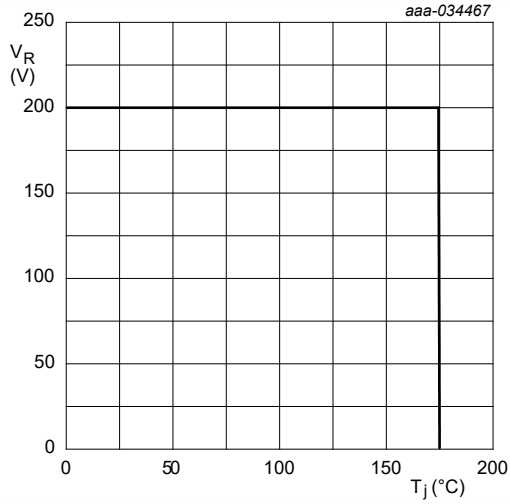
FR4 PCB, mounting pad for cathode  $1\text{ cm}^2$   
 $T_j = 175\text{ }^\circ\text{C}$   
 (1)  $\delta = 1$ ; DC  
 (2)  $\delta = 0.5$ ;  $f = 20\text{ kHz}$   
 (3)  $\delta = 0.2$ ;  $f = 20\text{ kHz}$   
 (4)  $\delta = 0.1$ ;  $f = 20\text{ kHz}$

**Fig. 9. Average forward current as a function of ambient temperature; typical values**



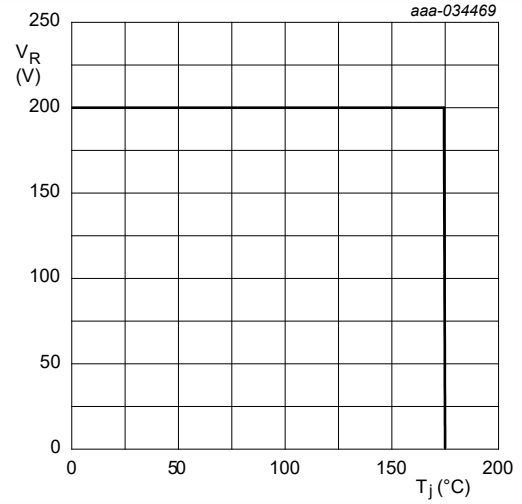
$T_j = 175\text{ }^\circ\text{C}$   
 (1)  $\delta = 1$ ; DC  
 (2)  $\delta = 0.5$ ;  $f = 20\text{ kHz}$   
 (3)  $\delta = 0.2$ ;  $f = 20\text{ kHz}$   
 (4)  $\delta = 0.1$ ;  $f = 20\text{ kHz}$

**Fig. 10. Average forward current as a function of solder point temperature; typical values**



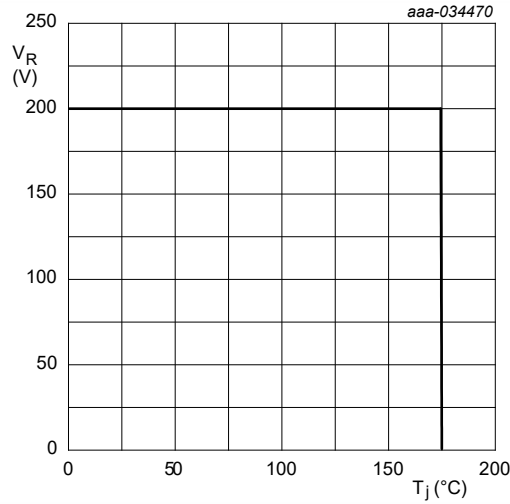
FR4 PCB, standard footprint  
 $R_{th} = 230 \text{ K/W}$

**Fig. 11. Derated maximum reverse voltage as a function of junction temperature; typical values**



FR4 PCB, mounting pad for cathode  $1 \text{ cm}^2$   
 $R_{th} = 125 \text{ K/W}$

**Fig. 12. Derated maximum reverse voltage as a function of junction temperature; typical values**



Soldering point of cathode tab  
 $R_{th} = 6 \text{ K/W}$

**Fig. 13. Derated maximum reverse voltage as a function of junction temperature; typical values**

### 11. Test information

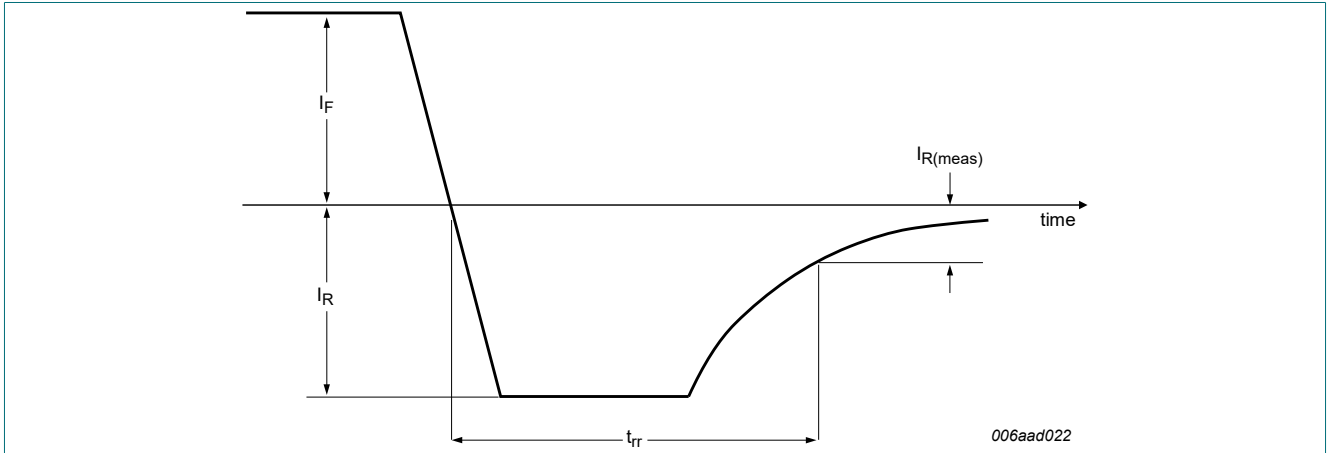


Fig. 14. Reverse recovery definition; step recovery

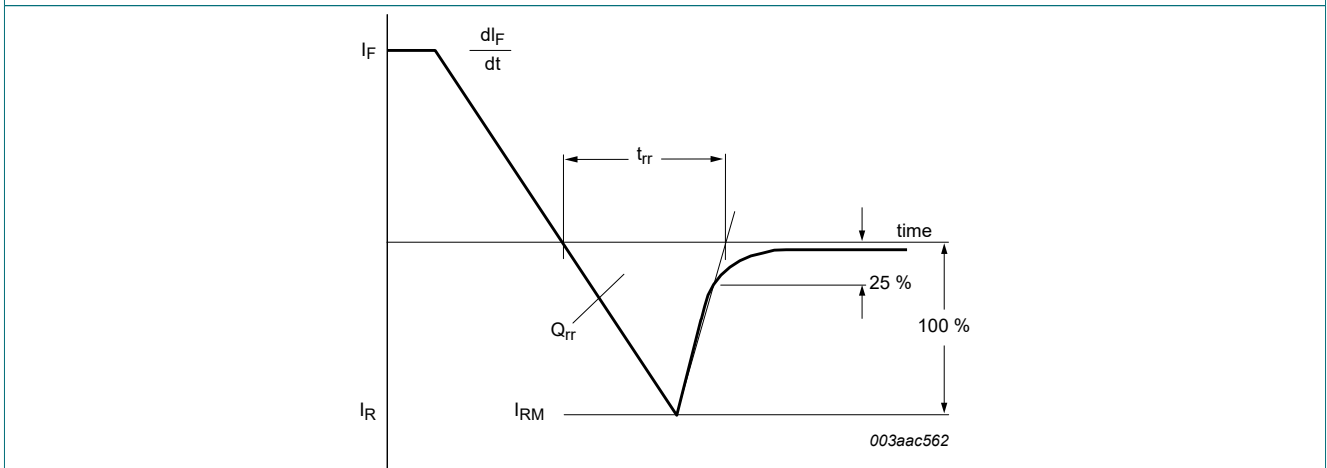


Fig. 15. Reverse recovery definition; ramp recovery

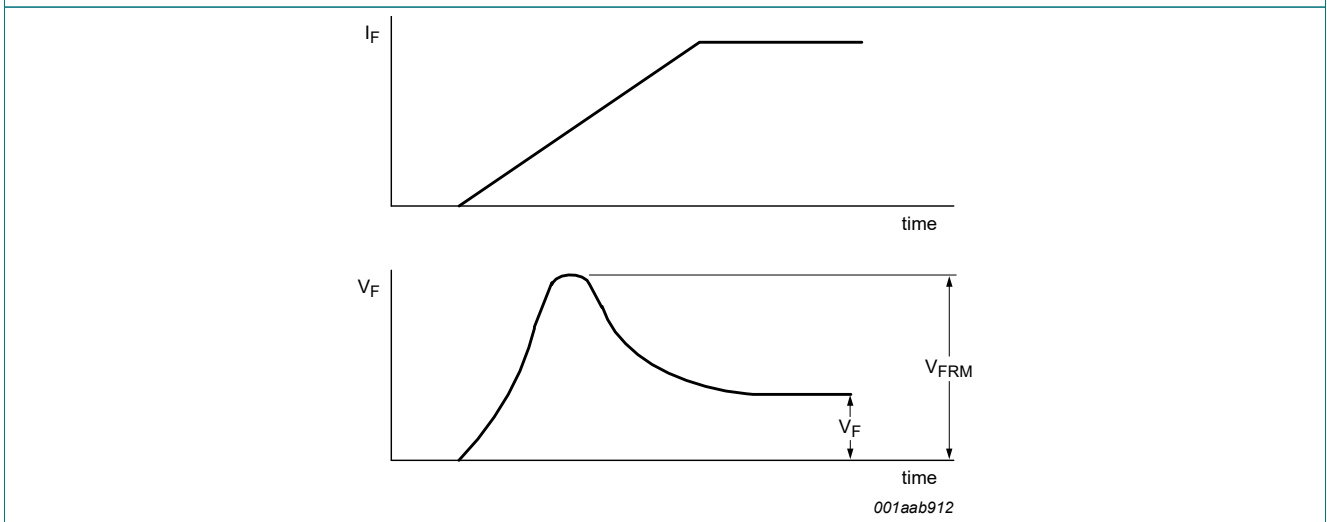


Fig. 16. Forward recovery definition



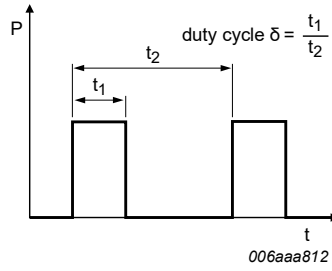


Fig. 17. Duty cycle definition

The current ratings for the typical waveforms are calculated according to the equations:

$$I_{F(AV)} = I_M \times \delta \text{ with } I_M \text{ defined as peak current}$$

$$I_{RMS} = I_{F(AV)} \text{ at DC, and } I_{RMS} = I_M \times \sqrt{\delta}$$

with  $I_{RMS}$  defined as RMS current.

## 12. Package outline

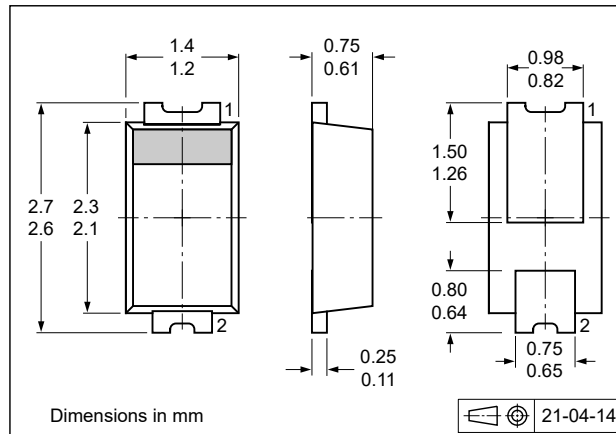


Fig. 18. Package outline CFP2-HP (SOD323HP)

### 13. Soldering

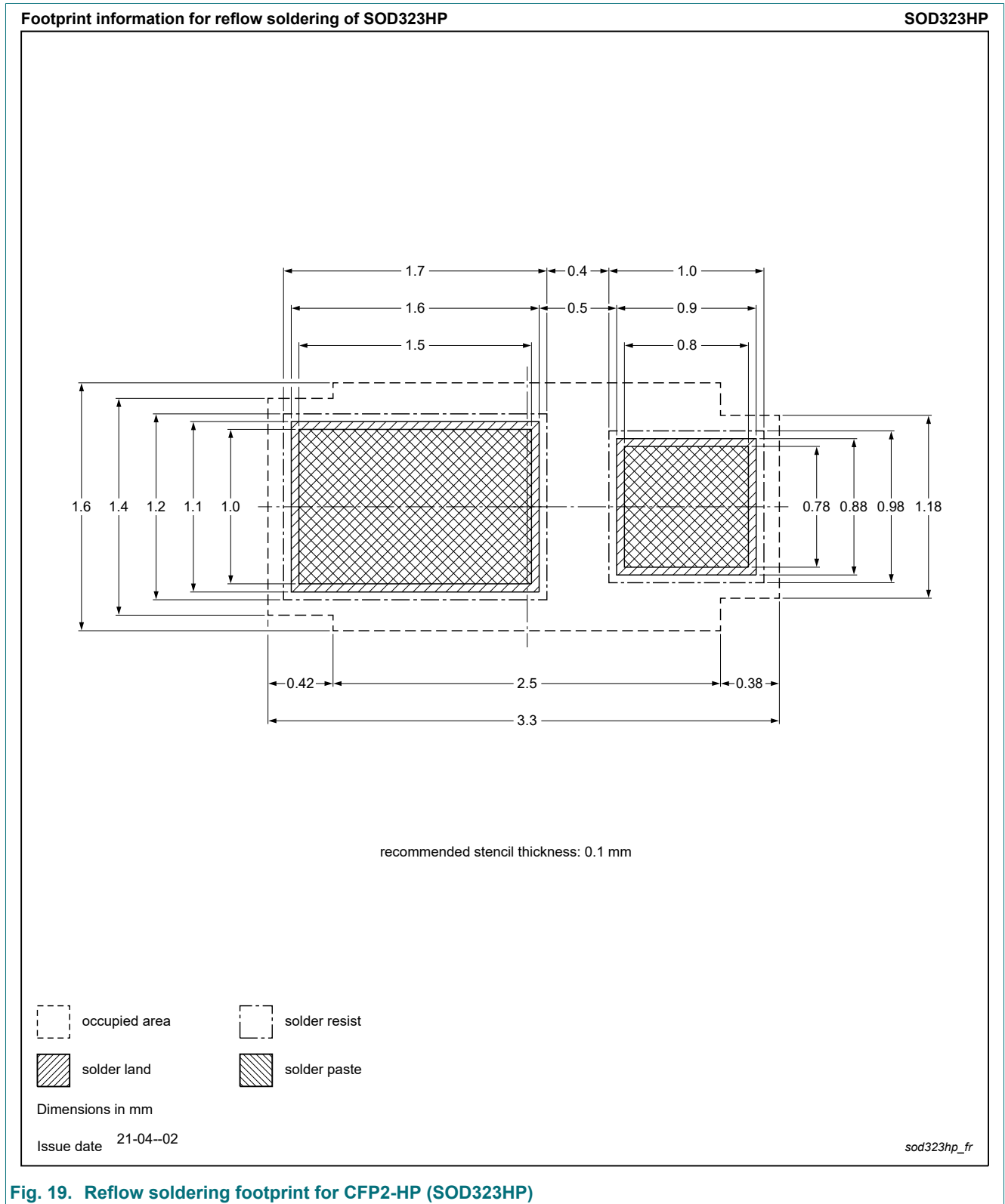


Fig. 19. Reflow soldering footprint for CFP2-HP (SOD323HP)

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PNE20010EXD v.2	20220401	Product data sheet	-	PNE20010EXD v.1
Modifications:	• Product status changed			
PNE20010EXD v.1	20220218	Preliminary data sheet	-	-

## 15. Legal information

### 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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