



# PNE20020AER-Q

200 V, 2 A hyperfast recovery rectifier

15 November 2024

Product data sheet

## 1. General description

High power density, hyperfast switching time recovery rectifier with high-efficiency planar technology, encapsulated in a CFP3 (SOD123W) small and flat lead Surface-Mounted Device (SMD) plastic package.

## 2. Features and benefits

- Reverse voltage  $V_R \leq 200$  V
- Forward current  $I_F \leq 2$  A
- Switching time  $t_{rr} \leq 25$  ns
- Pt doped lifetime control
- Low forward voltage
- High power capability due to clip-bond technology
- Planar die design
- Capable for reflow and wave soldering
- Qualified according to AEC-Q101 and recommended for use in automotive applications

## 3. Applications

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

## 4. Quick reference data

Table 1. Quick reference data

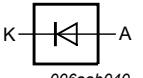
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$I_{F(AV)}$	average forward current	$\delta = 0.5$ ; $f = 20$ kHz; square wave; $T_{sp} \leq 164$ °C		-	-	2	A
$V_{RRM}$	repetitive peak reverse voltage	$T_j = 25$ °C		-	-	200	V
$V_R$	reverse voltage			-	-	200	V
$V_F$	forward voltage	$I_F = 2$ A; pulsed; $T_j = 25$ °C	[1]	-	880	950	mV
		$I_F = 2$ A; pulsed; $T_j = 125$ °C	[1]	-	735	820	mV
$I_R$	reverse current	$V_R = 200$ V; pulsed; $T_j = 25$ °C	[1]	-	-	1	µA
		$V_R = 200$ V; pulsed; $T_j = 125$ °C	[1]	-	1	10	µA

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

**nexperia**

## 5. Pinning information

**Table 2. Pinning information**

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	K	cathode	 <b>CFP3 (SOD123W)</b>	 006aab040
2	A	anode		

## 6. Ordering information

**Table 3. Ordering information**

Type number	Package		Version
	Name	Description	
PNE20020AER-Q	CFP3	plastic, surface mounted package; 2 terminals; 2.6 mm x 1.7 mm x 1 mm body	<a href="#">SOD123W</a>

## 7. Marking

**Table 4. Marking codes**

Type number	Marking code
PNE20020AER-Q	MT

## 8. Limiting values

**Table 5. Limiting values**

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

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{RRM}$	repetitive peak reverse voltage	$T_j = 25^\circ\text{C}$		-	200	V
$V_R$	reverse voltage			-	200	V
$V_{RMS}$	RMS voltage			-	140	V
$I_F$	forward current	$\delta = 1$ ; $T_{sp} \leq 160^\circ\text{C}$		-	2.8	A
$I_{F(AV)}$	average forward current	$\delta = 0.5$ ; $f = 20\text{ kHz}$ ; square wave; $T_{sp} \leq 164^\circ\text{C}$		-	2	A
$I_{FSM}$	non-repetitive peak forward current	$t_p = 8.3\text{ ms}$ ; half sine wave; $T_{j(\text{init})} = 25^\circ\text{C}$		-	55	A
$P_{tot}$	total power dissipation	$T_{amb} \leq 25^\circ\text{C}$	[1]	-	882	mW
			[2]	-	1.43	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  $1\text{ cm}^2$ .

## 9. Thermal characteristics

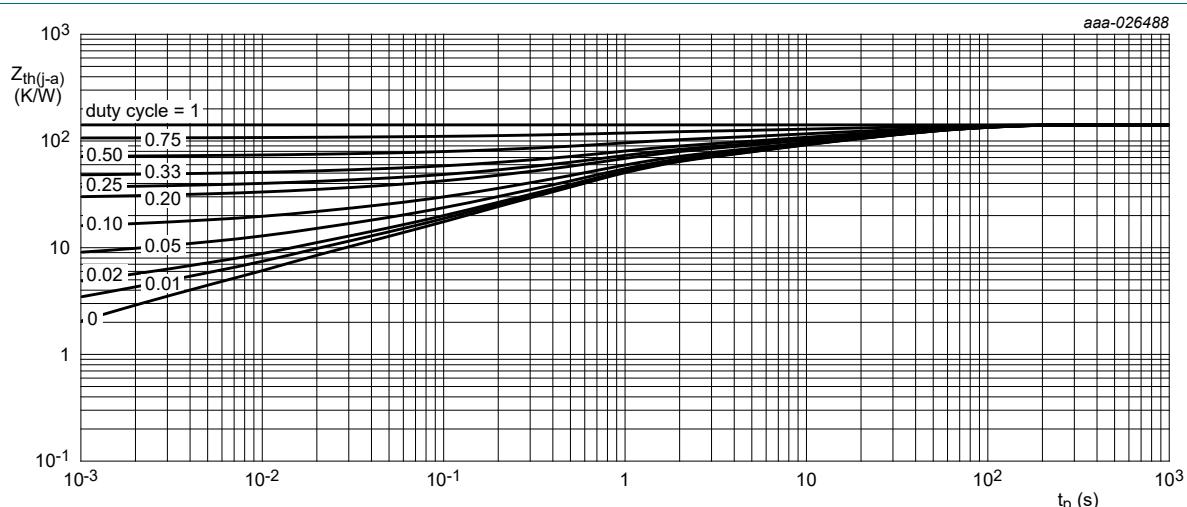
**Table 6. Thermal characteristics**

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	170	K/W
			[2]	-	-	105	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		[3]	-	-	15	K/W

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

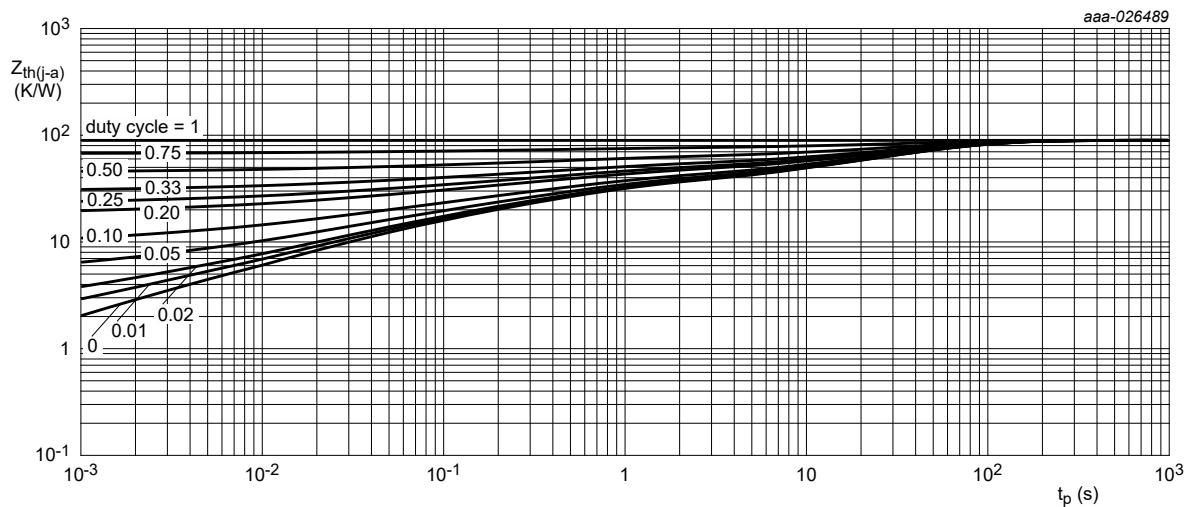
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for cathode 1 cm<sup>2</sup>.

[3] Soldering point of cathode tab.



FR4 PCB, standard footprint

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



FR4 PCB, mounting pad for cathode 1 cm<sup>2</sup>

**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	$I_R = 100 \mu A$ ; pulsed; $T_j = 25^\circ C$	[1]	200	-	-	V
$V_F$	forward voltage	$I_F = 2 A$ ; pulsed; $T_j = 25^\circ C$	[1]	-	880	950	mV
		$I_F = 2 A$ ; pulsed; $T_j = 125^\circ C$	[1]	-	735	820	mV
$I_R$	reverse current	$V_R = 200 V$ ; pulsed; $T_j = 25^\circ C$	[1]	-	-	1	$\mu A$
		$V_R = 200 V$ ; pulsed; $T_j = 125^\circ C$	[1]	-	1	10	$\mu A$
$C_d$	diode capacitance	$V_R = 4 V$ ; $f = 1 MHz$ ; $T_j = 25^\circ C$		-	21	-	pF
$t_{rr}$	reverse recovery time ; step recovery	$I_F = 0.5 A$ ; $I_R = 1 A$ ; $I_{R(meas)} = 0.25 A$ ; $T_j = 25^\circ C$		-	10	25	ns
		$I_F = 1 A$ ; $dI_F/dt = 50 A/\mu s$ ; $V_R = 30 V$ ; $T_j = 25^\circ C$		-	20	-	ns
		$I_F = 1 A$ ; $dI_F/dt = 100 A/\mu s$ ; $V_R = 30 V$ ; $T_j = 25^\circ C$		-	16	-	ns
$I_{RM}$	peak reverse recovery current			-	1	-	A
$Q_{rr}$	reverse recovery charge			-	9	-	nC
$V_{FRM}$	peak forward recovery voltage	$I_F = 1 A$ ; $dI_F/dt = 50 A/\mu s$ ; $T_j = 25^\circ C$		-	900	-	mV

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

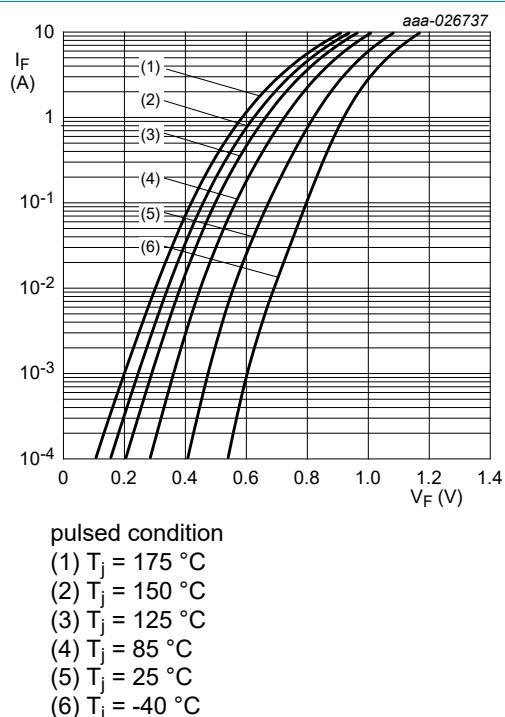


Fig. 3. Forward current as a function of forward voltage; typical values

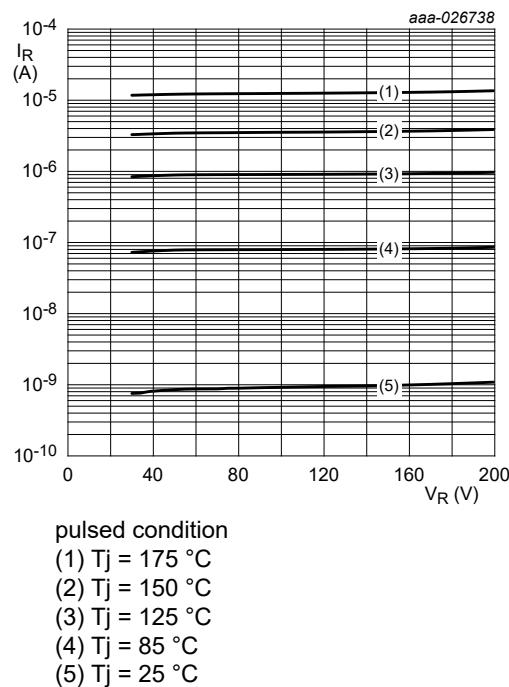
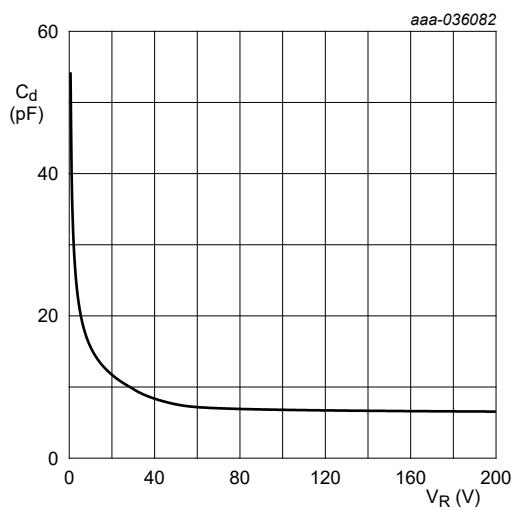
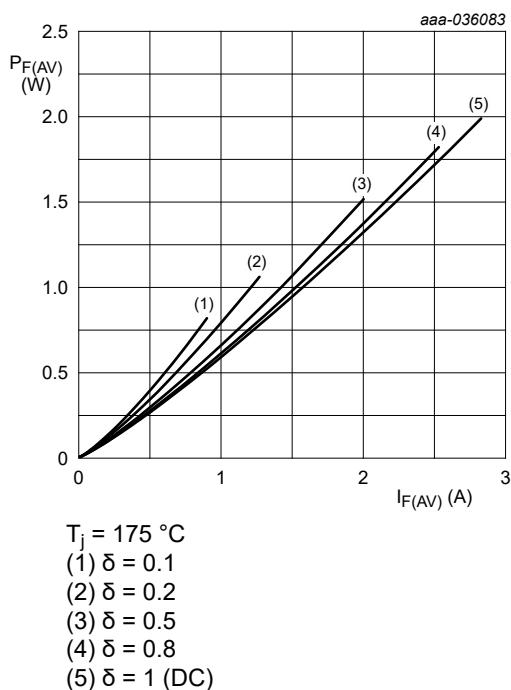


Fig. 4. Reverse current as a function of reverse voltage; typical values

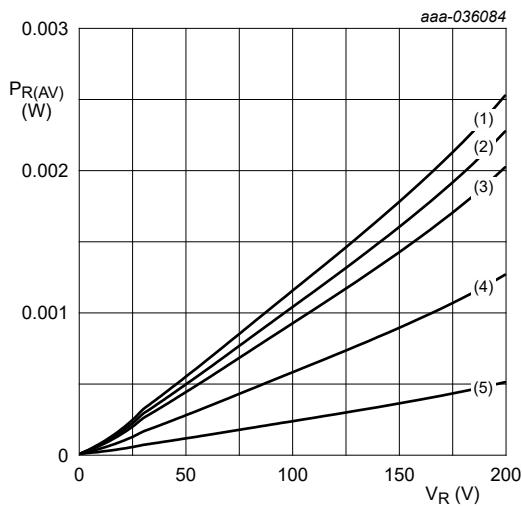


$f = 1$  MHz;  $T_{amb} = 25$  °C

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



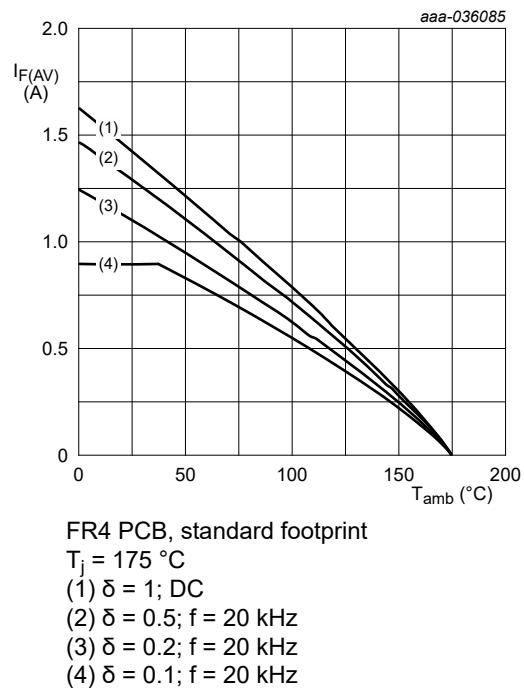
**Fig. 6. Average forward power dissipation as a function of average forward current; typical values**



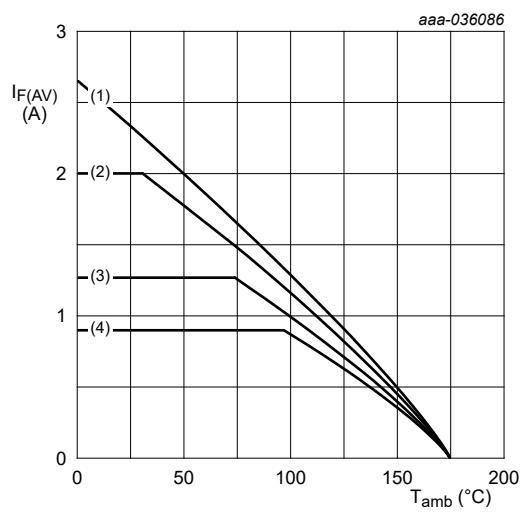
$T_j = 175$  °C

- (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**

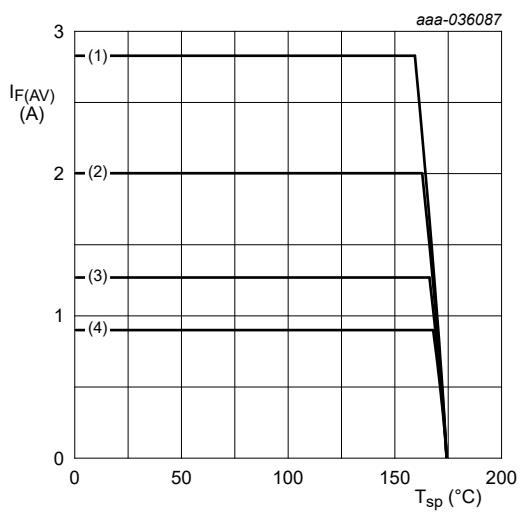


**Fig. 8. Average forward current as a function of ambient temperature; typical values**



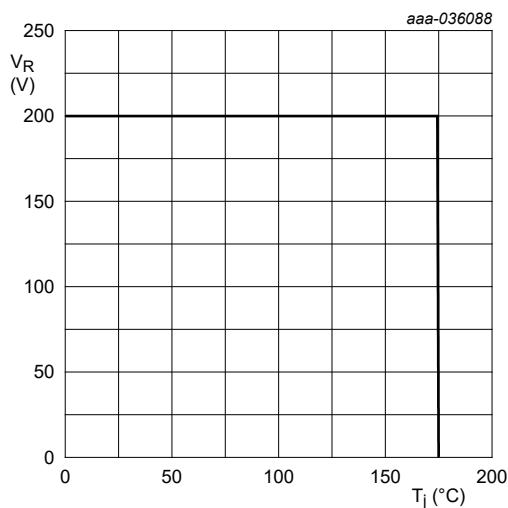
FR4 PCB, mounting pad for cathode 1 cm<sup>2</sup>  
 $T_j = 175$  °C  
(1)  $\delta = 1$ ; DC  
(2)  $\delta = 0.5$ ;  $f = 20$  kHz  
(3)  $\delta = 0.2$ ;  $f = 20$  kHz  
(4)  $\delta = 0.1$ ;  $f = 20$  kHz

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



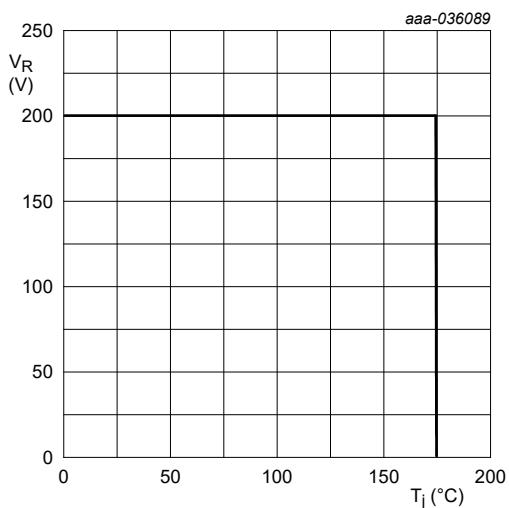
$T_j = 175$  °C  
(1)  $\delta = 1$ ; DC  
(2)  $\delta = 0.5$ ;  $f = 20$  kHz  
(3)  $\delta = 0.2$ ;  $f = 20$  kHz  
(4)  $\delta = 0.1$ ;  $f = 20$  kHz

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



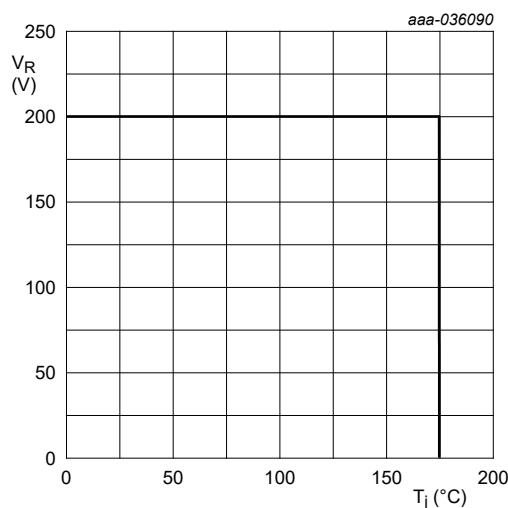
FR4 PCB, standard footprint  
 $R_{th} = 170$  K/W

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



FR4 PCB, mounting pad for cathode 1 cm<sup>2</sup>  
 $R_{th} = 105$  K/W

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



Soldering point of cathode tab  
 $R_{th} = 15 \text{ K/W}$

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

## 11. Test information

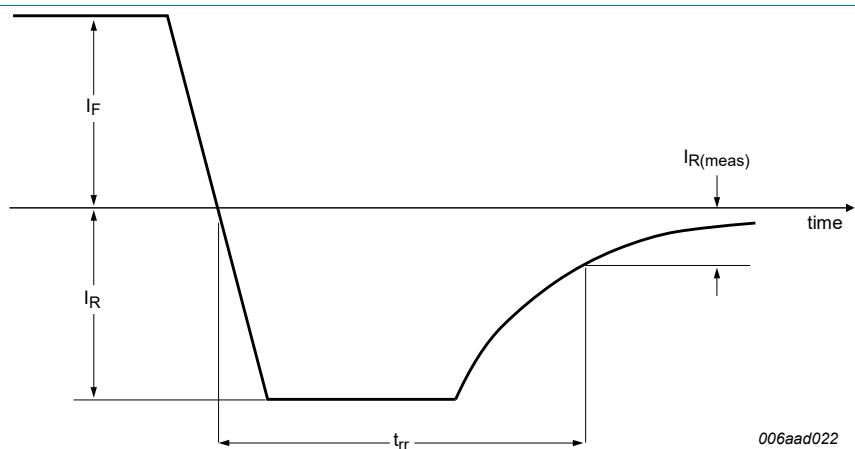


Fig. 14. Reverse recovery definition; step recovery

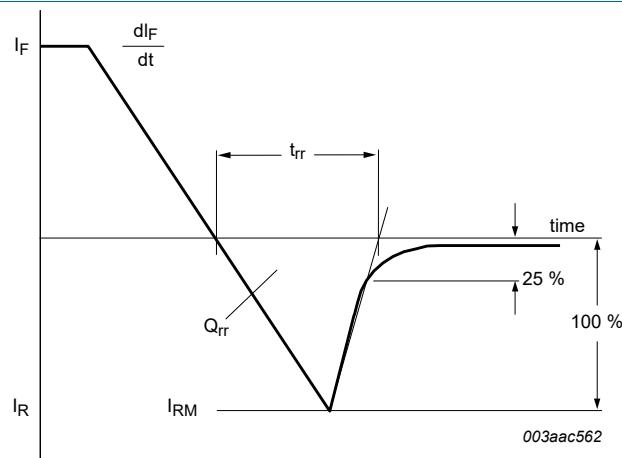


Fig. 15. Reverse recovery definition; ramp recovery

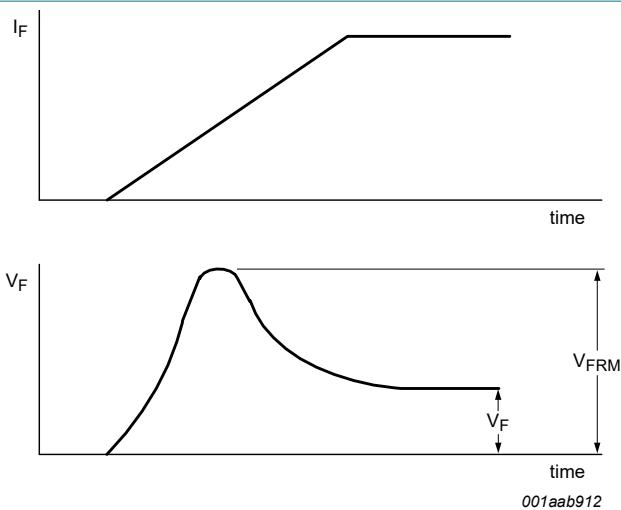


Fig. 16. Forward recovery definition

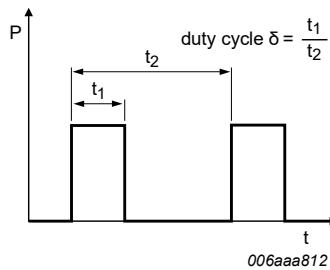


Fig. 17. Duty cycle definition

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.

### Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard Q101 - *Stress test qualification for discrete semiconductors*, and is suitable for use in automotive applications.

## 12. Package outline

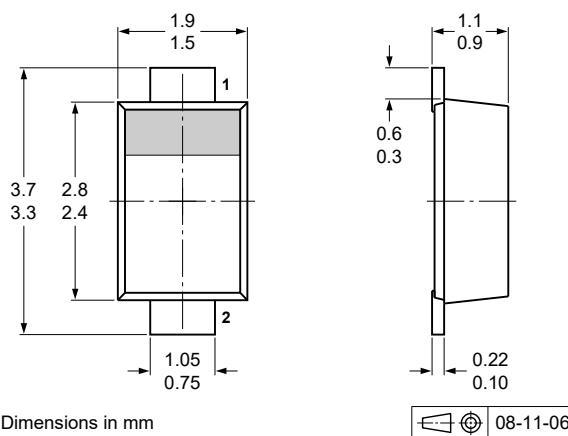


Fig. 18. Package outline CFP3 (SOD123W)

## 13. Soldering

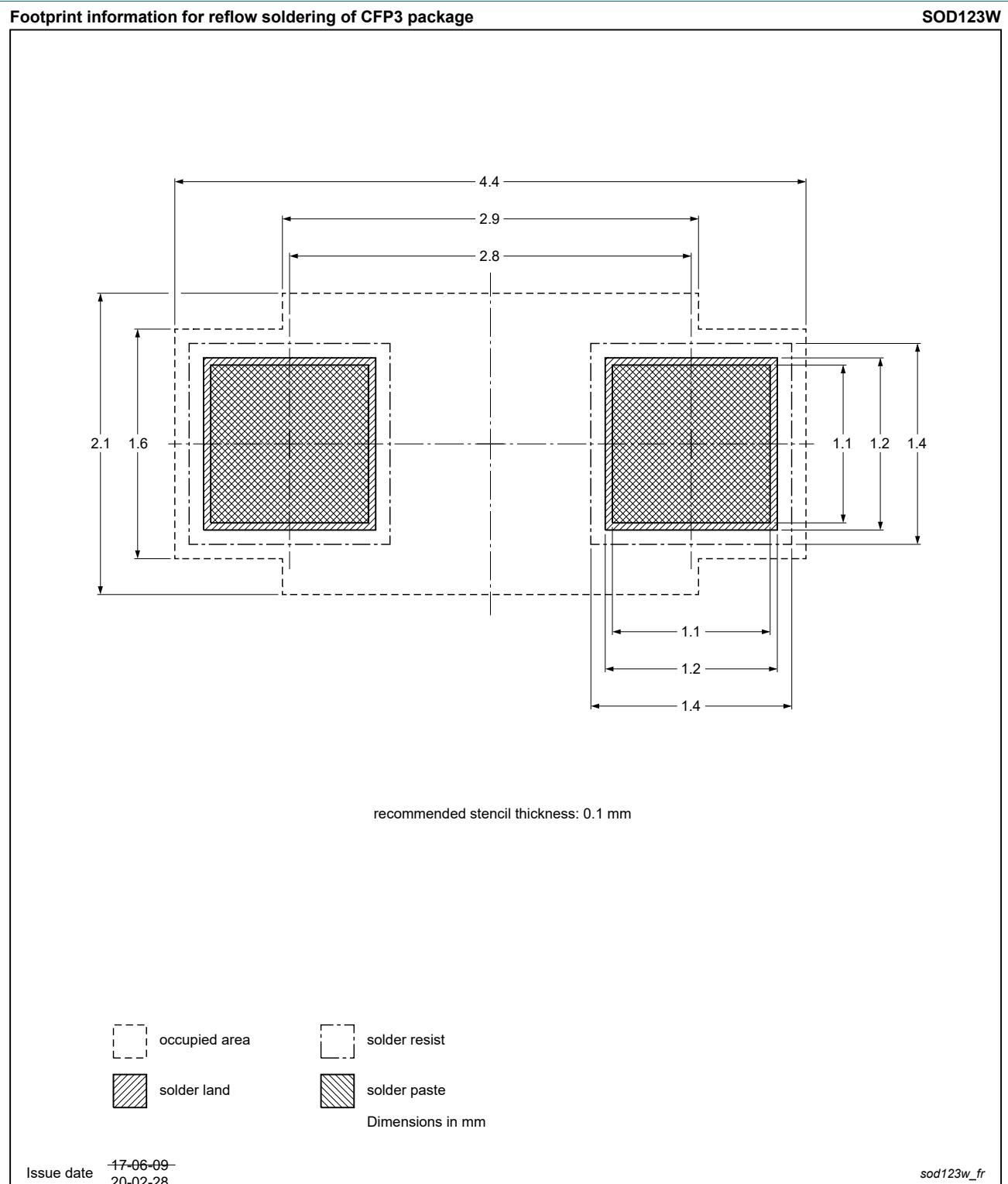
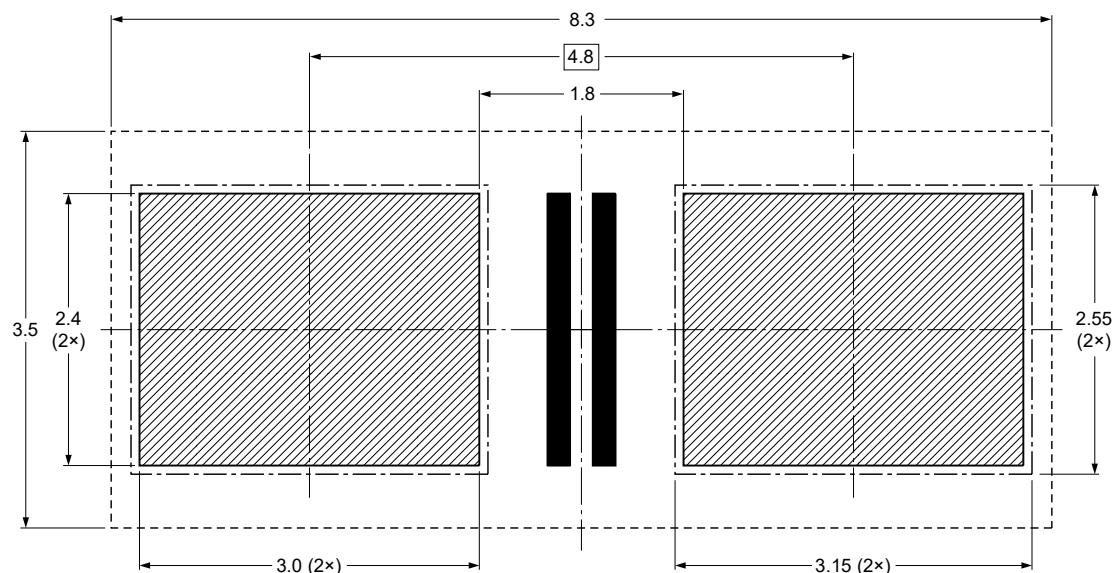


Fig. 19. Reflow soldering footprint for CFP3 (SOD123W)

## Wave soldering footprint information

SOD123W



occupied area

solder resist

solder lands

dummy track (solder resist and Cu free)

Dimensions in mm

Issue date 17-06-06  
17-06-07

sod123w\_fw

Fig. 20. Wave soldering footprint for CFP3 (SOD123W)

## 14. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PNE20020AER-Q v.2	20241115	Product data sheet	-	PNE20020AER-Q v.1
Modifications:	<ul style="list-style-type: none"><li>Thermal characteristics: Footnote 1 removed as not applicable</li></ul>			
PNE20020AER-Q v.1	20230321	Product 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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