



# PNE20040EPE-Q

200 V, 4 A hyperfast recovery rectifier

16 June 2022

Product data sheet

## 1. General description

High power density, hyperfast switching time recovery rectifier with high-efficiency planar technology, encapsulated in a CFP15B (SOT1289B) power and flat lead Surface-Mounted Device (SMD) plastic package.

## 2. Features and benefits

- Reverse voltage:  $V_R \leq 200$  V
- Forward current:  $I_F \leq 4$  A
- Switching time:  $t_{tr} \leq 30$  ns
- Pt doped life time control
- Low inductance
- Power and flat lead SMD plastic package
- Package height typical 0.95 mm
- High power capability due to clip-bond technology
- Planar die design
- Qualified according to AEC-Q101 and recommended for use in automotive applications

## 3. Applications

- General-purpose rectification
- Reverse polarity protection
- Hyperfast switching
- Freewheeling applications
- Engine Control Unit (ECU)

## 4. Quick reference data

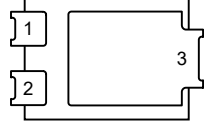
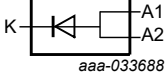
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$I_{F(AV)}$	average forward current	$\delta = 0.5$ ; $f = 20$ kHz; square wave; $T_{sp} \leq 173$ °C		-	-	4	A
$V_R$	reverse voltage	$T_j = 25$ °C		-	-	200	V
$V_{RRM}$	repetitive peak reverse voltage			-	-	200	V
$V_F$	forward voltage	$I_F = 4$ A; $T_j = 25$ °C	[1]	-	860	930	mV
		$I_F = 4$ A; $T_j = 125$ °C	[1]	-	710	780	mV
$I_R$	reverse current	$V_R = 200$ V; $T_j = 25$ °C	[1]	-	-	1	$\mu$ A
		$V_R = 200$ V; $T_j = 125$ °C	[1]	-	1.5	10	$\mu$ A

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

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	A1	anode 1	 CFP15B (SOT1289B)	 aaa-033688
2	A2	anode 2		
3	K	cathode		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
<a href="#">PNE20040EPE-Q</a>	CFP15B	plastic, thermal enhanced ultra thin SMD package; 3 leads; 2.13 mm pitch; 5.8 x 4.3 x 0.95 mm body	<a href="#">SOT1289B</a>

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PNE20040EPE-Q	200E 104E

## 8. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC60134)

Symbol	Parameter	Conditions		Min	Max	Unit
$V_R$	reverse voltage	$T_j = 25\text{ °C}$		-	200	V
$V_{RRM}$	repetitive peak reverse voltage			-	200	V
$V_{R(RMS)lim}$	limiting RMS reverse voltage			-	140	V
$I_F$	forward current	$\delta = 1; T_{sp} \leq 150\text{ °C}$		-	5.6	A
$I_{F(AV)}$	average forward current	$\delta = 0.5; f = 20\text{ kHz};$ square wave; $T_{sp} \leq 173\text{ °C}$		-	4	A
$I_{FSM}$	non-repetitive peak forward current	$t_p = 8.3\text{ ms};$ single half sine wave (applied at rated load condition); $T_{j(init)} = 25\text{ °C}$		-	130	A
$P_{tot}$	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[1]	-	1.75	W
			[2]	-	2.15	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 Printed-Circuit Board (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]	-	-	85	K/W
			[2]	-	-	70	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		[3]	-	-	1.2	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.

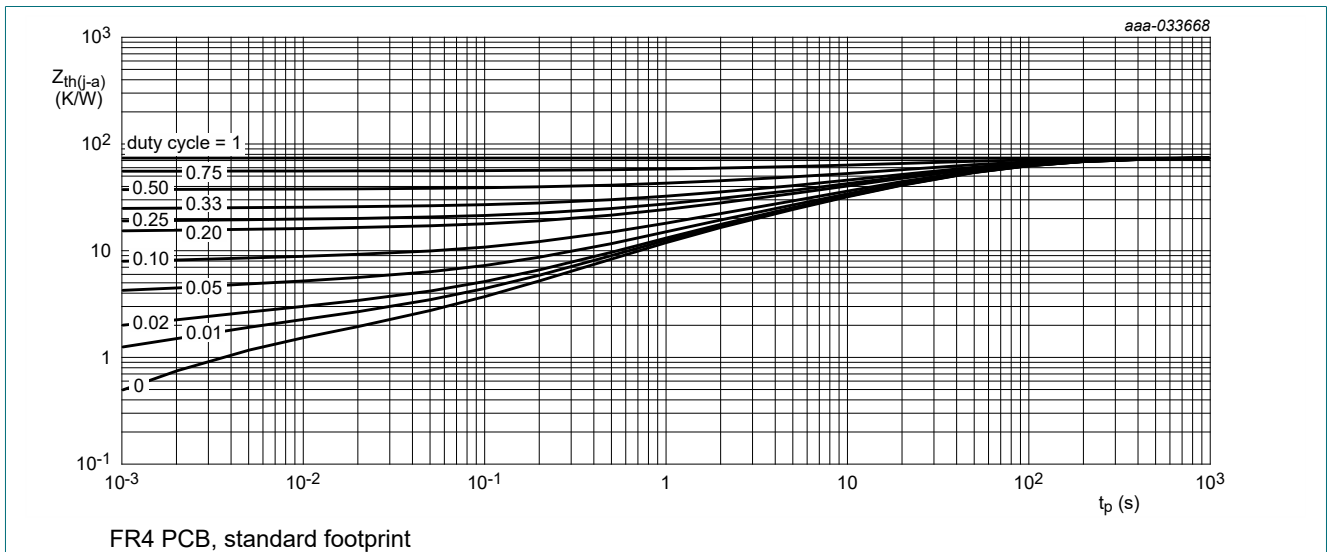


Fig. 1. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

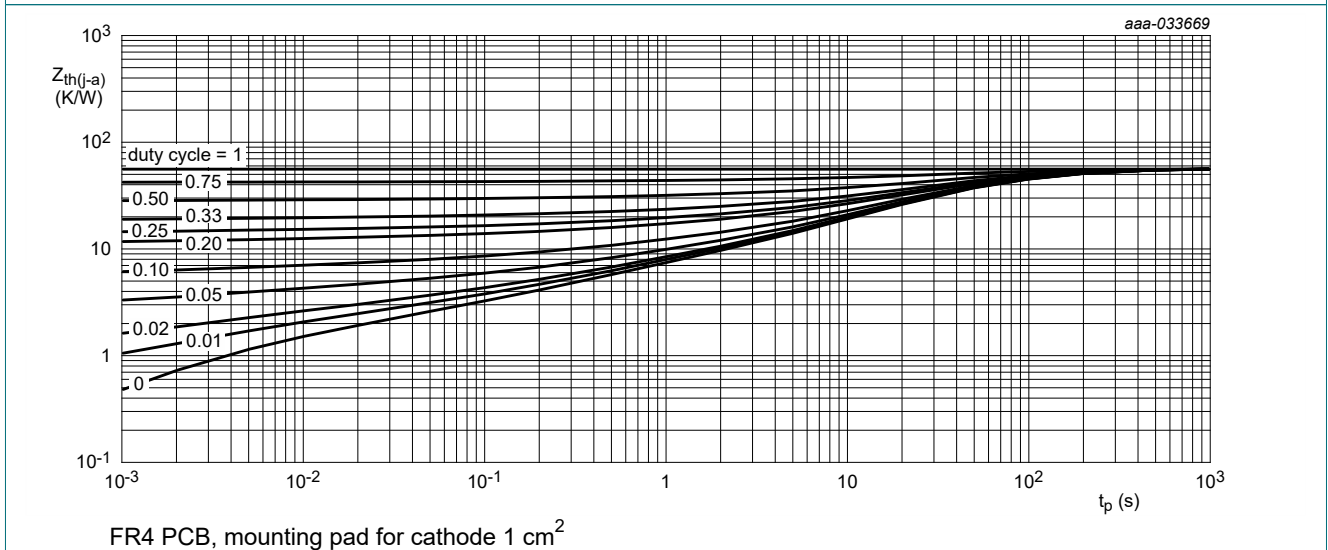


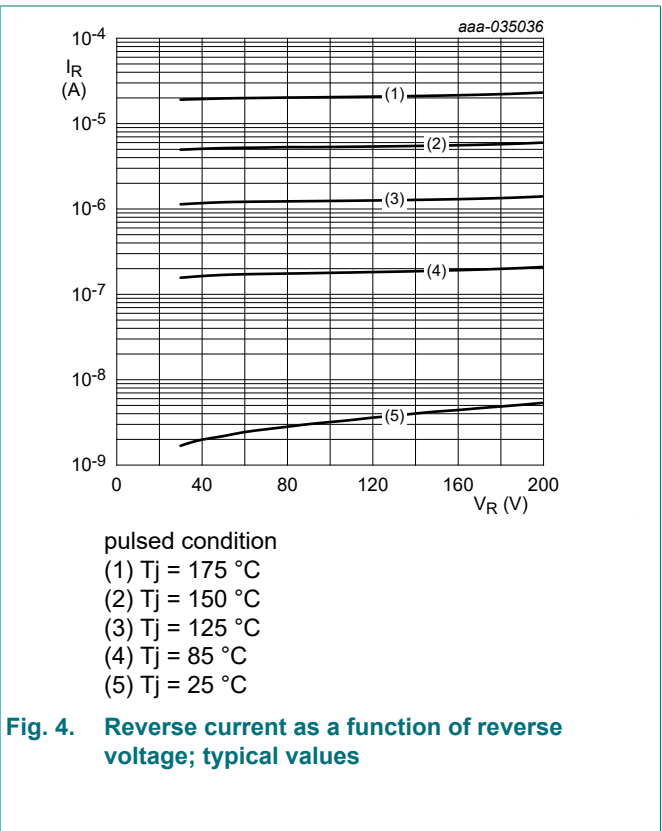
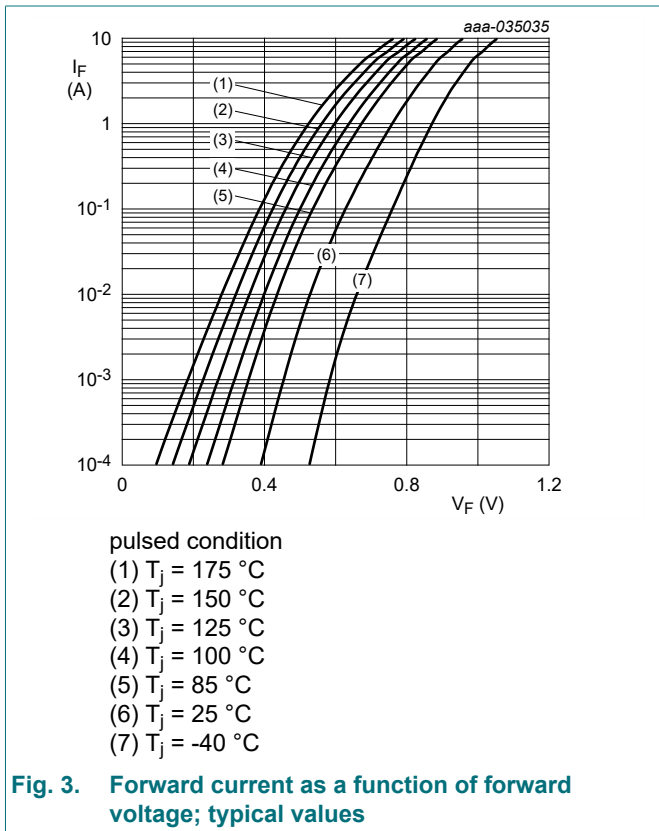
Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

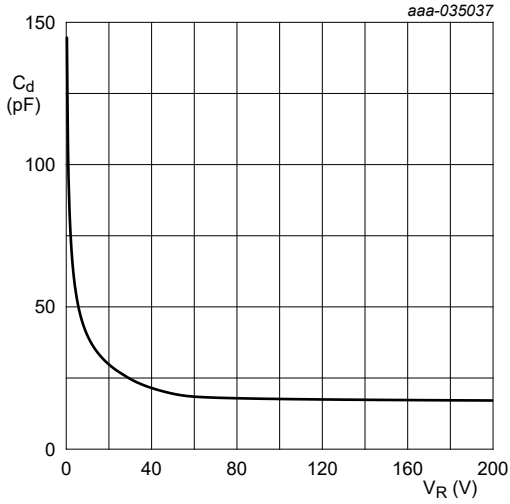
### 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$V_{(BR)R}$	reverse breakdown voltage	$I_R = 100 \mu A; T_j = 25 \text{ }^\circ C$	[1]	200	-	V	
$V_F$	forward voltage	$I_F = 4 \text{ A}; T_j = 25 \text{ }^\circ C$	[1]	-	860	930	mV
		$I_F = 4 \text{ A}; T_j = 125 \text{ }^\circ C$	[1]	-	710	780	mV
$I_R$	reverse current	$V_R = 200 \text{ V}; T_j = 25 \text{ }^\circ C$	[1]	-	-	1	$\mu A$
		$V_R = 200 \text{ V}; T_j = 125 \text{ }^\circ C$	[1]	-	1.5	10	$\mu A$
$C_d$	diode capacitance	$V_R = 4 \text{ V}; f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$	-	61	-	pF	
$t_{rr}$	reverse recovery time	$I_F = 0.5 \text{ A}; I_R = 1 \text{ A}; I_{R(meas)} = 0.25 \text{ A}; T_j = 25 \text{ }^\circ C$	-	12	30	ns	
	step recovery	$dI_F/dt = 50 \text{ A}/\mu s; I_F = 1 \text{ A}; V_R = 30 \text{ V}; T_j = 25 \text{ }^\circ C$	-	18	-	ns	
$V_{FRM}$	peak forward recovery voltage	$I_F = 1 \text{ A}; dI_F/dt = 50 \text{ A}/\mu s; T_j = 25 \text{ }^\circ C$	-	830	-	mV	

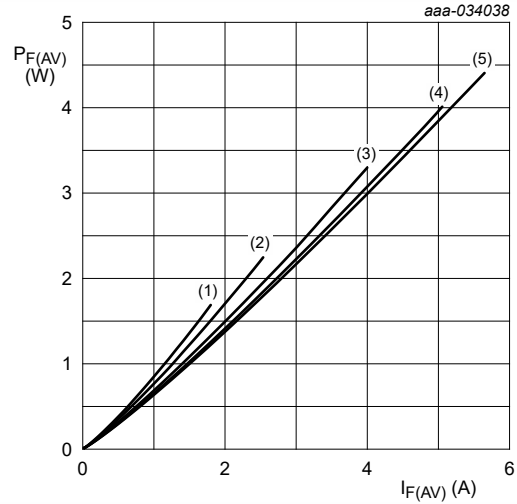
[1] Very short pulse, in order to maintain a stable junction temperature.





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

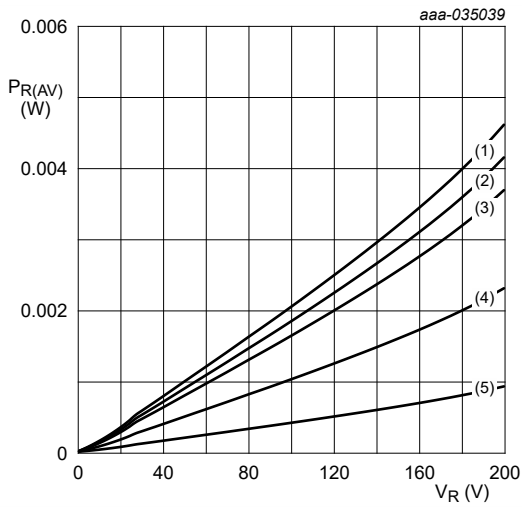
**Fig. 5. Diode capacitance as a function of reverse voltage; typical values**



$T_j = 175 \text{ }^\circ\text{C}$

- (1)  $\delta = 0.1$
- (2)  $\delta = 0.2$
- (3)  $\delta = 0.5$
- (4)  $\delta = 0.8$
- (5)  $\delta = 1; \text{DC}$

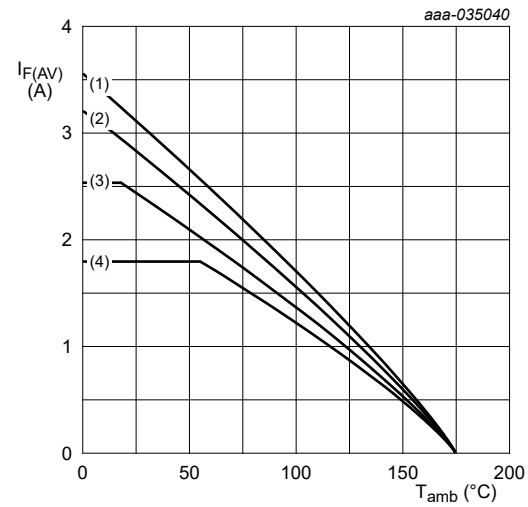
**Fig. 6. Average forward power dissipation as a function of average forward current; typical values**



$T_j = 175 \text{ }^\circ\text{C}$

- (1)  $\delta = 1; \text{DC}$
- (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**

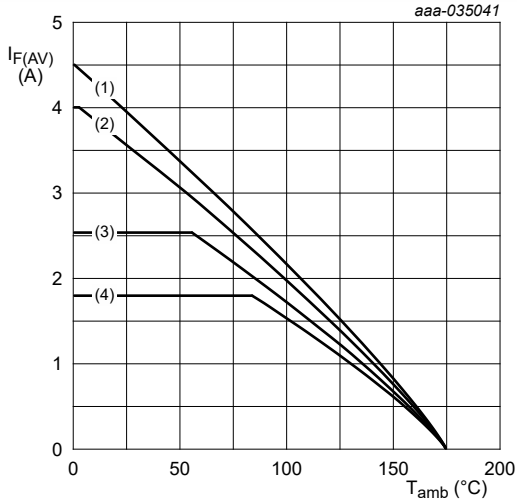


FR4 PCB, standard footprint

$T_j = 175 \text{ }^\circ\text{C}$

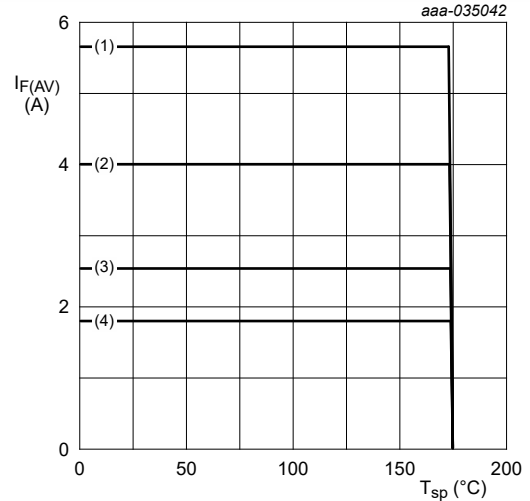
- (1)  $\delta = 1; \text{DC}$
- (2)  $\delta = 0.5; f = 20 \text{ kHz}$
- (3)  $\delta = 0.2; f = 20 \text{ kHz}$
- (4)  $\delta = 0.1; f = 20 \text{ kHz}$

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



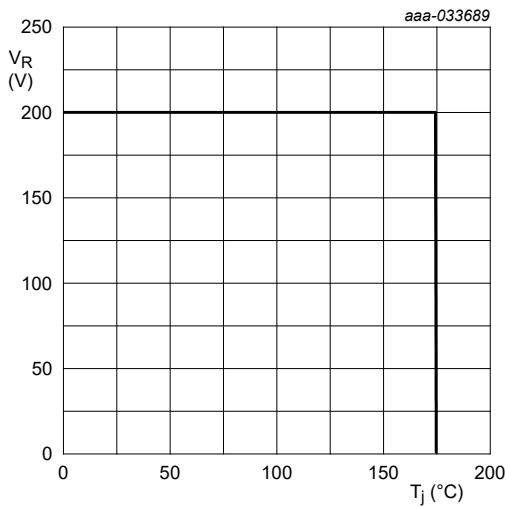
FR4 PCB, mounting pad for cathode 1 cm<sup>2</sup>  
 $T_j = 175$  °C  
 (1)  $\delta = 1$ ; DC  
 (2)  $\delta = 0.5$ ;  $f = 20$  kHz  
 (3)  $\delta = 0.2$ ;  $f = 20$  kHz  
 (4)  $\delta = 0.1$ ;  $f = 20$  kHz

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



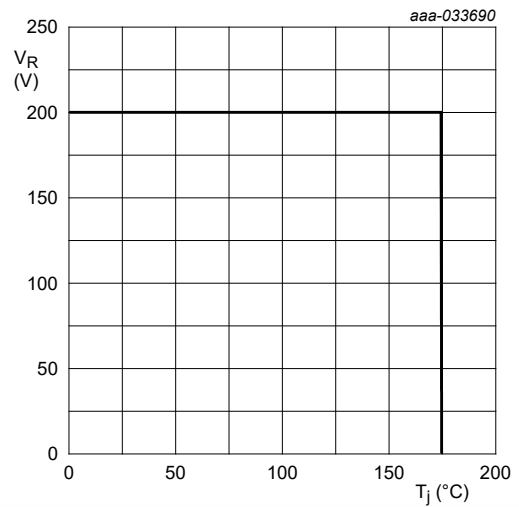
$T_j = 175$  °C  
 (1)  $\delta = 1$ ; DC  
 (2)  $\delta = 0.5$ ;  $f = 20$  kHz  
 (3)  $\delta = 0.2$ ;  $f = 20$  kHz  
 (4)  $\delta = 0.1$ ;  $f = 20$  kHz

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



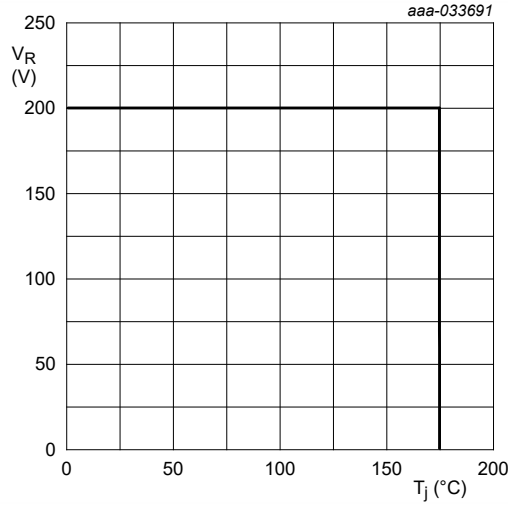
FR4 PCB, standard footprint  
 $R_{th} = 85$  K/W

**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>  
 $R_{th} = 70$  K/W

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



Soldering point of cathode tab  
 $R_{th} = 1.2 \text{ K/W}$

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

### 11. Test information

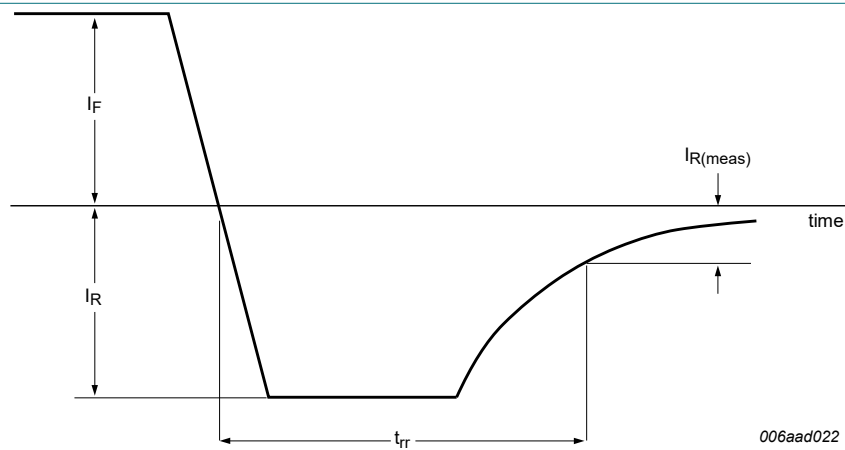


Fig. 14. Reverse recovery definition; step recovery

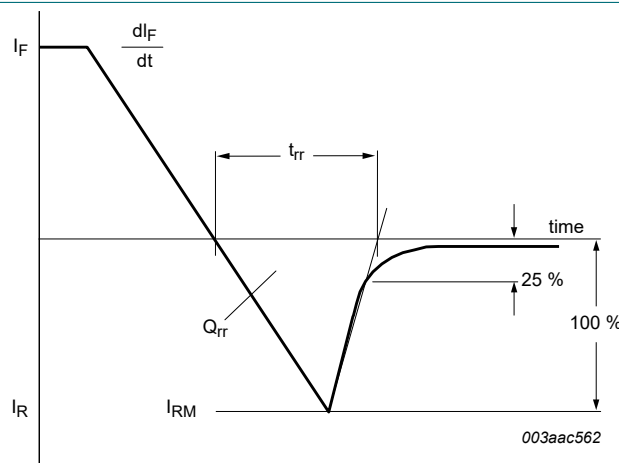


Fig. 15. Reverse recovery definition; ramp recovery

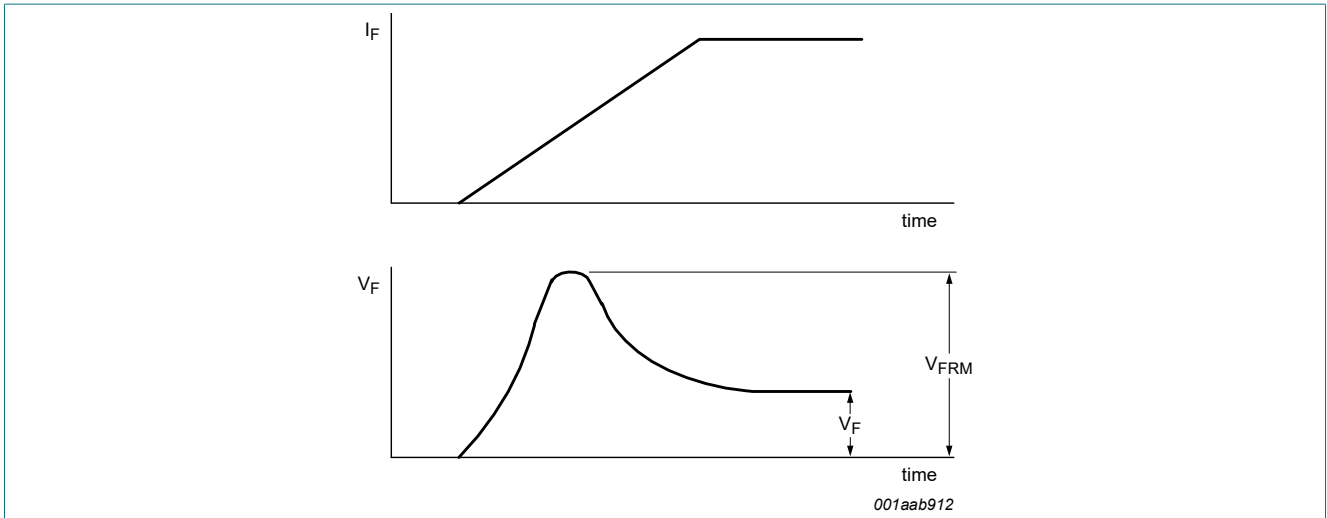


Fig. 16. Forward recovery definition

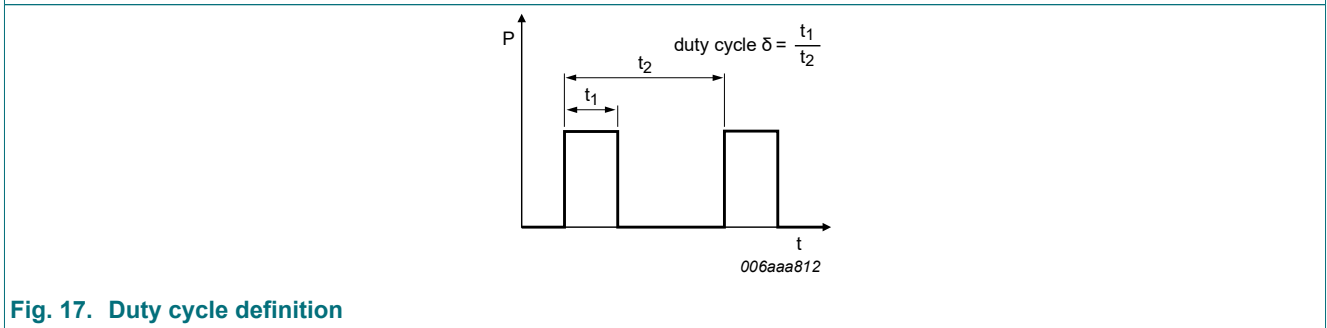


Fig. 17. Duty cycle definition

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

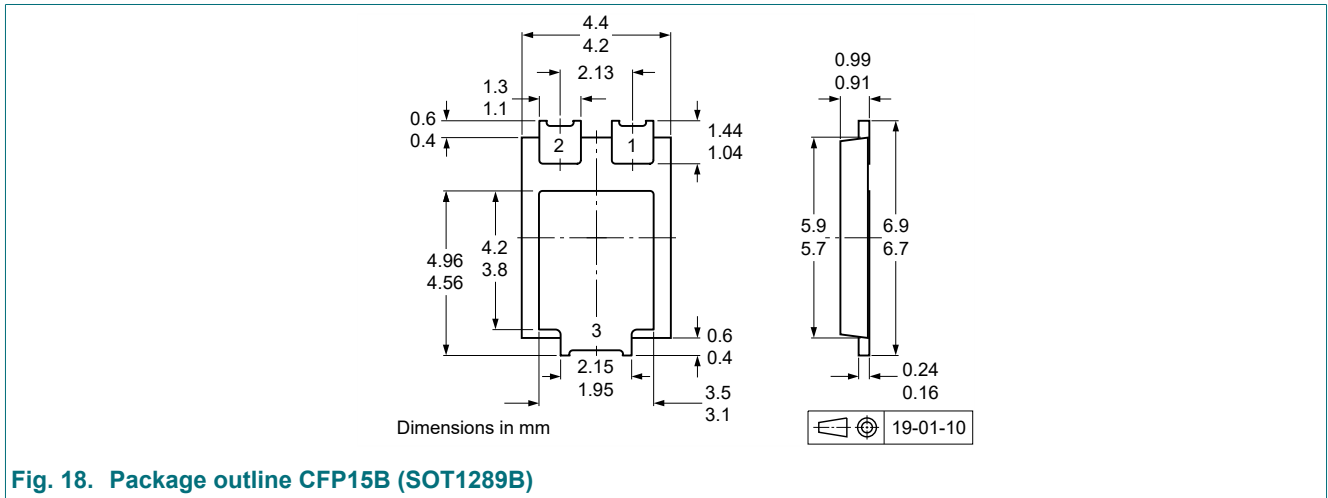


Fig. 18. Package outline CFP15B (SOT1289B)

## 13. Soldering

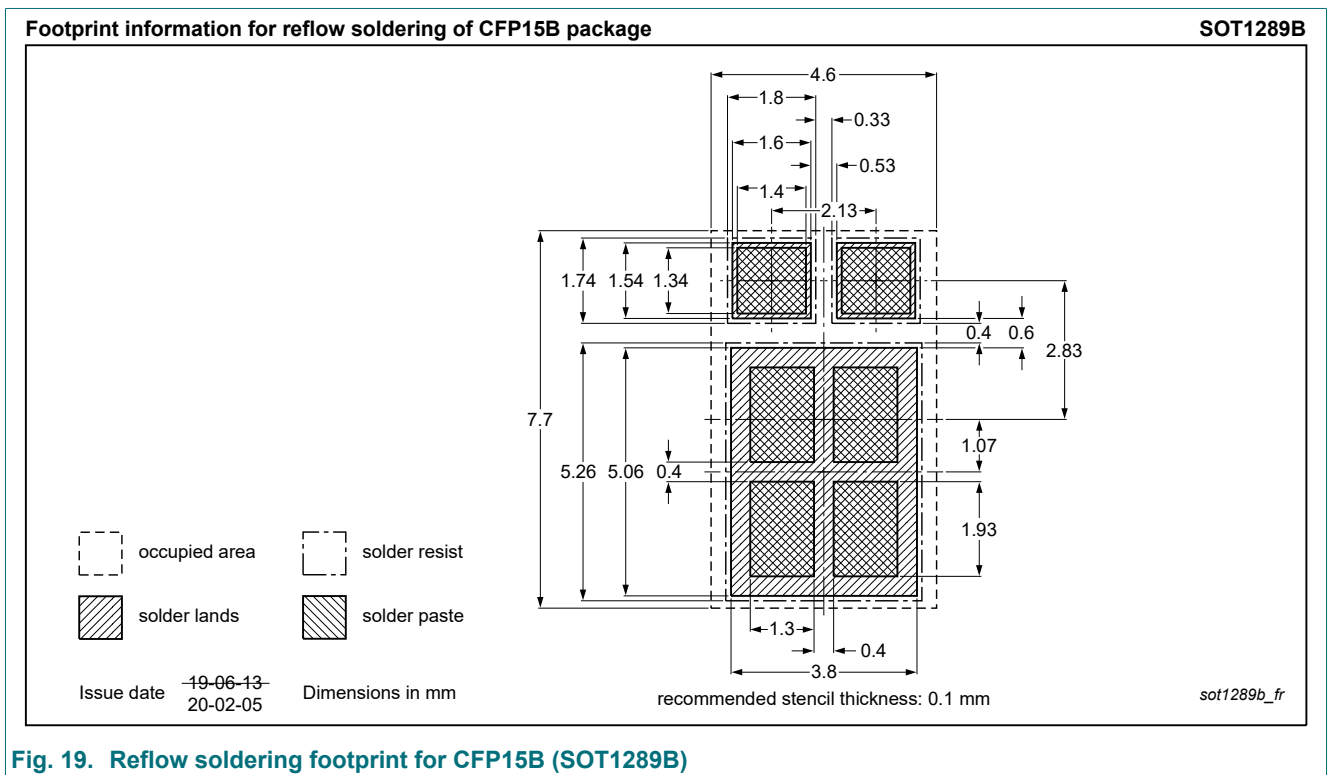


Fig. 19. Reflow soldering footprint for CFP15B (SOT1289B)

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PNE20040EPE-Q v.1	20220616	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.
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