



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

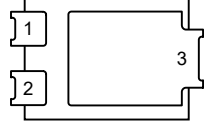
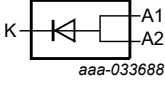
Table 1. Quick reference data

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	μ A
		$V_R = 200$ V; $T_j = 125$ °C	[1]	-	1.5	10	μ 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
PNE20040EPE-Q	CFP15B	plastic, thermal enhanced ultra thin SMD package; 3 leads; 2.13 mm pitch; 5.8 x 4.3 x 0.95 mm body	SOT1289B

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 cm².

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 cm².
- [3] Soldering point of cathode tab.

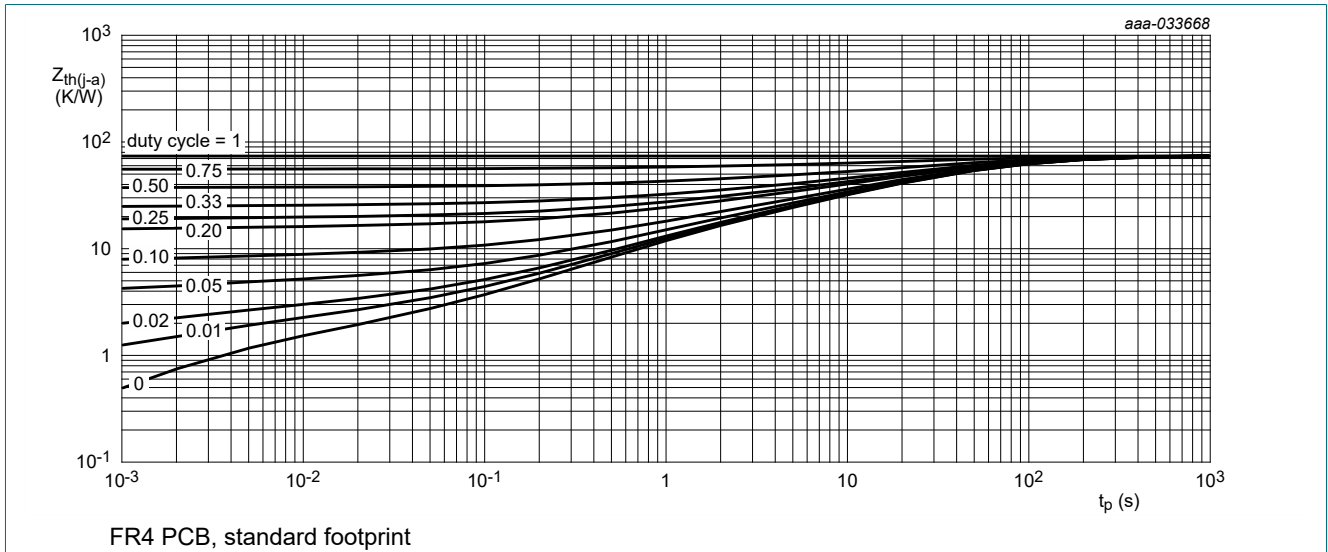


Fig. 1. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

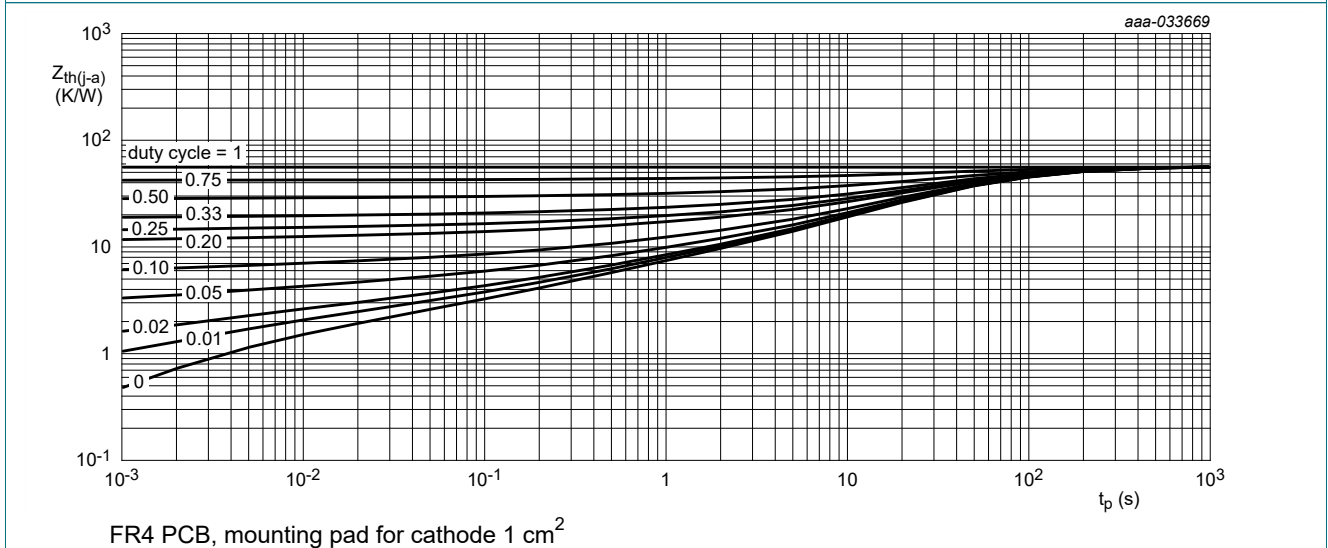


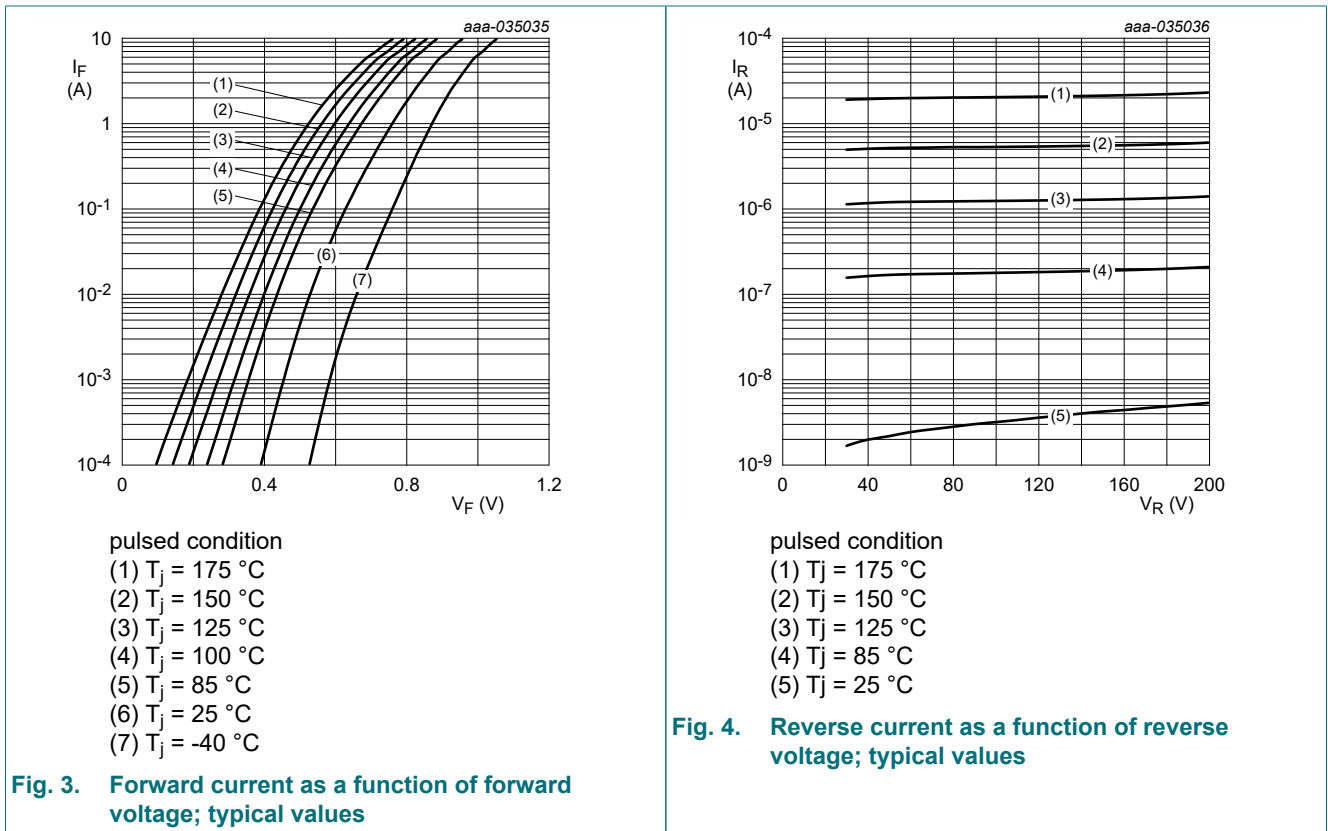
Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

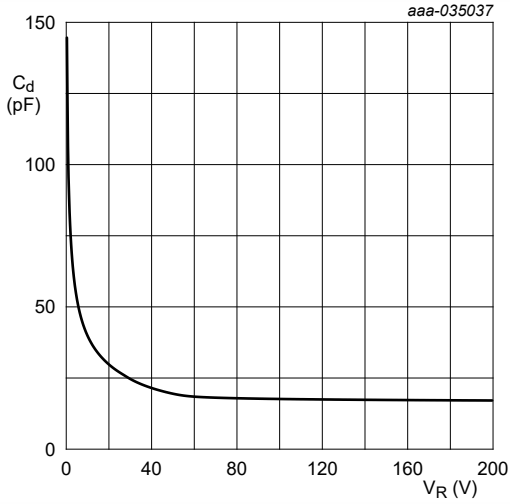
10. Characteristics

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	μA
		$V_R = 200 \text{ V}; T_j = 125 \text{ }^\circ C$	[1]	-	1.5	10	μA
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	

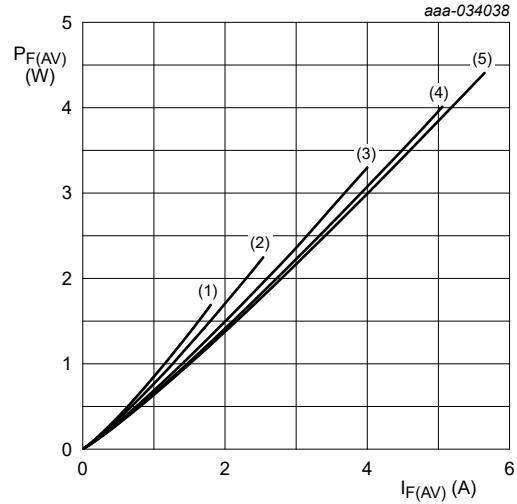
[1] Very short pulse, in order to maintain a stable junction temperature.





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

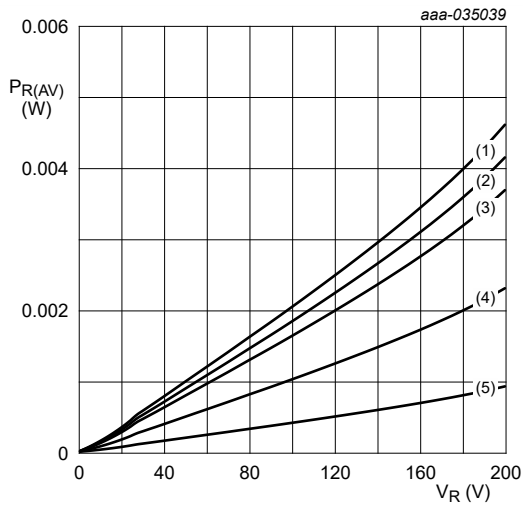
Fig. 5. Diode capacitance as a function of reverse voltage; typical values



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

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

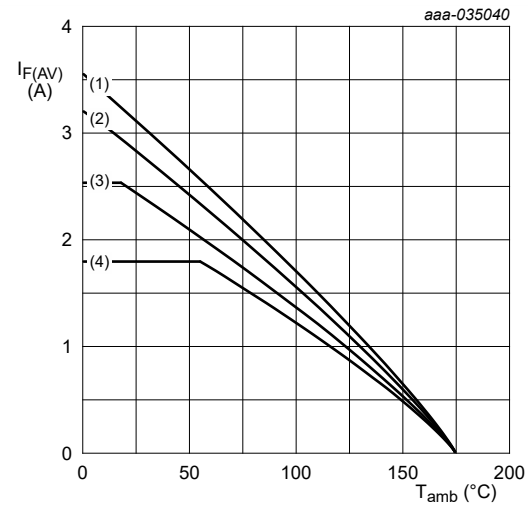
Fig. 6. Average forward power dissipation as a function of average forward current; typical values



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

- (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

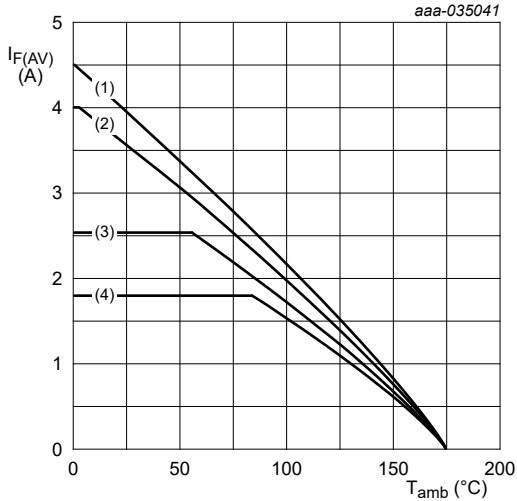


FR4 PCB, standard footprint

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

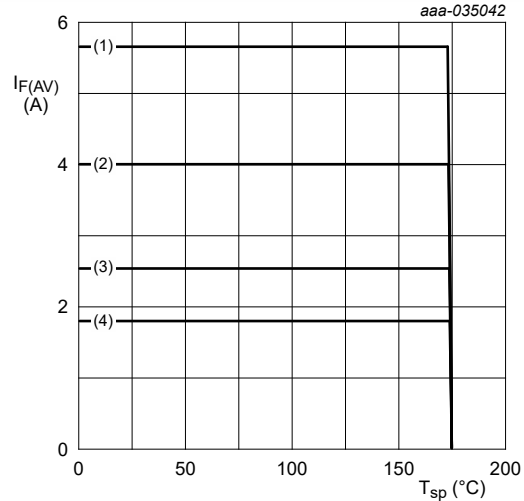
- (1) $\delta = 1; \text{DC}$
- (2) $\delta = 0.5; f = 20 \text{ kHz}$
- (3) $\delta = 0.2; f = 20 \text{ kHz}$
- (4) $\delta = 0.1; f = 20 \text{ kHz}$

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



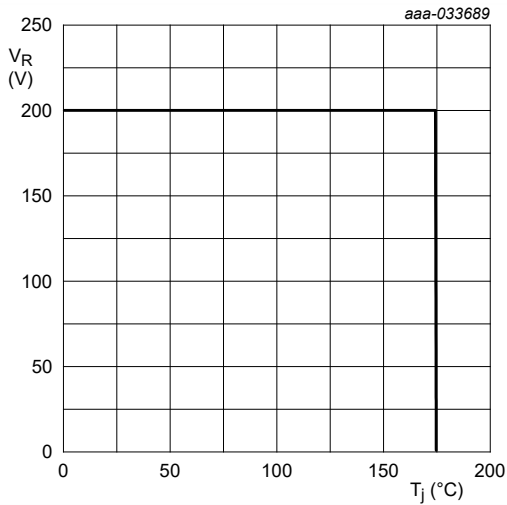
FR4 PCB, mounting pad for cathode 1 cm²
 $T_j = 175$ °C
 (1) $\delta = 1$; DC
 (2) $\delta = 0.5$; $f = 20$ kHz
 (3) $\delta = 0.2$; $f = 20$ kHz
 (4) $\delta = 0.1$; $f = 20$ kHz

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



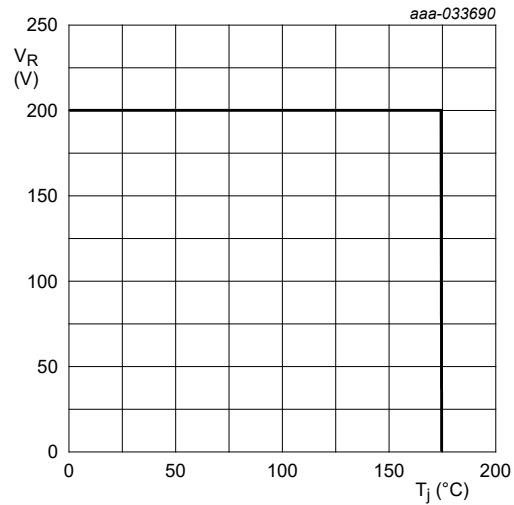
$T_j = 175$ °C
 (1) $\delta = 1$; DC
 (2) $\delta = 0.5$; $f = 20$ kHz
 (3) $\delta = 0.2$; $f = 20$ kHz
 (4) $\delta = 0.1$; $f = 20$ kHz

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



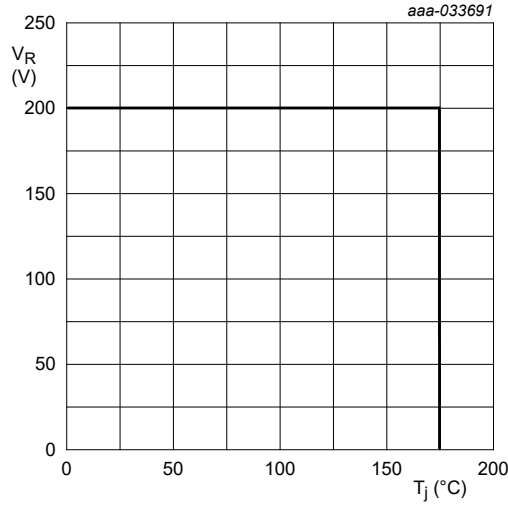
FR4 PCB, standard footprint
 $R_{th} = 85$ K/W

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



FR4 PCB, mounting pad for cathode 1 cm²
 $R_{th} = 70$ 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

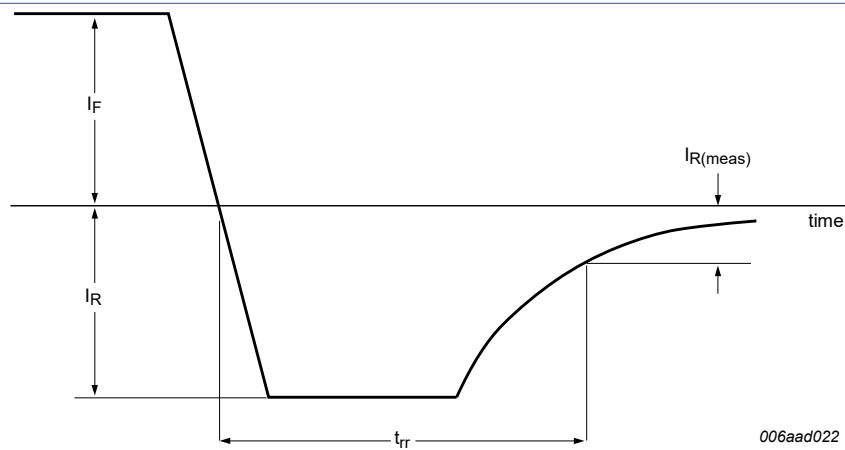


Fig. 14. Reverse recovery definition; step recovery

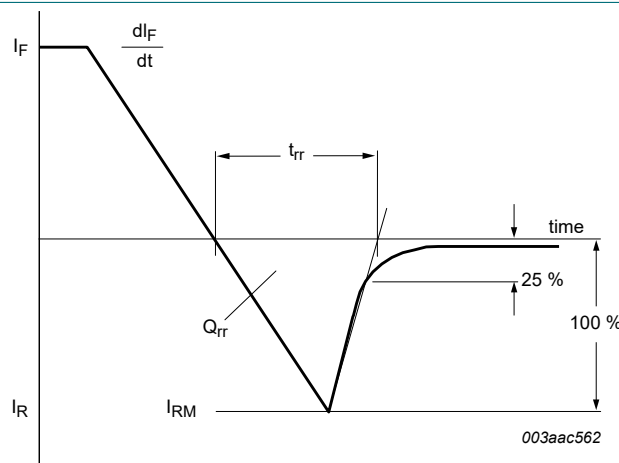


Fig. 15. Reverse recovery definition; ramp recovery

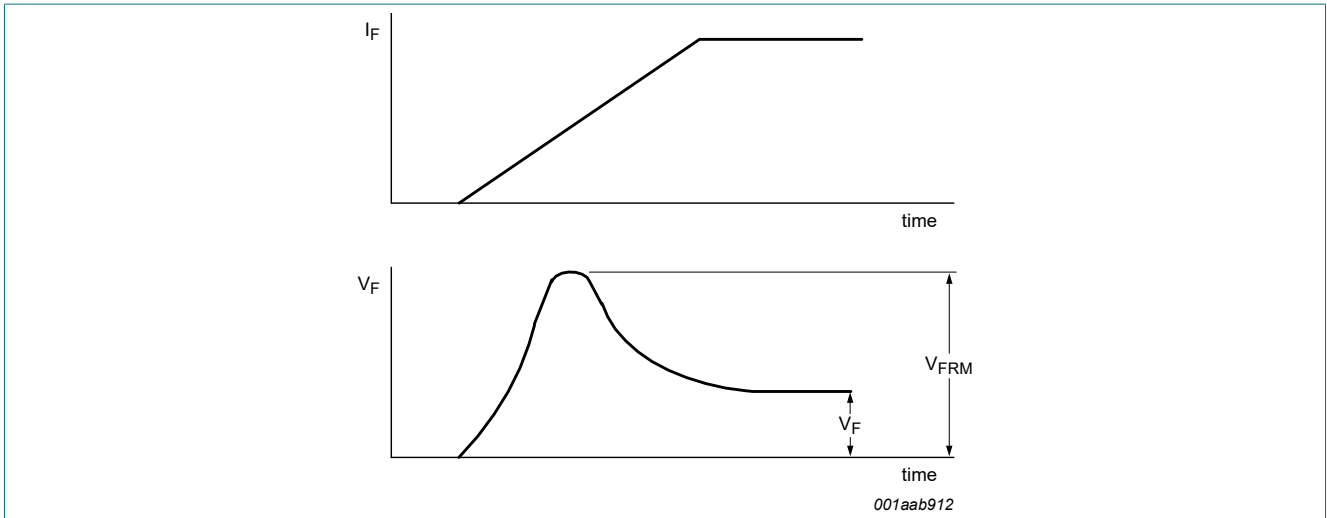


Fig. 16. Forward recovery definition

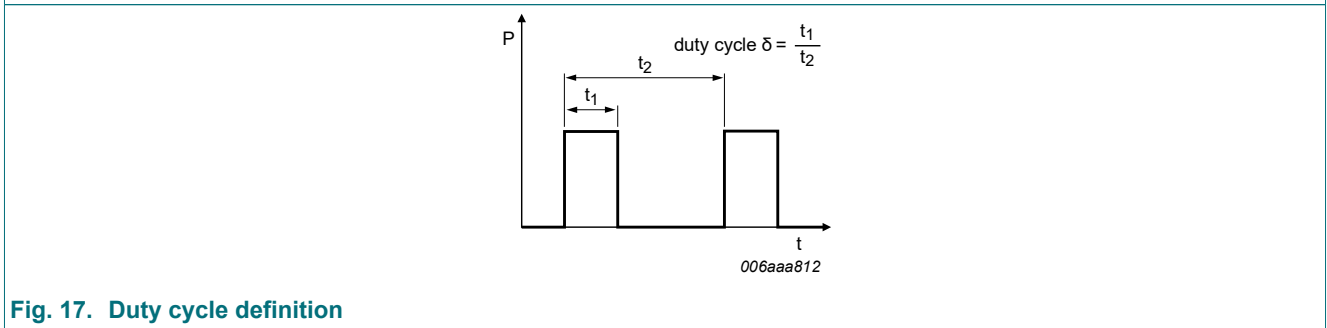


Fig. 17. Duty cycle definition

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

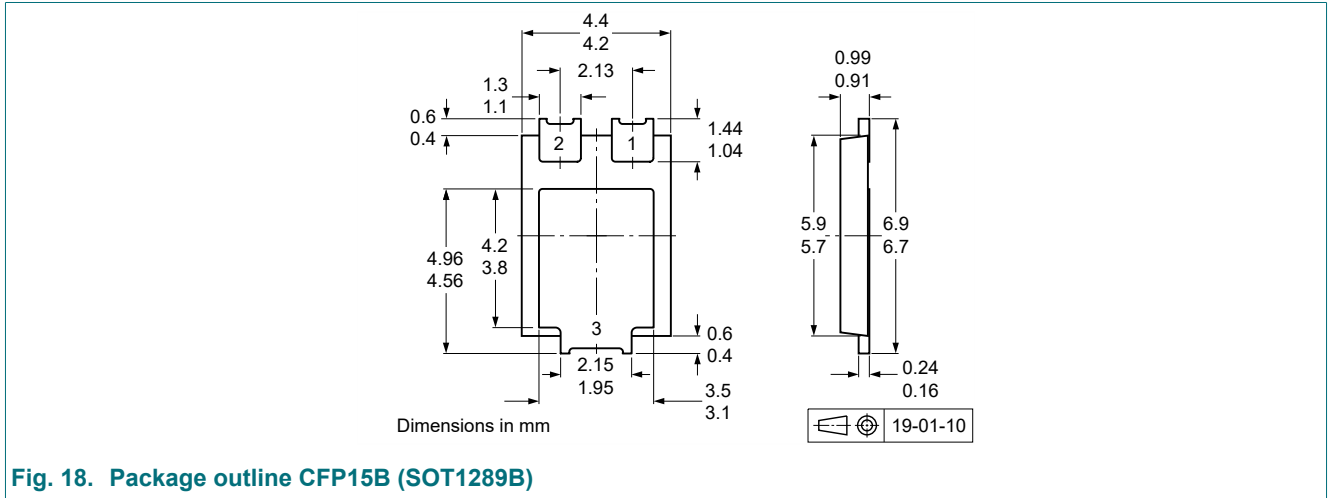


Fig. 18. Package outline CFP15B (SOT1289B)

13. Soldering

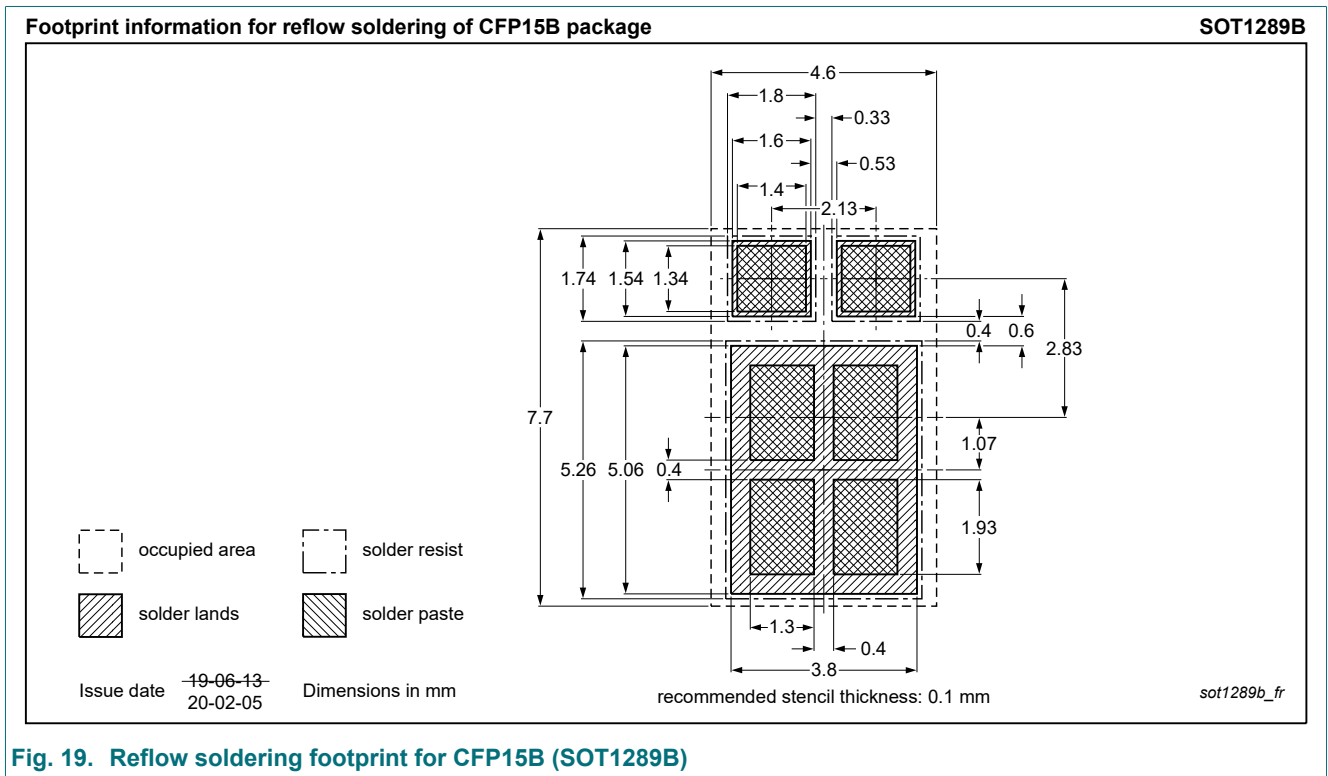


Fig. 19. Reflow soldering footprint for CFP15B (SOT1289B)

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.

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