



# PNE20060CPE

200 V, 2 x 3 A dual common cathode hyperfast recovery rectifier

14 February 2020

Product data sheet

## 1. General description

High power density, hyperfast switching time dual recovery rectifier in common cathode configuration 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:  $I_F \leq 3$  A (per diode)
- 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
- AEC-Q101 qualified

## 3. Applications

- General-purpose rectification
- Hyperfast switching
- Solenoid control
- Piezo injection
- Freewheeling applications

## 4. Quick reference data

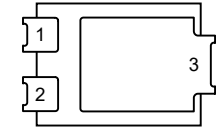
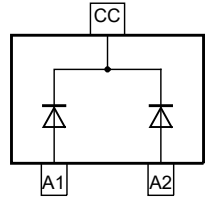
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per diode (unless otherwise specified)</b>						
$I_{F(AV)}$	average forward current	$\delta = 0.5$ ; square wave; $f = 20$ kHz; $T_{sp} \leq 155$ °C	-	-	3	A
$V_{RRM}$	repetitive peak reverse voltage	$T_j = 25$ °C	-	-	200	V
$V_R$	reverse voltage		-	-	200	V
$V_F$	forward voltage	$I_F = 3$ A; $T_j = 25$ °C	[1]	870	940	mV
		$I_F = 3$ A; $T_j = 125$ °C	[1]	730	820	mV
$I_R$	reverse current	$V_R = 200$ V; $T_j = 25$ °C	[1]	-	1	µA
		$V_R = 200$ V; $T_j = 125$ °C	[1]	1.5	35	µA

[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 (diode 1)	 <p>CFP15B (SOT1289B)</p>	 <p>aaa-030081</p>
2	A2	anode (diode 2)		
3	CC	common cathode		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PNE20060CPE	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
PNE20060CPE	200E 006C

## 8. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC60134)

Symbol	Parameter	Conditions	Min	Max	Unit	
<b>Per diode (unless otherwise specified)</b>						
$V_R$	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	$\delta = 1; T_{sp} \leq 150\text{ °C}$	-	4.2	A	
$I_{F(AV)}$	average forward current	$\delta = 0.5$ ; square wave; $f = 20\text{ kHz}$ ; $T_{sp} \leq 155\text{ °C}$	-	3	A	
$I_{FSM}$	non-repetitive peak forward current	$t_p = 8.3\text{ ms}$ ; single half sine wave (applied at rated load condition); $T_{j(init)} = 25\text{ °C}$	-	80	A	
		$t_p = 8.3\text{ ms}$ ; single half sine wave (applied at rated load condition); per device; $T_{j(init)} = 25\text{ °C}$	-	150	A	
<b>Per device, one diode loaded</b>						
$P_{tot}$	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[1]	-	1.66	W
			[2]	-	2.15	W

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Symbol	Parameter	Conditions	Min	Max	Unit
$T_j$	junction temperature		-	175	°C
$T_{amb}$	ambient temperature		-55	175	°C
$T_{stg}$	storage temperature		-65	175	°C

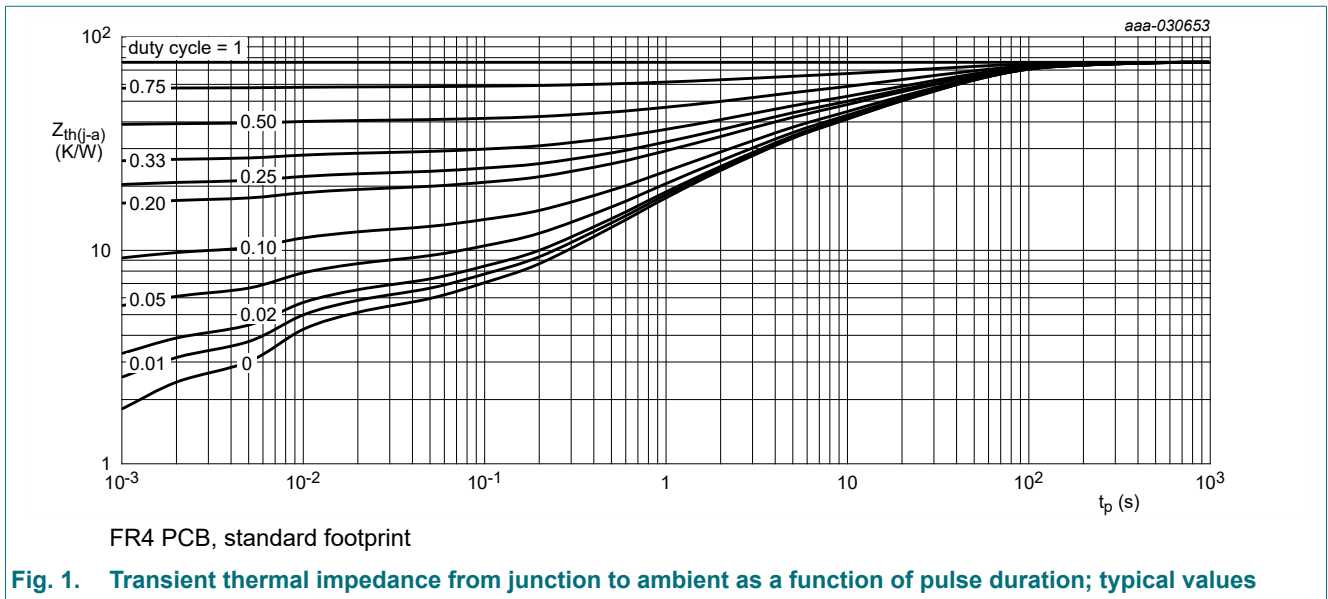
- [1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.
- [2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for cathode 1 cm<sup>2</sup>.

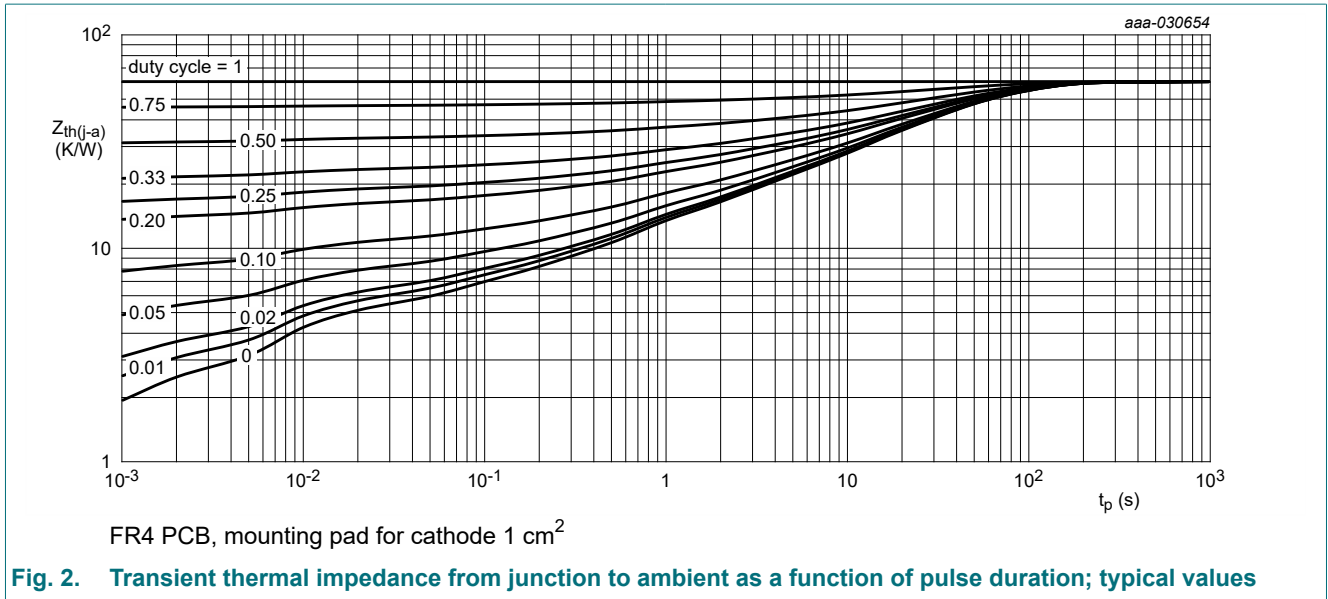
## 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b>Per device, one diode loaded</b>							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	90	K/W
			[2]	-	-	70	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		[3]	-	-	7	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.



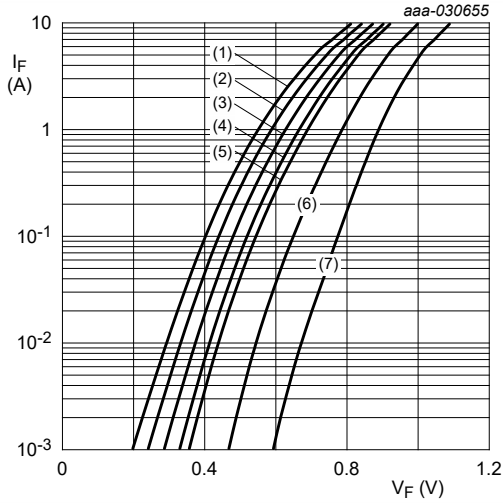


## 10. Characteristics

Table 7. Characteristics

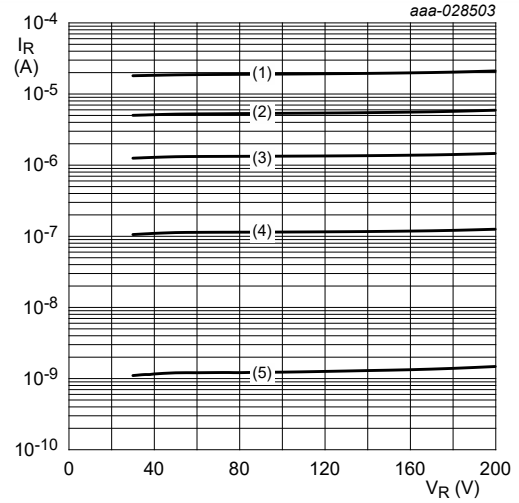
Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b>Per diode (unless otherwise specified)</b>							
$V_{(BR)R}$	reverse breakdown voltage	$I_R = 100 \mu A; T_j = 25 \text{ }^\circ C$	[1]	200	-	V	
$V_F$	forward voltage	$I_F = 3 A; T_j = 25 \text{ }^\circ C$	[1]	-	870	940	mV
		$I_F = 3 A; T_j = 125 \text{ }^\circ C$	[1]	-	730	820	mV
$I_R$	reverse current	$V_R = 200 V; T_j = 25 \text{ }^\circ C$	[1]	-	-	1	$\mu A$
		$V_R = 200 V; T_j = 125 \text{ }^\circ C$	[1]	-	1.5	35	$\mu A$
$C_d$	diode capacitance	$V_R = 4 V; f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$	-	37	-	pF	
$t_{rr}$	reverse recovery time step recovery	$I_F = 0.5 A; I_R = 1 A; I_{R(meas)} = 0.25 A; T_j = 25 \text{ }^\circ C$	-	13	30	ns	
	reverse recovery time ramp recovery	$di_F/dt = 50 A/\mu s; I_F = 1 A; V_R = 30 V; T_j = 25 \text{ }^\circ C$	-	22	-	ns	
	reverse recovery time	$di_F/dt = 100 A/\mu s; I_F = 1 A; V_R = 30 V; T_j = 25 \text{ }^\circ C$	-	17	-	ns	
$I_{RM}$	peak reverse recovery current	$T_j = 25 \text{ }^\circ C$	-	1	-	A	
$Q_{rr}$	reverse recovery charge		-	10	-	nC	
$V_{FRM}$	peak forward recovery voltage	$I_F = 1 A; di_F/dt = 50 A/\mu s; T_j = 25 \text{ }^\circ C$	-	815	-	mV	

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



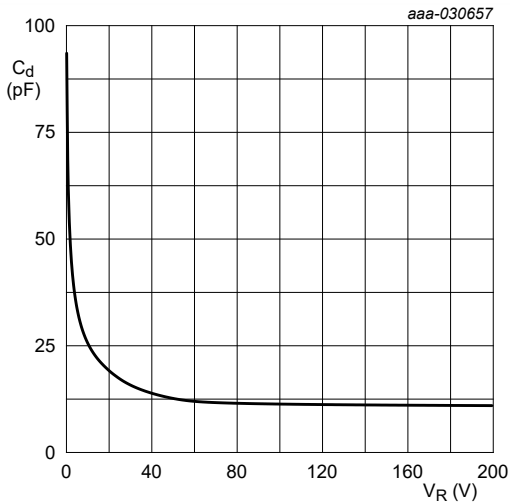
pulsed condition  
 (1)  $T_j = 175^\circ\text{C}$   
 (2)  $T_j = 150^\circ\text{C}$   
 (3)  $T_j = 125^\circ\text{C}$   
 (4)  $T_j = 100^\circ\text{C}$   
 (5)  $T_j = 85^\circ\text{C}$   
 (6)  $T_j = 25^\circ\text{C}$   
 (7)  $T_j = -40^\circ\text{C}$

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



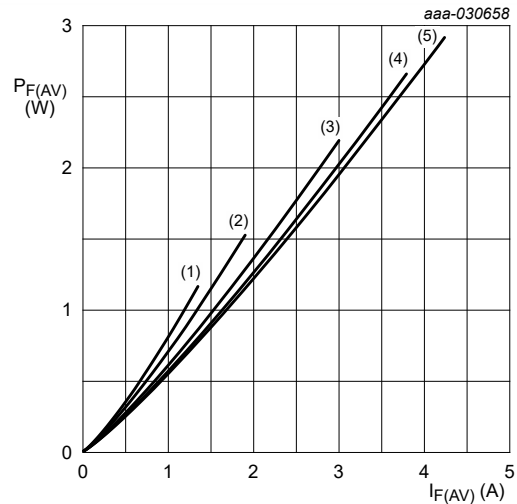
pulsed condition  
 (1)  $T_j = 175^\circ\text{C}$   
 (2)  $T_j = 150^\circ\text{C}$   
 (3)  $T_j = 125^\circ\text{C}$   
 (4)  $T_j = 85^\circ\text{C}$   
 (5)  $T_j = 25^\circ\text{C}$

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



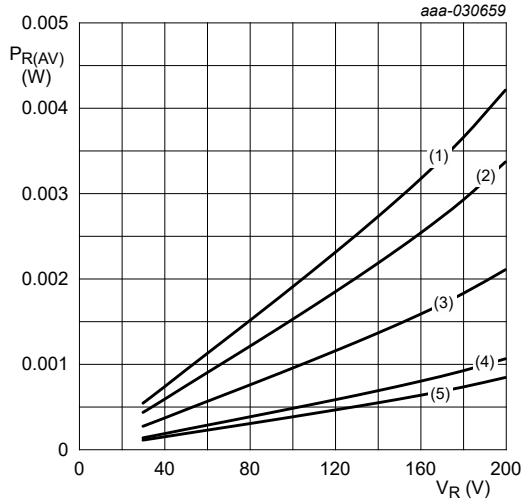
$f = 1\text{ MHz}; T_{\text{amb}} = 25^\circ\text{C}$

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



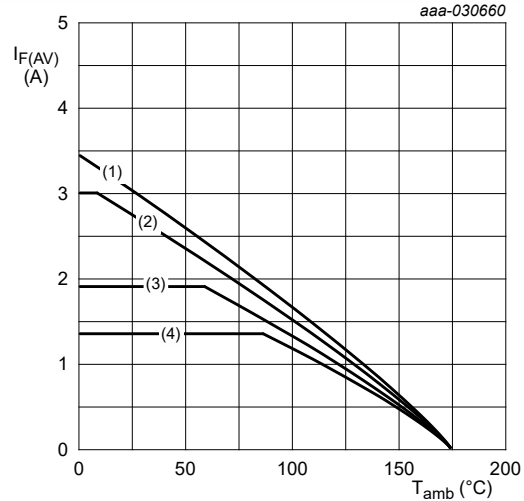
$T_j = 175^\circ\text{C}$   
 (1)  $\delta = 0.1$   
 (2)  $\delta = 0.2$   
 (3)  $\delta = 0.5$   
 (4)  $\delta = 0.8$   
 (5)  $\delta = 1$ ; DC

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



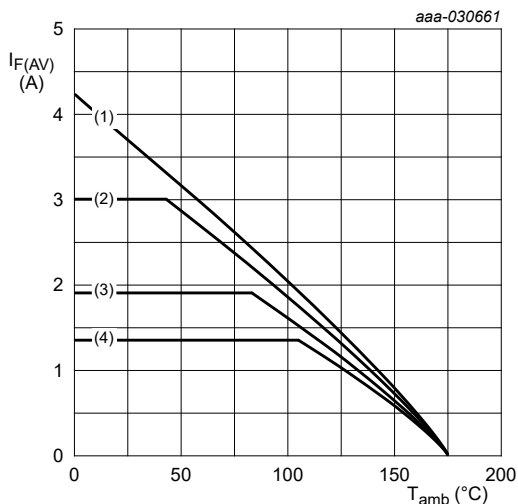
$T_j = 175^\circ\text{C}$   
 (1)  $\delta = 1$ ; DC  
 (2)  $\delta = 0.9$   
 (3)  $\delta = 0.8$   
 (4)  $\delta = 0.5$   
 (5)  $\delta = 0.2$

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



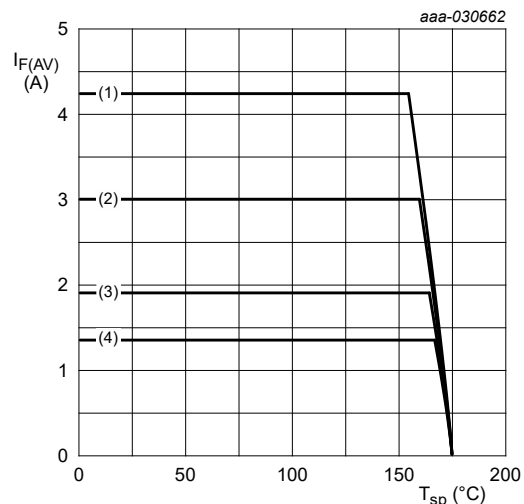
FR4 PCB, standard footprint  
 $T_j = 175^\circ\text{C}$   
 (1)  $\delta = 1$ ; DC  
 (2)  $\delta = 0.5$ ;  $f = 20$  kHz  
 (3)  $\delta = 0.2$ ;  $f = 20$  kHz  
 (4)  $\delta = 0.1$ ;  $f = 20$  kHz

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



FR4 PCB, mounting pad for cathode  $1\text{ cm}^2$   
 $T_j = 175^\circ\text{C}$   
 (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

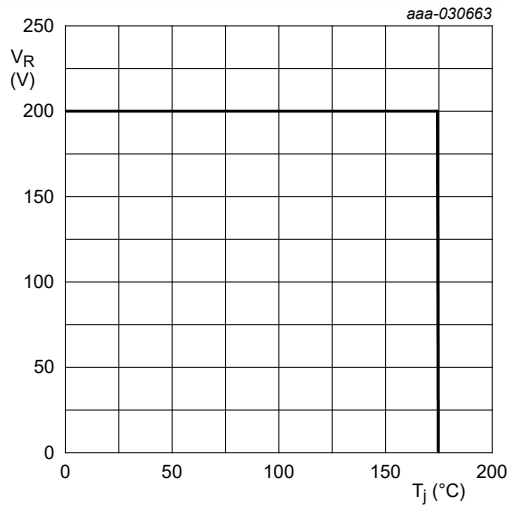
Fig. 9. Average forward current as a function of ambient temperature; typical values



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

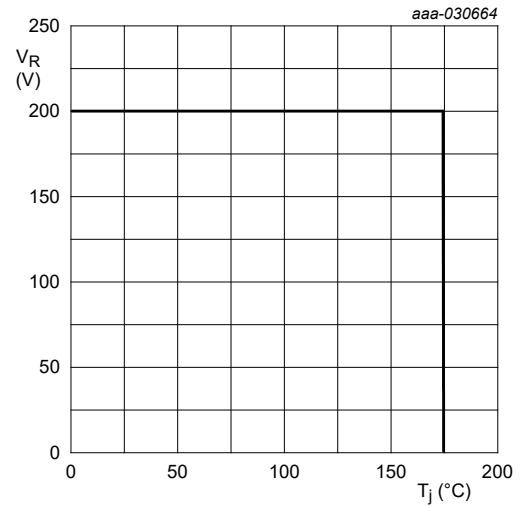
Fig. 10. Average forward current as a function of solder point temperature; typical values

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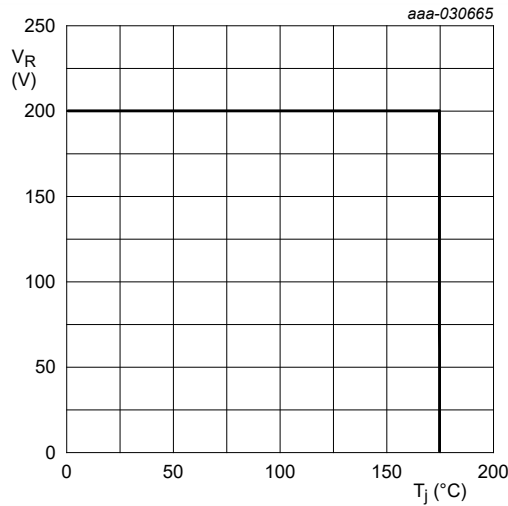
FR4 PCB, standard footprint  
 $R_{th} = 90 \text{ K/W}$

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



FR4 PCB, mounting pad for cathode  $1 \text{ cm}^2$   
 $R_{th} = 70 \text{ K/W}$

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



Soldering point of cathode tab  
 $R_{th} = 7 \text{ K/W}$

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

11. Test information

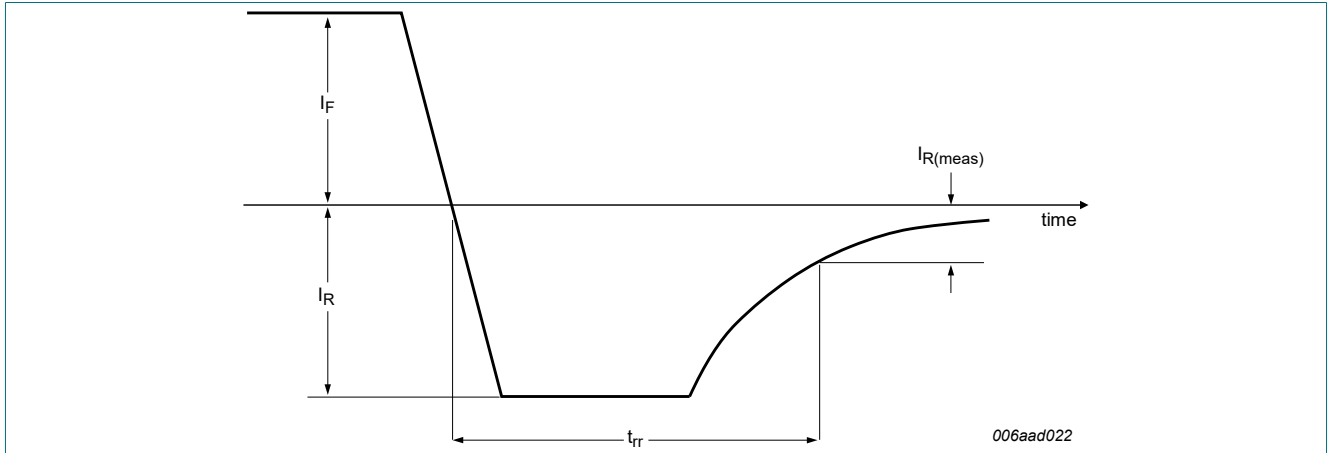


Fig. 14. Reverse recovery definition; step recovery

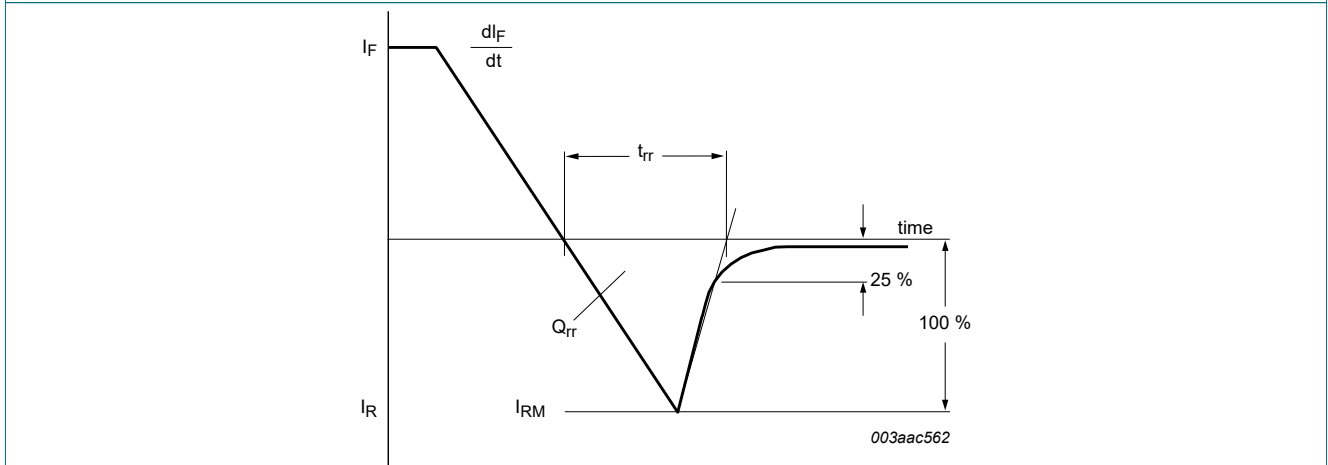


Fig. 15. Reverse recovery definition; ramp recovery

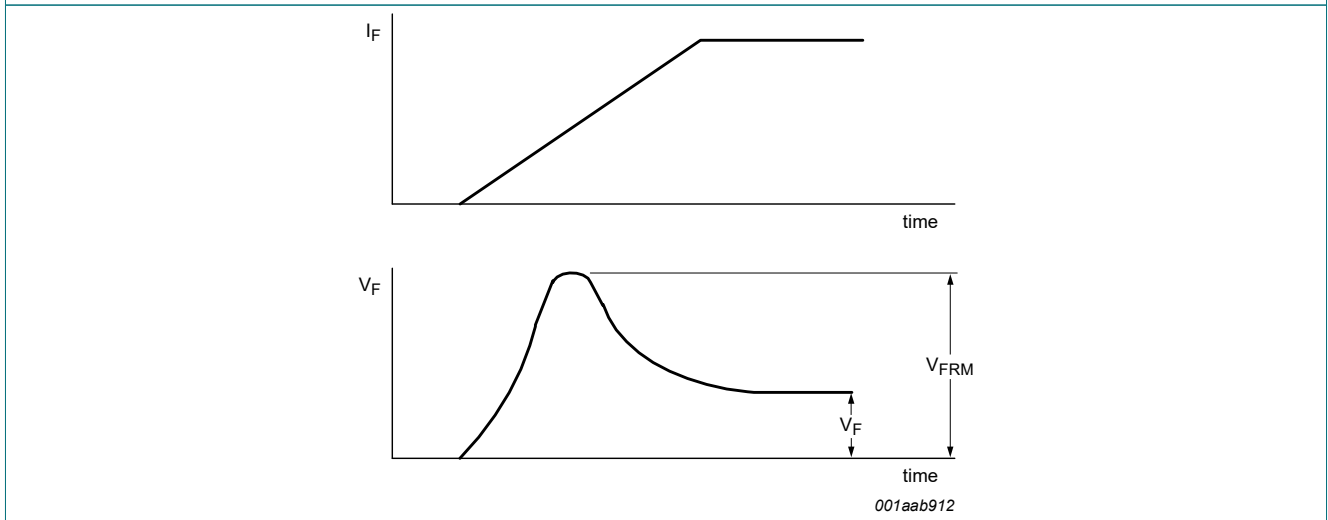


Fig. 16. Forward recovery definition



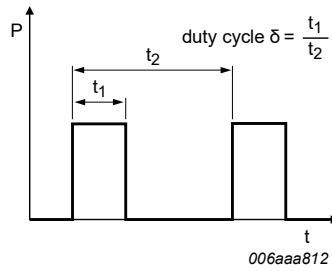


Fig. 17. Duty cycle definition

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**

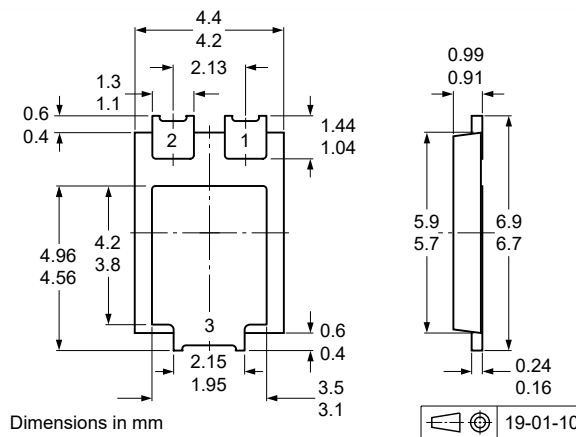
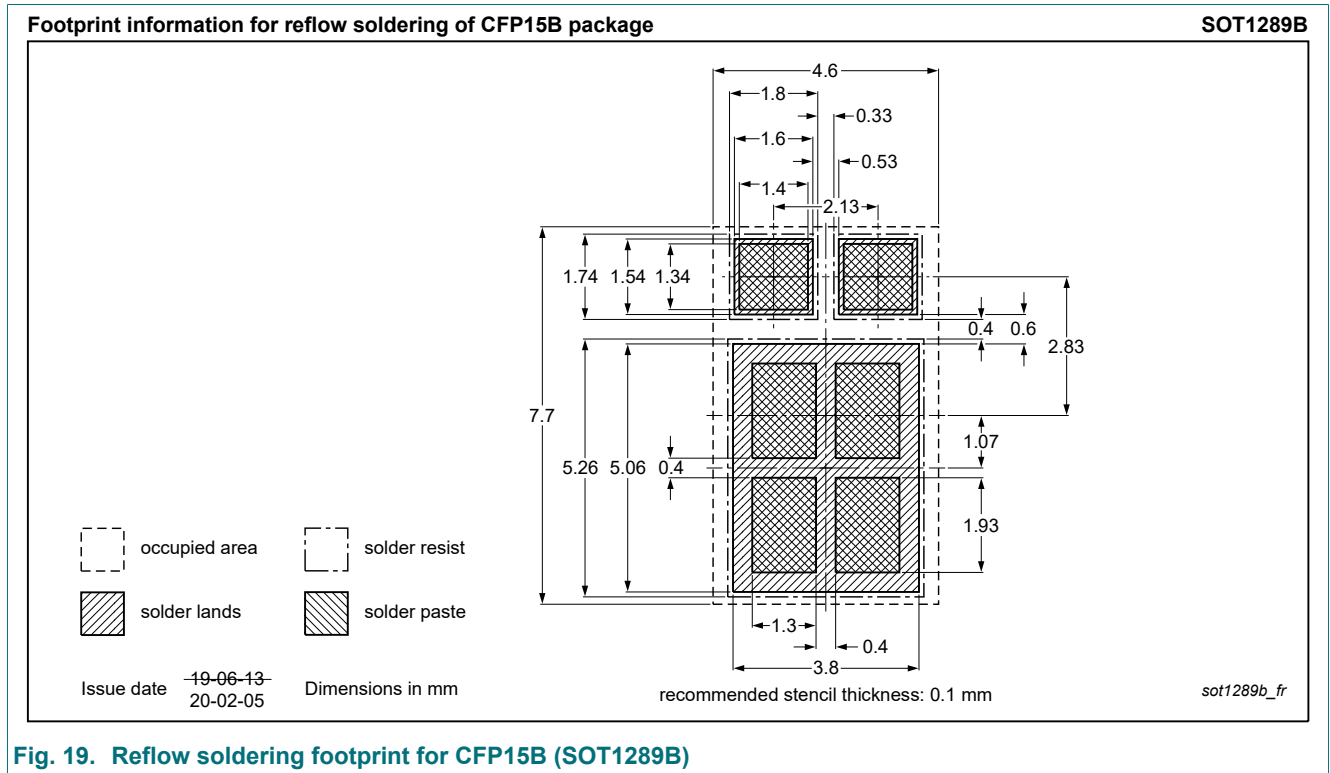


Fig. 18. Package outline CFP15B (SOT1289B)

### 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
PNE20060CPE v.2	20200214	Product data sheet	-	PNE20060CPE v.1
Modifications:	<ul style="list-style-type: none"><li>• Small footprint inserted</li><li>• Graphic symbol exchanged</li></ul>			
PNE20060CPE v.1	20200127	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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Date of release: 14 February 2020

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