



PNE20060EPE-Q

200 V, 6 A hyperfast recovery rectifier

13 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: $I_F \leq 6$ A
- Switching time: $t_{rr} \leq 30$ 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

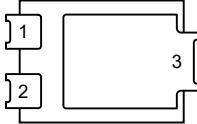
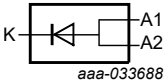
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$I_{F(AV)}$	average forward current	$\delta = 0.5$; $f = 20$ kHz; square wave; $T_{sp} \leq 170$ °C		-	-	6	A
V_R	reverse voltage	$T_j = 25$ °C		-	-	200	V
V_{RRM}	repetitive peak reverse voltage			-	-	200	V
V_F	forward voltage	$I_F = 6$ A; $T_j = 25$ °C	[1]	-	880	940	mV
		$I_F = 6$ A; $T_j = 125$ °C	[1]	-	740	800	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]	-	2	15	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 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
PNE20060EPE-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
PNE20060EPE-Q	200E 106E

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	$T_j = 25\text{ }^{\circ}\text{C}$		-	200	V
V_{RRM}	repetitive peak reverse voltage			-	200	V
$V_{R(RMS)lim}$	limiting RMS reverse voltage			-	140	V
I_F	forward current	$\delta = 1$; $T_{sp} \leq 150\text{ }^{\circ}\text{C}$		-	8.5	A
$I_{F(AV)}$	average forward current	$\delta = 0.5$; $f = 20\text{ kHz}$; square wave; $T_{sp} \leq 170\text{ }^{\circ}\text{C}$		-	6	A
I_{FSM}	non-repetitive peak forward current	$t_p = 8.3\text{ ms}$; single half sine wave (applied at rated load condition); $T_{j(init)} = 25\text{ }^{\circ}\text{C}$		-	150	A
P_{tot}	total power dissipation	$T_{amb} \leq 25\text{ }^{\circ}\text{C}$	[1]	-	1.75	W
			[2]	-	2.15	W
T_j	junction temperature			-	175	$^{\circ}\text{C}$
T_{amb}	ambient temperature			-55	175	$^{\circ}\text{C}$
T_{stg}	storage temperature			-65	175	$^{\circ}\text{C}$

[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.

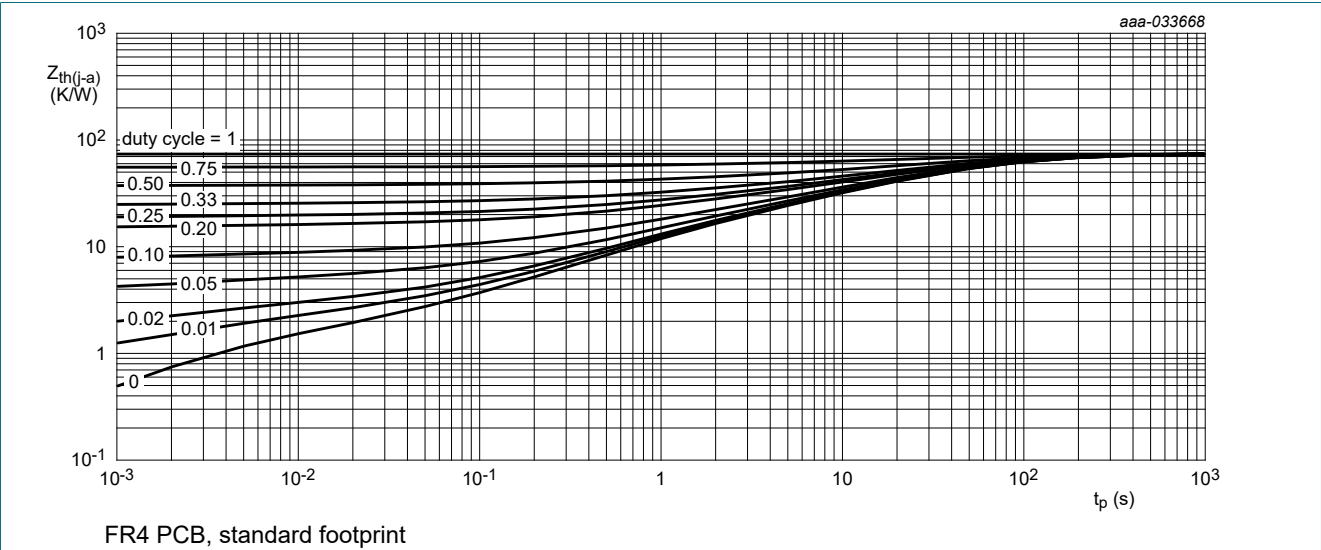


Fig. 1. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

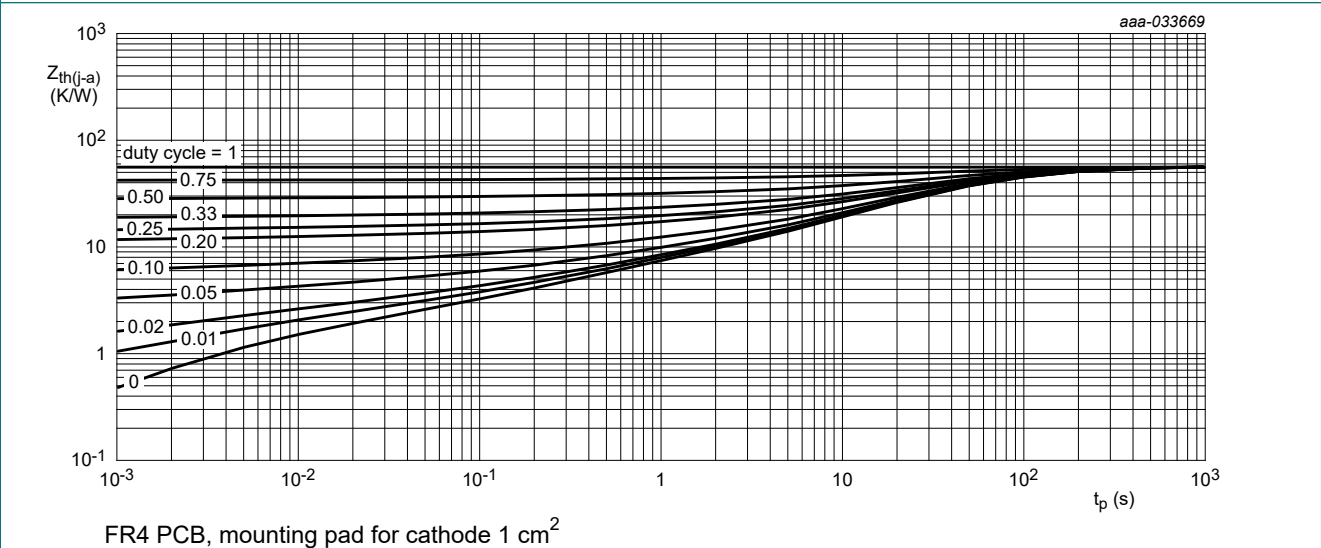


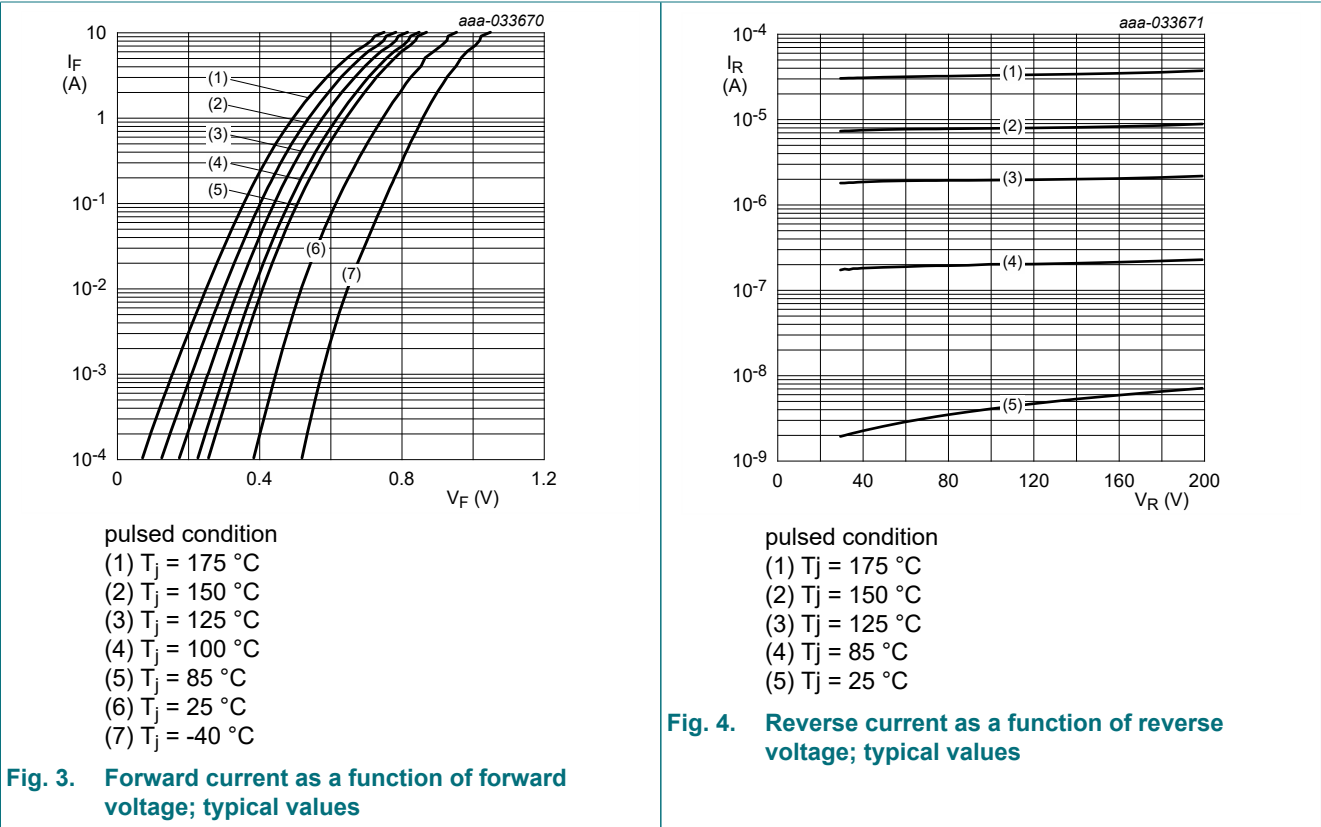
Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$V_{(BR)R}$	reverse breakdown voltage	$I_R = 100\text{ }\mu\text{A}$; $T_j = 25\text{ }^\circ\text{C}$	[1]	200	-	-	V
V_F	forward voltage	$I_F = 6\text{ A}$; $T_j = 25\text{ }^\circ\text{C}$	[1]	-	880	940	mV
		$I_F = 6\text{ A}$; $T_j = 125\text{ }^\circ\text{C}$	[1]	-	740	800	mV
I_R	reverse current	$V_R = 200\text{ V}$; $T_j = 25\text{ }^\circ\text{C}$	[1]	-	-	1	μA
		$V_R = 200\text{ V}$; $T_j = 125\text{ }^\circ\text{C}$	[1]	-	2	15	μA
C_d	diode capacitance	$V_R = 4\text{ V}$; $f = 1\text{ MHz}$; $T_j = 25\text{ }^\circ\text{C}$		-	65	-	pF
t_{rr}	reverse recovery time step recovery	$I_F = 0.5\text{ A}$; $I_R = 1\text{ A}$; $I_{R(\text{meas})} = 0.25\text{ A}$; $T_j = 25\text{ }^\circ\text{C}$		-	14	30	ns
	reverse recovery time ramp recovery	$dI_F/dt = 50\text{ A}/\mu\text{s}$; $I_F = 1\text{ A}$; $V_R = 30\text{ V}$; $T_j = 25\text{ }^\circ\text{C}$		-	17	-	ns
V_{FRM}	peak forward recovery voltage	$I_F = 1\text{ A}$; $dI_F/dt = 50\text{ A}/\mu\text{s}$; $T_j = 25\text{ }^\circ\text{C}$		-	820	-	mV

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



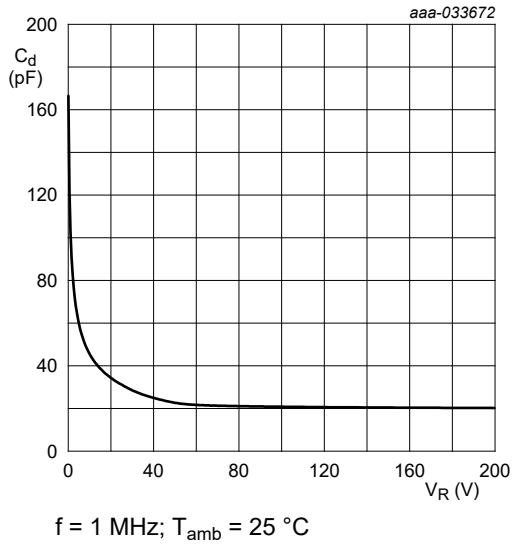


Fig. 5. Diode capacitance as a function of reverse voltage; typical values

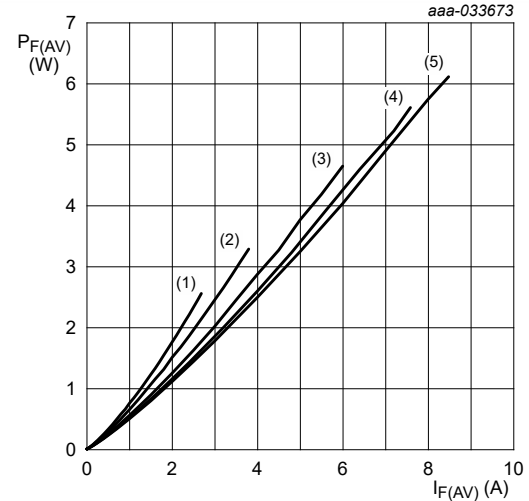


Fig. 6. Average forward power dissipation as a function of average forward current; typical values

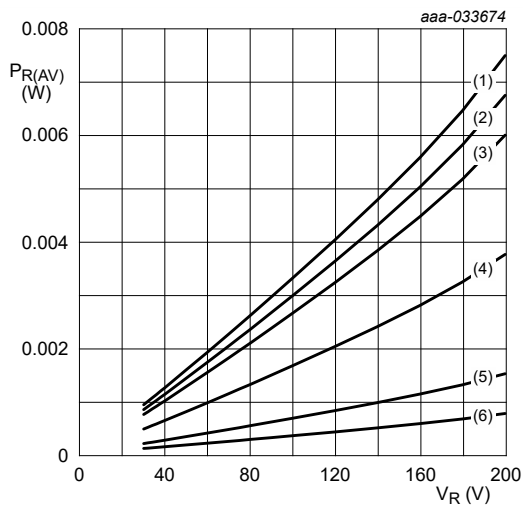


Fig. 7. Average reverse power dissipation as a function of reverse voltage; typical values

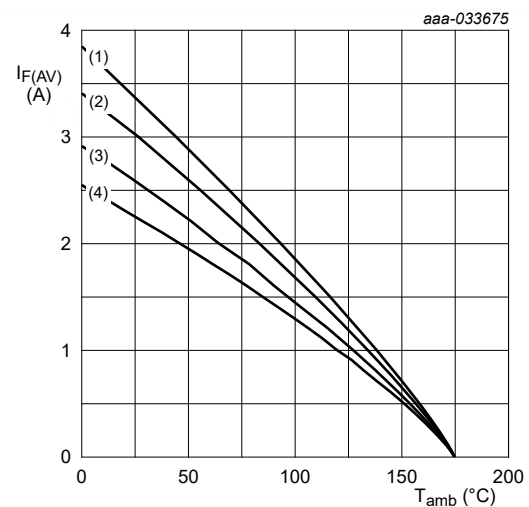
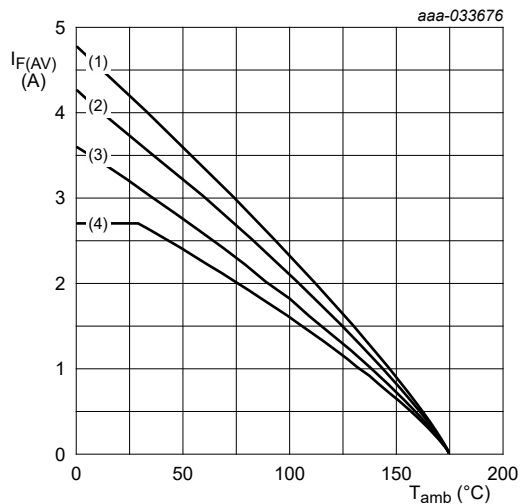
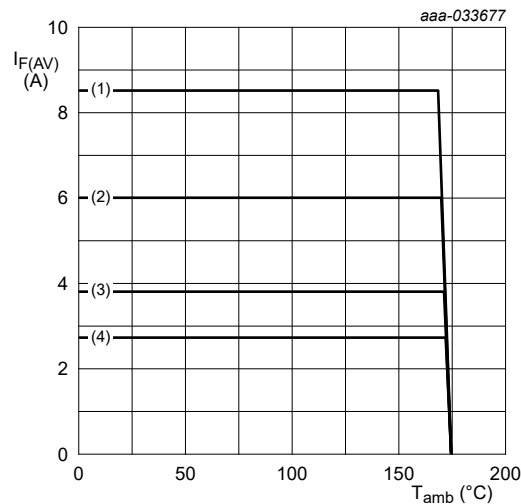


Fig. 8. Average forward current as a function of ambient temperature; typical values



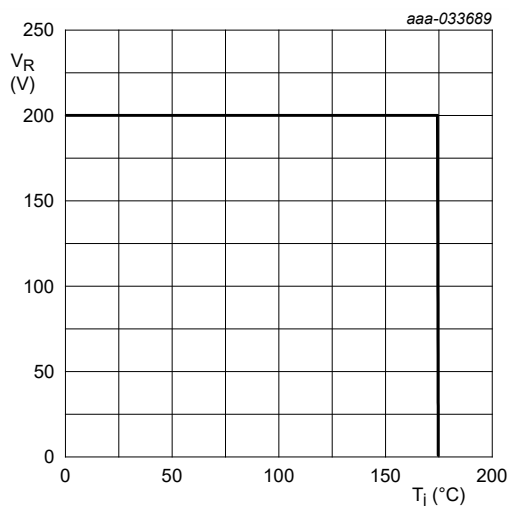
FR4 PCB, mounting pad for cathode 1 cm²
 $T_j = 175$ °C
(1) $\delta = 1$; DC
(2) $\delta = 0.5$; $f = 20$ kHz
(3) $\delta = 0.2$; $f = 20$ kHz
(4) $\delta = 0.1$; $f = 20$ kHz

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



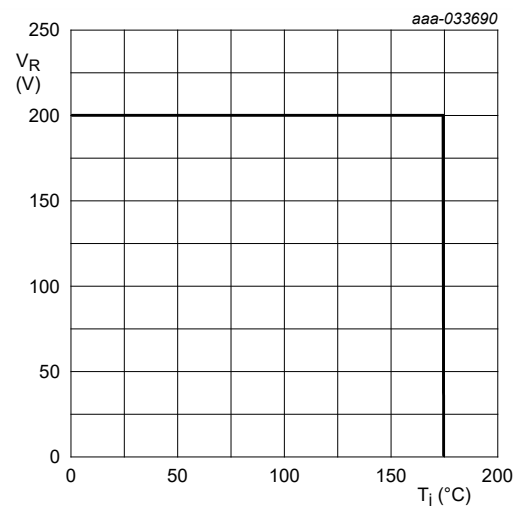
$T_j = 175$ °C
(1) $\delta = 1$; DC
(2) $\delta = 0.5$; $f = 20$ kHz
(3) $\delta = 0.2$; $f = 20$ kHz
(4) $\delta = 0.1$; $f = 20$ kHz

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



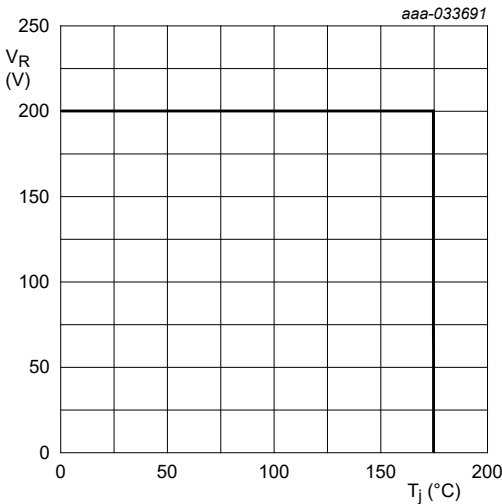
FR4 PCB, standard footprint
 $R_{th} = 85$ K/W

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

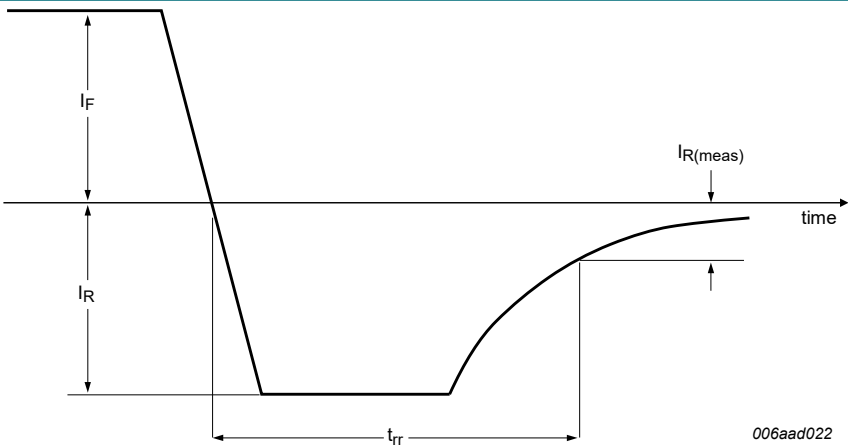


Fig. 14. Reverse recovery definition; step recovery

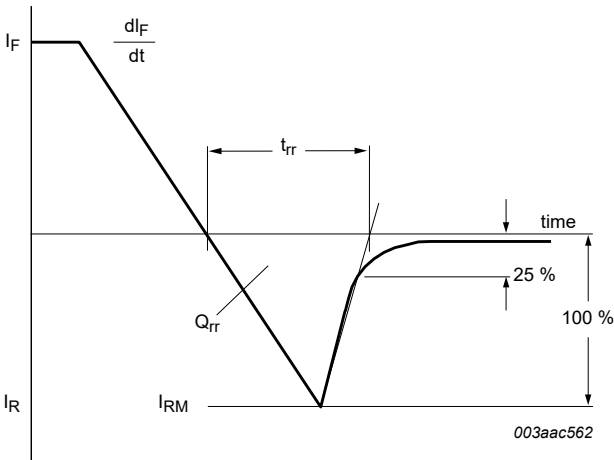


Fig. 15. Reverse recovery definition; ramp recovery

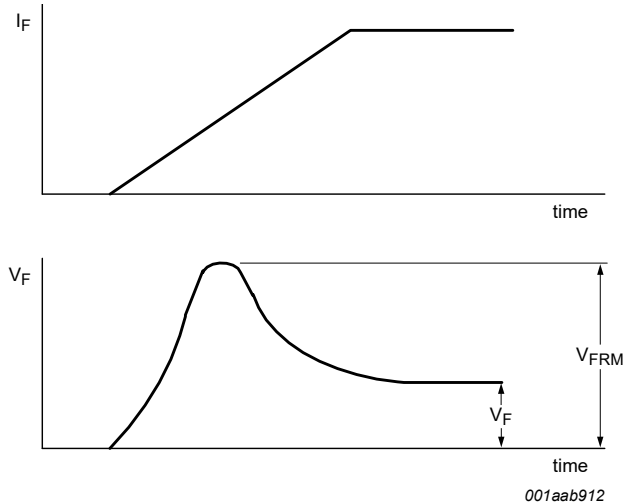


Fig. 16. Forward recovery definition

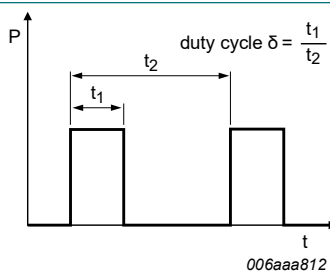


Fig. 17. Duty cycle definition

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.

14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PNE20060EPE-Q v.3	20220613	Product data sheet	-	PNE20060EPE-Q v.2
Modifications:	- Characteristics: Figures 4, 5, 8, 9 and 10 adapted - Characteristics: value V_{FRM} corrected			
PNE20060EPE-Q v.2	20211116	Product data sheet	-	PNE20060EPE-Q v.1
PNE20060EPE-Q v.1	20210715	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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