# 1. General description

High power density, hyperfast switching time recovery rectifier with high-efficiency planar technology, encapsulated in a CFP5 (SOD128) small and flat lead Surface-Mounted Device (SMD) plastic package.

## 2. Features and benefits

Reverse voltage: V<sub>R</sub> ≤ 200 V
 Forward current: I<sub>F</sub> ≤ 4 A

Switching time: t<sub>rr</sub> ≤ 30 ns

Planar die design

· Pt doped life time control

Low inductance

Power and flat lead SMD plastic package

High power capability due to clip-bond technology

# 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	Тур	Max	Unit
I <sub>F(AV)</sub>	average forward current	$\delta$ = 0.5; f = 20 kHz; square wave; T <sub>sp</sub> $\leq$ 158 °C		-	-	4	А
$V_{RRM}$	repetitive peak reverse voltage	T <sub>j</sub> = 25 °C		-	-	200	V
$V_R$	reverse voltage			-	-	200	V
V <sub>F</sub>	forward voltage	I <sub>F</sub> = 4 A; pulsed; T <sub>j</sub> = 25 °C	[1]	-	860	930	mV
		I <sub>F</sub> = 4 A; pulsed; T <sub>j</sub> = 125 °C	[1]	-	720	780	mV
I <sub>R</sub>	reverse current	V <sub>R</sub> = 200 V; pulsed; T <sub>j</sub> = 25 °C	[1]	-	-	1	μA
		V <sub>R</sub> = 200 V; pulsed; T <sub>j</sub> = 125 °C	[1]	-	1.5	10	μΑ

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



## 200 V, 4 A hyperfast switching recovery rectifier

# 5. Pinning information

### **Table 2. Pinning information**

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	K	cathode		
2	Α	anode	1 2	K A
			CFP5 (SOD128)	006aab040

# 6. Ordering information

#### **Table 3. Ordering information**

Type number	Package						
	Name	Description	Version				
PNE20040EP		plastic, surface mounted package; 2 terminals; 4 mm pitch; 3.8 mm x 2.6 mm x 1 mm body	SOD128				

# 7. Marking

## Table 4. Marking codes

Type number	Marking code
PNE20040EP	ET

# 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 <sub>j</sub> = 25 °C		-	200	V
V <sub>RRM</sub>	repetitive peak reverse voltage			-	200	V
V <sub>R(RMS)lim</sub>	limiting RMS reverse voltage			-	140	V
l <sub>F</sub>	forward current	δ = 1; T <sub>sp</sub> ≤ 153 °C		-	5.6	А
I <sub>F(AV)</sub>	average forward current	$\delta$ = 0.5; f = 20 kHz; square wave; T <sub>sp</sub> ≤ 158 °C		-	4	A
I <sub>FSM</sub>	non-repetitive peak forward current	$t_p$ = 8.3 ms; single half sine wave (applied at rated load condition); $T_{j(init)}$ = 25 °C		-	80	А
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> ≤ 25 °C	[1]	-	0.81	W
			[2]	-	1.3	W
Tj	junction temperature			-	175	°C
T <sub>amb</sub>	ambient temperature			-55	175	°C
T <sub>stg</sub>	storage temperature			-65	175	°C

Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.

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

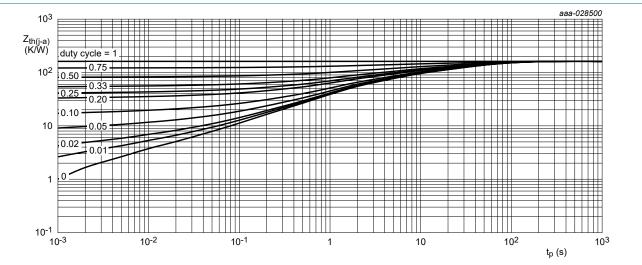
### 200 V, 4 A hyperfast switching recovery rectifier

## 9. Thermal characteristics

**Table 6. Thermal characteristics** 

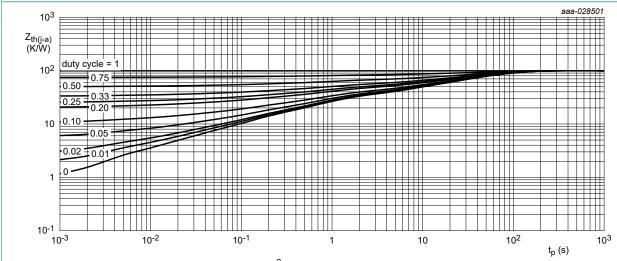
Symbol	Parameter	Conditions		Min	Тур	Max	Unit
R <sub>th(j-a)</sub>	thermal resistance from	in free air	[1]	-	-	185	K/W
junction t	junction to ambient	o ambient	[2]	-	-	115	K/W
R <sub>th(j-sp)</sub>	thermal resistance from junction to solder point		[3]	-	-	8	K/W

- [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 mounting base.



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

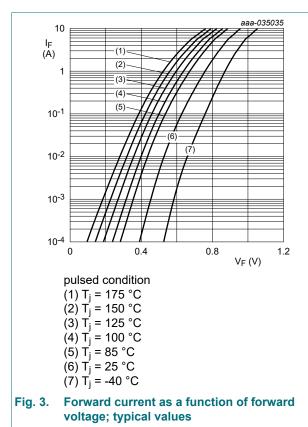
## 200 V, 4 A hyperfast switching recovery rectifier

## 10. Characteristics

**Table 7. Characteristics** 

Symbol	Parameter	Conditions		Min	Тур	Max	Unit
$V_{(BR)R}$	reverse breakdown voltage	I <sub>R</sub> = 100 μA; T <sub>j</sub> = 25 °C	[1]	200	-	-	V
V <sub>F</sub>	forward voltage	I <sub>F</sub> = 4 A; pulsed; T <sub>j</sub> = 25 °C	[1]	-	860	930	mV
		I <sub>F</sub> = 4 A; pulsed; T <sub>j</sub> = 125 °C	[1]	-	720	780	mV
I <sub>R</sub>	reverse current	V <sub>R</sub> = 200 V; pulsed; T <sub>j</sub> = 25 °C	[1]	-	-	1	μΑ
		V <sub>R</sub> = 200 V; pulsed; T <sub>j</sub> = 125 °C	[1]	-	1.5	10	μΑ
C <sub>d</sub>	diode capacitance	V <sub>R</sub> = 4 V; f = 1 MHz; T <sub>j</sub> = 25 °C		-	55	-	pF
t <sub>rr</sub>	reverse recovery time step recovery	$I_F = 0.5 \text{ A}; I_R = 1 \text{ A}; I_{R(meas)} = 0.25 \text{ A};$ $T_j = 25 \text{ °C}$		-	13	30	ns
	reverse recovery time ramp recovery	$dI_F/dt = 100 \text{ A/}\mu\text{s}; I_F = 1 \text{ A}; V_R = 30 \text{ V};$ $T_j = 25 ^{\circ}\text{C}$		-	17	-	ns
I <sub>RM</sub>	peak reverse recovery current			-	1	-	Α
Q <sub>rr</sub>	reverse recovery charge			-	9	-	nC
$V_{FRM}$	peak forward recovery voltage	$I_F = 1 \text{ A}; \text{ d}I_F/\text{d}t = 50 \text{ A}/\mu\text{s}; T_j = 25 ^{\circ}\text{C}$		-	770	-	mV

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



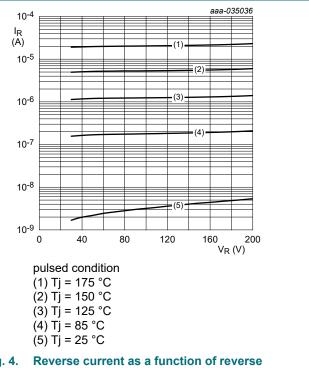


Fig. 4. Reverse current as a function of reverse voltage; typical values

## 200 V, 4 A hyperfast switching recovery rectifier

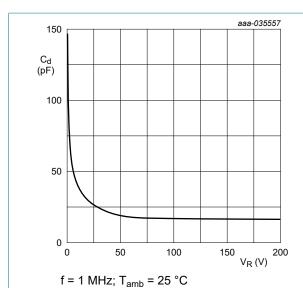
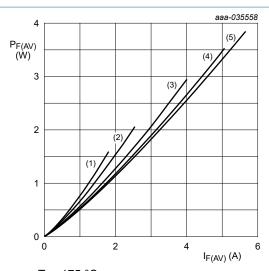
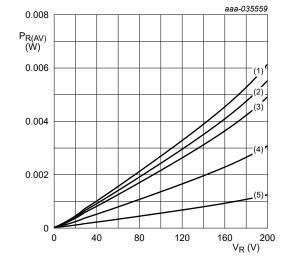


Fig. 5. Diode capacitance as a function of reverse voltage; typical values



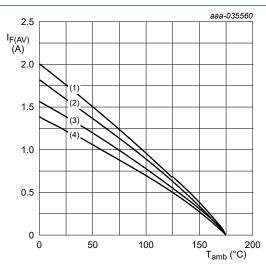
 $T_j = 175 \,^{\circ}\text{C}$ (1)  $\delta = 0.1$ (2)  $\delta = 0.2$ (3)  $\delta = 0.5$ (4)  $\delta = 0.8$ (5)  $\delta = 1$ ; DC

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

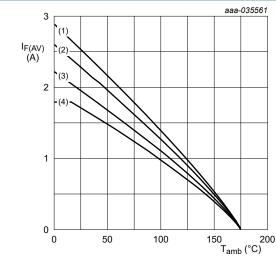


FR4 PCB, standard footprint

 $T_j = 175$  °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

## 200 V, 4 A hyperfast switching recovery rectifier



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

 $T_i = 175 \,{}^{\circ}\text{C}$ 

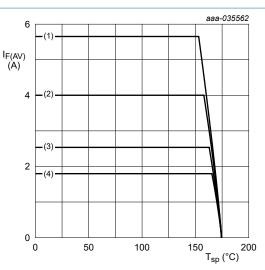
 $(1) \delta = 1$ ; DC

 $(2) \delta = 0.5$ ; 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<sub>i</sub> = 175 °C

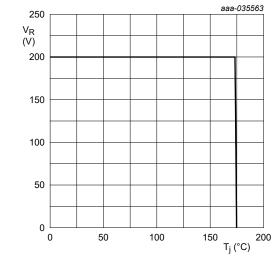
 $(1) \delta = 1; DC$ 

(2)  $\delta$  = 0.5; f = 20 kHz

(3)  $\delta = 0.2$ ; f = 20 kHz

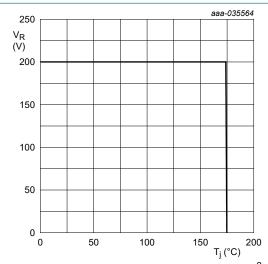
 $(4) \delta = 0.1$ ; f = 20 kHz

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



FR4 PCB, standard footprint  $R_{th}$  = 185 K/W

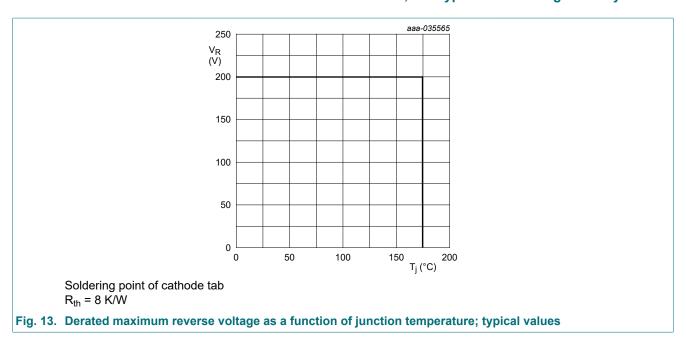
of junction temperature; typical values



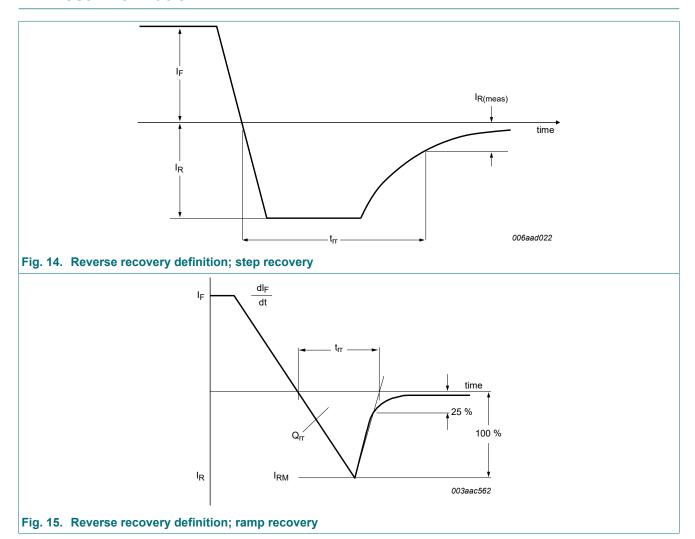
FR4 PCB, mounting pad for cathode 1 cm<sup>2</sup>  $R_{th} = 115 \text{ K/W}$ 

Fig. 11. Derated maximum reverse voltage as a function | Fig. 12. Derated maximum reverse voltage as a function of junction temperature; typical values

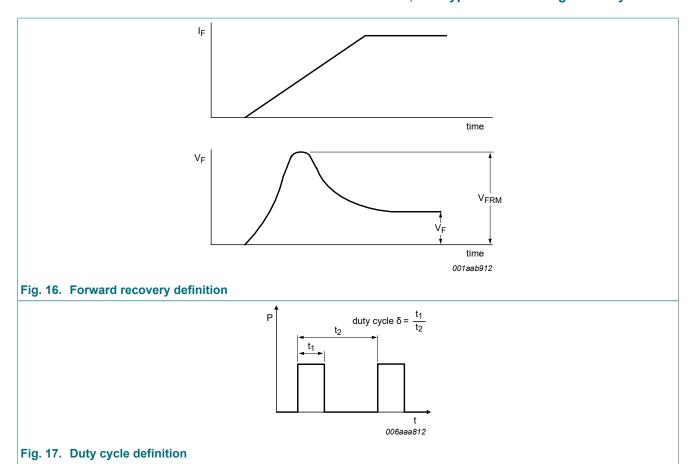
## 200 V, 4 A hyperfast switching recovery rectifier



# 11. Test information



## 200 V, 4 A hyperfast switching recovery rectifier



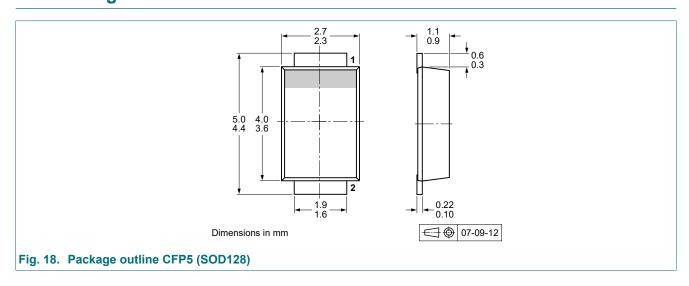
The current ratings for the typical waveforms are calculated according to the equations:

 $I_{F(AV)} = I_M \times \delta$  with  $I_M$  defined as peak current

 $I_{RMS} = I_{F(AV)}$  at DC, and  $I_{RMS} = I_{M} \times \sqrt{\delta}$ 

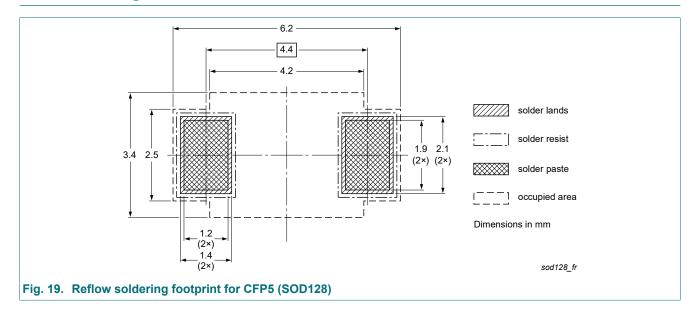
with  $I_{\mbox{\scriptsize RMS}}$  defined as RMS current.

# 12. Package outline

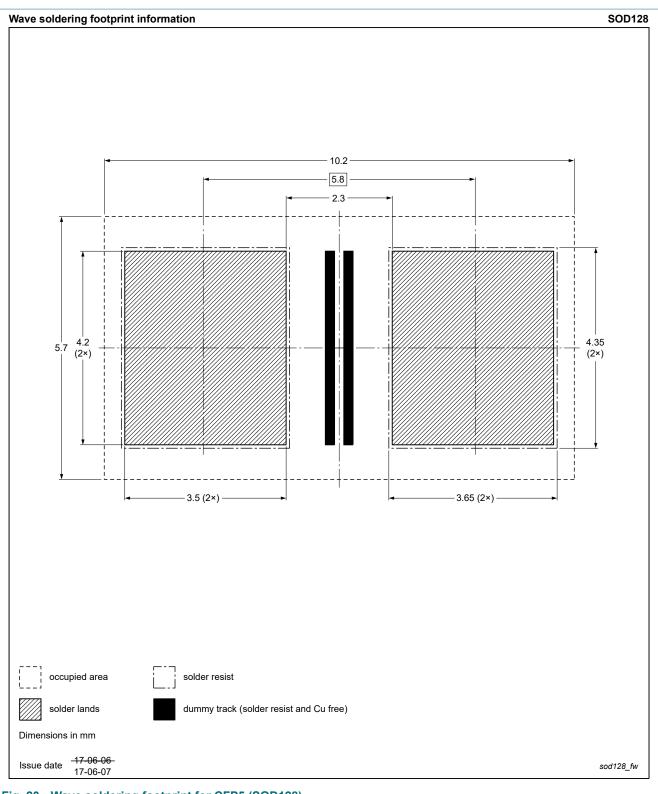


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# 13. Soldering



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# 200 V, 4 A hyperfast switching recovery rectifier

# 14. Revision history

### **Table 8. Revision history**

Table of Health Inches,							
Data sheet ID	Release date	Data sheet status	Change notice	Supersedes			
PNE20040EP v.2	20221121	Product data sheet	-	PNE20040EP v.1			
Modifications:	General descr	General description: Typo corrected					
PNE20040EP v.1	20221110	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.

- Please consult the most recently issued document before initiating or completing a design.
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Date of release: 21 November 2022

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