



# PNE20020ER

200 V, 2 A hyperfast PN-rectifier

30 August 2017

Product data sheet

## 1. General description

High power density, hyperfast PN-rectifier with high-efficiency planar technology, encapsulated in a small and flat lead SOD123W Surface-Mounted Device (SMD) plastic package.

## 2. Features and benefits

- Reverse voltage  $V_R \leq 200$  V
- Forward current  $I_F \leq 2$  A
- Switching time  $t_{rr} \leq 25$  ns
- Pt doped life time control
- Low inductance
- Small and flat lead SMD plastic package
- Package height typ. 1 mm
- High power capability due to clip-bond technology
- Planar die design
- Capable for reflow and wave soldering
- AEC-Q101 qualified

## 3. Applications

- General-purpose rectification
- Reverse polarity protection
- Hyperfast switching
- Freewheeling applications

## 4. Quick reference data


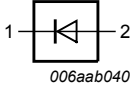
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{F(AV)}$	average forward current	$\delta = 0.5$ ; $f = 20$ kHz; square wave; $T_{sp} \leq 153$ °C	-	-	2	A
$V_{RRM}$	repetitive peak reverse voltage	$T_j = 25$ °C	-	-	200	V
$V_R$	reverse voltage		-	-	200	V
$V_F$	forward voltage	$I_F = 2$ A; pulsed; $T_j = 25$ °C	[1]	915	980	mV
		$I_F = 2$ A; pulsed; $T_j = 125$ °C	[1]	780	870	mV
$I_R$	reverse current	$V_R = 200$ V; pulsed; $T_j = 25$ °C	[1]	5	200	nA
		$V_R = 200$ V; pulsed; $T_j = 125$ °C	[1]	1.5	20	$\mu$ 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	K	cathode	 CFP3 (SOD123W)	 006aab040
2	A	anode		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PNE20020ER	CFP3	plastic, surface mounted package; 2 terminals; 2.6 mm x 1.7 mm x 1 mm body	SOD123W

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PNE20020ER	K4

## 8. Limiting values

**Table 5. Limiting values**

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{RRM}$	repetitive peak reverse voltage	$T_j = 25\text{ °C}$		-	200	V
$V_R$	reverse voltage			-	200	V
$V_{RMS}$	RMS voltage			-	140	V
$I_F$	forward current	$\delta = 1$ ; $T_{sp} \leq 147\text{ °C}$		-	2.8	A
$I_{F(AV)}$	average forward current	$\delta = 0.5$ ; $f = 20\text{ kHz}$ ; square wave; $T_{sp} \leq 153\text{ °C}$		-	2	A
$I_{FSM}$	non-repetitive peak forward current	$t_p = 8.3\text{ ms}$ ; $T_{j(\text{init})} = 25\text{ °C}$ ; single half sine wave (applied at rated load condition)		-	32	A
$P_{tot}$	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[1]	-	882	mW
			[2]	-	1.43	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 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]	-	-	170	K/W
			[2]	-	-	105	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		[3]	-	-	15	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.

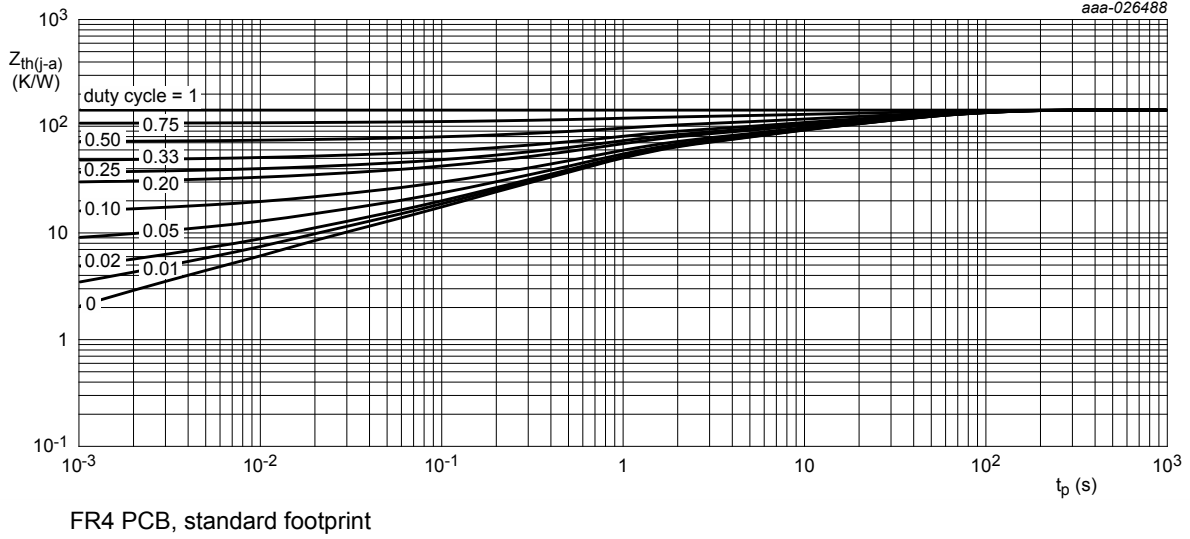


Fig. 1. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

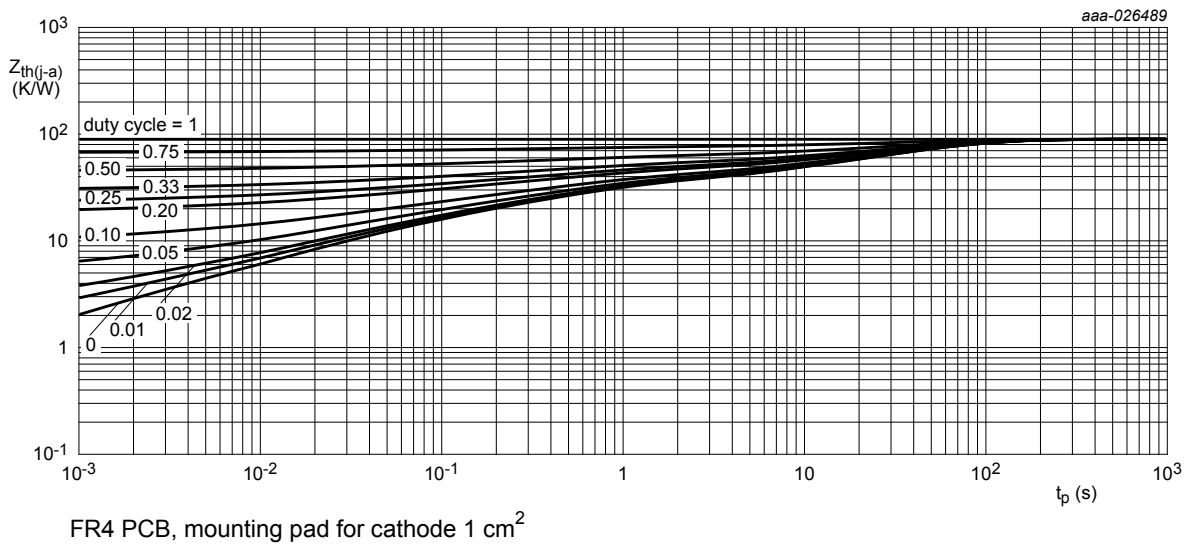


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$V_{(BR)R}$	reverse breakdown voltage	$I_R = 100 \mu\text{A}$ ; pulsed; $T_j = 25 \text{ }^\circ\text{C}$	[1]	200	-	-	V
$V_F$	forward voltage	$I_F = 2 \text{ A}$ ; pulsed; $T_j = 25 \text{ }^\circ\text{C}$	[1]	-	915	980	mV
		$I_F = 2 \text{ A}$ ; pulsed; $T_j = 125 \text{ }^\circ\text{C}$	[1]	-	780	870	mV
$I_R$	reverse current	$V_R = 200 \text{ V}$ ; pulsed; $T_j = 25 \text{ }^\circ\text{C}$	[1]	-	5	200	nA
		$V_R = 200 \text{ V}$ ; pulsed; $T_j = 125 \text{ }^\circ\text{C}$	[1]	-	1.5	20	$\mu\text{A}$
$C_d$	diode capacitance	$V_R = 4 \text{ V}$ ; $f = 1 \text{ MHz}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	17	-	pF
$t_{rr}$	reverse recovery time ; step recovery	$I_F = 0.5 \text{ A}$ ; $I_R = 1 \text{ A}$ ; $I_{R(\text{meas})} = 0.25 \text{ A}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	10	25	ns
		$I_F = 1 \text{ A}$ ; $dI_F/dt = 50 \text{ A}/\mu\text{s}$ ; $V_R = 30 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	20	-	ns
	reverse recovery time ; ramp recovery	$I_F = 1 \text{ A}$ ; $dI_F/dt = 100 \text{ A}/\mu\text{s}$ ; $V_R = 30 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	16	-	ns
$I_{RM}$	peak reverse recovery current	$T_j = 25 \text{ }^\circ\text{C}$		-	1.1	-	A
$Q_{rr}$	reverse recovery charge			-	9	-	nC
$V_{FRM}$	peak forward recovery voltage	$I_F = 1 \text{ A}$ ; $dI_F/dt = 50 \text{ A}/\mu\text{s}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	930	-	mV

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

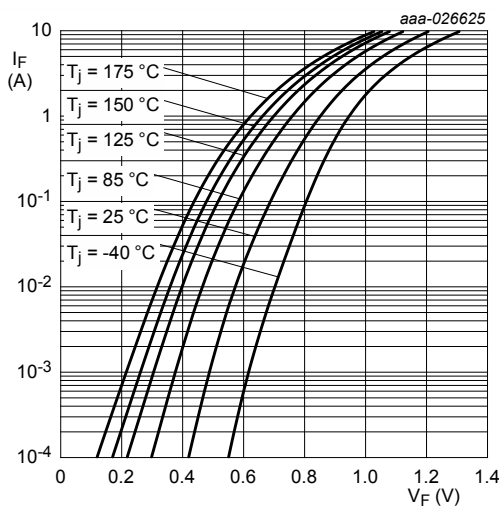


Fig. 3. Forward current as a function of forward voltage; typical values

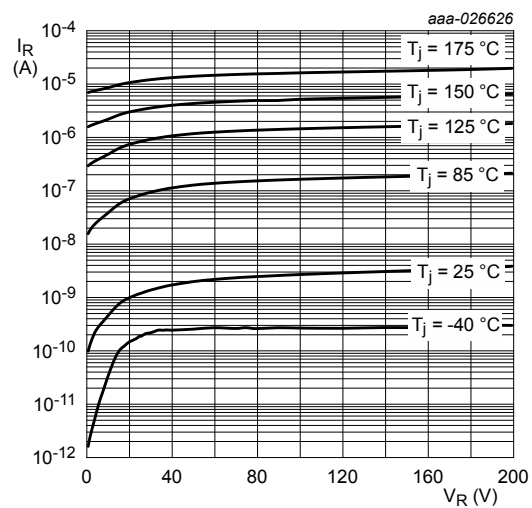
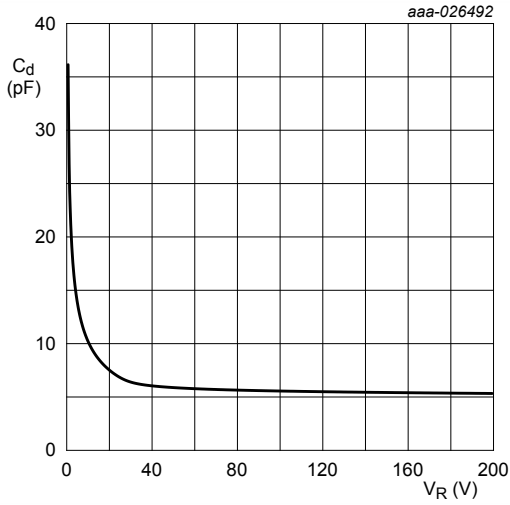
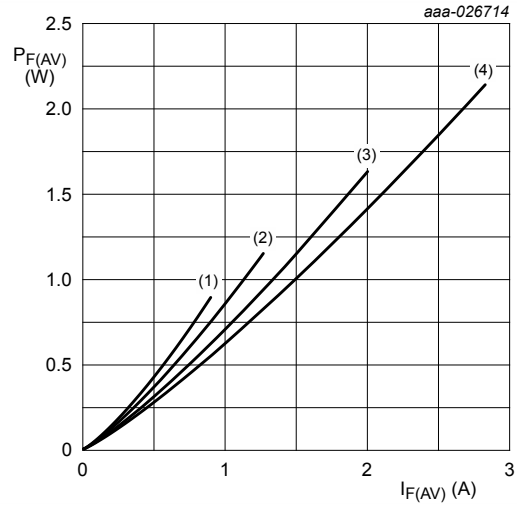


Fig. 4. Reverse current as a function of reverse voltage; typical values



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

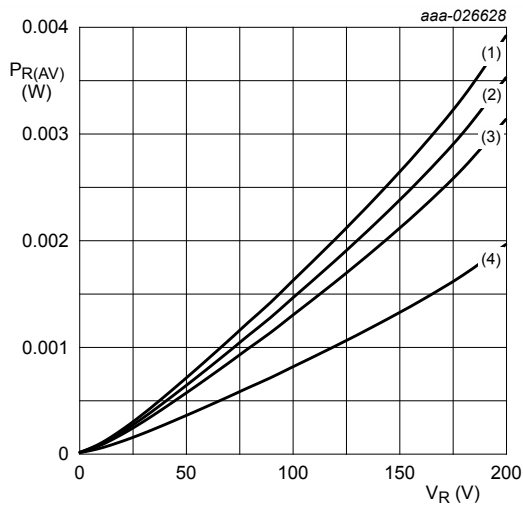
**Fig. 5. Diode capacitance as a function of reverse voltage; typical values**



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

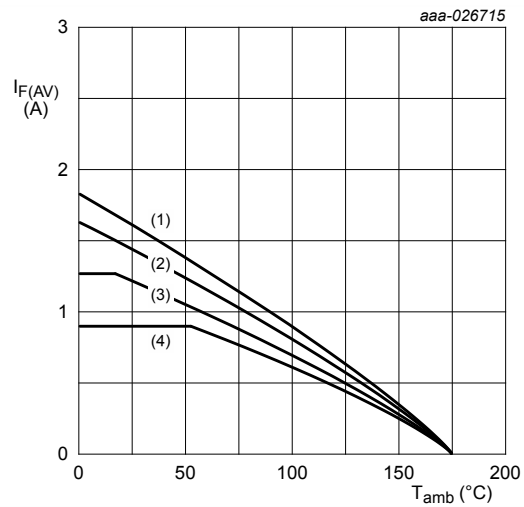
- (1)  $\delta = 0.1$
- (2)  $\delta = 0.2$
- (3)  $\delta = 0.5$
- (4)  $\delta = 1 \text{ (DC)}$

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



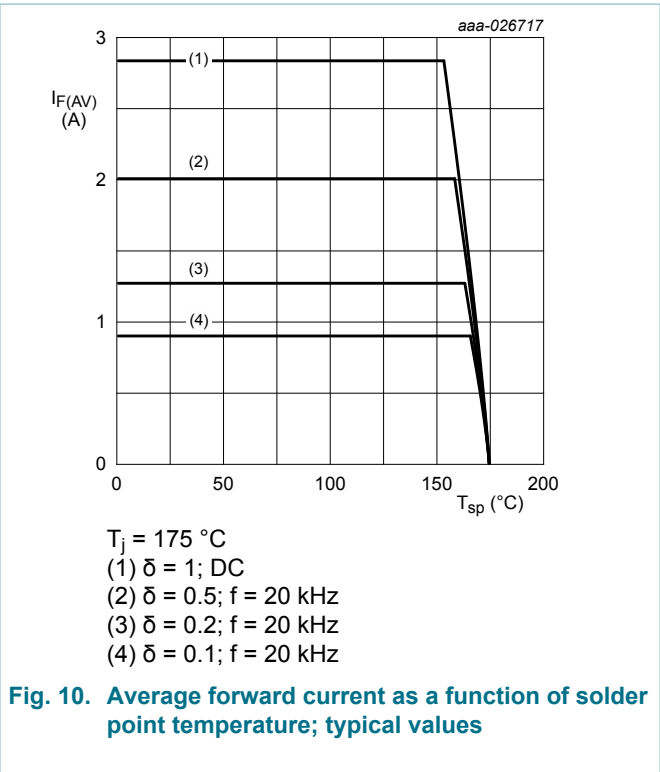
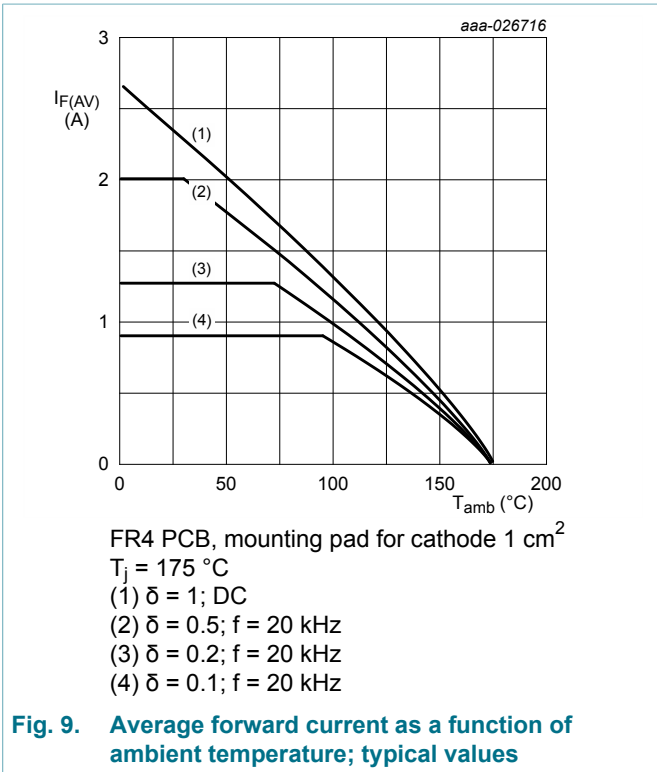
- $T_j = 175 \text{ }^\circ\text{C}$
- (1)  $\delta = 1; \text{DC}$
- (2)  $\delta = 0.9$
- (3)  $\delta = 0.8$
- (4)  $\delta = 0.5$

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

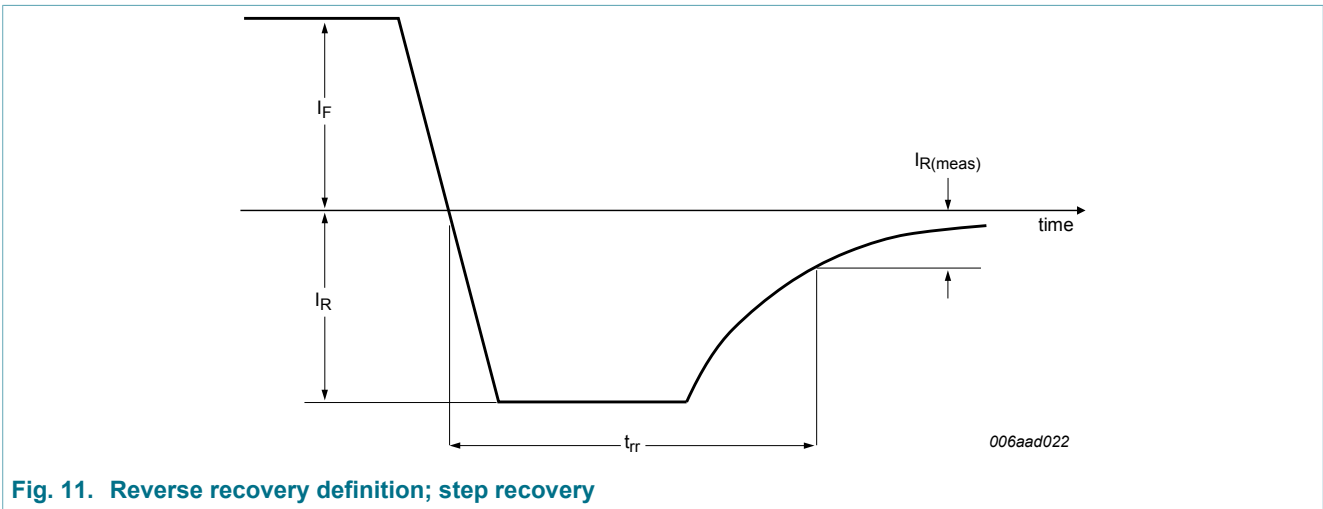


- FR4 PCB, standard footprint
- $T_j = 175 \text{ }^\circ\text{C}$
- (1)  $\delta = 1; \text{DC}$
- (2)  $\delta = 0.5; f = 20 \text{ kHz}$
- (3)  $\delta = 0.2; f = 20 \text{ kHz}$
- (4)  $\delta = 0.1; f = 20 \text{ kHz}$

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



### 11. Test information



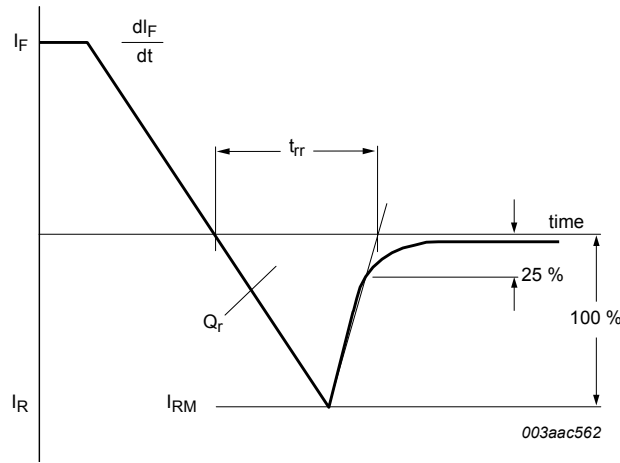


Fig. 12. Reverse recovery definition; ramp recovery

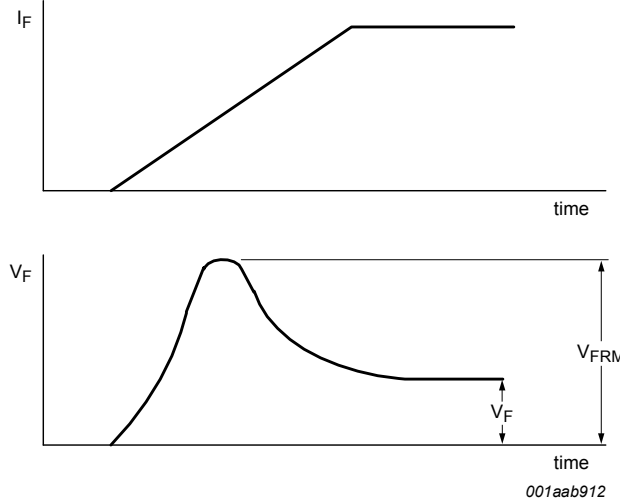


Fig. 13. Forward recovery definition

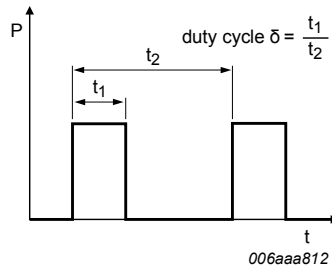


Fig. 14. Duty cycle definition

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**

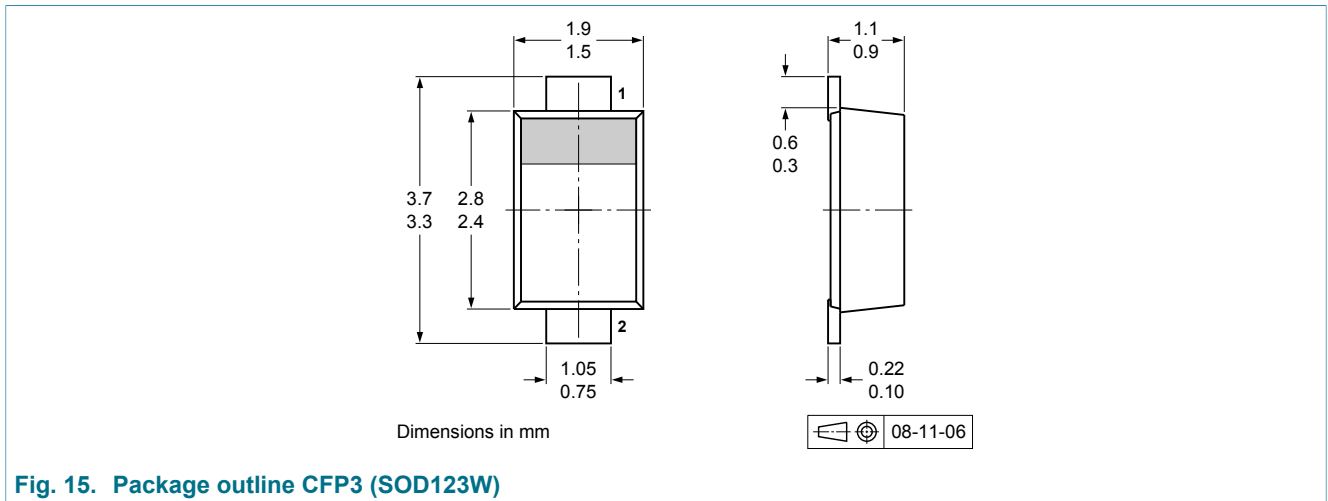


Fig. 15. Package outline CFP3 (SOD123W)

**13. Soldering**

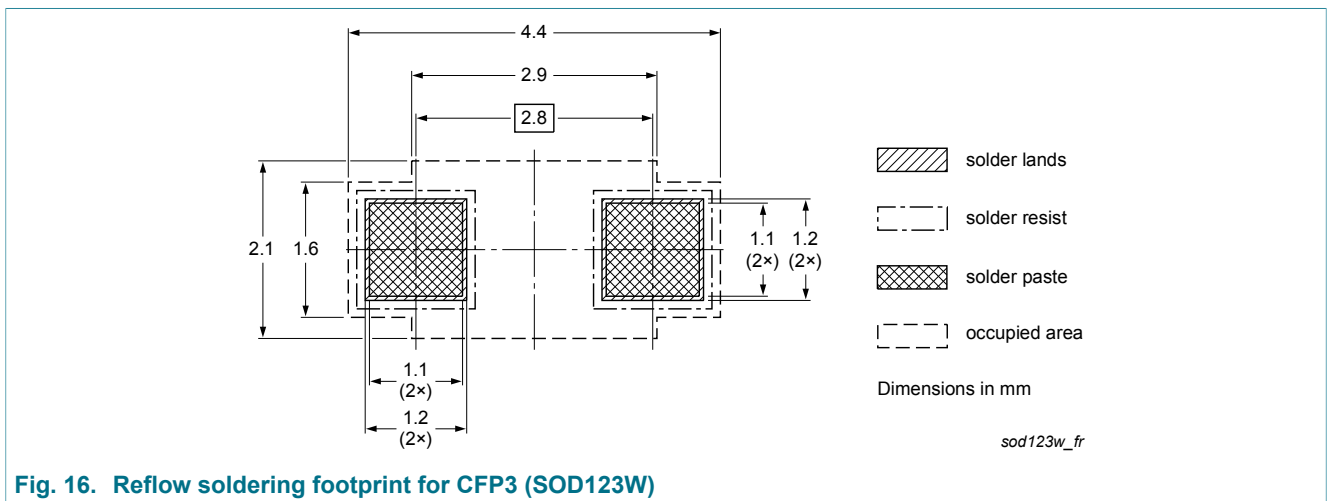
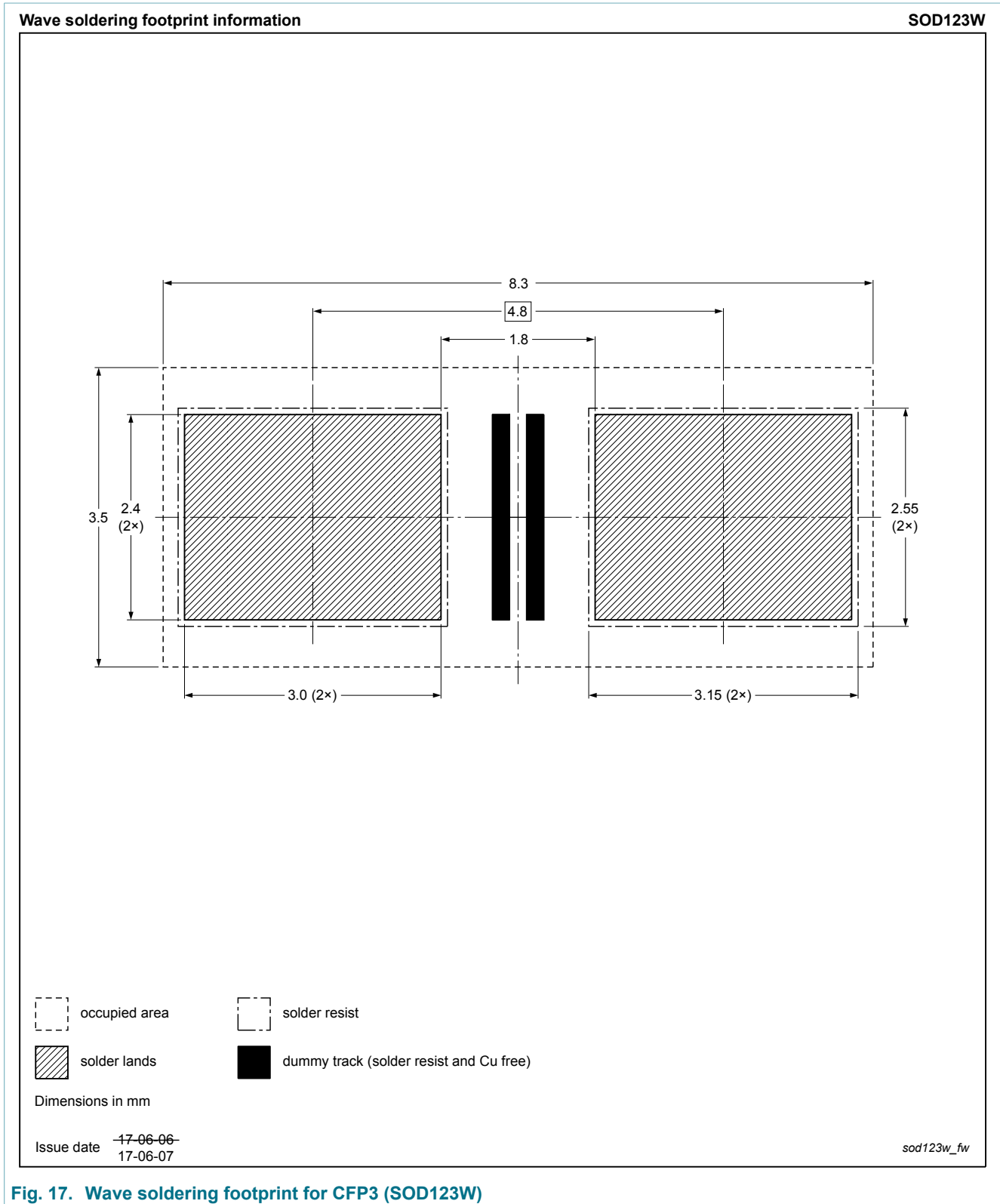


Fig. 16. Reflow soldering footprint for CFP3 (SOD123W)



## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PNE20020ER v.3	20170830	Product data sheet	-	PNE20020ER v.2
Modifications>	<ul style="list-style-type: none"><li>• Product status changed</li><li>• Features and benefits: Updated</li><li>• Soldering: Fig. 17 added</li></ul>			
PNE20020ER v.2	20170519	Preliminary data sheet	-	PNE20020ER v.1

## 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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