# PNE20010ER

## 200 V, 1 A hyperfast recovery rectifier

3 January 2019 **Product data sheet**

## 1. General description

High power density, hyperfast recovery 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 $I_F \leq 1$ A
- Hyperfast recovery time $t_{rr} \leq 25$ ns
- Pt doped lifetime 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**

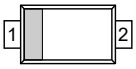
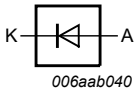
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_{F(AV)}$ | average forward current | δ = 0.5; f = 20 kHz; square wave; $T_{sp} \leq$ 165 °C | | - | - | 1 | A |
| $V_{RRM}$ | repetitive peak reverse voltage | $T_j$ = 25 °C | | - | - | 200 | V |
| $V_R$ | reverse voltage | | | - | - | 200 | V |
| $V_F$ | forward voltage | $I_F$ = 1 A; pulsed; $T_j$ = 25 °C | [1] | - | 845 | 930 | mV |
| | | $I_F$ = 1 A; pulsed; $T_j$ = 125 °C | [1] | - | 700 | 790 | mV |
| $I_R$ | reverse current | $V_R$ = 200 V; pulsed; $T_j$ = 25 °C | [1] | - | 10 | 200 | nA |
| | | $V_R$ = 200 V; pulsed; $T_j$ = 125 °C | [1] | - | 1.5 | 20 | µA |

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

nexperia

## 5. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | K | cathode |  CFP3 (SOD123W) |  |
| 2 | A | anode | | |

## 6. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| PNE20010ER | 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 |
|---|---|
| PNE20010ER | K3 |

# 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 °C | | - | 200 | V |
| $V_R$ | reverse voltage | | | - | 200 | V |
| $V_{RMS}$ | RMS voltage | | | - | 140 | V |
| $I_F$ | forward current | δ = 1; $T_{sp} \leq$ 162 °C | | - | 1.4 | A |
| $I_{F(AV)}$ | average forward current | δ = 0.5; f = 20 kHz; square wave; $T_{sp} \leq$ 165 °C | | - | 1 | A |
| $I_{FSM}$ | non-repetitive peak forward current | $t_p$ = 8.3 ms; $T_{j(init)}$ = 25 °C; single half sine wave (applied at reated load condition) | | - | 38 | A |
| $P_{tot}$ | total power dissipation | $T_{amb} \leq$ 25 °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 |

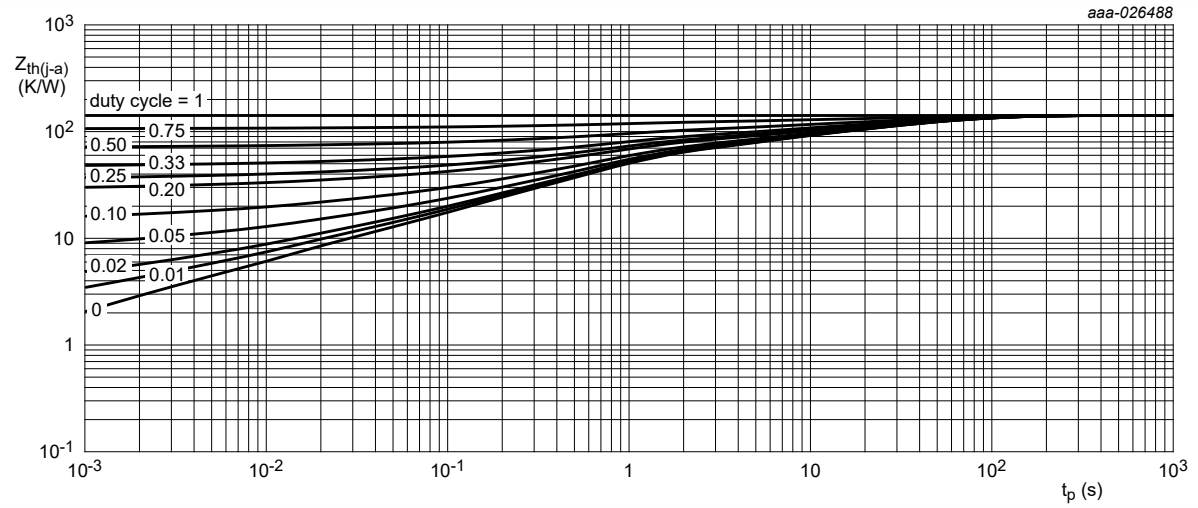
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for cathode 1 $cm^2$.

# 9. Thermal characteristics

**Table 6. Thermal characteristics**

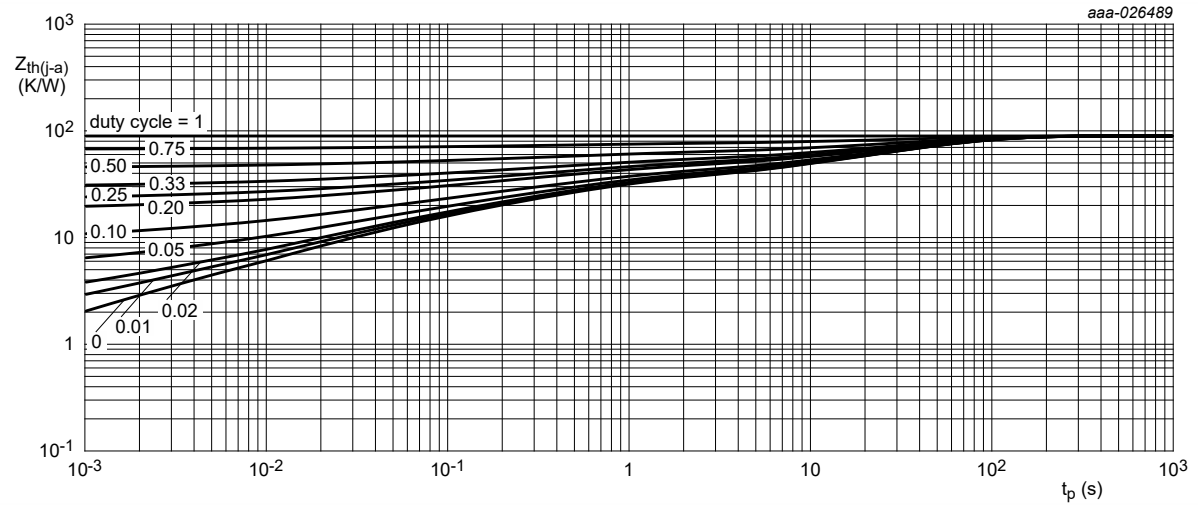
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] | - | - | 170 | K/W |
| | | | [2] | - | - | 105 | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | [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 $cm^2$.
[3] Soldering point of cathode tab.




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 $cm^2$

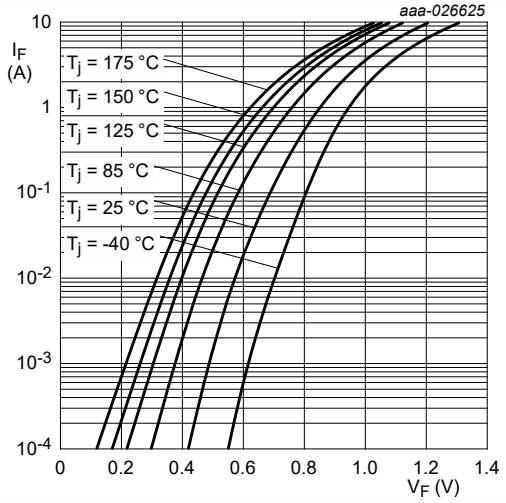
**Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**

# 10. Characteristics

**Table 7. Characteristics**

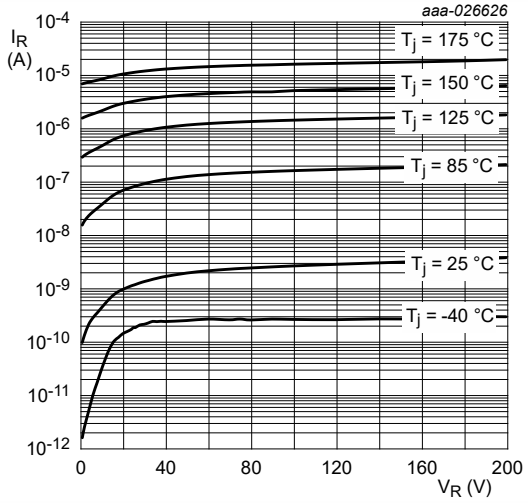
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{(BR)R}$ | reverse breakdown voltage | $I_R$ = 100 µA; pulsed; $T_j$ = 25 °C | [1] | 200 | - | - | V |
| $V_F$ | forward voltage | $I_F$ = 1 A; pulsed; $T_j$ = 25 °C | [1] | - | 845 | 930 | mV |
| | | $I_F$ = 1 A; pulsed; $T_j$ = 125 °C | [1] | - | 700 | 790 | mV |
| $I_R$ | reverse current | $V_R$ = 200 V; pulsed; $T_j$ = 25 °C | [1] | - | 10 | 200 | nA |
| | | $V_R$ = 200 V; pulsed; $T_j$ = 125 °C | [1] | - | 1.5 | 20 | µA |
| $C_d$ | diode capacitance | $V_R$ = 4 V; f = 1 MHz; $T_j$ = 25 °C | | - | 17 | - | 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 °C | | - | 10 | 25 | ns |
| | reverse recovery time ; ramp recovery | $I_F$ = 1 A; $dI_F/dt$ = 50 A/µs; $V_R$ = 30 V; $T_j$ = 25 °C | | - | 20 | - | ns |
| | | $I_F$ = 1 A; $dI_F/dt$ = 100 A/µs; $V_R$ = 30 V; $T_j$ = 25 °C | | - | 16 | - | ns |
| $I_{RM}$ | peak reverse recovery current | | | - | 1.1 | - | A |
| $Q_{rr}$ | reverse recovery charge | | | - | 9 | - | nC |
| $V_{FRM}$ | peak forward recovery voltage | $I_F$ = 1 A; $dI_F/dt$ = 50 A/µs; $T_j$ = 25 °C | | - | 930 | - | mV |

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



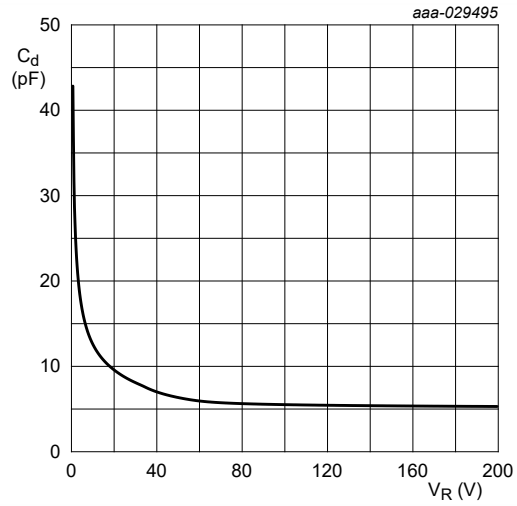

pulsed condition

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



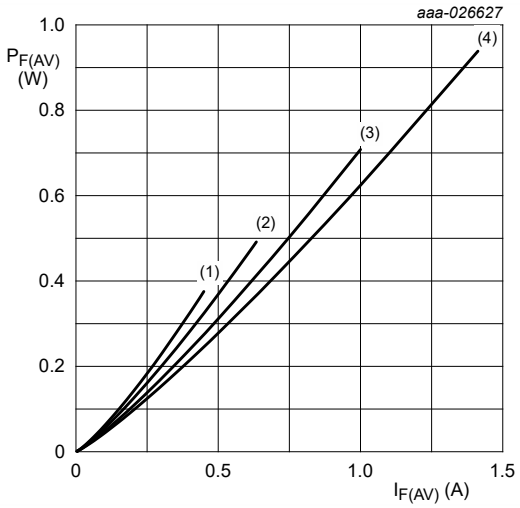

pulsed condition

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



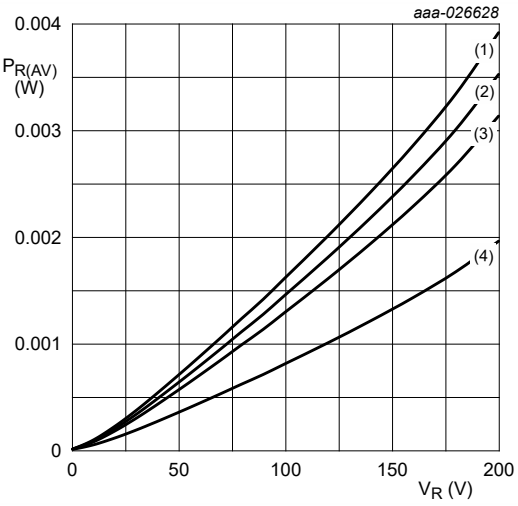

f = 1 MHz; $T_{amb}$ = 25 °C

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



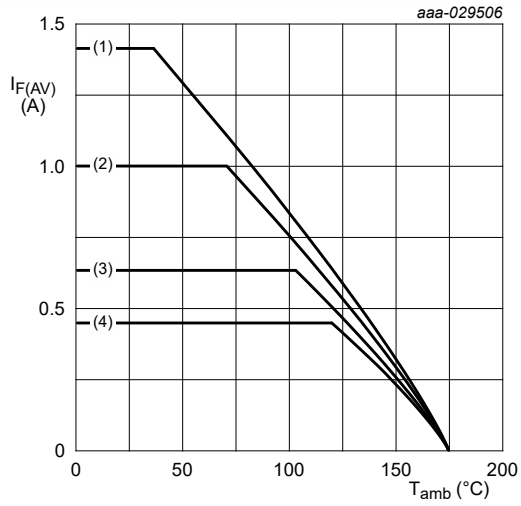

$T_j$ = 175 °C
(1) δ = 0.1
(2) δ = 0.2
(3) δ = 0.5
(4) δ = 1; DC

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



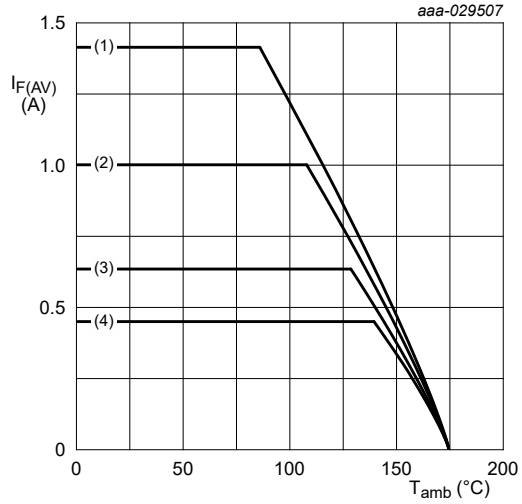

$T_j$ = 175 °C
(1) δ = 1; DC
(2) δ = 0.9
(3) δ = 0.8
(4) δ = 0.5

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



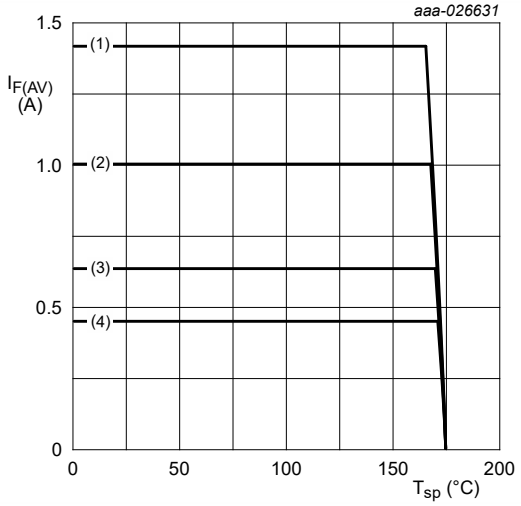

FR4 PCB, standard footprint
$T_j$ = 175 °C
(1) δ = 1; DC
(2) δ = 0.5; f = 20 kHz
(3) δ = 0.2; f = 20 kHz
(4) δ = 0.1; f = 20 kHz

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




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

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




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

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

## 11. Test information

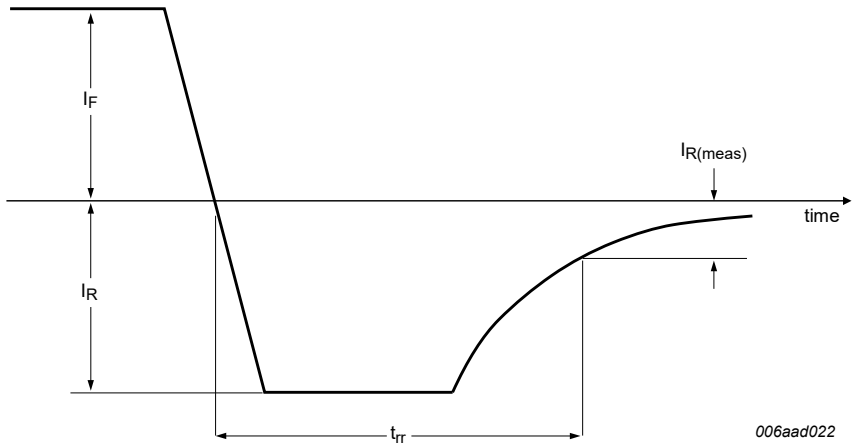



**Fig. 11. Reverse recovery definition; step recovery**

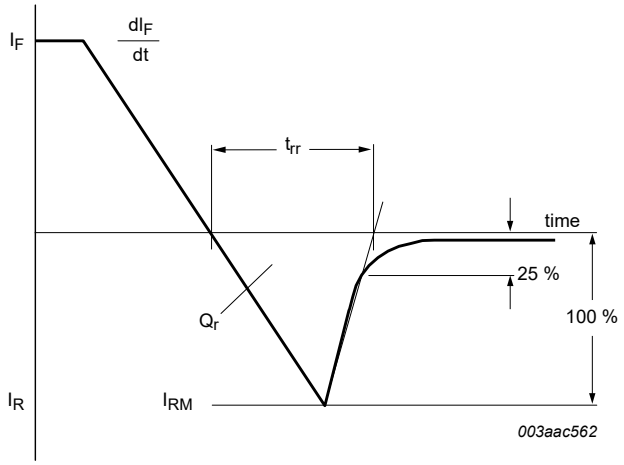



**Fig. 12. Reverse recovery definition; ramp recovery**

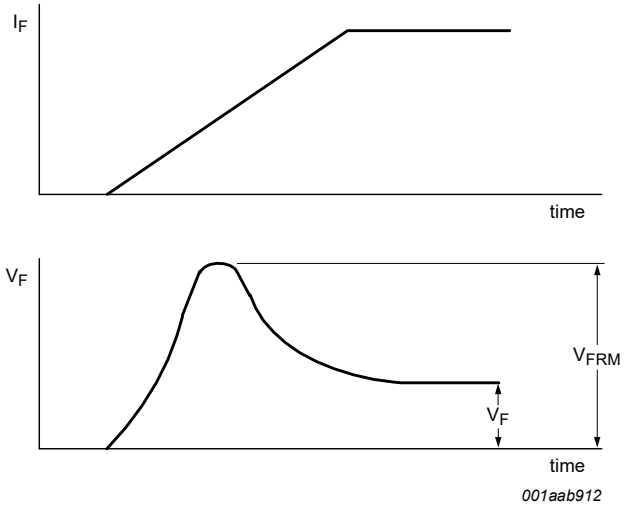



**Fig. 13. Forward recovery definition**

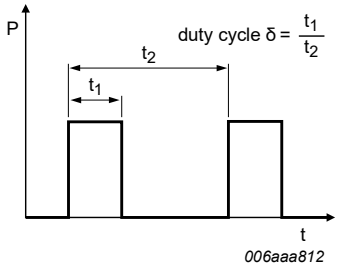



**Fig. 14. Duty cycle definition**

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

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

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

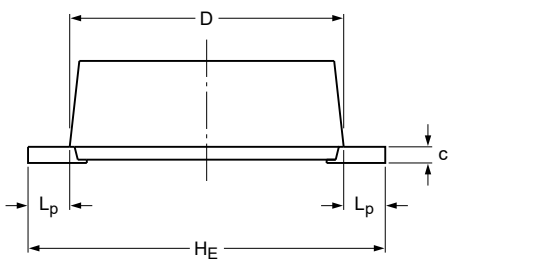
with $I_{RMS}$ defined as RMS current.

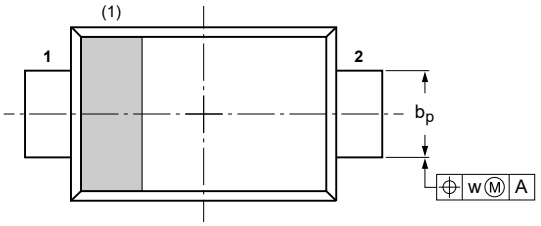
## Quality information

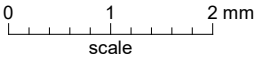
This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard Q101 - Stress test qualification for discrete semiconductors, and is suitable for use in automotive applications.

## 12. Package outline

**Plastic surface-mounted package; 2 leads** **SOD123W**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $b_p$ | c | D | E | $H_E$ | $L_p$ | w |
|---|---|---|---|---|---|---|---|---|
| mm | 1.1<br>0.9 | 1.05<br>0.75 | 0.22<br>0.10 | 2.8<br>2.4 | 1.9<br>1.5 | 3.7<br>3.3 | 0.6<br>0.3 | 0.13 |

**Note**

1. The marking bar indicates the cathode.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOD123W | | | | | | ~~07-06-28~~<br>08-11-06 |

**Fig. 15. Package outline CFP3 (SOD123W)**

## 13. Soldering

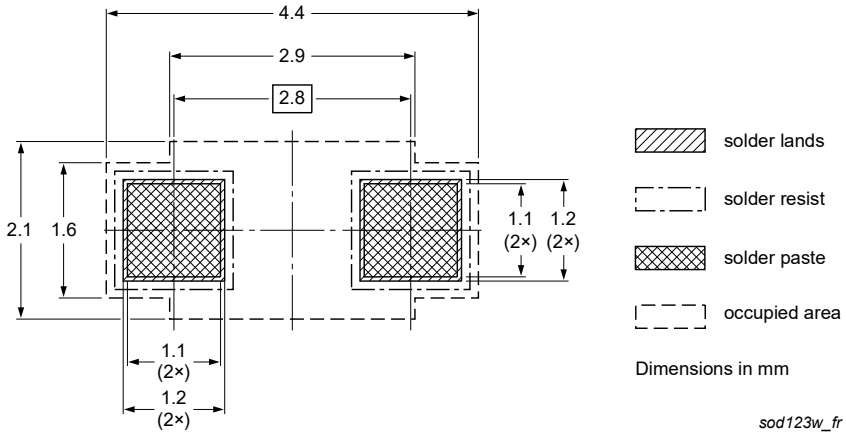
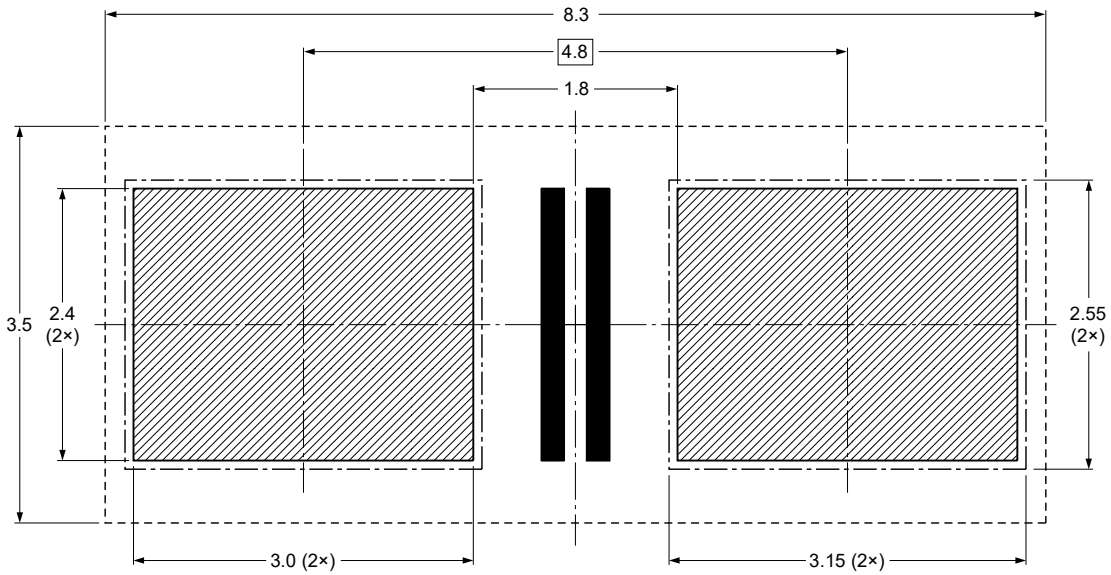



**Fig. 16. Reflow soldering footprint for CFP3 (SOD123W)**

**Wave soldering footprint information** **SOD123W**




occupied area

solder resist

solder lands

dummy track (solder resist and Cu free)

Dimensions in mm

Issue date ~~17-06-06~~ 17-06-07

*sod123w_fw*

**Fig. 17. Wave soldering footprint for CFP3 (SOD123W)**

# 14. Revision history

**Table 8. Revision history**

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| PNE20010ER v.3 | 20190103 | Product data sheet | - | PNE20010ER v.2 |
| Modifications: | • Category changed from PN-rectifier to recovery rectifier<br>• Update due to change of wafer fabrication | | | |
| PNE20010ER v.2 | 20170830 | Product data sheet | - | PNE20010ER v.1 |
| PNE20010ER v.1 | 20170519 | 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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**Date of release: 3 January 2019**

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