



# PNS40010AER

400 V, 1 A high power density, standard switching time recovery rectifier

3 June 2024

Product data sheet

## 1. General description

High power density, standard switching time 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

- Forward current  $I_F \leq 1$  A
- Reverse voltage  $V_R \leq 400$  V
- Standard switching time
- Low forward voltage
- Low reverse current
- Low inductance
- Small and flat lead SMD plastic package
- Package height typ. 1 mm
- High power capability
- Capable for reflow and wave soldering

## 3. Applications

- General-purpose rectification
- Reverse polarity protection
- Standard switching applications

## 4. Quick reference data


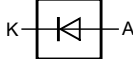
Table 1. Quick reference data

| Symbol      | Parameter                       | Conditions   | Min | Typ   | Max  | Unit |
|-------------|---------------------------------|--|-----|-------|------|------|
| $I_{F(AV)}$ | average forward current         | $\delta = 0.5$ ; $f = 20$ kHz; square wave; $T_{sp} \leq 166$ °C | -   | -     | 1    | A    |
| $V_{RRM}$   | repetitive peak reverse voltage |  | -   | -     | 400  | V    |
| $V_R$       | reverse voltage                 |  | -   | -     | 400  | V    |
| $V_F$       | forward voltage                 | $I_F = 0.5$ A; pulsed; $T_j = 25$ °C                             | [1] | 0.89  | 1.05 | V    |
|             |                                 | $I_F = 0.7$ A; pulsed; $T_j = 25$ °C                             | [1] | 0.91  | 1.07 | V    |
|             |                                 | $I_F = 1$ A; pulsed; $T_j = 25$ °C                               | [1] | 0.93  | 1.1  | V    |
| $I_R$       | reverse current                 | $V_R = 400$ V; pulsed; $T_j = -40$ °C                            | [1] | 0.1   | 10   | nA   |
|             |                                 | $V_R = 400$ V; pulsed; $T_j = 25$ °C                             | [1] | 0.001 | 1    | 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   | K      | cathode     | <br>CFP3 (SOD123W) | <br>006aab040 |
| 2   | A      | anode       |   |  |

## 6. Ordering information

Table 3. Ordering information

| Type number                 | Package |  |                         |
|-----------------------------|---------|--|-------------------------|
|                             | Name    | Description  | Version                 |
| <a href="#">PNS40010AER</a> | CFP3    | plastic, surface mounted package; 2 terminals; 2.6 mm x 1.7 mm x 1 mm body | <a href="#">SOD123W</a> |

## 7. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| PNS40010AER | N2           |

## 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     |   |     | -   | 400 | V                |
| $V_R$       | reverse voltage                     |   |     | -   | 400 | V                |
| $I_F$       | forward current                     | $T_{sp} \leq 163 \text{ }^\circ\text{C}$  |     | -   | 1.4 | A                |
| $I_{F(AV)}$ | average forward current             | $\delta = 0.5$ ; $f = 20 \text{ kHz}$ ; square wave; $T_{sp} \leq 166 \text{ }^\circ\text{C}$ |     | -   | 1   | A                |
| $I_{FSM}$   | non-repetitive peak forward current | $t_p = 8.3 \text{ ms}$ ; half sine wave; $T_{j(\text{init})} = 25 \text{ }^\circ\text{C}$     |     | -   | 30  | A                |
| $P_{tot}$   | total power dissipation             | $T_{amb} \leq 25 \text{ }^\circ\text{C}$  | [1] | -   | 750 | mW               |
|             |                                     |   | [2] | -   | 1.3 | 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 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  $1 \text{ cm}^2$ .

## 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] | -   | -   | 200 | K/W  |
|                |  |             | [2] | -   | -   | 115 | 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.

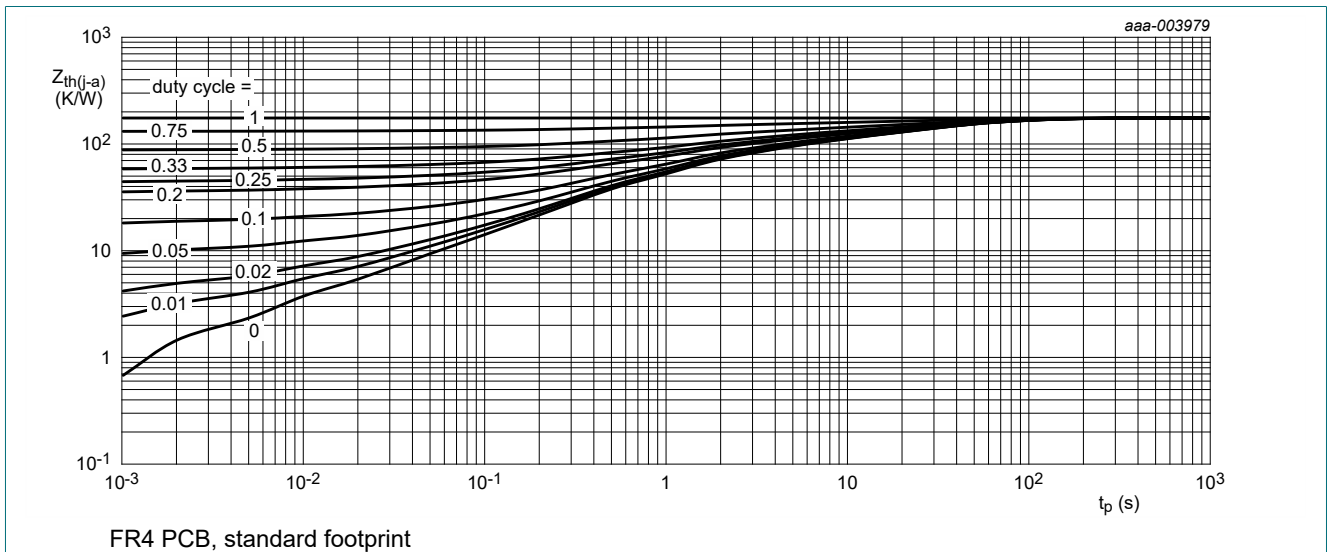


Fig. 1. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

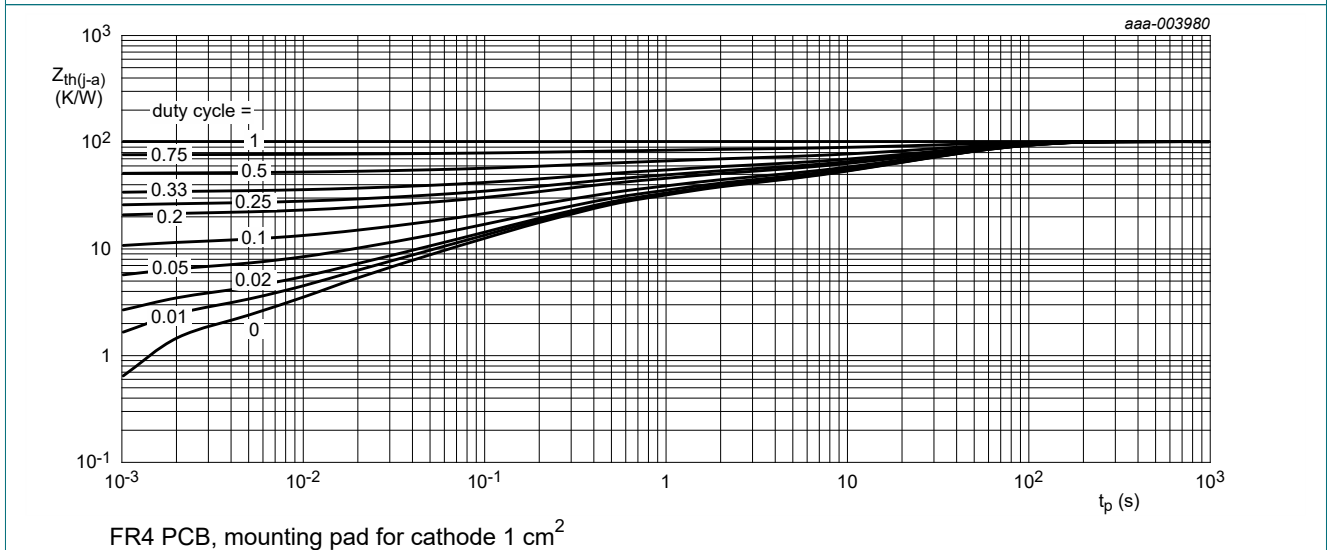


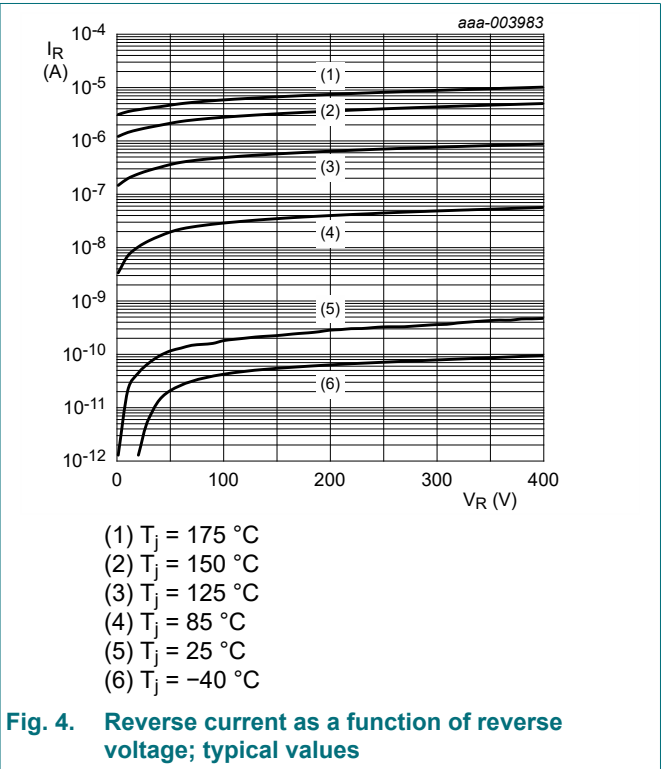
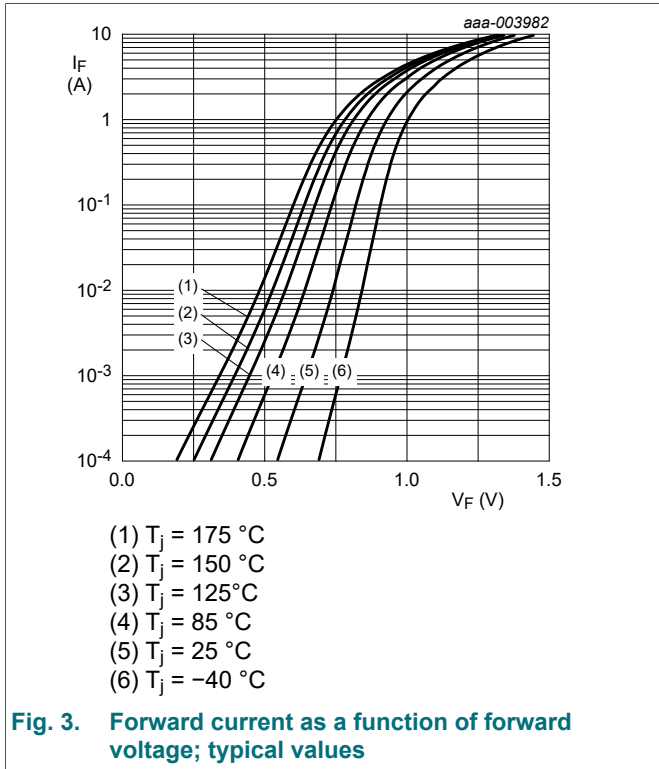
Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

## 10. Characteristics

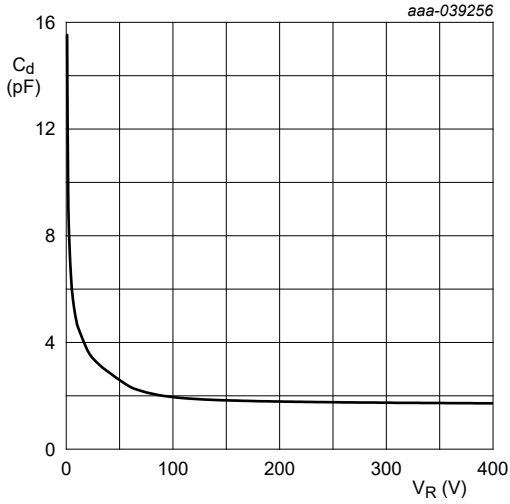
Table 7. Characteristics

| Symbol          | Parameter             | Conditions  | Min | Typ | Max   | Unit |    |
|-----------------|-----------------------|---|-----|-----|-------|------|----|
| V <sub>F</sub>  | forward voltage       | I <sub>F</sub> = 0.5 A; pulsed; T <sub>j</sub> = 25 °C  | [1] | -   | 0.89  | 1.05 | V  |
|                 |                       | I <sub>F</sub> = 0.7 A; pulsed; T <sub>j</sub> = 25 °C  | [1] | -   | 0.91  | 1.07 | V  |
|                 |                       | I <sub>F</sub> = 1 A; pulsed; T <sub>j</sub> = 25 °C  | [1] | -   | 0.93  | 1.1  | V  |
|                 |                       | I <sub>F</sub> = 0.5 A; pulsed; T <sub>j</sub> = 125 °C   | [1] | -   | 0.76  | 0.92 | V  |
|                 |                       | I <sub>F</sub> = 0.7 A; pulsed; T <sub>j</sub> = 125 °C   | [1] | -   | 0.78  | 0.95 | V  |
|                 |                       | I <sub>F</sub> = 1 A; pulsed; T <sub>j</sub> = 125 °C   | [1] | -   | 0.81  | 0.98 | V  |
|                 |                       | I <sub>F</sub> = 1 A; pulsed; T <sub>j</sub> = -40 °C   | [1] | -   | 1     | 1.18 | V  |
|                 |                       | I <sub>F</sub> = 1 A; pulsed; T <sub>j</sub> = 150 °C   | [1] | -   | 0.78  | 0.95 | V  |
|                 |                       | I <sub>F</sub> = 1 A; pulsed; T <sub>j</sub> = 175 °C   | [1] | -   | 0.75  | 0.92 | V  |
| I <sub>R</sub>  | reverse current       | V <sub>R</sub> = 400 V; pulsed; T <sub>j</sub> = -40 °C   | [1] | -   | 0.1   | 10   | nA |
|                 |                       | V <sub>R</sub> = 400 V; pulsed; T <sub>j</sub> = 25 °C  | [1] | -   | 0.001 | 1    | μA |
|                 |                       | V <sub>R</sub> = 400 V; pulsed; T <sub>j</sub> = 125 °C   | [1] | -   | 1     | 50   | μA |
|                 |                       | V <sub>R</sub> = 400 V; pulsed; T <sub>j</sub> = 150 °C   | [1] | -   | 5     | 250  | μA |
|                 |                       | V <sub>R</sub> = 400 V; pulsed; T <sub>j</sub> = 175 °C   | [1] | -   | 10    | 500  | μA |
| C <sub>d</sub>  | diode capacitance     | V <sub>R</sub> = 4 V; f = 1 MHz; T <sub>j</sub> = 25 °C   | -   | 6   | 15    | pF   |    |
| t <sub>rr</sub> | reverse recovery time | I <sub>F</sub> = 0.5 A; I <sub>R</sub> = 1 A; I <sub>R(meas)</sub> = 0.25 A; T <sub>j</sub> = 25 °C | -   | 0.5 | 1.5   | μs   |    |

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

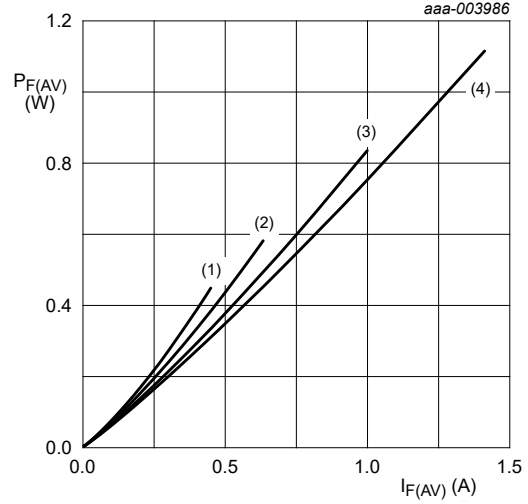


400 V, 1 A high power density, standard switching time recovery rectifier



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

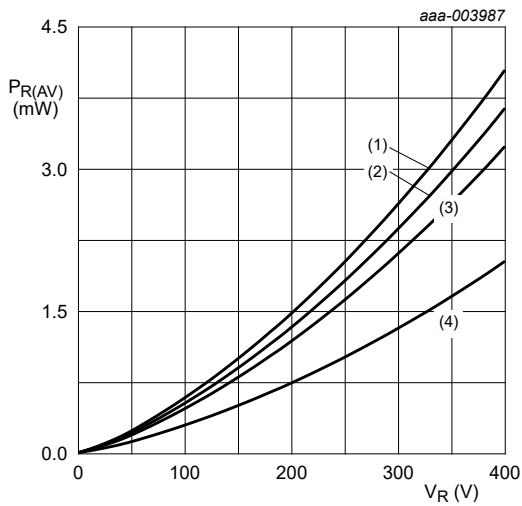
**Fig. 5. Diode capacitance as a function of reverse voltage; typical values**



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

- (1)  $\delta = 0.1$
- (2)  $\delta = 0.2$
- (3)  $\delta = 0.5$
- (4)  $\delta = 1$

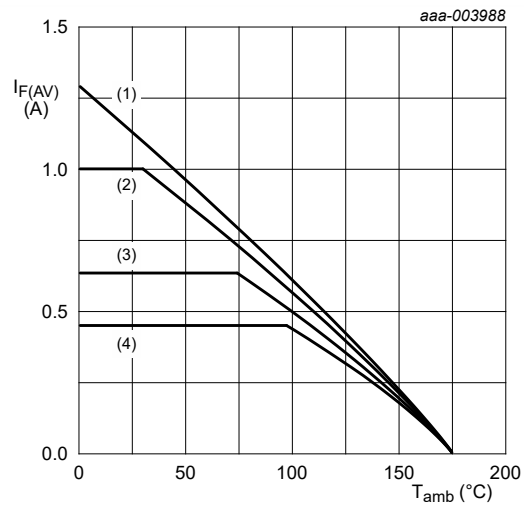
**Fig. 6. Average forward power dissipation as a function of average forward current; typical values**



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

- (1)  $\delta = 1$
- (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**



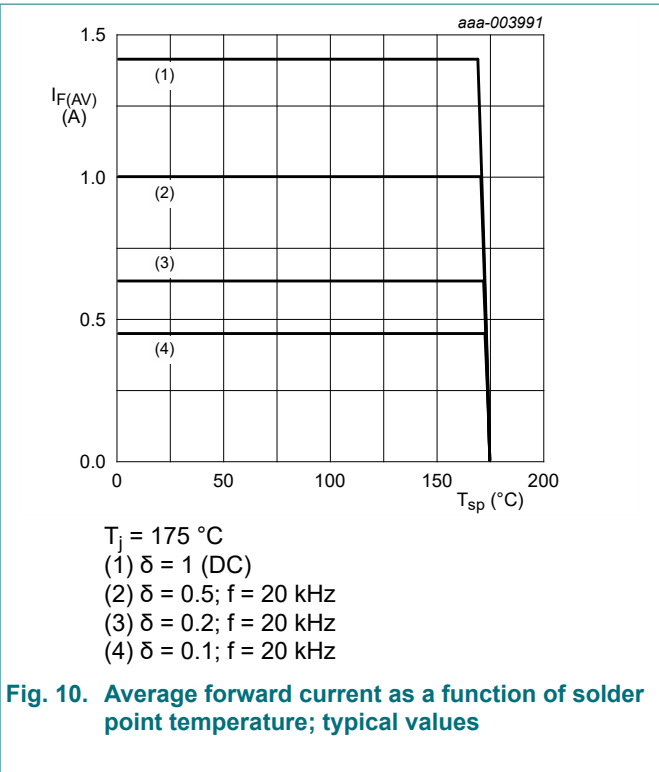
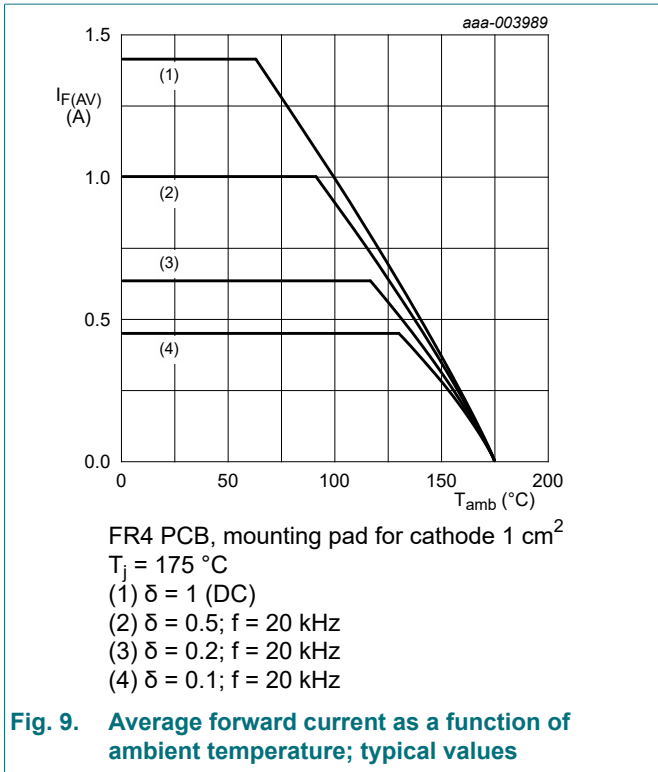
FR4 PCB, standard footprint

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

- (1)  $\delta = 1$  (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**

400 V, 1 A high power density, standard switching time recovery rectifier



11. Test information

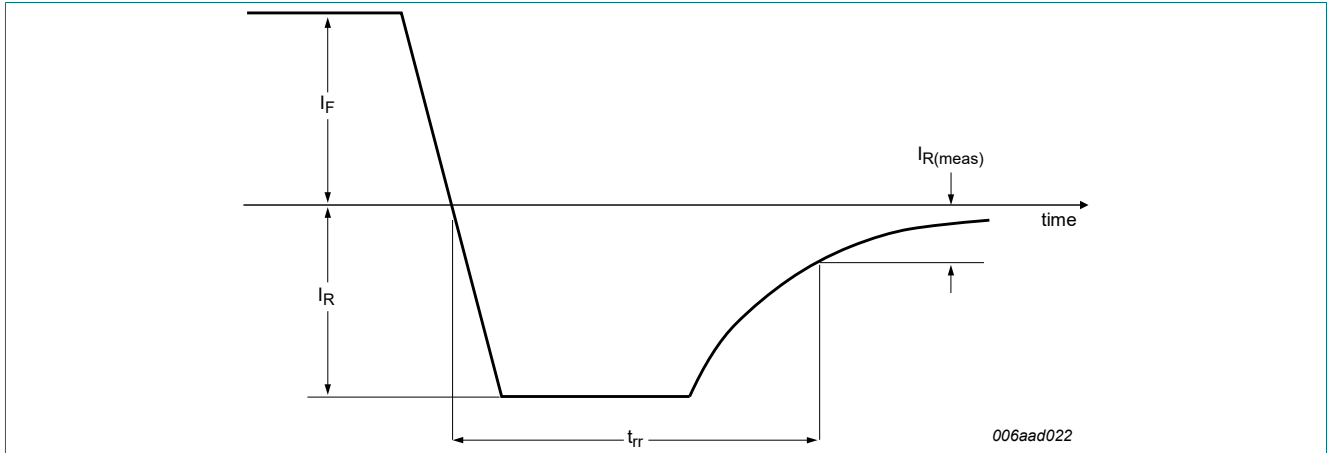


Fig. 11. Reverse recovery definition; step recovery

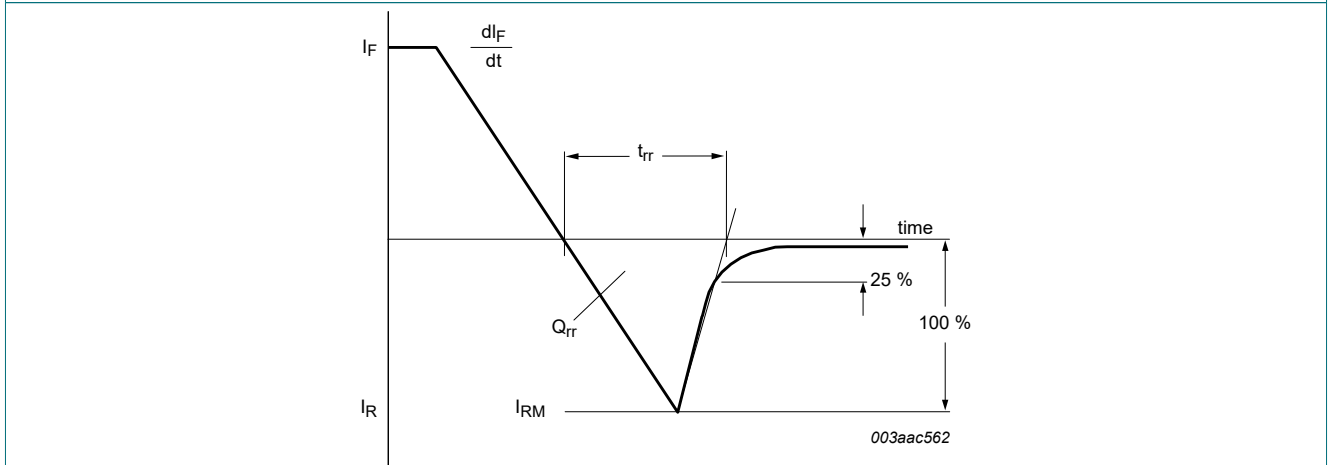


Fig. 12. Reverse recovery definition; ramp recovery

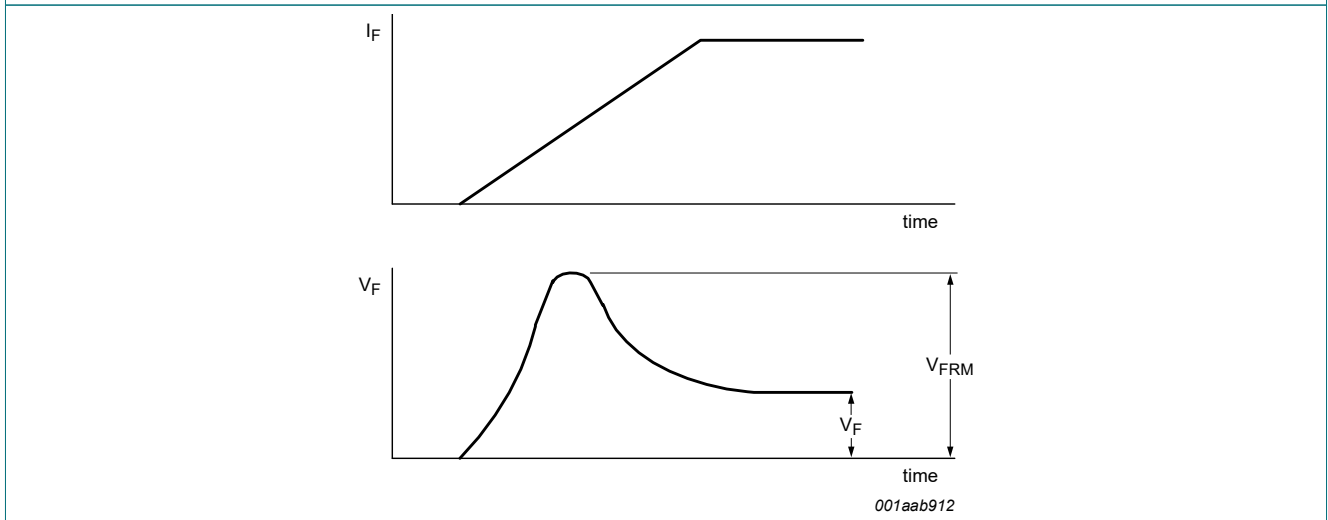


Fig. 13. Forward recovery definition

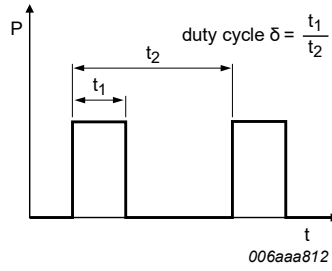


Fig. 14. Duty cycle definition

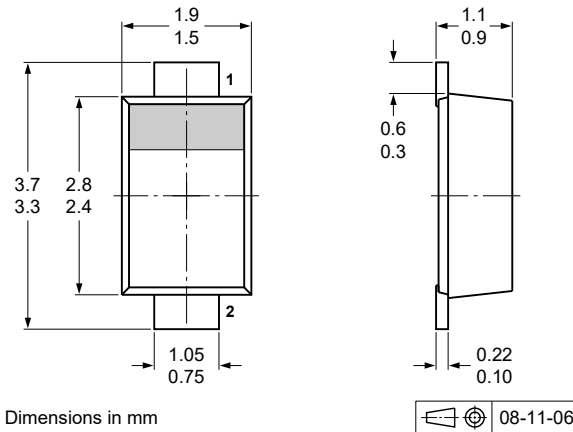
The current ratings for the typical waveforms are calculated according to the equations:

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

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

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

## 12. Package outline



Dimensions in mm

Fig. 15. Package outline CFP3 (SOD123W)



### 13. Soldering



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

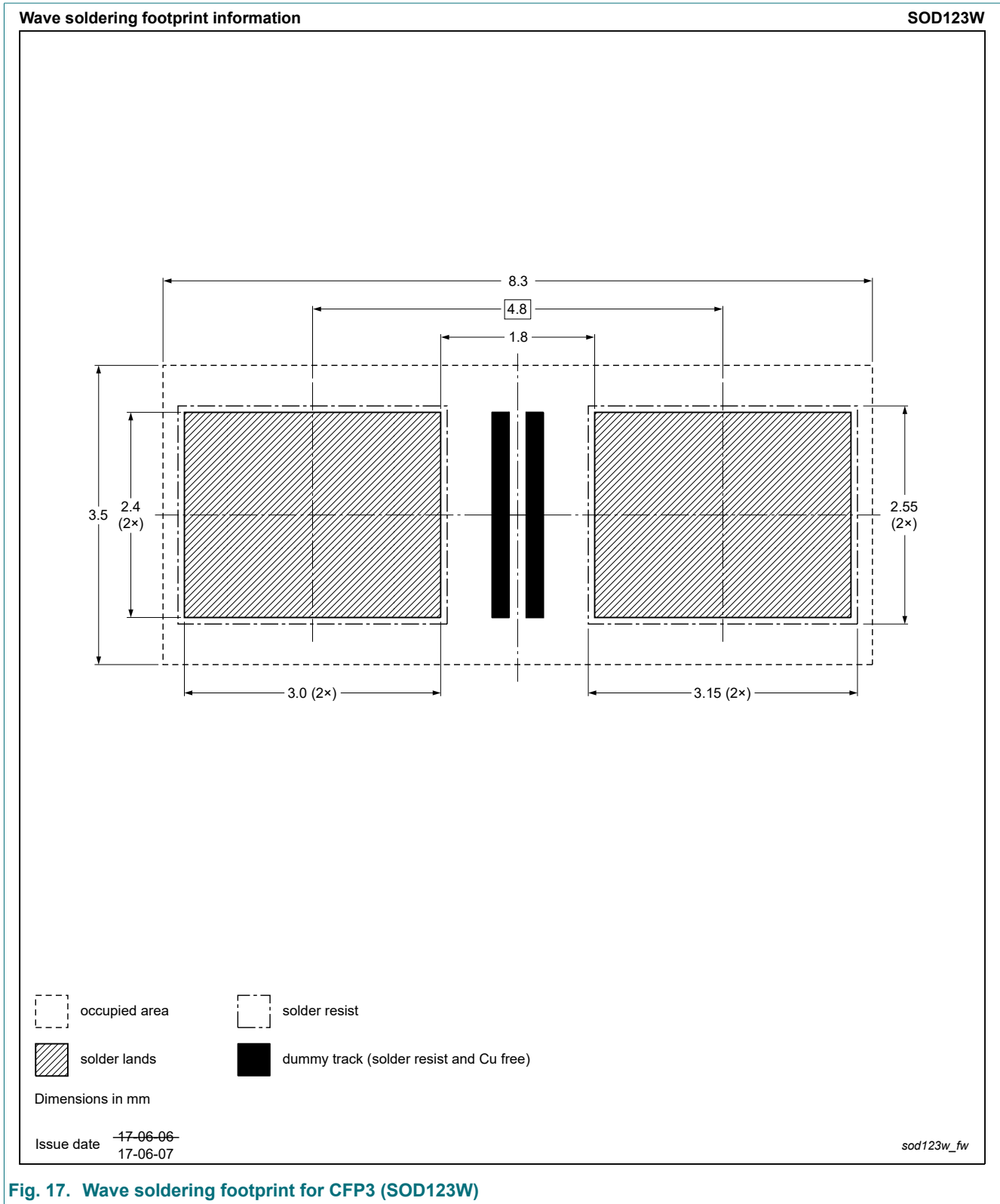


Fig. 17. Wave soldering footprint for CFP3 (SOD123W)

## 14. Revision history

Table 8. Revision history

| Data sheet ID   | Release date             | Data sheet status      | Change notice | Supersedes      |
|-----------------|--------------------------|------------------------|---------------|-----------------|
| PNS40010AER v.2 | 20240603                 | Product data sheet     | -             | PNS40010AER v.1 |
| Modifications   | • Product status changed |                        |               |                 |
| PNS40010AER v.1 | 20240319                 | 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.                                     |

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- [2] The term 'short data sheet' is explained in section "Definitions".
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