



# PNU65010ER

650 V, 1 A ultrafast recovery rectifier

30 September 2022

Product data sheet

## 1. General description

High power density, ultrafast switching time recovery rectifier with high-efficiency planar technology, encapsulated in a small and flat lead CFP3 (SOD123W) Surface-Mounted Device (SMD) plastic package.

## 2. Features and benefits

- Reverse voltage  $V_R \leq 650$  V
- Forward current  $I_F \leq 1$  A
- Typical switching time  $t_{rr}$  of 35 ns
- Pt doped life time control
- Low inductance
- Power and flat lead SMD plastic package
- High power capability due to clip-bond technology
- Planar die design

## 3. Applications

- AC/DC converter
- SMPS / UPS
- Battery charger
- Inverter
- Freewheeling applications

## 4. Quick reference data


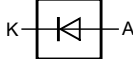
Table 1. Quick reference data

| Symbol      | Parameter                       | Conditions   | Min | Typ  | Max  | Unit    |
|-------------|---------------------------------|--|-----|------|------|---------|
| $I_{F(AV)}$ | average forward current         | $\delta = 0.5$ ; $f = 20$ kHz; square wave; $T_{sp} \leq 166$ °C | -   | -    | 1    | A       |
| $V_{RRM}$   | repetitive peak reverse voltage | $T_j = 25$ °C  | -   | -    | 650  | V       |
| $V_R$       | reverse voltage                 |  | -   | -    | 650  | V       |
| $V_F$       | forward voltage                 | $I_F = 1$ A; $T_j = 25$ °C                                       | [1] | 1    | 1.2  | V       |
|             |                                 | $I_F = 1$ A; $T_j = 125$ °C                                      | [1] | 0.93 | 1.06 | V       |
| $I_R$       | reverse current                 | $V_R = 650$ V; $T_j = 25$ °C                                     | [1] | -    | 1    | $\mu$ A |
|             |                                 | $V_R = 650$ V; $T_j = 125$ °C                                    | [1] | 0.5  | 10   | $\mu$ 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     | <br>CFP3 (SOD123W) | <br>006aab040 |
| 2   | A      | anode       |   |  |

## 6. Ordering information

Table 3. Ordering information

| Type number                | Package |  |                         |
|----------------------------|---------|--|-------------------------|
|                            | Name    | Description  | Version                 |
| <a href="#">PNU65010ER</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 |
|-------------|--------------|
| PNU65010ER  | ER           |

## 8. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 601134).

| Symbol      | Parameter                           | Conditions   |     | Min | Max  | Unit |
|-------------|-------------------------------------|--|-----|-----|------|------|
| $V_{RRM}$   | repetitive peak reverse voltage     | $T_j = 25\text{ °C}$   |     | -   | 650  | V    |
| $V_R$       | reverse voltage                     |  |     | -   | 650  | V    |
| $V_{RMS}$   | RMS voltage                         |  |     | -   | 460  | V    |
| $I_F$       | forward current                     | $\delta = 1; T_{sp} \leq 163\text{ °C}$  |     | -   | 1.4  | A    |
| $I_{F(AV)}$ | average forward current             | $\delta = 0.5; f = 20\text{ kHz};$ square wave; $T_{sp} \leq 166\text{ °C}$                                  |     | -   | 1    | A    |
| $I_{FSM}$   | non-repetitive peak forward current | $t_p = 8.3\text{ ms};$ single half sine wave (applied at rated load condition); $T_{j(init)} = 25\text{ °C}$ |     | -   | 33   | A    |
| $P_{tot}$   | total power dissipation             | $T_{amb} \leq 25\text{ °C}$  | [1] | -   | 0.75 | W    |
|             |                                     |  | [2] | -   | 1.2  | 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] | -   | -   | 200 | K/W  |
|                |  |             | [2] | -   | -   | 125 | K/W  |
| $R_{th(j-sp)}$ | 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 cathode tab.

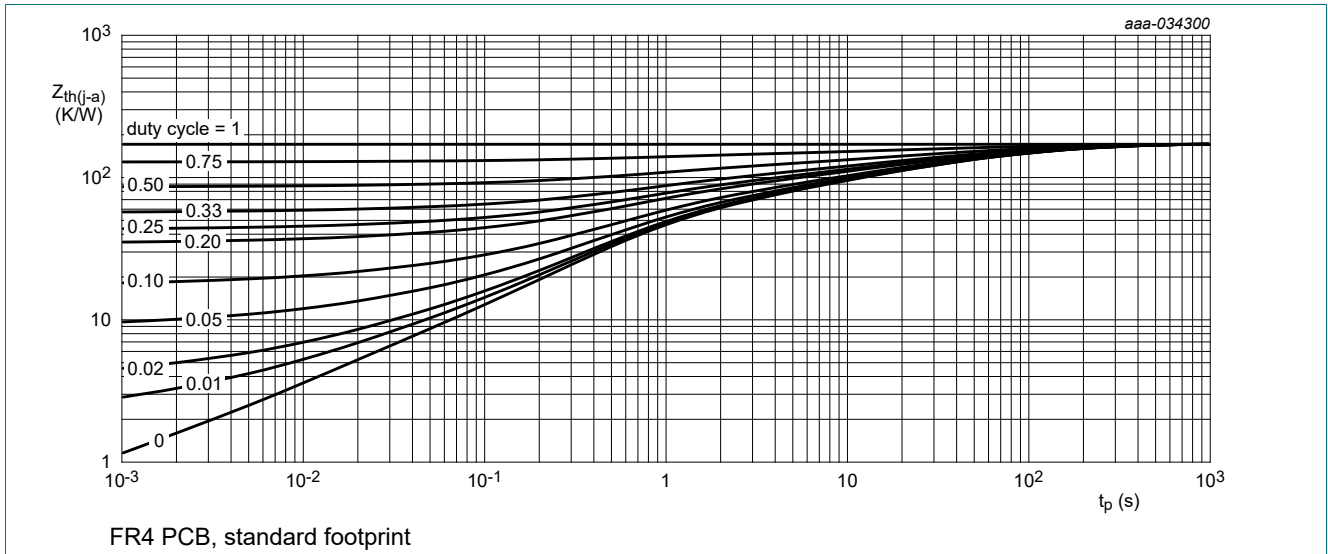


Fig. 1. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

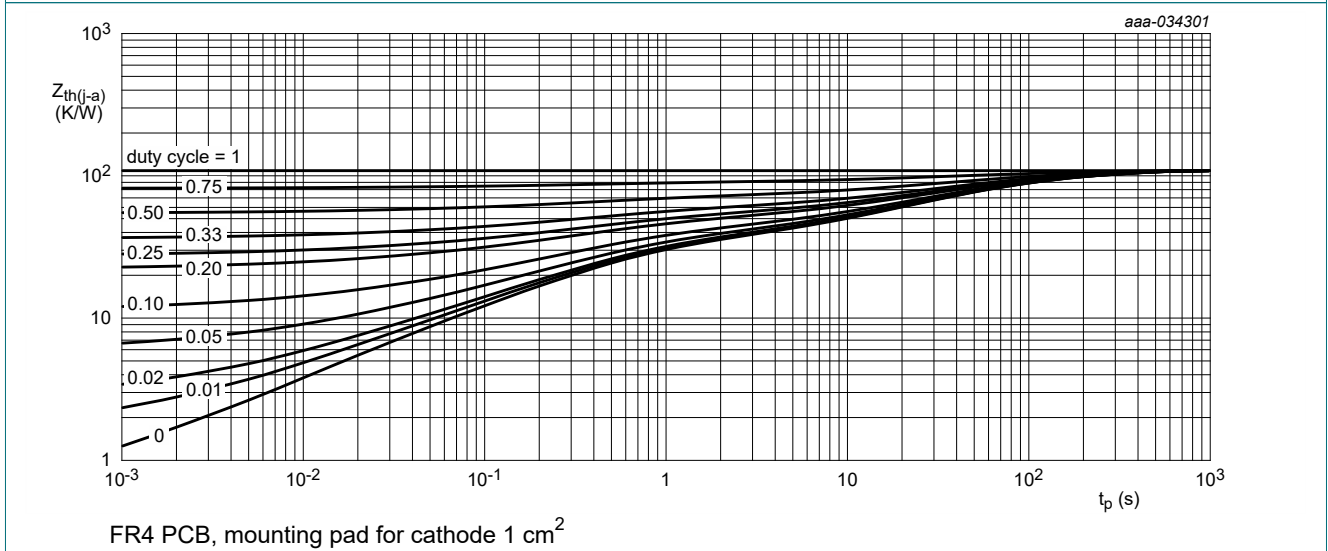


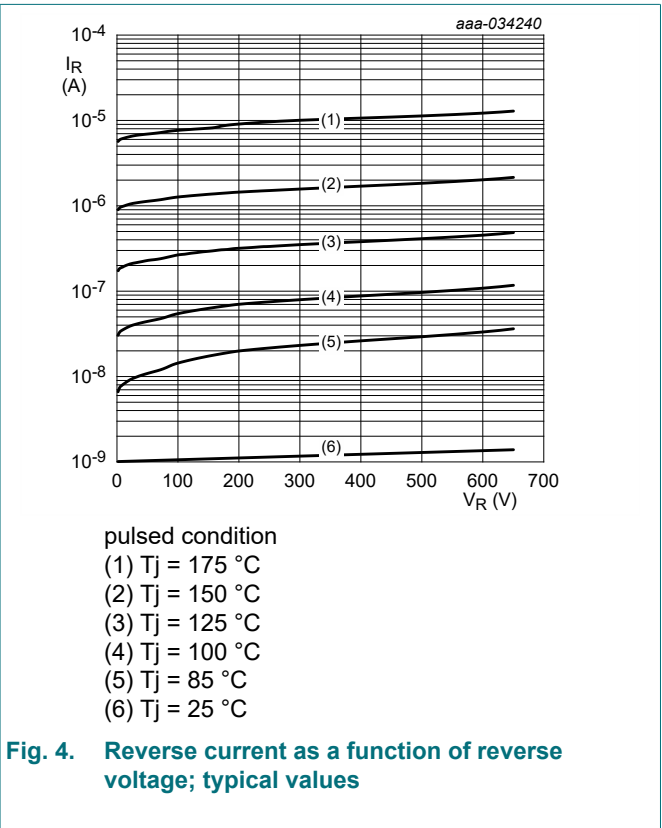
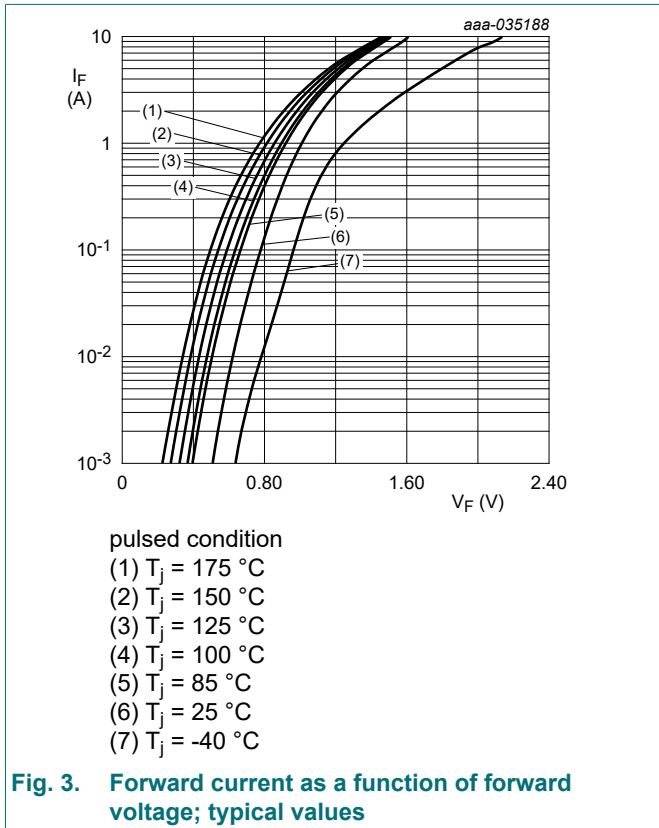
Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

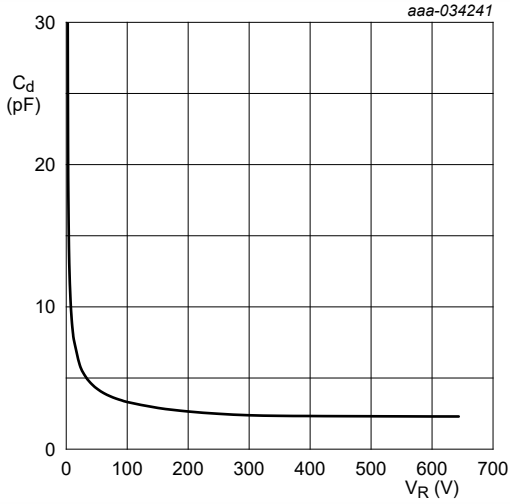
## 10. Characteristics

Table 7. Characteristics

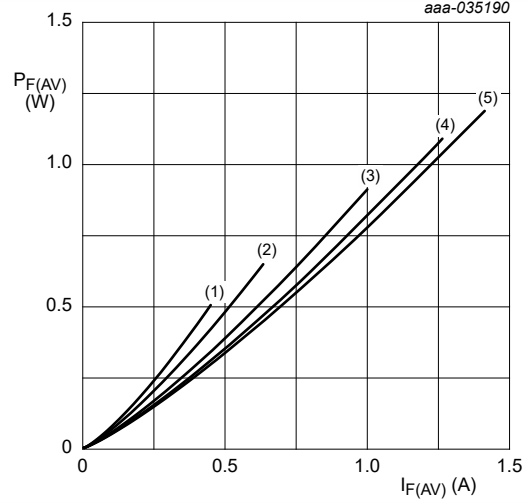
| Symbol      | Parameter                             | Conditions  | Min | Typ | Max  | Unit |         |
|-------------|---------------------------------------|---|-----|-----|------|------|---------|
| $V_{(BR)R}$ | reverse breakdown voltage             | $I_R = 100 \mu A; T_j = 25 \text{ }^\circ C$                              | [1] | 650 | -    | V    |         |
| $V_F$       | forward voltage                       | $I_F = 1 A; T_j = 25 \text{ }^\circ C$                                    | [1] | -   | 1    | 1.2  | V       |
|             |                                       | $I_F = 1 A; T_j = 125 \text{ }^\circ C$                                   | [1] | -   | 0.93 | 1.06 | V       |
| $I_R$       | reverse current                       | $V_R = 650 V; T_j = 25 \text{ }^\circ C$                                  | [1] | -   | -    | 1    | $\mu A$ |
|             |                                       | $V_R = 650 V; T_j = 125 \text{ }^\circ C$                                 | [1] | -   | 0.5  | 10   | $\mu A$ |
| $C_d$       | diode capacitance                     | $V_R = 4 V; f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$                 | -   | 11  | -    | pF   |         |
| $t_{rr}$    | reverse recovery time ; step recovery | $I_F = 0.5 A; I_R = 1 A; I_{R(meas)} = 0.25 A; T_j = 25 \text{ }^\circ C$ | -   | 35  | 65   | ns   |         |
|             |                                       | $I_F = 1 A; dI_F/dt = 50 A/\mu s; V_R = 30 V; T_j = 25 \text{ }^\circ C$  | -   | 39  | 85   | ns   |         |
|             |                                       | $I_F = 1 A; dI_F/dt = 100 A/\mu s; V_R = 30 V; T_j = 25 \text{ }^\circ C$ | -   | 26  | -    | ns   |         |
| $I_{RM}$    | peak reverse recovery current         | $T_j = 25 \text{ }^\circ C$   | -   | 1.5 | -    | A    |         |
| $Q_{rr}$    | reverse recovery charge               |   | -   | 20  | -    | nC   |         |
| $V_{FRM}$   | peak forward recovery voltage         | $I_F = 1 A; dI_F/dt = 50 A/\mu s; T_j = 25 \text{ }^\circ C$              | -   | 5.2 | -    | V    |         |

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

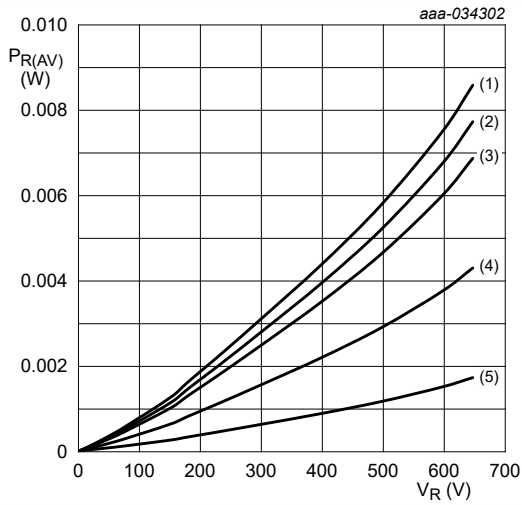




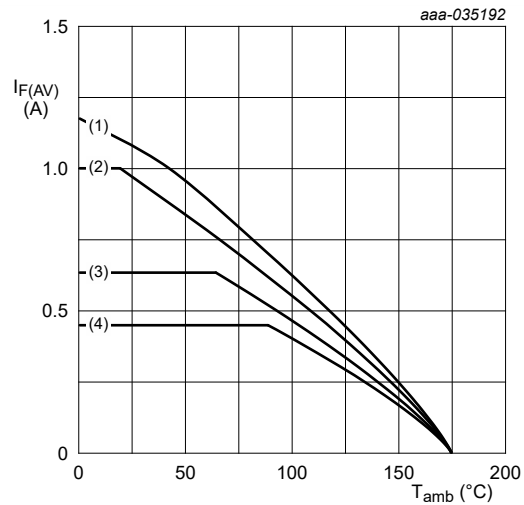
**Fig. 5. Diode capacitance as a function of reverse voltage; typical values**



**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**

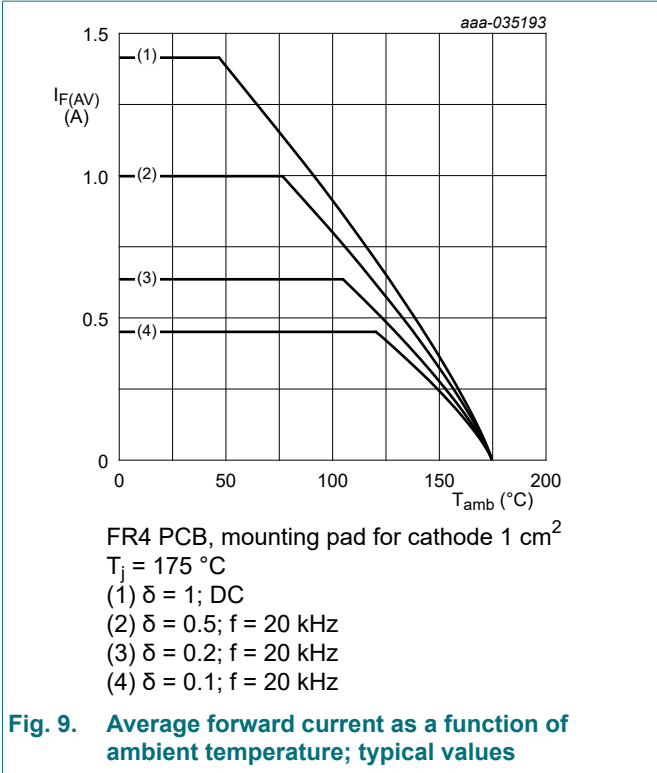


Fig. 9. Average forward current as a function of ambient temperature; typical values

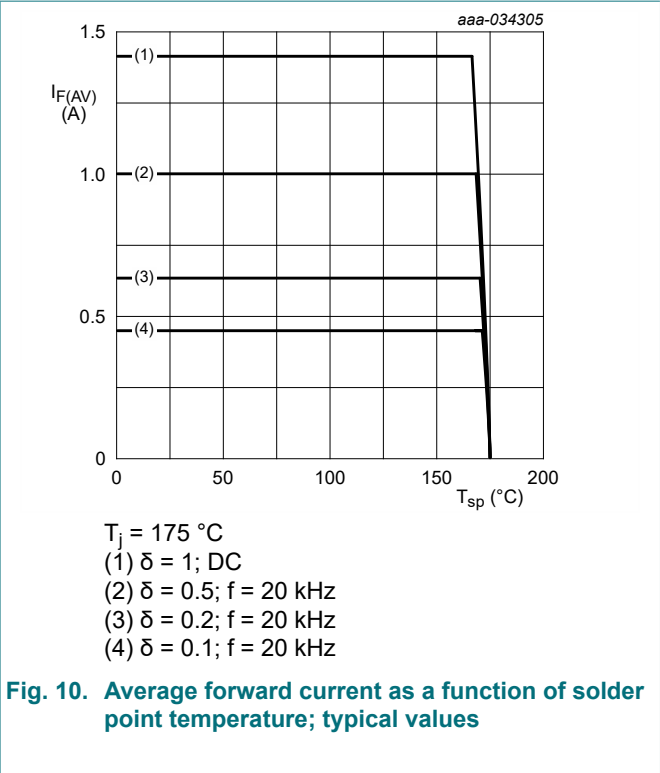


Fig. 10. Average forward current as a function of solder point temperature; typical values

### 11. Test information

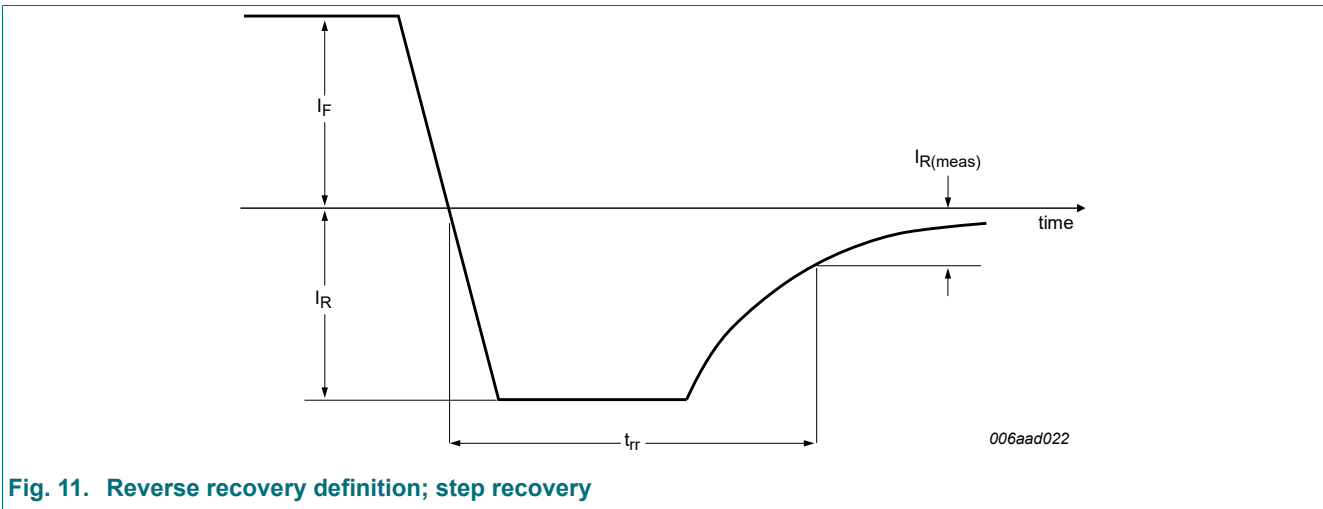


Fig. 11. Reverse recovery definition; step recovery

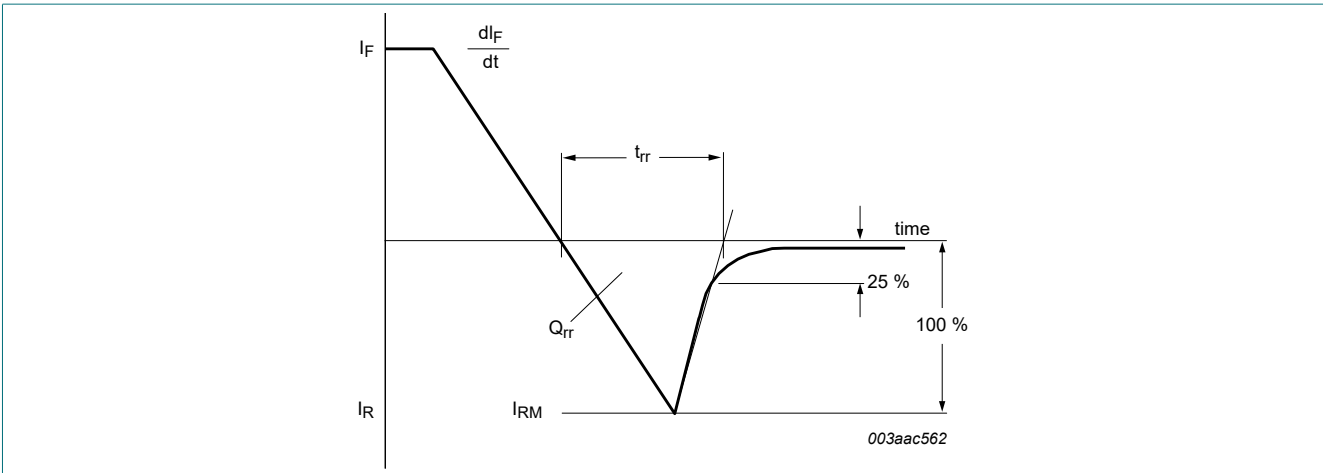


Fig. 12. Reverse recovery definition; ramp recovery



Fig. 13. Forward recovery definition



Fig. 14. Duty cycle definition

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

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

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

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

## 12. Package outline

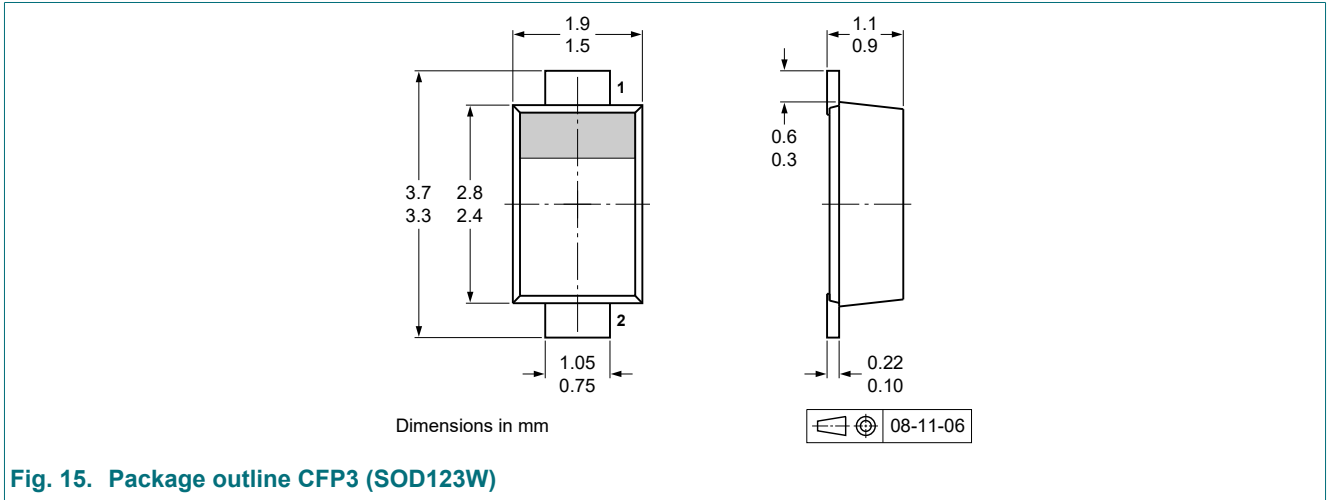


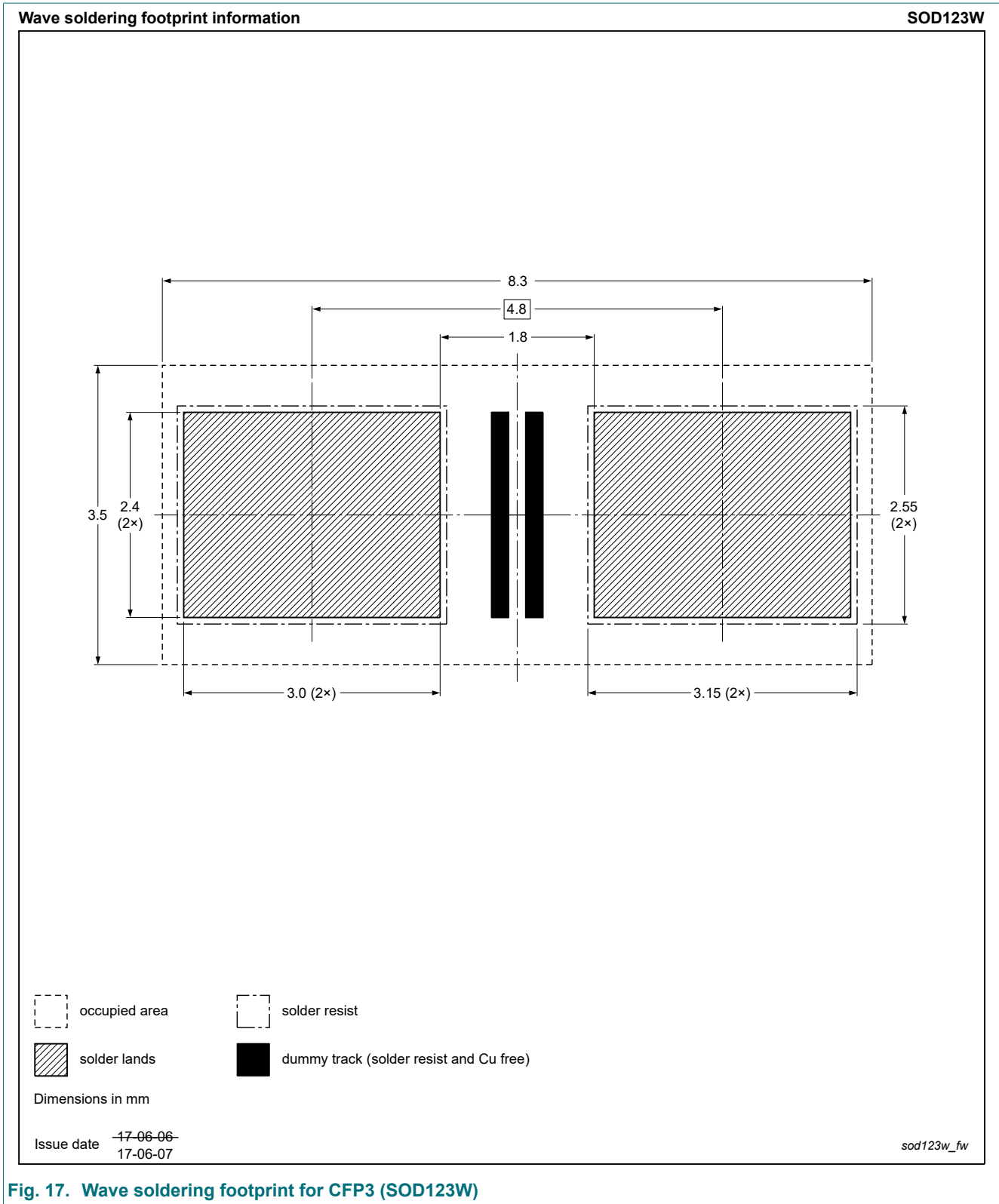
Fig. 15. Package outline CFP3 (SOD123W)



### 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     |
|----------------|---|------------------------|---------------|----------------|
| PNU65010ER v.4 | 20220930  | Product data sheet     | -             | PNU65010ER v.3 |
| Modifications: | • Specification adapted for a maximum temperature of 175 °C |                        |               |                |
| PNU65010ER v.3 | 20220801  | Product data sheet     | -             | PNU65010ER v.2 |
| PNU65010ER v.2 | 20220629  | Preliminary data sheet | -             | PNU65010ER v.1 |
| PNU65010ER v.1 | 20211222  | Objective 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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