



PNS40010ER

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

22 August 2018

Product data sheet

1. General description

High power density, standard switching time 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

- 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
- AEC-Q101 qualified
- Capable for reflow and wave soldering

3. Applications

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

4. Quick reference data


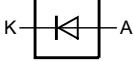
Table 1. Quick reference data

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-------------|---------------------------------|---|-----|-------|------|---------|
| $I_{F(AV)}$ | average forward current | $\delta = 0.5$; $f = 20$ kHz; square wave; $T_{amb} \leq 115$ °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; $t_p \leq 300$ μ s; $\delta \leq 0.02$; $T_j = 25$ °C | - | 0.89 | 1.05 | V |
| | | $I_F = 0.7$ A; $t_p \leq 300$ μ s; $\delta \leq 0.02$; $T_j = 25$ °C | - | 0.91 | 1.07 | V |
| I_R | reverse current | $V_R = 400$ V; $T_j = -40$ °C | - | 0.1 | 10 | nA |
| | | $V_R = 400$ V; $T_j = 25$ °C | - | 0.001 | 1 | μ A |

[1] Device mounted on a ceramic PCB, Al_2O_3 , standard footprint.

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 |
| PNS40010ER | 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 |
|-------------|--------------|
| PNS40010ER | EH |

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 |
| V_{RMS} | RMS voltage | | | - | 280 | V |
| I_F | forward current | $T_{sp} \leq 160\text{ °C}$ | | - | 1.4 | A |
| $I_{F(AV)}$ | average forward current | $\delta = 0.5$; $f = 20\text{ kHz}$; square wave; $T_{amb} \leq 115\text{ °C}$ | [1] | - | 1 | A |
| | | $\delta = 0.5$; $f = 20\text{ kHz}$; square wave; $T_{sp} \leq 170\text{ °C}$ | | - | 1 | A |
| I_{FSM} | non-repetitive peak forward current | $t_p = 8\text{ ms}$; $T_{j(\text{init})} = 25\text{ °C}$; square wave | | - | 32 | A |
| P_{tot} | total power dissipation | $T_{amb} \leq 25\text{ °C}$ | [2] | - | 750 | mW |
| | | | [3] | - | 1.3 | W |
| | | | [1] | - | 2.3 | 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 a ceramic PCB, Al_2O_3 , standard footprint.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[3] 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] | - | - | 200 | K/W |
| | | | [2] | - | - | 115 | K/W |
| | | | [3] | - | - | 65 | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | [4] | - | - | 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] Device mounted on an FR4 PCB, Al_2O_3 , standard footprint.

[4] Soldering point of cathode tab.

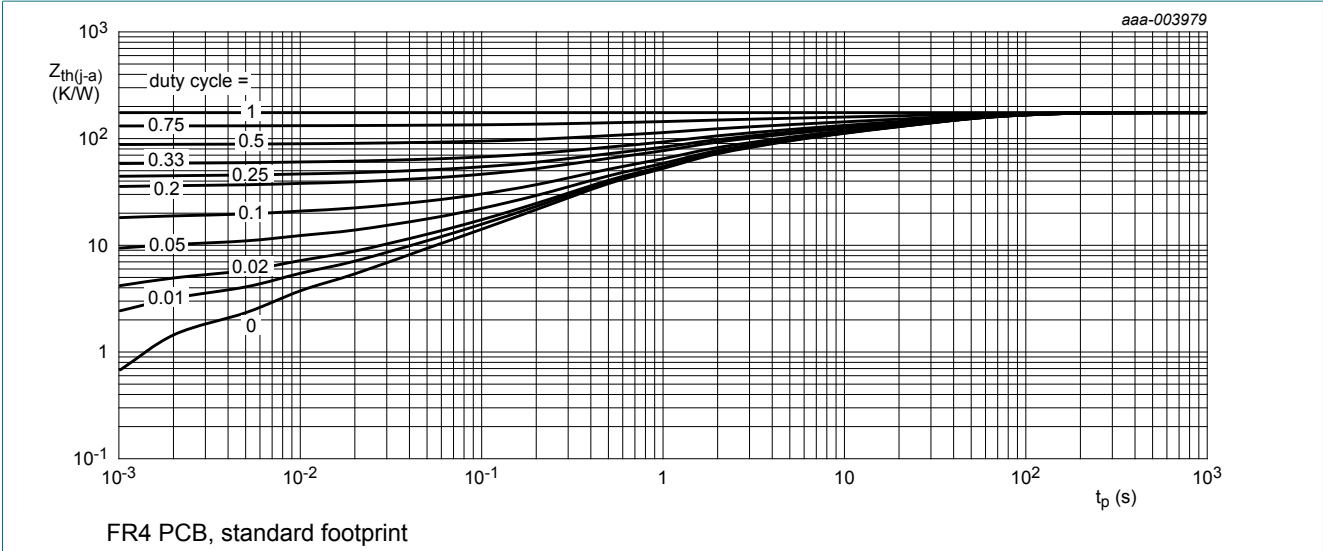


Fig. 1. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

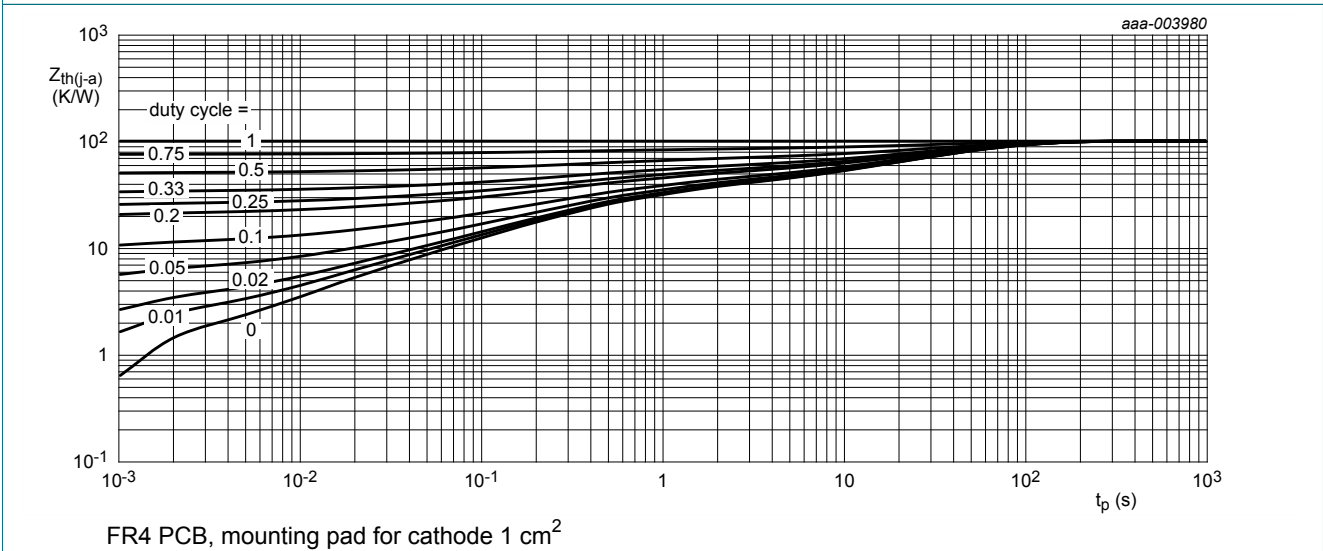


Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

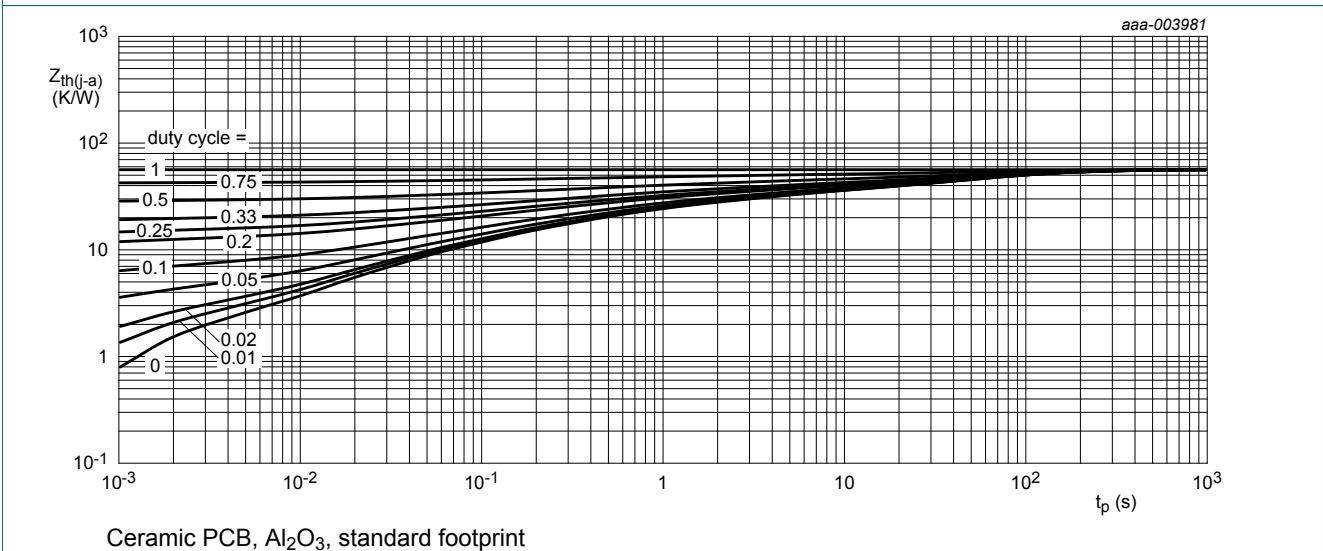
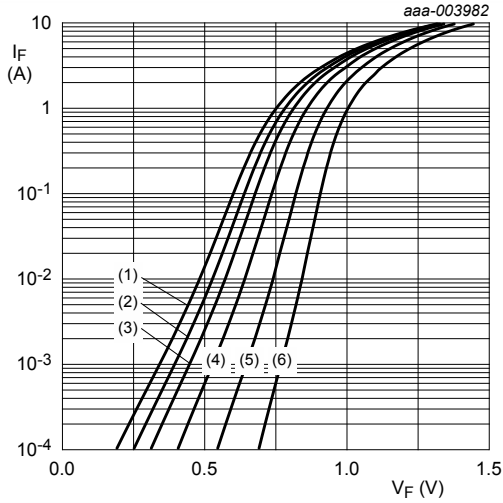


Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

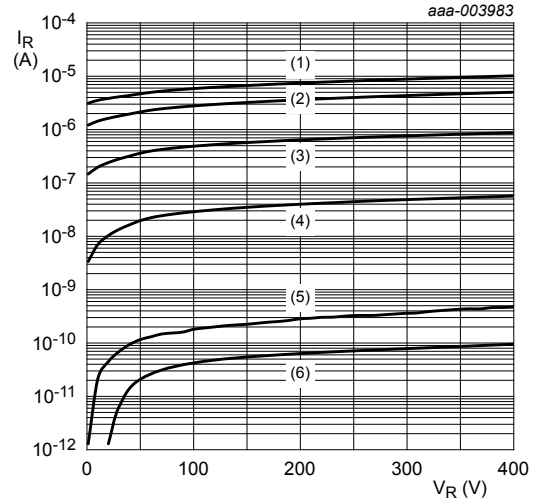
Table 7. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------------|-----------------------|--|-----|-------|------|------|
| V _F | forward voltage | I _F = 0.5 A; t _p ≤ 300 μs; δ ≤ 0.02; T _j = 25 °C | - | 0.89 | 1.05 | V |
| | | I _F = 0.7 A; t _p ≤ 300 μs; δ ≤ 0.02; T _j = 25 °C | - | 0.91 | 1.07 | V |
| | | I _F = 1 A; t _p ≤ 300 μs; δ ≤ 0.02; T _j = 25 °C | - | 0.93 | 1.1 | V |
| | | I _F = 0.5 A; t _p ≤ 300 μs; δ ≤ 0.02; T _j = 125 °C | - | 0.76 | 0.92 | V |
| | | I _F = 0.7 A; t _p ≤ 300 μs; δ ≤ 0.02; T _j = 125 °C | - | 0.78 | 0.95 | V |
| | | I _F = 1 A; t _p ≤ 300 μs; δ ≤ 0.02; T _j = 125 °C | - | 0.81 | 0.98 | V |
| | | I _F = 1 A; t _p ≤ 300 μs; δ ≤ 0.02; T _j = -40 °C | - | 1.01 | 1.18 | V |
| | | I _F = 1 A; t _p ≤ 300 μs; δ ≤ 0.02; T _j = 150 °C | - | 0.78 | 0.95 | V |
| | | I _F = 1 A; t _p ≤ 300 μs; δ ≤ 0.02; T _j = 175 °C | - | 0.75 | 0.92 | V |
| I _R | reverse current | V _R = 400 V; T _j = -40 °C | - | 0.1 | 10 | nA |
| | | V _R = 400 V; T _j = 25 °C | - | 0.001 | 1 | μA |
| | | V _R = 400 V; T _j = 125 °C | - | 1 | 50 | μA |
| | | V _R = 400 V; T _j = 150 °C | - | 5 | 250 | μA |
| | | V _R = 400 V; T _j = 175 °C | - | 10 | 500 | μA |
| C _d | diode capacitance | V _R = 4 V; f = 1 MHz; T _{amb} = 25 °C | - | 8 | 20 | pF |
| t _{rr} | reverse recovery time | I _F = 0.5 A; I _R = 1 A; I _{R(meas)} = 0.25 A; T _{amb} = 25 °C | - | 0.8 | 1.8 | μs |



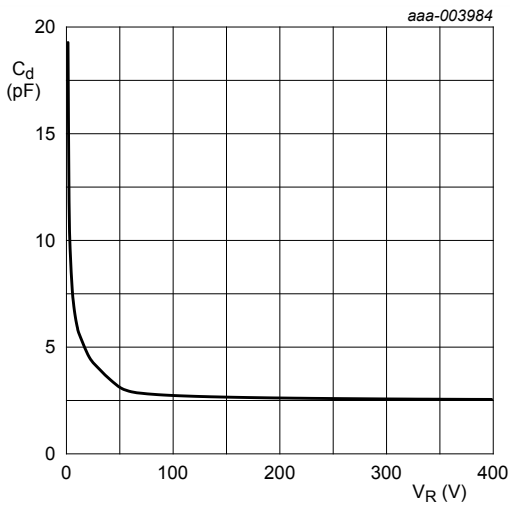
- (1) $T_j = 175\text{ °C}$
- (2) $T_j = 150\text{ °C}$
- (3) $T_j = 125\text{ °C}$
- (4) $T_j = 85\text{ °C}$
- (5) $T_j = 25\text{ °C}$
- (6) $T_j = -40\text{ °C}$

Fig. 4. Forward current as a function of forward voltage; typical values



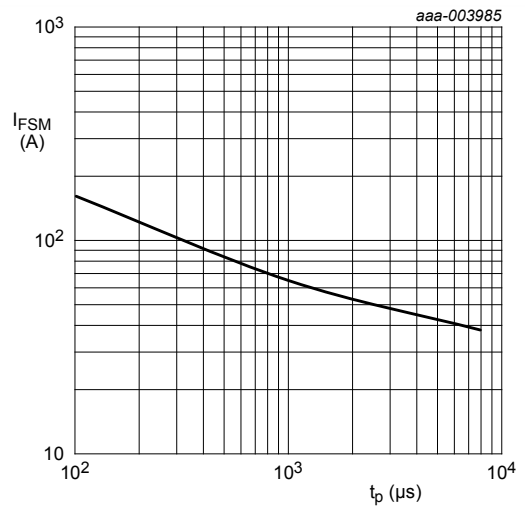
- (1) $T_j = 175\text{ °C}$
- (2) $T_j = 150\text{ °C}$
- (3) $T_j = 125\text{ °C}$
- (4) $T_j = 85\text{ °C}$
- (5) $T_j = 25\text{ °C}$
- (6) $T_j = -40\text{ °C}$

Fig. 5. Reverse current as a function of reverse voltage; typical values



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

Fig. 6. Diode capacitance as a function of reverse voltage; typical values



$T_{amb} = 25\text{ °C}$

Fig. 7. Non-repetitive peak forward current as a function of pulse duration; typical values

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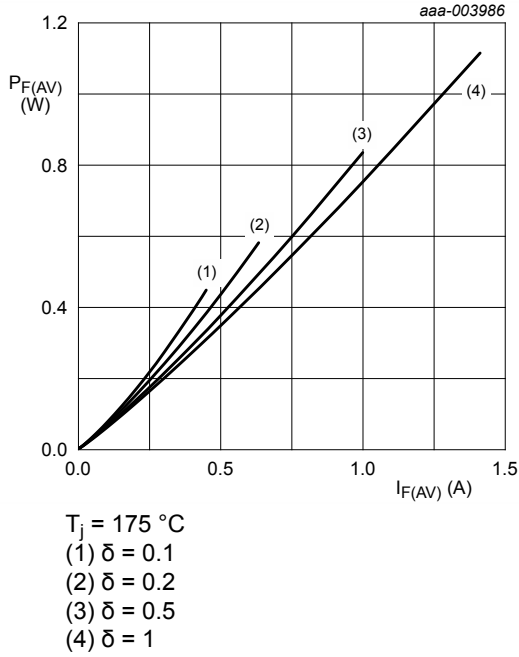


Fig. 8. Average forward power dissipation as a function of average forward current; typical values

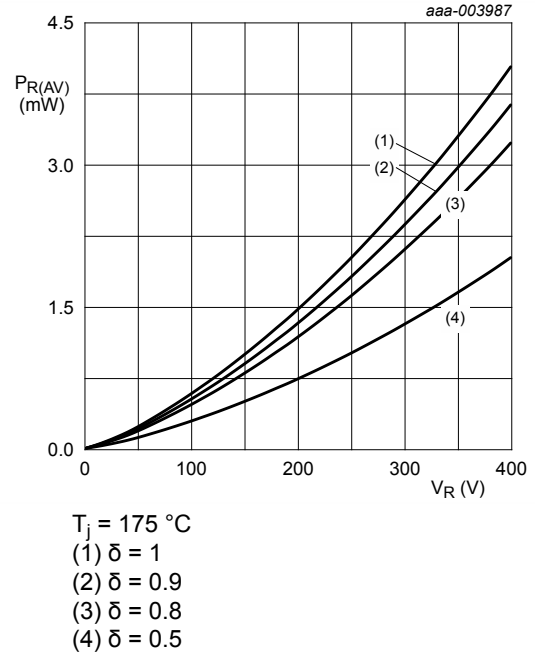


Fig. 9. Average reverse power dissipation as a function of reverse voltage; typical values

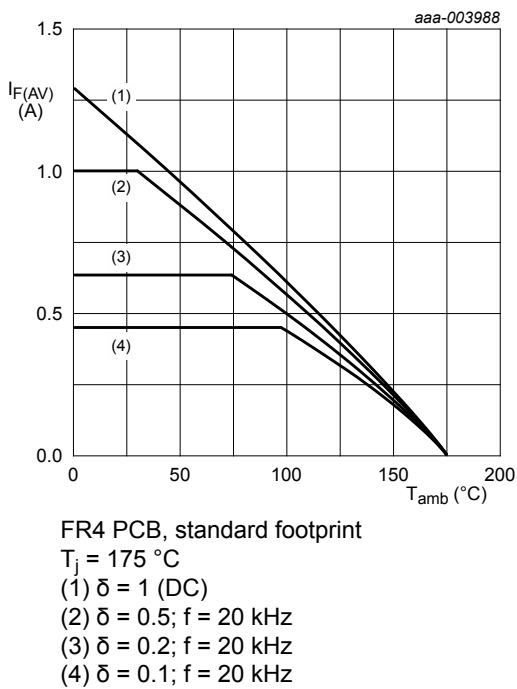


Fig. 10. Average forward current as a function of ambient temperature; typical values

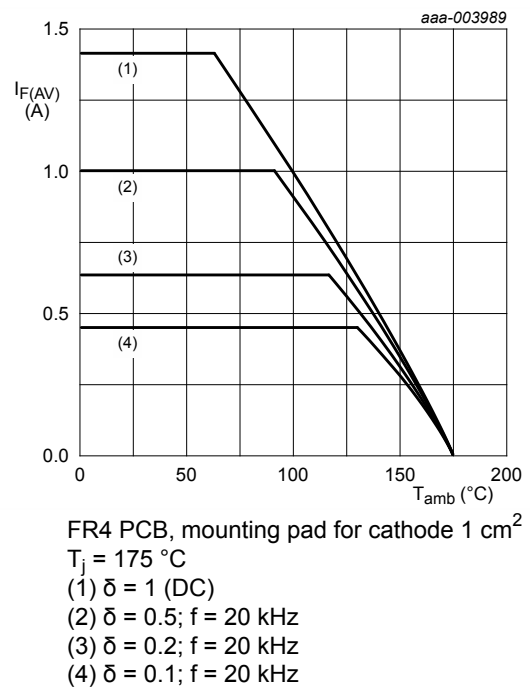
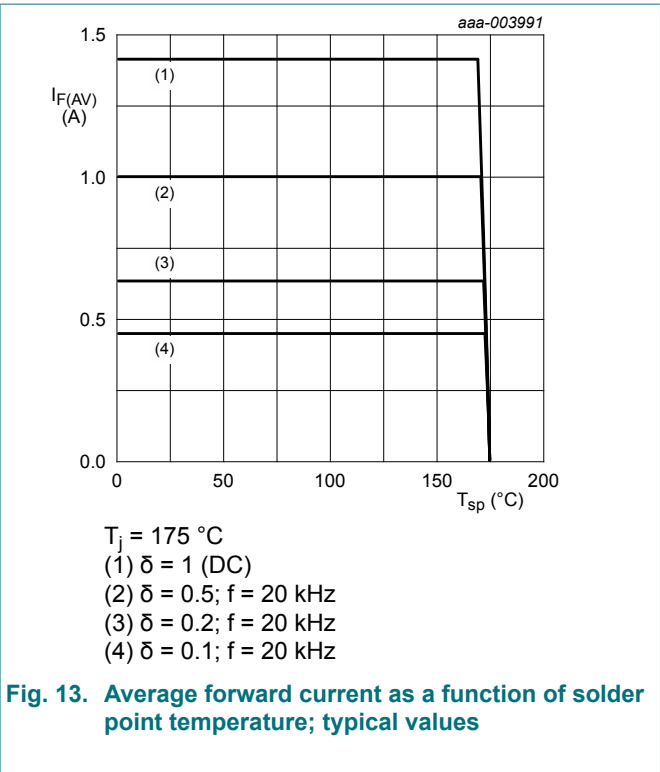
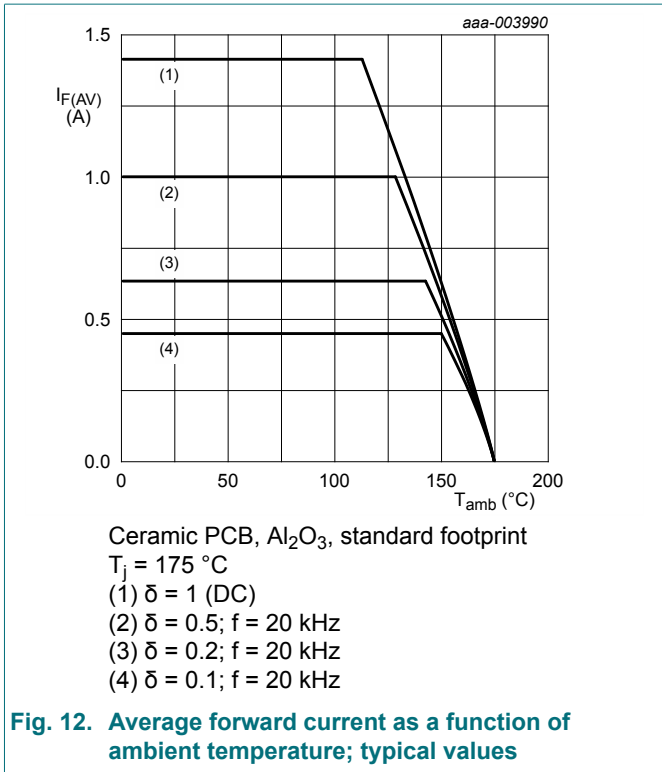


Fig. 11. Average forward current as a function of ambient temperature; typical values

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



11. Test information

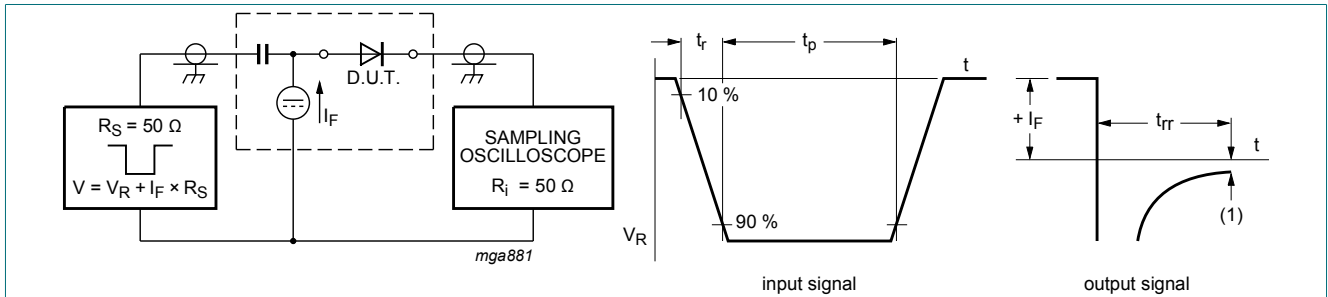


Fig. 14. Reverse recovery time: test circuit and waveforms

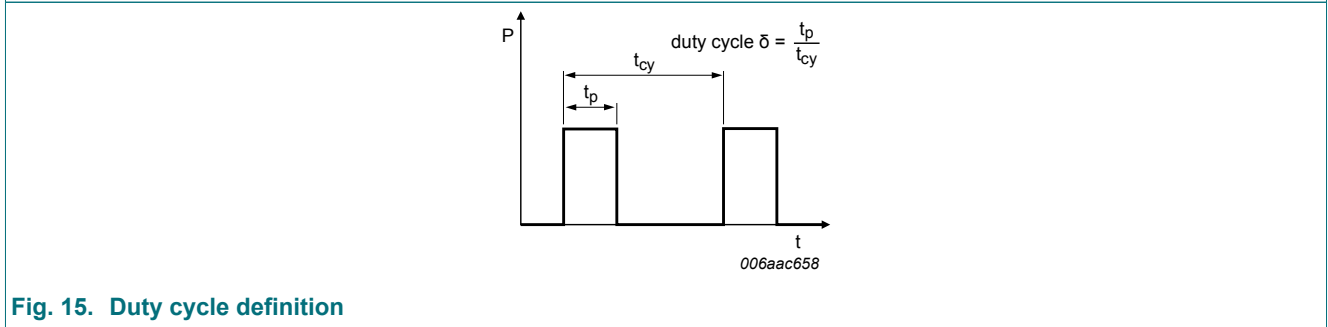


Fig. 15. Duty cycle definition

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

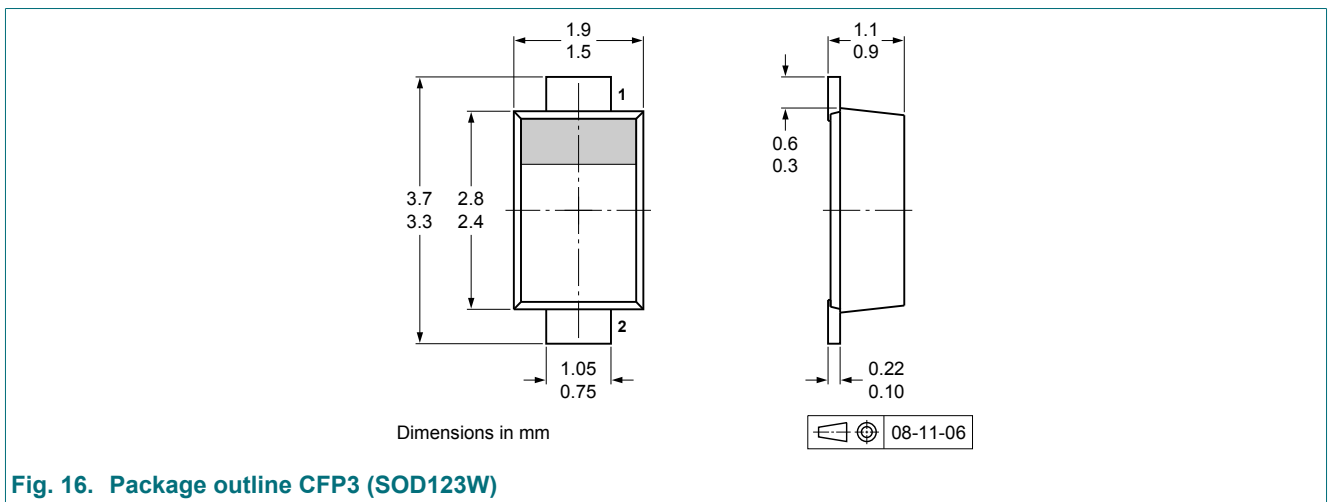


Fig. 16. Package outline CFP3 (SOD123W)

13. Soldering

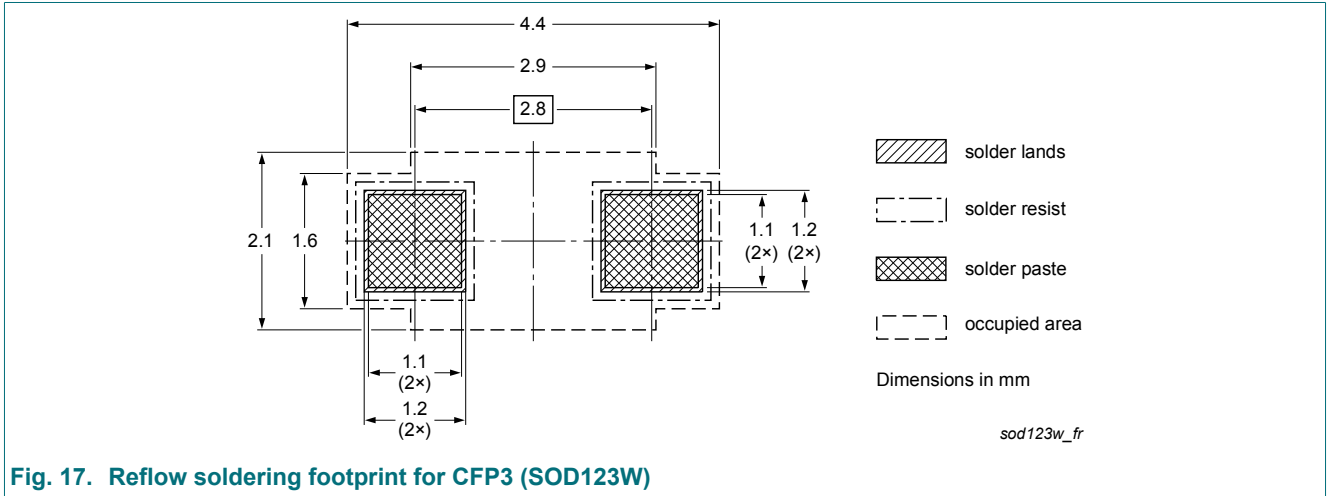


Fig. 17. Reflow soldering footprint for CFP3 (SOD123W)

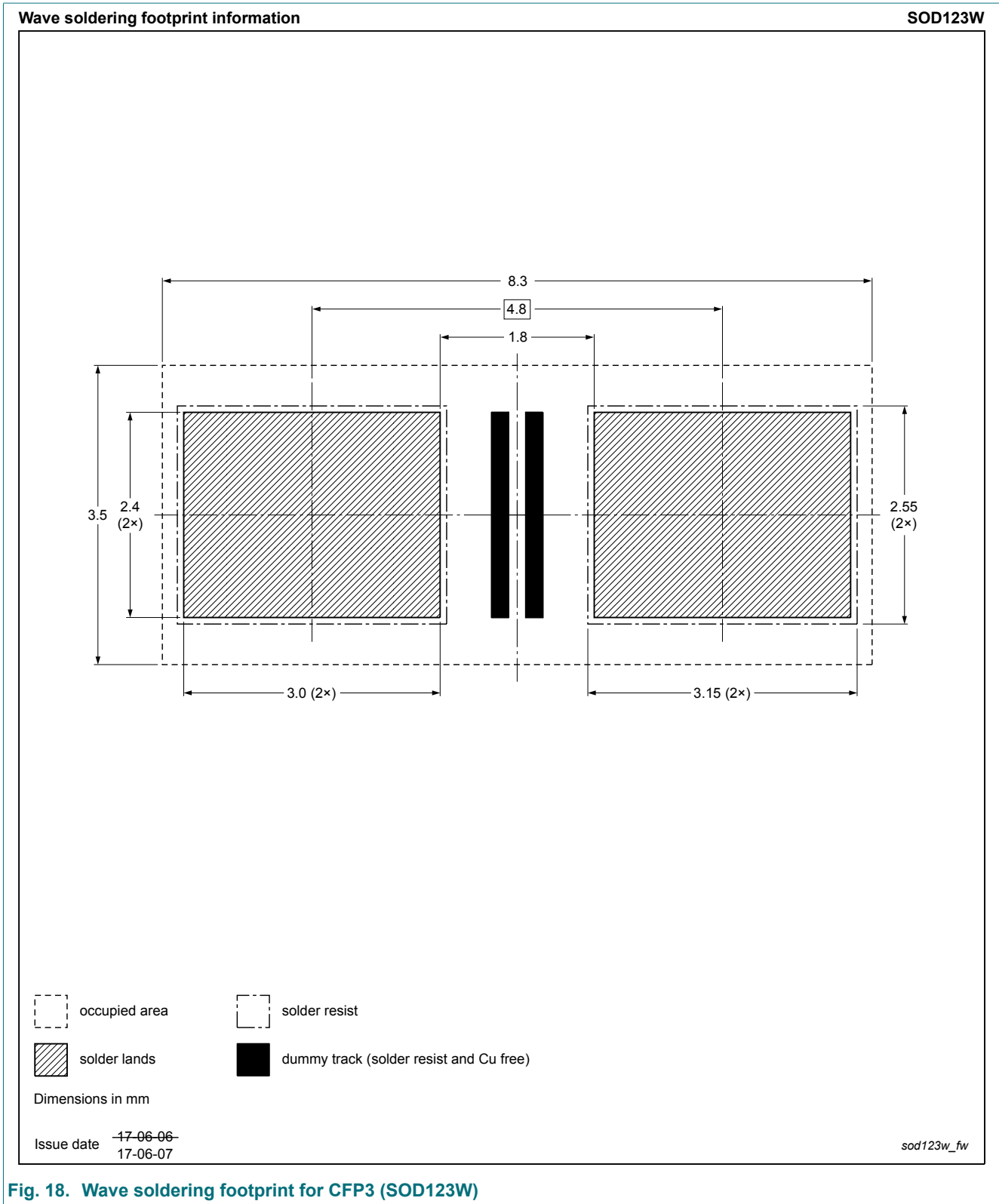


Fig. 18. Wave soldering footprint for CFP3 (SOD123W)

14. Revision history

Table 8. Revision history

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|--|------------------------|---------------|----------------|
| PNS40010ER v.3 | 20180822 | Product data sheet | - | PNS40010ER v.2 |
| Modifications: | <ul style="list-style-type: none">• Features and benefits: Capable for reflow and wave soldering added• Soldering: Wave soldering footprint added | | | |
| PNS40010ER v.2 | 20120821 | Product data sheet | - | PNS40010ER v.1 |
| PNS40010ER v.1 | 20120615 | 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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