



# ES3DP

200 V, 3 A hyperfast PN-rectifier

3 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 CFP5 (SOD128) Surface-Mounted Device (SMD) plastic package.

## 2. Features and benefits

- Reverse voltage  $V_R \leq 200$  V
- Forward current  $I_F \leq 3$  A
- Hyperfast recovery 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

## 3. Applications

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

## 4. Quick reference data

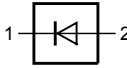
Table 1. Quick reference data

| Symbol      | Parameter                       | Conditions                                                          |     | Min | Typ | Max | Unit |
|-------------|---------------------------------|---------------------------------------------------------------------|-----|-----|-----|-----|------|
| $I_{F(AV)}$ | average forward current         | $\delta = 0.5$ ; $f = 20$ kHz; square wave;<br>$T_{sp} \leq 128$ °C |     | -   | -   | 3   | A    |
| $V_{RRM}$   | repetitive peak reverse voltage | $T_j = 25$ °C                                                       |     | -   | -   | 200 | V    |
| $V_R$       | reverse voltage                 |                                                                     |     | -   | -   | 200 | V    |
| $V_F$       | forward voltage                 | $I_F = 3$ A; pulsed; $T_j = 25$ °C                                  | [1] | -   | 900 | 980 | mV   |
|             |                                 | $I_F = 3$ A; pulsed; $T_j = 125$ °C                                 | [1] | -   | 755 | 840 | mV   |
| $I_R$       | reverse current                 | $V_R = 200$ V; pulsed; $T_j = 25$ °C                                | [1] | -   | 7   | 200 | nA   |
|             |                                 | $V_R = 200$ V; pulsed; $T_j = 125$ °C                               | [1] | -   | 2   | 30  | 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>CFP5 (SOD128) | <br>006aab040 |
| 2   | A      | anode       |                                                                                                    |                                                                                                  |

## 6. Ordering information

Table 3. Ordering information

| Type number | Package |                                                                                        |         |
|-------------|---------|----------------------------------------------------------------------------------------|---------|
|             | Name    | Description                                                                            | Version |
| ES3DP       | CFP5    | plastic, surface mounted package; 2 terminals; 4 mm pitch; 3.8 mm x 2.6 mm x 1 mm body | SOD128  |

## 7. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| ES3DP       | DP           |

## 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                     | $\delta = 1$ ; $T_{sp} \leq 121\text{ °C}$                                                                     |     | -   | 4.24  | A    |
| $I_{F(AV)}$ | average forward current             | $\delta = 0.5$ ; $f = 20\text{ kHz}$ ; square wave; $T_{sp} \leq 128\text{ °C}$                                |     | -   | 3     | A    |
| $I_{FSM}$   | non-repetitive peak forward current | $t_p = 8.3\text{ ms}$ ; $T_{j(init)} = 25\text{ °C}$ ; single half sine wave (applied at rated load condition) |     | -   | 60    | A    |
| $P_{tot}$   | total power dissipation             | $T_{amb} \leq 25\text{ °C}$                                                                                    | [1] | -   | 835   | mW   |
|             |                                     |                                                                                                                | [2] | -   | 1.316 | W    |
| $T_j$       | junction temperature                |                                                                                                                |     | -   | 150   | °C   |
| $T_{amb}$   | ambient temperature                 |                                                                                                                |     | -55 | 150   | °C   |
| $T_{stg}$   | storage temperature                 |                                                                                                                |     | -65 | 150   | °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] | -   | -   | 150 | K/W  |
|                |                                                  |             | [2] | -   | -   | 95  | K/W  |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point |             | [3] | -   | -   | 10  | 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.

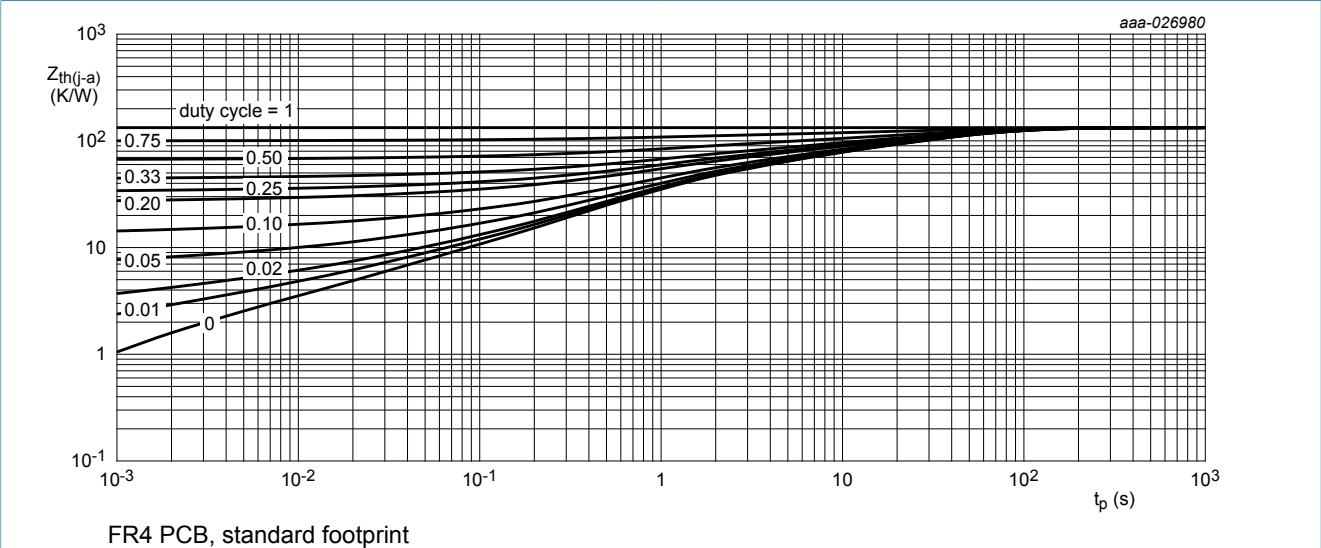


Fig. 1. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

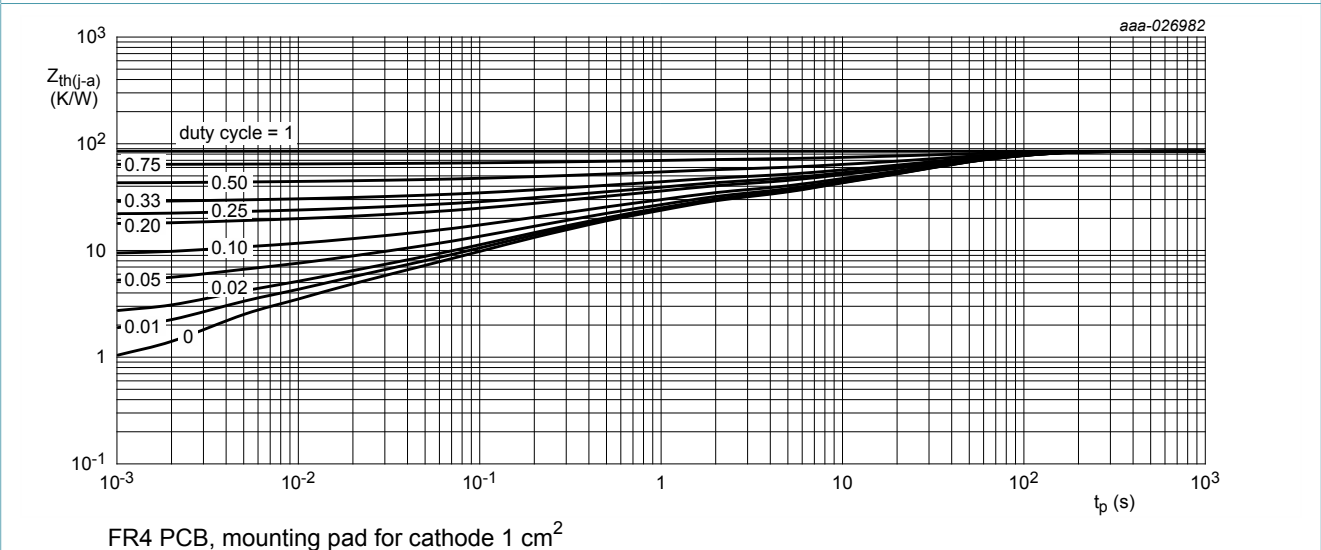


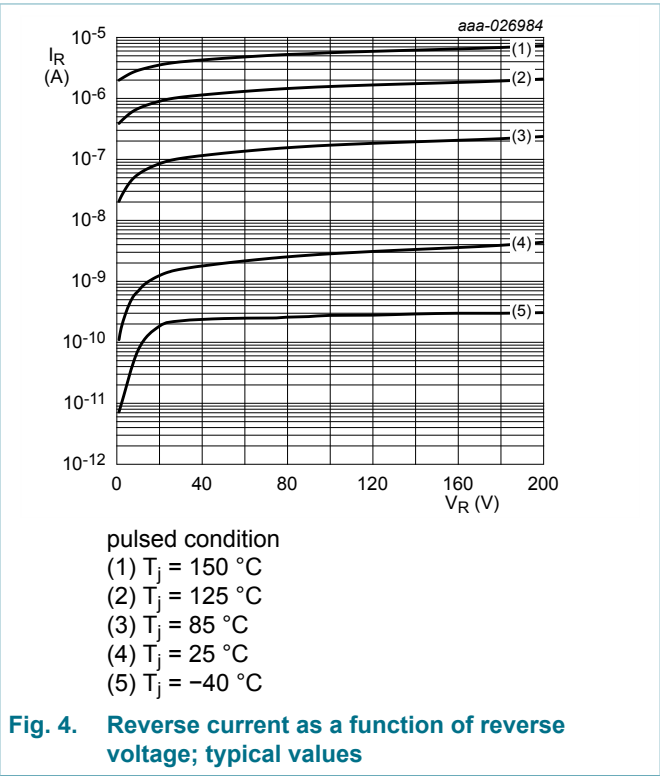
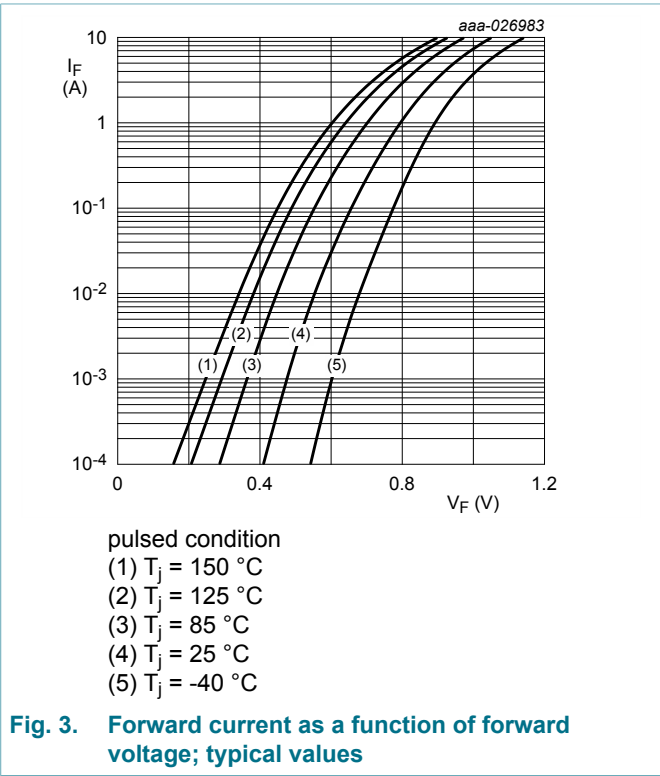
Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

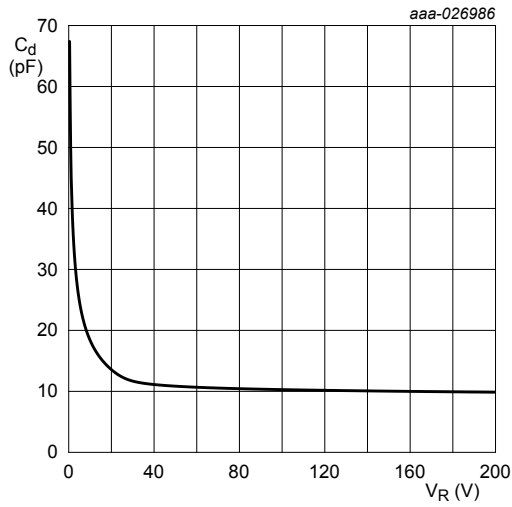
# 10. Characteristics

Table 7. Characteristics

| Symbol      | Parameter                                | Conditions                                                                   |     | Min | Typ | Max | Unit    |
|-------------|------------------------------------------|------------------------------------------------------------------------------|-----|-----|-----|-----|---------|
| $V_{(BR)R}$ | reverse breakdown voltage                | $I_R = 100 \mu A$ ; pulsed; $T_j = 25^\circ C$                               | [1] | 200 | -   | -   | V       |
| $V_F$       | forward voltage                          | $I_F = 3 A$ ; pulsed; $T_j = 25^\circ C$                                     | [1] | -   | 900 | 980 | mV      |
|             |                                          | $I_F = 3 A$ ; pulsed; $T_j = 125^\circ C$                                    | [1] | -   | 755 | 840 | mV      |
| $I_R$       | reverse current                          | $V_R = 200 V$ ; pulsed; $T_j = 25^\circ C$                                   | [1] | -   | 7   | 200 | nA      |
|             |                                          | $V_R = 200 V$ ; pulsed; $T_j = 125^\circ C$                                  | [1] | -   | 2   | 30  | $\mu A$ |
| $C_d$       | diode capacitance                        | $V_R = 4 V$ ; $f = 1 MHz$ ; $T_j = 25^\circ C$                               |     | -   | 27  | -   | pF      |
| $t_{rr}$    | reverse recovery time ;<br>step recovery | $I_F = 0.5 A$ ; $I_R = 1 A$ ; $I_{R(meas)} = 0.25 A$ ;<br>$T_j = 25^\circ C$ |     | -   | 12  | 25  | ns      |
|             | reverse recovery time ;<br>ramp recovery | $I_F = 1 A$ ; $V_R = 30 V$ ; $dI_F/dt = 50 A/\mu s$ ;<br>$T_j = 25^\circ C$  |     | -   | 25  | -   | ns      |
| $V_{FRM}$   | peak forward recovery voltage            | $I_F = 1 A$ ; $dI_F/dt = 50 A/\mu s$ ; $T_j = 25^\circ C$                    |     | -   | 810 | -   | mV      |

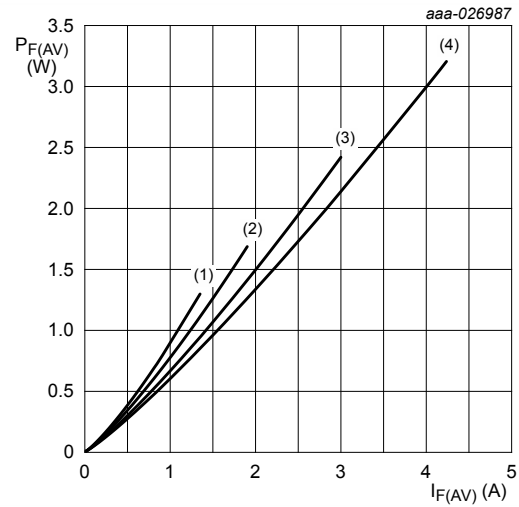
[1] Very short pulse, in order to maintain a stable junction temperature.





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

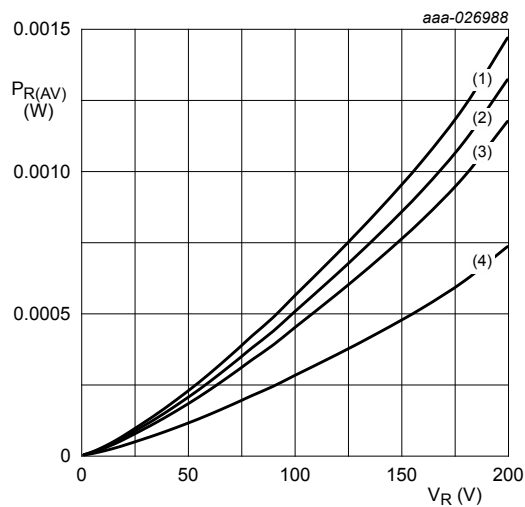
**Fig. 5.** Diode capacitance as a function of reverse voltage; typical values



$T_j = 150 \text{ }^{\circ}\text{C}$

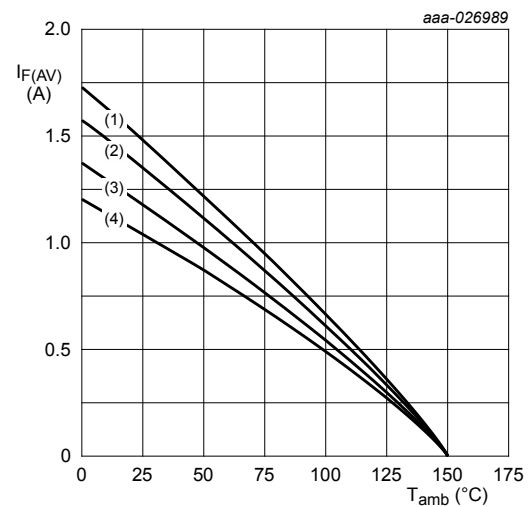
- (1)  $\delta = 0.1$
- (2)  $\delta = 0.2$
- (3)  $\delta = 0.5$
- (4)  $\delta = 1$ ; DC

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



- $T_j = 150 \text{ }^{\circ}\text{C}$
- (1)  $\delta = 1$ ; DC
  - (2)  $\delta = 0.9$
  - (3)  $\delta = 0.8$
  - (4)  $\delta = 0.5$

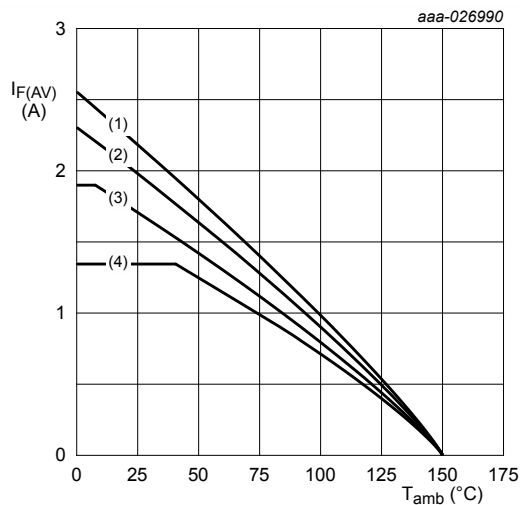
**Fig. 7.** Average reverse power dissipation as a function of reverse voltage; typical values



FR4 PCB, standard footprint

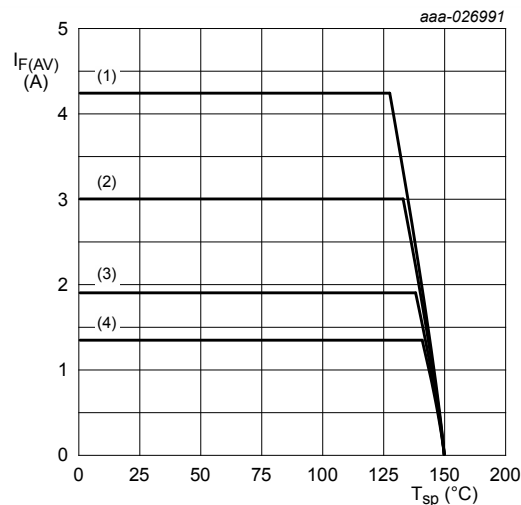
- $T_j = 150 \text{ }^{\circ}\text{C}$
- (1)  $\delta = 1$ ; DC
  - (2)  $\delta = 0.5$ ;  $f = 20 \text{ kHz}$
  - (3)  $\delta = 0.2$ ;  $f = 20 \text{ kHz}$
  - (4)  $\delta = 0.1$ ;  $f = 20 \text{ kHz}$

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



FR4 PCB, mounting pad for cathode 1 cm<sup>2</sup>  
 $T_j = 150$  °C  
(1)  $\delta = 1$ ; DC  
(2)  $\delta = 0.5$ ;  $f = 20$  kHz  
(3)  $\delta = 0.2$ ;  $f = 20$  kHz  
(4)  $\delta = 0.1$ ;  $f = 20$  kHz

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



$T_j = 150$  °C  
(1)  $\delta = 1$ ; DC  
(2)  $\delta = 0.5$ ;  $f = 20$  kHz  
(3)  $\delta = 0.2$ ;  $f = 20$  kHz  
(4)  $\delta = 0.1$ ;  $f = 20$  kHz

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

## 11. Test information

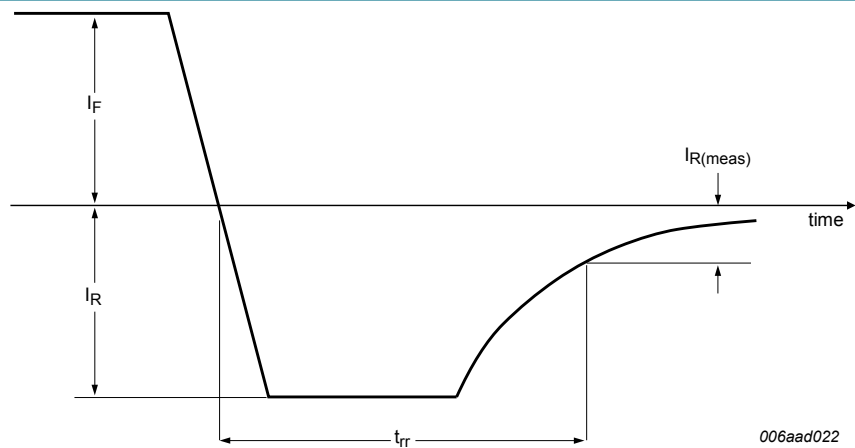


Fig. 11. Reverse recovery definition; step recovery

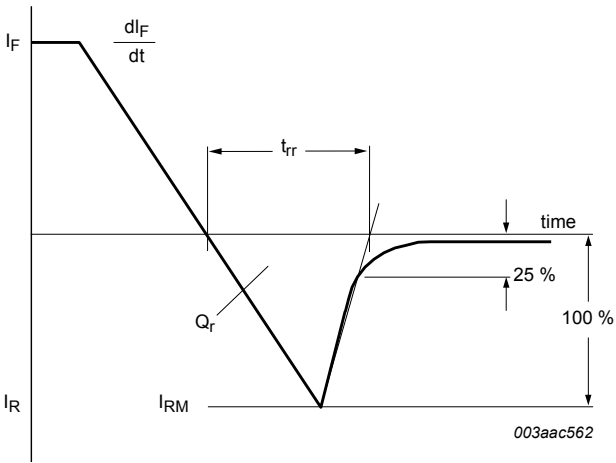


Fig. 12. Reverse recovery definition; ramp recovery

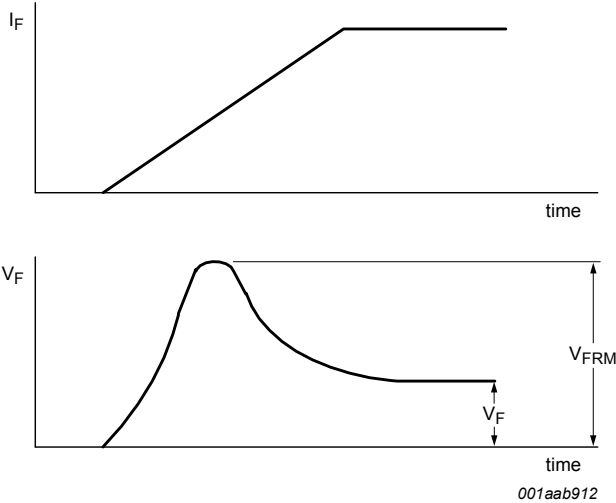


Fig. 13. Forward recovery definition

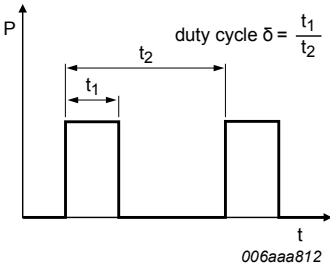
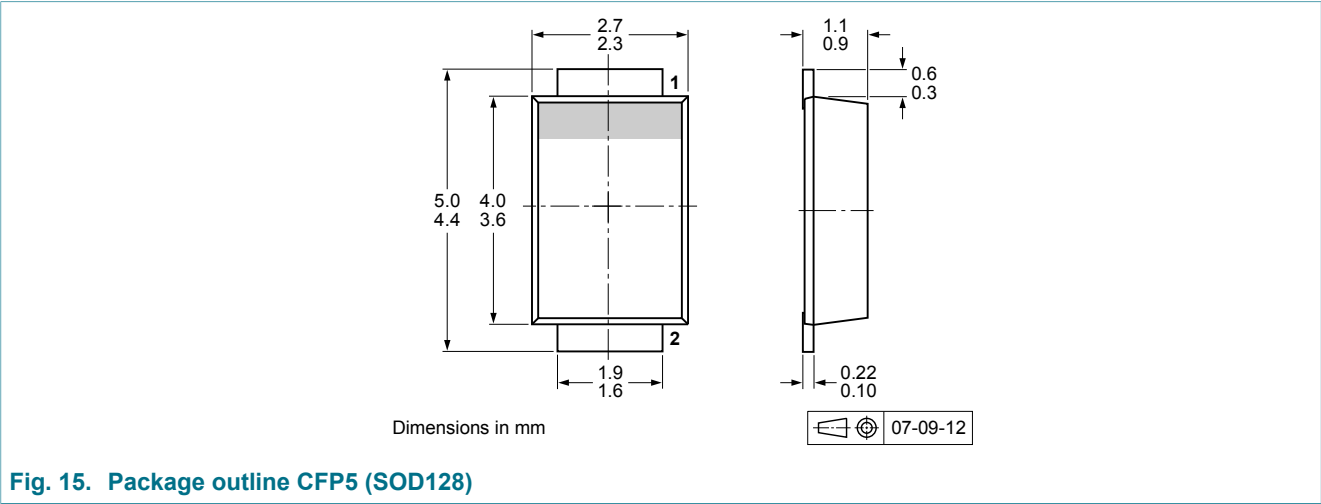


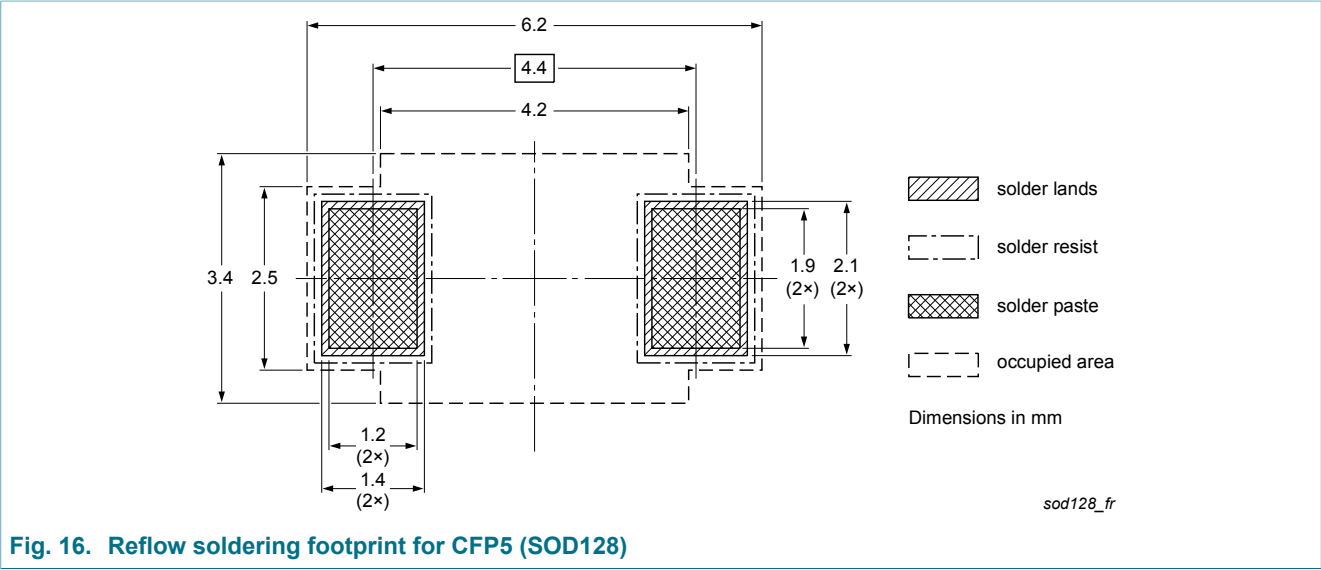
Fig. 14. Duty cycle definition

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.

12. Package outline



13. Soldering



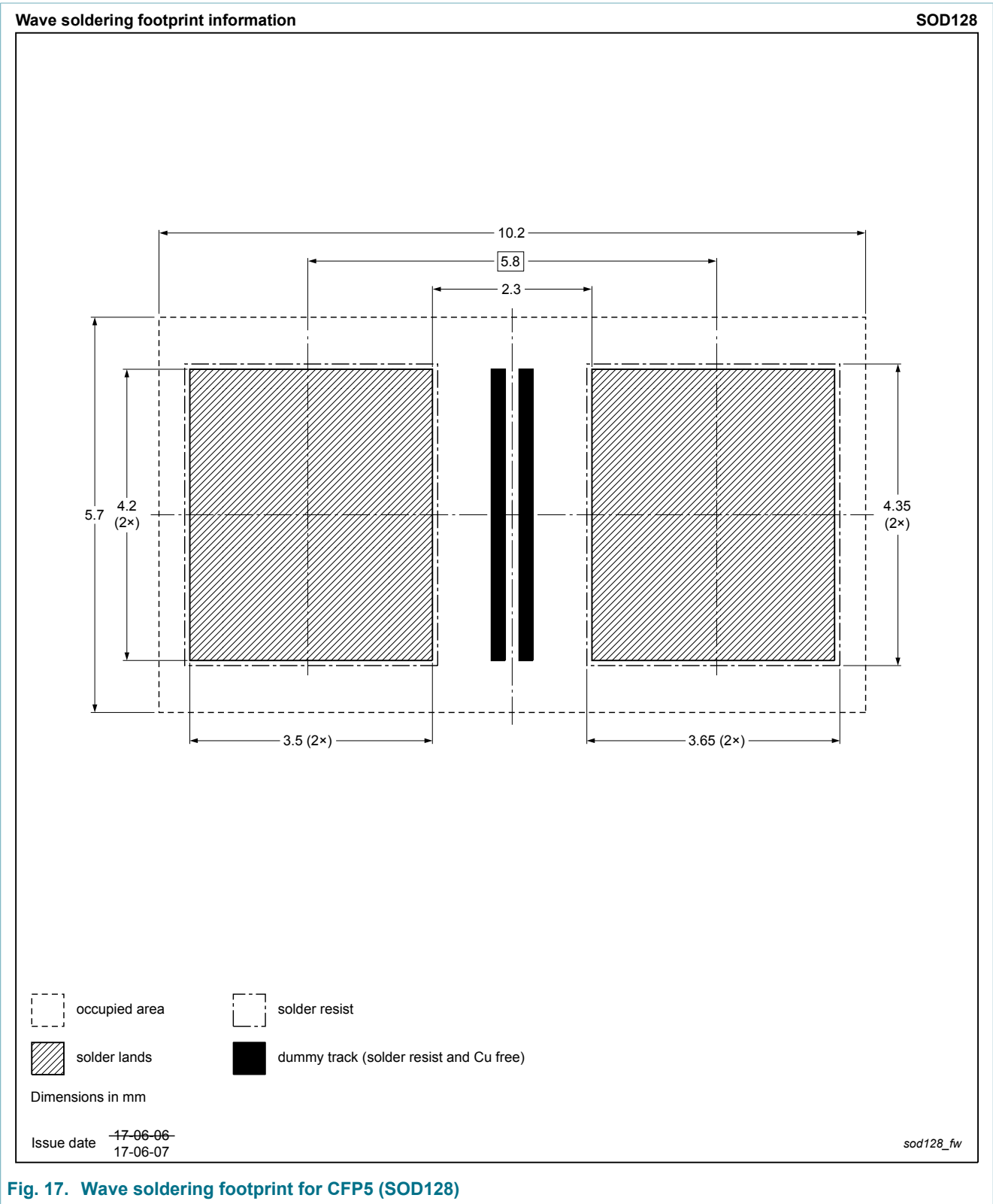


Fig. 17. Wave soldering footprint for CFP5 (SOD128)

14. Revision history

Table 8. Revision history

| Data sheet ID | Release date | Data sheet status  | Change notice | Supersedes |
|---------------|--------------|--------------------|---------------|------------|
| ES3DP v.1     | 20170803     | Product 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. |
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| Product [short] data sheet     | Production         | This document contains the product specification.                                     |

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