



# PNE20040EPE

200 V, 4 A hyperfast recovery rectifier

16 June 2022

Product data sheet

## 1. General description

High power density, hyperfast switching time recovery rectifier with high-efficiency planar technology, encapsulated in a CFP15B (SOT1289B) power and flat lead Surface-Mounted Device (SMD) plastic package.

## 2. Features and benefits

- Reverse voltage:  $V_R \leq 200$  V
- Forward current:  $I_F \leq 4$  A
- Switching time:  $t_{rr} \leq 30$  ns
- Pt doped life time control
- Low inductance
- Power and flat lead SMD plastic package
- Package height typical 0.95 mm
- High power capability due to clip-bond technology
- Planar die design

## 3. Applications

- General-purpose rectification
- Reverse polarity protection
- Hyperfast switching
- Freewheeling applications
- Engine Control Unit (ECU)

## 4. Quick reference data

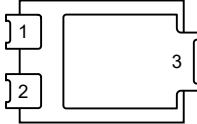
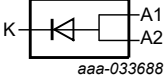
Table 1. Quick reference data

| Symbol      | Parameter                       | Conditions                                                       |     | Min | Typ | Max | Unit |
|-------------|---------------------------------|------------------------------------------------------------------|-----|-----|-----|-----|------|
| $I_{F(AV)}$ | average forward current         | $\delta = 0.5$ ; $f = 20$ kHz; square wave; $T_{sp} \leq 173$ °C |     | -   | -   | 4   | A    |
| $V_R$       | reverse voltage                 | $T_j = 25$ °C                                                    |     | -   | -   | 200 | V    |
| $V_{RRM}$   | repetitive peak reverse voltage |                                                                  |     | -   | -   | 200 | V    |
| $V_F$       | forward voltage                 | $I_F = 4$ A; $T_j = 25$ °C                                       | [1] | -   | 860 | 930 | mV   |
|             |                                 | $I_F = 4$ A; $T_j = 125$ °C                                      | [1] | -   | 710 | 780 | mV   |
| $I_R$       | reverse current                 | $V_R = 200$ V; $T_j = 25$ °C                                     | [1] | -   | -   | 1   | µA   |
|             |                                 | $V_R = 200$ V; $T_j = 125$ °C                                    | [1] | -   | 1.5 | 10  | 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   | A1     | anode 1     | <br>CFP15B (SOT1289B) | <br>aaa-033688 |
| 2   | A2     | anode 2     |                                                                                                        |                                                                                                   |
| 3   | K      | cathode     |                                                                                                        |                                                                                                   |

6. Ordering information

Table 3. Ordering information

| Type number                 | Package |                                                                                                    |                          |
|-----------------------------|---------|----------------------------------------------------------------------------------------------------|--------------------------|
|                             | Name    | Description                                                                                        | Version                  |
| <a href="#">PNE20040EPE</a> | CFP15B  | plastic, thermal enhanced ultra thin SMD package; 3 leads; 2.13 mm pitch; 5.8 x 4.3 x 0.95 mm body | <a href="#">SOT1289B</a> |

7. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| PNE20040EPE | 200E<br>104E |

8. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC60134)

| Symbol          | Parameter                           | Conditions                                                                                                                  |     | Min | Max  | Unit               |
|-----------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-----|-----|------|--------------------|
| $V_R$           | reverse voltage                     | $T_j = 25\text{ }^{\circ}\text{C}$                                                                                          |     | -   | 200  | V                  |
| $V_{RRM}$       | repetitive peak reverse voltage     |                                                                                                                             |     | -   | 200  | V                  |
| $V_{R(RMS)lim}$ | limiting RMS reverse voltage        |                                                                                                                             |     | -   | 140  | V                  |
| $I_F$           | forward current                     | $\delta = 1$ ; $T_{sp} \leq 150\text{ }^{\circ}\text{C}$                                                                    |     | -   | 5.6  | A                  |
| $I_{F(AV)}$     | average forward current             | $\delta = 0.5$ ; $f = 20\text{ kHz}$ ; square wave; $T_{sp} \leq 173\text{ }^{\circ}\text{C}$                               |     | -   | 4    | A                  |
| $I_{FSM}$       | non-repetitive peak forward current | $t_p = 8.3\text{ ms}$ ; single half sine wave (applied at rated load condition); $T_{j(init)} = 25\text{ }^{\circ}\text{C}$ |     | -   | 130  | A                  |
| $P_{tot}$       | total power dissipation             | $T_{amb} \leq 25\text{ }^{\circ}\text{C}$                                                                                   | [1] | -   | 1.75 | W                  |
|                 |                                     |                                                                                                                             | [2] | -   | 2.15 | 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 Printed-Circuit Board (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] | -   | -   | 85  | K/W  |
|                |                                                  |             | [2] | -   | -   | 70  | K/W  |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point |             | [3] | -   | -   | 1.2 | 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.

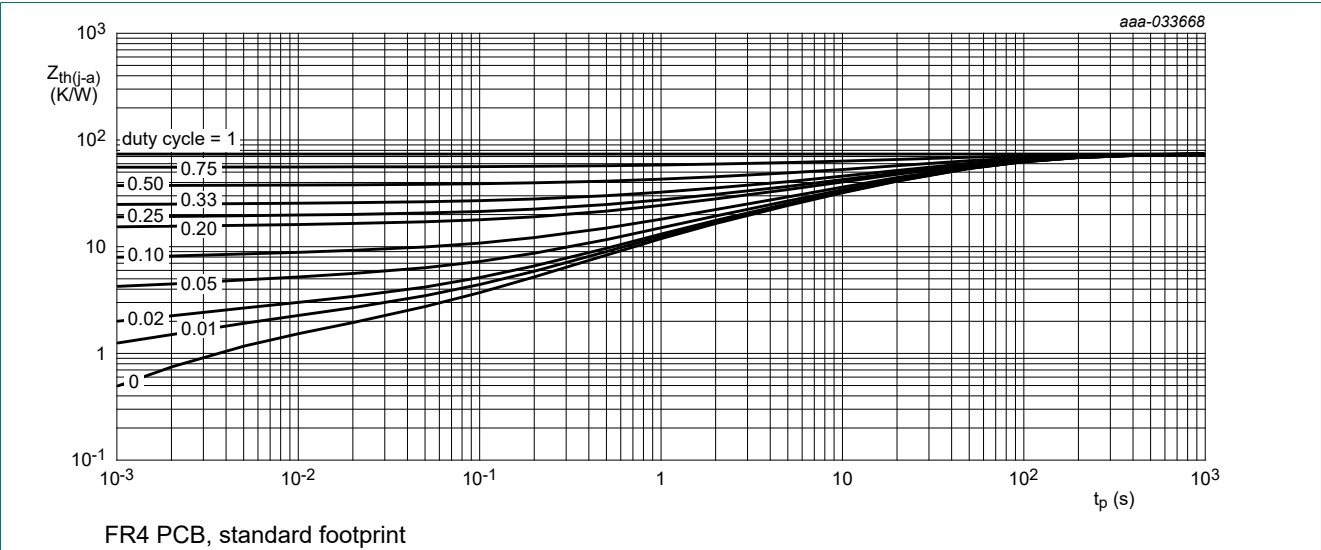


Fig. 1. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

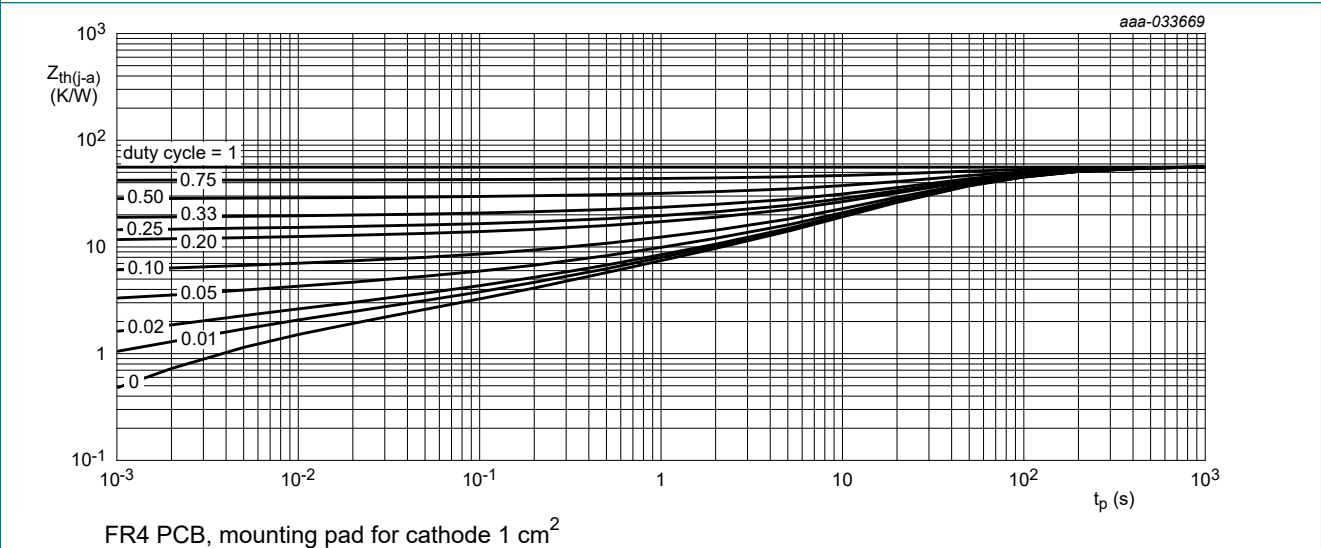


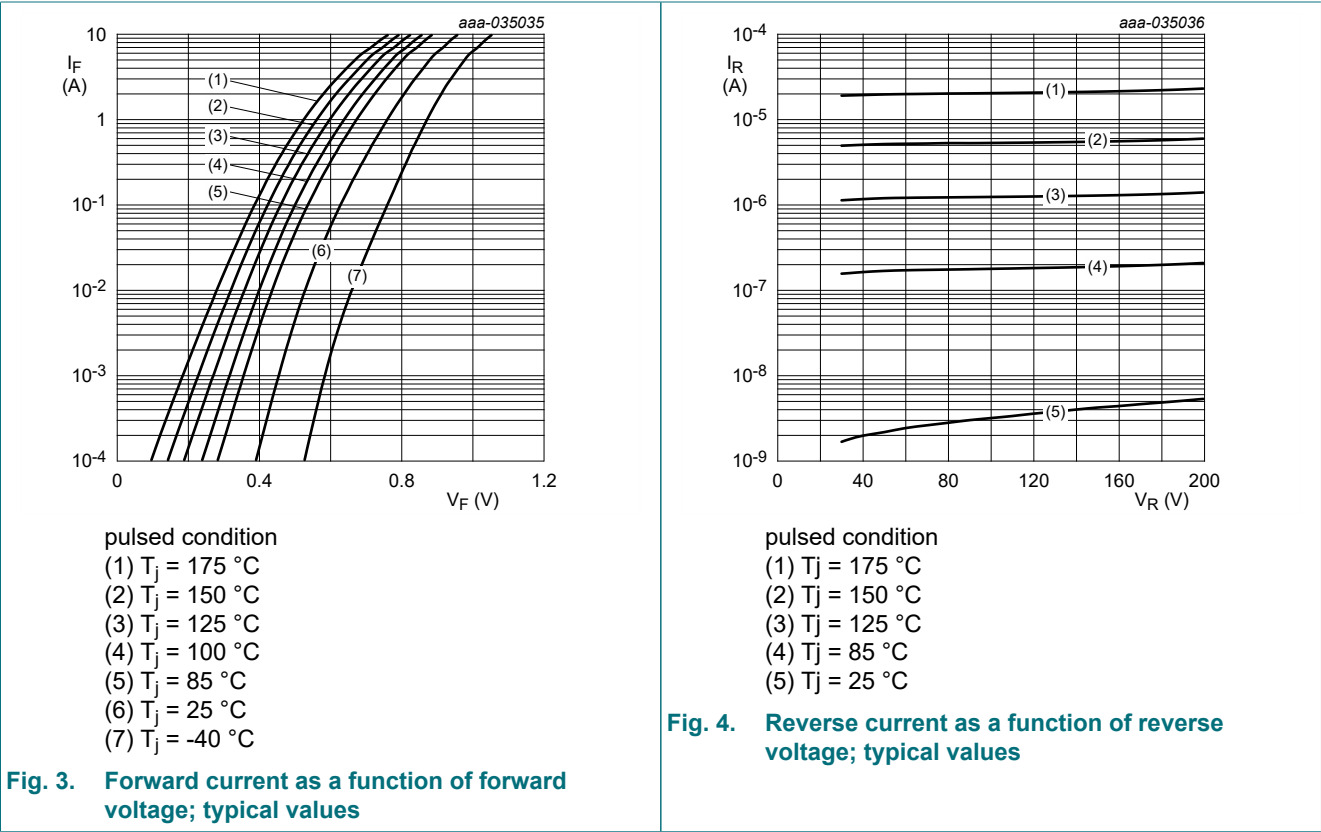
Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

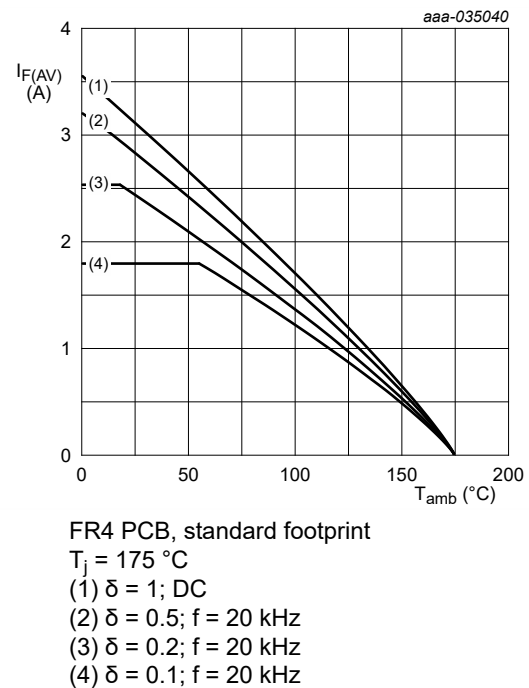
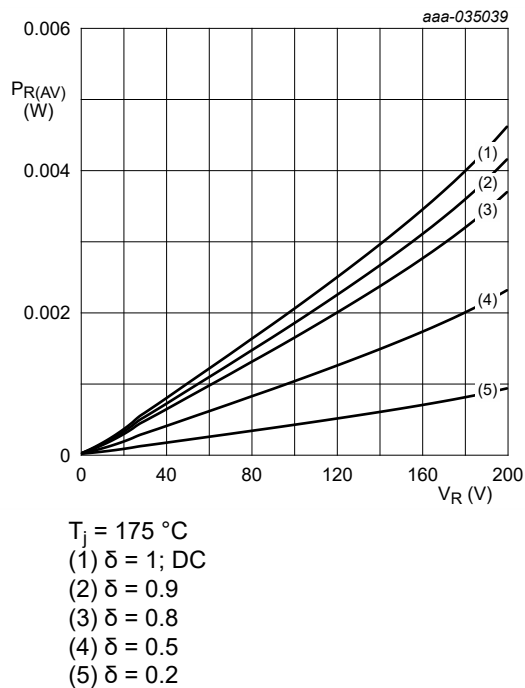
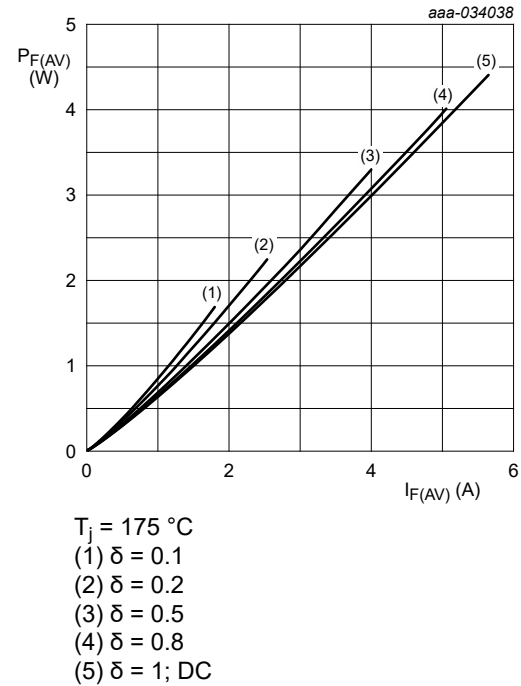
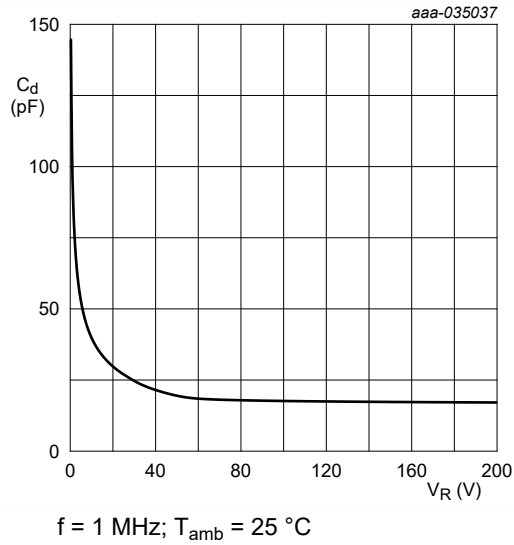
10. Characteristics

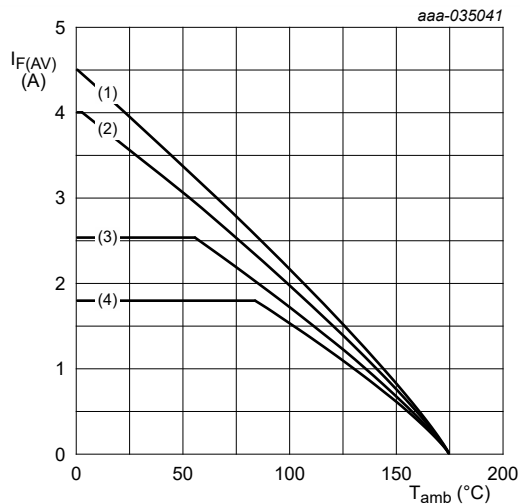
Table 7. Characteristics

| Symbol      | Parameter                           | Conditions                                                                                                            |     | Min | Typ | Max | Unit          |
|-------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|---------------|
| $V_{(BR)R}$ | reverse breakdown voltage           | $I_R = 100\text{ }\mu\text{A}$ ; $T_j = 25\text{ }^{\circ}\text{C}$                                                   | [1] | 200 | -   | -   | V             |
| $V_F$       | forward voltage                     | $I_F = 4\text{ A}$ ; $T_j = 25\text{ }^{\circ}\text{C}$                                                               | [1] | -   | 860 | 930 | mV            |
|             |                                     | $I_F = 4\text{ A}$ ; $T_j = 125\text{ }^{\circ}\text{C}$                                                              | [1] | -   | 710 | 780 | mV            |
| $I_R$       | reverse current                     | $V_R = 200\text{ V}$ ; $T_j = 25\text{ }^{\circ}\text{C}$                                                             | [1] | -   | -   | 1   | $\mu\text{A}$ |
|             |                                     | $V_R = 200\text{ V}$ ; $T_j = 125\text{ }^{\circ}\text{C}$                                                            | [1] | -   | 1.5 | 10  | $\mu\text{A}$ |
| $C_d$       | diode capacitance                   | $V_R = 4\text{ V}$ ; $f = 1\text{ MHz}$ ; $T_j = 25\text{ }^{\circ}\text{C}$                                          |     | -   | 61  | -   | pF            |
| $t_{rr}$    | reverse recovery time step recovery | $I_F = 0.5\text{ A}$ ; $I_R = 1\text{ A}$ ; $I_{R(\text{meas})} = 0.25\text{ A}$ ; $T_j = 25\text{ }^{\circ}\text{C}$ |     | -   | 12  | 30  | ns            |
|             | reverse recovery time ramp recovery | $di_F/dt = 50\text{ A}/\mu\text{s}$ ; $I_F = 1\text{ A}$ ; $V_R = 30\text{ V}$ ; $T_j = 25\text{ }^{\circ}\text{C}$   |     | -   | 18  | -   | ns            |
| $V_{FRM}$   | peak forward recovery voltage       | $I_F = 1\text{ A}$ ; $di_F/dt = 50\text{ A}/\mu\text{s}$ ; $T_j = 25\text{ }^{\circ}\text{C}$                         |     | -   | 830 | -   | mV            |

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

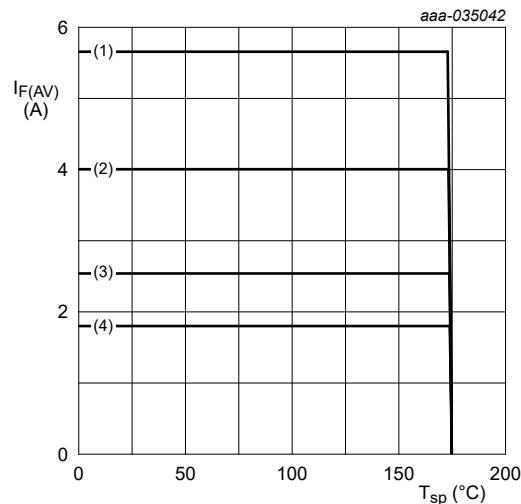






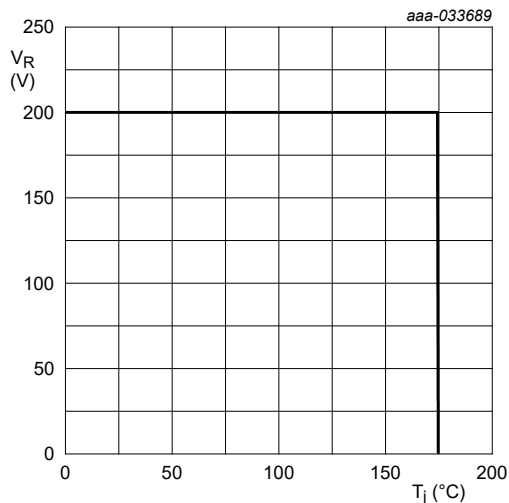
FR4 PCB, mounting pad for cathode 1 cm<sup>2</sup>  
 $T_j = 175$  °C  
(1)  $\delta = 1$ ; DC  
(2)  $\delta = 0.5$ ;  $f = 20$  kHz  
(3)  $\delta = 0.2$ ;  $f = 20$  kHz  
(4)  $\delta = 0.1$ ;  $f = 20$  kHz

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



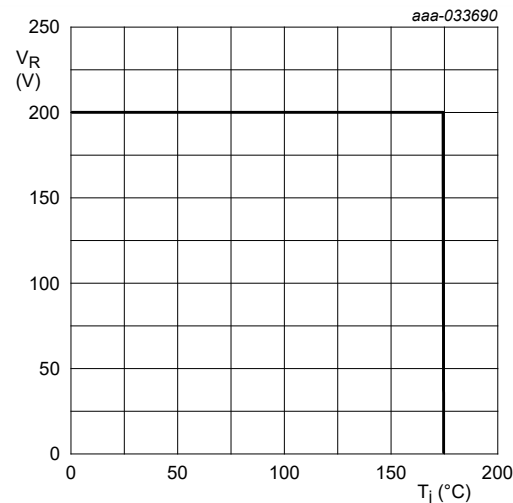
$T_j = 175$  °C  
(1)  $\delta = 1$ ; DC  
(2)  $\delta = 0.5$ ;  $f = 20$  kHz  
(3)  $\delta = 0.2$ ;  $f = 20$  kHz  
(4)  $\delta = 0.1$ ;  $f = 20$  kHz

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



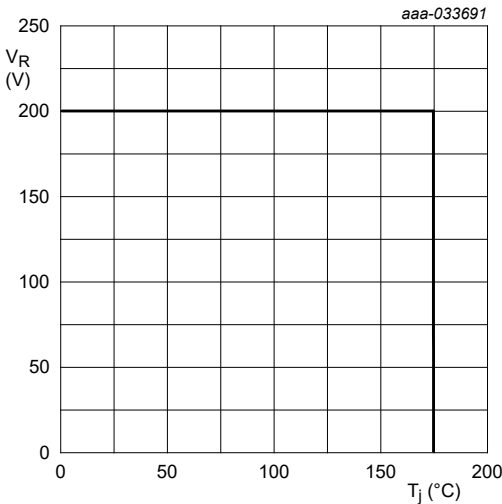
FR4 PCB, standard footprint  
 $R_{th} = 85$  K/W

Fig. 11. Derated maximum reverse voltage as a function of junction temperature; typical values



FR4 PCB, mounting pad for cathode 1 cm<sup>2</sup>  
 $R_{th} = 70$  K/W

Fig. 12. Derated maximum reverse voltage as a function of junction temperature; typical values



Soldering point of cathode tab  
 $R_{th} = 1.2 \text{ K/W}$

Fig. 13. Derated maximum reverse voltage as a function of junction temperature; typical values

11. Test information

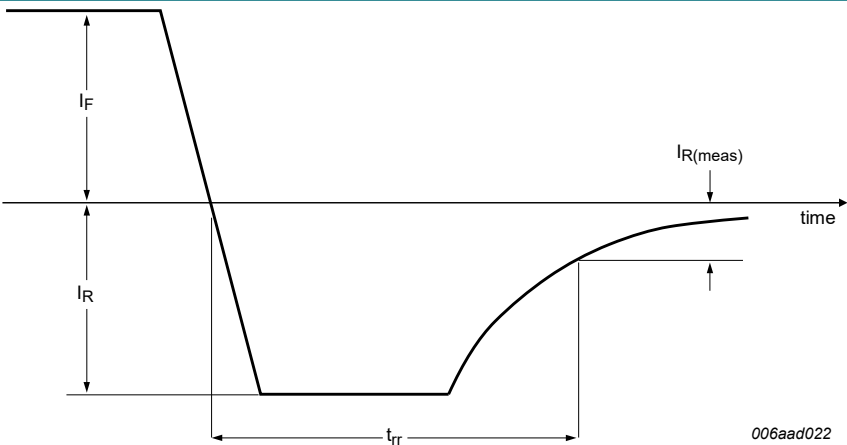


Fig. 14. Reverse recovery definition; step recovery

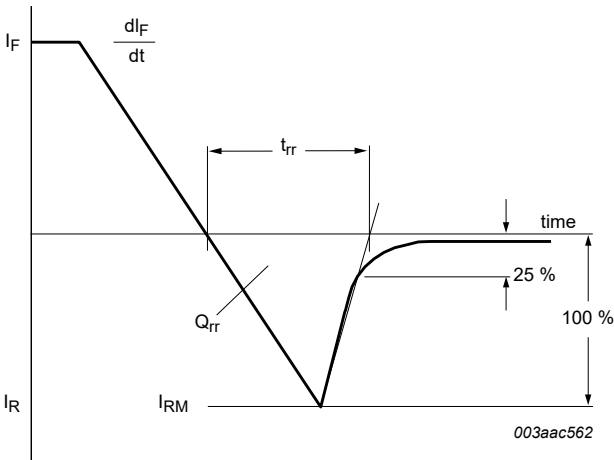


Fig. 15. Reverse recovery definition; ramp recovery

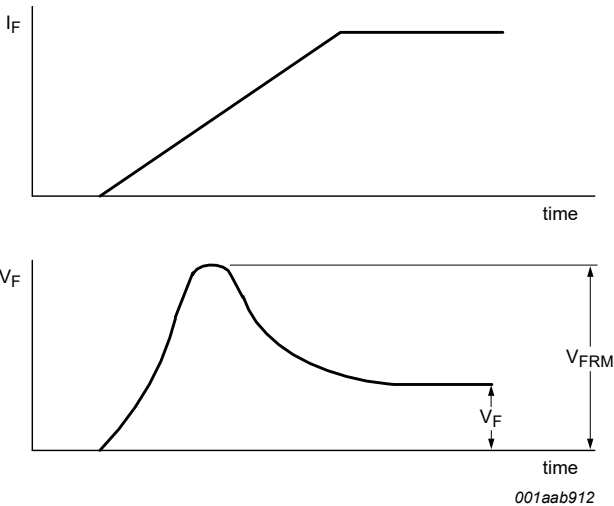


Fig. 16. Forward recovery definition

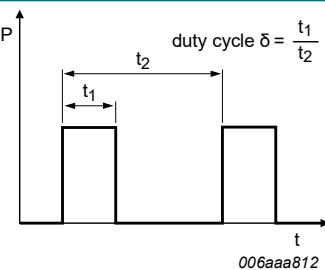


Fig. 17. Duty cycle definition

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

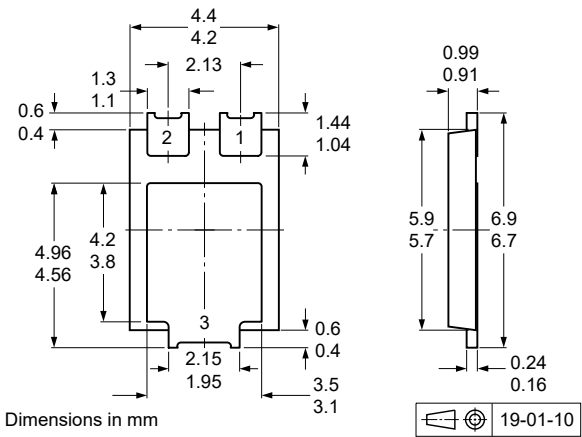


Fig. 18. Package outline CFP15B (SOT1289B)

13. Soldering

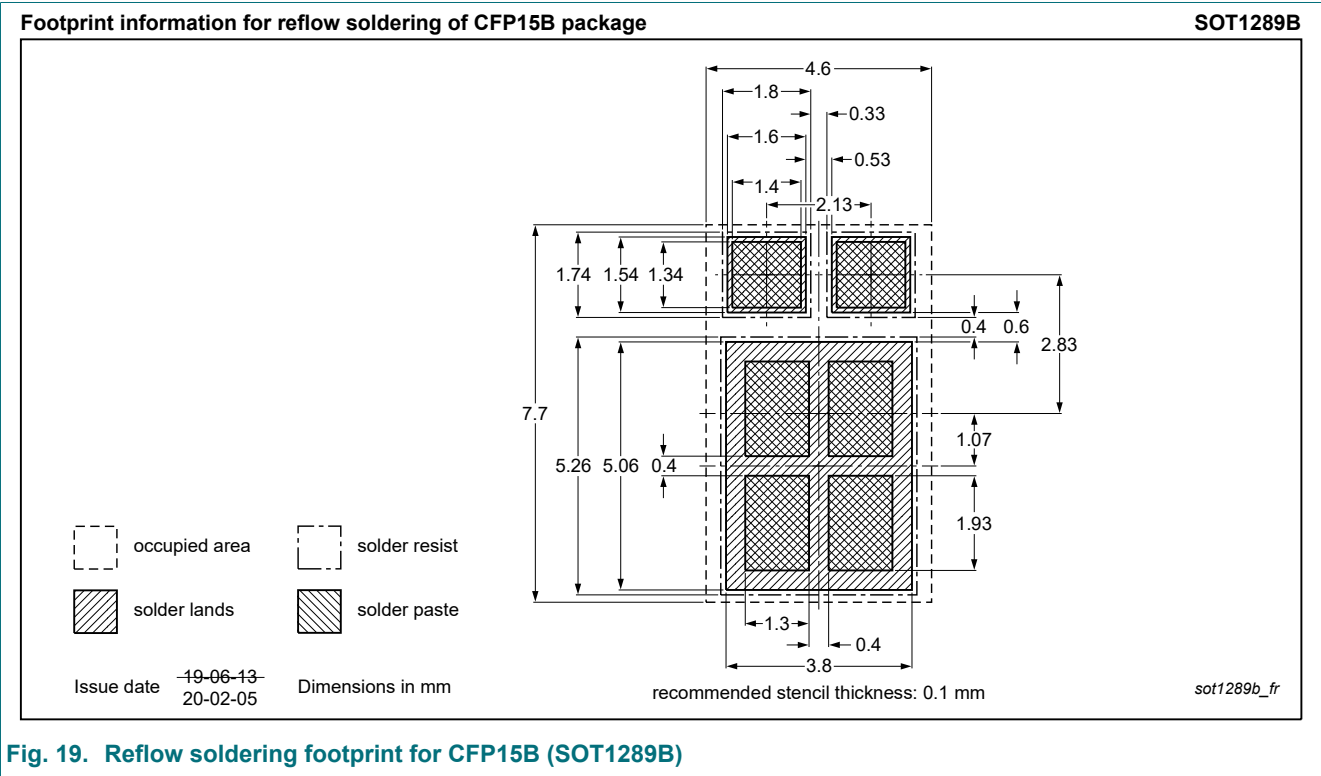


Fig. 19. Reflow soldering footprint for CFP15B (SOT1289B)

14. Revision history

Table 8. Revision history

| Data sheet ID   | Release date | Data sheet status  | Change notice | Supersedes |
|-----------------|--------------|--------------------|---------------|------------|
| PNE20040EPE v.1 | 20220616     | Product data sheet | -             | -          |

## 15. Legal information

### Data sheet status

| Document status<br>[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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