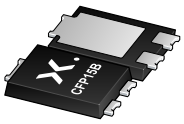


# PNE20060EPE

## 200 V, 6 A hyperfast recovery rectifier

13 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: $I_F \leq 6$ 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; $T_{sp} \leq 170$ °C | | - | - | 6 | A |
| $V_R$ | reverse voltage | $T_j = 25$ °C | | - | - | 200 | V |
| $V_{RRM}$ | repetitive peak reverse voltage | | | - | - | 200 | V |
| $V_F$ | forward voltage | $I_F = 6$ A; $T_j = 25$ °C | [1] | - | 880 | 940 | mV |
| | | $I_F = 6$ A; $T_j = 125$ °C | [1] | - | 740 | 800 | 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] | - | 2 | 15 | µA |

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

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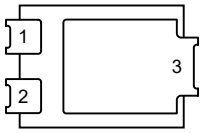
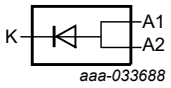
# 5. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | A1 | anode 1 |  CFP15B (SOT1289B) |  |
| 2 | A2 | anode 2 | | |
| 3 | K | cathode | | |

# 6. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| PNE20060EPE | CFP15B | plastic, thermal enhanced ultra thin SMD package; 3 leads; 2.13 mm pitch; 5.8 x 4.3 x 0.95 mm body | SOT1289B |

# 7. Marking

**Table 4. Marking codes**

| Type number | Marking code |
|---|---|
| PNE20060EPE | 200E<br>106E |

# 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 °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 | δ = 1; $T_{sp}$ ≤ 150 °C | | - | 8.5 | A |
| $I_{F(AV)}$ | average forward current | δ = 0.5; f = 20 kHz; square wave; $T_{sp}$ ≤ 170 °C | | - | 6 | A |
| $I_{FSM}$ | non-repetitive peak forward current | $t_p$ = 8.3 ms; single half sine wave (applied at rated load condition); $T_{j(init)}$ = 25 °C | | - | 150 | A |
| $P_{tot}$ | total power dissipation | $T_{amb}$ ≤ 25 °C | [1] | - | 1.75 | W |
| | | | [2] | - | 2.15 | W |
| $T_j$ | junction temperature | | | - | 175 | °C |
| $T_{amb}$ | ambient temperature | | | -55 | 175 | °C |
| $T_{stg}$ | storage temperature | | | -65 | 175 | °C |

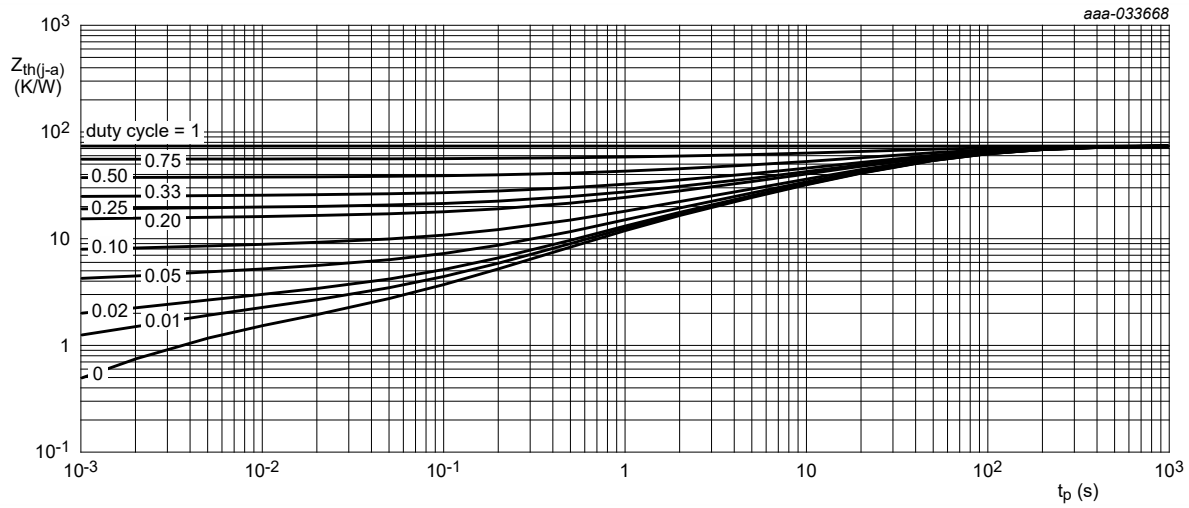
[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for cathode 1 $cm^2$.

# 9. Thermal characteristics

**Table 6. Thermal characteristics**

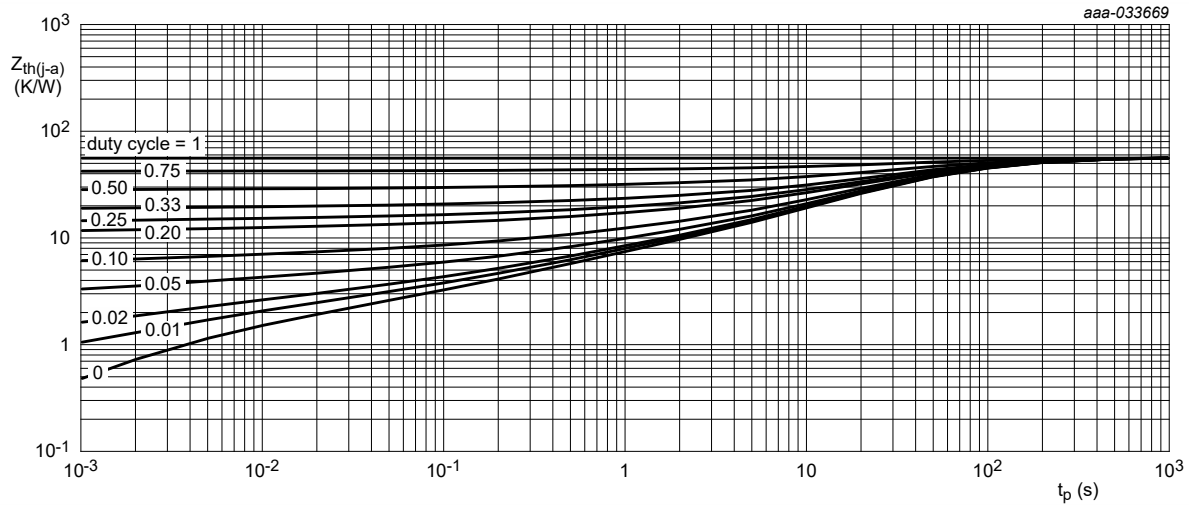
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] | - | - | 85 | K/W |
| | | | [2] | - | - | 70 | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | [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 $cm^2$.
[3] Soldering point of cathode tab.




FR4 PCB, standard footprint

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




FR4 PCB, mounting pad for cathode 1 $cm^2$

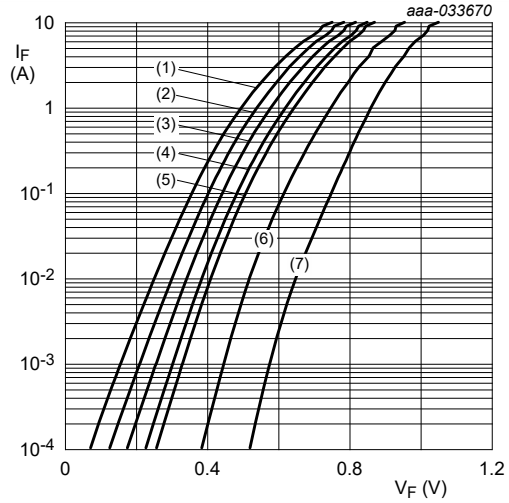
**Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values**

# 10. Characteristics

**Table 7. Characteristics**

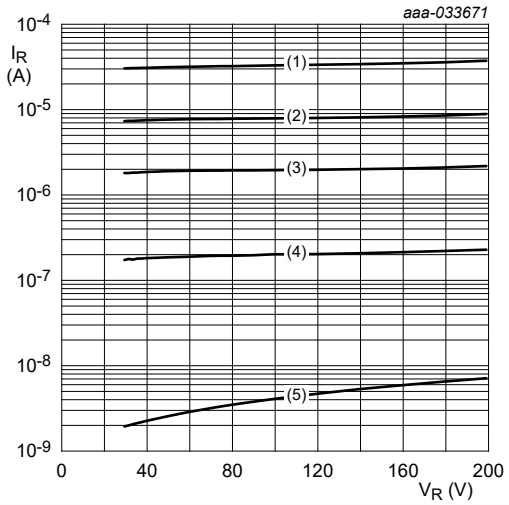
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{(BR)R}$ | reverse breakdown voltage | $I_R$ = 100 µA; $T_j$ = 25 °C | [1] | 200 | - | - | V |
| $V_F$ | forward voltage | $I_F$ = 6 A; $T_j$ = 25 °C | [1] | - | 880 | 940 | mV |
| | | $I_F$ = 6 A; $T_j$ = 125 °C | [1] | - | 740 | 800 | 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] | - | 2 | 15 | µA |
| $C_d$ | diode capacitance | $V_R$ = 4 V; f = 1 MHz; $T_j$ = 25 °C | | - | 65 | - | 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 °C | | - | 14 | 30 | ns |
| | reverse recovery time ramp recovery | $dI_F/dt$ = 50 A/µs; $I_F$ = 1 A; $V_R$ = 30 V; $T_j$ = 25 °C | | - | 17 | - | ns |
| $V_{FRM}$ | peak forward recovery voltage | $I_F$ = 1 A; $dI_F/dt$ = 50 A/µs; $T_j$ = 25 °C | | - | 820 | - | mV |

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



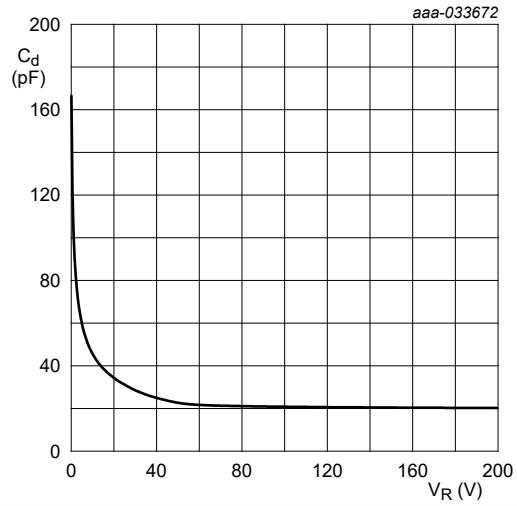

pulsed condition
(1) $T_j$ = 175 °C
(2) $T_j$ = 150 °C
(3) $T_j$ = 125 °C
(4) $T_j$ = 100 °C
(5) $T_j$ = 85 °C
(6) $T_j$ = 25 °C
(7) $T_j$ = -40 °C

**Fig. 3. Forward current as a function of forward voltage; typical values**



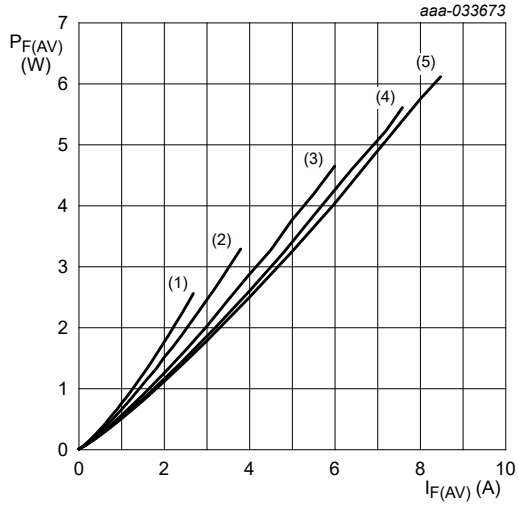

pulsed condition
(1) Tj = 175 °C
(2) Tj = 150 °C
(3) Tj = 125 °C
(4) Tj = 85 °C
(5) Tj = 25 °C

**Fig. 4. Reverse current as a function of reverse voltage; typical values**



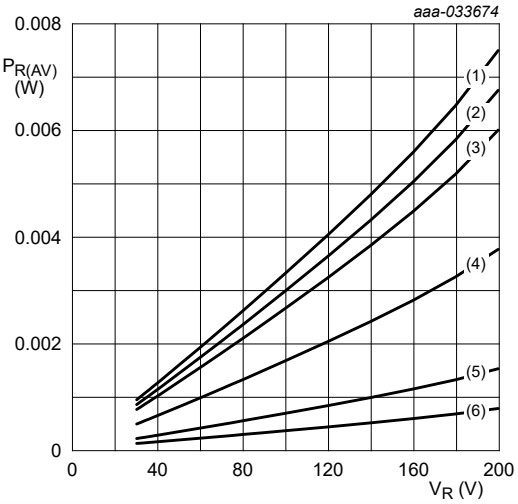

f = 1 MHz; $T_{amb}$ = 25 °C

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



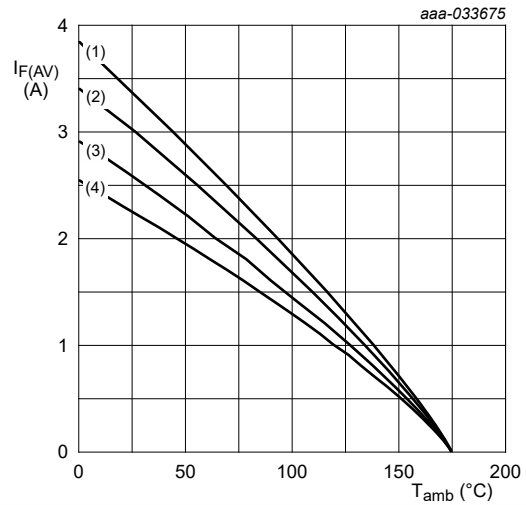

$T_j$ = 175 °C
(1) δ = 0.1
(2) δ = 0.2
(3) δ = 0.5
(4) δ = 0.8
(5) δ = 1; DC

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



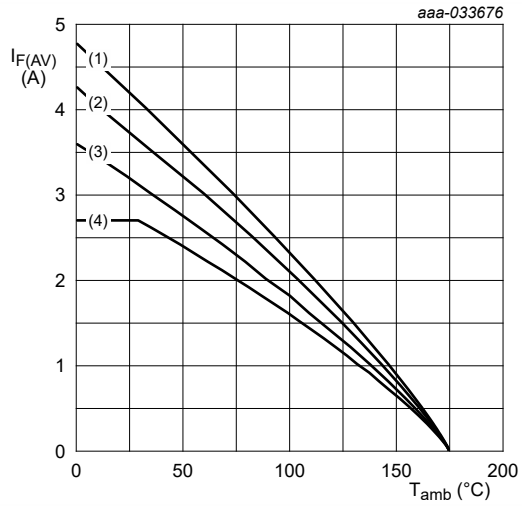

$T_j$ = 175 °C
(1) δ = 1; DC
(2) δ = 0.9
(3) δ = 0.8
(4) δ = 0.5
(5) δ = 0.2
(6) δ = 0.1

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



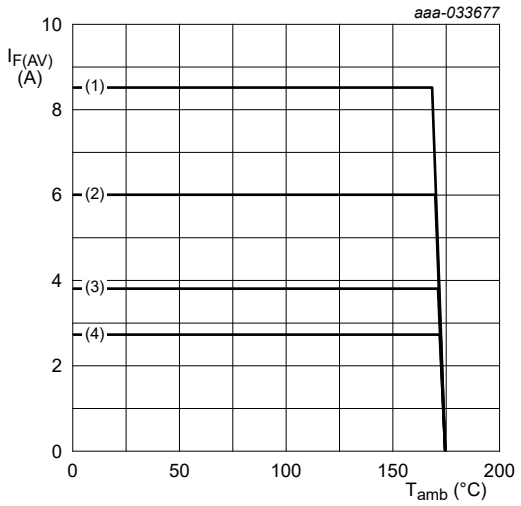

FR4 PCB, standard footprint
$T_j$ = 175 °C
(1) δ = 1; DC
(2) δ = 0.5; f = 20 kHz
(3) δ = 0.2; f = 20 kHz
(4) δ = 0.1; f = 20 kHz

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



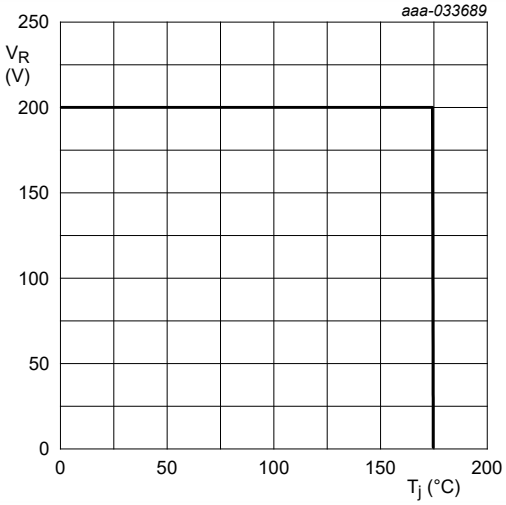

FR4 PCB, mounting pad for cathode 1 $cm^2$
$T_j$ = 175 °C
(1) δ = 1; DC
(2) δ = 0.5; f = 20 kHz
(3) δ = 0.2; f = 20 kHz
(4) δ = 0.1; f = 20 kHz

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



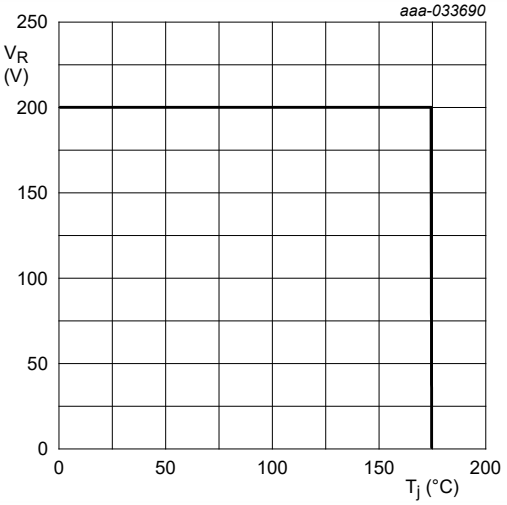

$T_j$ = 175 °C
(1) δ = 1; DC
(2) δ = 0.5; f = 20 kHz
(3) δ = 0.2; f = 20 kHz
(4) δ = 0.1; f = 20 kHz

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



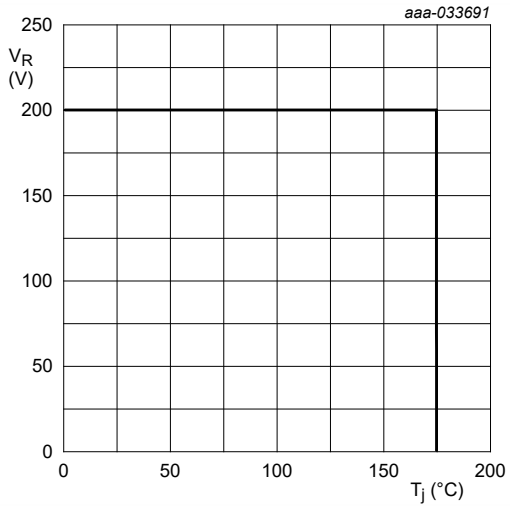

FR4 PCB, standard footprint
$R_{th}$ = 85 K/W

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




FR4 PCB, mounting pad for cathode 1 $cm^2$
$R_{th}$ = 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 K/W

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

## 11. Test information

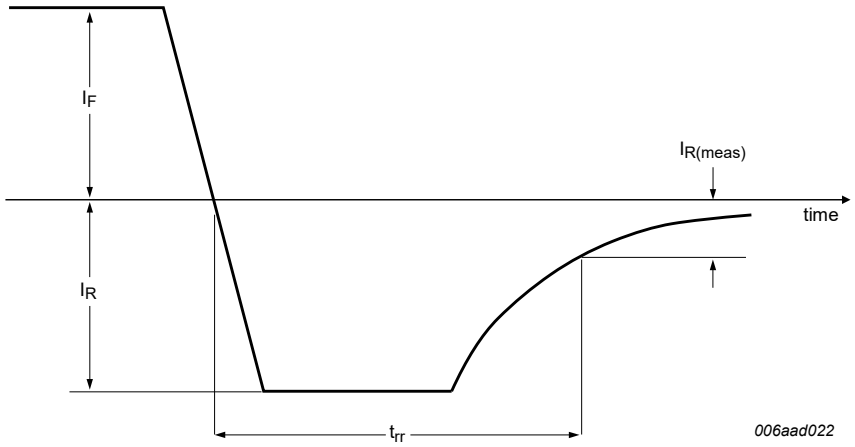



**Fig. 14. Reverse recovery definition; step recovery**

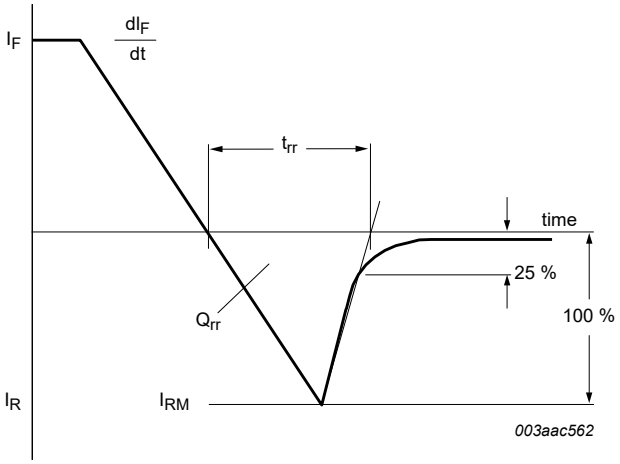



**Fig. 15. Reverse recovery definition; ramp recovery**

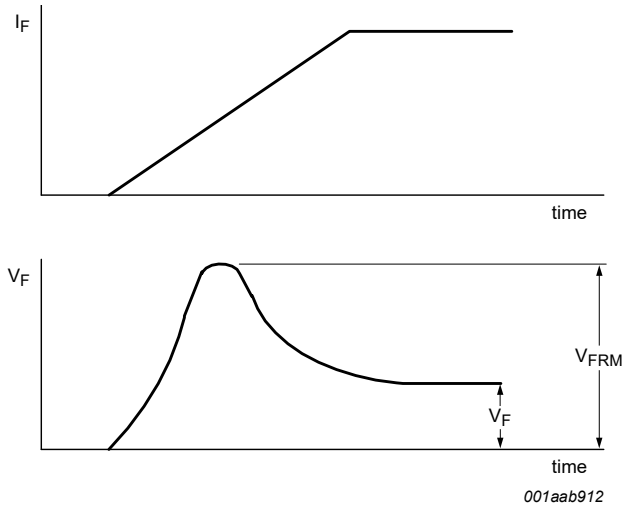



**Fig. 16. Forward recovery definition**

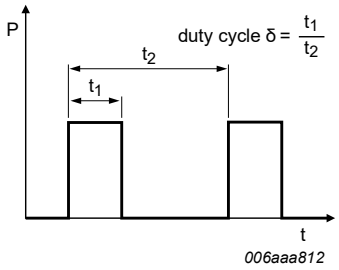



**Fig. 17. Duty cycle definition**

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

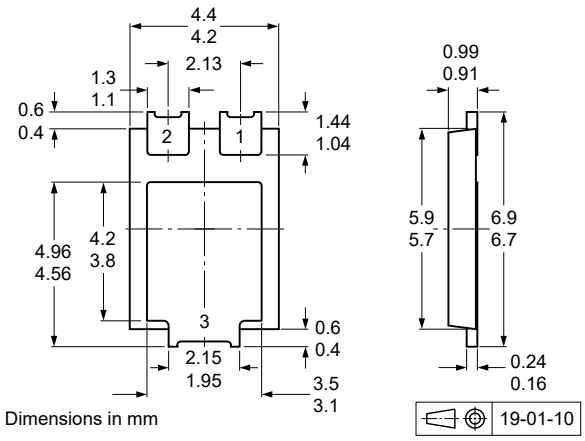



**Fig. 18. Package outline CFP15B (SOT1289B)**

## 13. Soldering

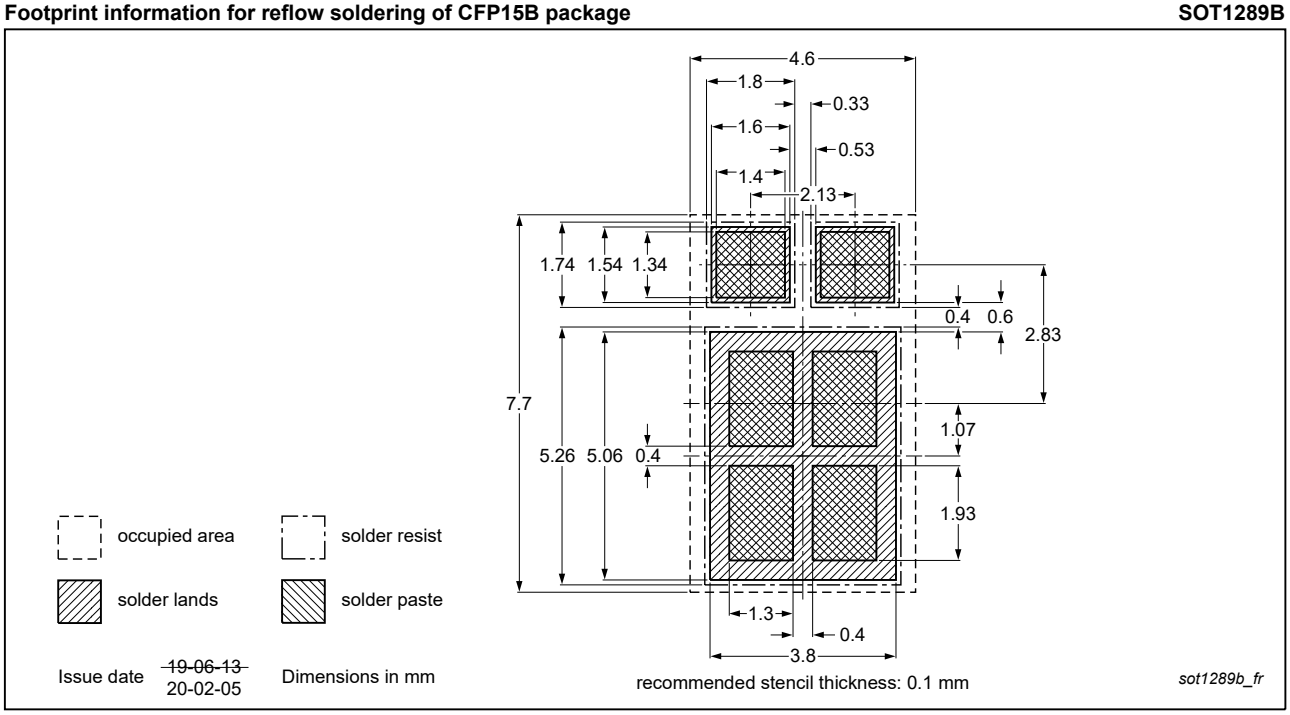



**Fig. 19. Reflow soldering footprint for CFP15B (SOT1289B)**

# 14. Revision history

**Table 8. Revision history**

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| PNE20060EPE v.2 | 20220613 | Product data sheet | - | - |
| Modifications: | • Characteristics: Figures 4, 5, 8, 9 and 10 adapted<br>• Characteristics: value $V_{FRM}$ corrected | | | |
| PNE20060EPE v.1 | 20211116 | 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. |
| 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".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at https://www.nexperia.com.

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**Date of release: 13 June 2022**