



PNE20020EP-Q

200 V, 2 A hyperfast recovery rectifier

21 March 2023

Product data sheet

1. General description

High power density, hyperfast recovery 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 $I_F \leq 2$ A
- Switching time $t_{tr} \leq 25$ ns
- Pt doped lifetime 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
- Qualified according to AEC-Q101 and recommended for use in automotive applications

3. Applications

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

4. Quick reference data


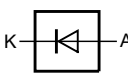
Table 1. Quick reference data

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|-------------|---------------------------------|--|-----|-----|-----|-----|---------|
| $I_{F(AV)}$ | average forward current | $\delta = 0.5$; $f = 20$ kHz; square wave; $T_{sp} \leq 157$ °C | | - | - | 2 | A |
| V_{RRM} | repetitive peak reverse voltage | $T_j = 25$ °C | | - | - | 200 | V |
| V_R | reverse voltage | | | - | - | 200 | V |
| V_F | forward voltage | $I_F = 2$ A; $T_j = 25$ °C | [1] | - | 880 | 950 | mV |
| | | $I_F = 2$ A; $T_j = 125$ °C | [1] | - | 735 | 825 | mV |
| I_R | reverse current | $V_R = 200$ V; $T_j = 25$ °C | [1] | - | - | 1 | μ A |
| | | $V_R = 200$ V; $T_j = 125$ °C | [1] | - | 1 | 20 | μ 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 |  CFP5 (SOD128) |  006aab040 |
| 2 | A | anode | | |

6. Ordering information

Table 3. Ordering information

| Type number | Package | | |
|------------------------------|---------|--|------------------------|
| | Name | Description | Version |
| PNE20020EP-Q | 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 |
|--------------|--------------|
| PNE20020EP-Q | DF |

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 | $T_j = 25\text{ °C}$ | | - | 200 | V |
| V_R | reverse voltage | | | - | 200 | V |
| V_{RMS} | RMS voltage | | | - | 140 | V |
| I_F | forward current | $\delta = 1; T_{sp} \leq 151\text{ °C}$ | | - | 2.8 | A |
| $I_{F(AV)}$ | average forward current | $\delta = 0.5; f = 20\text{ kHz};$ square wave; $T_{sp} \leq 157\text{ °C}$ | | - | 2 | A |
| I_{FSM} | non-repetitive peak forward current | $t_p = 8.3\text{ ms};$ single half sine wave (applied at rated load condition); $T_{j(init)} = 25\text{ °C}$ | | - | 60 | A |
| P_{tot} | total power dissipation | $T_{amb} \leq 25\text{ °C}$ | [1] | - | 1 | W |
| | | | [2] | - | 1.575 | 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 cm².

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 cm².
- [3] Soldering point of cathode tab.

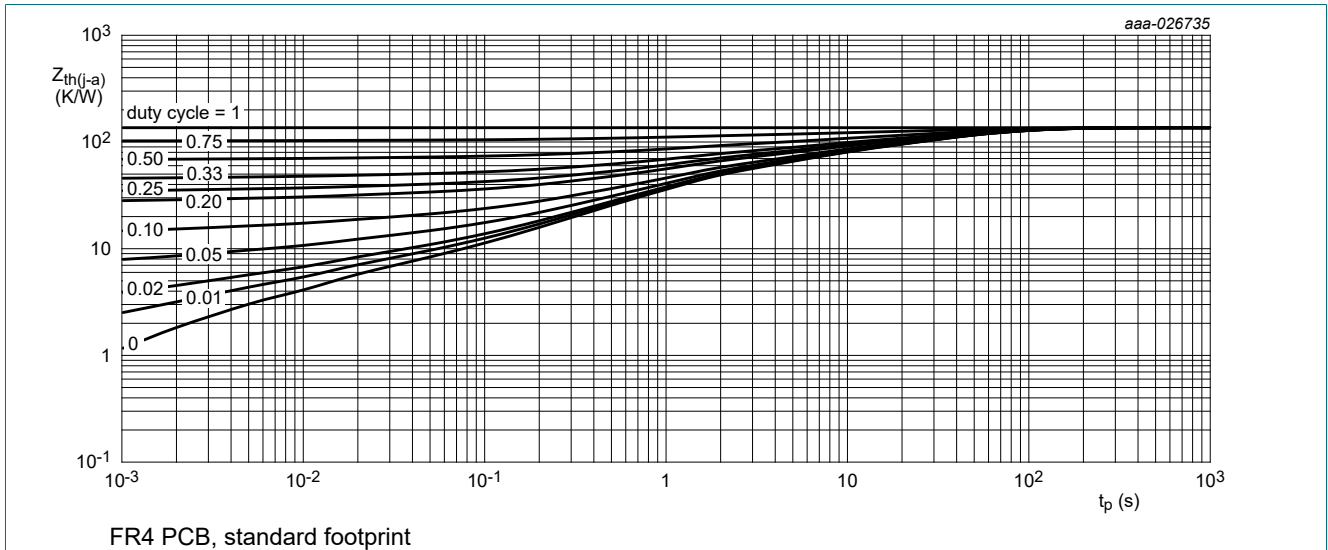


Fig. 1. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

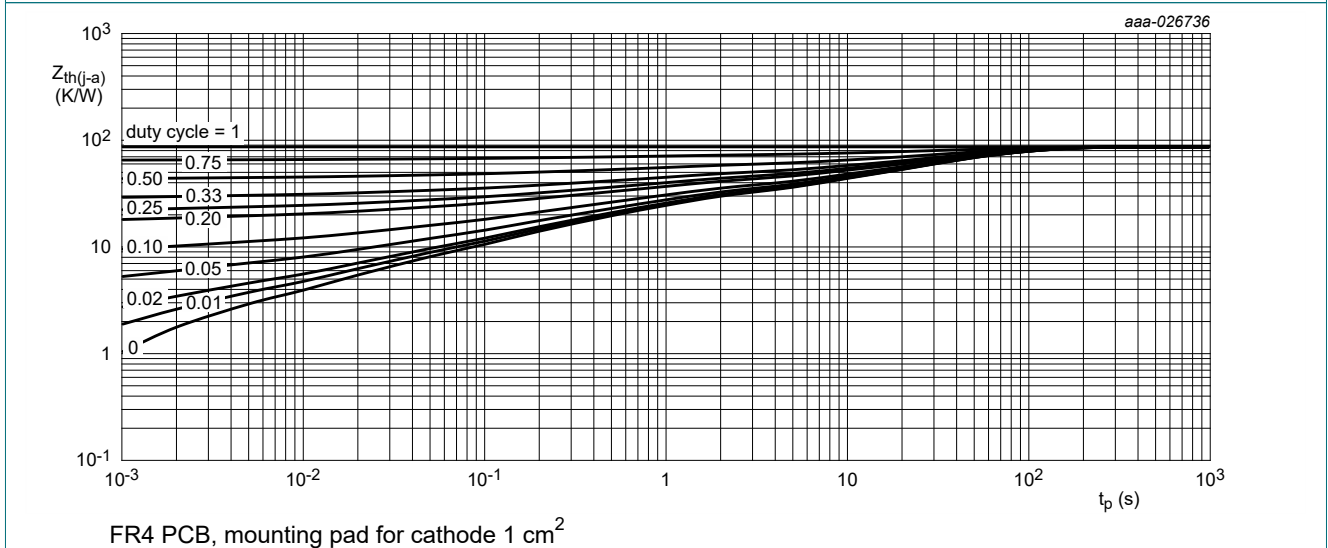


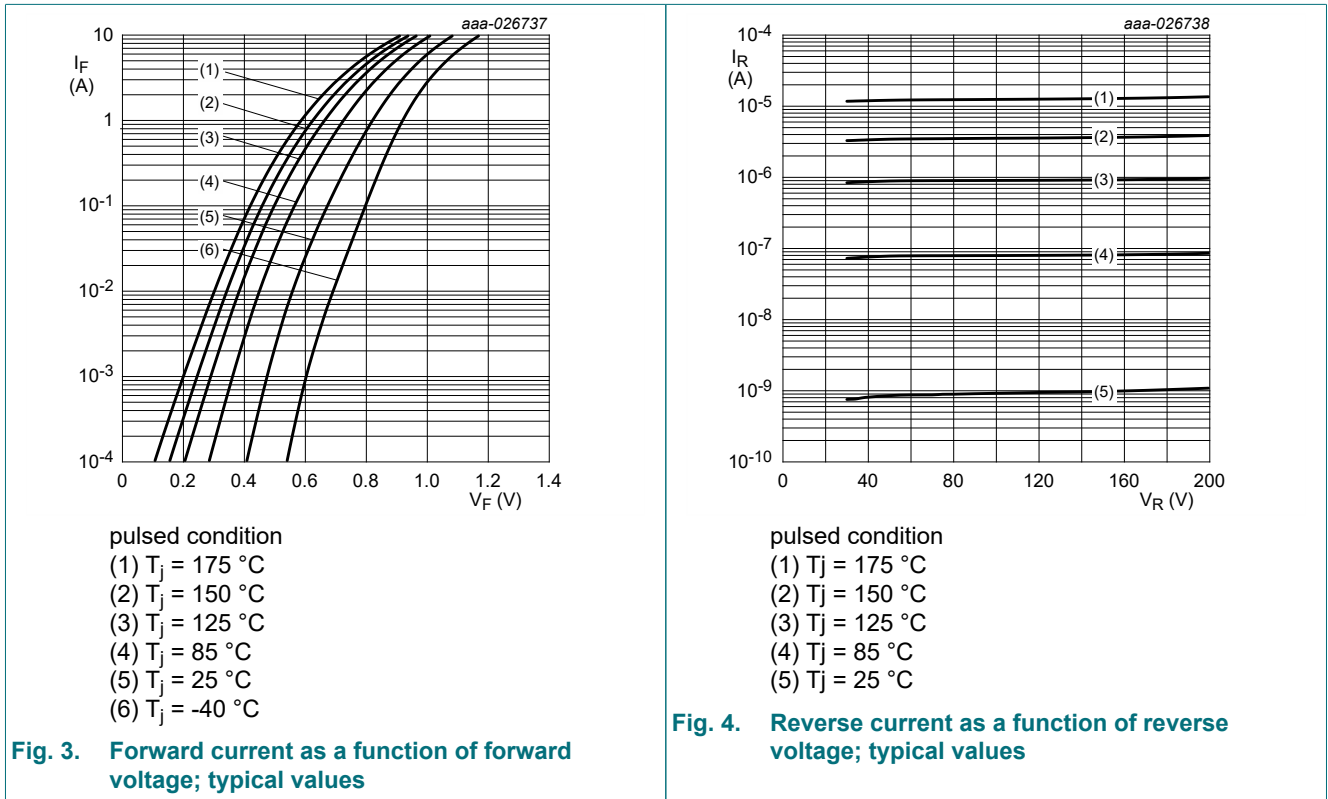
Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit | |
|-------------|---------------------------------------|--|-----|-----|-----|------|---------|
| $V_{(BR)R}$ | reverse breakdown voltage | $I_R = 100 \mu A$; pulsed; $T_j = 25 \text{ }^\circ C$ | [1] | 200 | - | V | |
| V_F | forward voltage | $I_F = 2 \text{ A}$; $T_j = 25 \text{ }^\circ C$ | [1] | - | 880 | 950 | mV |
| | | $I_F = 2 \text{ A}$; $T_j = 125 \text{ }^\circ C$ | [1] | - | 735 | 825 | mV |
| I_R | reverse current | $V_R = 200 \text{ V}$; $T_j = 25 \text{ }^\circ C$ | [1] | - | - | 1 | μA |
| | | $V_R = 200 \text{ V}$; $T_j = 125 \text{ }^\circ C$ | [1] | - | 1 | 20 | μA |
| C_d | diode capacitance | $V_R = 4 \text{ V}$; $f = 1 \text{ MHz}$; $T_j = 25 \text{ }^\circ C$ | - | 20 | - | pF | |
| t_{rr} | reverse recovery time ; step recovery | $I_F = 0.5 \text{ A}$; $I_R = 1 \text{ A}$; $I_{R(meas)} = 0.25 \text{ A}$; $T_j = 25 \text{ }^\circ C$ | - | 10 | 25 | ns | |
| | | $I_F = 1 \text{ A}$; $dI_F/dt = 50 \text{ A}/\mu s$; $V_R = 30 \text{ V}$; $T_j = 25 \text{ }^\circ C$ | - | 20 | - | ns | |
| | | $I_F = 1 \text{ A}$; $dI_F/dt = 100 \text{ A}/\mu s$; $V_R = 30 \text{ V}$; $T_j = 25 \text{ }^\circ C$ | - | 16 | - | ns | |
| I_{RM} | peak reverse recovery current | $T_j = 25 \text{ }^\circ C$ | - | 1 | - | A | |
| Q_{rr} | reverse recovery charge | | - | 9 | - | nC | |
| V_{FRM} | peak forward recovery voltage | $I_F = 1 \text{ A}$; $dI_F/dt = 50 \text{ A}/\mu s$; $T_j = 25 \text{ }^\circ C$ | - | 900 | - | mV | |

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



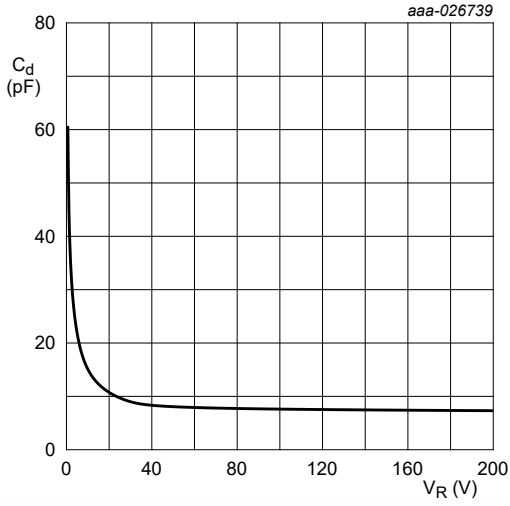


Fig. 5. Diode capacitance as a function of reverse voltage; typical values

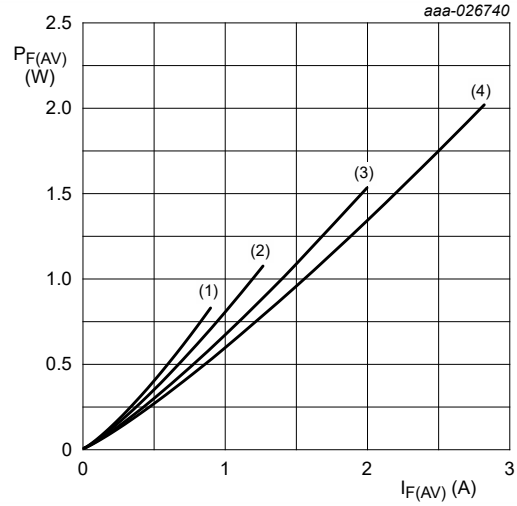


Fig. 6. Average forward power dissipation as a function of average forward current; typical values

$T_j = 175\text{ °C}$
 (1) $\delta = 0.1$
 (2) $\delta = 0.2$
 (3) $\delta = 0.5$
 (4) $\delta = 1$ (DC)

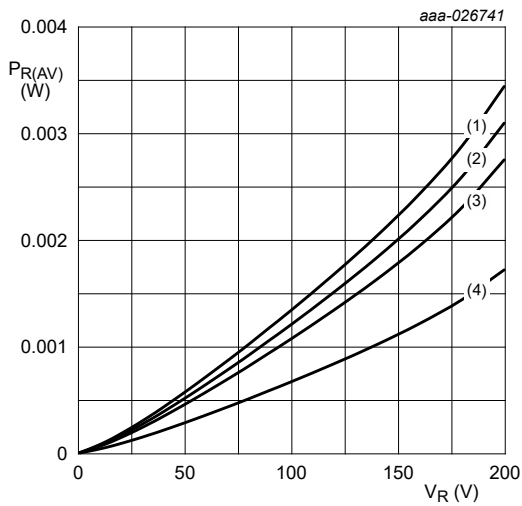


Fig. 7. Average reverse power dissipation as a function of reverse voltage; typical values

$T_j = 175\text{ °C}$
 (1) $\delta = 1$; DC
 (2) $\delta = 0.9$
 (3) $\delta = 0.8$
 (4) $\delta = 0.5$

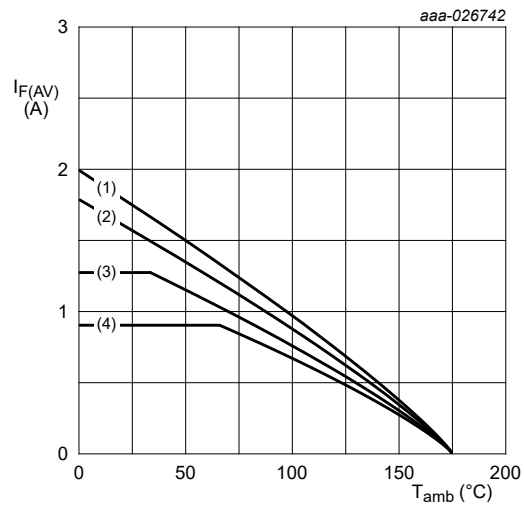


Fig. 8. Average forward current as a function of ambient temperature; typical values

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

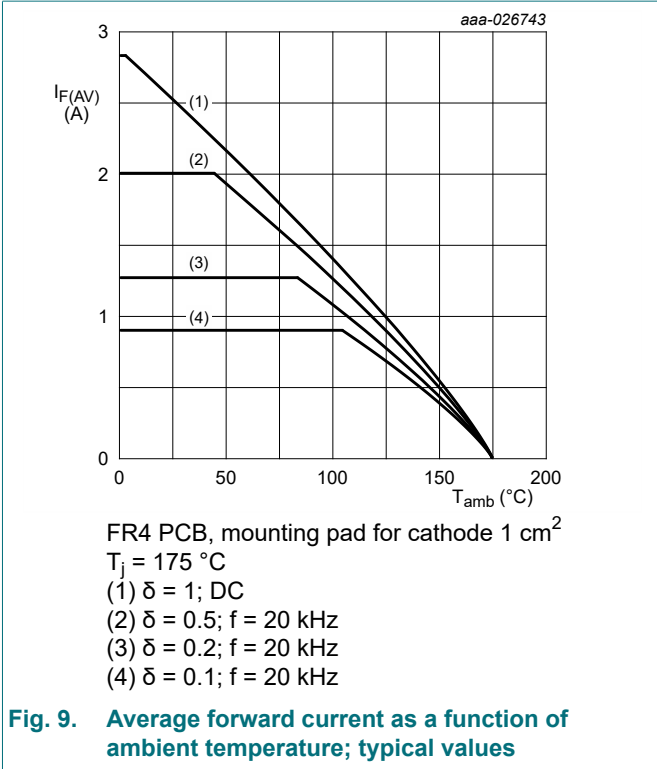


Fig. 9. Average forward current as a function of ambient temperature; typical values

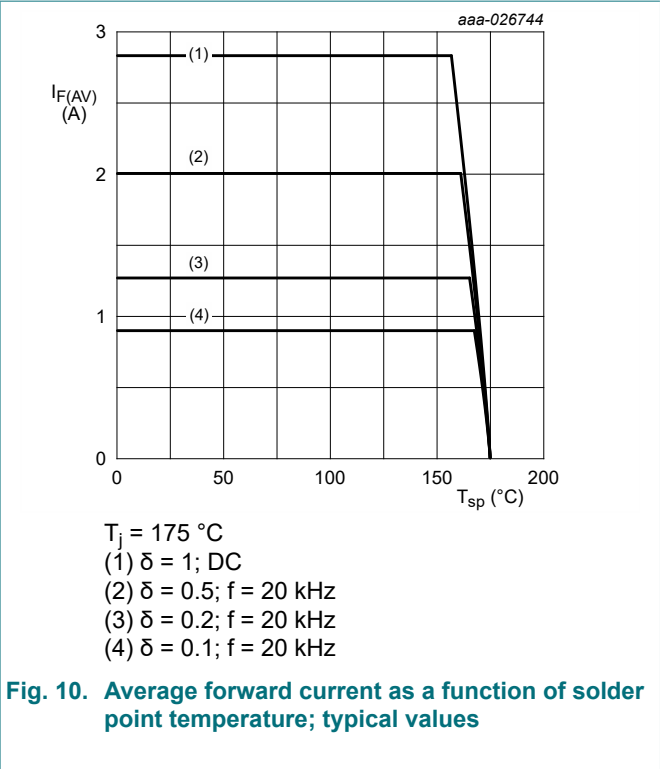


Fig. 10. Average forward current as a function of solder point temperature; typical values

11. Test information

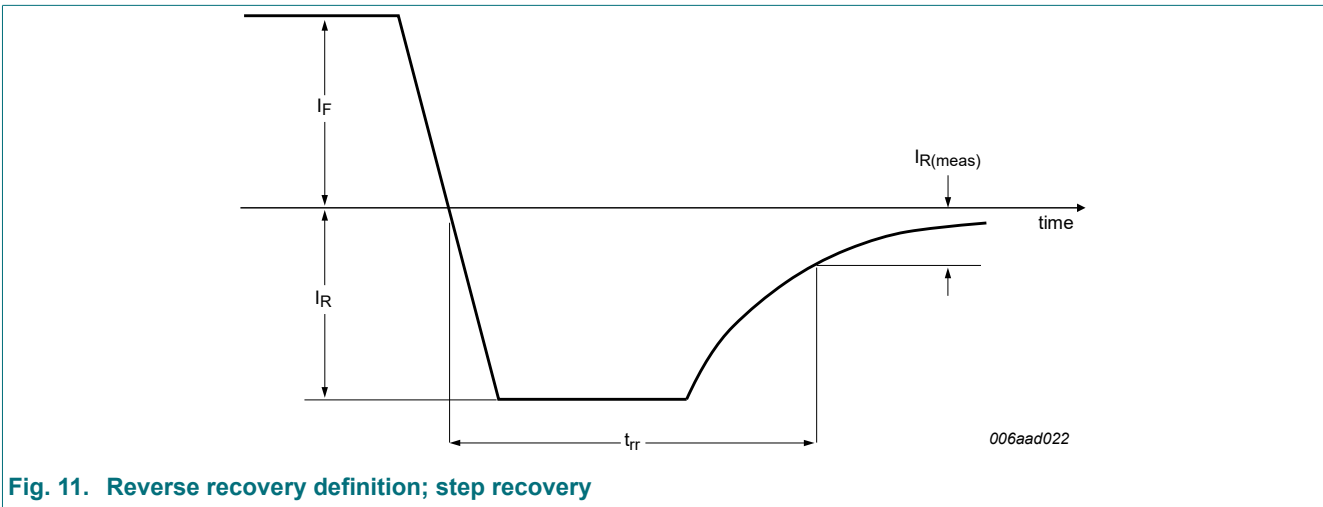


Fig. 11. Reverse recovery definition; step recovery

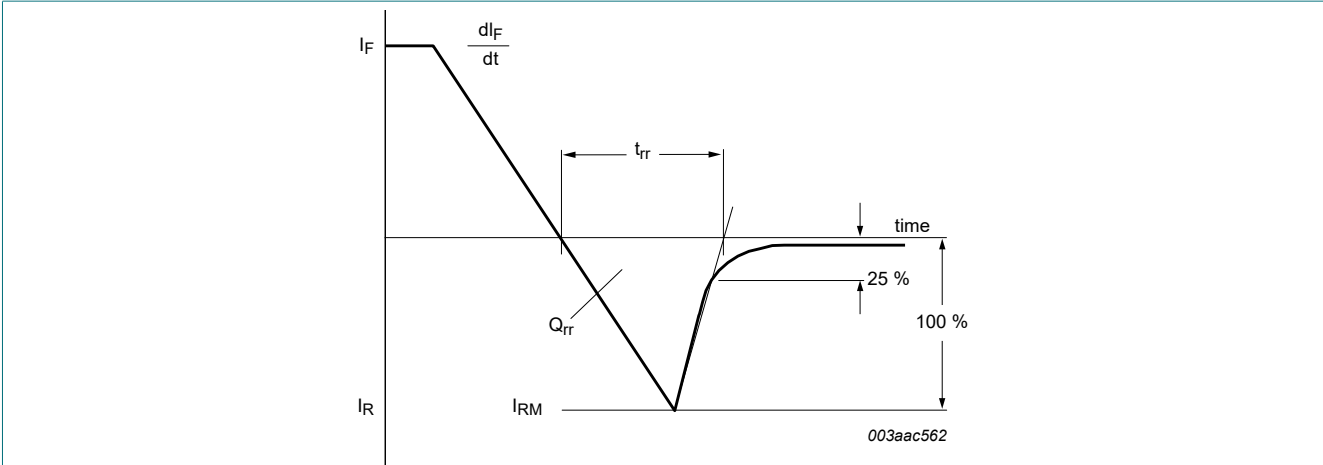


Fig. 12. Reverse recovery definition; ramp recovery



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.

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

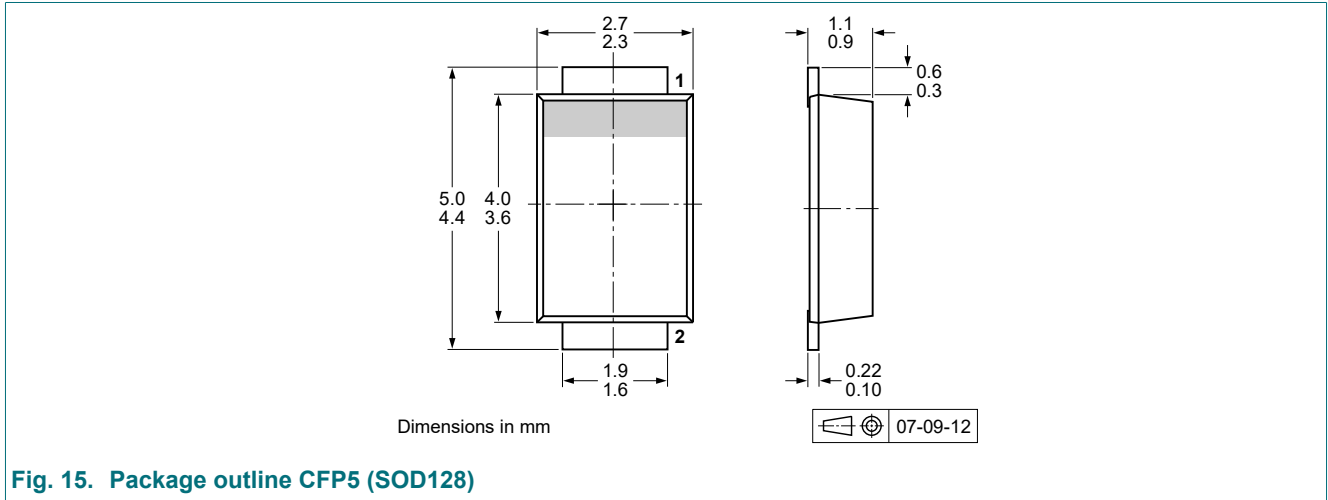


Fig. 15. Package outline CFP5 (SOD128)

13. Soldering

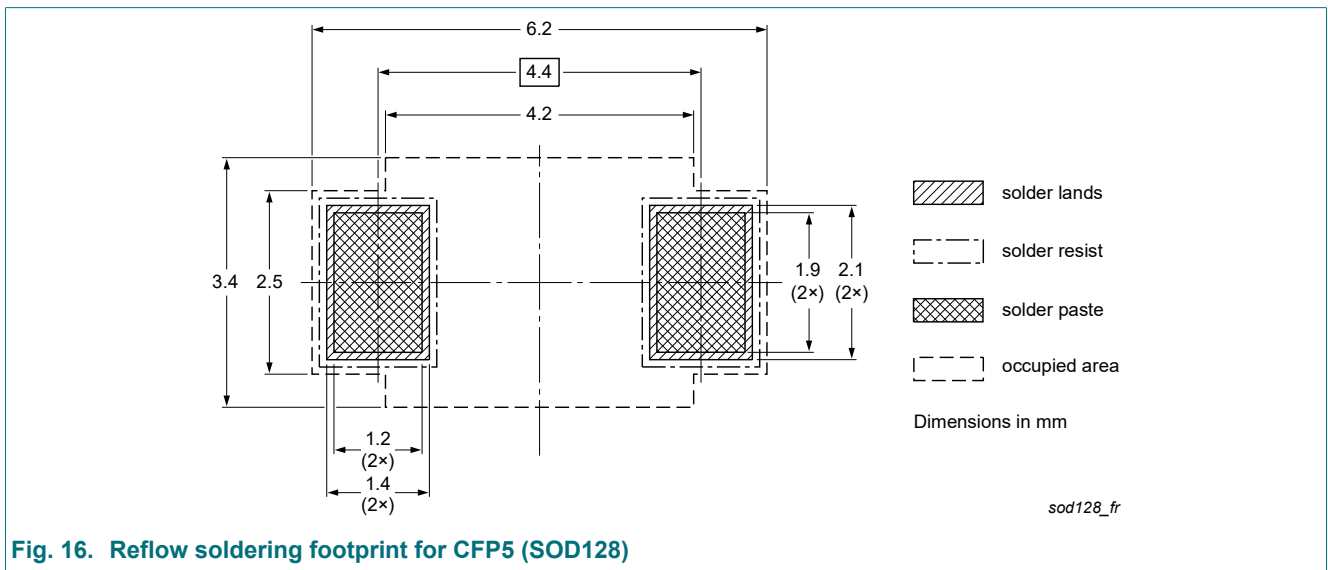


Fig. 16. Reflow soldering footprint for CFP5 (SOD128)

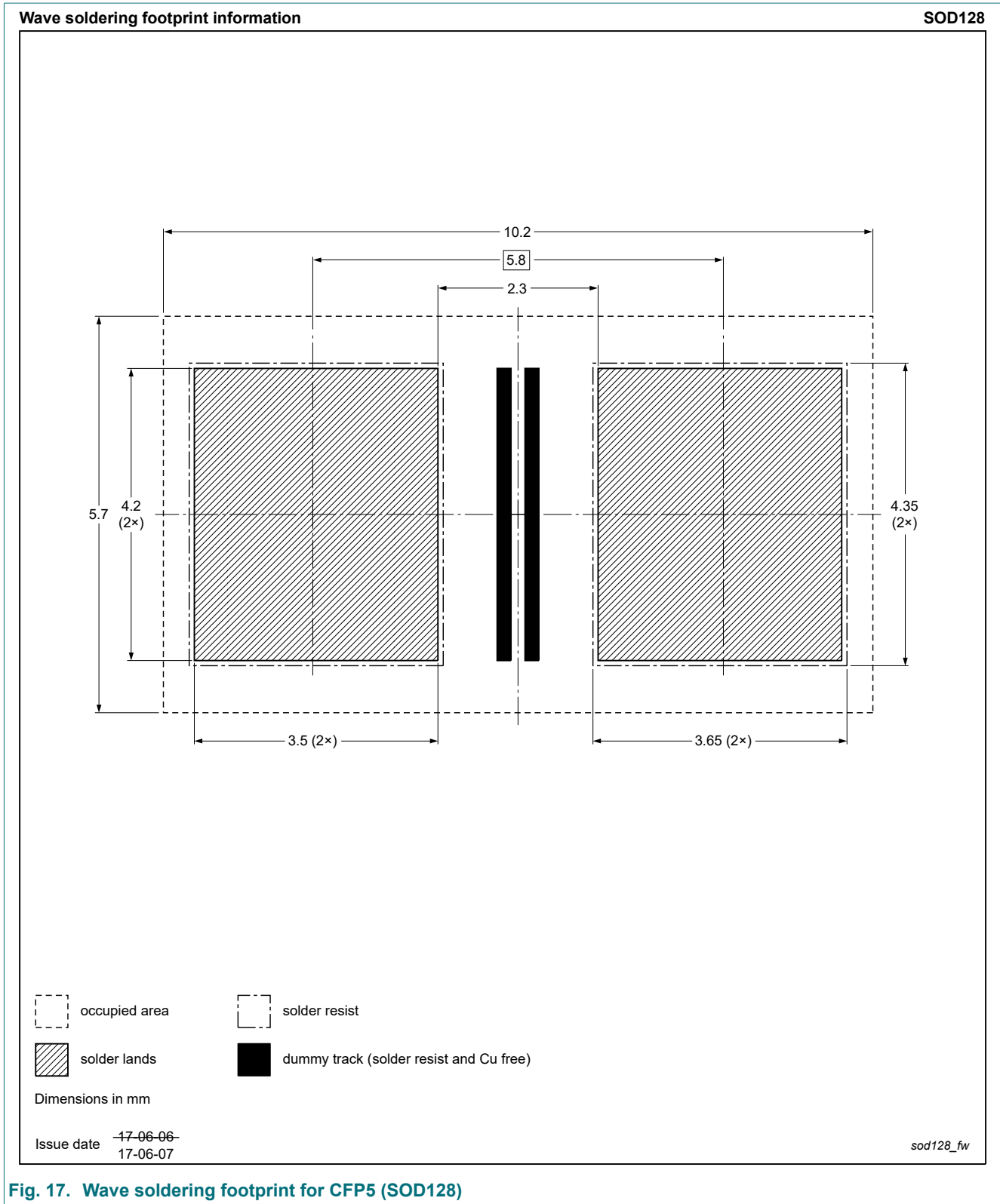


Fig. 17. Wave soldering footprint for CFP5 (SOD128)

14. Revision history

Table 8. Revision history

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|------------------|--|----------------------|---------------|------------------|
| PNE20020EP-Q v.2 | 20230321 | Product data sheet | - | PNE20020EP-Q v.1 |
| Modifications: | <ul style="list-style-type: none">Product status changedLimiting values: Value changed for I_{FSM} | | | |
| PNE20020EP-Q v.1 | 20220509 | 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. |

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