

# ANTREX Electronics

Electronic Components Sourcing Information

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## Product Reference Information

**Part Number:** PNU65020EP-QX  
**Manufacturer:** Nexperia USA Inc.  
**Package:** SOD-128  
**Availability:** Please confirm with sales

### Product Page:

<https://antrexco.com/product/details/nexperia-usa-inc/pnu65020ep-qx.html>

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### Note:

This PDF includes an ANTREX product reference cover page.

The original manufacturer datasheet follows from the next page.

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# PNU65020EP-Q

650 V, 2 A ultrafast recovery rectifier

1 March 2023

Product data sheet

## 1. General description

High power density, ultrafast switching time 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  $V_R \leq 650$  V
- Forward current  $I_F \leq 2$  A
- Typical switching time  $t_{rr}$  of 35 ns
- Pt doped life time control
- Low inductance
- Power and flat lead SMD plastic package
- High power capability due to clip-bond technology
- Planar die design
- Qualified according to AEC-Q101 and recommended for use in automotive applications

## 3. Applications

- On Board Charger
- DC/DC converter
- AC/DC converter
- Battery heating / cooling
- Inverter
- Freewheeling applications

## 4. Quick reference data

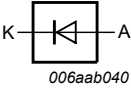
Table 1. Quick reference data

| Symbol      | Parameter                       | Conditions                                                       |     | Min | Typ  | Max  | Unit |
|-------------|---------------------------------|------------------------------------------------------------------|-----|-----|------|------|------|
| $I_{F(AV)}$ | average forward current         | $\delta = 0.5$ ; $f = 20$ kHz; square wave; $T_{sp} \leq 160$ °C |     | -   | -    | 2    | A    |
| $V_{RRM}$   | repetitive peak reverse voltage | $T_j = 25$ °C                                                    |     | -   | -    | 650  | V    |
| $V_R$       | reverse voltage                 |                                                                  |     | -   | -    | 650  | V    |
| $V_F$       | forward voltage                 | $I_F = 2$ A; $T_j = 25$ °C                                       | [1] | -   | 1    | 1.2  | V    |
|             |                                 | $I_F = 2$ A; $T_j = 125$ °C                                      | [1] | -   | 0.87 | 1.04 | V    |
| $I_R$       | reverse current                 | $V_R = 650$ V; $T_j = 25$ °C                                     | [1] | -   | -    | 1    | µA   |
|             |                                 | $V_R = 650$ V; $T_j = 125$ °C                                    | [1] | -   | 0.76 | 15   | 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                |
| PNU65020EP-Q | CFP5    | plastic, surface mounted package; 2 terminals; 4 mm pitch; 3.8 mm x 2.6 mm x 1 mm body | <a href="#">SOD128</a> |

7. Marking

Table 4. Marking codes

| Type number  | Marking code |
|--------------|--------------|
| PNU65020EP-Q | EV           |

8. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 601134).

| Symbol             | Parameter                           | Conditions                                                                                                     |     | Min | Max  | Unit |
|--------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------|-----|-----|------|------|
| V <sub>RRM</sub>   | repetitive peak reverse voltage     | T <sub>j</sub> = 25 °C                                                                                         |     | -   | 650  | V    |
| V <sub>R</sub>     | reverse voltage                     |                                                                                                                |     | -   | 650  | V    |
| V <sub>RMS</sub>   | RMS voltage                         |                                                                                                                |     | -   | 460  | V    |
| I <sub>F</sub>     | forward current                     | δ = 1; T <sub>sp</sub> ≤ 156 °C                                                                                |     | -   | 2.8  | A    |
| I <sub>F(AV)</sub> | average forward current             | δ = 0.5; f = 20 kHz; square wave; T <sub>sp</sub> ≤ 160 °C                                                     |     | -   | 2    | A    |
| I <sub>FSM</sub>   | non-repetitive peak forward current | t <sub>p</sub> = 8.3 ms; single half sine wave (applied at rated load condition); T <sub>j(init)</sub> = 25 °C |     | -   | 60   | A    |
| P <sub>tot</sub>   | total power dissipation             | T <sub>amb</sub> ≤ 25 °C                                                                                       | [1] | -   | 0.81 | W    |
|                    |                                     |                                                                                                                | [2] | -   | 1.3  | W    |
| T <sub>j</sub>     | junction temperature                |                                                                                                                |     | -   | 175  | °C   |
| T <sub>amb</sub>   | ambient temperature                 |                                                                                                                |     | -55 | 175  | °C   |
| T <sub>stg</sub>   | 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 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] | -   | -   | 185 | K/W  |
|                |                                                  |             | [2] | -   | -   | 115 | K/W  |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point |             | [3] | -   | -   | 8   | 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.

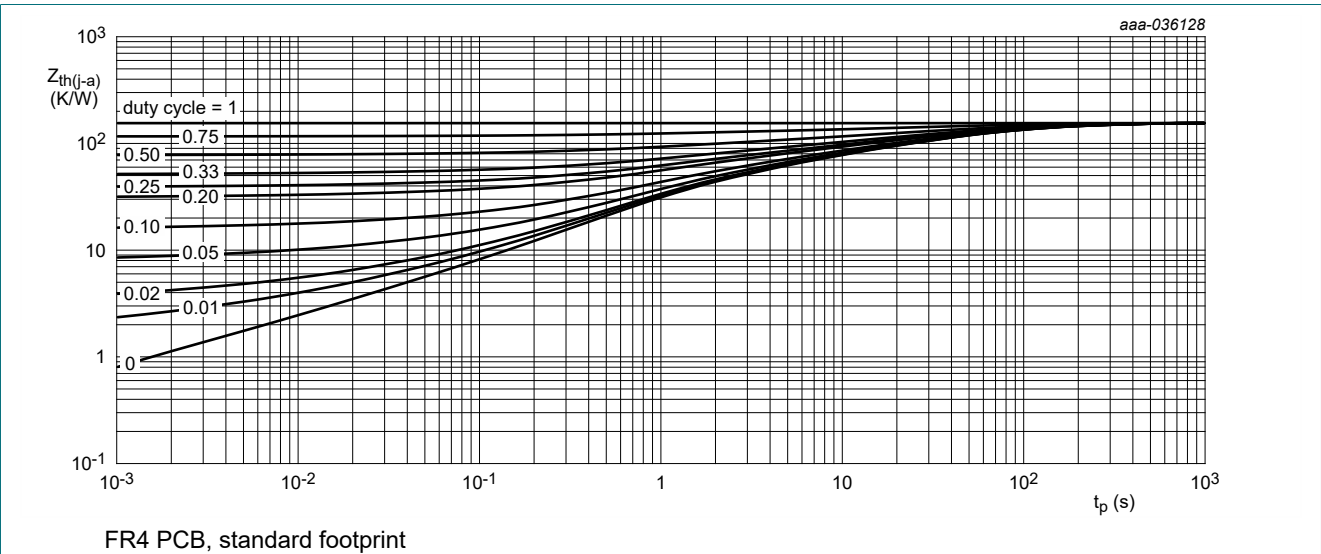


Fig. 1. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

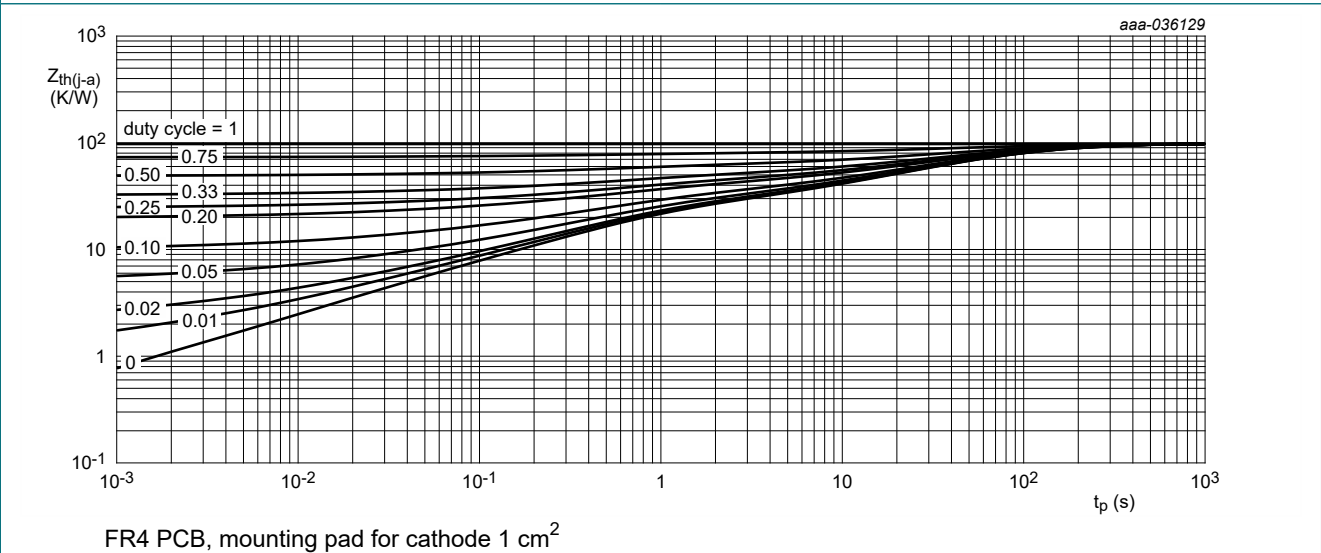


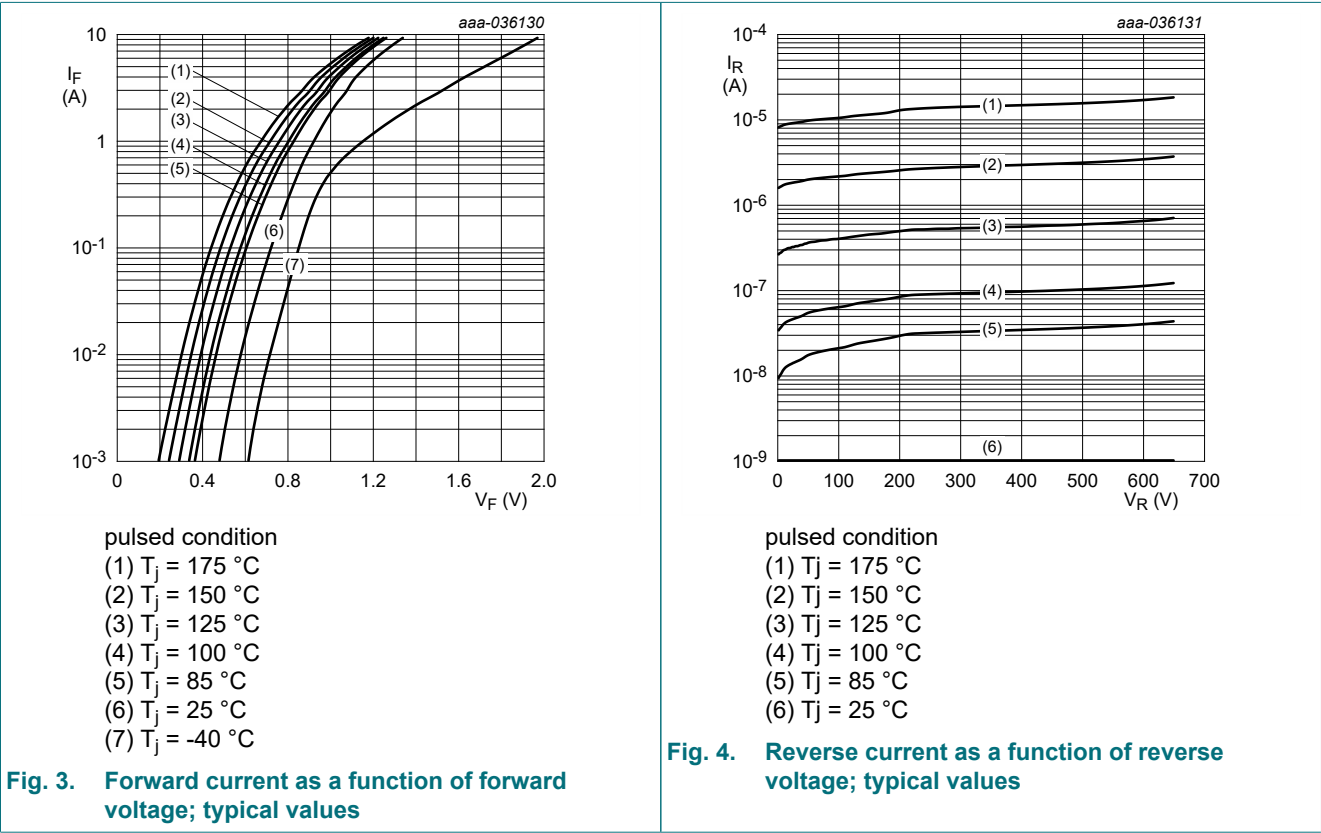
Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

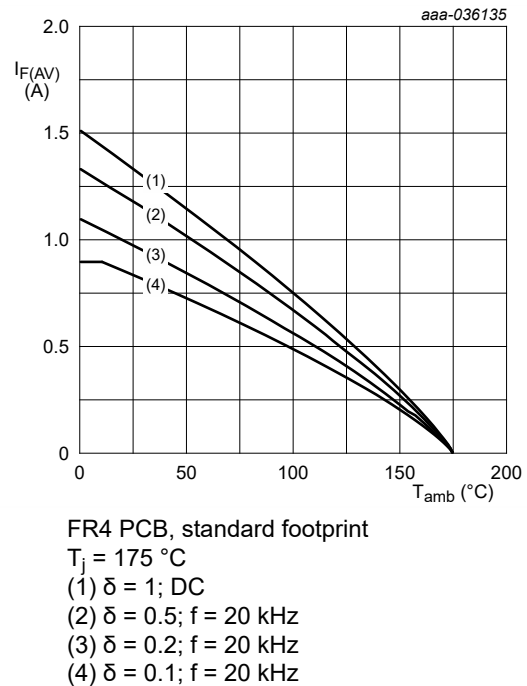
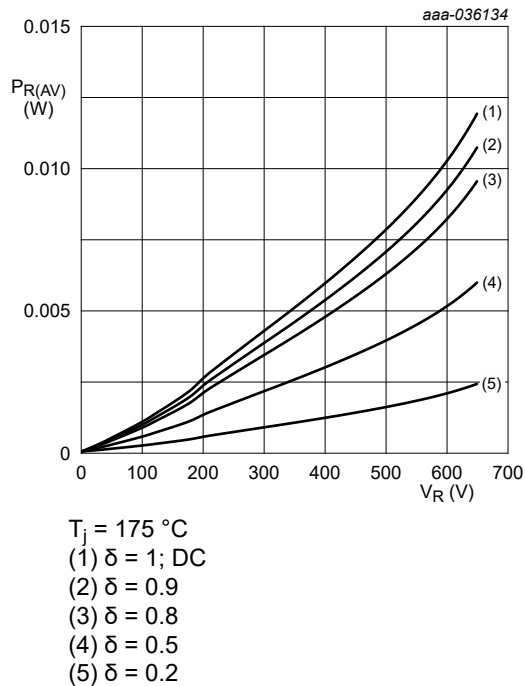
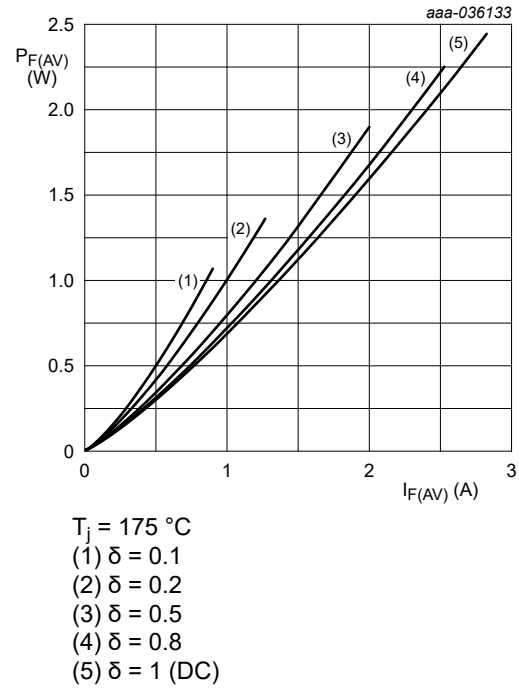
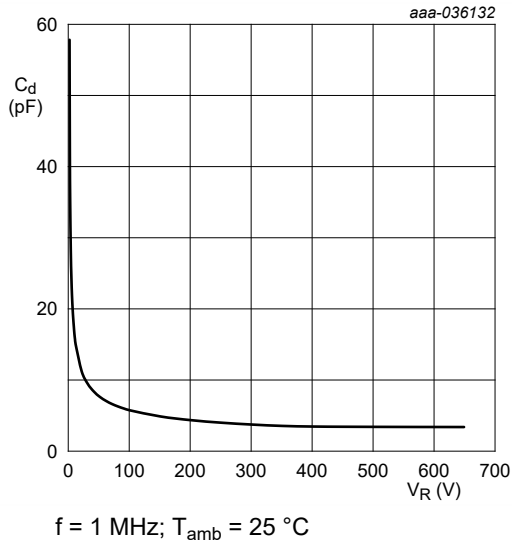
10. Characteristics

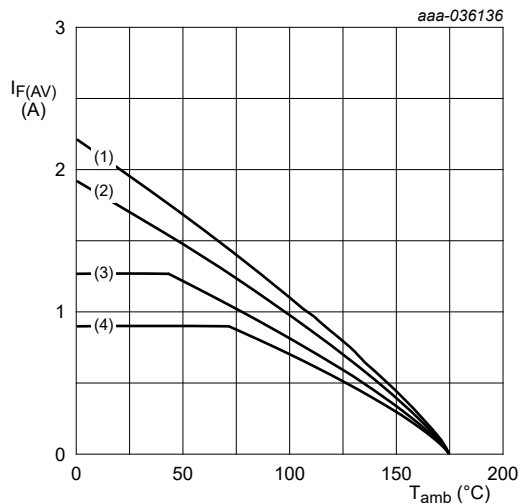
Table 7. Characteristics

| 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] | 650 | -    | -    | V             |
| $V_F$       | forward voltage                       | $I_F = 2\text{ A}$ ; $T_j = 25\text{ }^\circ\text{C}$                                                               | [1] | -   | 1    | 1.2  | V             |
|             |                                       | $I_F = 2\text{ A}$ ; $T_j = 125\text{ }^\circ\text{C}$                                                              | [1] | -   | 0.87 | 1.04 | V             |
| $I_R$       | reverse current                       | $V_R = 650\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$                                                             | [1] | -   | -    | 1    | $\mu\text{A}$ |
|             |                                       | $V_R = 650\text{ V}$ ; $T_j = 125\text{ }^\circ\text{C}$                                                            | [1] | -   | 0.76 | 15   | $\mu\text{A}$ |
| $C_d$       | diode capacitance                     | $V_R = 4\text{ V}$ ; $f = 1\text{ MHz}$ ; $T_j = 25\text{ }^\circ\text{C}$                                          |     | -   | 21   | -    | pF            |
| $t_{rr}$    | reverse recovery time ; step recovery | $I_F = 0.5\text{ A}$ ; $I_R = 1\text{ A}$ ; $I_{R(\text{meas})} = 0.25\text{ A}$ ; $T_j = 25\text{ }^\circ\text{C}$ |     | -   | 35   | 65   | ns            |
|             | reverse recovery time ; ramp recovery | $I_F = 1\text{ A}$ ; $dI_F/dt = 50\text{ A}/\mu\text{s}$ ; $V_R = 30\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$   |     | -   | 40   | 85   | ns            |
|             |                                       | $I_F = 1\text{ A}$ ; $dI_F/dt = 100\text{ A}/\mu\text{s}$ ; $V_R = 30\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$  |     | -   | 31   | -    | ns            |
| $I_{RM}$    | peak reverse recovery current         | $T_j = 25\text{ }^\circ\text{C}$                                                                                    |     | -   | 1.7  | -    | A             |
| $Q_{rr}$    | reverse recovery charge               |                                                                                                                     |     | -   | 32   | -    | nC            |
| $V_{FRM}$   | peak forward recovery voltage         | $I_F = 1\text{ A}$ ; $dI_F/dt = 50\text{ A}/\mu\text{s}$ ; $T_j = 25\text{ }^\circ\text{C}$                         |     | -   | 3.9  | -    | V             |

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

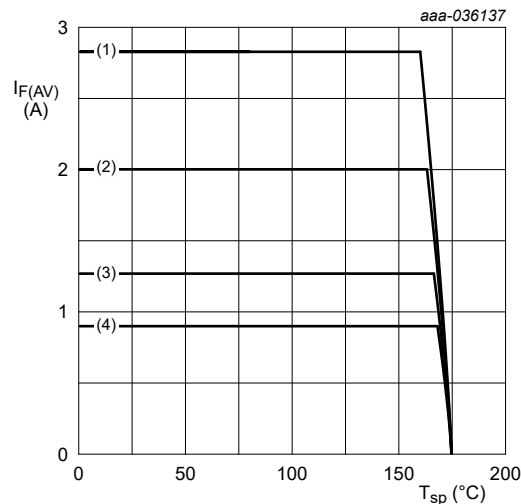






FR4 PCB, mounting pad for cathode 1 cm<sup>2</sup>  
 $T_j = 175\text{ °C}$   
(1)  $\delta = 1$ ; DC  
(2)  $\delta = 0.5$ ;  $f = 20\text{ kHz}$   
(3)  $\delta = 0.2$ ;  $f = 20\text{ kHz}$   
(4)  $\delta = 0.1$ ;  $f = 20\text{ kHz}$

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



$T_j = 175\text{ °C}$   
(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. 10. Average forward current as a function of solder point temperature; typical values

11. Test information

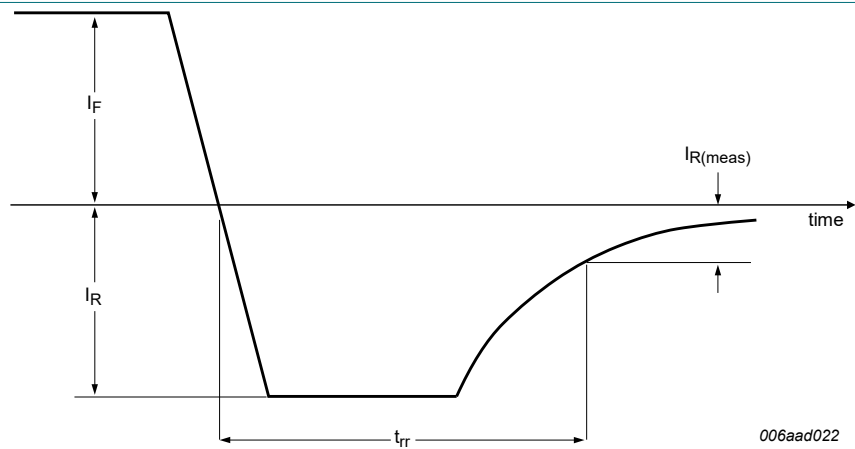


Fig. 11. Reverse recovery definition; step recovery

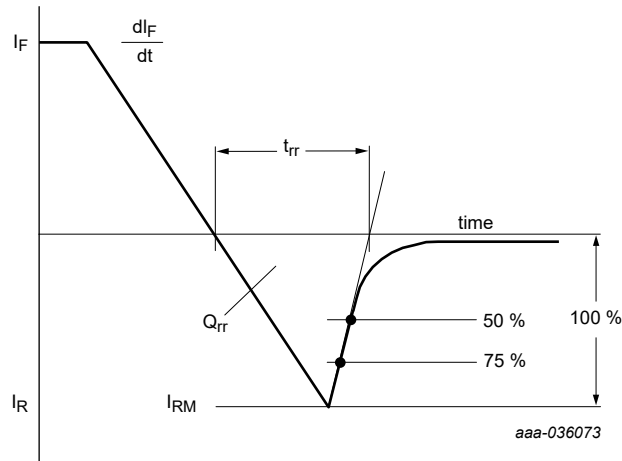


Fig. 12. Reverse recovery definition; ramp recovery

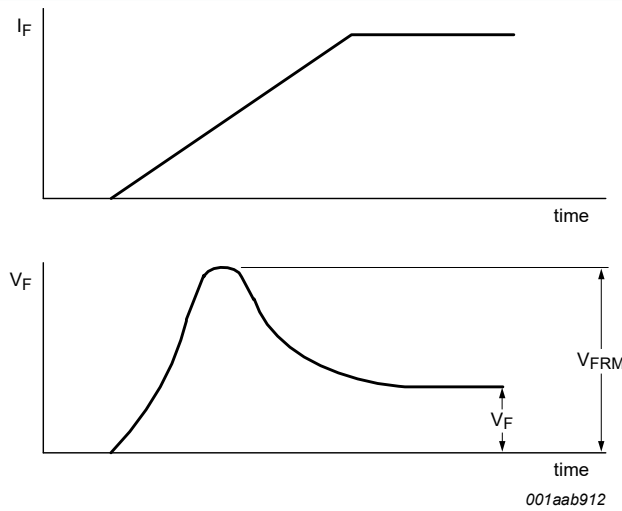


Fig. 13. Forward recovery definition

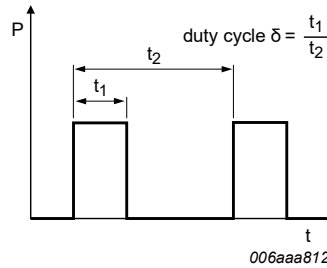


Fig. 14. Duty cycle definition

The current ratings for the typical waveforms are calculated according to the equations:

$$I_{F(AV)} = I_M \times \delta \text{ with } I_M \text{ defined as peak current}$$

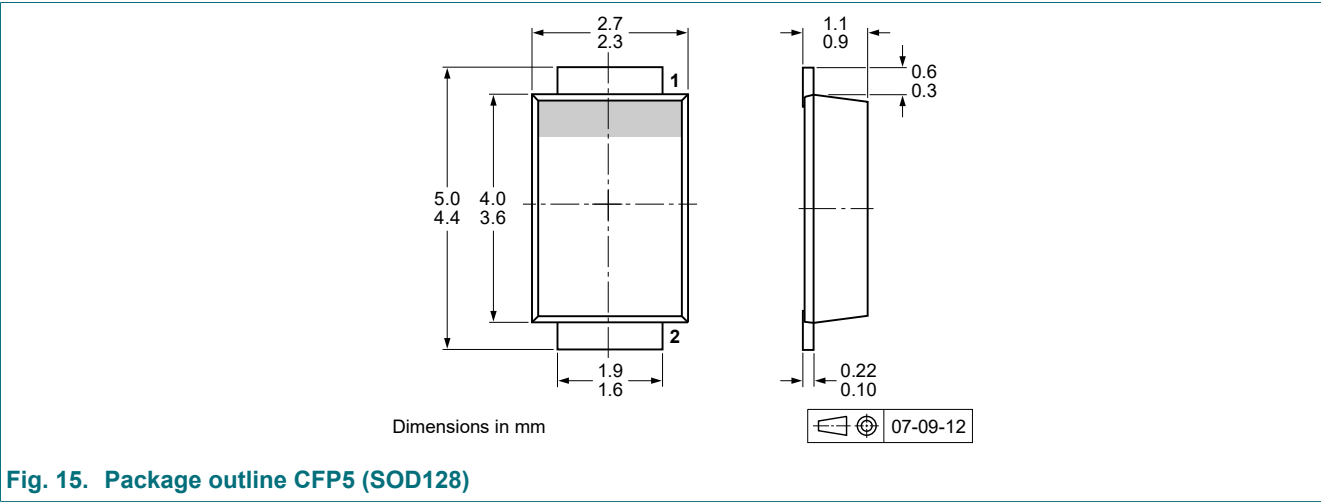
$$I_{RMS} = I_{F(AV)} \text{ at DC, and } I_{RMS} = I_M \times \sqrt{\delta}$$

with  $I_{RMS}$  defined as RMS current.

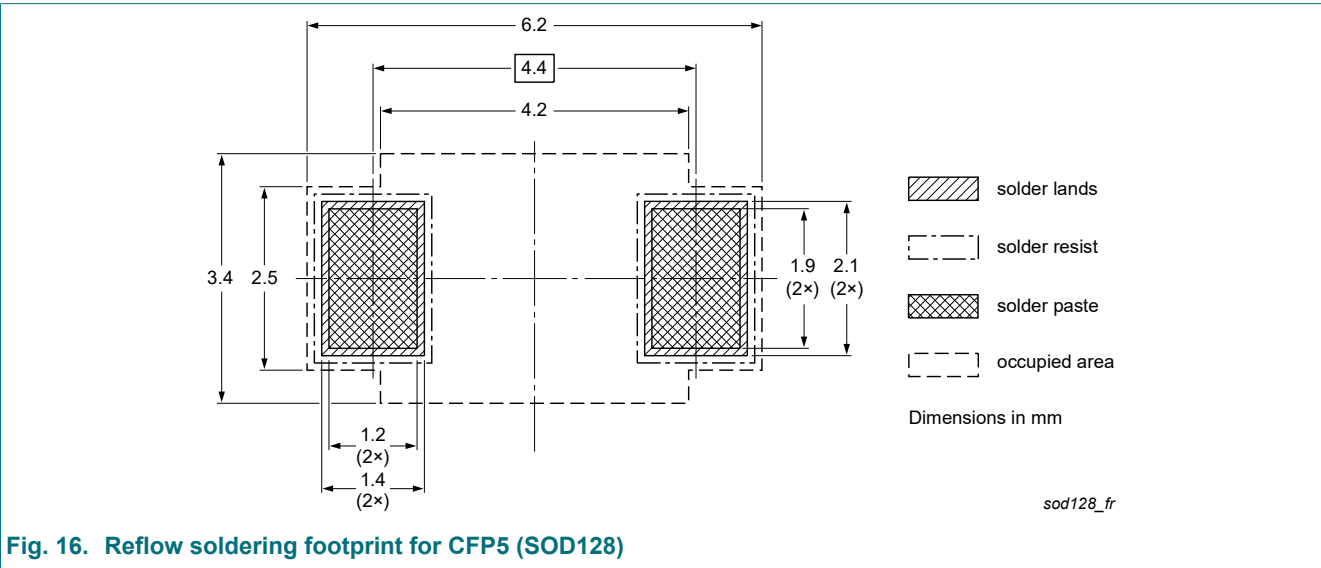
### Quality information

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



13. Soldering



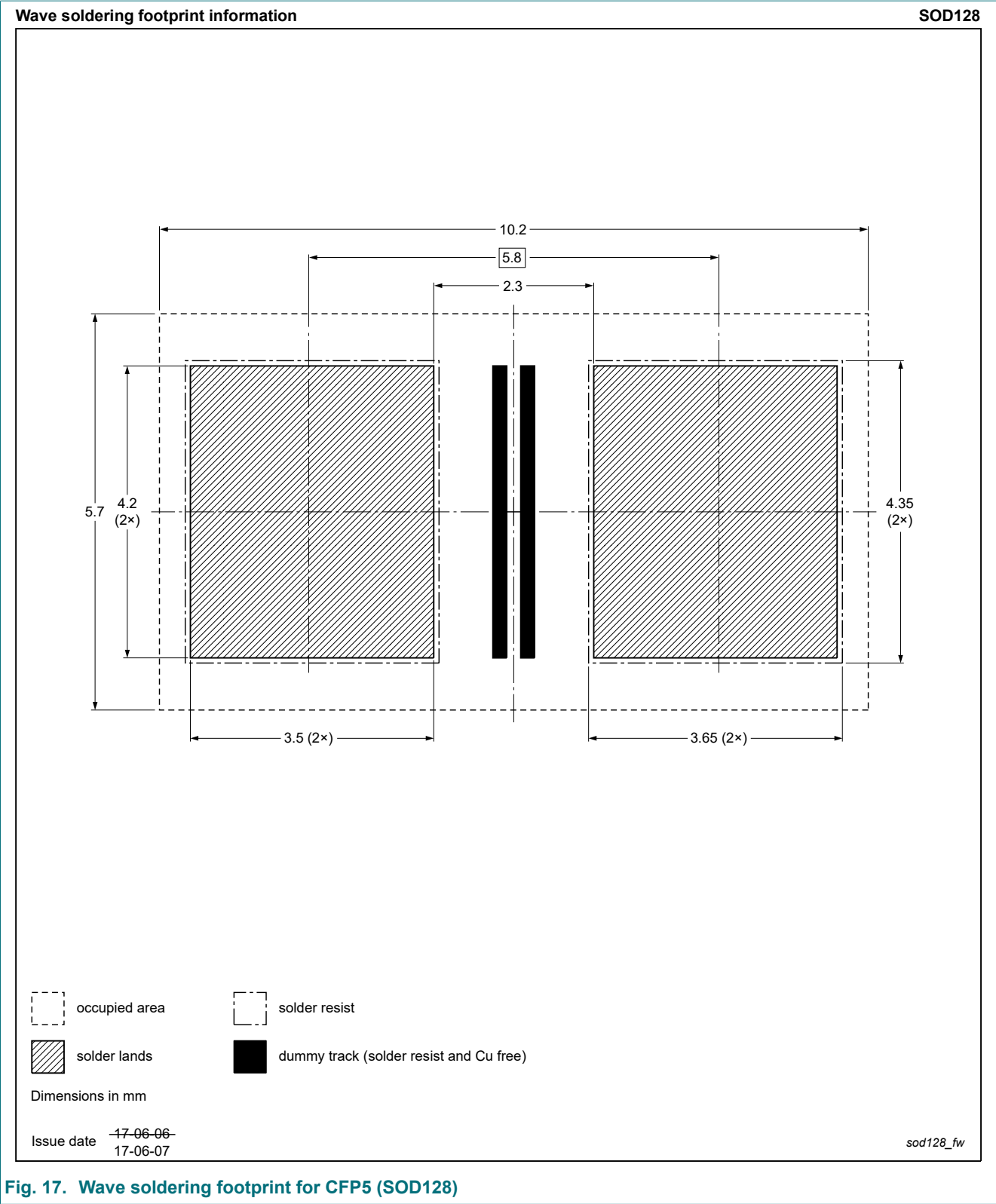


Fig. 17. Wave soldering footprint for CFP5 (SOD128)

14. Revision history

Table 8. Revision history

| Data sheet ID    | Release date | Data sheet status  | Change notice | Supersedes |
|------------------|--------------|--------------------|---------------|------------|
| PNU65020EP-Q v.1 | 20230301     | 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".
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