



# PNU650300AEJ

650 V, 30 A ultrafast recovery rectifier

3 May 2024

Product data sheet

## 1. General description

High power density, ultrafast switching time recovery rectifier with high-efficiency planar technology, encapsulated in D2PAK Real-2-Pin (SOT8018).

## 2. Features and benefits

- Reverse voltage  $V_R \leq 650$  V
- Forward current  $I_F \leq 30$  A
- Typical switching time  $t_{tr}$  of 32 ns
- Pt doped life time control
- Low inductance
- Planar die design

## 3. Applications

- AC/DC converter
- DC/DC converter
- SMPS/UPS
- Battery charger
- Inverter
- Freewheeling applications

## 4. Quick reference data

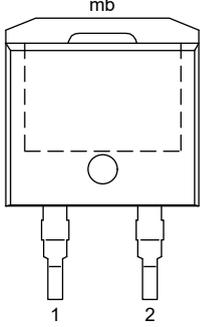
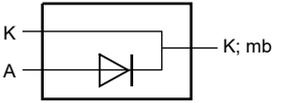
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$I_{F(AV)}$	average forward current	$\delta = 0.5$ ; $f = 20$ kHz; square wave; $T_c \leq 98$ °C		-	-	30	A
$V_{RRM}$	repetitive peak reverse voltage	$T_j = 25$ °C		-	-	650	V
$V_R$	reverse voltage			-	-	650	V
$V_F$	forward voltage	$I_F = 30$ A; pulsed; $T_j = 25$ °C	[1]	-	1.38	1.8	V
		$I_F = 30$ A; pulsed; $T_j = 125$ °C	[1]	-	1.26	1.6	V
		$I_F = 30$ A; pulsed; $T_j = 175$ °C	[1]	-	1.19	-	V
$I_R$	reverse current	$V_R = 650$ V; pulsed; $T_j = 25$ °C	[1]	-	-	5	$\mu$ A
		$V_R = 650$ V; pulsed; $T_j = 125$ °C	[1]	-	2.7	50	$\mu$ A
		$V_R = 650$ V; pulsed; $T_j = 175$ °C	[1]	-	47	-	$\mu$ 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	 <p>D2PAK R2P (SOT8018)</p>	 <p>aaa-037872</p>
2	A	anode		
mb	K	mounting base; connected to cathode, also referred to as the case		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
<a href="#">PNU650300AEJ</a>	D2PAK R2P	Plastic, single-ended surface-mounted package (D2PAK R2P); Real-2-Pin configuration; 5.08 mm pitch; 8.8 mm x 10.35 mm x 4.46 mm body	<a href="#">SOT8018</a>

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PNU650300AEJ	U65030A

## 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	$T_j = 25\text{ °C}$		-	650	V
$V_R$	reverse voltage			-	650	V
$V_{RMS}$	RMS voltage			-	460	V
$I_F$	forward current	$\delta = 1; T_c \leq 80\text{ °C}$		-	42	A
$I_{F(AV)}$	average forward current	$\delta = 0.5; f = 20\text{ kHz};$ square wave; $T_c \leq 98\text{ °C}$		-	30	A
$I_{FSM}$	non-repetitive peak forward current	$t_p = 8.3\text{ ms};$ single half sine wave (applied at rated load condition); $T_{j(\text{init})} = 25\text{ °C}$		-	209	A
		$t_p = 10\text{ ms};$ square wave; $T_{j(\text{init})} = 25\text{ °C}$		-	158	A
$P_{tot}$	total power dissipation	$T_c \leq 25\text{ °C}$	[1]	-	2.4	W
			[2]	-	4.2	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 6 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]	-	-	61	K/W
			[2]	-	-	36	K/W
$R_{th(j-c)}$	thermal resistance from junction to case		[3]	-	-	1.5	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 6 cm<sup>2</sup>.
- [3] Soldering point of cathode tab.

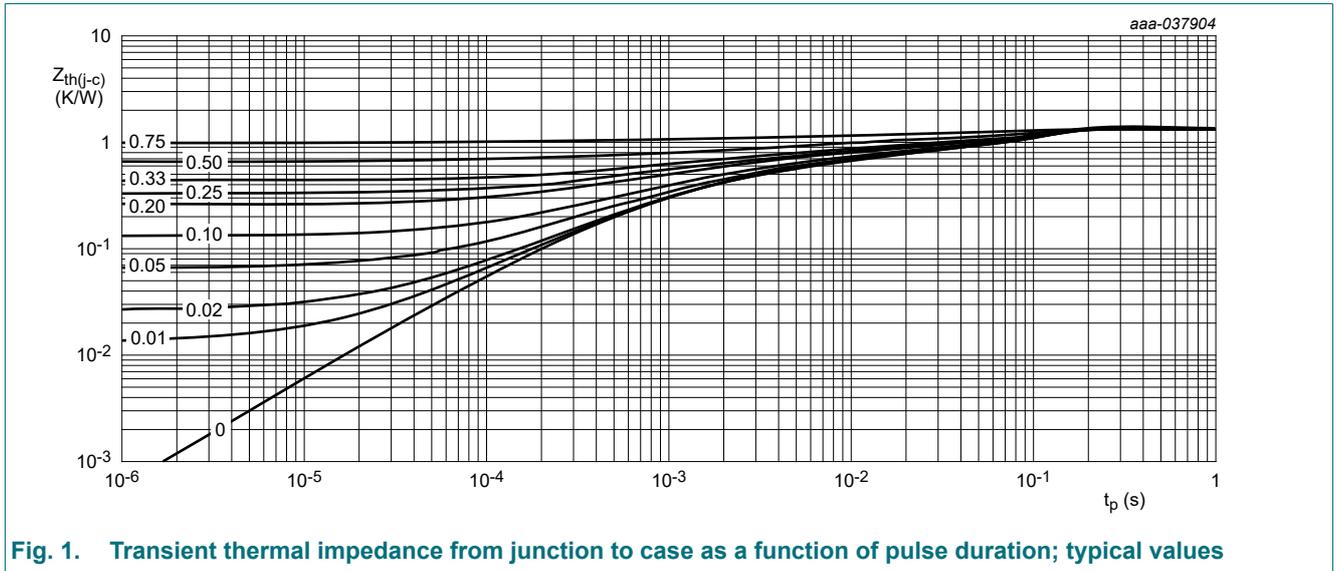


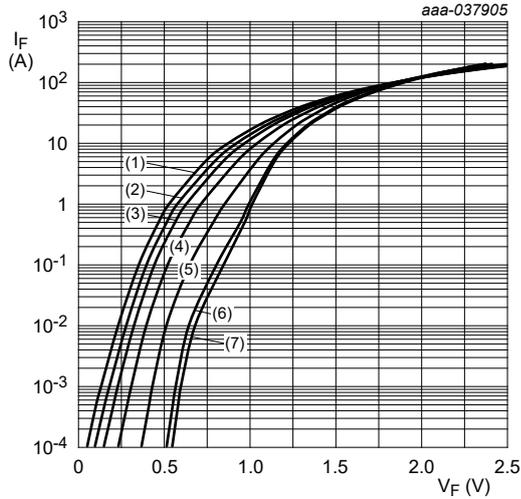
Fig. 1. Transient thermal impedance from junction to case as a function of pulse duration; typical values

## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$V_{(BR)R}$	reverse breakdown voltage	$I_R = 100 \mu\text{A}$ ; pulsed; $T_j = 25 \text{ }^\circ\text{C}$	[1]	650	-	-	V
$V_F$	forward voltage	$I_F = 30 \text{ A}$ ; pulsed; $T_j = 25 \text{ }^\circ\text{C}$	[1]	-	1.38	1.8	V
		$I_F = 30 \text{ A}$ ; pulsed; $T_j = 125 \text{ }^\circ\text{C}$	[1]	-	1.26	1.6	V
		$I_F = 30 \text{ A}$ ; pulsed; $T_j = 175 \text{ }^\circ\text{C}$	[1]	-	1.19	-	V
$I_R$	reverse current	$V_R = 650 \text{ V}$ ; pulsed; $T_j = 25 \text{ }^\circ\text{C}$	[1]	-	-	5	$\mu\text{A}$
		$V_R = 650 \text{ V}$ ; pulsed; $T_j = 125 \text{ }^\circ\text{C}$	[1]	-	2.7	50	$\mu\text{A}$
		$V_R = 650 \text{ V}$ ; pulsed; $T_j = 175 \text{ }^\circ\text{C}$	[1]	-	47	-	$\mu\text{A}$
$C_d$	diode capacitance	$V_R = 400 \text{ V}$ ; $f = 1 \text{ MHz}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	13	-	pF
$t_{rr}$	reverse recovery time ; step recovery	$I_F = 0.5 \text{ A}$ ; $I_R = 1 \text{ A}$ ; $I_{R(\text{meas})} = 0.25 \text{ A}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	32	60	ns
	reverse recovery time ; ramp recovery	$I_F = 30 \text{ A}$ ; $di_F/dt = -200 \text{ A}/\mu\text{s}$ ; $V_R = 400 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	133	-	ns
		$I_F = 30 \text{ A}$ ; $di_F/dt = -1000 \text{ A}/\mu\text{s}$ ; $V_R = 400 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	83	-	ns
		$I_F = 30 \text{ A}$ ; $di_F/dt = -200 \text{ A}/\mu\text{s}$ ; $V_R = 400 \text{ V}$ ; $T_j = 125 \text{ }^\circ\text{C}$		-	211	-	ns
		$I_F = 30 \text{ A}$ ; $di_F/dt = -1000 \text{ A}/\mu\text{s}$ ; $V_R = 400 \text{ V}$ ; $T_j = 125 \text{ }^\circ\text{C}$		-	127	-	ns
$I_{RM}$	peak reverse recovery current	$I_F = 30 \text{ A}$ ; $di_F/dt = -200 \text{ A}/\mu\text{s}$ ; $V_R = 400 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	9	-	A
		$I_F = 30 \text{ A}$ ; $di_F/dt = -1000 \text{ A}/\mu\text{s}$ ; $V_R = 400 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	27	-	A
		$I_F = 30 \text{ A}$ ; $di_F/dt = -200 \text{ A}/\mu\text{s}$ ; $V_R = 400 \text{ V}$ ; $T_j = 125 \text{ }^\circ\text{C}$		-	14	-	A
		$I_F = 30 \text{ A}$ ; $di_F/dt = -1000 \text{ A}/\mu\text{s}$ ; $V_R = 400 \text{ V}$ ; $T_j = 125 \text{ }^\circ\text{C}$		-	38	-	A
$Q_{rr}$	reverse recovery charge	$I_F = 30 \text{ A}$ ; $di_F/dt = -200 \text{ A}/\mu\text{s}$ ; $V_R = 400 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	690	-	nC
		$I_F = 30 \text{ A}$ ; $di_F/dt = -1000 \text{ A}/\mu\text{s}$ ; $V_R = 400 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$		-	1349	-	nC
		$I_F = 30 \text{ A}$ ; $di_F/dt = -200 \text{ A}/\mu\text{s}$ ; $V_R = 400 \text{ V}$ ; $T_j = 125 \text{ }^\circ\text{C}$		-	1788	-	nC
		$I_F = 30 \text{ A}$ ; $di_F/dt = -1000 \text{ A}/\mu\text{s}$ ; $V_R = 400 \text{ V}$ ; $T_j = 125 \text{ }^\circ\text{C}$		-	2897	-	nC

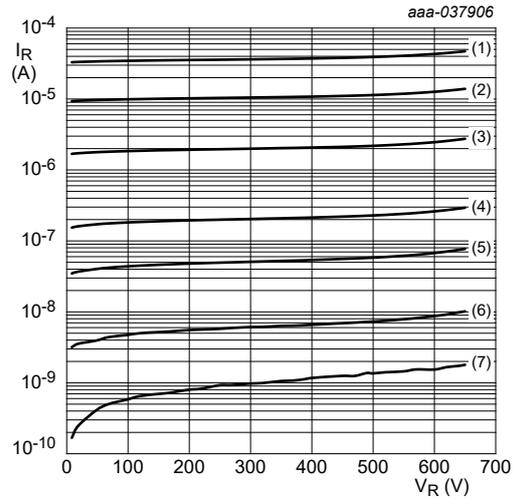
[1] Very short pulse, in order to maintain a stable junction temperature.



pulsed condition

- (1)  $T_j = 175\text{ °C}$
- (2)  $T_j = 150\text{ °C}$
- (3)  $T_j = 125\text{ °C}$
- (4)  $T_j = 85\text{ °C}$
- (5)  $T_j = 25\text{ °C}$
- (6)  $T_j = -40\text{ °C}$
- (7)  $T_j = -55\text{ °C}$

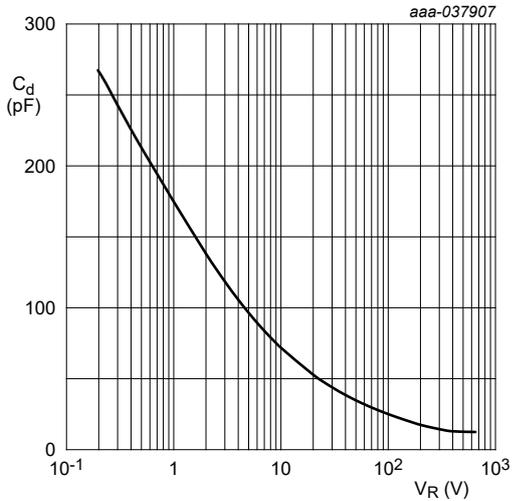
**Fig. 2. Forward current as a function of forward voltage; typical values**



pulsed condition

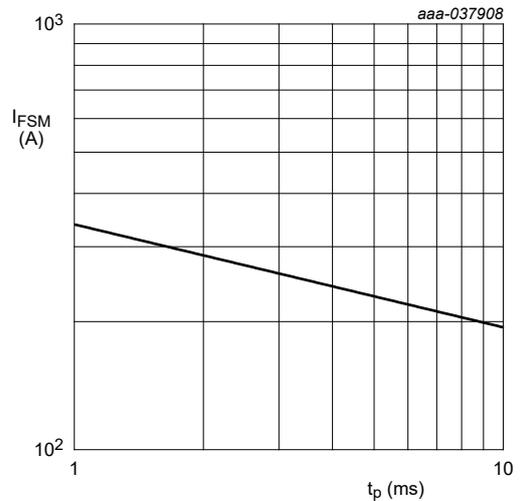
- (1)  $T_j = 175\text{ °C}$
- (2)  $T_j = 150\text{ °C}$
- (3)  $T_j = 125\text{ °C}$
- (4)  $T_j = 100\text{ °C}$
- (5)  $T_j = 85\text{ °C}$
- (6)  $T_j = 55\text{ °C}$
- (7)  $T_j = 25\text{ °C}$

**Fig. 3. Reverse current as a function of reverse voltage; typical values**



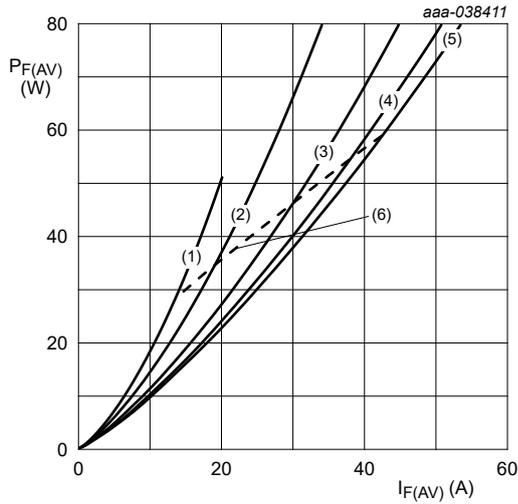
$f = 1\text{ MHz}; T_{amb} = 25\text{ °C}$

**Fig. 4. Diode capacitance as a function of reverse voltage; typical values**



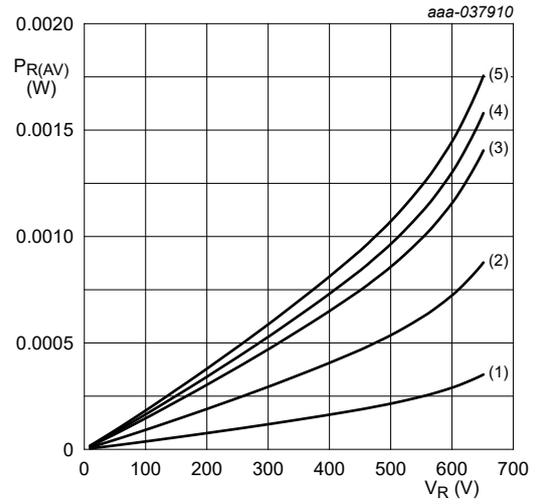
square wave;  $T_{amb} = 25\text{ °C}$

**Fig. 5. Non-repetitive peak forward current as a function of pulse duration; typical values**



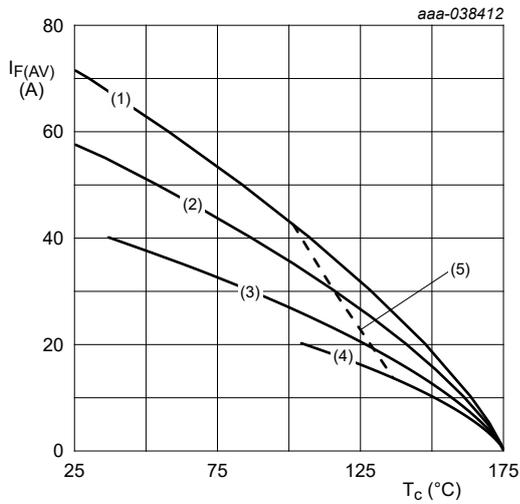
$T_j = 125\text{ }^\circ\text{C}$   
 (1)  $\delta = 0.1$   
 (2)  $\delta = 0.2$   
 (3)  $\delta = 0.5$   
 (4)  $\delta = 0.8$   
 (5)  $\delta = 1$  (DC)  
 (6) RMS limit

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



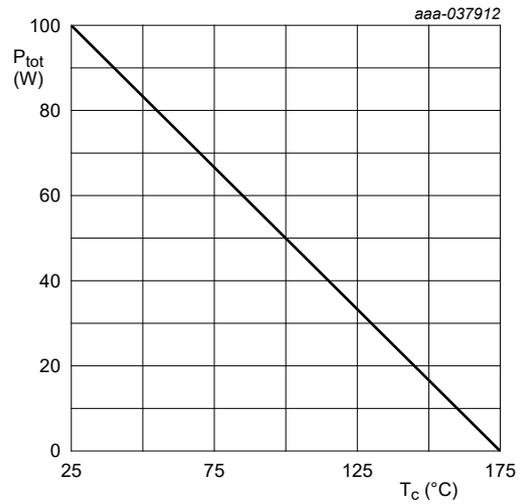
$T_j = 125\text{ }^\circ\text{C}$   
 (1)  $\delta = 0.2$   
 (2)  $\delta = 0.5$   
 (3)  $\delta = 0.8$   
 (4)  $\delta = 0.9$   
 (5)  $\delta = 1$  (DC)

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

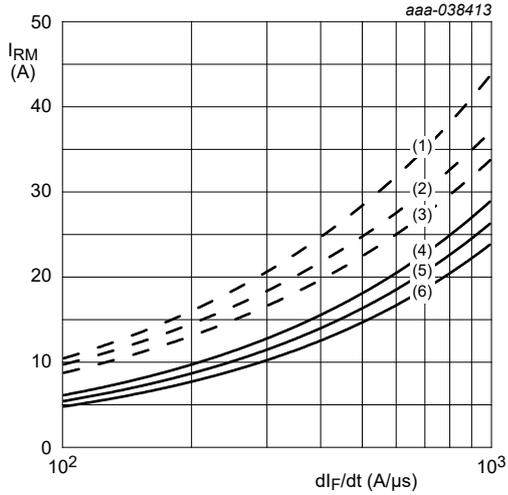


$T_j = 175\text{ }^\circ\text{C}$   
 (1)  $\delta = 1$ ; DC  
 (2)  $\delta = 0.5$ ;  $f = 20\text{ kHz}$   
 (3)  $\delta = 0.2$ ;  $f = 20\text{ kHz}$   
 (4)  $\delta = 0.1$ ;  $f = 20\text{ kHz}$   
 (5) RMS limit

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

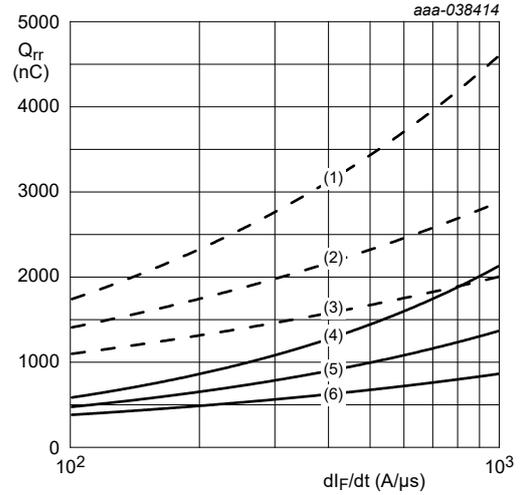


**Fig. 9. Power dissipation as a function of case temperature; maximum values**



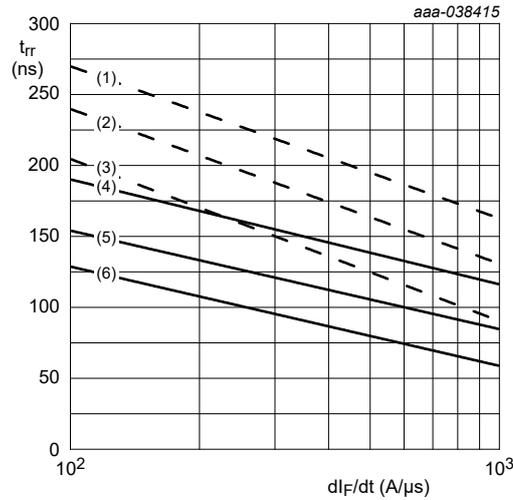
- $V_R = 400\text{ V}$
- (1)  $I_F = 60\text{ A}; T_j = 125\text{ °C}$
  - (2)  $I_F = 30\text{ A}; T_j = 125\text{ °C}$
  - (3)  $I_F = 15\text{ A}; T_j = 125\text{ °C}$
  - (4)  $I_F = 60\text{ A}; T_j = 25\text{ °C}$
  - (5)  $I_F = 30\text{ A}; T_j = 25\text{ °C}$
  - (6)  $I_F = 15\text{ A}; T_j = 25\text{ °C}$

Fig. 10. Peak reverse recovery current as a function of ramp rate; typical values



- $V_R = 400\text{ V}$
- (1)  $I_F = 60\text{ A}; T_j = 125\text{ °C}$
  - (2)  $I_F = 30\text{ A}; T_j = 125\text{ °C}$
  - (3)  $I_F = 15\text{ A}; T_j = 125\text{ °C}$
  - (4)  $I_F = 60\text{ A}; T_j = 25\text{ °C}$
  - (5)  $I_F = 30\text{ A}; T_j = 25\text{ °C}$
  - (6)  $I_F = 15\text{ A}; T_j = 25\text{ °C}$

Fig. 11. Reverse recovery charge as a function of ramp rate; typical values



- $V_R = 400\text{ V}$
- (1)  $I_F = 60\text{ A}; T_j = 125\text{ °C}$
  - (2)  $I_F = 30\text{ A}; T_j = 125\text{ °C}$
  - (3)  $I_F = 15\text{ A}; T_j = 125\text{ °C}$
  - (4)  $I_F = 60\text{ A}; T_j = 25\text{ °C}$
  - (5)  $I_F = 30\text{ A}; T_j = 25\text{ °C}$
  - (6)  $I_F = 15\text{ A}; T_j = 25\text{ °C}$

Fig. 12. Reverse recovery time as a function of ramp rate; typical values

### 11. Test information

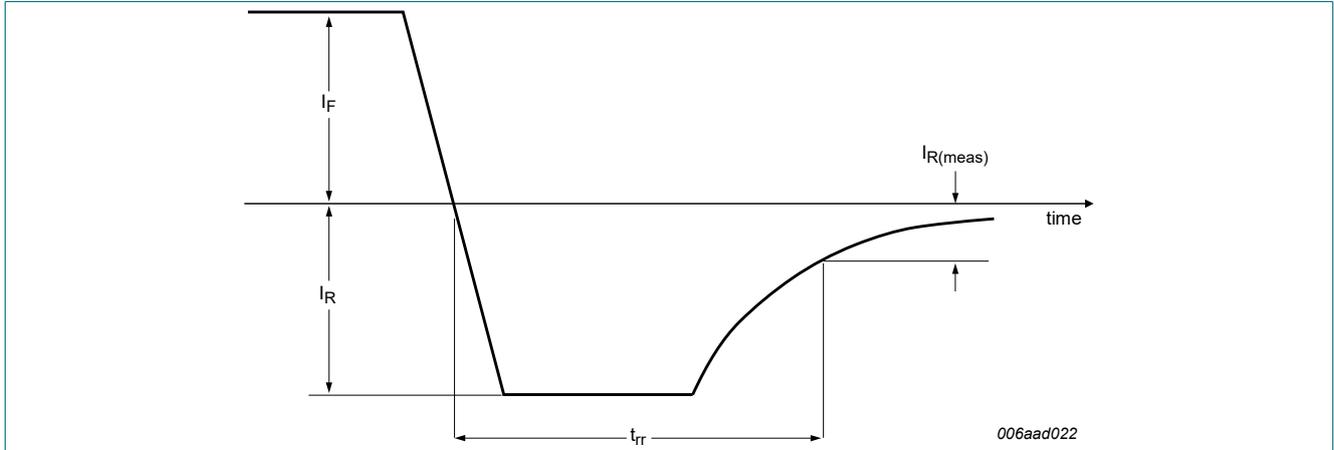


Fig. 13. Reverse recovery definition; step recovery

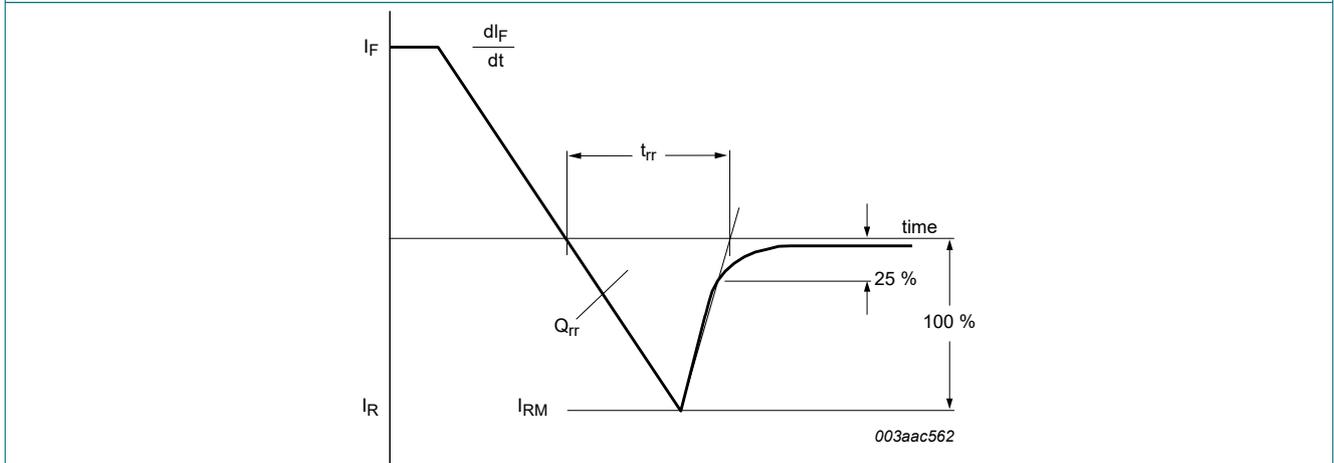


Fig. 14. Reverse recovery definition; ramp recovery

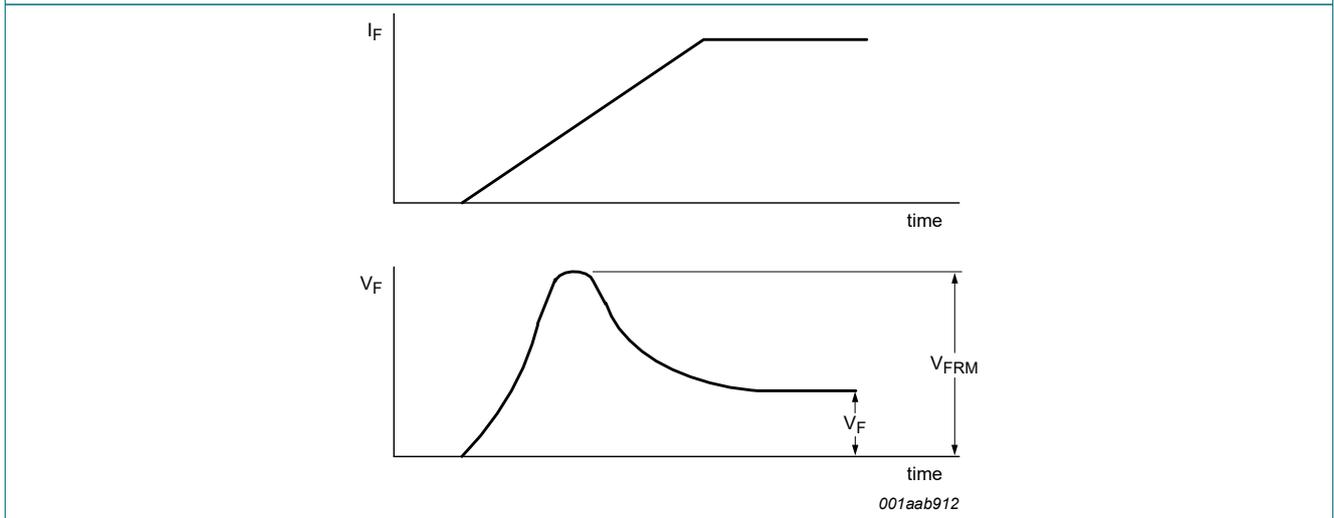


Fig. 15. Forward recovery definition

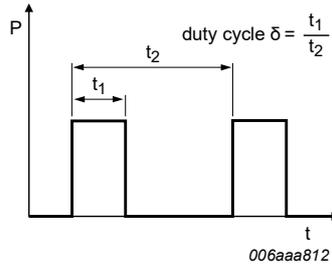


Fig. 16. Duty cycle definition

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

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

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

## 12. Package outline

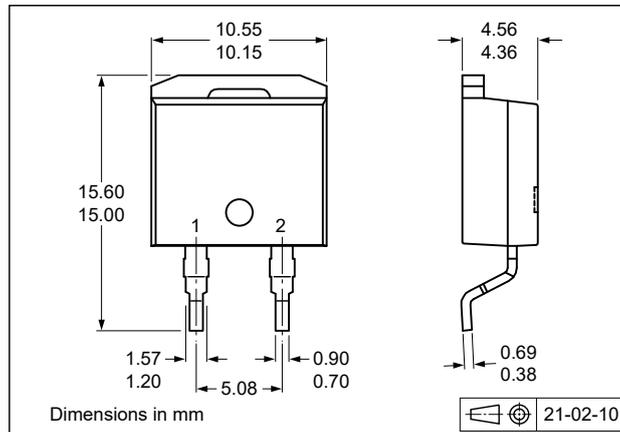


Fig. 17. Package outline D2PAK R2P (SOT8018)

### 13. Soldering

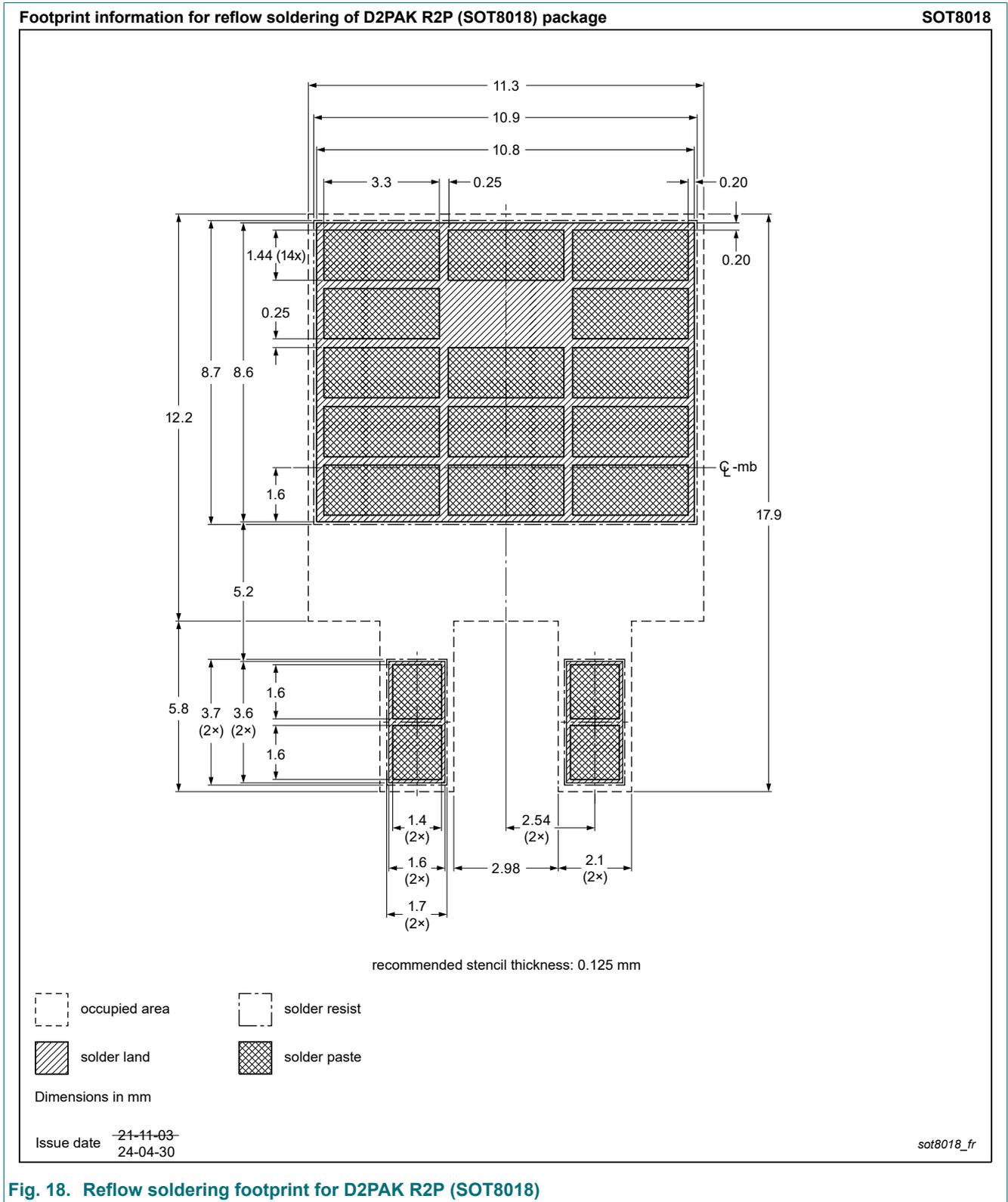


Fig. 18. Reflow soldering footprint for D2PAK R2P (SOT8018)

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PNU650300AEJ v.1	20240503	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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