PNS40010AER-Q

400 V, 1 A high power density, standard switching time recovery rectifier

3 June 2024 **Product data sheet**

1. General description

High power density, standard switching time recovery rectifier with high-efficiency planar technology, encapsulated in a small and flat lead SOD123W Surface-Mounted Device (SMD) plastic package.

2. Features and benefits

- Forward current $I_F \leq 1$ A
- Reverse voltage $V_R \leq 400$ V
- Standard switching time
- Low forward voltage
- Low reverse current
- Low inductance
- Small and flat lead SMD plastic package
- Package height typ. 1 mm
- High power capability
- 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
- Standard switching applications

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$I_{F(AV)}$	average forward current	δ = 0.5; f = 20 kHz; square wave; $T_{sp} \leq$ 166 °C		-	-	1	A
V_{RRM}	repetitive peak reverse voltage			-	-	400	V
V_R	reverse voltage			-	-	400	V
V_F	forward voltage	I_F = 0.5 A; pulsed; T_j = 25 °C	[1]	-	0.89	1.05	V
		I_F = 0.7 A; pulsed; T_j = 25 °C	[1]	-	0.91	1.07	V
		I_F = 1 A; pulsed; T_j = 25 °C	[1]	-	0.93	1.1	V
I_R	reverse current	V_R = 400 V; pulsed; T_j = -40 °C	[1]	-	0.1	10	nA
		V_R = 400 V; pulsed; T_j = 25 °C	[1]	-	0.001	1	µA

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

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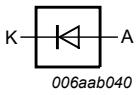
5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	K	cathode	 CFP3 (SOD123W)	 006aab040
2	A	anode		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PNS40010AER-Q	CFP3	plastic, surface mounted package; 2 terminals; 2.6 mm x 1.7 mm x 1 mm body	SOD123W

7. Marking

Table 4. Marking codes

Type number	Marking code
PNS40010AER-Q	N2

8. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
V_{RRM}	repetitive peak reverse voltage			-	400	V
V_R	reverse voltage			-	400	V
I_F	forward current	$T_{sp} \leq 163$ °C		-	1.4	A
$I_{F(AV)}$	average forward current	$\delta = 0.5$; f = 20 kHz; square wave; $T_{sp} \leq 166$ °C		-	1	A
I_{FSM}	non-repetitive peak forward current	$t_p = 8.3$ ms; half sine wave; $T_{j(init)} = 25$ °C		-	30	A
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	750	mW
			[2]	-	1.3	W
T_j	junction temperature			-	175	°C
T_{amb}	ambient temperature			-55	175	°C
T_{stg}	storage temperature			-65	175	°C

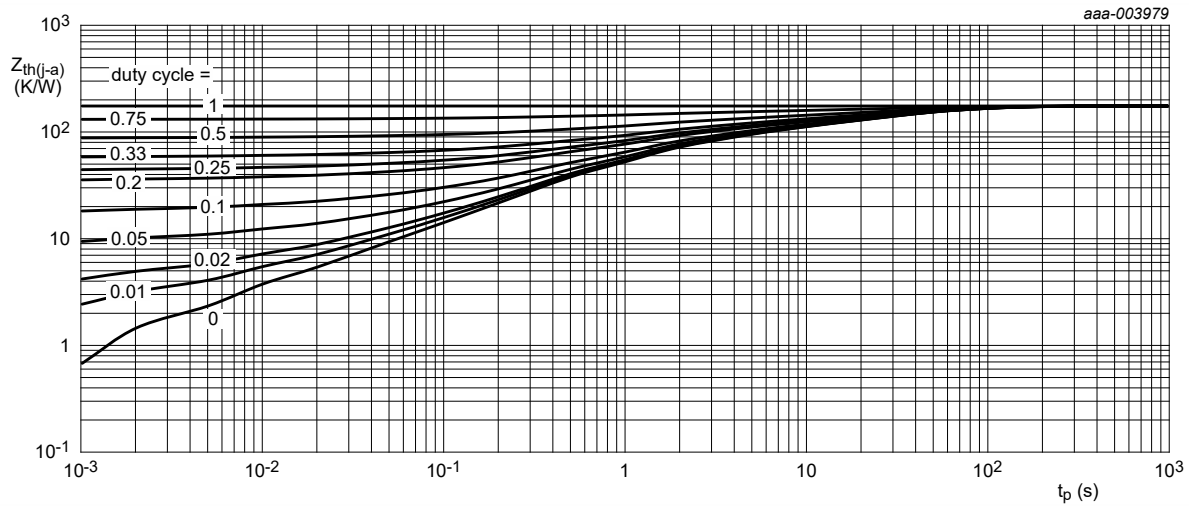
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for cathode 1 cm^2.

9. Thermal characteristics

Table 6. Thermal characteristics

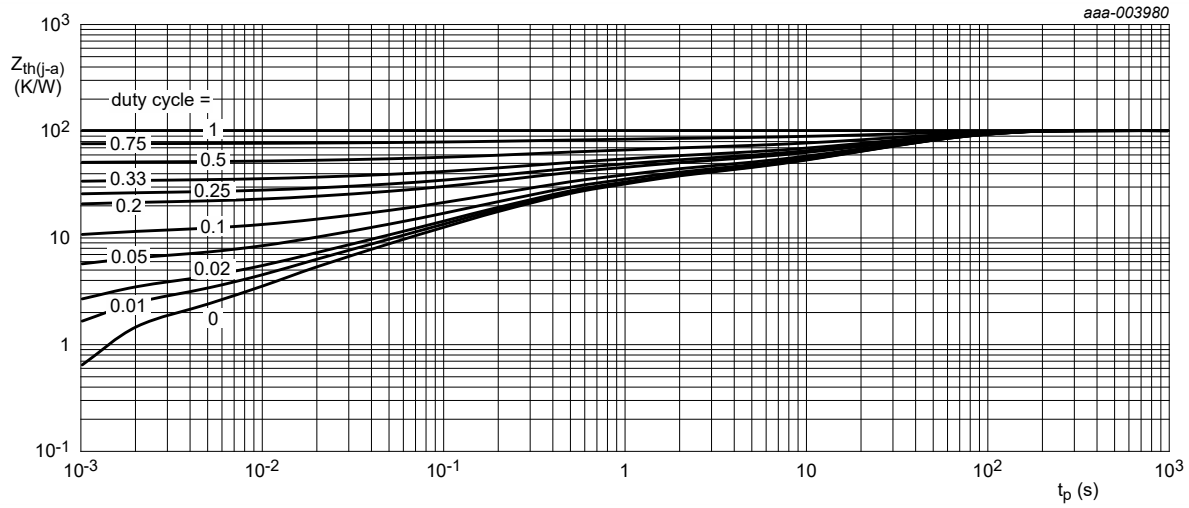
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	200	K/W
			[2]	-	-	115	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		[3]	-	-	15	K/W

[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

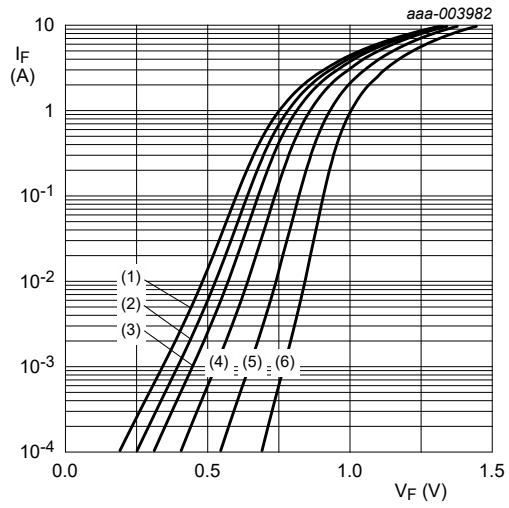
Fig. 2. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

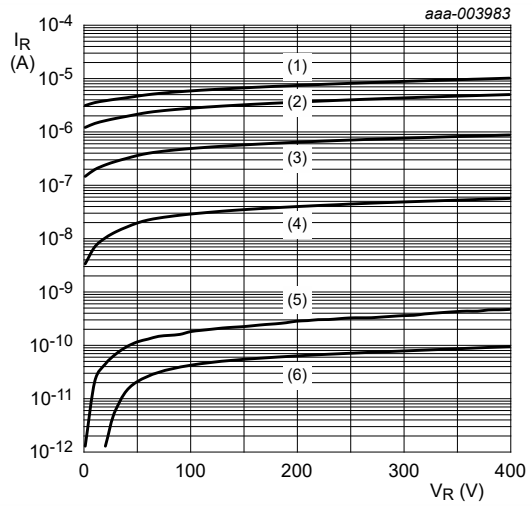
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_F	forward voltage	I_F = 0.5 A; pulsed; T_j = 25 °C	[1]	-	0.89	1.05	V
		I_F = 0.7 A; pulsed; T_j = 25 °C	[1]	-	0.91	1.07	V
		I_F = 1 A; pulsed; T_j = 25 °C	[1]	-	0.93	1.1	V
		I_F = 0.5 A; pulsed; T_j = 125 °C	[1]	-	0.76	0.92	V
		I_F = 0.7 A; pulsed; T_j = 125 °C	[1]	-	0.78	0.95	V
		I_F = 1 A; pulsed; T_j = 125 °C	[1]	-	0.81	0.98	V
		I_F = 1 A; pulsed; T_j = -40 °C	[1]	-	1	1.18	V
		I_F = 1 A; pulsed; T_j = 150 °C	[1]	-	0.78	0.95	V
		I_F = 1 A; pulsed; T_j = 175 °C	[1]	-	0.75	0.92	V
I_R	reverse current	V_R = 400 V; pulsed; T_j = -40 °C	[1]	-	0.1	10	nA
		V_R = 400 V; pulsed; T_j = 25 °C	[1]	-	0.001	1	µA
		V_R = 400 V; pulsed; T_j = 125 °C	[1]	-	1	50	µA
		V_R = 400 V; pulsed; T_j = 150 °C	[1]	-	5	250	µA
		V_R = 400 V; pulsed; T_j = 175 °C	[1]	-	10	500	µA
C_d	diode capacitance	V_R = 4 V; f = 1 MHz; T_j = 25 °C		-	6	15	pF
t_{rr}	reverse recovery time	I_F = 0.5 A; I_R = 1 A; $I_{R(meas)}$ = 0.25 A; T_j = 25 °C		-	0.5	1.5	µs

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



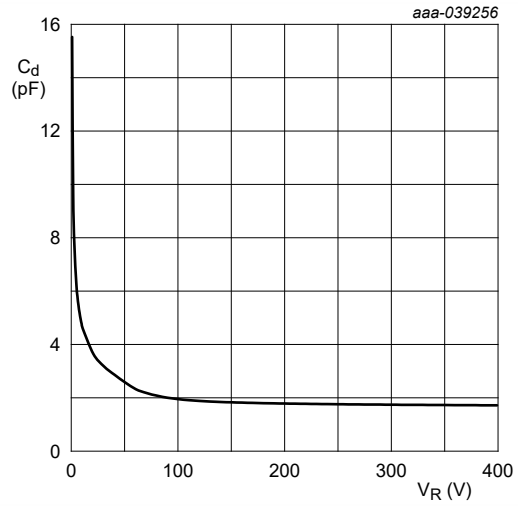
(1) T_j = 175 °C
(2) T_j = 150 °C
(3) T_j = 125°C
(4) T_j = 85 °C
(5) T_j = 25 °C
(6) T_j = −40 °C

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



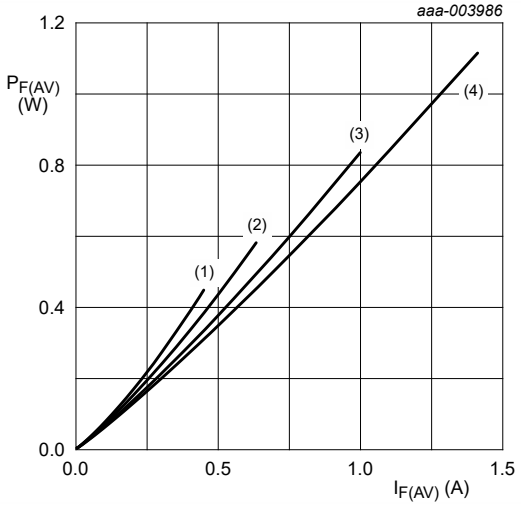
(1) T_j = 175 °C
(2) T_j = 150 °C
(3) T_j = 125 °C
(4) T_j = 85 °C
(5) T_j = 25 °C
(6) T_j = −40 °C

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



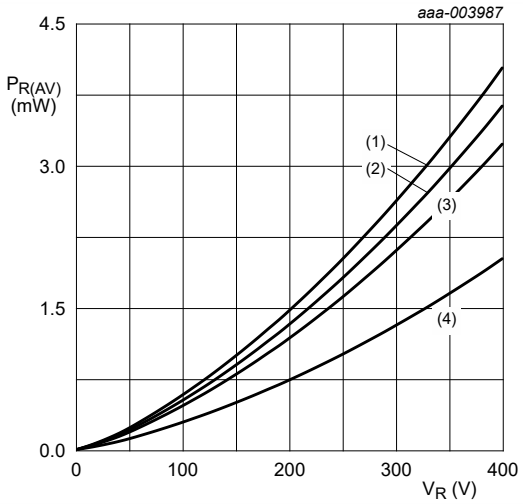
f = 1 MHz; T_j = 25 °C

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



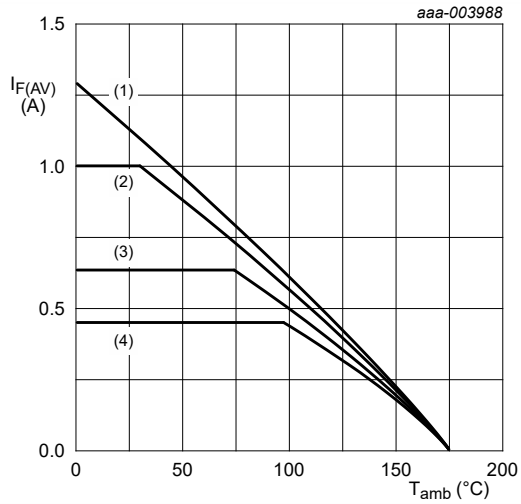
T_j = 175 °C
(1) δ = 0.1
(2) δ = 0.2
(3) δ = 0.5
(4) δ = 1

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



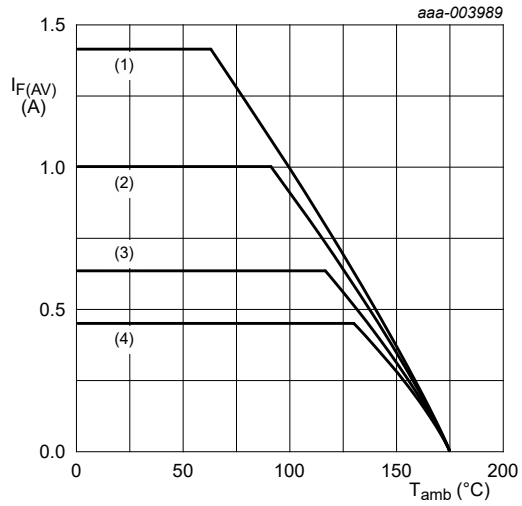
T_j = 175 °C
(1) δ = 1
(2) δ = 0.9
(3) δ = 0.8
(4) δ = 0.5

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



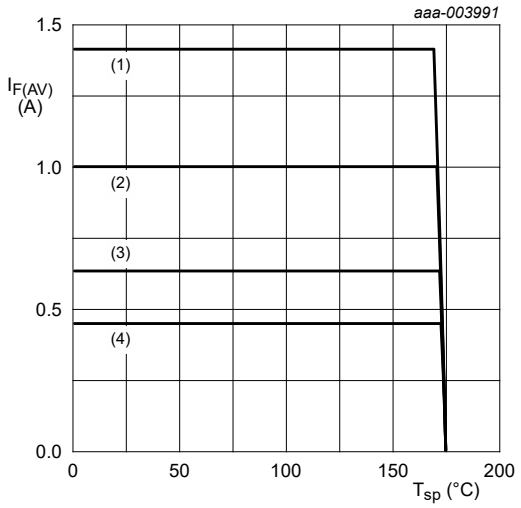
FR4 PCB, standard footprint
T_j = 175 °C
(1) δ = 1 (DC)
(2) δ = 0.5; f = 20 kHz
(3) δ = 0.2; f = 20 kHz
(4) δ = 0.1; f = 20 kHz

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

11. Test information

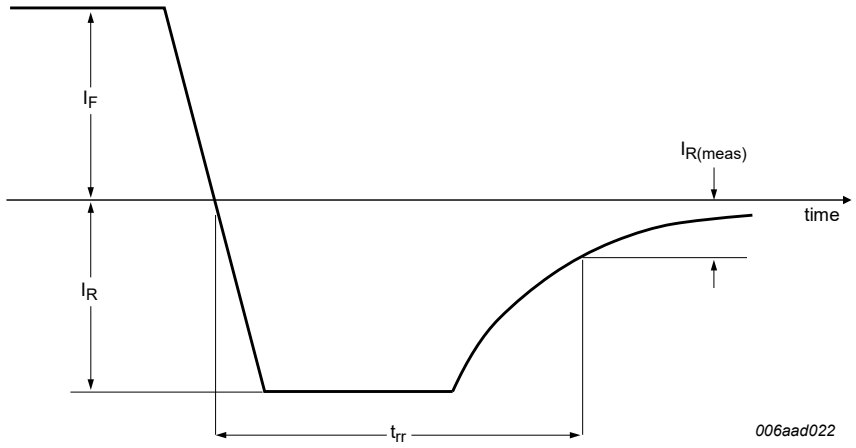


Fig. 11. Reverse recovery definition; step recovery

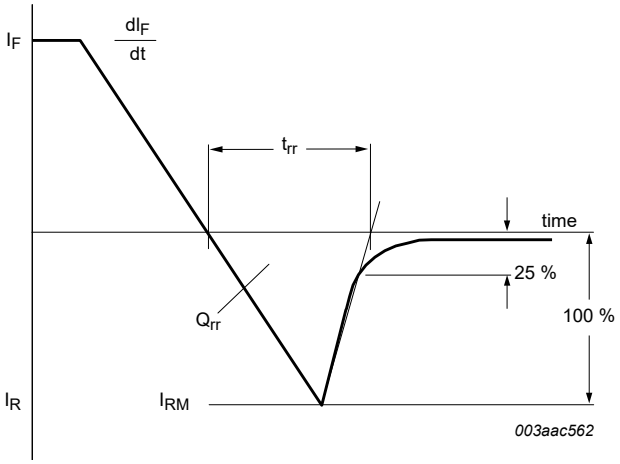


Fig. 12. Reverse recovery definition; ramp recovery

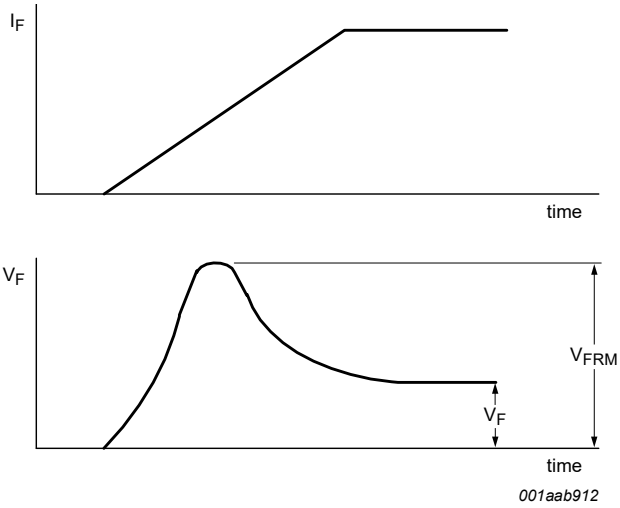


Fig. 13. Forward recovery definition

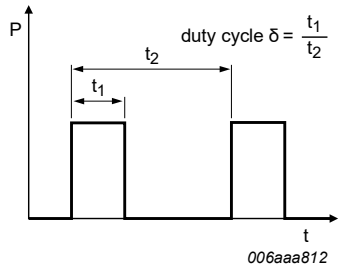


Fig. 14. Duty cycle definition

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

$I_{F(AV)}=I_M \times \delta$ 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.

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

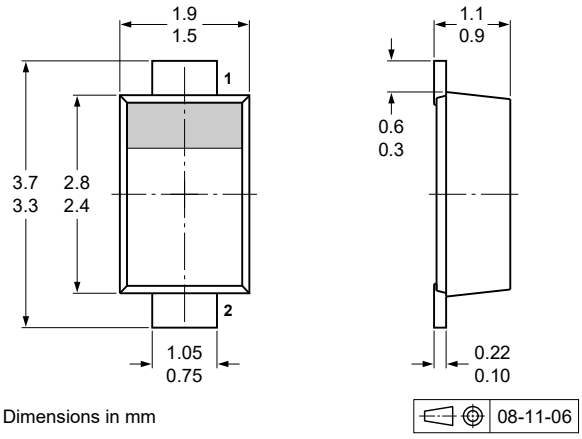


Fig. 15. Package outline CFP3 (SOD123W)

13. Soldering

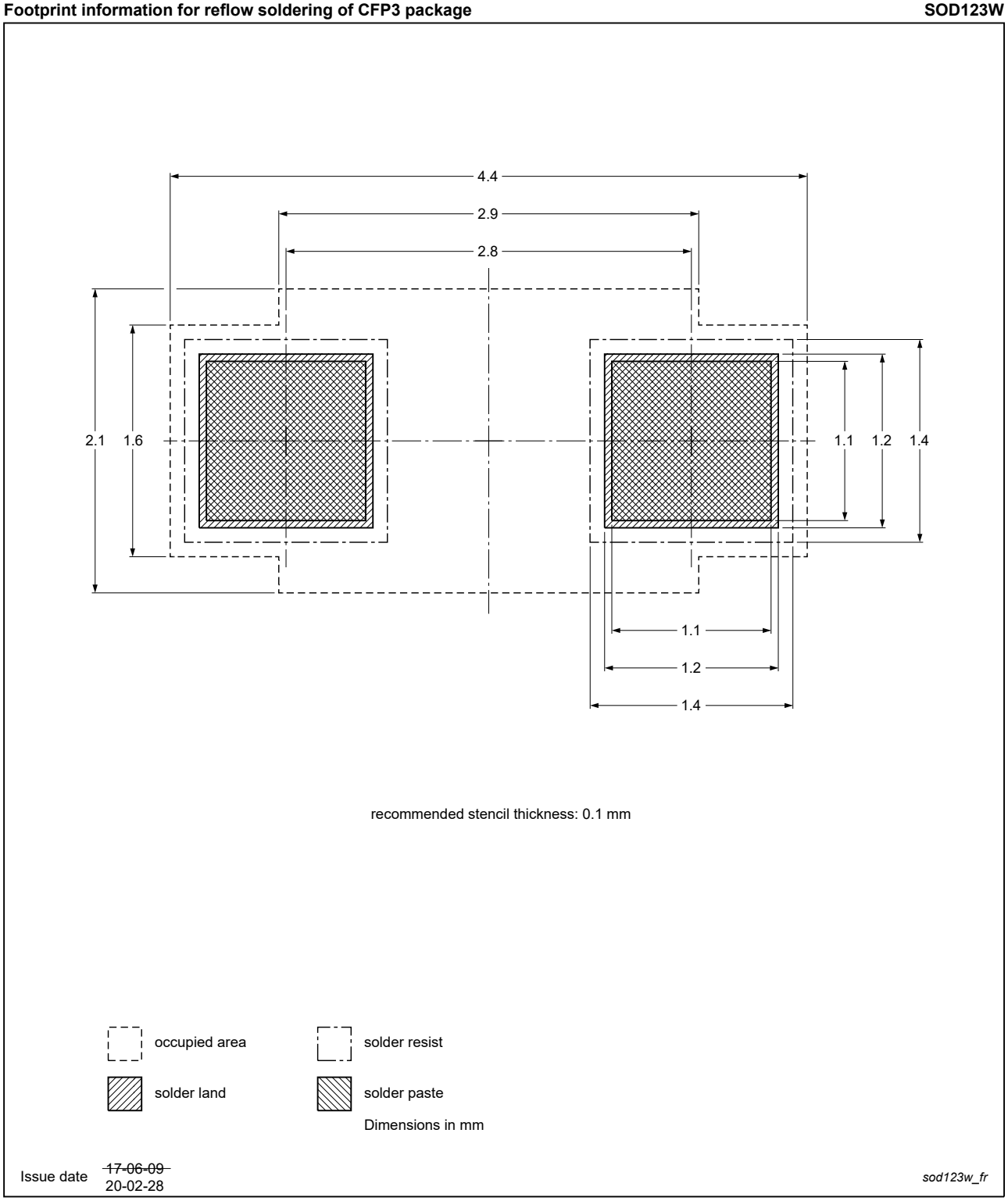


Fig. 16. Reflow soldering footprint for CFP3 (SOD123W)

Wave soldering footprint information **SOD123W**

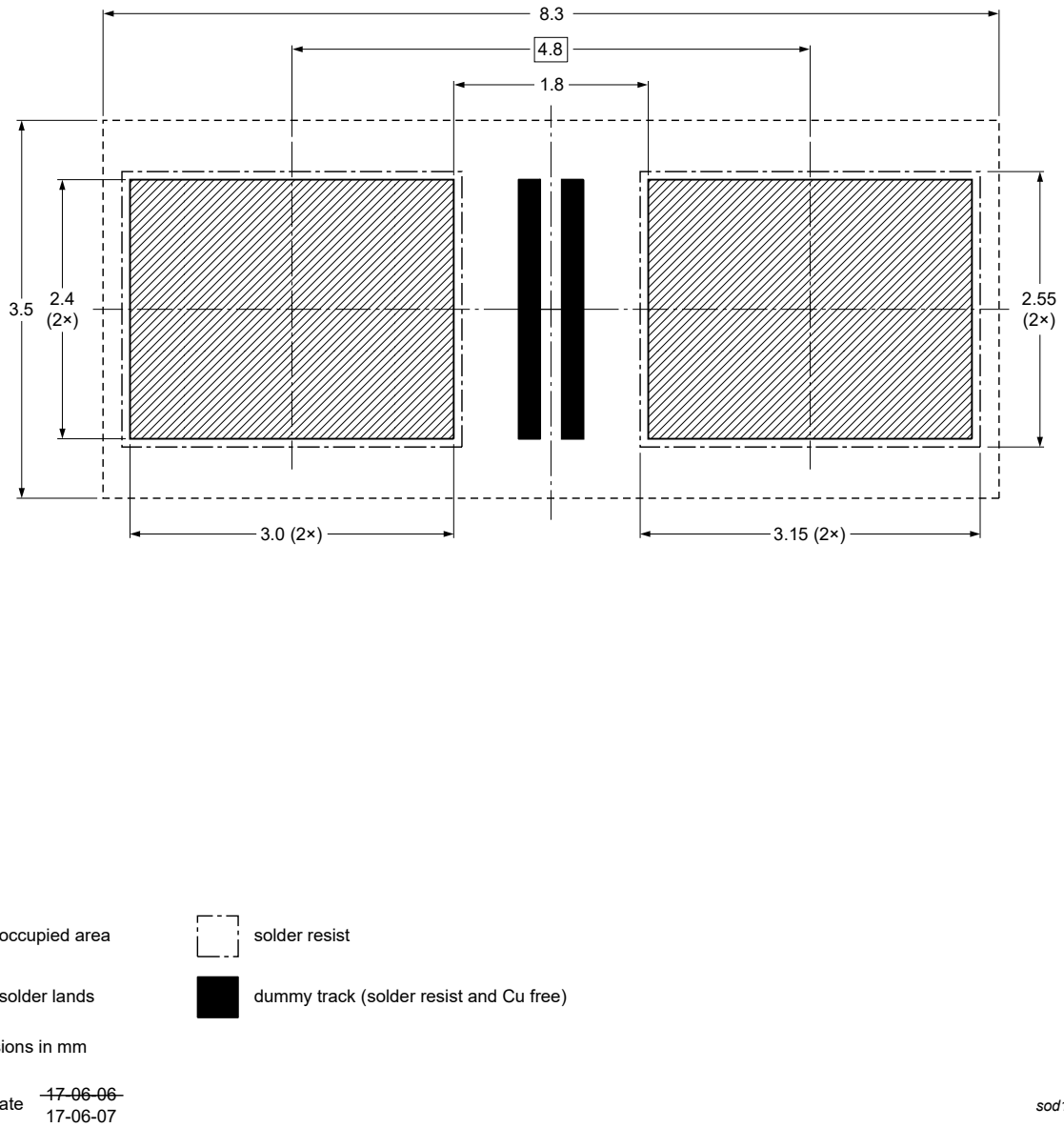


Fig. 17. Wave soldering footprint for CFP3 (SOD123W)

14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PNS40010AER-Q v.2	20240603	Product data sheet	-	PNS40010AER-Q v.1
Modifications	• Product status changed			
PNS40010AER-Q v.1	20240319	Preliminary 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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Date of release: 3 June 2024