PNS40010ER

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

19 August 2019 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
- AEC-Q101 qualified
- Capable for reflow and wave soldering

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; $T_{amb} \leq$ 115 °C	[1]	-	-	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; $t_p \leq$ 300 µs; δ ≤ 0.02; T_j = 25 °C		-	0.89	1.05	V
		I_F = 0.7 A; $t_p \leq$ 300 µs; δ ≤ 0.02; T_j = 25 °C		-	0.91	1.07	V
I_R	reverse current	V_R = 400 V; T_j = -40 °C		-	0.1	10	nA
		V_R = 400 V; T_j = 25 °C		-	0.001	1	µA

[1] Device mounted on a ceramic PCB, Al_2O_3, standard footprint.

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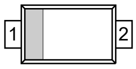
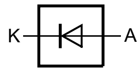
5. Pinning information

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
PNS40010ER	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
PNS40010ER	EH

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
V_{RMS}	RMS voltage			-	280	V
I_F	forward current	$T_{sp} \leq$ 160 °C		-	1.4	A
$I_{F(AV)}$	average forward current	δ = 0.5; f = 20 kHz; square wave; $T_{amb} \leq$ 115 °C	[1]	-	1	A
		δ = 0.5; f = 20 kHz; square wave; $T_{sp} \leq$ 170 °C		-	1	A
I_{FSM}	non-repetitive peak forward current	t_p = 8 ms; $T_{j(init)}$ = 25 °C; square wave		-	32	A
P_{tot}	total power dissipation	$T_{amb} \leq$ 25 °C	[2]	-	750	mW
			[3]	-	1.3	W
			[1]	-	2.3	W
T_j	junction temperature			-	175	°C
T_{amb}	ambient temperature			-55	175	°C
T_{stg}	storage temperature			-65	175	°C

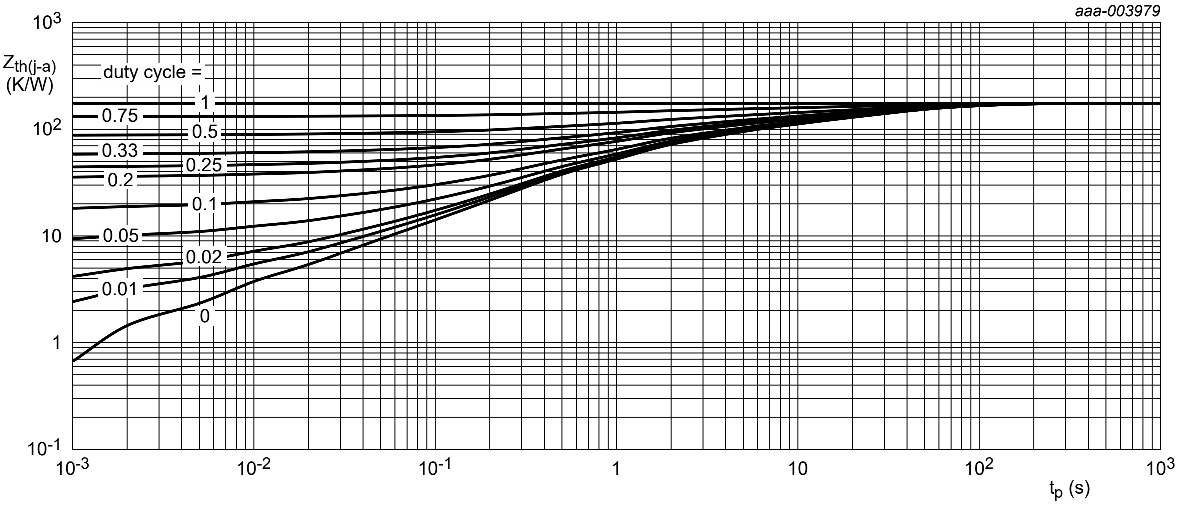
[1] Device mounted on a ceramic PCB, Al_2O_3, standard footprint.
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.
[3] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for cathode 1 cm^2.

9. Thermal characteristics

Table 6. Thermal characteristics

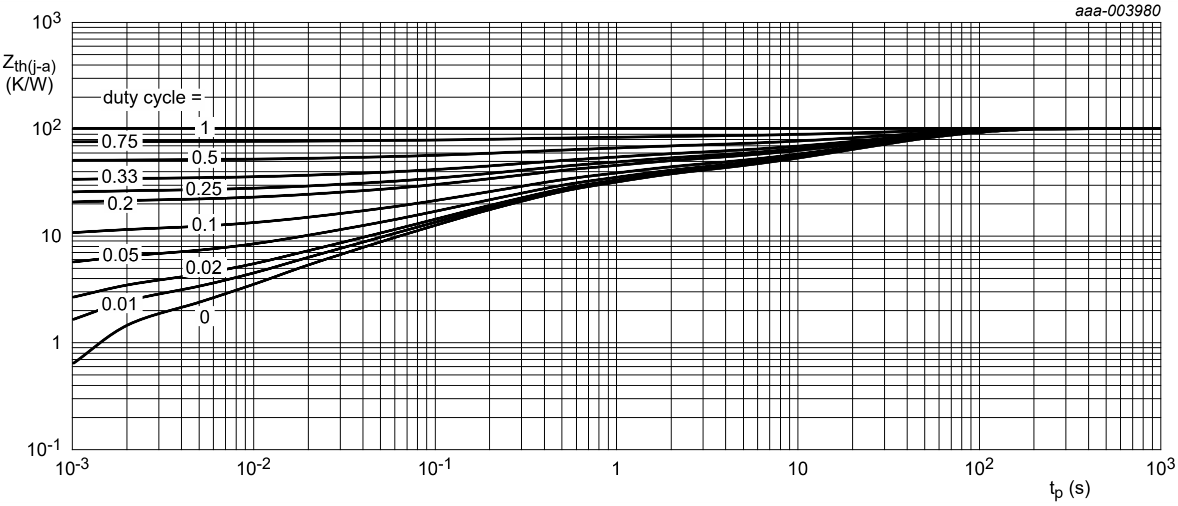
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	200	K/W
			[2]	-	-	115	K/W
			[3]	-	-	65	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point		[4]	-	-	15	K/W

[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] Device mounted on an FR4 PCB, Al_2O_3, standard footprint.
[4] Soldering point of cathode tab.



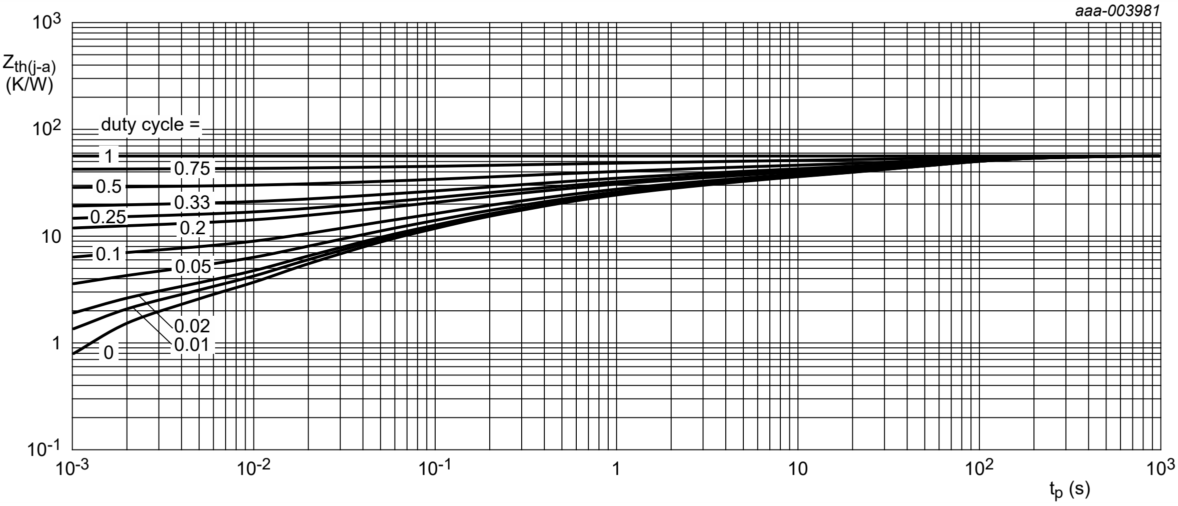
FR4 PCB, standard footprint

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



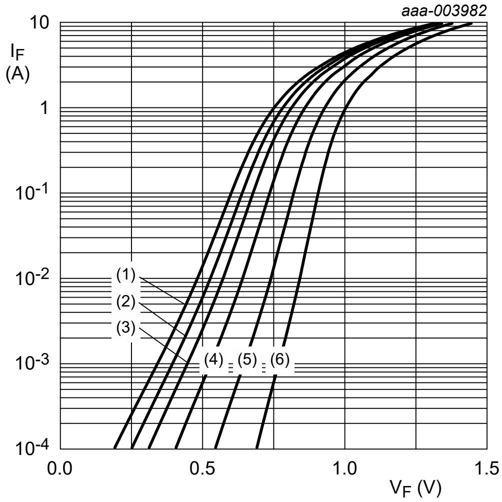
Ceramic PCB, Al_2O_3, standard footprint

Fig. 3. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

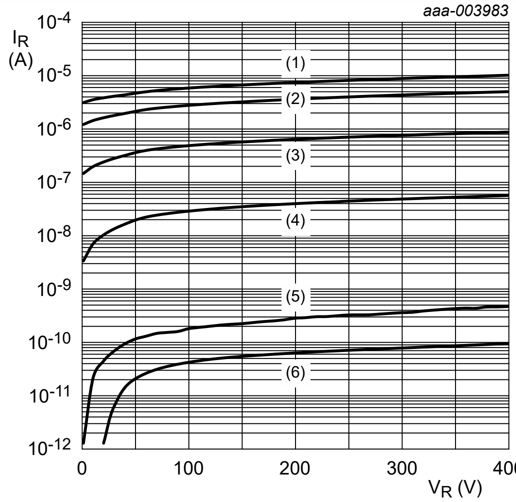
Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_F	forward voltage	I_F = 0.5 A; t_p ≤ 300 µs; δ ≤ 0.02; T_j = 25 °C		-	0.89	1.05	V
		I_F = 0.7 A; t_p ≤ 300 µs; δ ≤ 0.02; T_j = 25 °C		-	0.91	1.07	V
		I_F = 1 A; t_p ≤ 300 µs; δ ≤ 0.02; T_j = 25 °C		-	0.93	1.1	V
		I_F = 0.5 A; t_p ≤ 300 µs; δ ≤ 0.02; T_j = 125 °C		-	0.76	0.92	V
		I_F = 0.7 A; t_p ≤ 300 µs; δ ≤ 0.02; T_j = 125 °C		-	0.78	0.95	V
		I_F = 1 A; t_p ≤ 300 µs; δ ≤ 0.02; T_j = 125 °C		-	0.81	0.98	V
		I_F = 1 A; t_p ≤ 300 µs; δ ≤ 0.02; T_j = -40 °C		-	1.01	1.18	V
		I_F = 1 A; t_p ≤ 300 µs; δ ≤ 0.02; T_j = 150 °C		-	0.78	0.95	V
		I_F = 1 A; t_p ≤ 300 µs; δ ≤ 0.02; T_j = 175 °C		-	0.75	0.92	V
I_R	reverse current	V_R = 400 V; T_j = -40 °C		-	0.1	10	nA
		V_R = 400 V; T_j = 25 °C		-	0.001	1	µA
		V_R = 400 V; T_j = 125 °C		-	1	50	µA
		V_R = 400 V; T_j = 150 °C		-	5	250	µA
		V_R = 400 V; T_j = 175 °C		-	10	500	µA
C_d	diode capacitance	V_R = 4 V; f = 1 MHz; T_{amb} = 25 °C		-	8	20	pF
t_{rr}	reverse recovery time	I_F = 0.5 A; I_R = 1 A; $I_{R(meas)}$ = 0.25 A; T_{amb} = 25 °C		-	0.8	1.8	µs



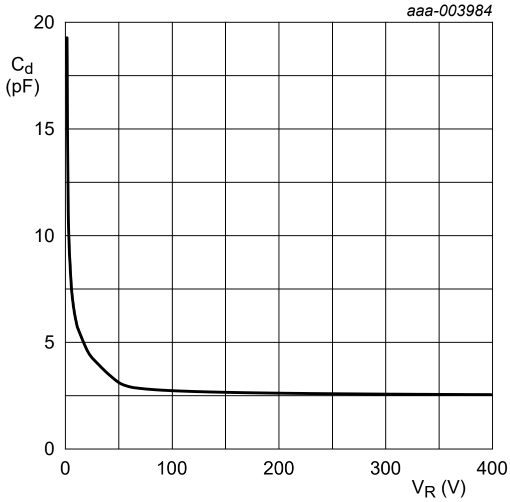
(1) T_j = 175 °C
(2) T_j = 150 °C
(3) T_j = 125°C
(4) T_j = 85 °C
(5) T_j = 25 °C
(6) T_j = −40 °C

Fig. 4. Forward current as a function of forward voltage; typical values



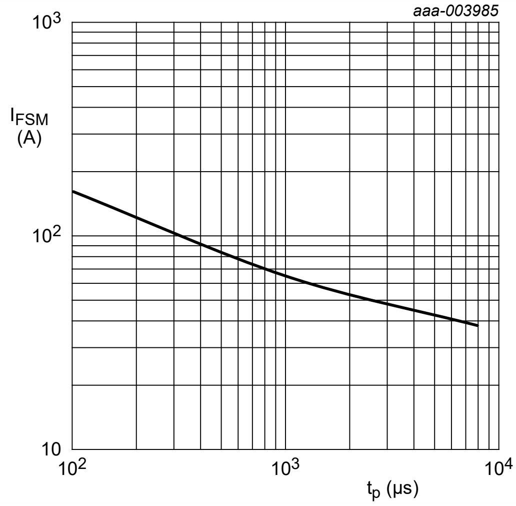
(1) T_j = 175 °C
(2) T_j = 150 °C
(3) T_j = 125 °C
(4) T_j = 85 °C
(5) T_j = 25 °C
(6) T_j = −40 °C

Fig. 5. Reverse current as a function of reverse voltage; typical values



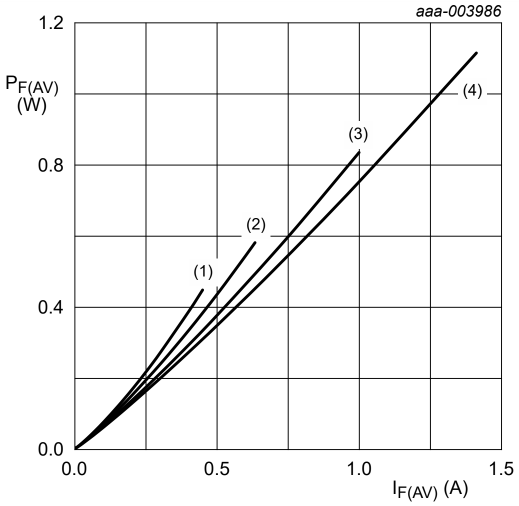
f = 1 MHz; T_{amb} = 25 °C

Fig. 6. Diode capacitance as a function of reverse voltage; typical values



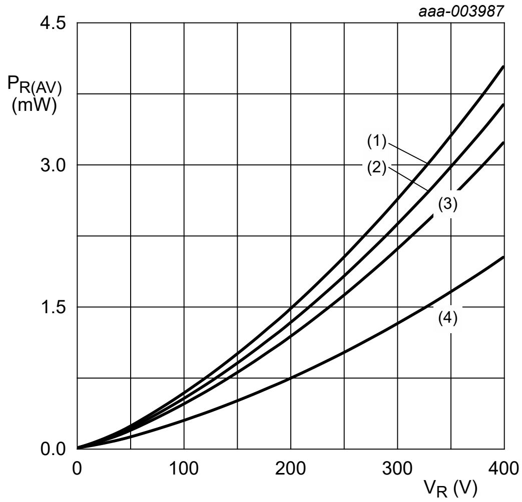
T_{amb} = 25 °C

Fig. 7. Non-repetitive peak forward current as a function of pulse duration; typical values



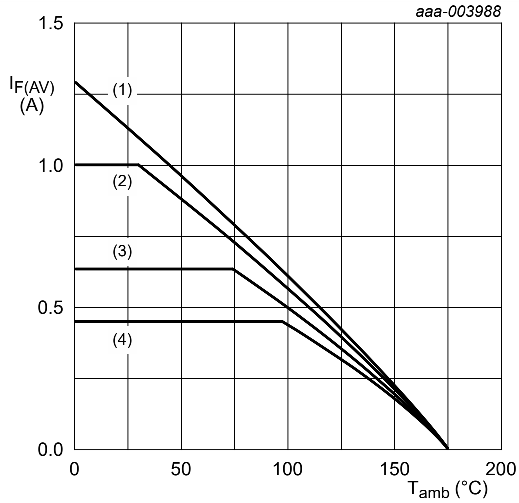
T_j = 175 °C
(1) δ = 0.1
(2) δ = 0.2
(3) δ = 0.5
(4) δ = 1

Fig. 8. Average forward power dissipation as a function of average forward current; typical values



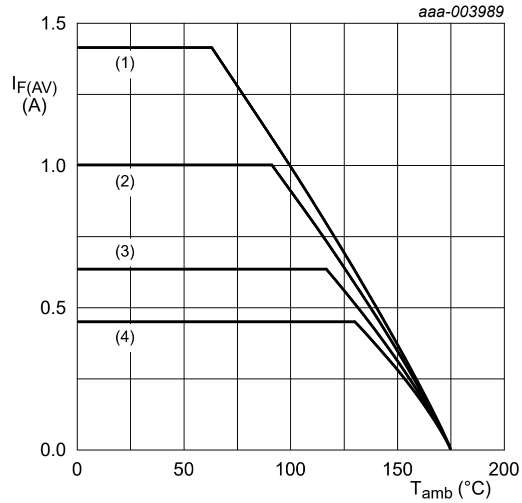
T_j = 175 °C
(1) δ = 1
(2) δ = 0.9
(3) δ = 0.8
(4) δ = 0.5

Fig. 9. Average reverse power dissipation as a function of reverse voltage; typical values



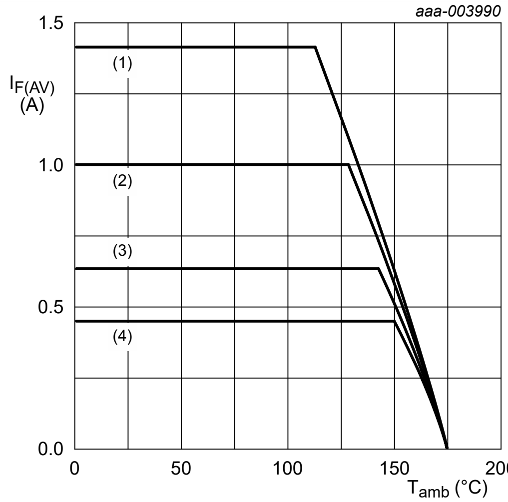
FR4 PCB, standard footprint
T_j = 175 °C
(1) δ = 1 (DC)
(2) δ = 0.5; f = 20 kHz
(3) δ = 0.2; f = 20 kHz
(4) δ = 0.1; f = 20 kHz

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



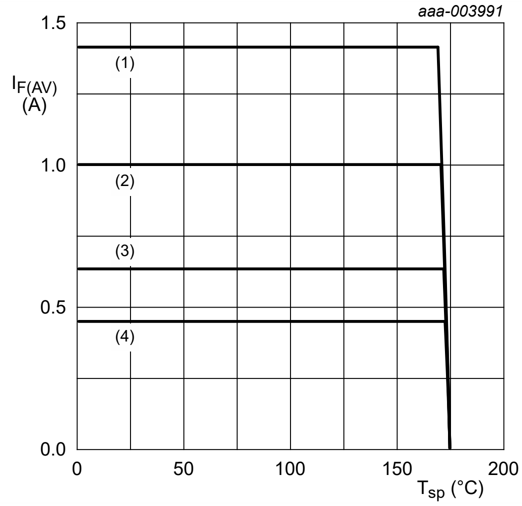
FR4 PCB, mounting pad for cathode 1 cm^2
T_j = 175 °C
(1) δ = 1 (DC)
(2) δ = 0.5; f = 20 kHz
(3) δ = 0.2; f = 20 kHz
(4) δ = 0.1; f = 20 kHz

Fig. 11. Average forward current as a function of ambient temperature; typical values



Ceramic PCB, Al_2O_3, 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. 12. 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. 13. Average forward current as a function of solder point temperature; typical values

11. Test information

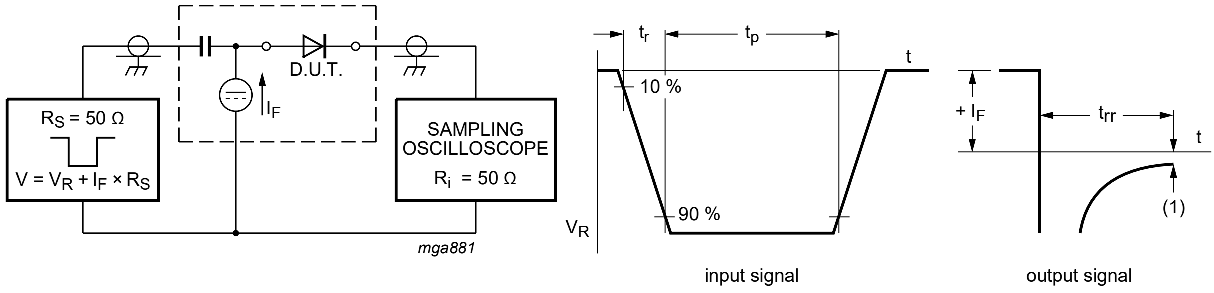


Fig. 14. Reverse recovery time: test circuit and waveforms

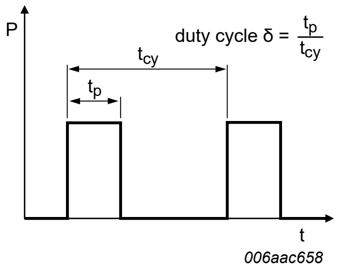


Fig. 15. Duty cycle definition

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

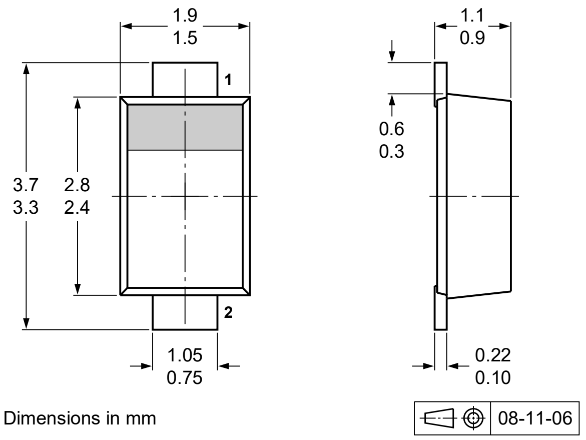


Fig. 16. Package outline CFP3 (SOD123W)

13. Soldering

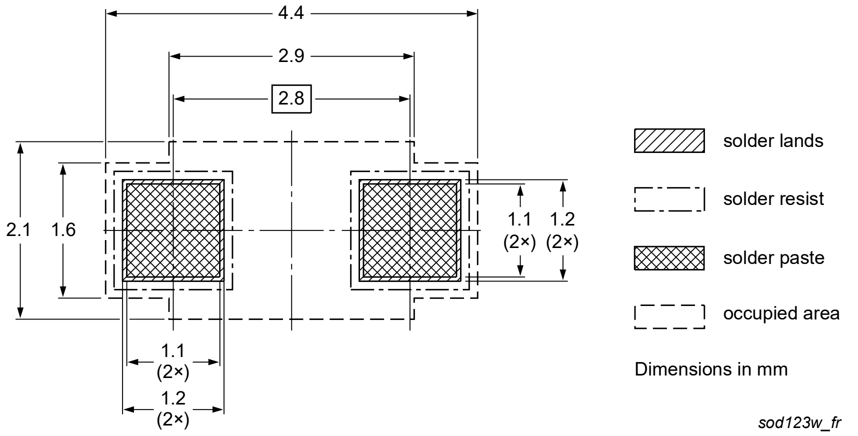


Fig. 17. Reflow soldering footprint for CFP3 (SOD123W)

Wave soldering footprint information **SOD123W**

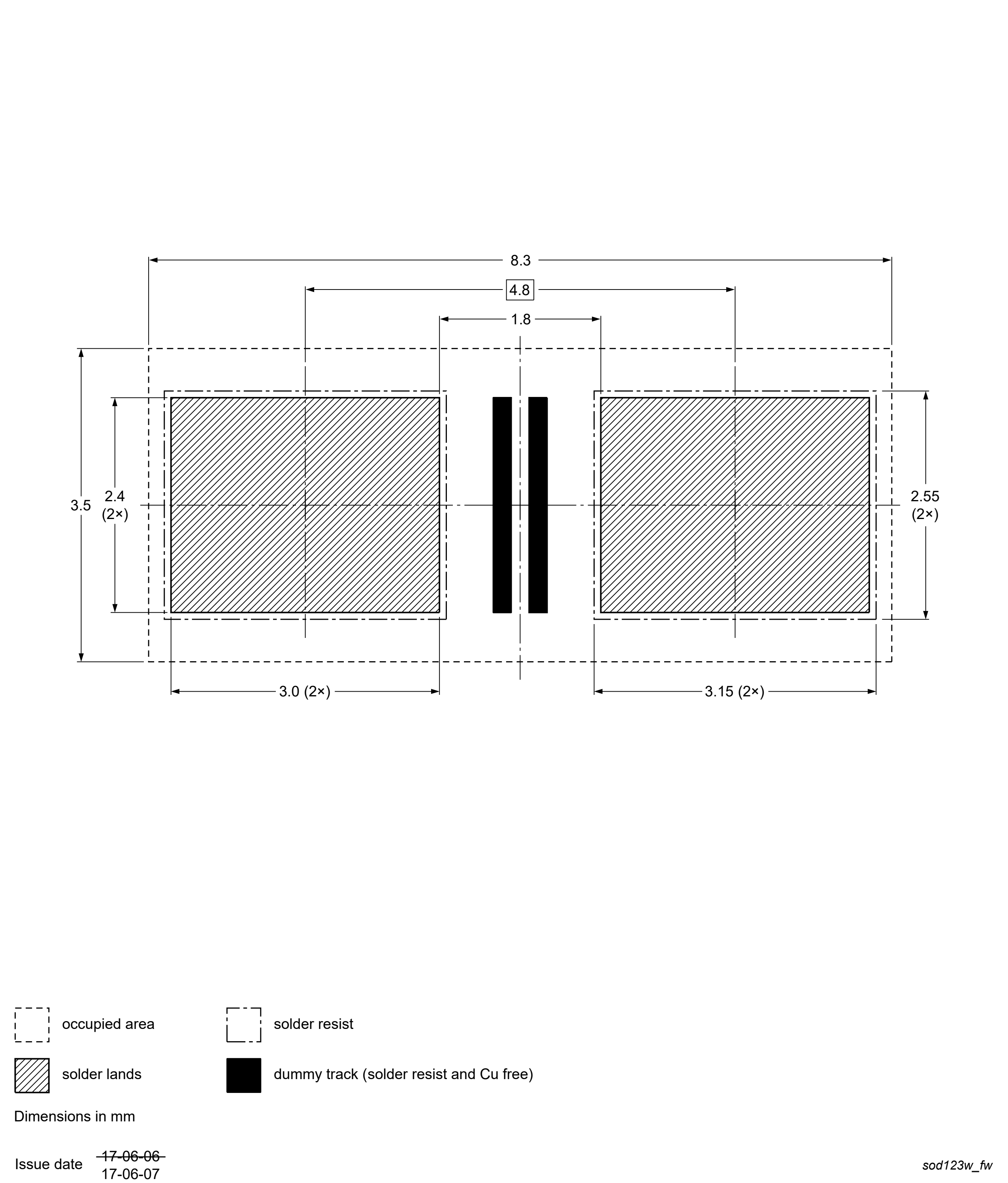


Fig. 18. Wave soldering footprint for CFP3 (SOD123W)

14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PNS40010ER v.4	20190819	Product data sheet	-	PNS40010ER v.3
Modifications:	• Category changed from PN-rectifier to recovery rectifier			
PNS40010ER v.3	20180822	Product data sheet	-	PNS40010ER v.2
PNS40010ER v.2	20120821	Product data sheet	-	PNS40010ER v.1
PNS40010ER v.1	20120615	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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