NX7002AKA

60 V, single N-channel Trench MOSFET

18 February 2013 **Product data sheet**

1. General description

N-channel enhancement mode Field-Effect Transistor (FET) in a small SOT23 (TO-236AB) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

2. Features and benefits

- Very fast switching
- Trench MOSFET technology
- ESD protected
- AEC-Q101 qualified

3. Applications

- Relay driver
- High-speed line driver
- Low-side loadswitch
- Switching circuits

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	T_{amb} = 25 °C		-	-	60	V
V_{GS}	gate-source voltage			-20	-	20	V
I_D	drain current	V_{GS} = 10 V; T_{sp} = 25 °C		-	-	300	mA
		V_{GS} = 10 V; T_{amb} = 25 °C	[1]	-	-	190	mA
Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 100 mA; T_j = 25 °C		-	3	4.5	Ω

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

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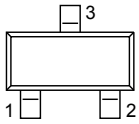
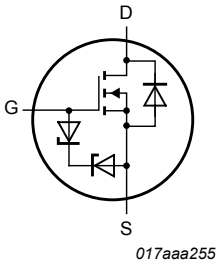
5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 TO-236AB (SOT23)	 017aaa255
2	S	source		
3	D	drain		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
NX7002AKA	TO-236AB	plastic surface-mounted package; 3 leads	SOT23

7. Limiting values

Table 4. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	T_{amb} = 25 °C		-	60	V
V_{GS}	gate-source voltage			-20	20	V
I_D	drain current	V_{GS} = 10 V; T_{sp} = 25 °C		-	300	mA
		V_{GS} = 10 V; T_{amb} = 25 °C	[1]	-	190	mA
		V_{GS} = 10 V; T_{amb} = 100 °C	[1]	-	120	mA
I_{DM}	peak drain current	T_{amb} = 25 °C; single pulse; $t_p \leq 10$ µs		-	760	mA
P_{tot}	total power dissipation	T_{amb} = 25 °C	[2]	-	265	mW
			[1]	-	325	mW
		T_{sp} = 25 °C		-	1330	mW
T_j	junction temperature			-55	150	°C
T_{amb}	ambient temperature			-55	150	°C
T_{stg}	storage temperature			-65	150	°C
Source-drain diode						
I_S	source current	T_{amb} = 25 °C	[1]	-	190	mA

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 1 cm^2.
[2] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.

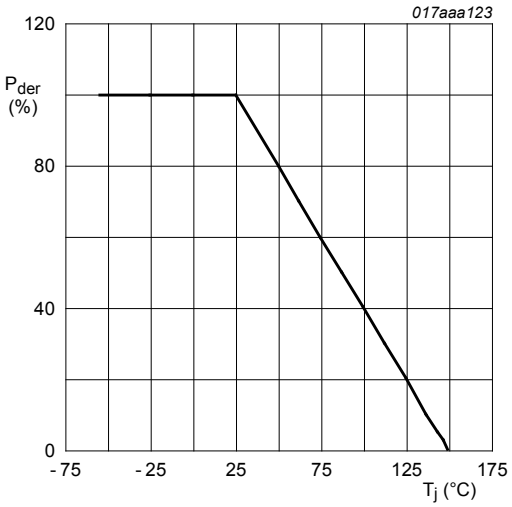


Fig. 1. Normalized total power dissipation as a function of junction temperature

$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\ \%$$

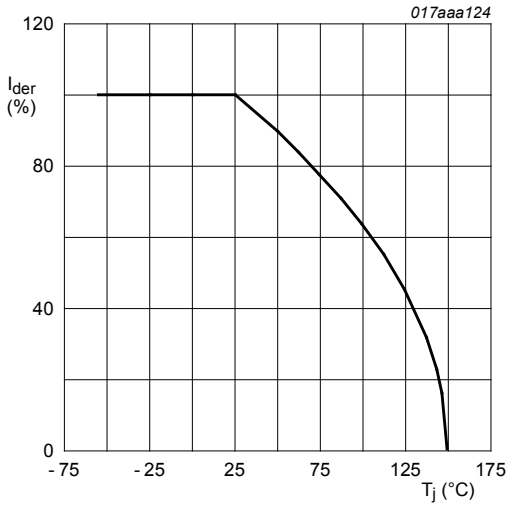
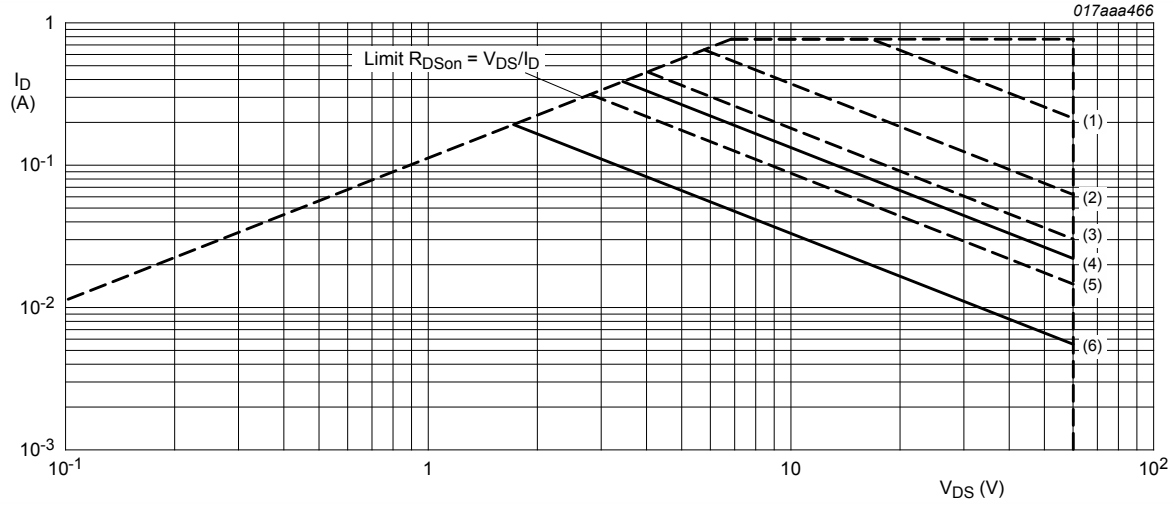


Fig. 2. Normalized continuous drain current as a function of junction temperature

$$I_{der} = \frac{I_D}{I_{D(25°C)}} \times 100\ \%$$



I_{DM} = single pulse
(1) t_p = 100 µs
(2) t_p = 1 ms
(3) t_p = 10 ms
(4) DC; T_{sp} = 25 °C
(5) t_p = 100 ms
(6) DC; T_{amb} = 25 °C; drain mounting pad 1 cm^2

Fig. 3. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage

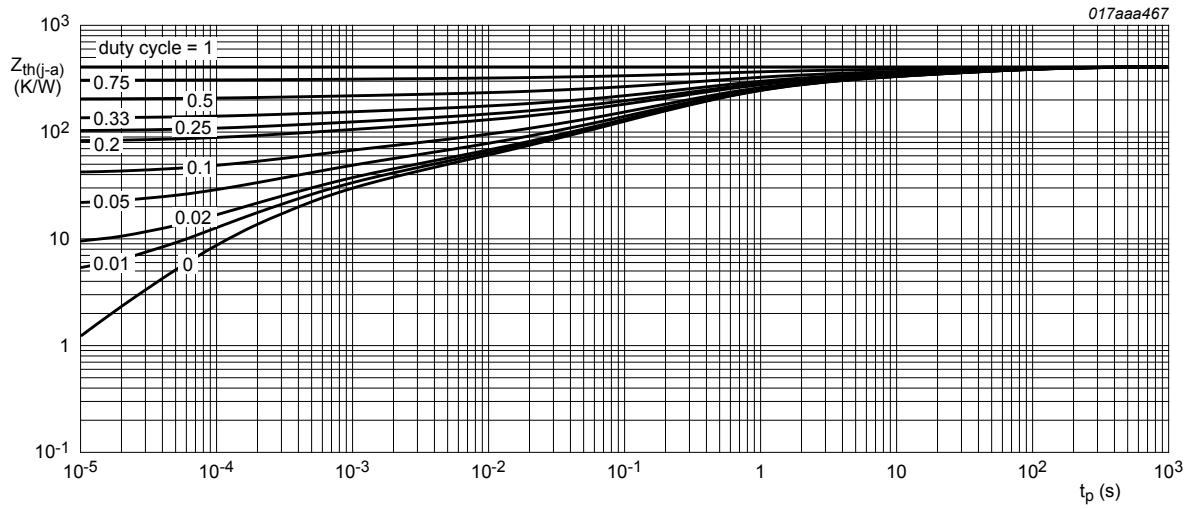
8. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	410	470	K/W
			[2]	-	330	380	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	95	K/W

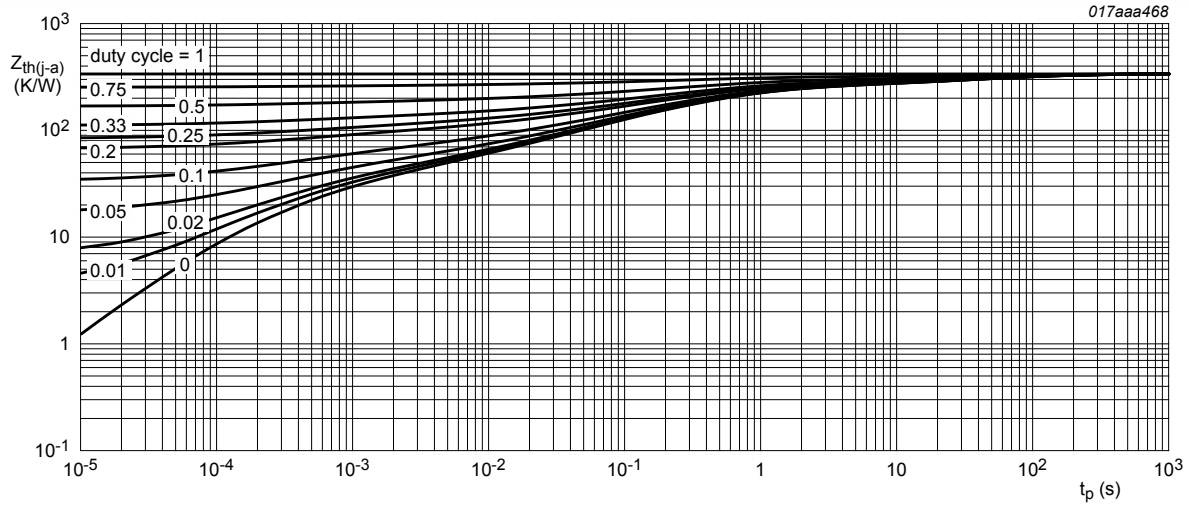
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

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



FR4 PCB, standard footprint

Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



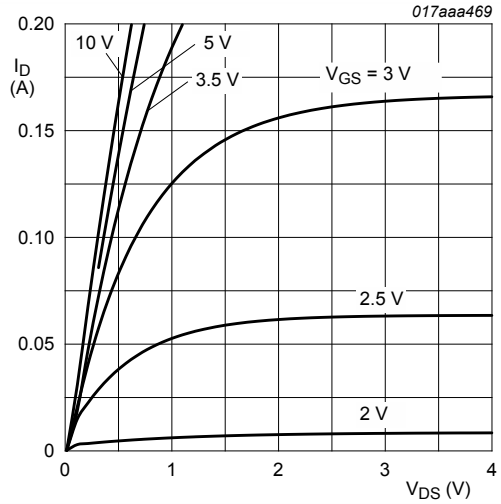
FR4 PCB, mounting pad for drain 1 cm^2

Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

9. Characteristics

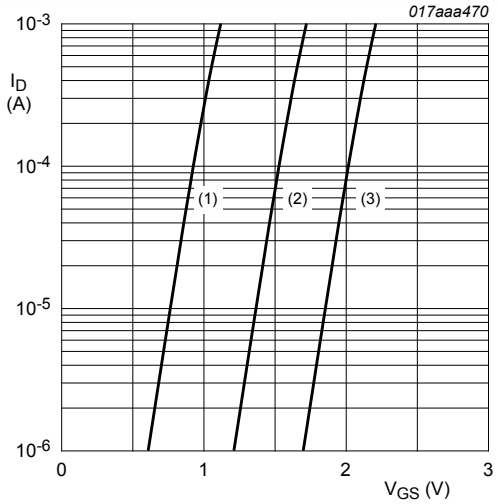
Table 6. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 µA; V_{GS} = 0 V; T_j = 25 °C		60	-	-	V
V_{GSth}	gate-source threshold voltage	I_D = 250 µA; V_{DS} = V_{GS}; T_j = 25 °C		1.1	1.6	2.1	V
I_{DSS}	drain leakage current	V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25 °C		-	-	1	µA
		V_{DS} = 60 V; V_{GS} = 0 V; T_j = 150 °C		-	-	10	µA
I_{GSS}	gate leakage current	V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25 °C		-	-	2	µA
		V_{GS} = -20 V; V_{DS} = 0 V; T_j = 25 °C		-	-	2	µA
		V_{GS} = 10 V; V_{DS} = 0 V; T_j = 25 °C		-	-	0.5	µA
		V_{GS} = -10 V; V_{DS} = 0 V; T_j = 25 °C		-	-	0.5	µA
		V_{GS} = 5 V; V_{DS} = 0 V; T_j = 25 °C		-	-	100	nA
		V_{GS} = -5 V; V_{DS} = 0 V; T_j = 25 °C		-	-	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 100 mA; T_j = 25 °C		-	3	4.5	Ω
		V_{GS} = 10 V; I_D = 100 mA; T_j = 150 °C		-	6.2	9.2	Ω
		V_{GS} = 5 V; I_D = 100 mA; T_j = 25 °C		-	3.7	5.2	Ω
g_{fs}	forward transconductance	V_{DS} = 10 V; I_D = 200 mA; T_j = 25 °C		-	230	-	mS
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	V_{DS} = 30 V; I_D = 200 mA; V_{GS} = 4.5 V; T_j = 25 °C		-	0.33	0.43	nC
Q_{GS}	gate-source charge			-	0.12	-	nC
Q_{GD}	gate-drain charge			-	0.09	-	nC
C_{iss}	input capacitance	V_{DS} = 10 V; f = 1 MHz; V_{GS} = 0 V; T_j = 25 °C		-	11	17	pF
C_{oss}	output capacitance			-	3.4	-	pF
C_{rss}	reverse transfer capacitance			-	1.4	-	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 40 V; R_L = 250 Ω; V_{GS} = 10 V; $R_{G(ext)}$ = 6 Ω; T_j = 25 °C		-	6	12	ns
t_r	rise time			-	7	-	ns
$t_{d(off)}$	turn-off delay time			-	20	40	ns
t_f	fall time			-	14	-	ns
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 115 mA; V_{GS} = 0 V; T_j = 25 °C		0.47	0.7	1.2	V



T_j = 25 °C

Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values



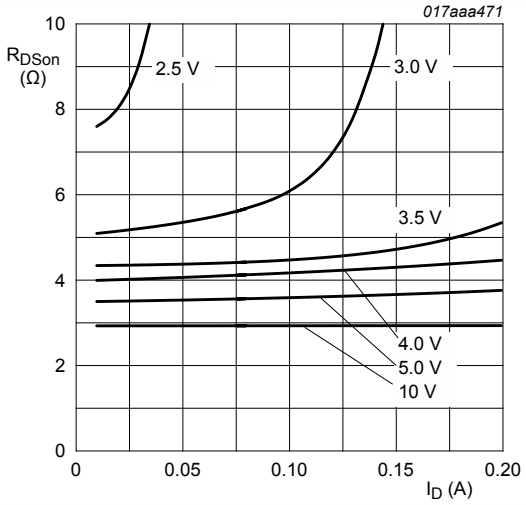
T_j = 25 °C; V_{DS} = 5 V

(1) minimum values

(2) typical values

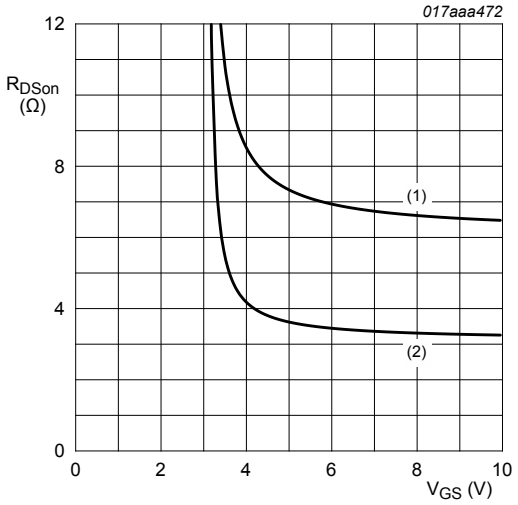
(3) maximum values

Fig. 7. Sub-threshold drain current as a function of gate-source voltage



T_j = 25 °C

Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

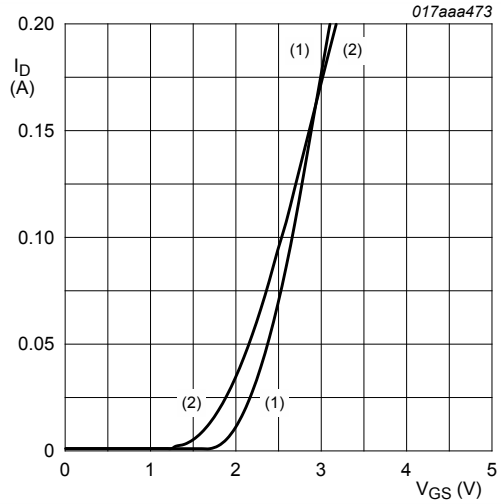


I_D = 0.2 A

(1) T_j = 150 °C

(2) T_j = 25 °C

Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values



$V_{DS} > I_D \times R_{DSon}$

(1) T_j = 25 °C

(2) T_j = 150 °C

Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values

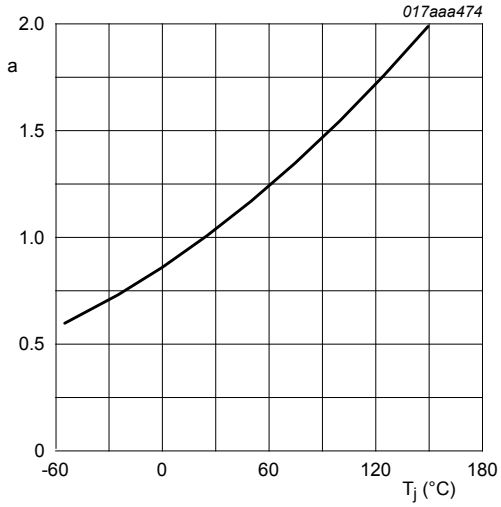
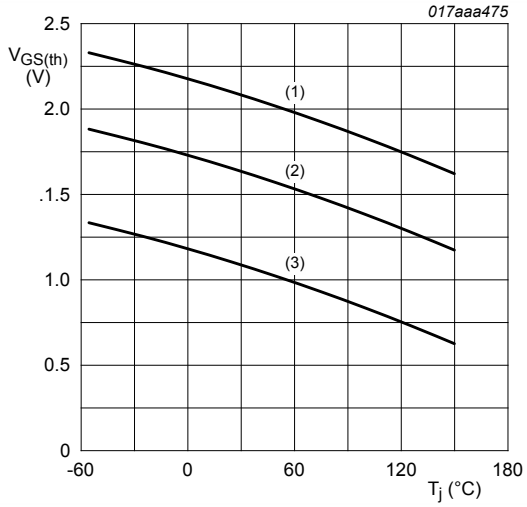


Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values

$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$



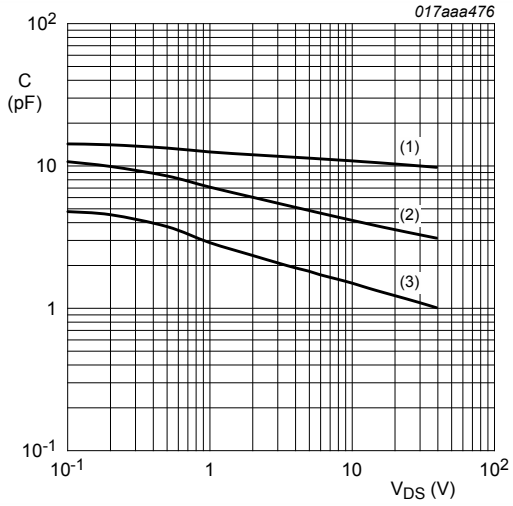
I_D = 0.25 mA; $V_{DS} = V_{GS}$

(1) maximum values

(2) typical values

(3) minimum values

Fig. 12. Gate-source threshold voltage as a function of junction temperature



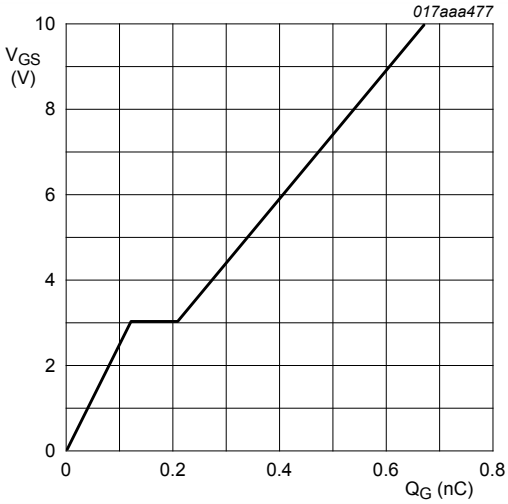
f = 1 MHz; V_{GS} = 0 V

(1) C_{iss}

(2) C_{oss}

(3) C_{rss}

Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



I_D = 0.2 A; V_{DS} = 30 V; T_{amb} = 25 °C

Fig. 14. Gate-source voltage as a function of gate charge; typical values

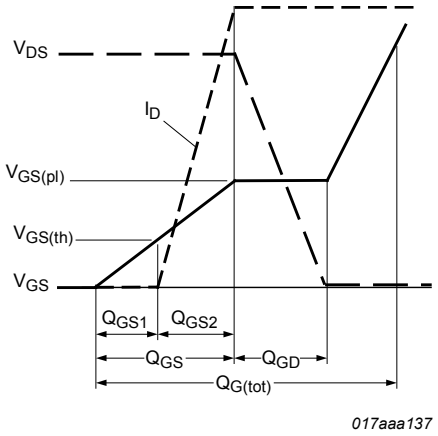
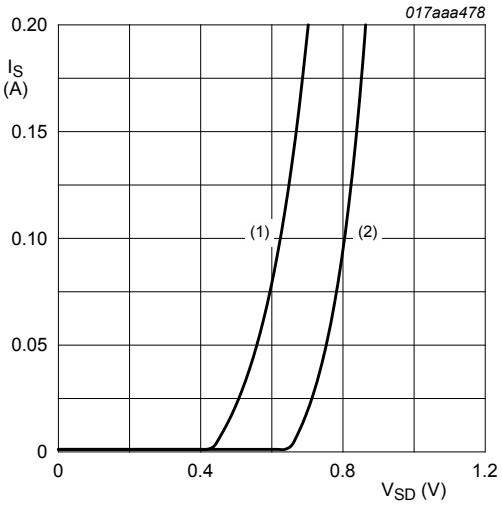


Fig. 15. Gate charge waveform definitions



V_{GS} = 0 V

(1) T_j = 150 °C

(2) T_j = 25 °C

Fig. 16. Source current as a function of source-drain voltage; typical values

10. Test information

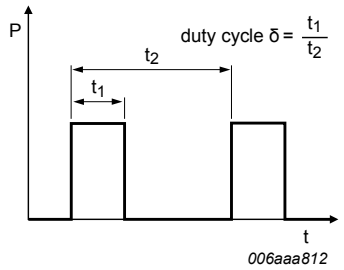


Fig. 17. Duty cycle definition

10.1 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.

11. Package outline

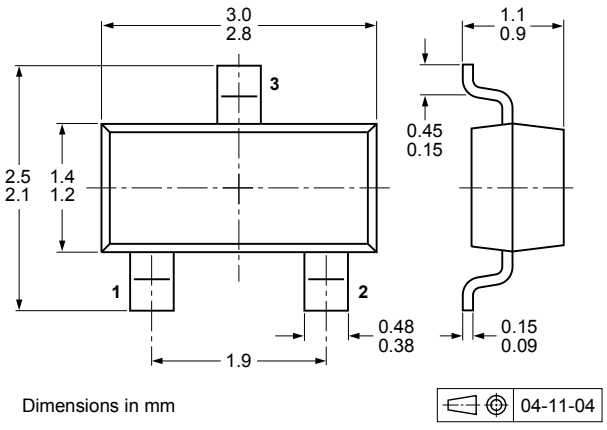


Fig. 18. Package outline TO-236AB (SOT23)

12. Soldering

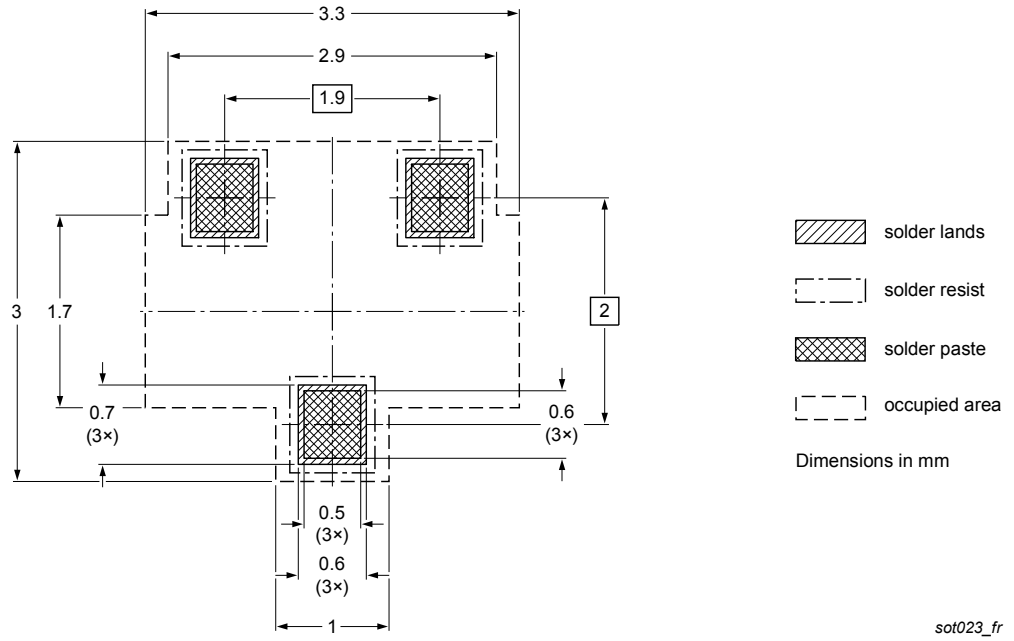


Fig. 19. Reflow soldering footprint for TO-236AB (SOT23)

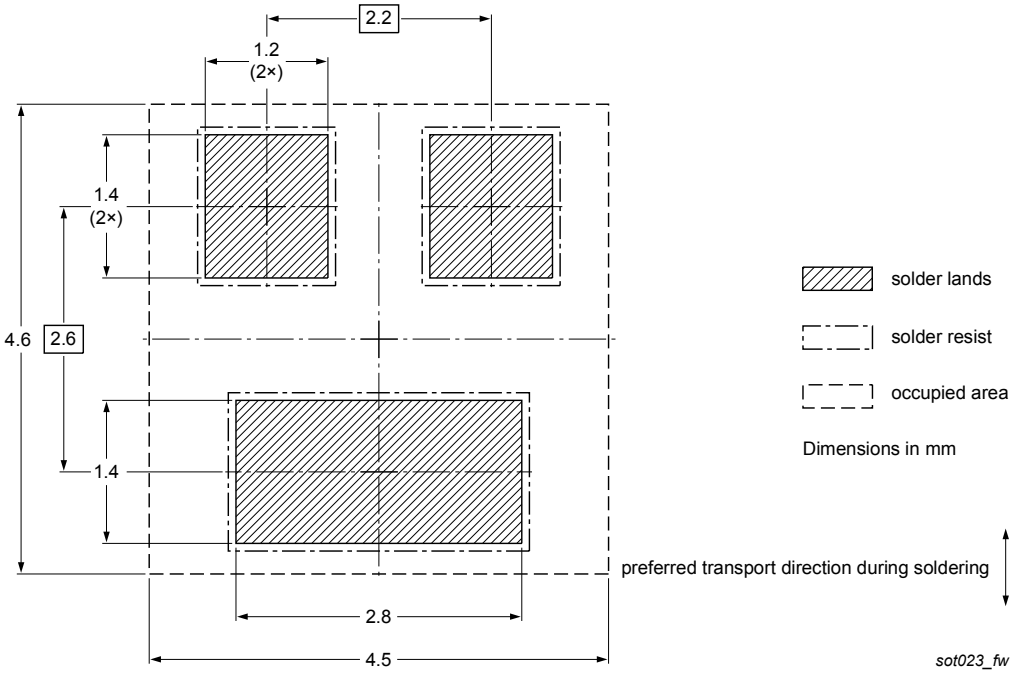


Fig. 20. Wave soldering footprint for TO-236AB (SOT23)

13. Revision history

Table 7. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NX7002AKA v.1	20130218	Product data sheet	-	-

14. Legal information

14.1 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.
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Date of release: 18 February 2013