



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	$T_{amb} = 25\text{ °C}$	-	-	60	V
V_{GS}	gate-source voltage		-20	-	20	V
I_D	drain current	$V_{GS} = 10\text{ V}; T_{sp} = 25\text{ °C}$	-	-	300	mA
		$V_{GS} = 10\text{ V}; T_{amb} = 25\text{ °C}$	[1]	-	190	mA
Static characteristics						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 100\text{ mA}; T_j = 25\text{ °C}$	-	3	4.5	Ω

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 1 cm².

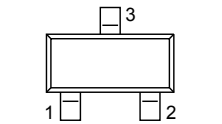
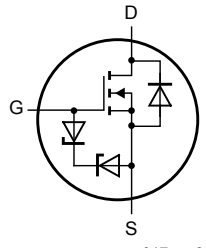


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5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 <p>TO-236AB (SOT23)</p>	 <p>017aaa255</p>
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	$T_{amb} = 25\text{ }^{\circ}\text{C}$		-	60	V
V_{GS}	gate-source voltage			-20	20	V
I_D	drain current	$V_{GS} = 10\text{ V}; T_{sp} = 25\text{ }^{\circ}\text{C}$		-	300	mA
		$V_{GS} = 10\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}$	[1]	-	190	mA
		$V_{GS} = 10\text{ V}; T_{amb} = 100\text{ }^{\circ}\text{C}$	[1]	-	120	mA
I_{DM}	peak drain current	$T_{amb} = 25\text{ }^{\circ}\text{C};$ single pulse; $t_p \leq 10\text{ }\mu\text{s}$		-	760	mA
P_{tot}	total power dissipation	$T_{amb} = 25\text{ }^{\circ}\text{C}$	[2]	-	265	mW
			[1]	-	325	mW
		$T_{sp} = 25\text{ }^{\circ}\text{C}$		-	1330	mW
T_j	junction temperature			-55	150	$^{\circ}\text{C}$
T_{amb}	ambient temperature			-55	150	$^{\circ}\text{C}$
T_{stg}	storage temperature			-65	150	$^{\circ}\text{C}$
Source-drain diode						
I_S	source current	$T_{amb} = 25\text{ }^{\circ}\text{C}$	[1]	-	190	mA

- [1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 1 cm².
- [2] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.

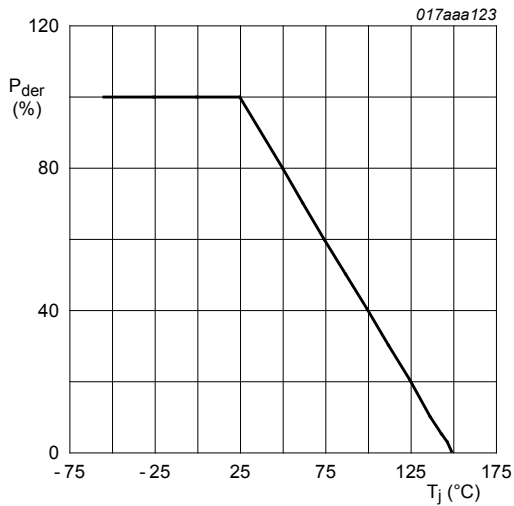


Fig. 1. Normalized total power dissipation as a function of junction temperature

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

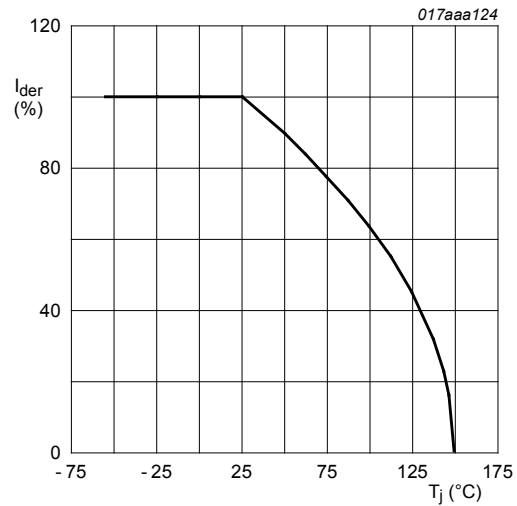
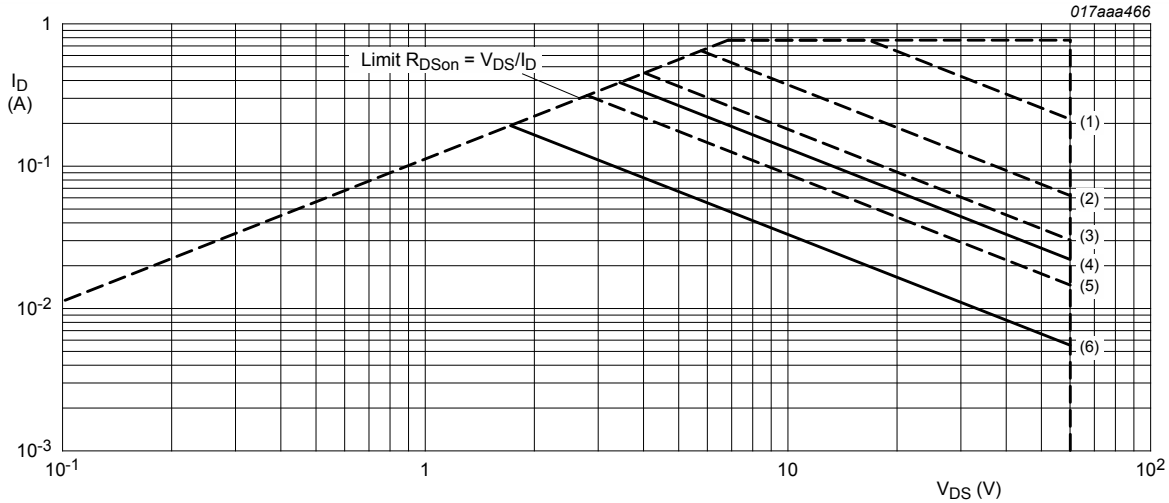


Fig. 2. Normalized continuous drain current as a function of junction temperature

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



- I_{DM} = single pulse
- (1) $t_p = 100 \mu s$
- (2) $t_p = 1 ms$
- (3) $t_p = 10 ms$
- (4) DC; $T_{sp} = 25^\circ C$
- (5) $t_p = 100 ms$
- (6) DC; $T_{amb} = 25^\circ C$; drain mounting pad 1 cm²

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 cm².

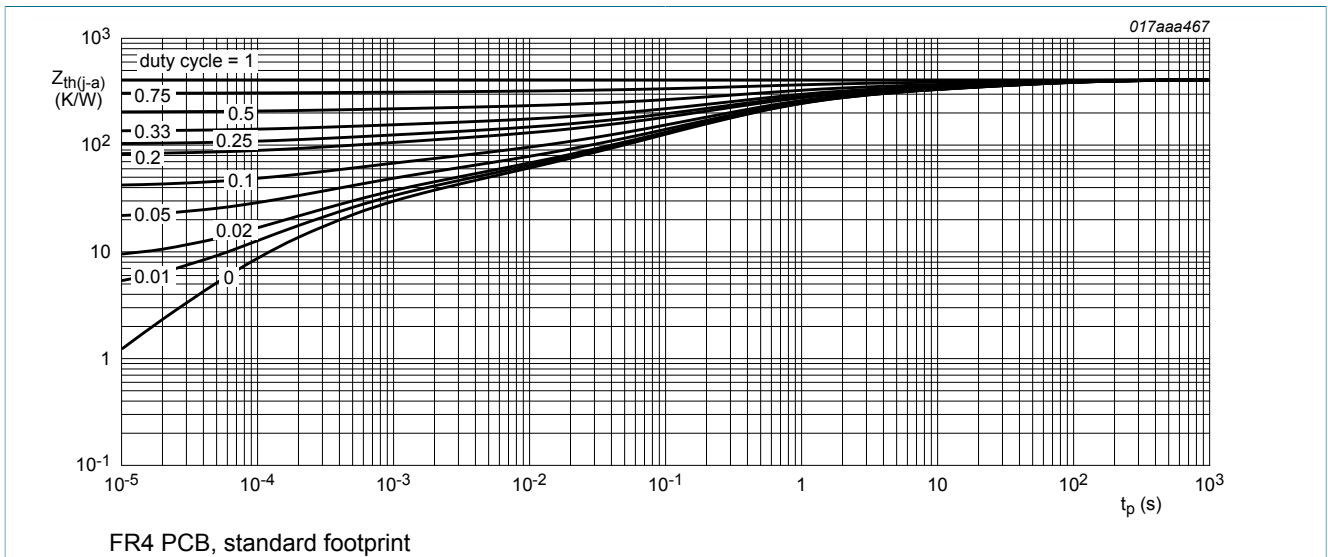


Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

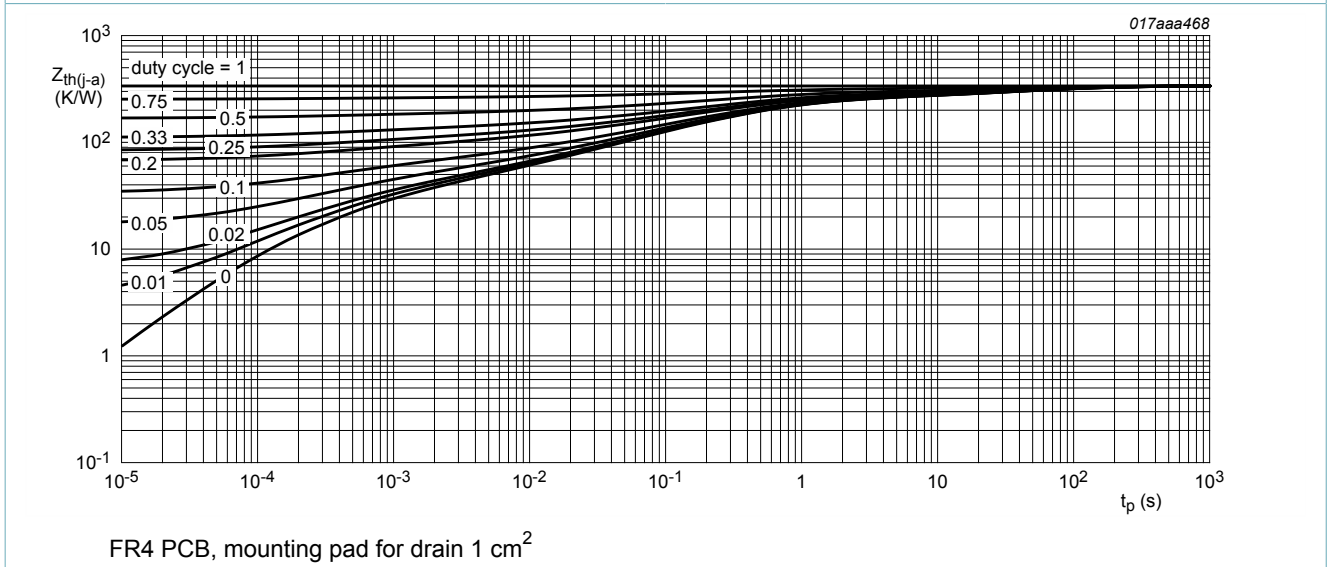


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

9. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	60	-	-	V
V_{GSth}	gate-source threshold voltage	$I_D = 250 \mu A; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$	1.1	1.6	2.1	V
I_{DSS}	drain leakage current	$V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	1	μA
		$V_{DS} = 60 V; V_{GS} = 0 V; T_j = 150 \text{ }^\circ C$	-	-	10	μA
I_{GSS}	gate leakage current	$V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	2	μA
		$V_{GS} = -20 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	2	μA
		$V_{GS} = 10 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	0.5	μA
		$V_{GS} = -10 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	0.5	μA
		$V_{GS} = 5 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	100	nA
		$V_{GS} = -5 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	-	100	nA
		$V_{GS} = 10 V; I_D = 100 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	3	4.5	Ω
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10 V; I_D = 100 \text{ mA}; T_j = 150 \text{ }^\circ C$	-	6.2	9.2	Ω
		$V_{GS} = 5 V; I_D = 100 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	3.7	5.2	Ω
		$V_{GS} = 10 V; I_D = 200 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	230	-	mS
g_{fs}	forward transconductance	$V_{DS} = 10 V; I_D = 200 \text{ mA}; T_j = 25 \text{ }^\circ C$	-	230	-	mS
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$V_{DS} = 30 V; I_D = 200 \text{ mA}; V_{GS} = 4.5 V; T_j = 25 \text{ }^\circ C$	-	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	$V_{DS} = 10 V; f = 1 \text{ MHz}; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	-	11	17	pF
C_{oss}	output capacitance		-	3.4	-	pF
C_{riss}	reverse transfer capacitance		-	1.4	-	pF
$t_{d(on)}$	turn-on delay time		$V_{DS} = 40 V; R_L = 250 \Omega; V_{GS} = 10 V; R_{G(ext)} = 6 \Omega; T_j = 25 \text{ }^\circ C$	-	6	12
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	$I_S = 115 \text{ mA}; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	0.47	0.7	1.2	V

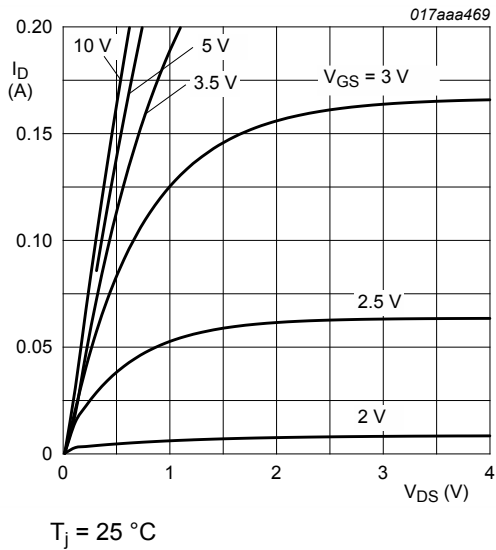


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

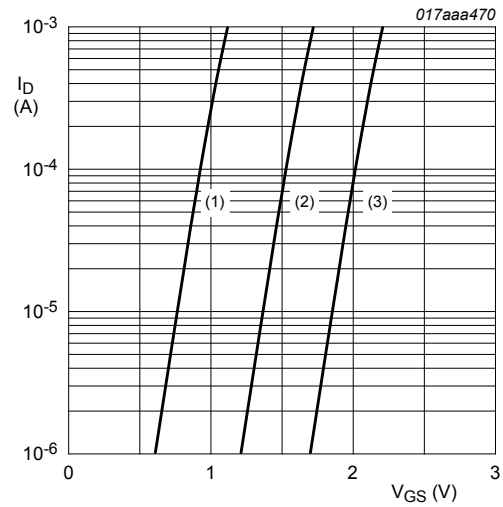


Fig. 7. Sub-threshold drain current as a function of gate-source voltage
 (1) minimum values
 (2) typical values
 (3) maximum values

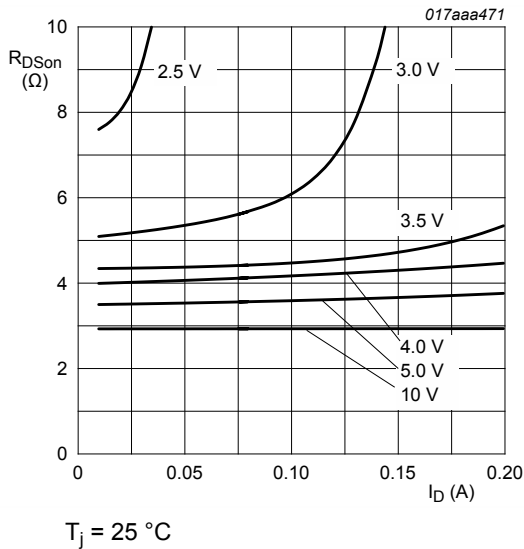


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

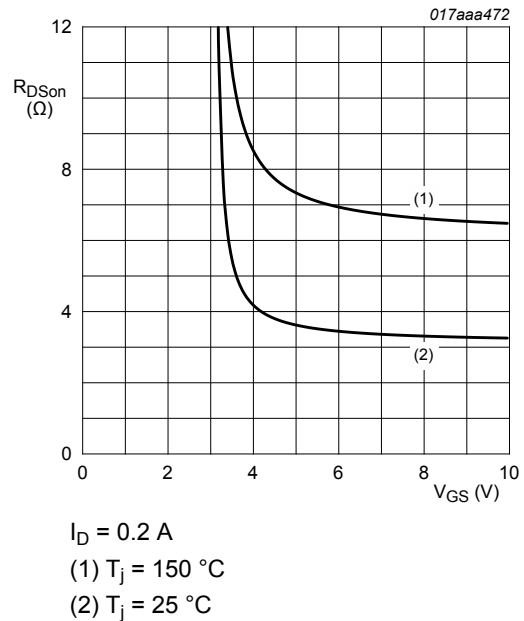
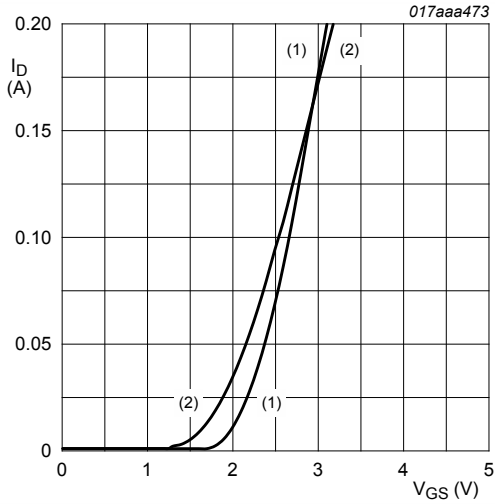


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values



$V_{DS} > I_D \times R_{DS(on)}$
 (1) $T_j = 25\text{ }^\circ\text{C}$
 (2) $T_j = 150\text{ }^\circ\text{C}$

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

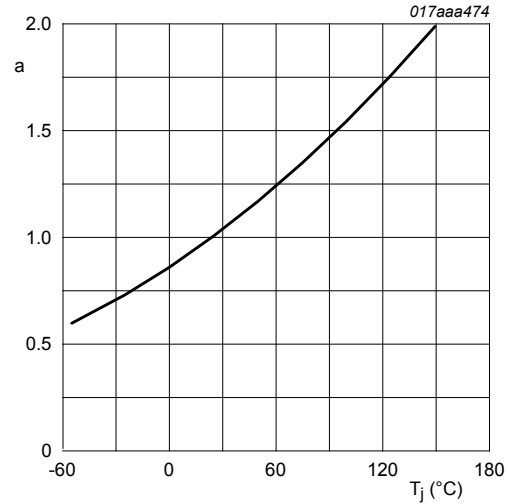
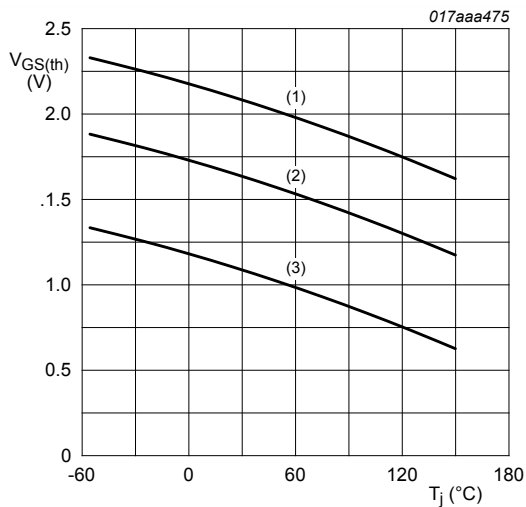


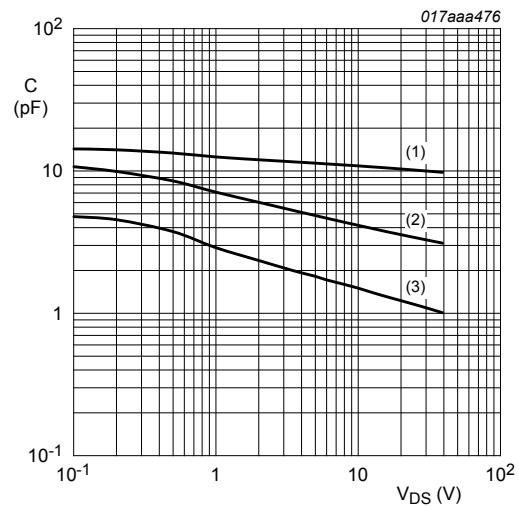
Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values

$$a = \frac{R_{DS(on)}}{R_{DS(on)(25^\circ\text{C})}}$$



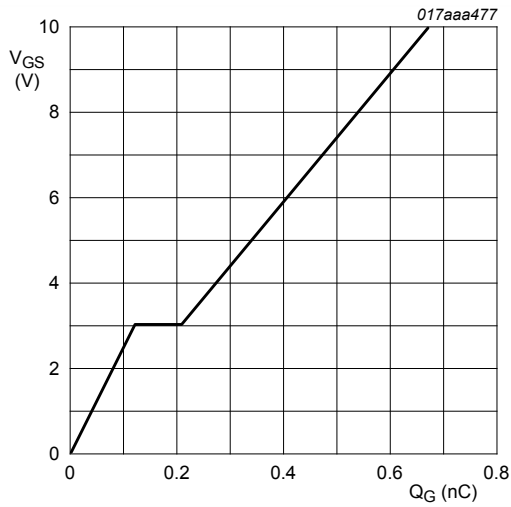
$I_D = 0.25\text{ mA}; V_{DS} = V_{GS}$
 (1) maximum values
 (2) typical values
 (3) minimum values

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



$f = 1\text{ MHz}; V_{GS} = 0\text{ V}$
 (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



$I_D = 0.2 \text{ A}; V_{DS} = 30 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$

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

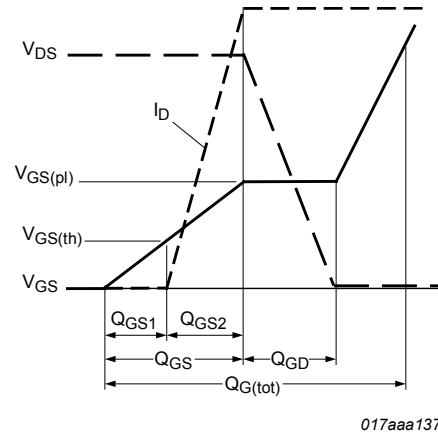
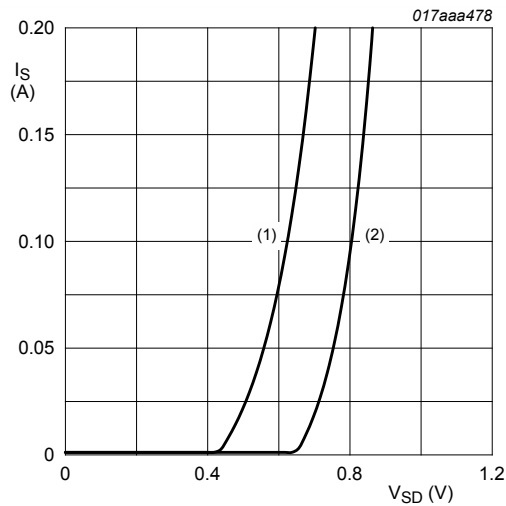


Fig. 15. Gate charge waveform definitions



$V_{GS} = 0 \text{ V}$
 (1) $T_j = 150 \text{ }^\circ\text{C}$
 (2) $T_j = 25 \text{ }^\circ\text{C}$

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

10. Test information

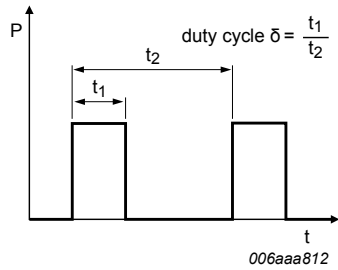


Fig. 17. Duty cycle definition

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

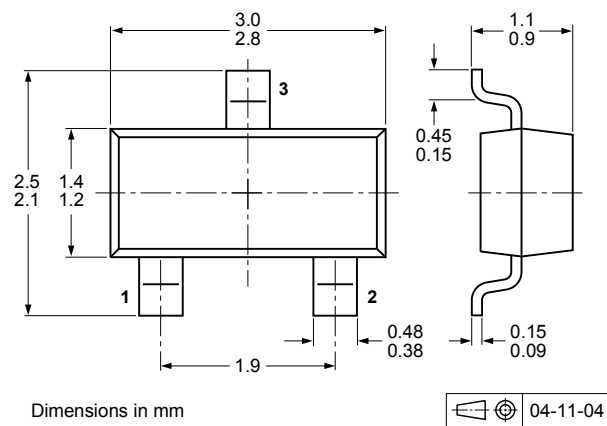


Fig. 18. Package outline TO-236AB (SOT23)

12. Soldering

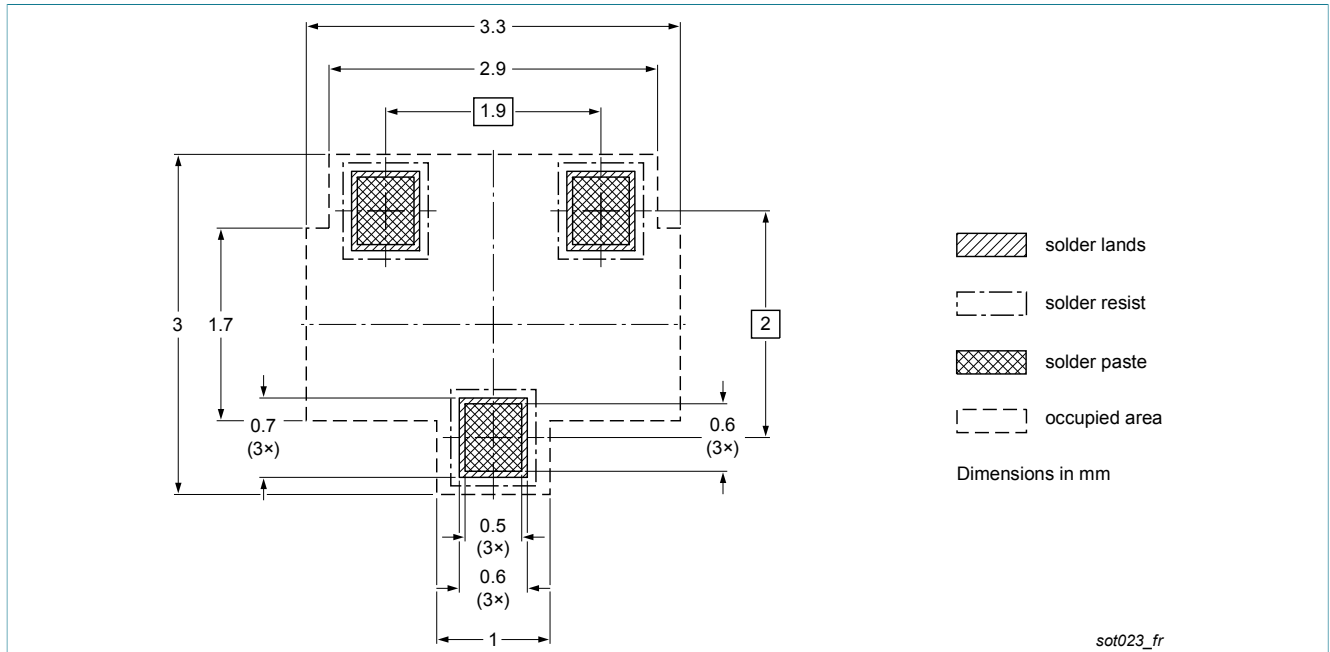


Fig. 19. Reflow soldering footprint for TO-236AB (SOT23)

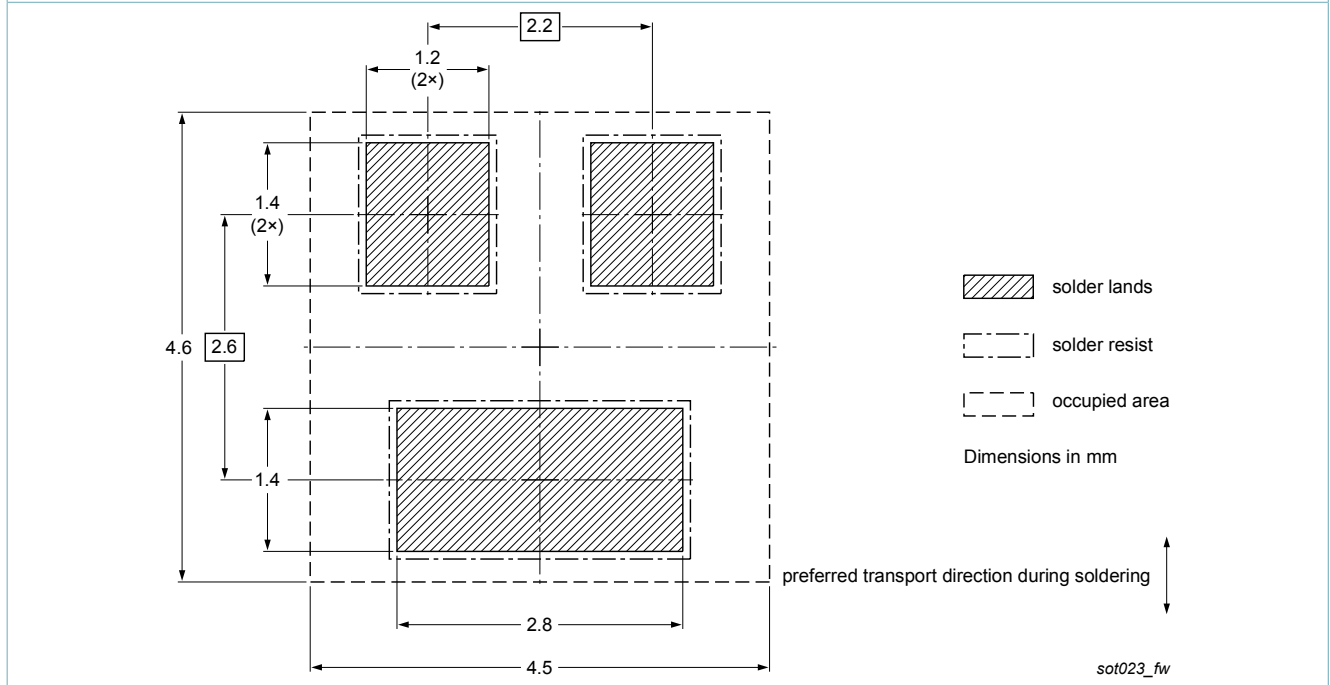


Fig. 20. Wave soldering footprint for TO-236AB (SOT23)

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.

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