



# THE DATASHEET OF NX7002AKAR





# 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	$T_{amb} = 25\text{ }^{\circ}\text{C}$	-	-	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
<b>Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 100\text{ mA}; T_j = 25\text{ }^{\circ}\text{C}$	-	3	4.5	$\Omega$

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

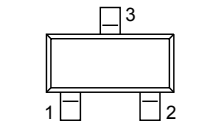
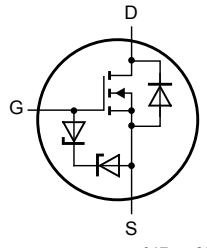


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## 5. Pinning information

**Table 2. Pinning information**

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 <p><b>TO-236AB (SOT23)</b></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

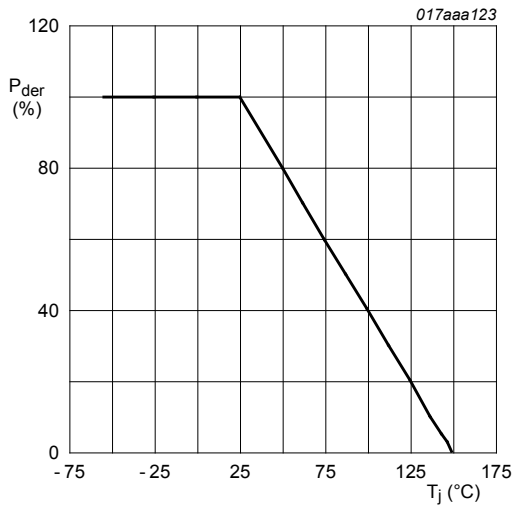
## 7. Limiting values

**Table 4. Limiting values**

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

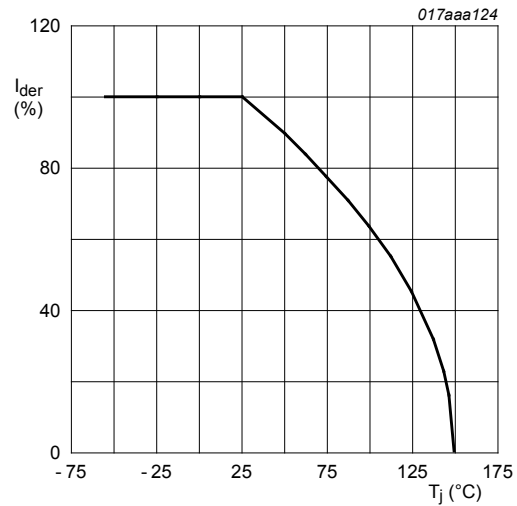
Symbol	Parameter	Conditions		Min	Max	Unit
$V_{DS}$	drain-source voltage	$T_{amb} = 25\text{ }^{\circ}\text{C}$		-	60	V
$V_{GS}$	gate-source voltage			-20	20	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_{sp} = 25\text{ }^{\circ}\text{C}$		-	300	mA
		$V_{GS} = 10\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}$	[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	$^{\circ}\text{C}$
<b>Source-drain diode</b>						
$I_S$	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 cm<sup>2</sup>.
- [2] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.



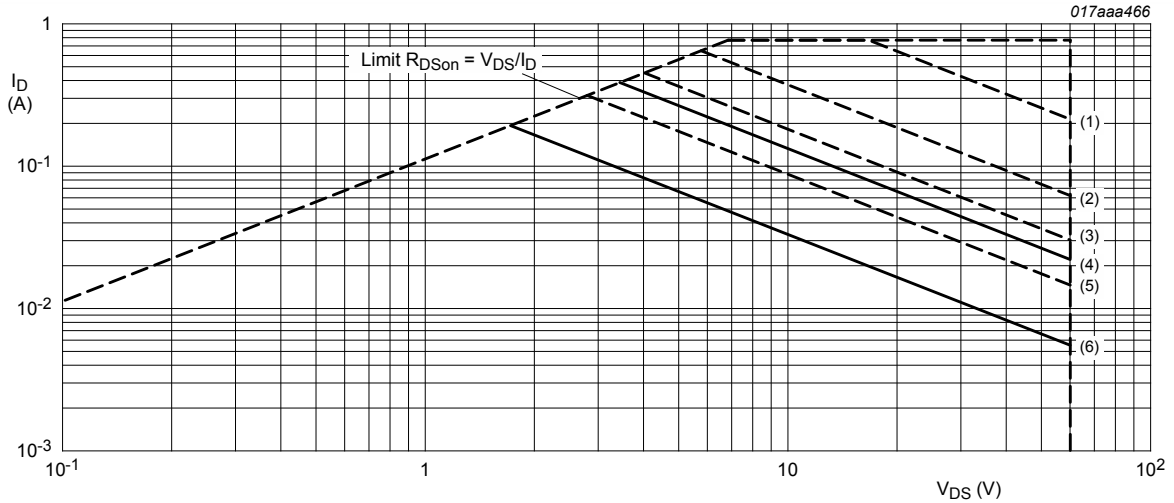
**Fig. 1. Normalized total power dissipation as a function of junction temperature**

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



**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 cm<sup>2</sup>

**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 <sub>th(j-a)</sub>	thermal resistance from junction to ambient	in free air	[1]	-	410	470	K/W
			[2]	-	330	380	K/W
R <sub>th(j-sp)</sub>	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<sup>2</sup>.

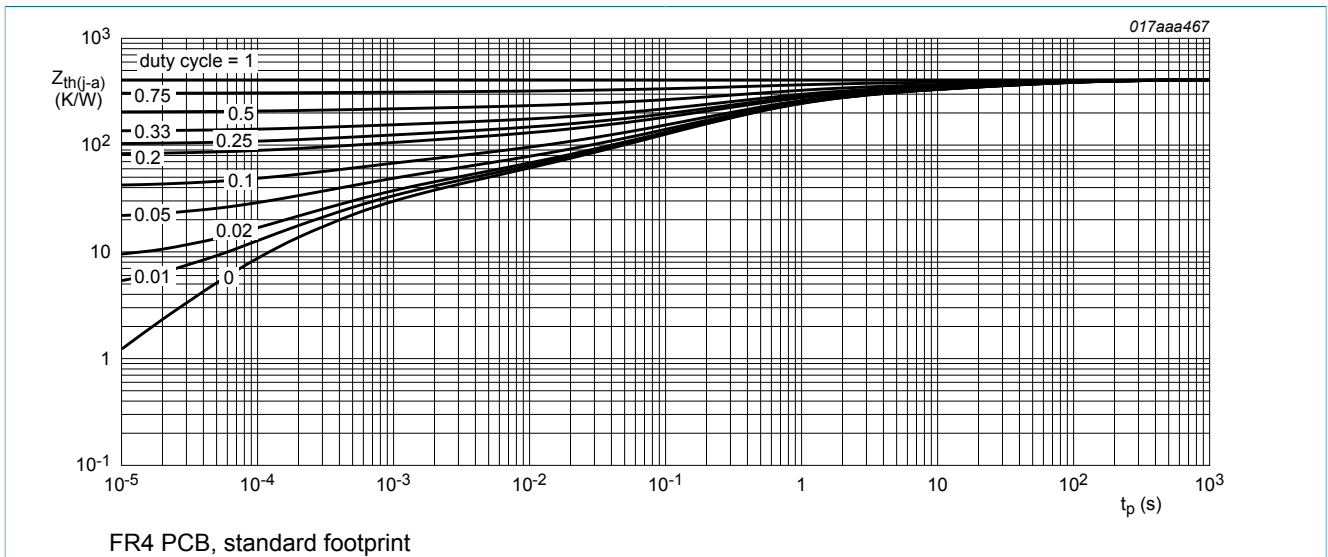


Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

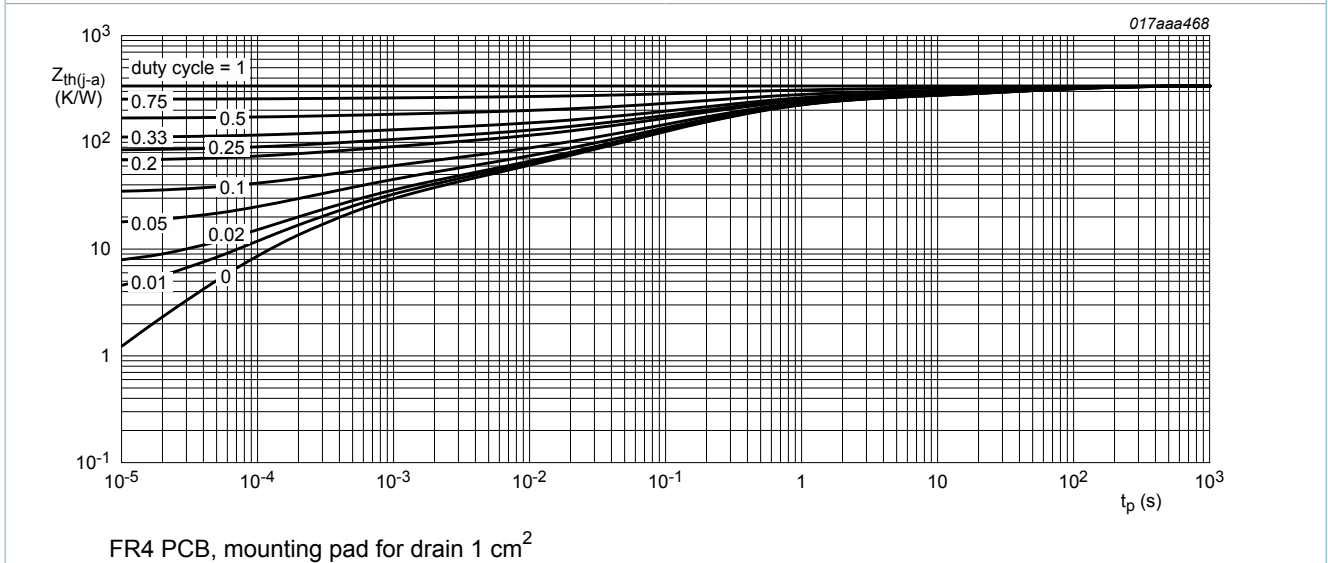
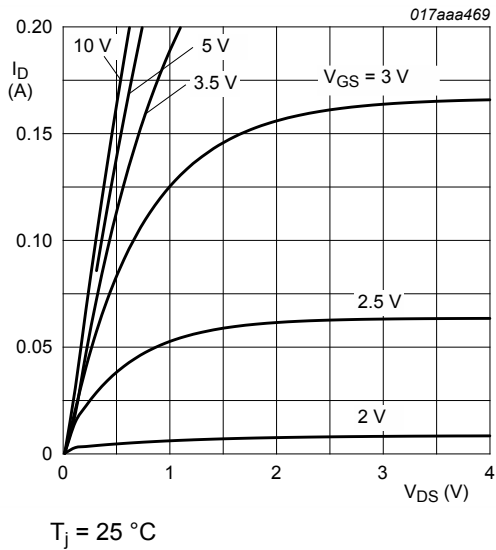


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

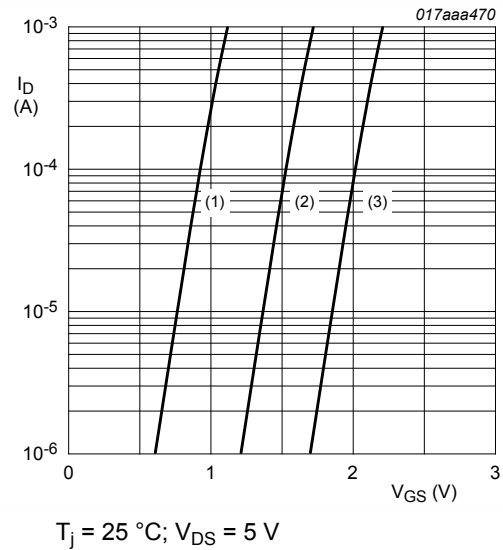
## 9. Characteristics

Table 6. Characteristics

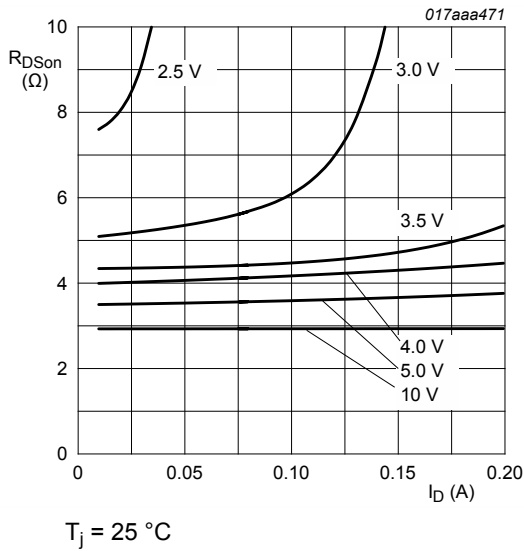
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A$ ; $V_{GS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	60	-	-	V
$V_{GSth}$	gate-source threshold voltage	$I_D = 250 \mu A$ ; $V_{DS} = V_{GS}$ ; $T_j = 25 \text{ }^\circ C$	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	$\mu A$
		$V_{DS} = 60 V$ ; $V_{GS} = 0 V$ ; $T_j = 150 \text{ }^\circ C$	-	-	10	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 20 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	2	$\mu A$
		$V_{GS} = -20 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	2	$\mu A$
		$V_{GS} = 10 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	0.5	$\mu A$
		$V_{GS} = -10 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	0.5	$\mu A$
		$V_{GS} = 5 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	100	nA
		$V_{GS} = -5 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 \text{ }^\circ C$	-	-	100	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10 V$ ; $I_D = 100 \text{ mA}$ ; $T_j = 25 \text{ }^\circ C$	-	3	4.5	$\Omega$
		$V_{GS} = 10 V$ ; $I_D = 100 \text{ mA}$ ; $T_j = 150 \text{ }^\circ C$	-	6.2	9.2	$\Omega$
		$V_{GS} = 5 V$ ; $I_D = 100 \text{ mA}$ ; $T_j = 25 \text{ }^\circ C$	-	3.7	5.2	$\Omega$
$g_{fs}$	forward transconductance	$V_{DS} = 10 V$ ; $I_D = 200 \text{ mA}$ ; $T_j = 25 \text{ }^\circ C$	-	230	-	mS
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	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	ns
$t_r$	rise time		-	7	-	ns
$t_{d(off)}$	turn-off delay time		-	20	40	ns
$t_f$	fall time		-	14	-	ns
<b>Source-drain diode</b>						
$V_{SD}$	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



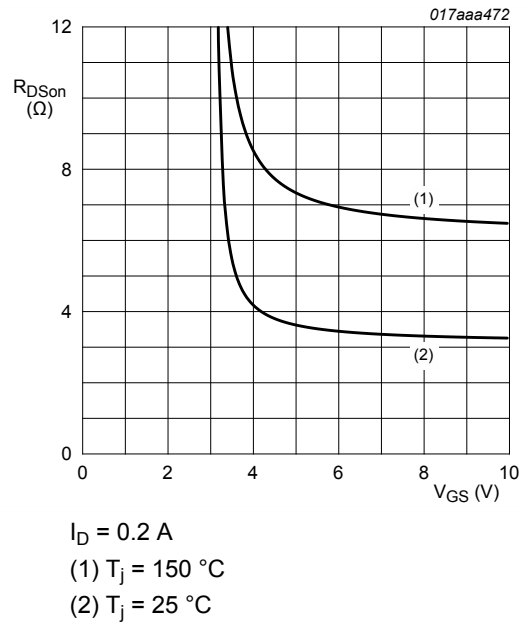
**Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values**



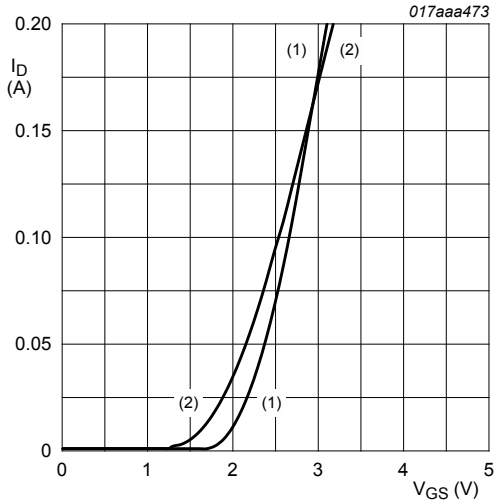
**Fig. 7. Sub-threshold drain current as a function of gate-source voltage**



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

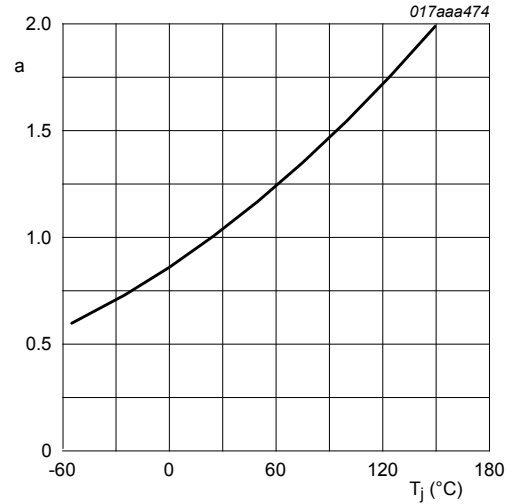


**Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values**



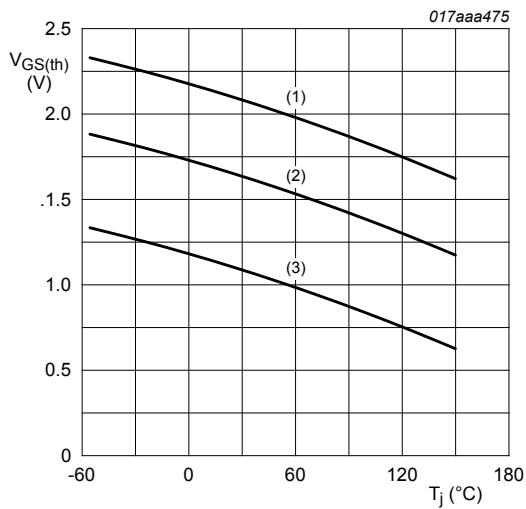
$V_{DS} > I_D \times R_{DS(on)}$   
 (1)  $T_j = 25\text{ °C}$   
 (2)  $T_j = 150\text{ °C}$

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



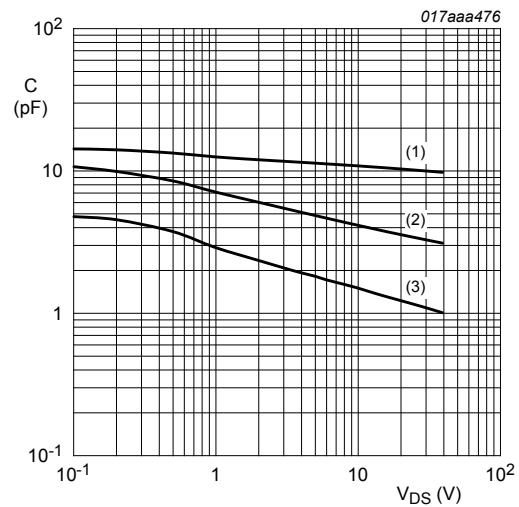
**Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values**

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



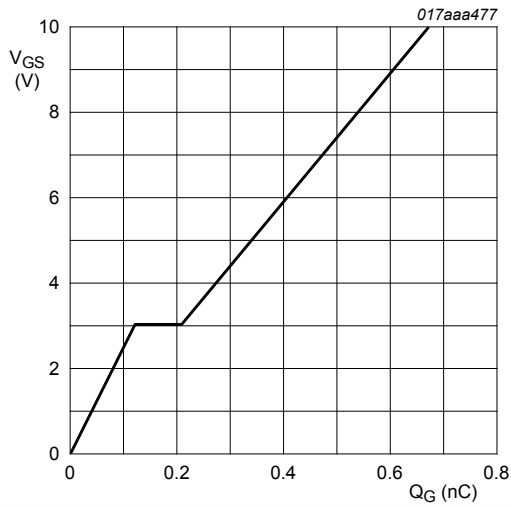
$I_D = 0.25\text{ mA}; V_{DS} = V_{GS}$   
 (1) maximum values  
 (2) typical values  
 (3) minimum values

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



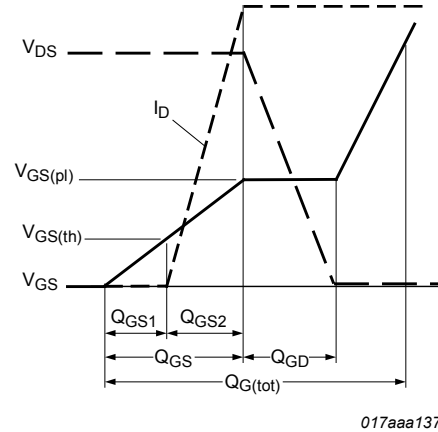
$f = 1\text{ MHz}; V_{GS} = 0\text{ V}$   
 (1)  $C_{iss}$   
 (2)  $C_{oss}$   
 (3)  $C_{rss}$

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

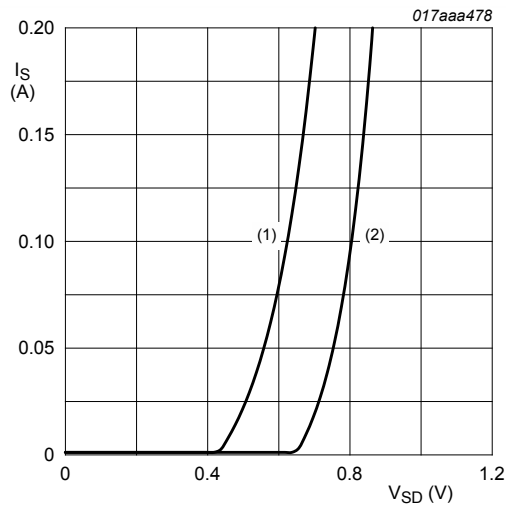


$I_D = 0.2 \text{ A}; V_{DS} = 30 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$

**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

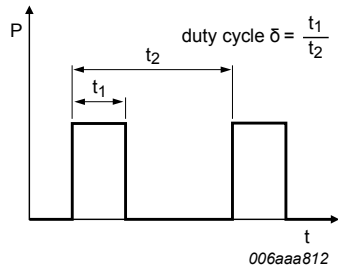


Fig. 17. Duty cycle definition

### 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

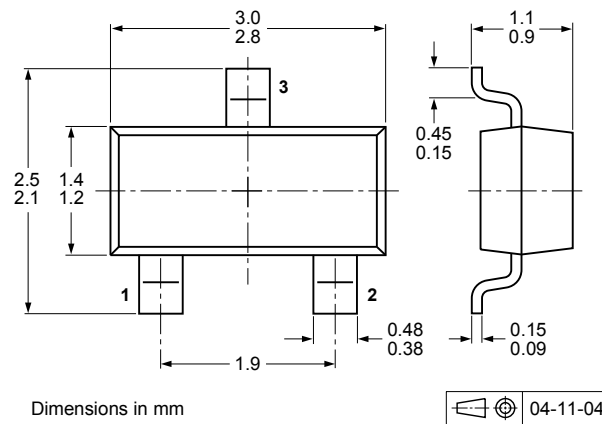


Fig. 18. Package outline TO-236AB (SOT23)

## 12. Soldering

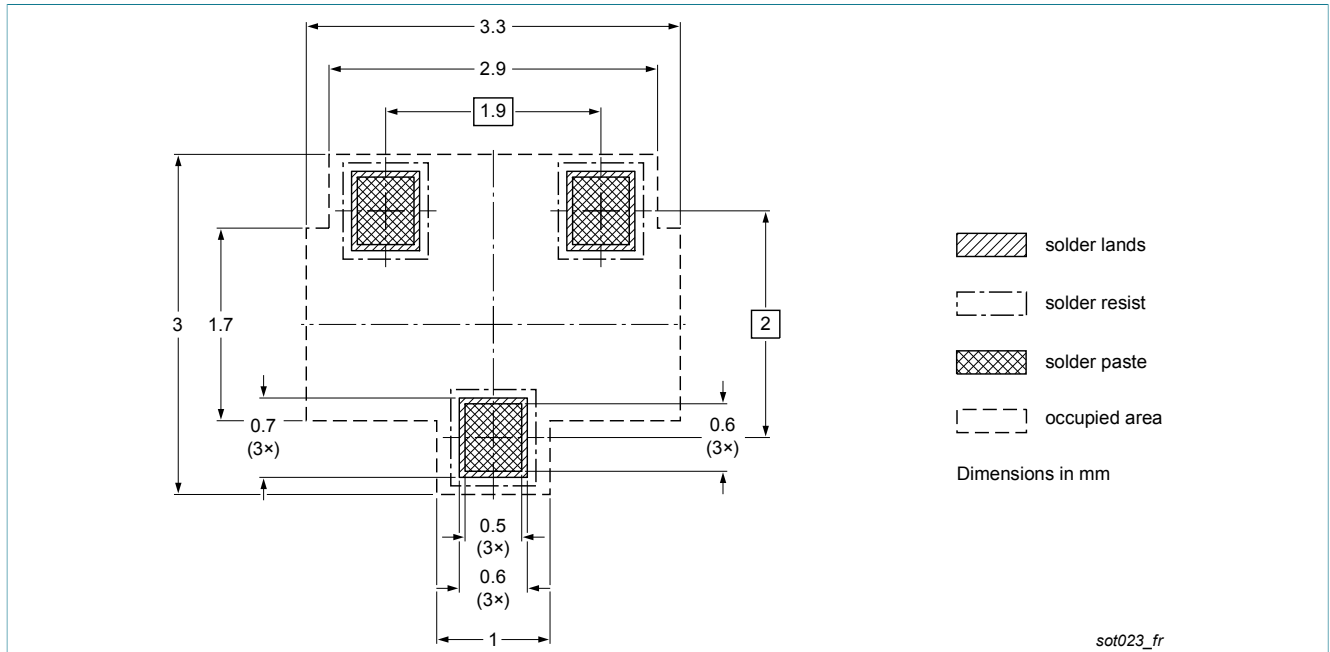


Fig. 19. Reflow soldering footprint for TO-236AB (SOT23)

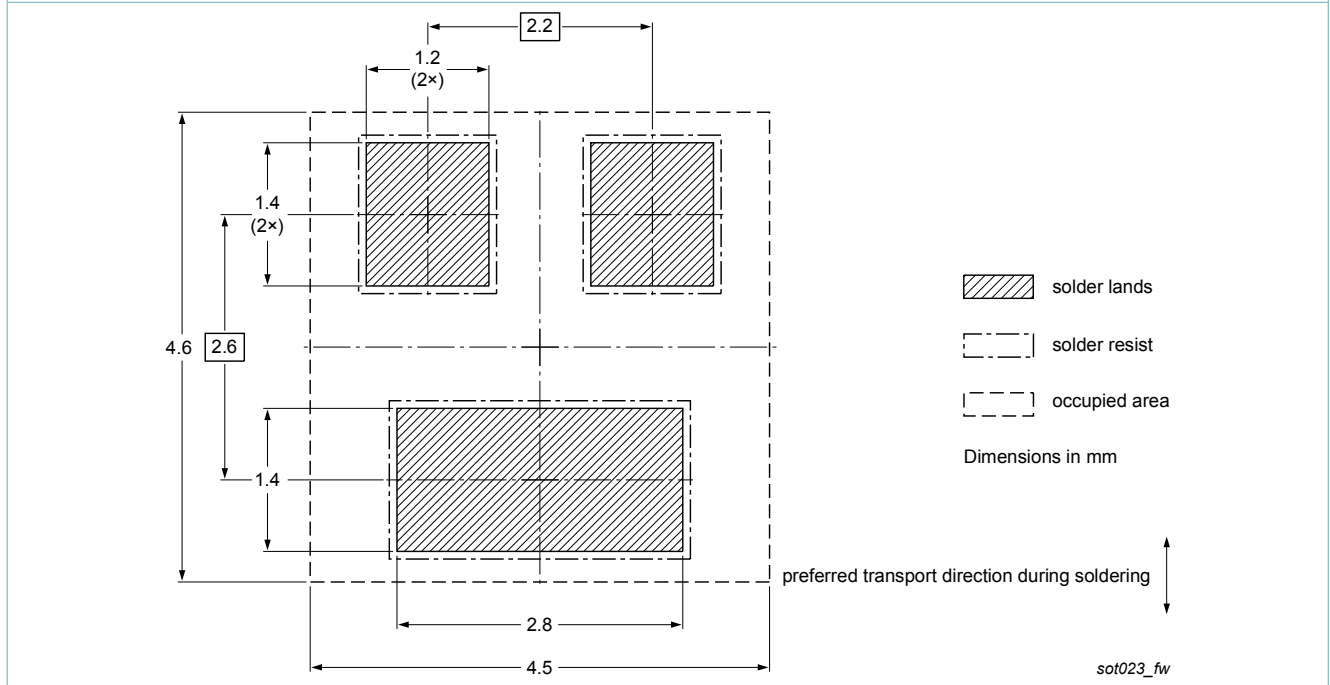


Fig. 20. Wave soldering footprint for TO-236AB (SOT23)

## 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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- [2] The term 'short data sheet' is explained in section "Definitions".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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## 15. Contents



<b>1</b>	<b>General description .....</b>	<b>1</b>
<b>2</b>	<b>Features and benefits .....</b>	<b>1</b>
<b>3</b>	<b>Applications .....</b>	<b>1</b>
<b>4</b>	<b>Quick reference data .....</b>	<b>1</b>
<b>5</b>	<b>Pinning information .....</b>	<b>2</b>
<b>6</b>	<b>Ordering information .....</b>	<b>2</b>
<b>7</b>	<b>Limiting values .....</b>	<b>2</b>
<b>8</b>	<b>Thermal characteristics .....</b>	<b>4</b>
<b>9</b>	<b>Characteristics .....</b>	<b>5</b>
<b>10</b>	<b>Test information .....</b>	<b>9</b>
10.1	Quality information .....	
<b>11</b>	<b>Package outline .....</b>	<b>9</b>
<b>12</b>	<b>Soldering .....</b>	<b>10</b>
<b>13</b>	<b>Revision history .....</b>	<b>11</b>
<b>14</b>	<b>Legal information .....</b>	<b>12</b>
14.1	Data sheet status .....	12
14.2	Definitions .....	12
14.3	Disclaimers .....	12
14.4	Trademarks .....	13

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