



NX7002AK

60 V, single N-channel Trench MOSFET

6 August 2015

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

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 _j = 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 .

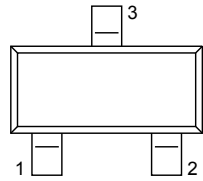
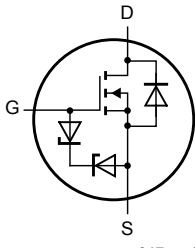


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5. Pinning information

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
NX7002AK	TO-236AB	plastic surface-mounted package; 3 leads	SOT23

7. Marking

Table 4. Marking codes

Type number	Marking code
	[1]
NX7002AK	%CM

[1] % = placeholder for manufacturing site code

8. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V _{DS}	drain-source voltage	T _j = 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 ≤ 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 cm².

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

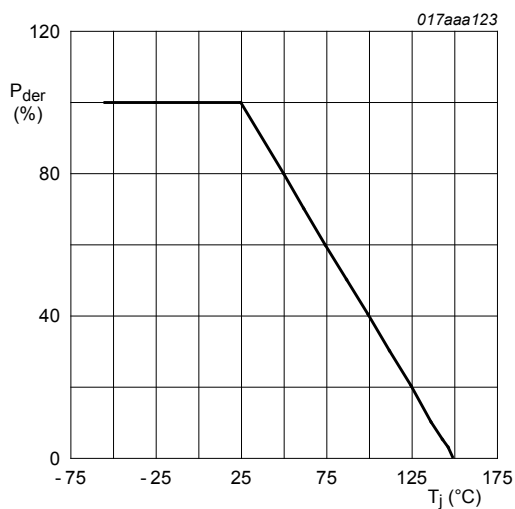


Fig. 1. Normalized total power dissipation as a function of junction temperature

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

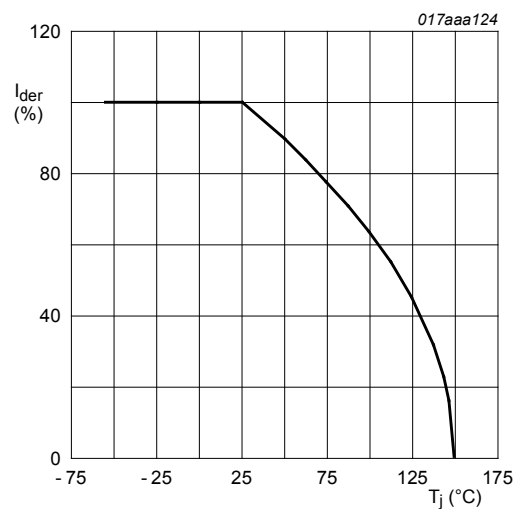
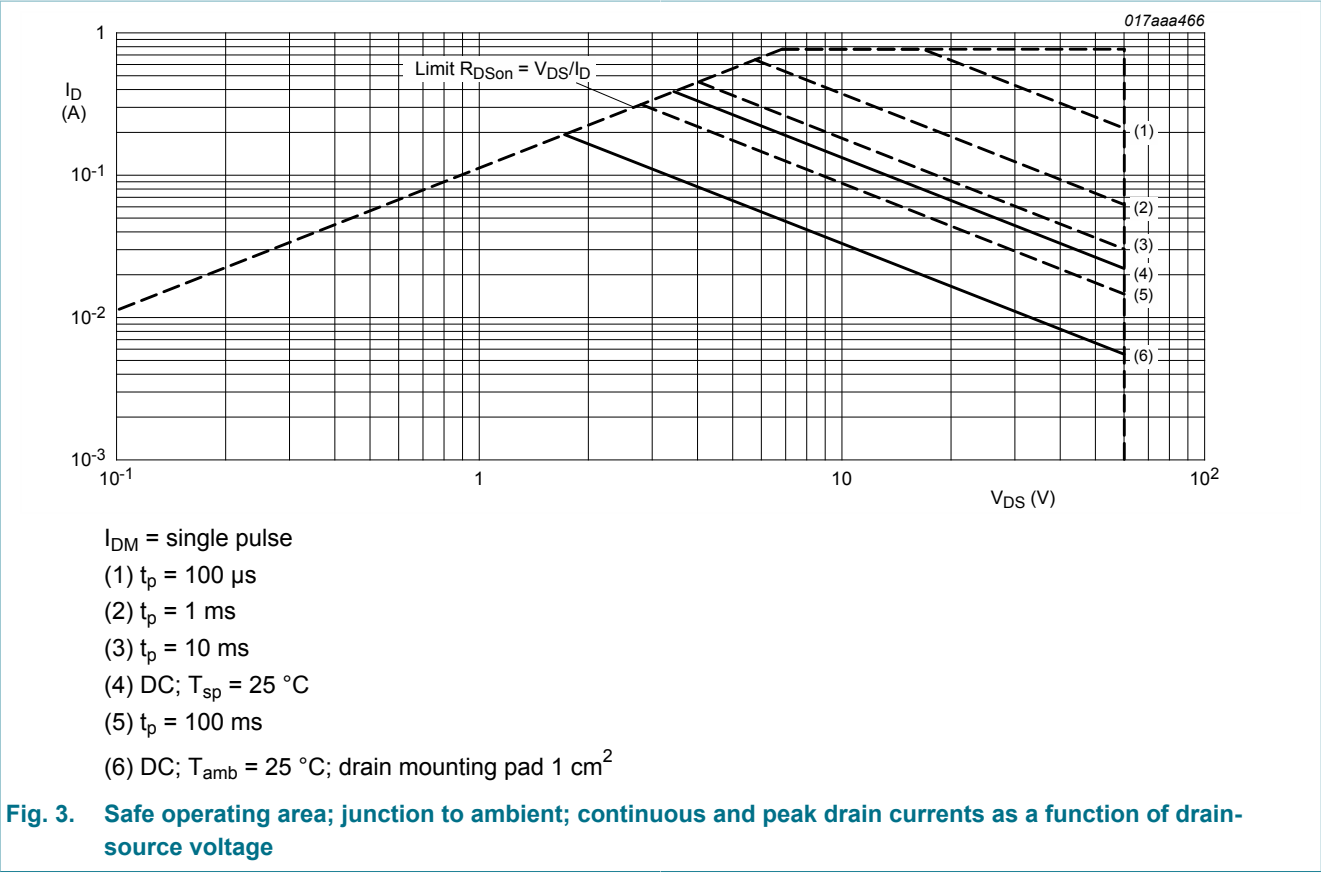


Fig. 2. Normalized continuous drain current as a function of junction temperature

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

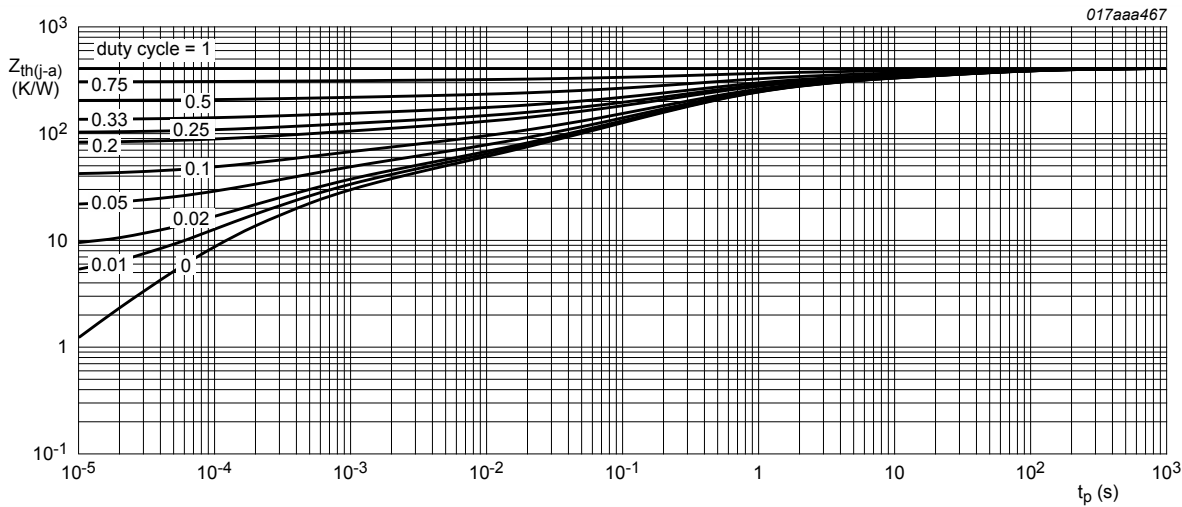


9. Thermal characteristics

Table 6. Thermal characteristics

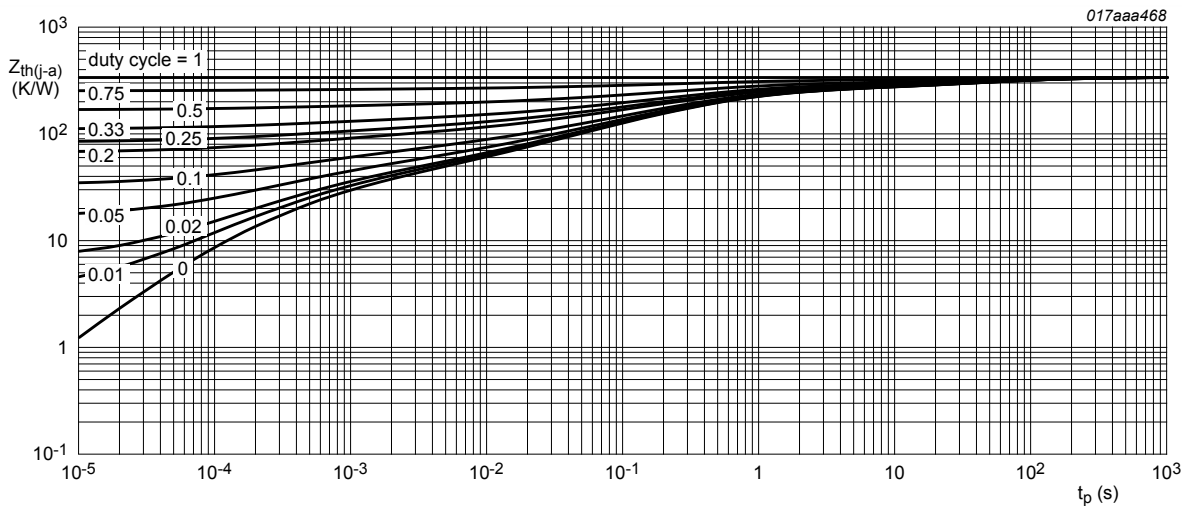
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	410	470	K/W
			[2]	-	330	380	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	-	95	K/W

[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

10. Characteristics

Table 7. 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		-	500	-	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		-	15	20	pF
C _{oss}	output capacitance			-	3.4	-	pF
C _{rss}	reverse transfer capacitance			-	2	-	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			-	11	20	ns
t _f	fall time			-	5	-	ns
Source-drain diode							
V _{SD}	source-drain voltage	I _S = 115 mA; V _{GS} = 0 V; T _j = 25 °C		0.47	0.8	1.2	V

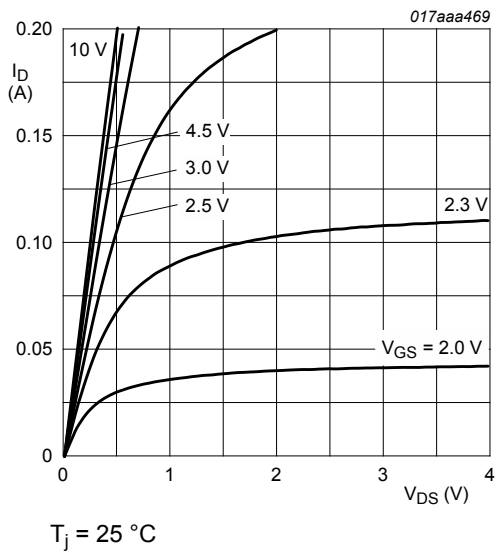


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

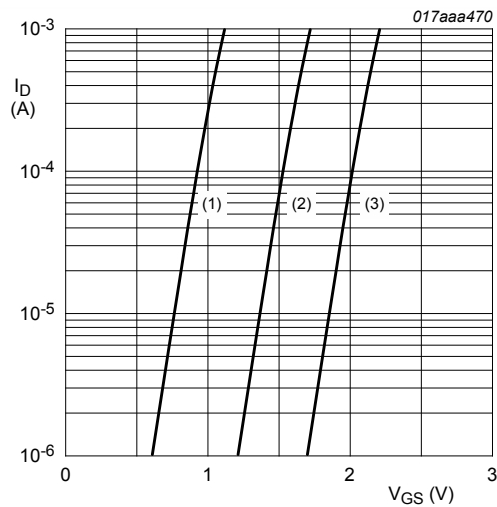


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

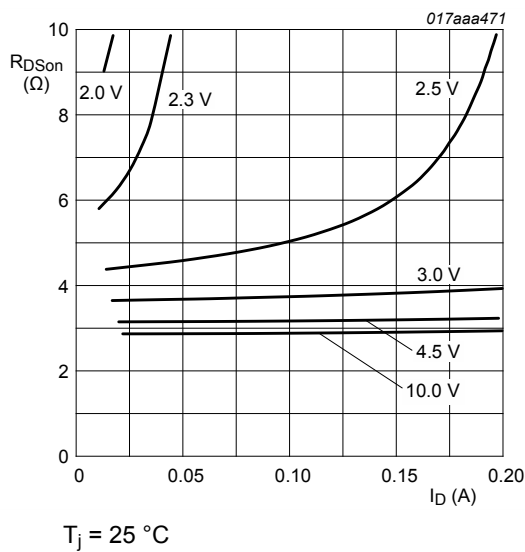


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

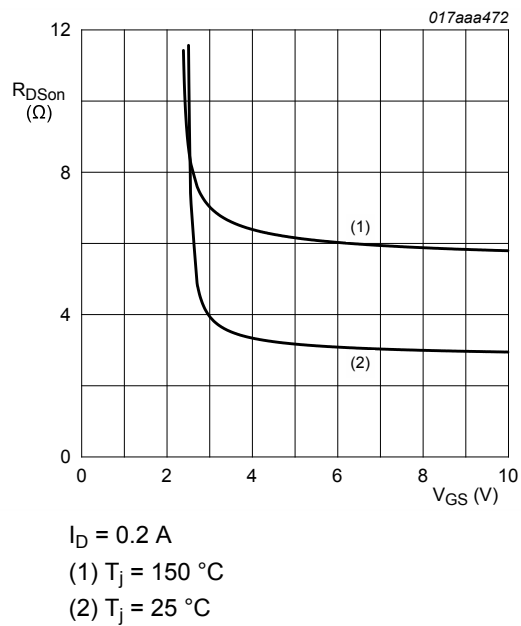
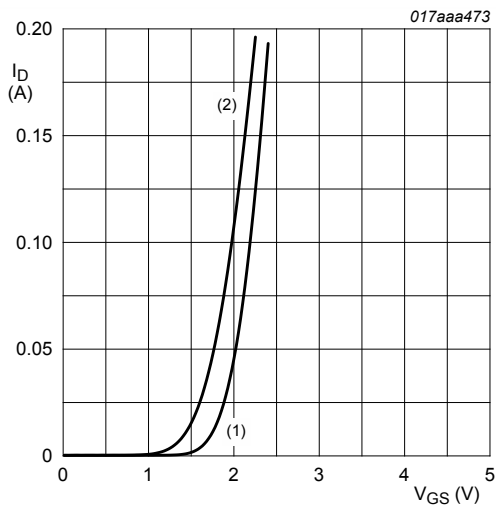


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values



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

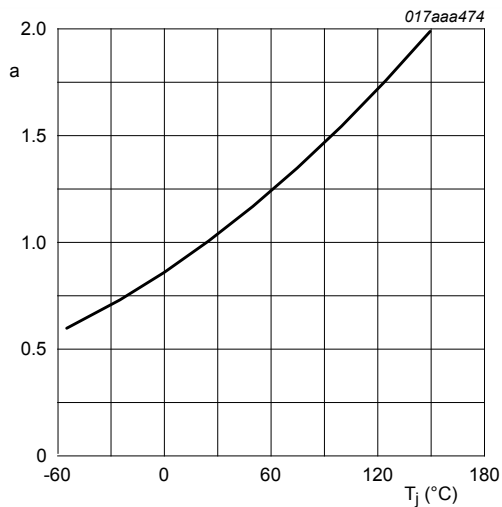
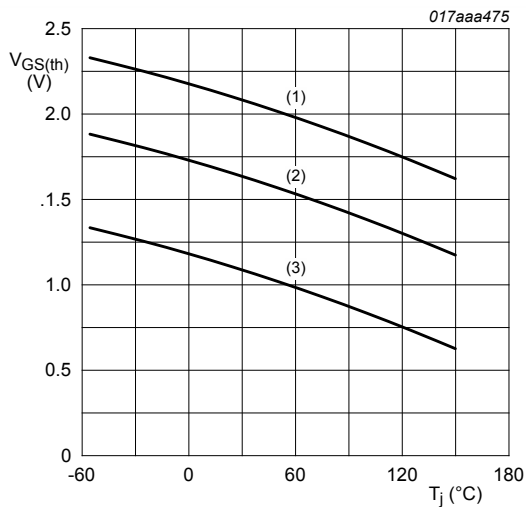


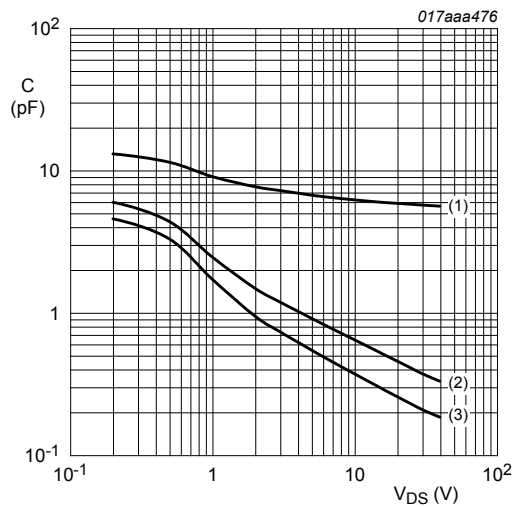
Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values

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



$I_D = 0.25\text{ mA}; V_{DS} = V_{GS}$
(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

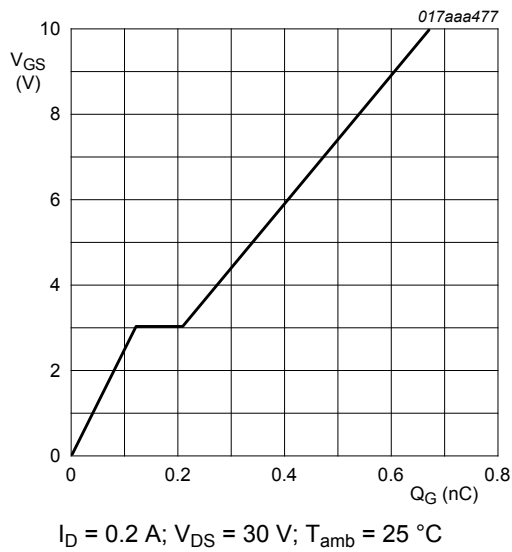


Fig. 14. Gate-source voltage as a function of gate charge; typical values

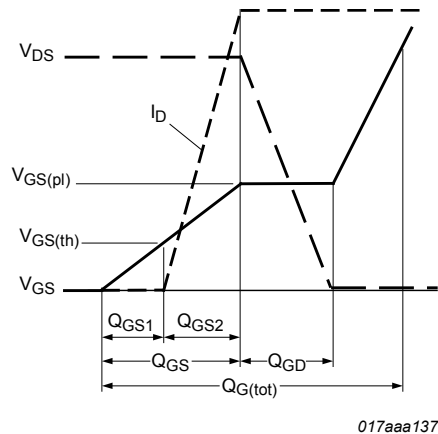
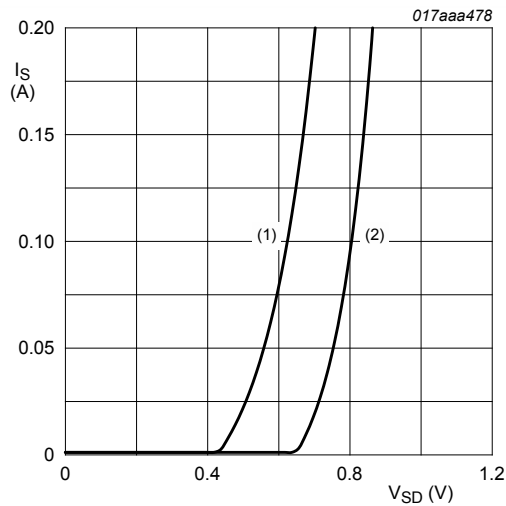


Fig. 15. MOSFET transistor: Gate charge waveform definitions



$V_{GS} = 0\text{ V}$
(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

11. Test information

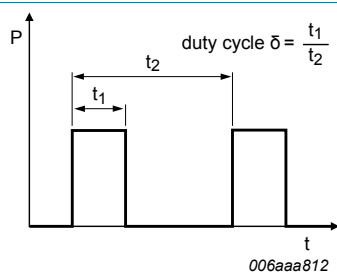
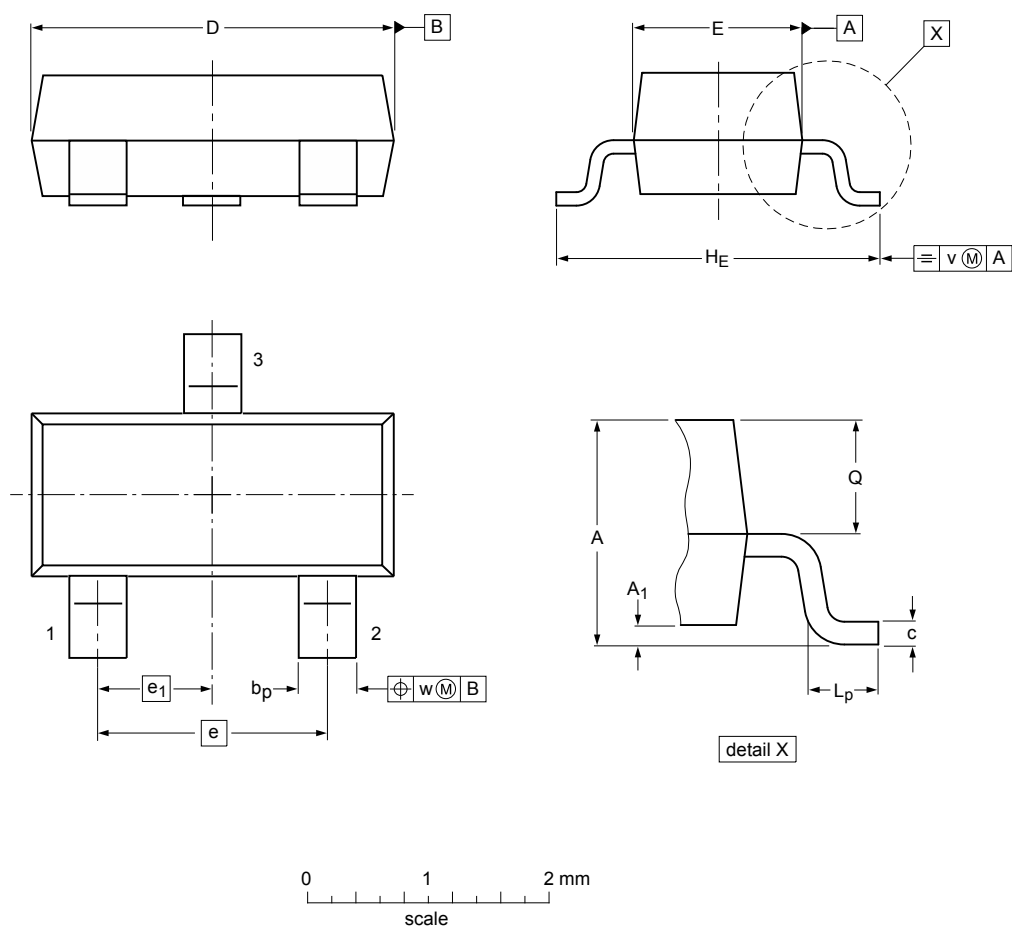


Fig. 17. Duty cycle definition

12. Package outline

Plastic surface-mounted package; 3 leads

SOT23



Dimensions (mm are the original dimensions)

Unit		A	A ₁	b _p	c	D	E	e	e ₁	H _E	L _p	Q	v	w
mm	max	1.1	0.1	0.48	0.15	3.0	1.4	1.9	0.95	2.5	0.45	0.55	0.2	0.1
	min	0.9		0.38	0.09	2.8	1.2			2.1	0.15	0.45		

sot023_po


Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT23		TO-236AB				14-06-19 14-09-22

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

13. Soldering

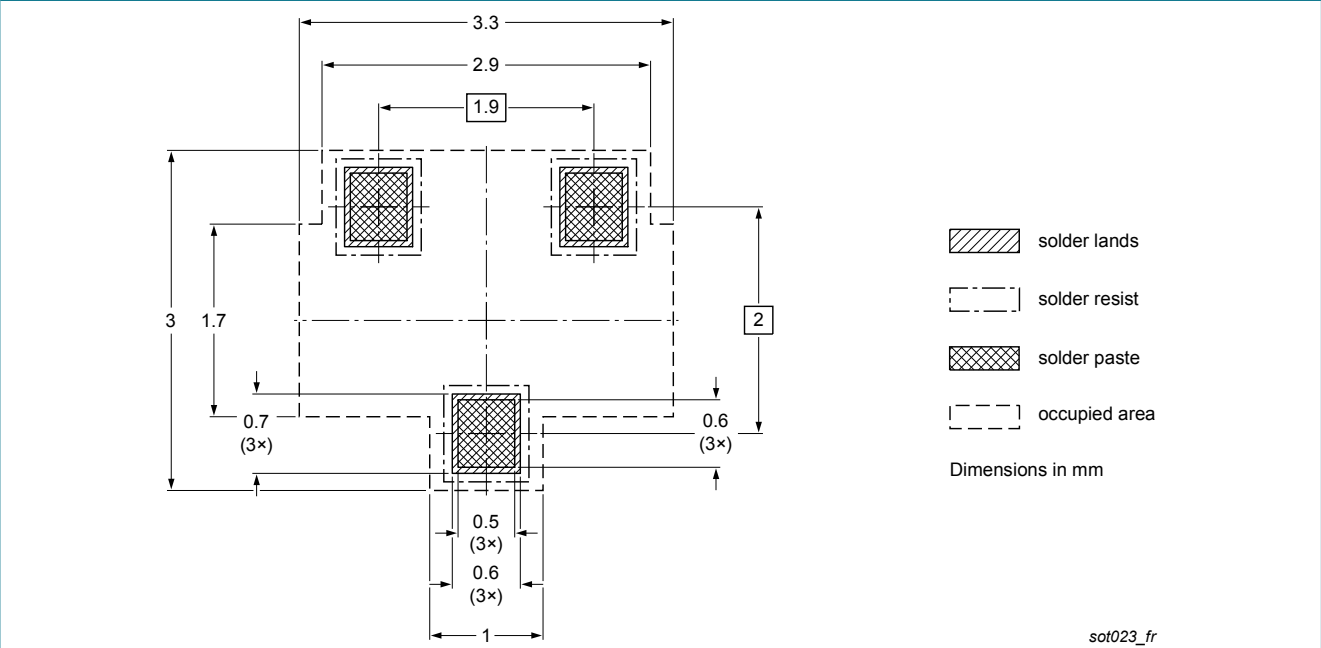


Fig. 19. Reflow soldering footprint for TO-236AB (SOT23)

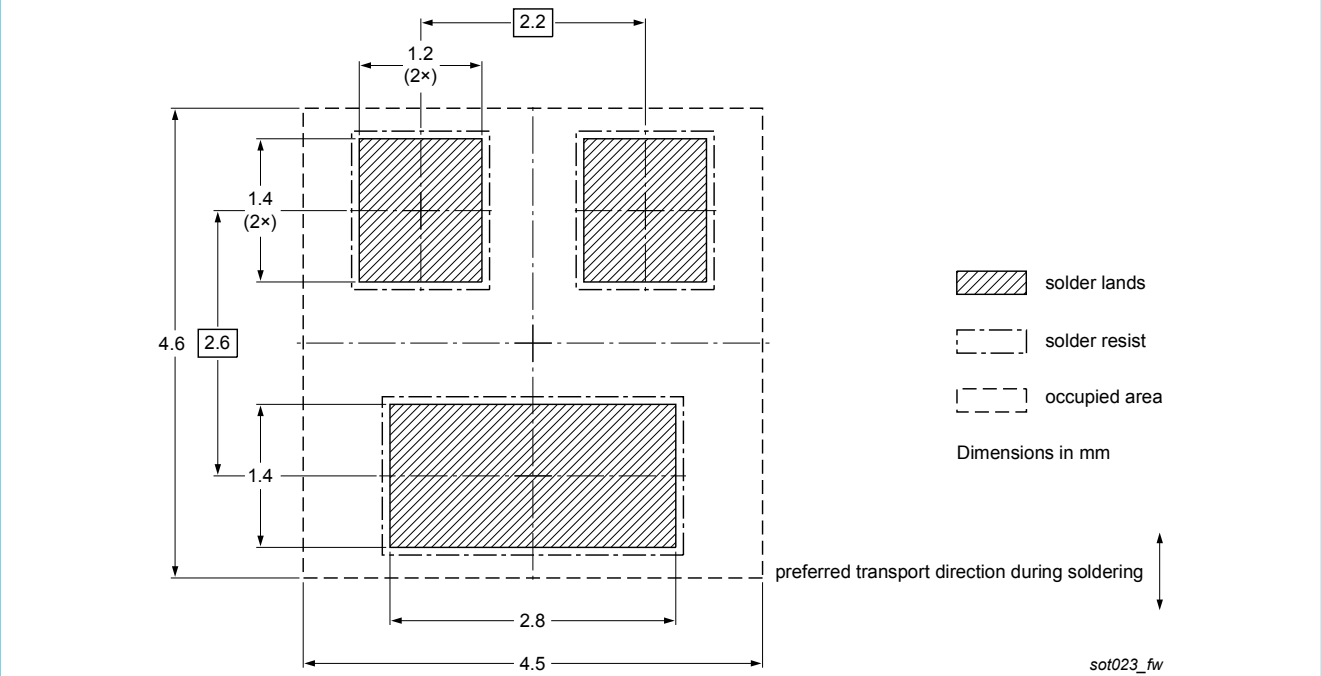


Fig. 20. Wave soldering footprint for TO-236AB (SOT23)

14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NX7002AK v.7	20150806	Product data sheet	-	NX7002AK v.6
Modifications:	<ul style="list-style-type: none">Dynamic parameters updated			
NX7002AK v.6	20150521	Product data sheet	-	NX7002AK v.5
NX7002AK v.5	20130213	Product data sheet	-	NX7002AK v.4
NX7002AK v.4	20121213	Product data sheet	-	NX7002AK v.3
NX7002AK v.3	20120710	Product data sheet	-	NX7002AK v.2
NX7002AK v.2	20120301	Product data sheet	-	NX7002AK v.1
NX7002AK v.1	20120212	Product data sheet	-	-

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15.1 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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