



NX138AK

60 V, N-channel Trench MOSFET

10 June 2016

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

- Low threshold voltage
- Very fast switching
- Trench MOSFET technology
- ElectroStatic Discharge (ESD) protection

3. Applications

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

4. Quick reference data

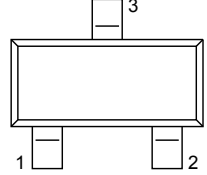
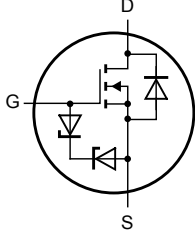
Table 1. Quick reference data

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

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

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
NX138AK	TO-236AB	plastic surface-mounted package; 3 leads	SOT23

7. Marking

Table 4. Marking codes

Type number	Marking code ^[1]
NX138AK	AP%

[1] % = placeholder for manufacturing site code

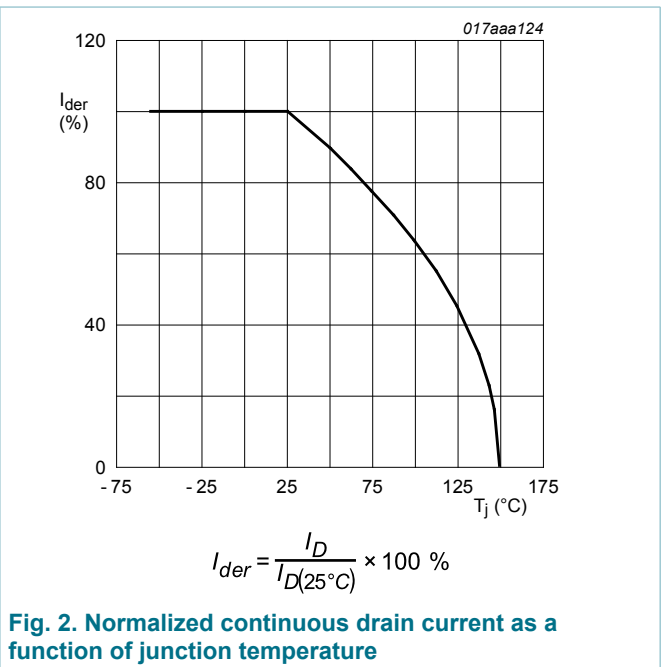
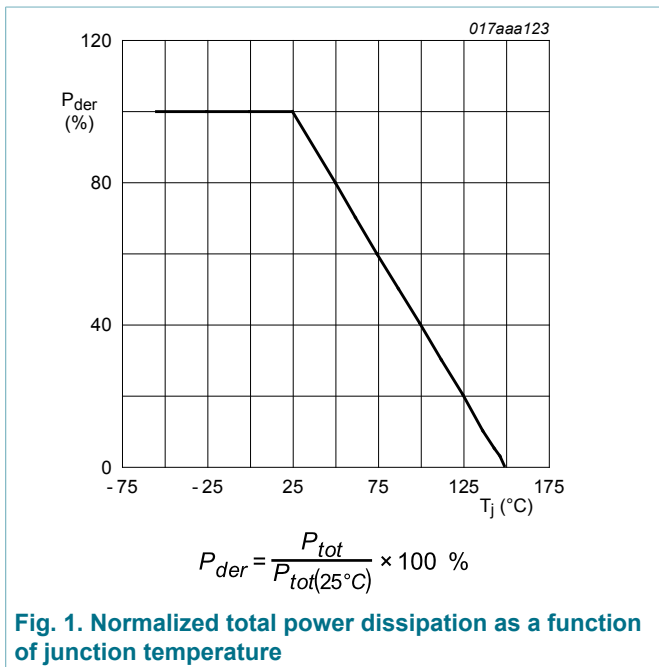
8. Limiting values

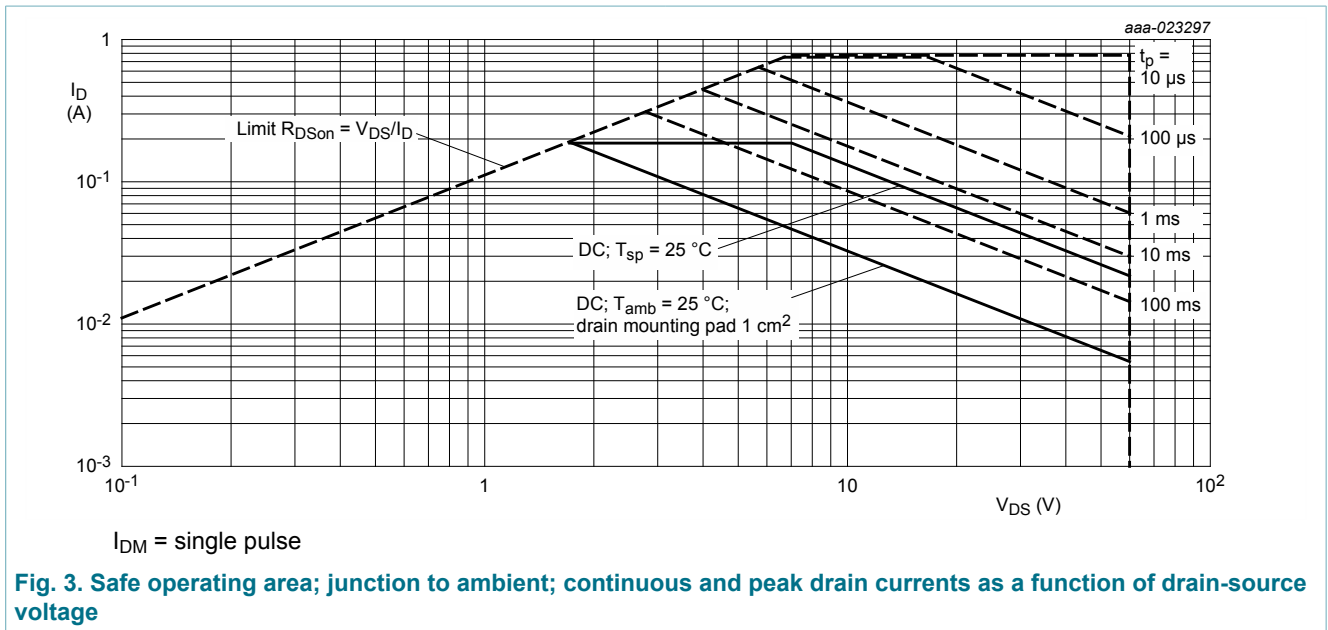
Table 5. Limiting values

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 _{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		-	765	mA
P _{tot}	total power dissipation	T _{amb} = 25 °C	[2]	-	265	mW
			[1]	-	325	mW
		T _{sp} = 25 °C		-	1.33	W
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 Printed-Circuit Board (PCB), single-sided copper, tin-plated and mounting pad for drain 1 cm².
- [2] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.





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			-	80	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 and mounting pad for drain 1 cm^2 .

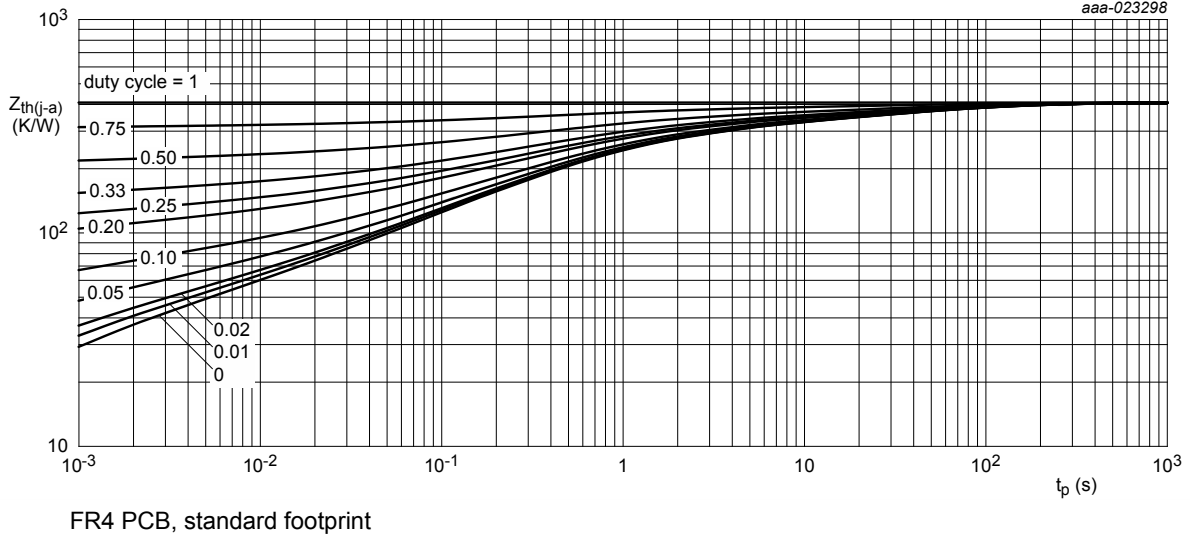


Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

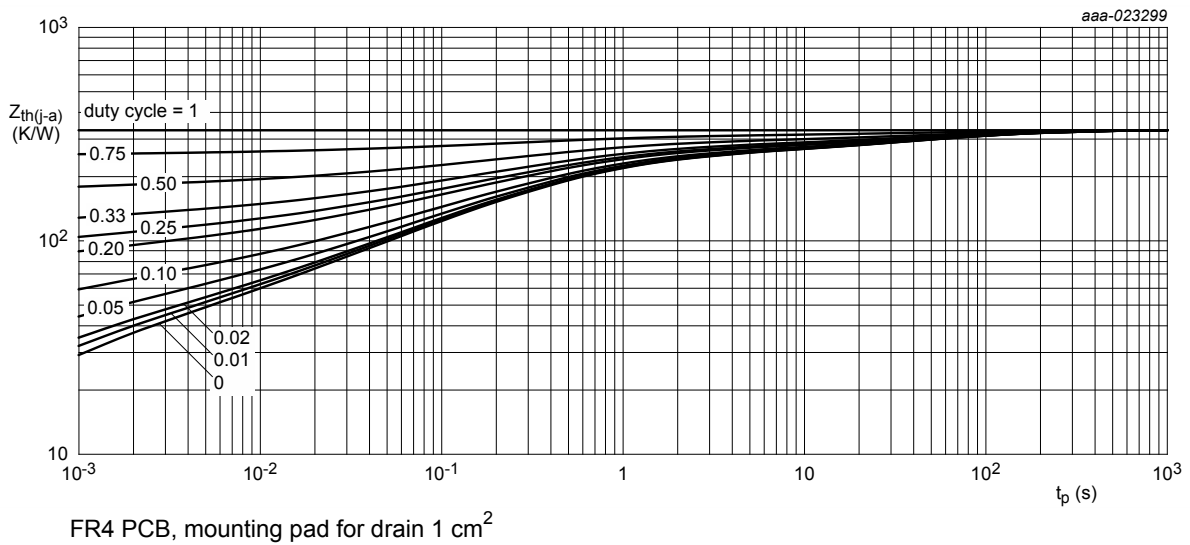


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. 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	$I_D = 250 \mu A$; $V_{DS} = V_{GS}$; $T_j = 25 \text{ }^\circ C$	0.8	1.1	1.5	V
I_{DSS}	drain leakage current	$V_{DS} = 60 V$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$	-	-	1	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
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10 V$; $I_D = 190 \text{ mA}$; $T_j = 25 \text{ }^\circ C$	-	3	4.5	Ω
		$V_{GS} = 10 V$; $I_D = 190 \text{ mA}$; $T_j = 150 \text{ }^\circ C$	-	6	9	Ω
		$V_{GS} = 5 V$; $I_D = 170 \text{ mA}$; $T_j = 25 \text{ }^\circ C$	-	4	5.2	Ω
		$V_{GS} = 2.5 V$; $I_D = 130 \text{ mA}$; $T_j = 25 \text{ }^\circ C$	-	5	10	Ω
g_{fs}	forward transconductance	$V_{DS} = 10 V$; $I_D = 180 \text{ mA}$; $T_j = 25 \text{ }^\circ C$	-	3.5	-	S
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$V_{DS} = 30 V$; $I_D = 190 \text{ mA}$; $V_{GS} = 10 V$; $T_j = 25 \text{ }^\circ C$	-	0.9	1.4	nC
Q_{GS}	gate-source charge		-	0.1	-	nC
Q_{GD}	gate-drain charge		-	0.2	-	nC
C_{iss}	input capacitance	$V_{DS} = 30 V$; $f = 1 \text{ MHz}$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$	-	15	20	pF
C_{oss}	output capacitance		-	2.3	-	pF
C_{rss}	reverse transfer capacitance		-	1.5	-	pF
$t_{d(on)}$	turn-on delay time		$V_{DS} = 30 V$; $I_D = 190 \text{ mA}$; $V_{GS} = 10 V$; $R_{G(ext)} = 75 \text{ } \Omega$; $T_j = 25 \text{ }^\circ C$	-	8	12
t_r	rise time	-		10	-	ns
$t_{d(off)}$	turn-off delay time	-		8	20	ns
t_f	fall time	-		5	-	ns
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 190 \text{ mA}$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$	-	0.8	1.2	V

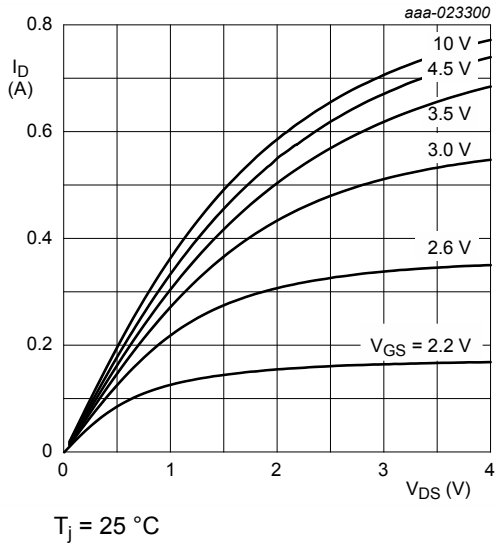


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

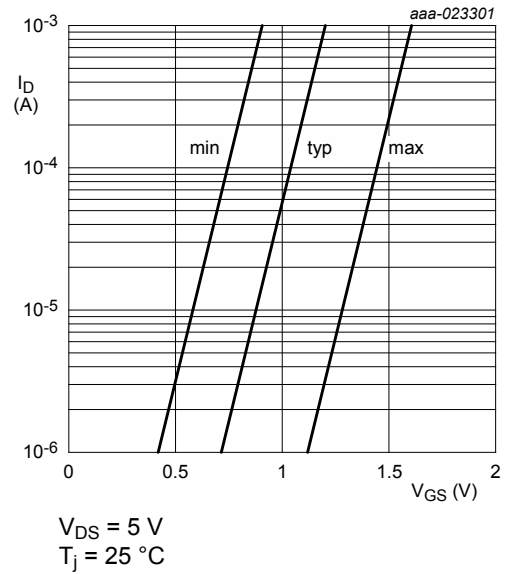


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

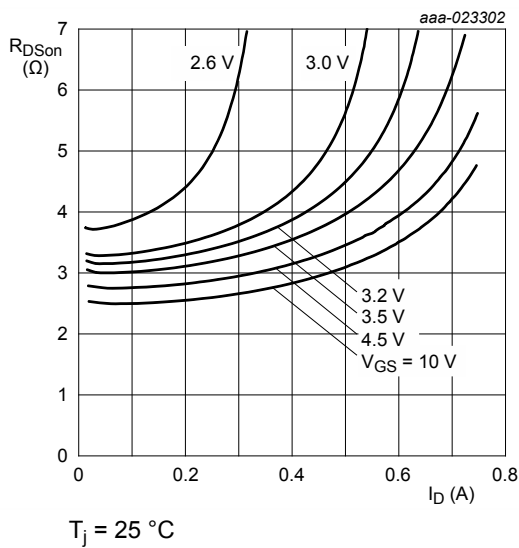


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

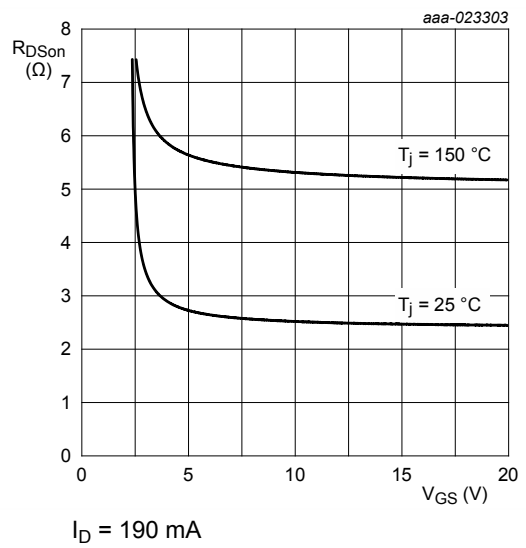


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

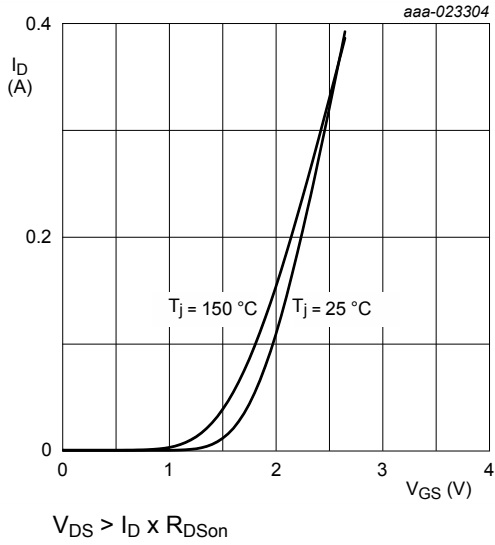


Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values

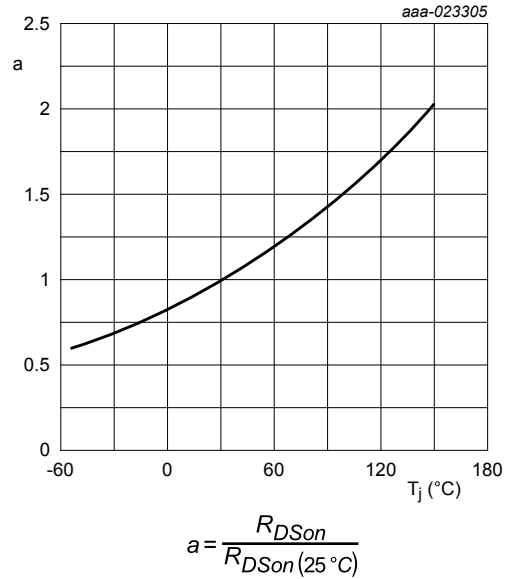


Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values

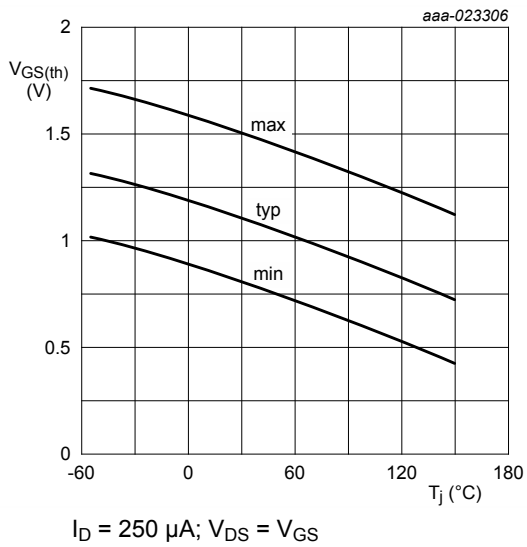


Fig. 12. Gate-source threshold voltage as a function of junction temperature

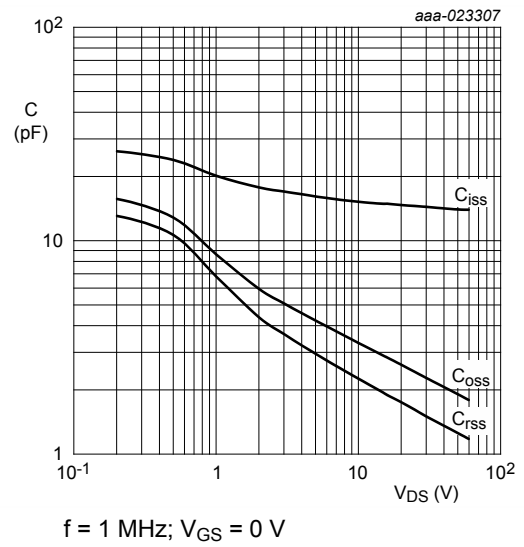


Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

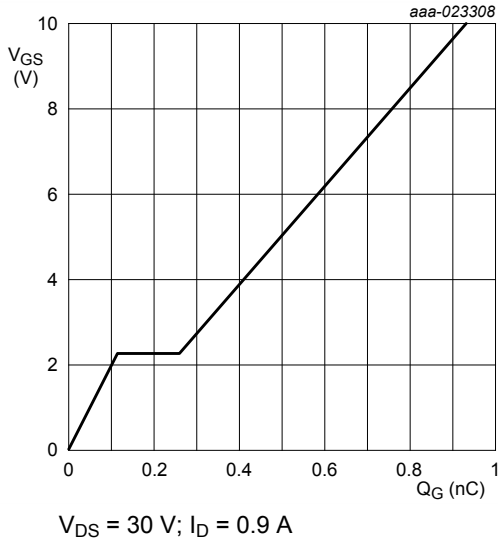


Fig. 14. Gate-source voltage as a function of gate charge; typical values

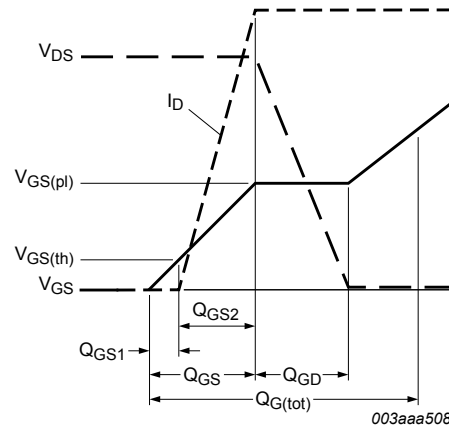


Fig. 15. MOSFET transistor: Gate charge waveform definitions

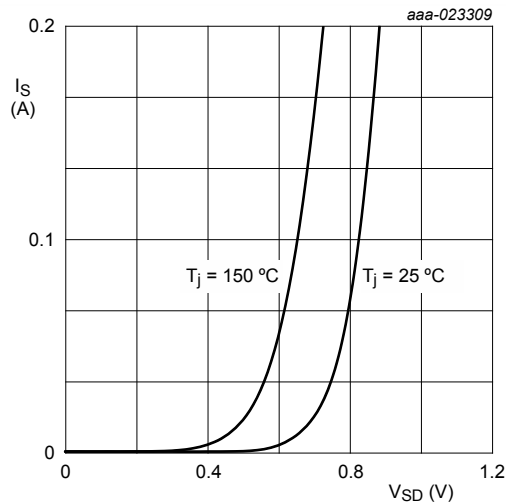


Fig. 16. Source current as a function of source-drain voltage; typical values

11. Test information

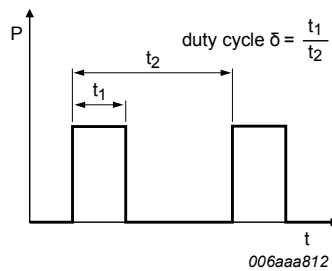
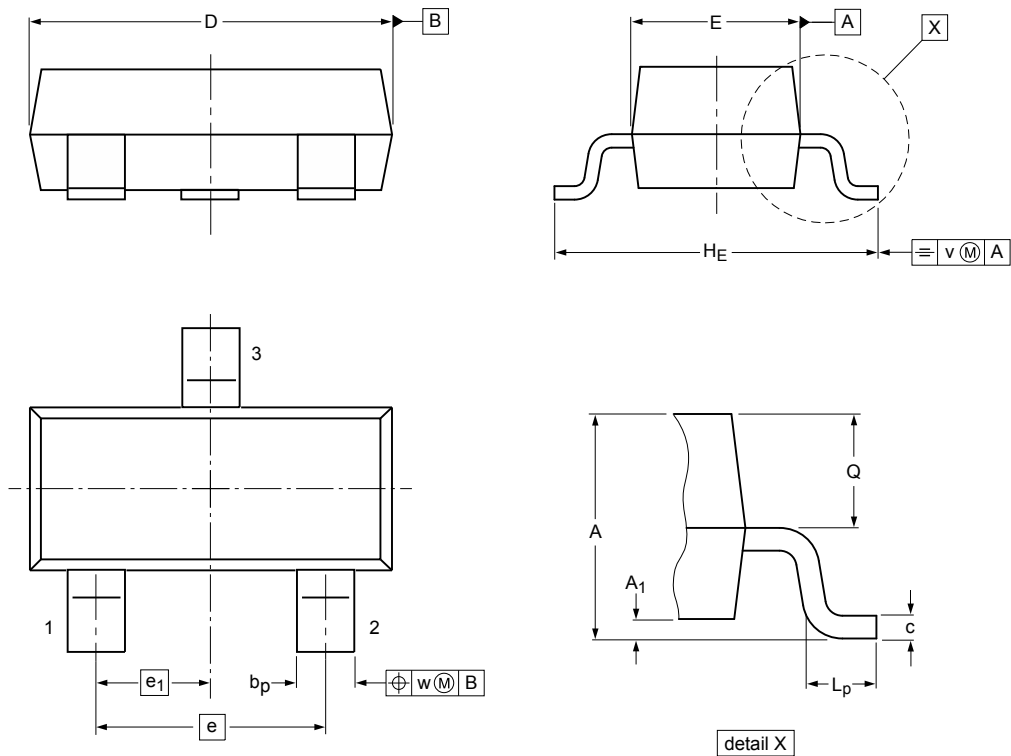


Fig. 17. Duty cycle definition

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
max	1.1	0.1	0.48	0.15	3.0	1.4			2.5	0.45	0.55		
nom							1.9	0.95				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

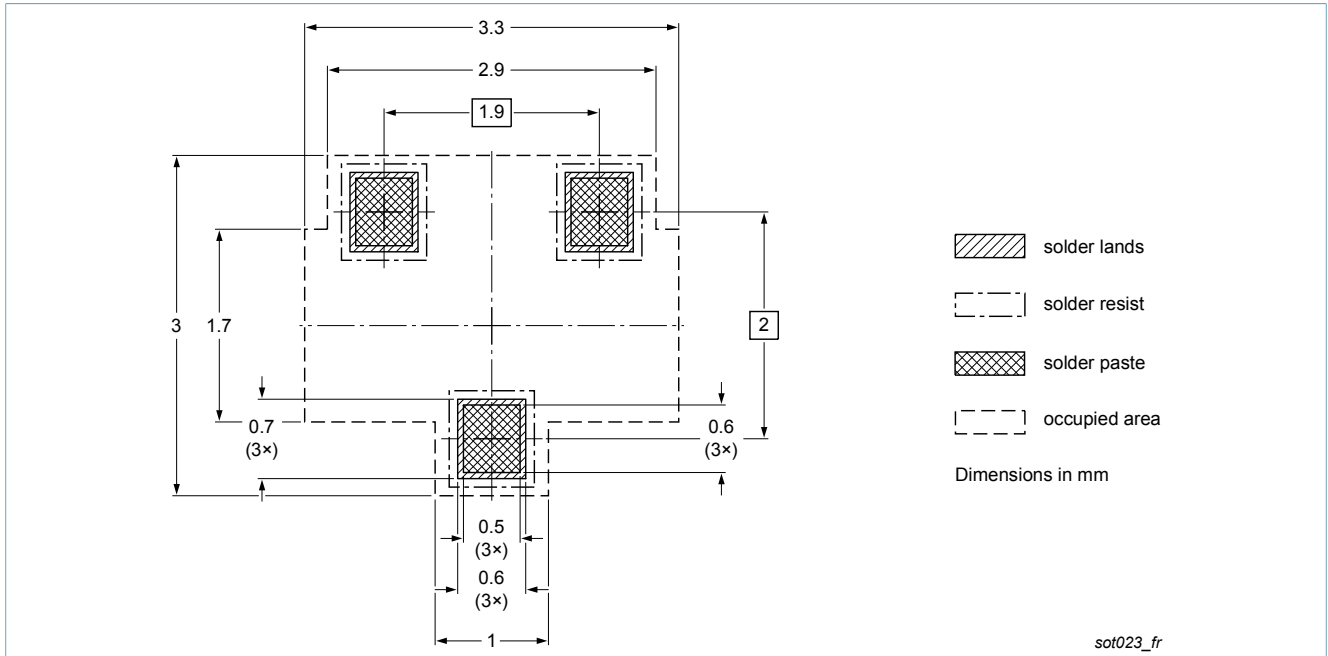


Fig. 19. Reflow soldering footprint for TO-236AB (SOT23)

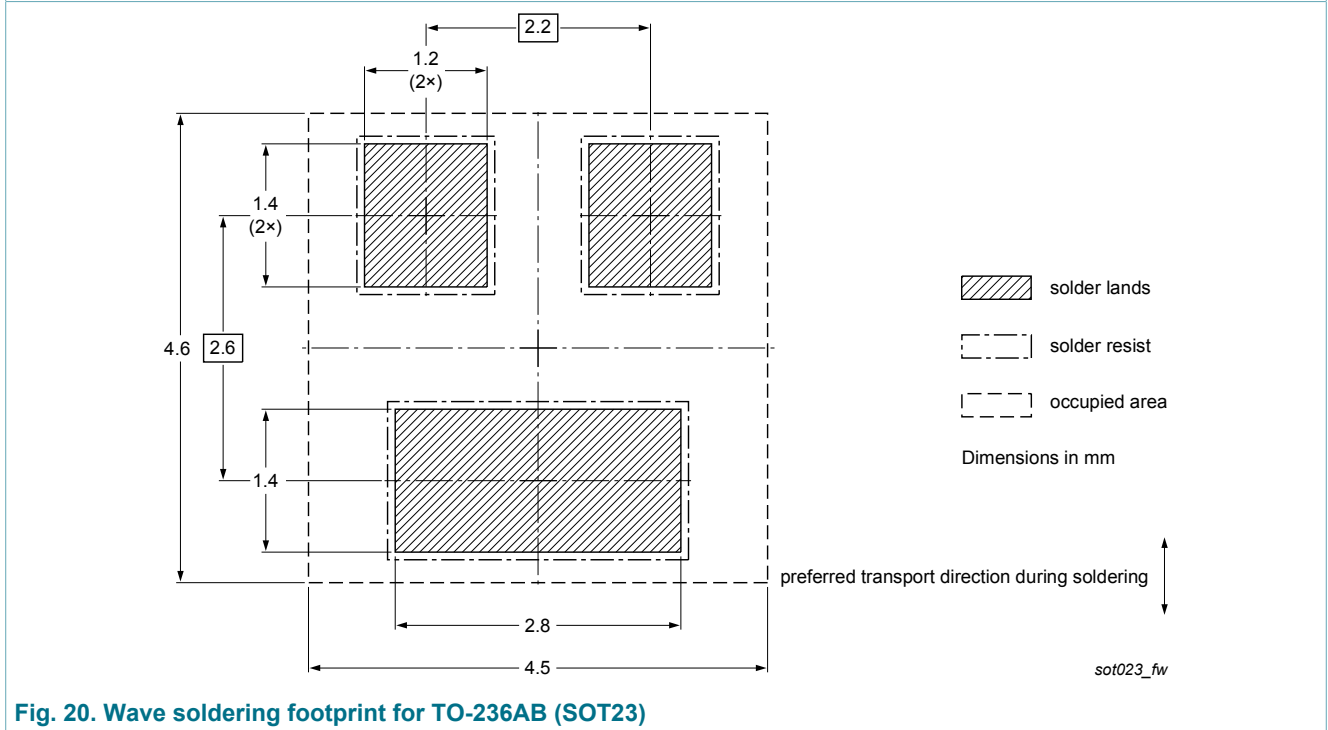


Fig. 20. Wave soldering footprint for TO-236AB (SOT23)

14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NX138AK v.2	20160610	Product data sheet	-	NX138AK v.1
Modifications:	<ul style="list-style-type: none">Title changed for figures 11 and 12 to junction temperature			
NX138AK v.1	20160607	Product 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.

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