NX138BKS

60 V, dual N-channel Trench MOSFET

15 June 2016 Product data sheet

1. General description

Dual N-channel enhancement mode Field-Effect Transistor (FET) in a very small SOT363 (SC-88) 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 > 2 kV HBM

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
Per transistor							
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]	-	-	210	mA
Static characteristics (per transistor)							
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 200 mA; T_j = 25 °C		-	2.1	3.5	Ω

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

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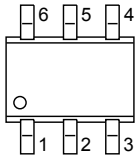
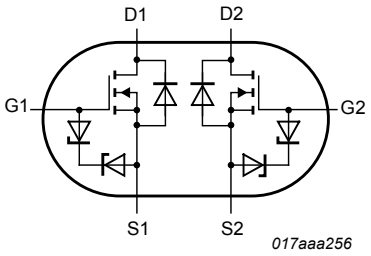
5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S1	source TR1	 TSSOP6 (SOT363)	
2	G1	gate TR1		
3	D2	drain TR2		
4	S2	source TR2		
5	G2	gate TR2		
6	D1	drain TR1		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
NX138BKS	TSSOP6	plastic surface-mounted package; 6 leads	SOT363

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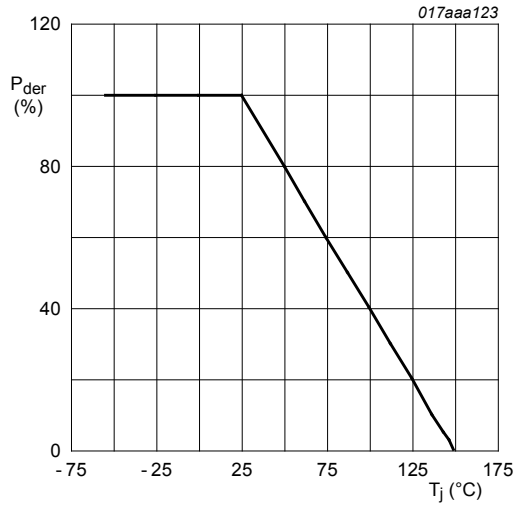
7. Limiting values

Table 4. Limiting values

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

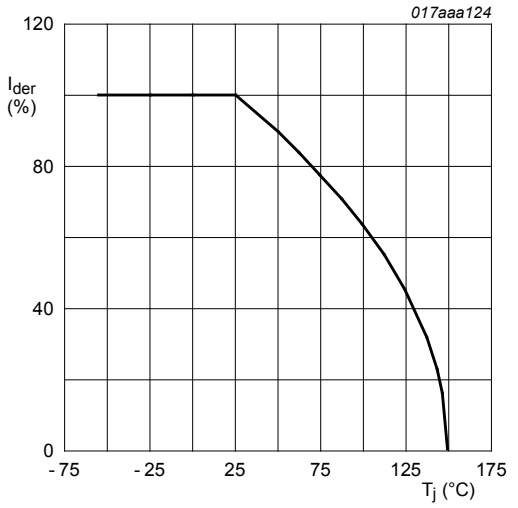
Symbol	Parameter	Conditions		Min	Max	Unit
Per transistor						
V_{DS}	drain-source voltage	T_j = 25 °C		-	60	V
V_{GS}	gate-source voltage			-20	20	V
I_D	drain current	V_{GS} = 10 V; T_{amb} = 25 °C	[1]	-	210	mA
		V_{GS} = 10 V; T_{amb} = 100 °C	[1]	-	135	mA
		V_{GS} = 10 V; T_{sp} = 25 °C		-	330	mA
I_{DM}	peak drain current	T_{amb} = 25 °C; single pulse; $t_p \leq$ 10 µs		-	855	mA
P_{tot}	total power dissipation	T_{amb} = 25 °C	[2]	-	285	mW
			[1]	-	320	mW
		T_{sp} = 25 °C		-	860	mW
Per device						
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]	-	170	mA

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



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

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



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

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

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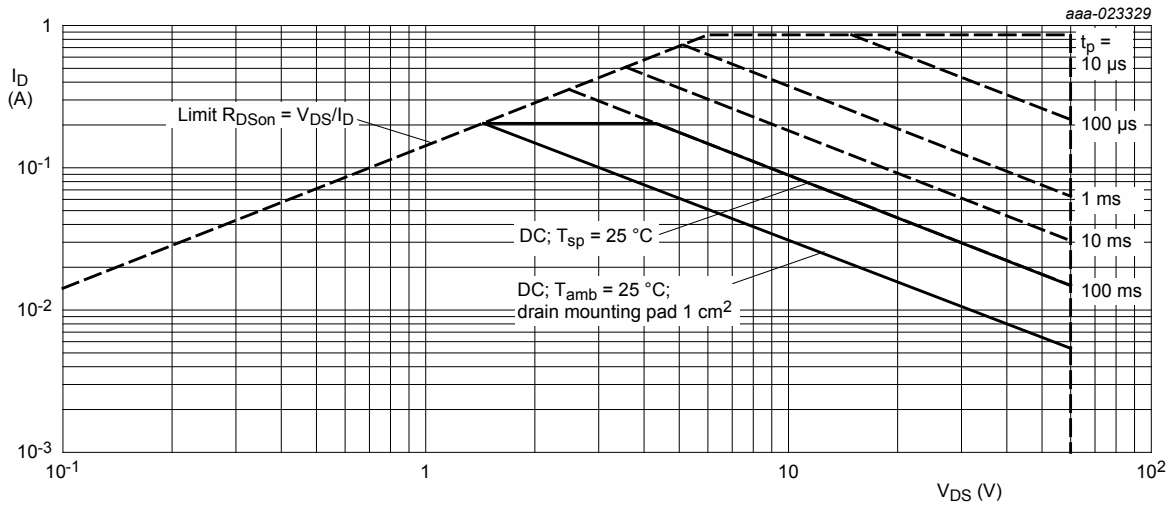

I_{DM} = single pulse

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
Per transistor							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	380	440	K/W
			[2]	-	340	390	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	125	145	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.

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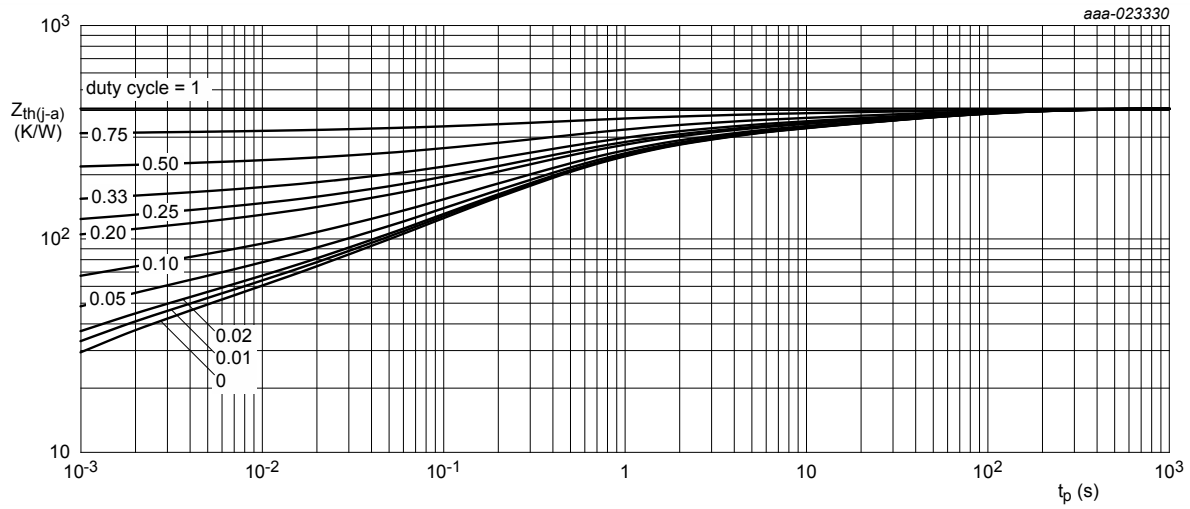
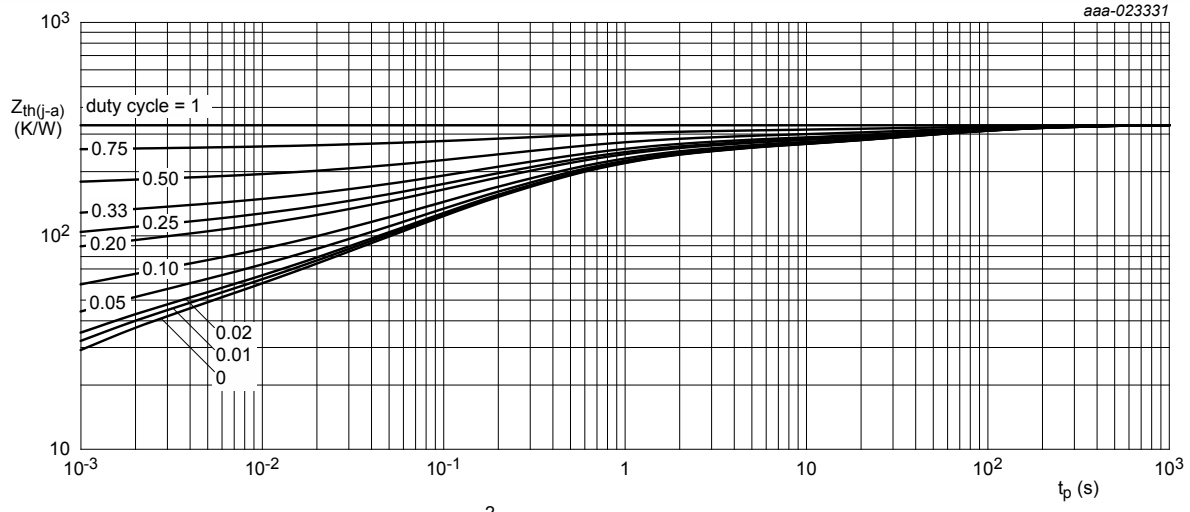


FR4 PCB, standard footprint

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

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9. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics (per transistor)							
$V_{(BR)DSS}$	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		0.5	1	1.5	V
I_{DSS}	drain leakage current	V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25 °C		-	-	1	µA
I_{GSS}	gate leakage current	V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25 °C		-	-	10	µA
		V_{GS} = -20 V; V_{DS} = 0 V; T_j = 25 °C		-	-	-10	µA
		V_{GS} = 10 V; V_{DS} = 0 V; T_j = 25 °C		-	-	1	µA
		V_{GS} = -10 V; V_{DS} = 0 V; T_j = 25 °C		-	-	-1	µA
		V_{GS} = 5 V; V_{DS} = 0 V; T_j = 25 °C		-	-	0.3	µA
		V_{GS} = -5 V; V_{DS} = 0 V; T_j = 25 °C		-	-	-0.3	µA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 200 mA; T_j = 25 °C		-	2.1	3.5	Ω
		V_{GS} = 10 V; I_D = 200 mA; T_j = 150 °C		-	4.3	7.2	Ω
		V_{GS} = 5 V; I_D = 170 mA; T_j = 25 °C		-	2.2	3.8	Ω
		V_{GS} = 2.5 V; I_D = 75 mA; T_j = 25 °C		-	2.6	5	Ω
g_{fs}	forward transconductance	V_{DS} = 10 V; I_D = 200 mA; T_j = 25 °C		-	0.7	-	S
Dynamic characteristics (per transistor)							
$Q_{G(tot)}$	total gate charge	V_{DS} = 30 V; I_D = 200 mA; V_{GS} = 10 V; T_j = 25 °C		-	0.5	0.7	nC
Q_{GS}	gate-source charge			-	0.12	-	nC
Q_{GD}	gate-drain charge			-	0.12	-	nC
C_{iss}	input capacitance	V_{DS} = 30 V; f = 1 MHz; V_{GS} = 0 V; T_j = 25 °C		-	20	-	pF
C_{oss}	output capacitance			-	3.1	-	pF
C_{rss}	reverse transfer capacitance			-	2	-	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 30 V; I_D = 200 mA; V_{GS} = 10 V; $R_{G(ext)}$ = 6 Ω; T_j = 25 °C		-	8	-	ns
t_r	rise time			-	8	-	ns
$t_{d(off)}$	turn-off delay time			-	13	-	ns
t_f	fall time			-	5	-	ns
Source-drain diode (per transistor)							
V_{SD}	source-drain voltage	I_S = 200 mA; V_{GS} = 0 V; T_j = 25 °C		-	0.9	1.2	V

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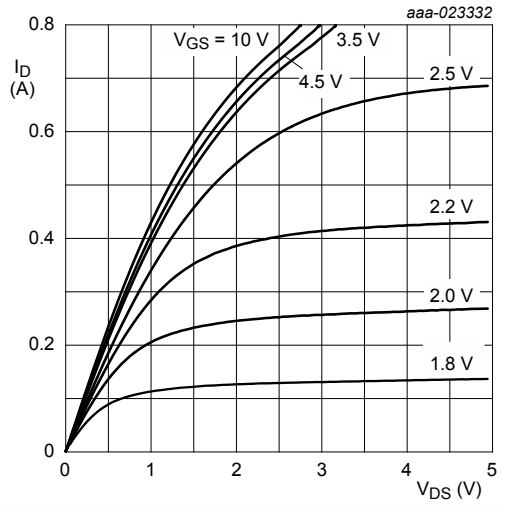
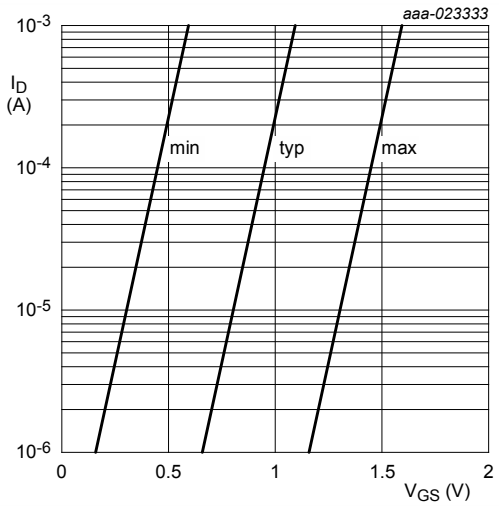


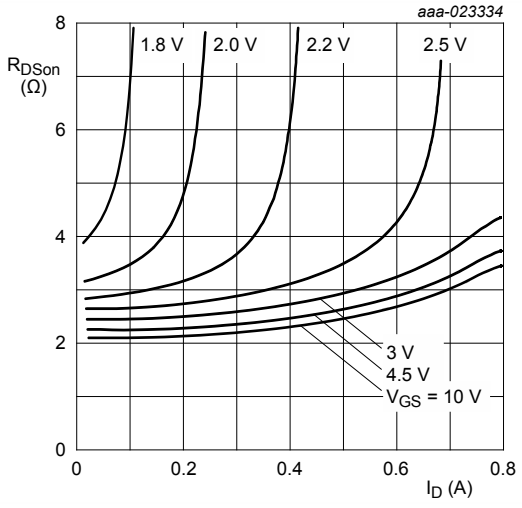
T_j = 25 °C

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



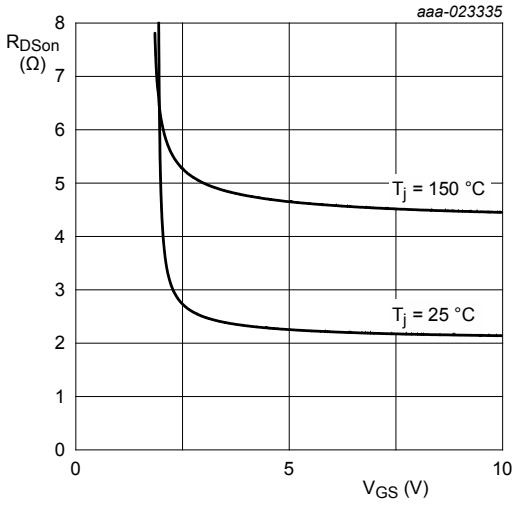
V_{DS} = 5 V
T_j = 25 °C

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

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

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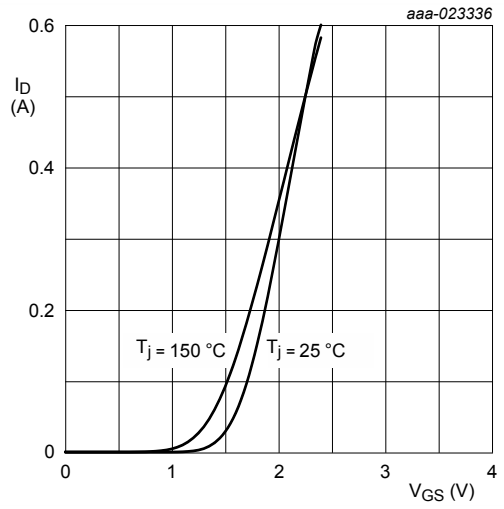
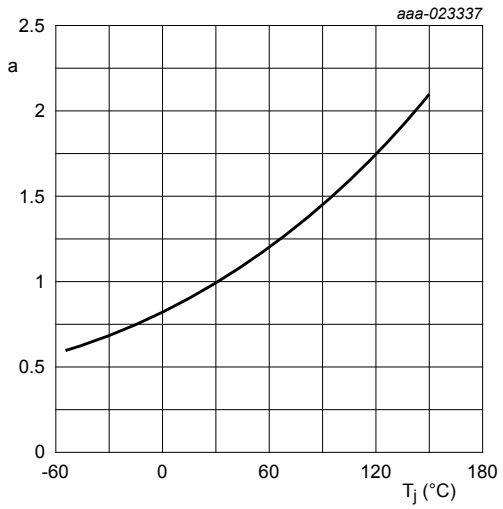


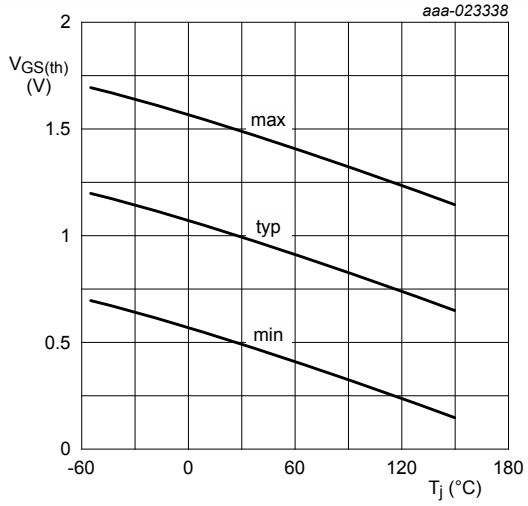
$V_{DS} > I_D \times R_{DSon}$

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



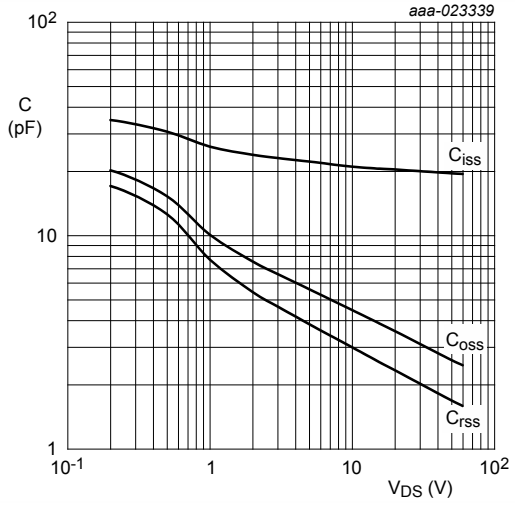
$$a = \frac{R_{DSon}}{R_{DSon(25\,°C)}}$$

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



I_D = 250 µA; $V_{DS} = V_{GS}$

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



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

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

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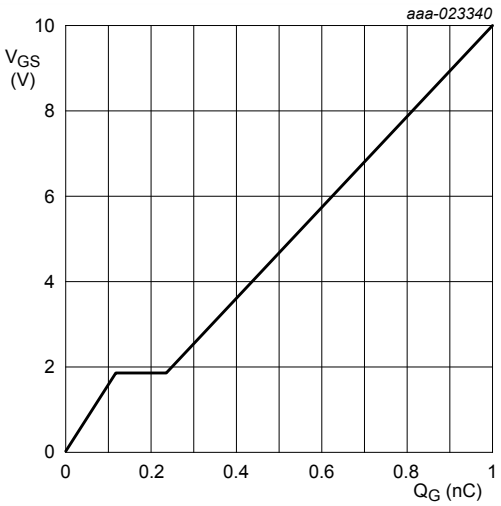


V_{DS} = 30 V; I_D = 0.2 A

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

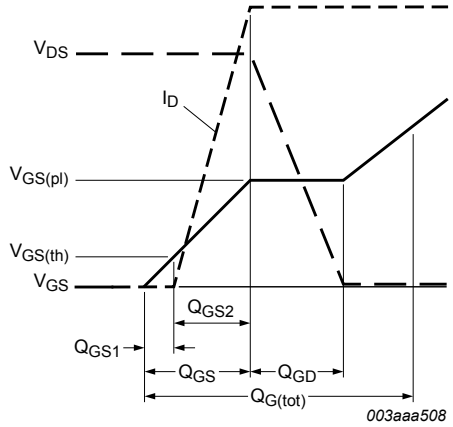
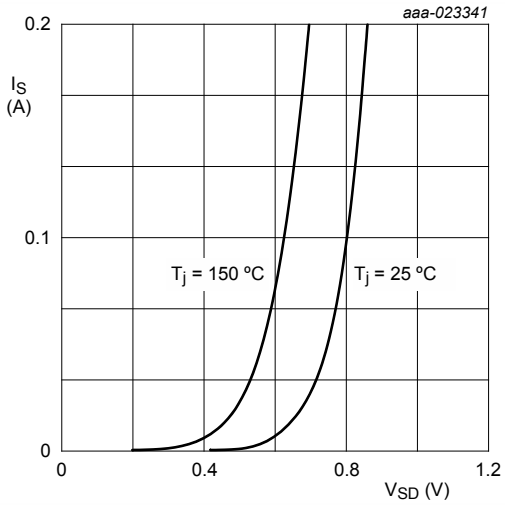


Fig. 15. MOSFET transistor: Gate charge waveform definitions



V_{GS} = 0 V

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

10. Test information

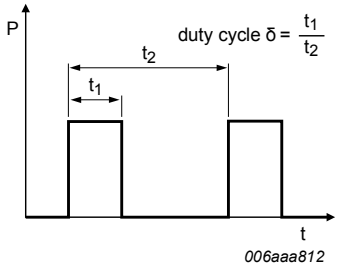


Fig. 17. Duty cycle definition

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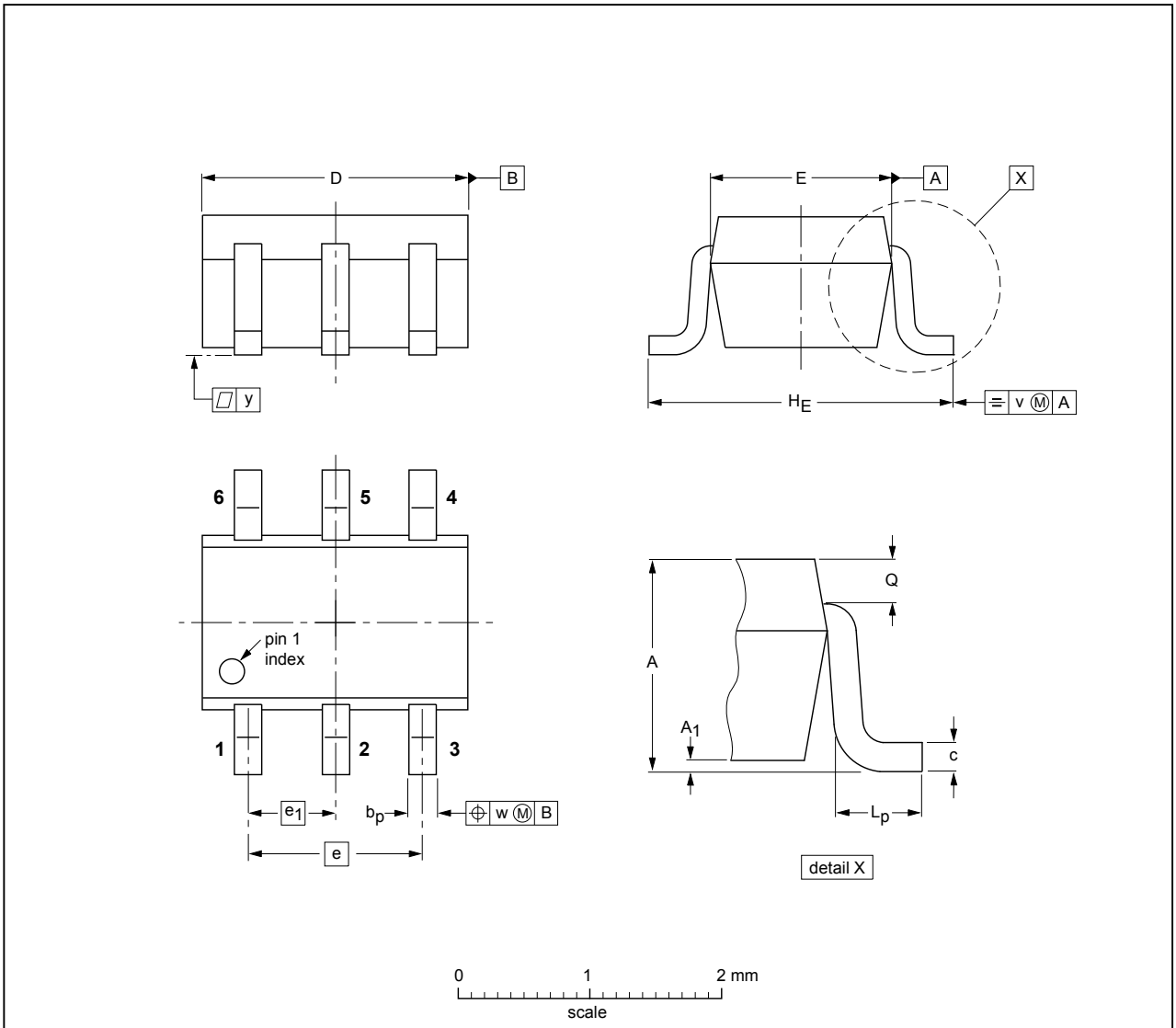
11. Package outline

Plastic surface-mounted package; 6 leads **SOT363**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT363			SC-88			~~04-11-08~~ 06-03-16

Fig. 18. Package outline TSSOP6 (SOT363)

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12. Soldering

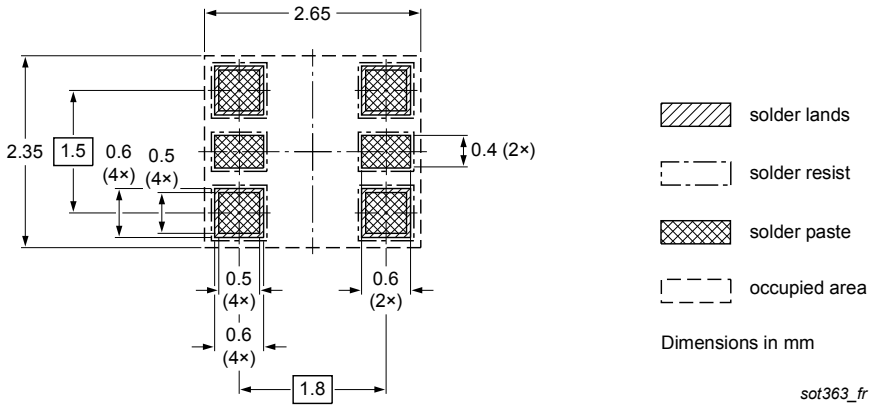

Fig. 19. Reflow soldering footprint for TSSOP6 (SOT363)

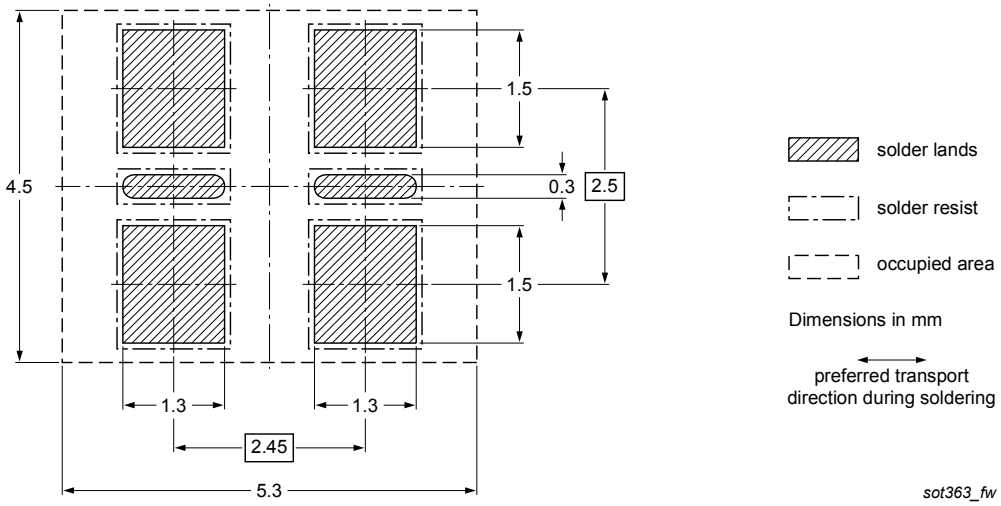

Fig. 20. Wave soldering footprint for TSSOP6 (SOT363)

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13. Revision history

Table 7. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NX138BKS v.1	20160615	Product data sheet	-	-

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14. 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.

[1] Please consult the most recently issued document before initiating or completing a design.
[2] The term 'short data sheet' is explained in section "Definitions".
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