



**THE DATASHEET OF
NX138BKWX**





NX138BKW

60 V, N-channel Trench MOSFET

15 June 2016

Product data sheet

1. General description

N-channel enhancement mode Field-Effect Transistor (FET) in a very small SOT323 (SC-70) 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

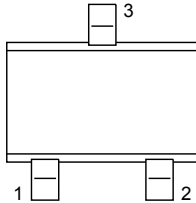
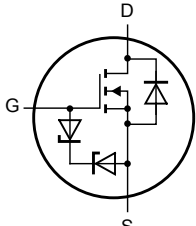
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
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]	-	210	mA
Static characteristics						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 200\text{ mA}; T_j = 25\text{ °C}$	-	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 cm².

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 <p>SC-70 (SOT323)</p>	 <p>017aaa255</p>
2	S	source		
3	D	drain		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
NX138BKW	SC-70	plastic surface-mounted package; 3 leads	SOT323

7. Marking

Table 4. Marking codes

Type number	Marking code
NX138BKW	B8% [1]

[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	$T_j = 25\text{ °C}$		-	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]	-	210	mA
		$V_{GS} = 10\text{ V}; T_{amb} = 100\text{ °C}$	[1]	-	135	mA
		$V_{GS} = 10\text{ V}; T_{sp} = 25\text{ °C}$		-	330	mA
I_{DM}	peak drain current	$T_{amb} = 25\text{ °C}; \text{single pulse}; t_p \leq 10\text{ }\mu\text{s}$		-	855	mA
P_{tot}	total power dissipation	$T_{amb} = 25\text{ °C}$	[2]	-	266	mW
			[1]	-	321	mW
		$T_{sp} = 25\text{ °C}$		-	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	$T_{amb} = 25\text{ °C}$	[1]	-	210	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 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

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

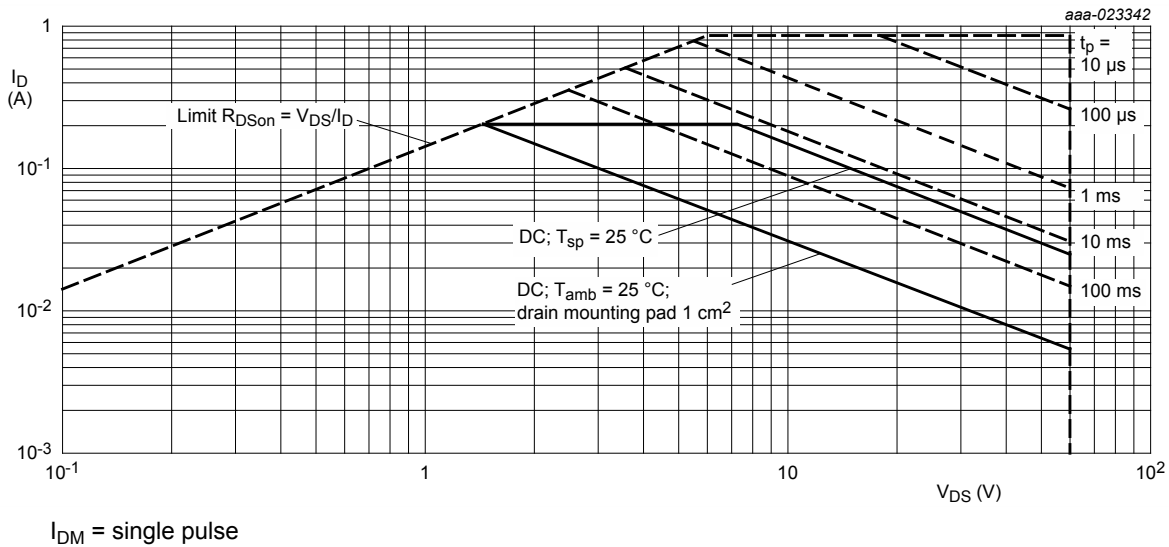


Fig. 3. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage

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]	-	340	390	K/W

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point		-	75	85	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 cm².

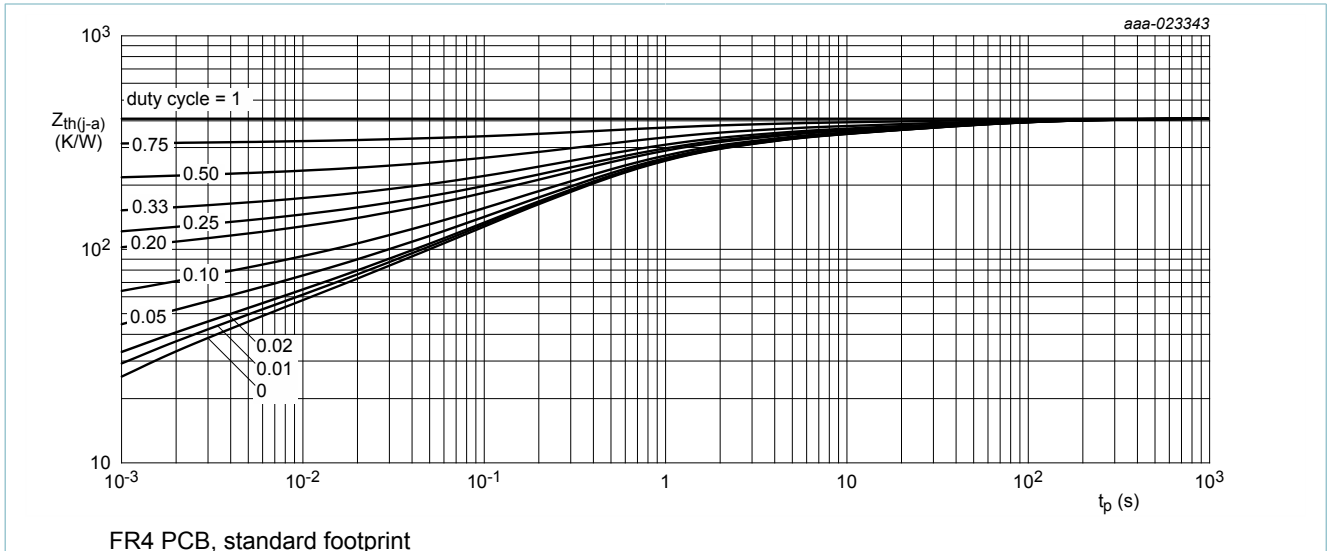


Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

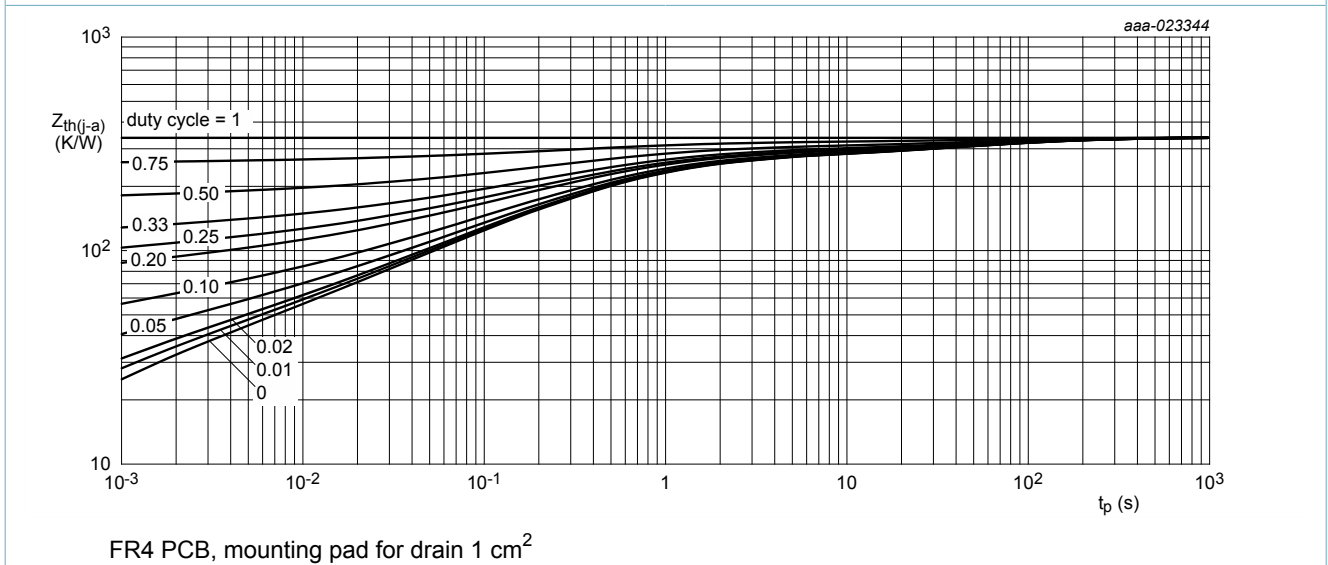


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	60	-	-	V
V_{GSth}	gate-source threshold voltage	$I_D = 250 \mu\text{A}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C}$	0.5	1	1.5	V
I_{DSS}	drain leakage current	$V_{DS} = 60 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	1	μA
I_{GSS}	gate leakage current	$V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	10	μA
		$V_{GS} = -20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	-10	μA
		$V_{GS} = 10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	1	μA
		$V_{GS} = -10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	-1	μA
		$V_{GS} = 5 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	0.3	μA
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 200 \text{ mA}; T_j = 25 \text{ }^\circ\text{C}$	-	2.1	3.5	Ω
		$V_{GS} = 10 \text{ V}; I_D = 200 \text{ mA}; T_j = 150 \text{ }^\circ\text{C}$	-	4.3	7.2	Ω
		$V_{GS} = 5 \text{ V}; I_D = 170 \text{ mA}; T_j = 25 \text{ }^\circ\text{C}$	-	2.2	3.8	Ω
		$V_{GS} = 2.5 \text{ V}; I_D = 75 \text{ mA}; T_j = 25 \text{ }^\circ\text{C}$	-	2.6	5	Ω
g_{fs}	forward transconductance	$V_{DS} = 10 \text{ V}; I_D = 200 \text{ mA}; T_j = 25 \text{ }^\circ\text{C}$	-	0.7	-	S
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$V_{DS} = 30 \text{ V}; I_D = 200 \text{ mA}; V_{GS} = 10 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	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	$V_{DS} = 30 \text{ V}; f = 1 \text{ MHz}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	20	-	pF
C_{oss}	output capacitance		-	3.1	-	pF
C_{riss}	reverse transfer capacitance		-	2	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30 \text{ V}; I_D = 200 \text{ mA}; V_{GS} = 10 \text{ V}; R_{G(ext)} = 6 \text{ } \Omega; T_j = 25 \text{ }^\circ\text{C}$	-	8	12	ns
t_r	rise time		-	8	-	ns
$t_{d(off)}$	turn-off delay time		-	13	20	ns
t_f	fall time		-	5	-	ns
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 200 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.9	1.2	V

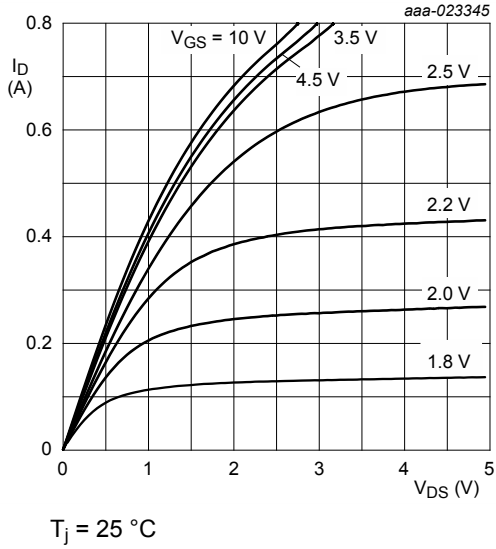


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

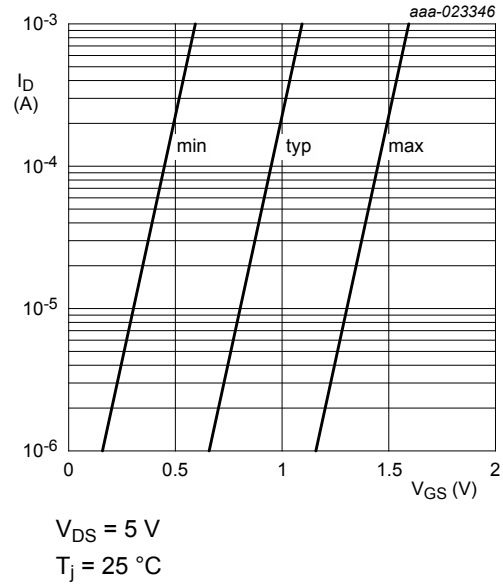


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

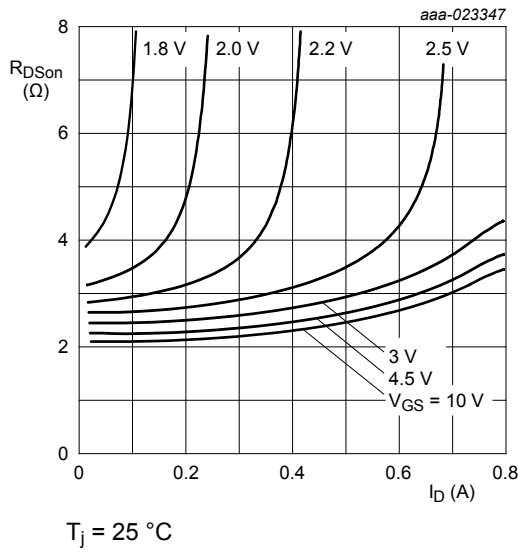


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

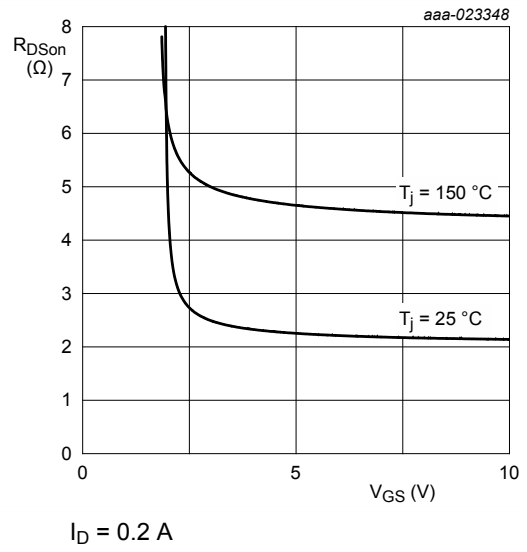


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

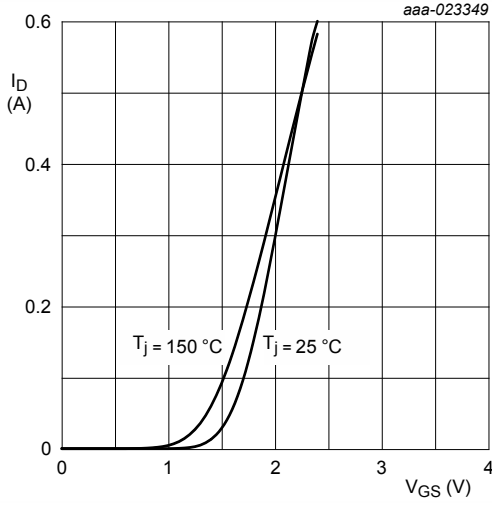


Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values

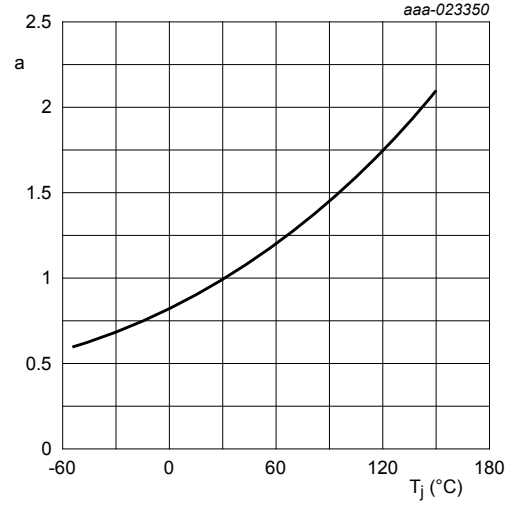


Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values

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

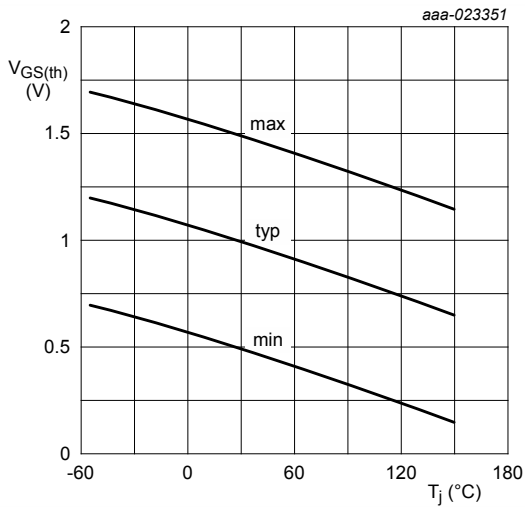


Fig. 12. Gate-source threshold voltage as a function of junction temperature

$I_D = 250\ \mu\text{A}; V_{DS} = V_{GS}$

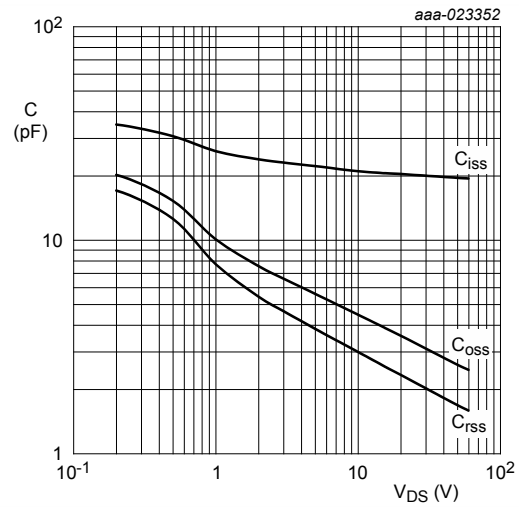
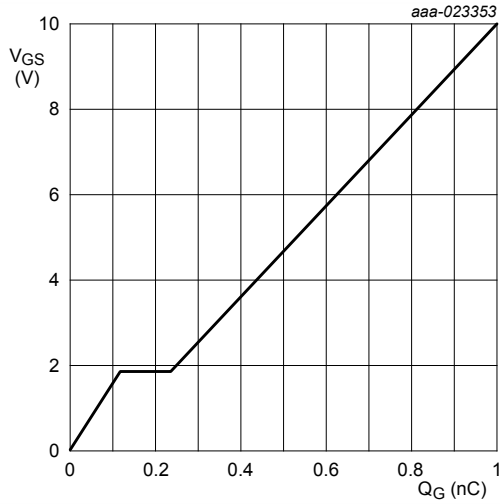


Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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



$V_{DS} = 30\text{ V}; I_D = 0.2\text{ A}$

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

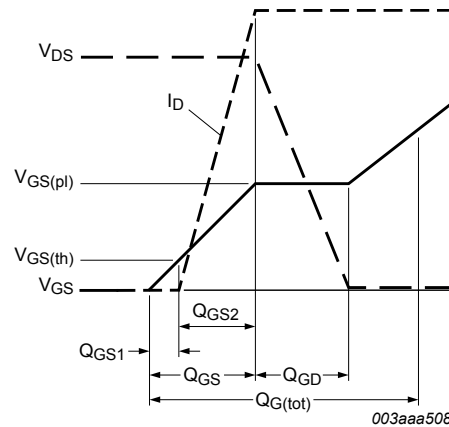
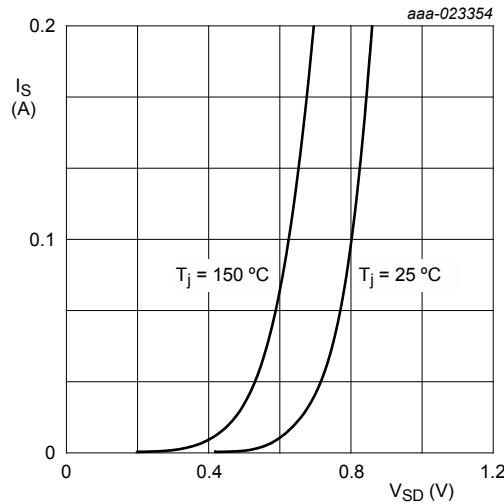


Fig. 15. MOSFET transistor: Gate charge waveform definitions



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

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

11. Test information

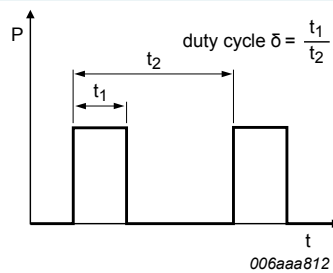


Fig. 17. Duty cycle definition

12. Package outline

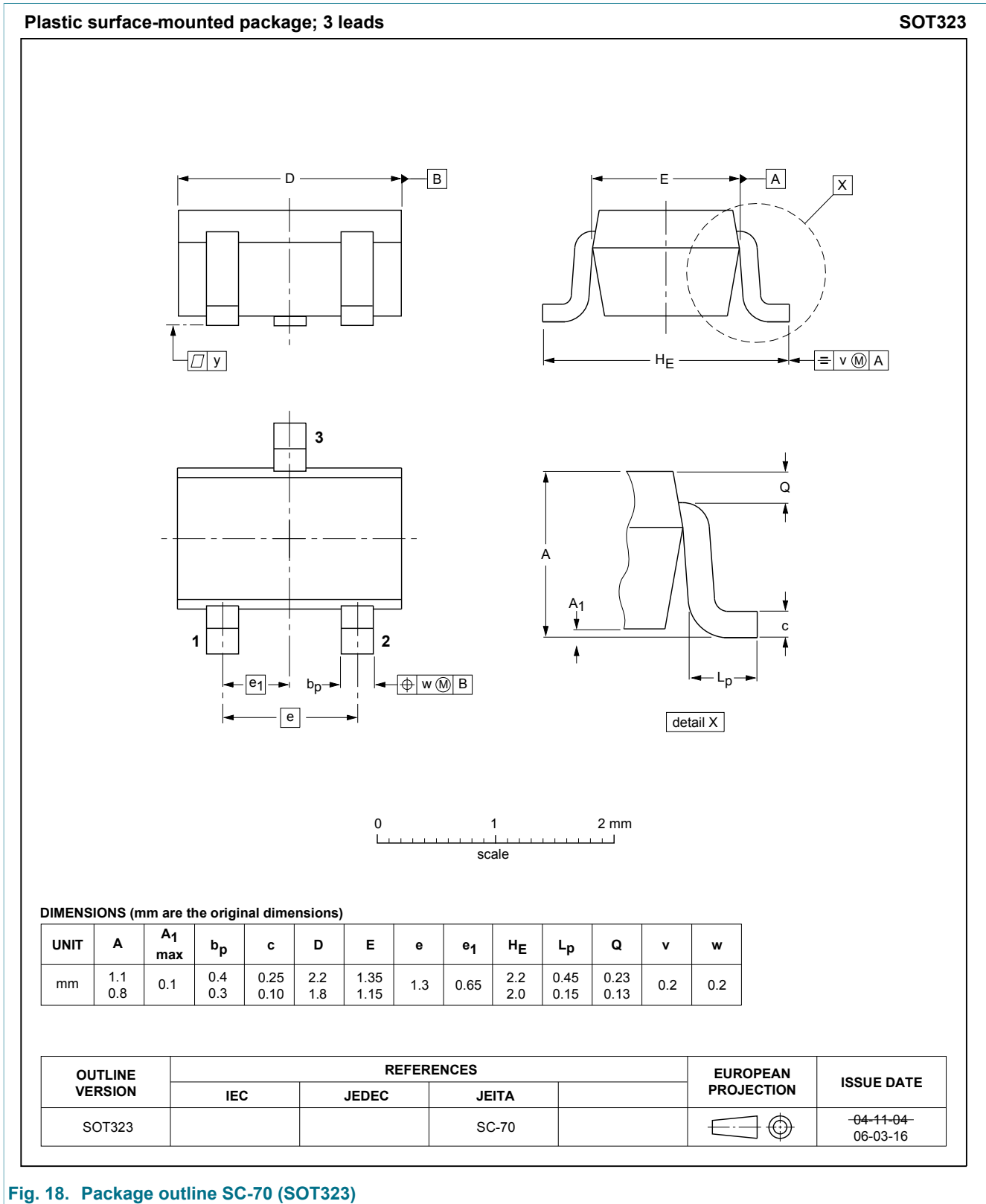


Fig. 18. Package outline SC-70 (SOT323)

13. Soldering

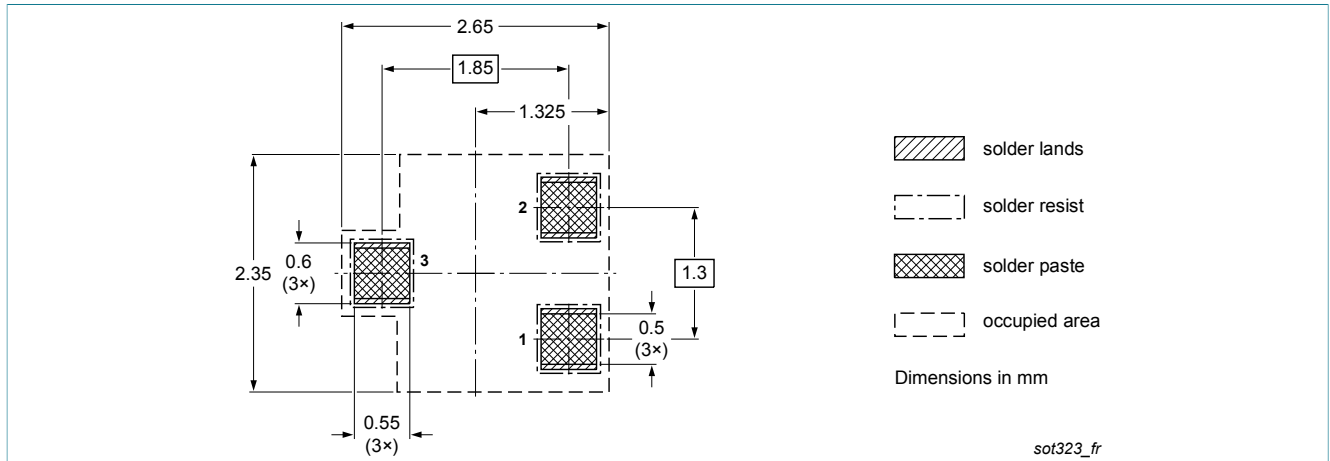


Fig. 19. Reflow soldering footprint for SC-70 (SOT323)

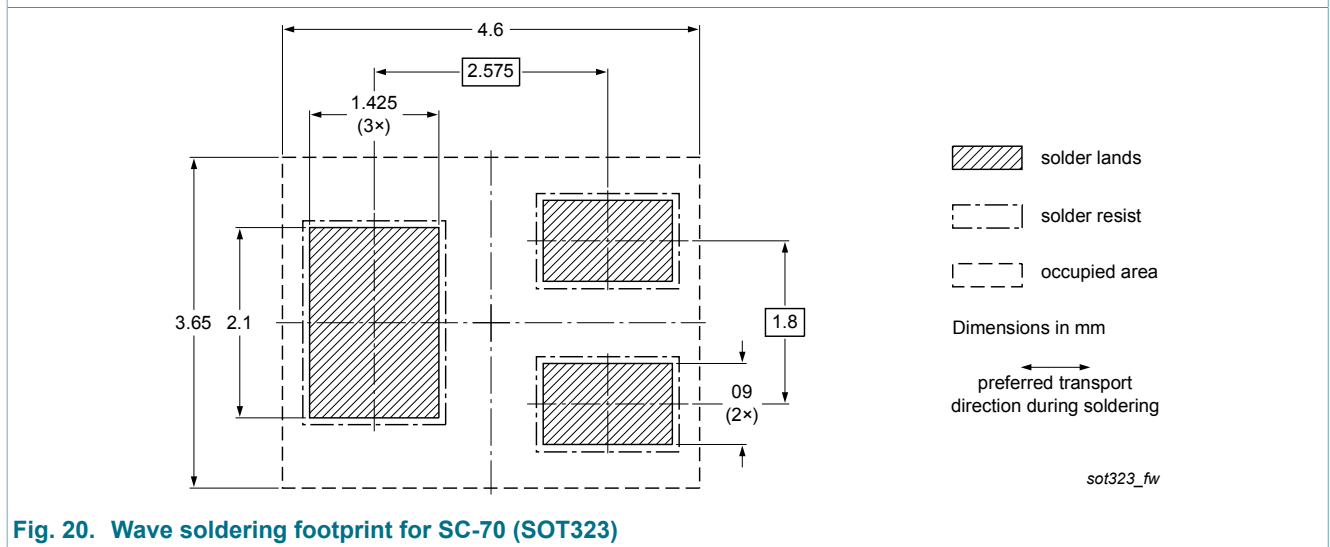


Fig. 20. Wave soldering footprint for SC-70 (SOT323)

14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
NX138BKW v.1	20160615	Product data sheet	-	-

15. Legal information

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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Date of release: 15 June 2016

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