



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

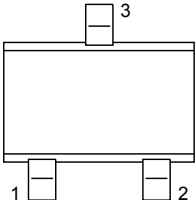
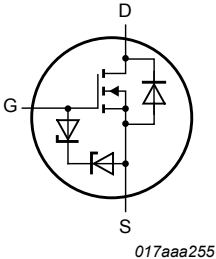
Table 1. Quick reference data

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	 SC-70 (SOT323)	 017aaa255
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] % = 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	$T_j = 25\text{ }^{\circ}\text{C}$		-	60	V
V_{GS}	gate-source voltage			-20	20	V
I_D	drain current	$V_{GS} = 10\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}$	[1]	-	210	mA
		$V_{GS} = 10\text{ V}; T_{amb} = 100\text{ }^{\circ}\text{C}$	[1]	-	135	mA
		$V_{GS} = 10\text{ V}; T_{sp} = 25\text{ }^{\circ}\text{C}$		-	330	mA
I_{DM}	peak drain current	$T_{amb} = 25\text{ }^{\circ}\text{C}$; single pulse; $t_p \leq 10\text{ }\mu\text{s}$		-	855	mA
P_{tot}	total power dissipation	$T_{amb} = 25\text{ }^{\circ}\text{C}$	[2]	-	266	mW
			[1]	-	321	mW
		$T_{sp} = 25\text{ }^{\circ}\text{C}$		-	1.33	W
T_j	junction temperature			-55	150	$^{\circ}\text{C}$
T_{amb}	ambient temperature			-55	150	$^{\circ}\text{C}$
T_{stg}	storage temperature			-65	150	$^{\circ}\text{C}$
Source-drain diode						
I_S	source current	$T_{amb} = 25\text{ }^{\circ}\text{C}$	[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.

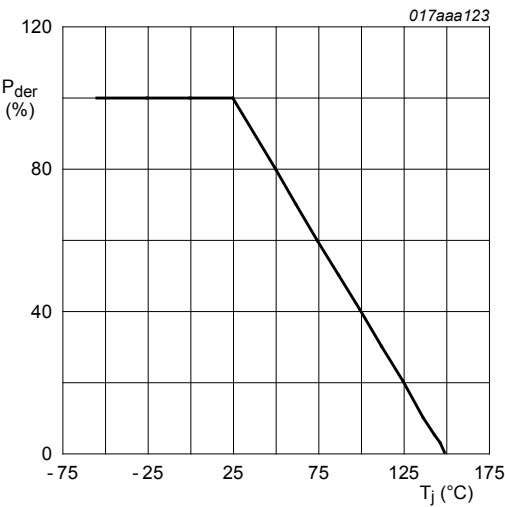


Fig. 1. Normalized total power dissipation as a function of junction temperature

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

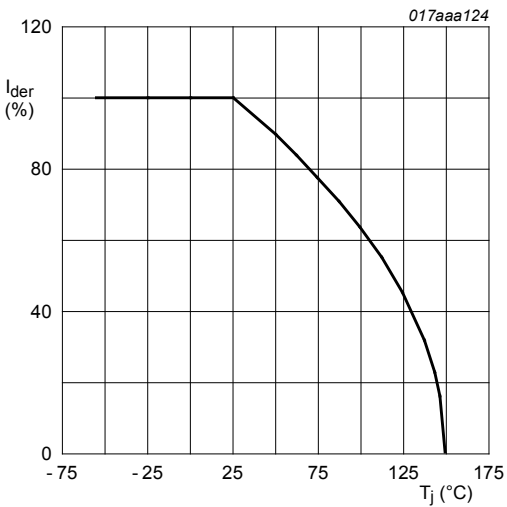


Fig. 2. Normalized continuous drain current as a function of junction temperature

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

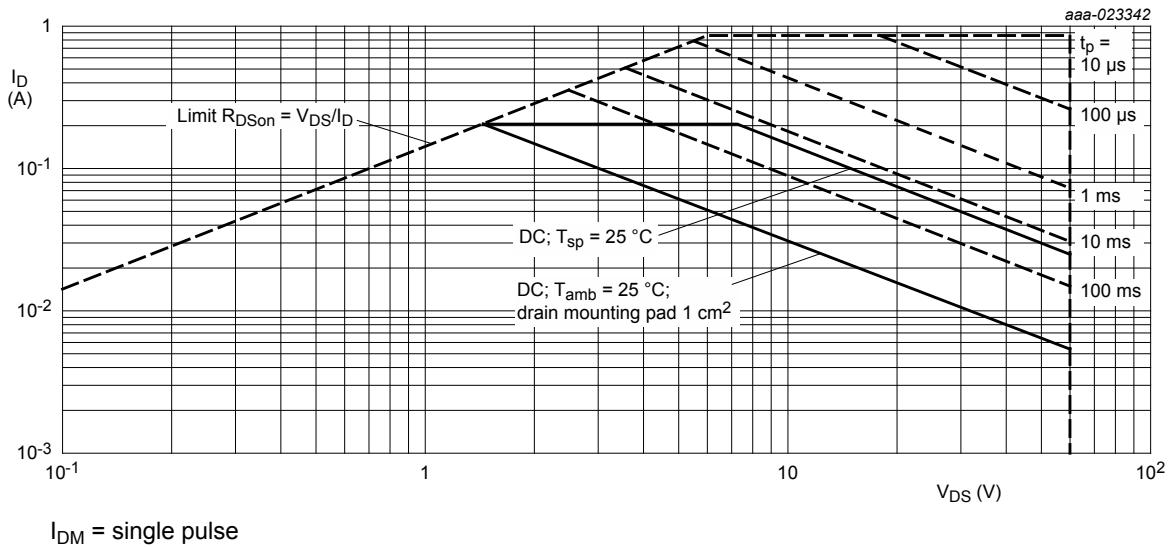


Fig. 3. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage

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.

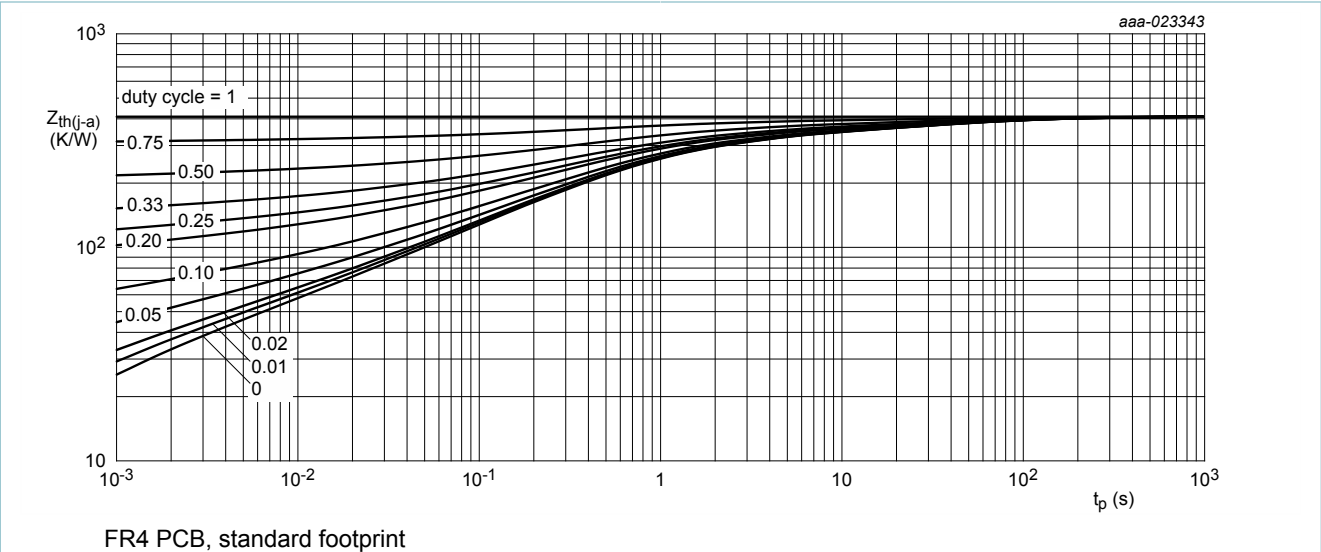


Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

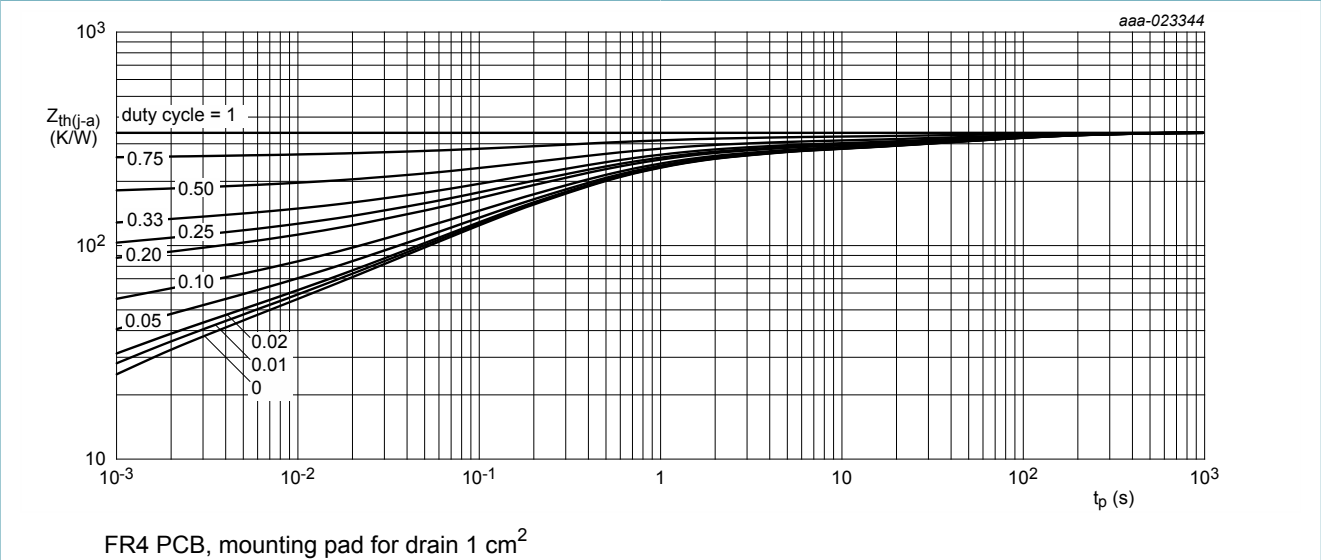


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
V _{(BR)DSS}	drain-source breakdown voltage	I _D = 250 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							
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	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 mA; V _{GS} = 0 V; T _j = 25 °C		-	0.9	1.2	V

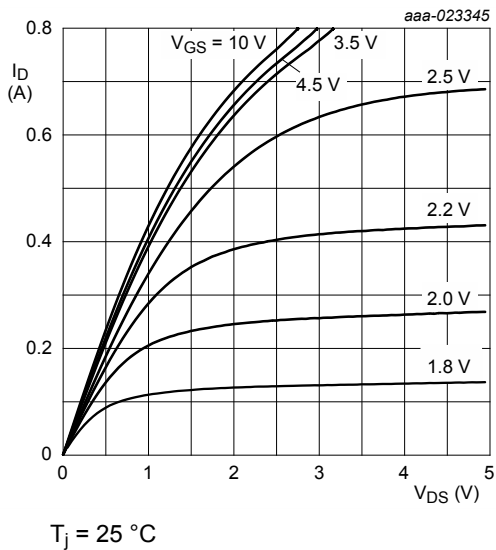


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

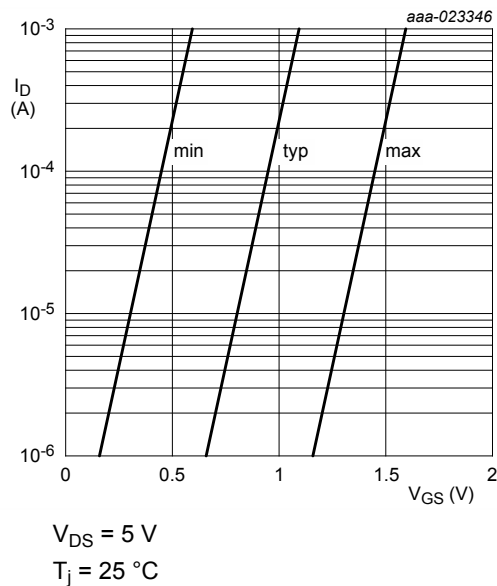


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

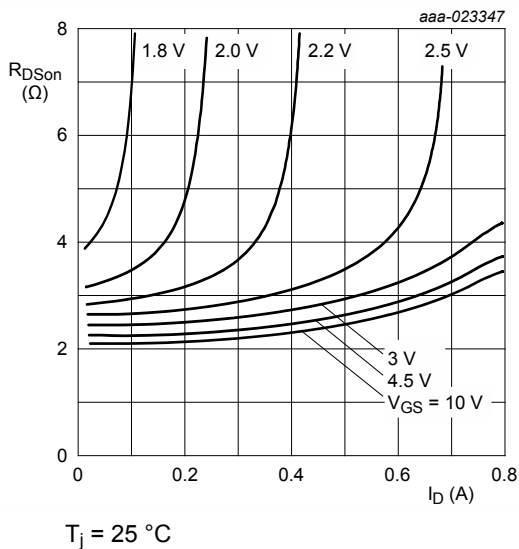


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

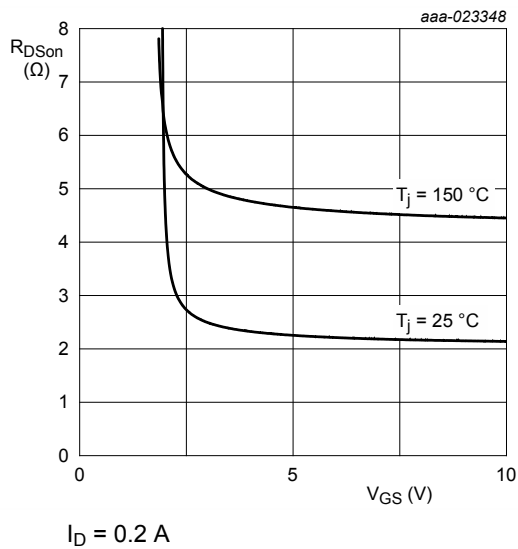


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

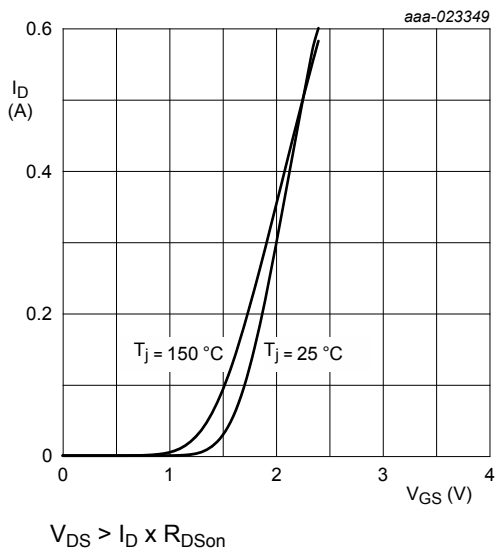


Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values

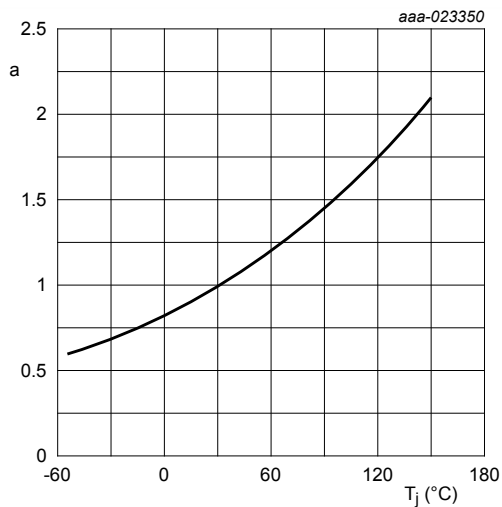


Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values

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

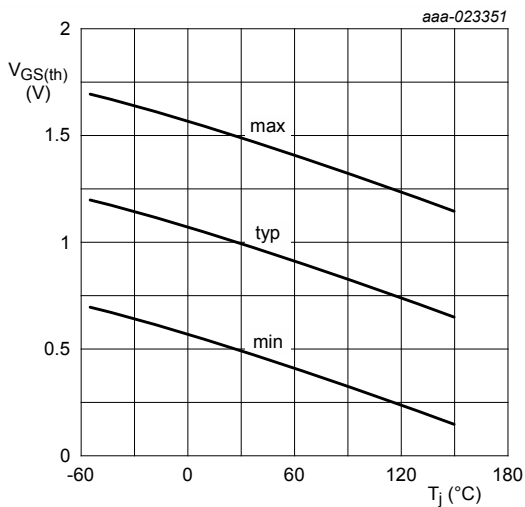


Fig. 12. Gate-source threshold voltage as a function of junction temperature

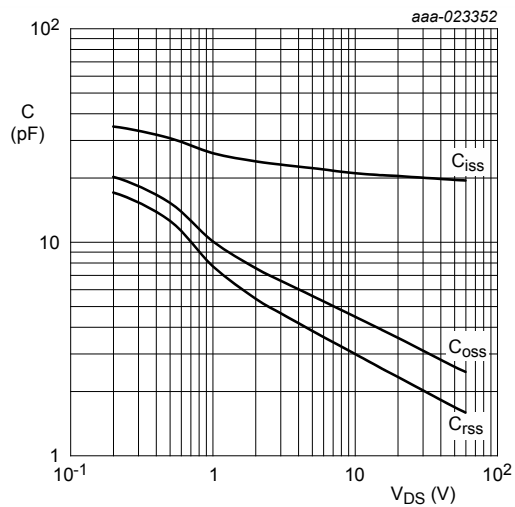


Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

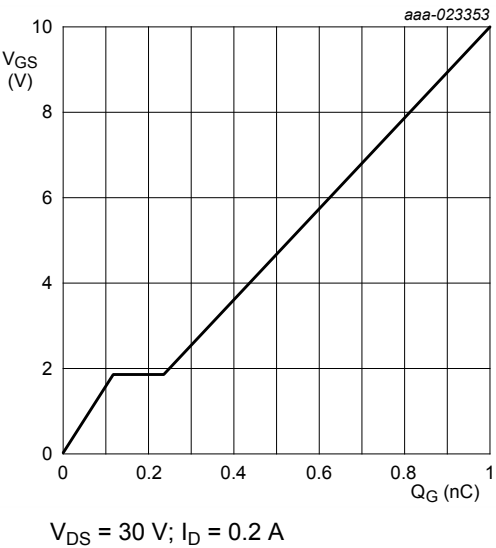


Fig. 14. Gate-source voltage as a function of gate charge; typical values

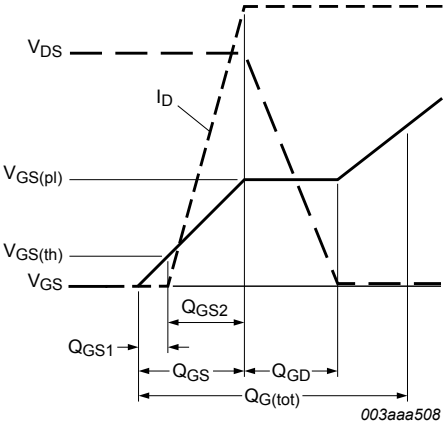
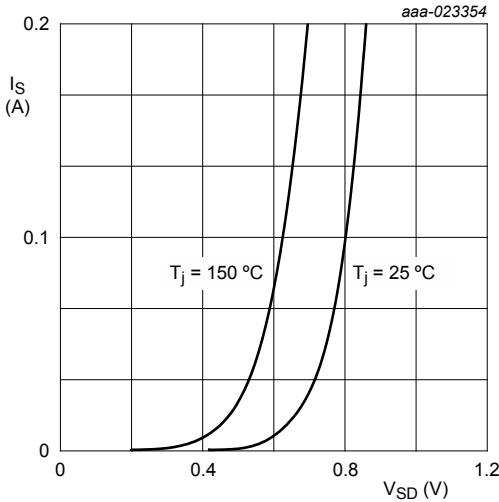


Fig. 15. MOSFET transistor: Gate charge waveform definitions



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

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

11. Test information

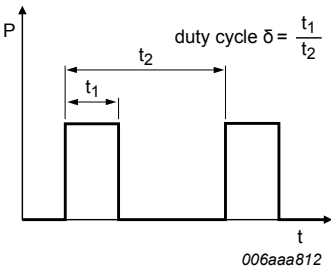
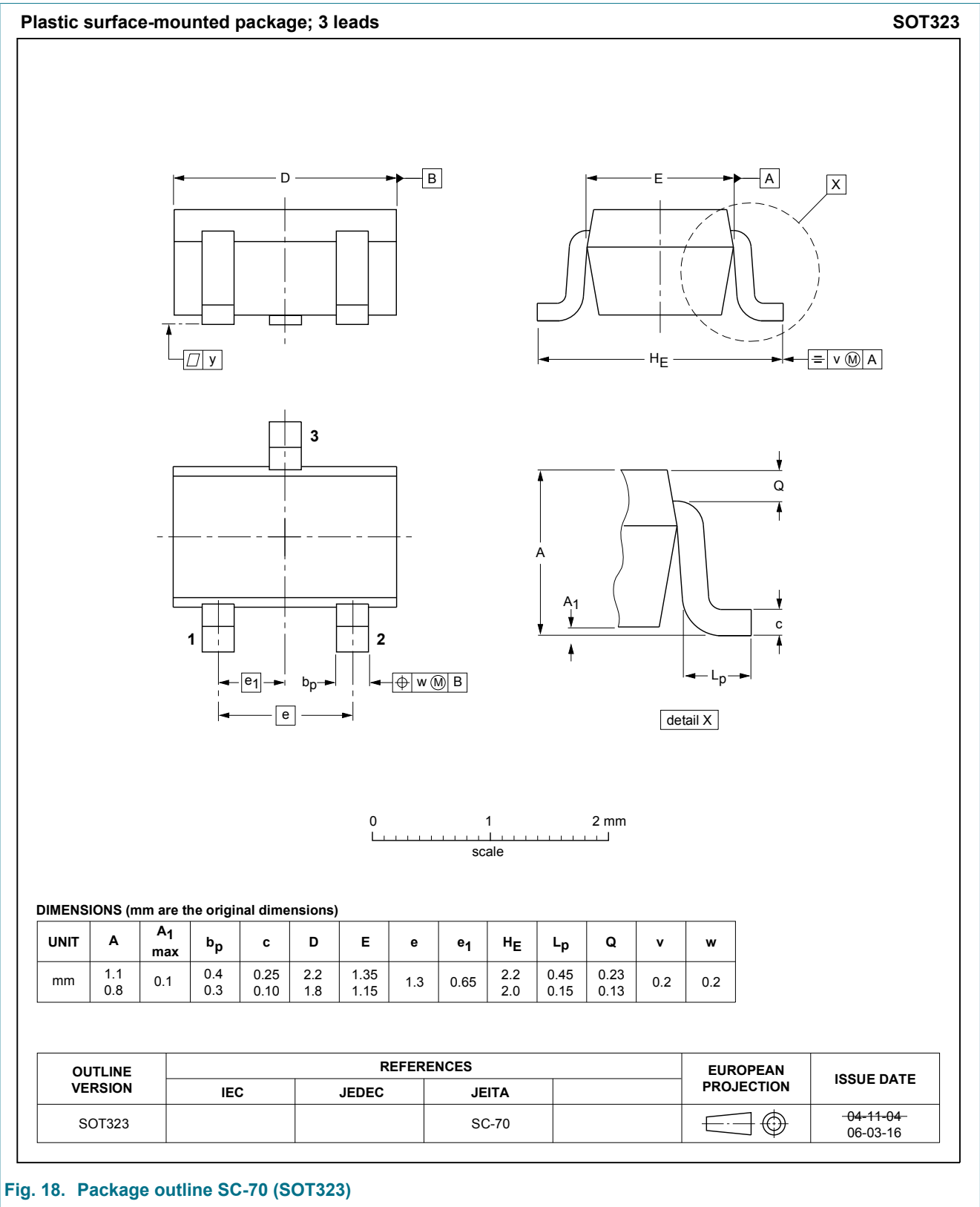
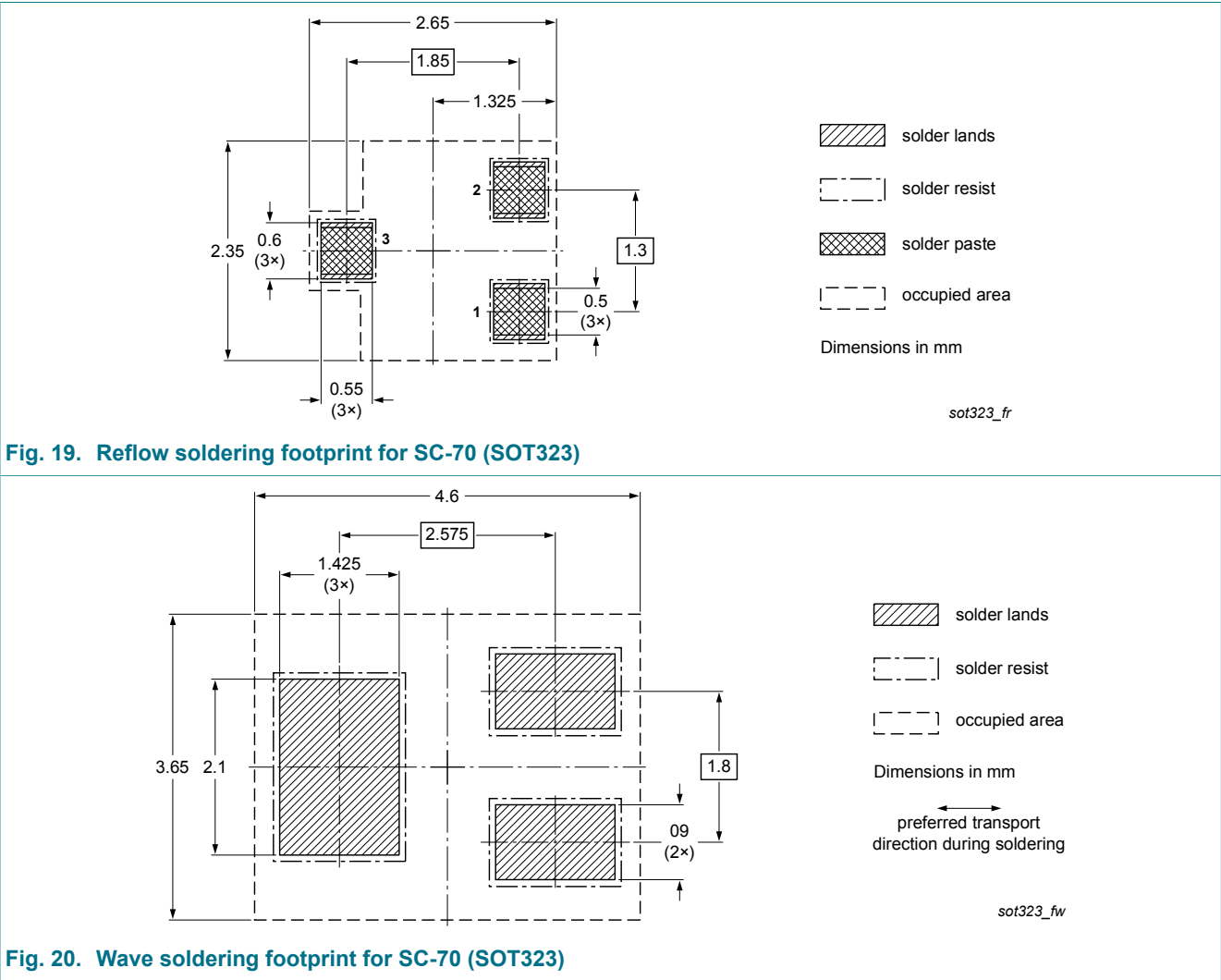


Fig. 17. Duty cycle definition

12. Package outline



13. Soldering



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.
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