



# BSN20BK

60 V, N-channel Trench MOSFET

18 December 2014

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

- Logic-level compatible
- 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	$T_j = 25^\circ\text{C}$		-	-	60	V
$V_{GS}$	gate-source voltage			-20	-	20	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_{amb} = 25^\circ\text{C}$	[1]	-	-	265	mA
		$V_{GS} = 10\text{ V}; T_{sp} = 25^\circ\text{C}$		-	-	330	mA
<b>Static characteristics</b>							
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 200\text{ mA}; T_j = 25^\circ\text{C}$		-	2.1	2.8	$\Omega$

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and mounting pad for drain 1 cm<sup>2</sup>.

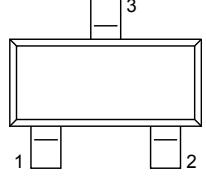
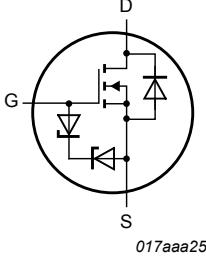


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## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate		
2	S	source		
3	D	drain	 <b>TO-236AB (SOT23)</b>	

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BSN20BK	TO-236AB	plastic surface-mounted package; 3 leads	SOT23

## 7. Marking

Table 4. Marking codes

Type number	Marking code
BSN20BK	[1] %4S

[1] % = placeholder for manufacturing site code

## 8. Limiting values

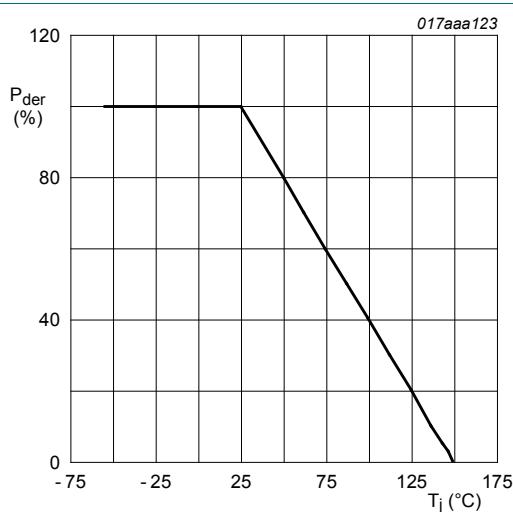
**Table 5. Limiting values**

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

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{DS}$	drain-source voltage	$T_j = 25^\circ\text{C}$		-	60	V
$V_{GS}$	gate-source voltage			-20	20	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_{amb} = 25^\circ\text{C}$	[1]	-	265	mA
		$V_{GS} = 10\text{ V}; T_{amb} = 100^\circ\text{C}$	[1]	-	170	mA
		$V_{GS} = 10\text{ V}; T_{sp} = 25^\circ\text{C}$		-	330	mA
$I_{DM}$	peak drain current	$T_{amb} = 25^\circ\text{C}$ ; single pulse; $t_p \leq 10\text{ }\mu\text{s}$		-	0.9	A
$P_{tot}$	total power dissipation	$T_{amb} = 25^\circ\text{C}$	[2]	-	310	mW
		$T_{sp} = 25^\circ\text{C}$	[1]	-	402	mW
				-	1672	mW
$T_j$	junction temperature			-55	150	°C
$T_{amb}$	ambient temperature			-55	150	°C
$T_{stg}$	storage temperature			-65	150	°C
<b>Source-drain diode</b>						
$I_S$	source current	$T_{amb} = 25^\circ\text{C}$	[1]	-	200	mA

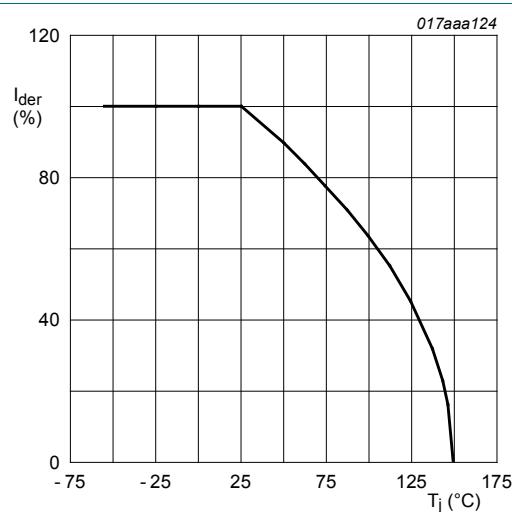
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and mounting pad for drain 1 cm<sup>2</sup>.

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



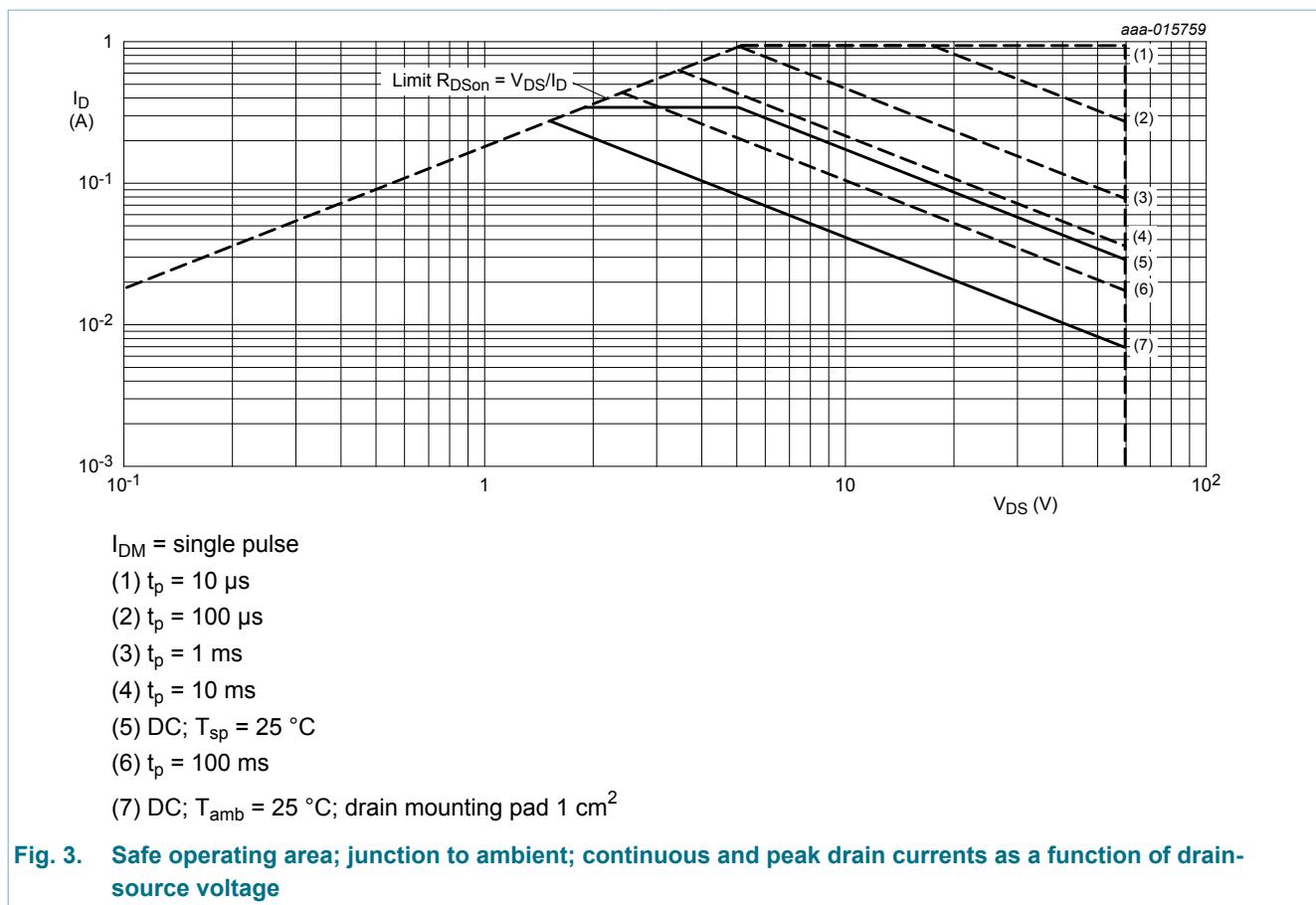
**Fig. 1. Normalized total power dissipation as a function of junction temperature**

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



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

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



## 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]	-	351	404	K/W
			[2]	-	271	311	K/W
		$t \leq 5 \text{ s}$	[2]	-	210	241	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	65	75	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  $1 \text{ cm}^2$ .

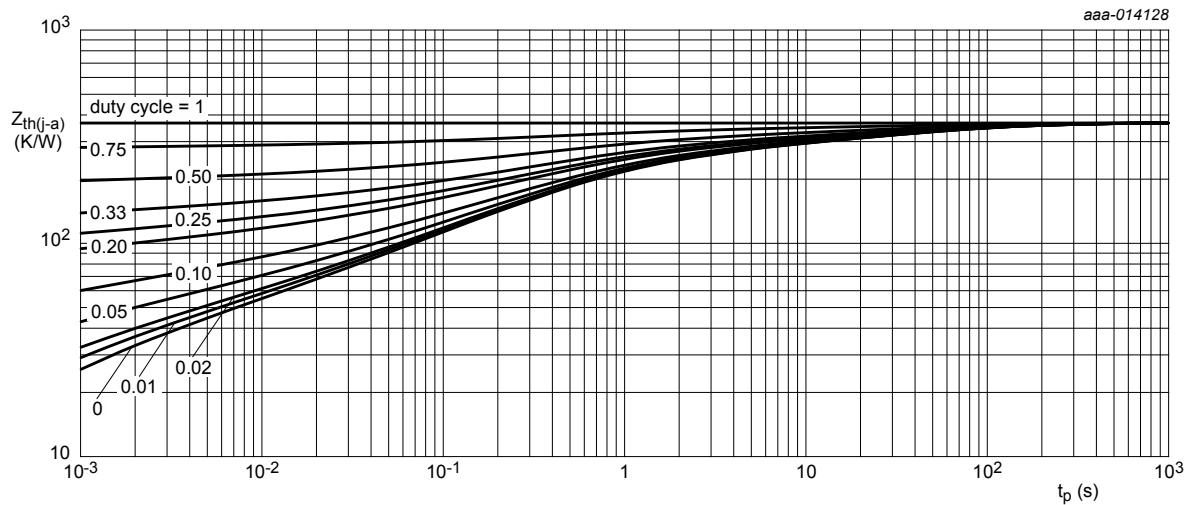


Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

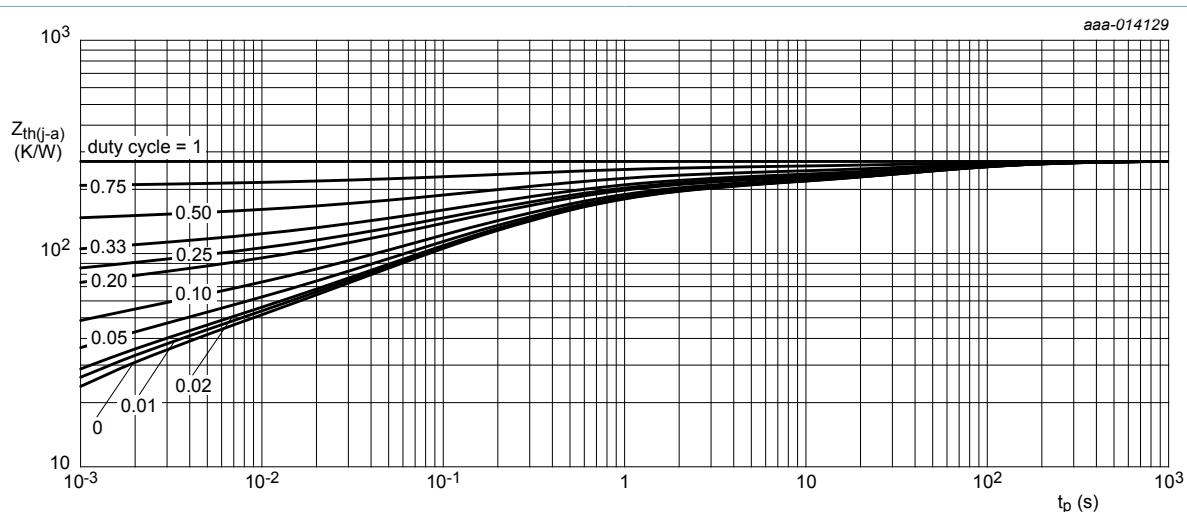
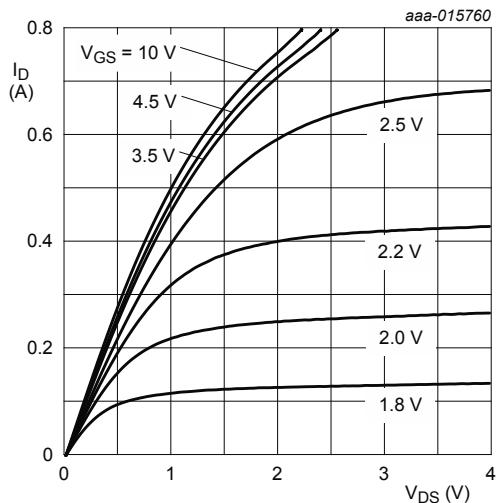


Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

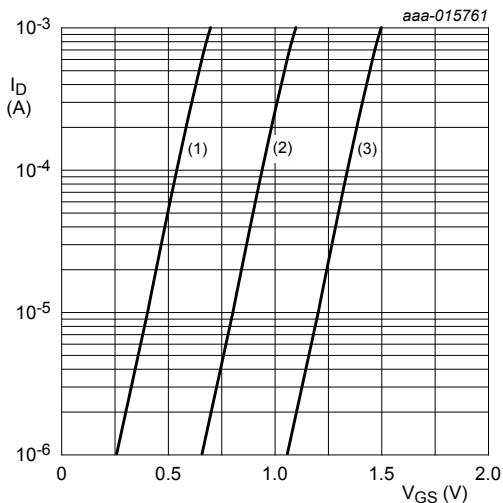
## 10. Characteristics

**Table 7. Characteristics**

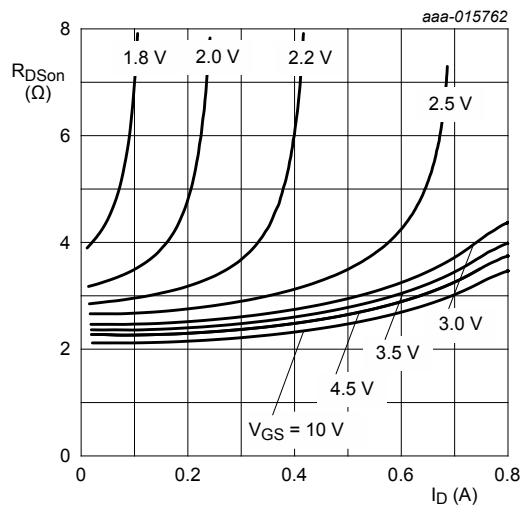
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<b>Static characteristics</b>							
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A$ ; $V_{GS} = 0 V$ ; $T_j = 25^\circ C$		60	-	-	V
$V_{GSth}$	gate-source threshold voltage	$I_D = 250 \mu A$ ; $V_{DS} = V_{GS}$ ; $T_j = 25^\circ C$		0.6	1	1.4	V
$I_{DSS}$	drain leakage current	$V_{DS} = 60 V$ ; $V_{GS} = 0 V$ ; $T_j = 25^\circ C$		-	-	1	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 20 V$ ; $V_{DS} = 0 V$ ; $T_j = 25^\circ C$		-	-	10	$\mu A$
		$V_{GS} = -20 V$ ; $V_{DS} = 0 V$ ; $T_j = 25^\circ C$		-	-	-10	$\mu A$
		$V_{GS} = 10 V$ ; $V_{DS} = 0 V$ ; $T_j = 25^\circ C$		-	-	1	$\mu A$
		$V_{GS} = -10 V$ ; $V_{DS} = 0 V$ ; $T_j = 25^\circ C$		-	-	-1	$\mu A$
		$V_{GS} = 5 V$ ; $V_{DS} = 0 V$ ; $T_j = 25^\circ C$		-	-	0.3	$\mu A$
		$V_{GS} = -5 V$ ; $V_{DS} = 0 V$ ; $T_j = 25^\circ C$		-	-	-0.3	$\mu A$
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10 V$ ; $I_D = 200 mA$ ; $T_j = 25^\circ C$		-	2.1	2.8	$\Omega$
		$V_{GS} = 10 V$ ; $I_D = 200 mA$ ; $T_j = 150^\circ C$		-	4.3	5.7	$\Omega$
		$V_{GS} = 5 V$ ; $I_D = 200 mA$ ; $T_j = 25^\circ C$		-	2.2	3.2	$\Omega$
		$V_{GS} = 2.5 V$ ; $I_D = 75 mA$ ; $T_j = 25^\circ C$		-	2.6	4	$\Omega$
$g_{fs}$	forward transconductance	$V_{DS} = 10 V$ ; $I_D = 200 mA$ ; $T_j = 25^\circ C$		-	0.71	-	S
<b>Dynamic characteristics</b>							
$Q_{G(tot)}$	total gate charge	$V_{DS} = 30 V$ ; $I_D = 200 mA$ ; $V_{GS} = 4.5 V$ ; $T_j = 25^\circ C$		-	0.49	-	nC
$Q_{GS}$	gate-source charge			-	0.12	-	nC
$Q_{GD}$	gate-drain charge			-	0.12	-	nC
$C_{iss}$	input capacitance	$V_{DS} = 30 V$ ; $f = 1 MHz$ ; $V_{GS} = 0 V$ ; $T_j = 25^\circ C$		-	20.2	-	pF
$C_{oss}$	output capacitance			-	3.1	10	pF
$C_{rss}$	reverse transfer capacitance			-	2	7	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30 V$ ; $I_D = 200 mA$ ; $V_{GS} = 4.5 V$ ; $R_{G(ext)} = 6 \Omega$ ; $T_j = 25^\circ C$		-	7.9	-	ns
$t_r$	rise time			-	8.4	-	ns
$t_{d(off)}$	turn-off delay time			-	12.5	-	ns
$t_f$	fall time			-	5.1	-	ns
<b>Source-drain diode</b>							
$V_{SD}$	source-drain voltage	$I_S = 200 mA$ ; $V_{GS} = 0 V$ ; $T_j = 25^\circ C$		-	0.86	1.2	V



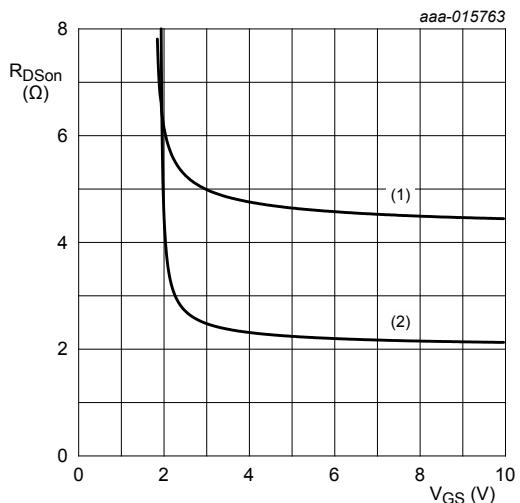
**Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values**



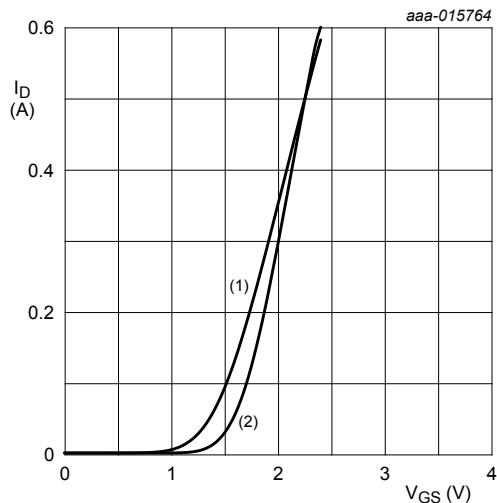
**Fig. 7. Sub-threshold drain current as a function of gate-source voltage**



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



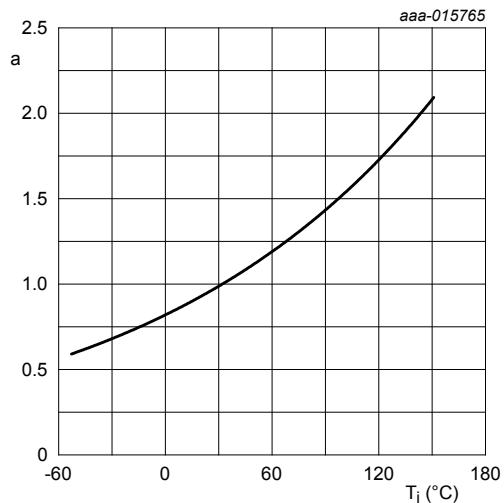
**Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values**



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

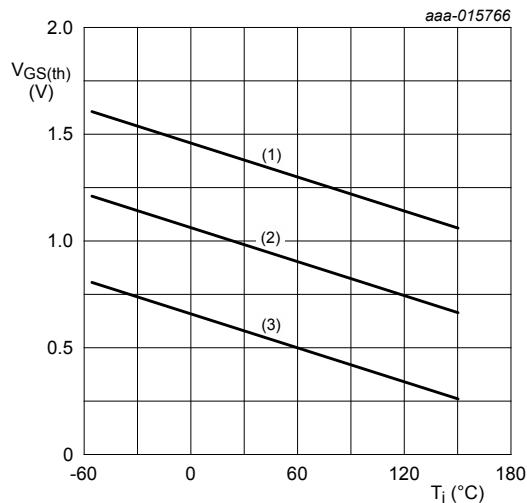
- (1)  $T_j = 150 \text{ } ^\circ\text{C}$
- (2)  $T_j = 25 \text{ } ^\circ\text{C}$

**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**

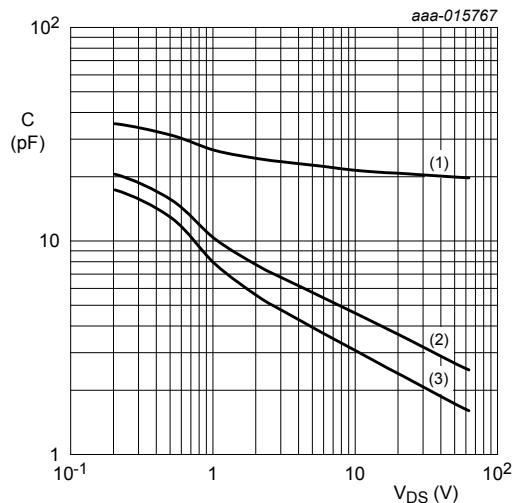
$$a = \frac{R_{DSon}}{R_{DSon}(25^\circ\text{C})}$$



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

- (1) maximum values
- (2) typical values
- (3) minimum values

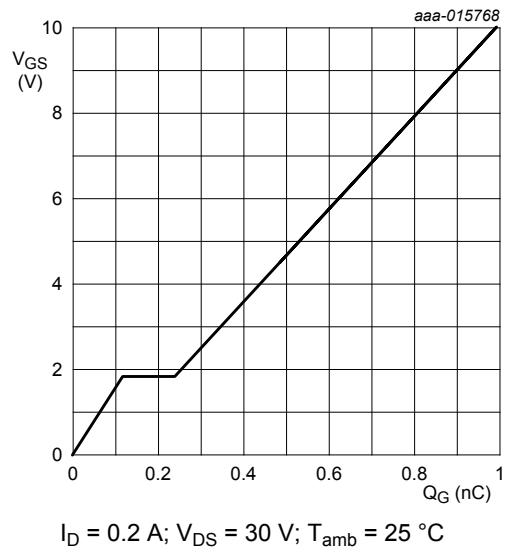
**Fig. 12. Gate-source threshold voltage as a function of junction temperature**



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

- (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**



$I_D = 0.2$  A;  $V_{DS} = 30$  V;  $T_{amb} = 25$  °C

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

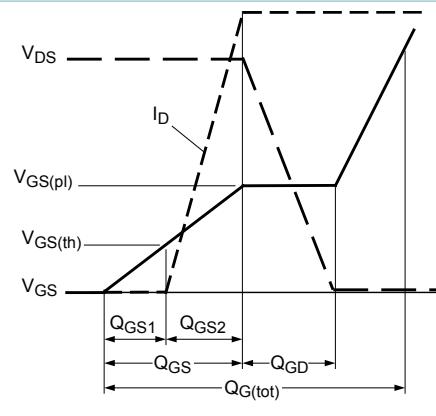
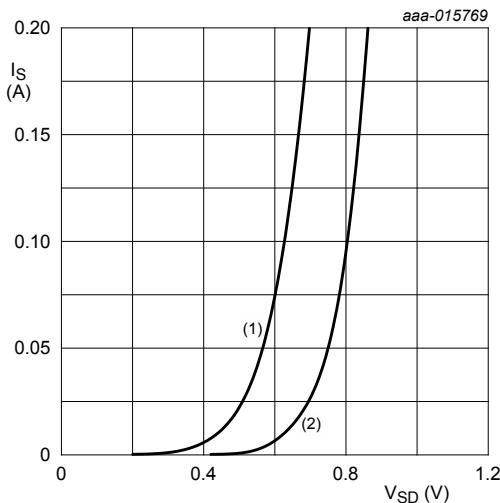


Fig. 15. MOSFET transistor: Gate charge waveform definitions



$V_{GS} = 0$  V

(1)  $T_j = 150$  °C

(2)  $T_j = 25$  °C

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

## 11. Test information

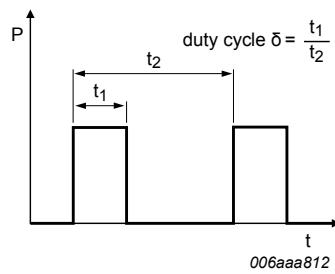
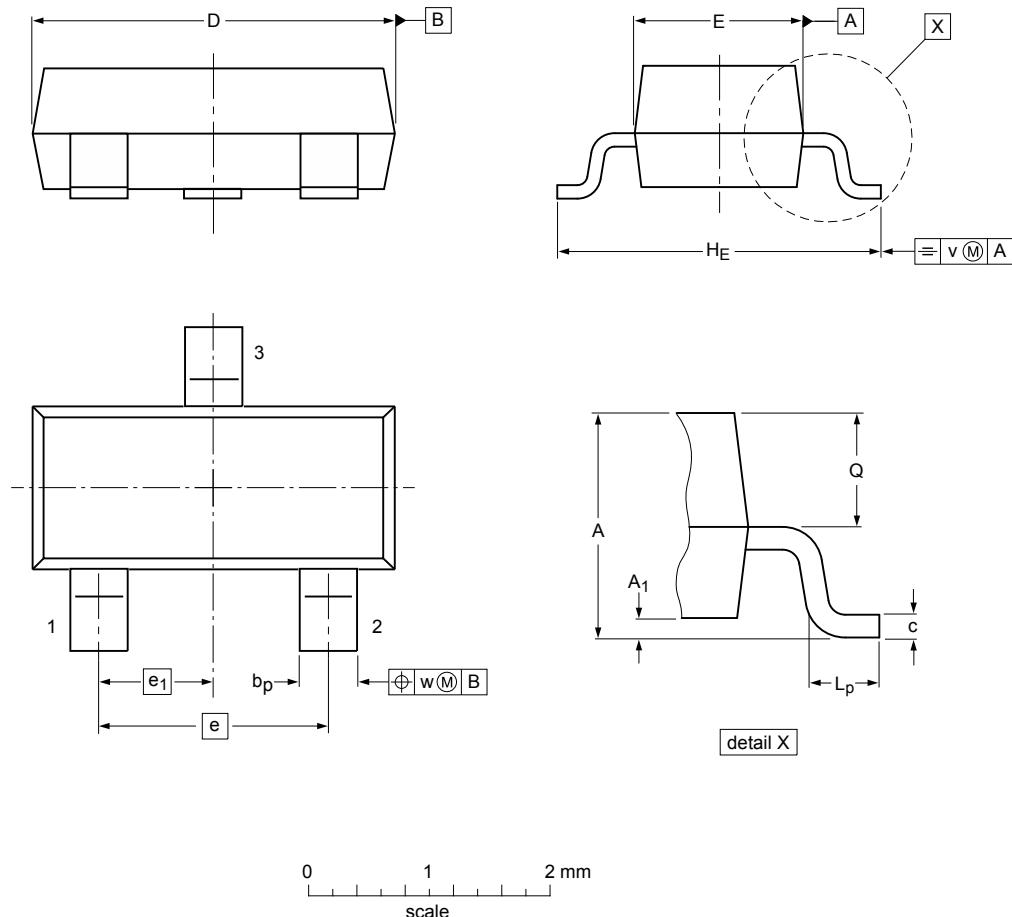


Fig. 17. Duty cycle definition

## 12. Package outline

Plastic surface-mounted package; 3 leads

SOT23



Dimensions (mm are the original dimensions)

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

sot23\_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

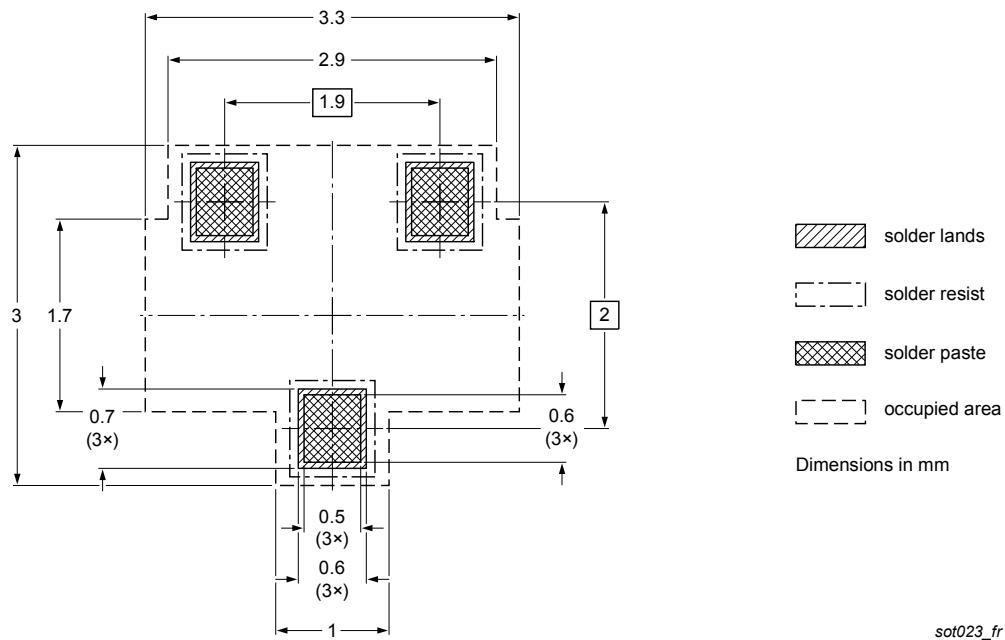


Fig. 19. Reflow soldering footprint for TO-236AB (SOT23)

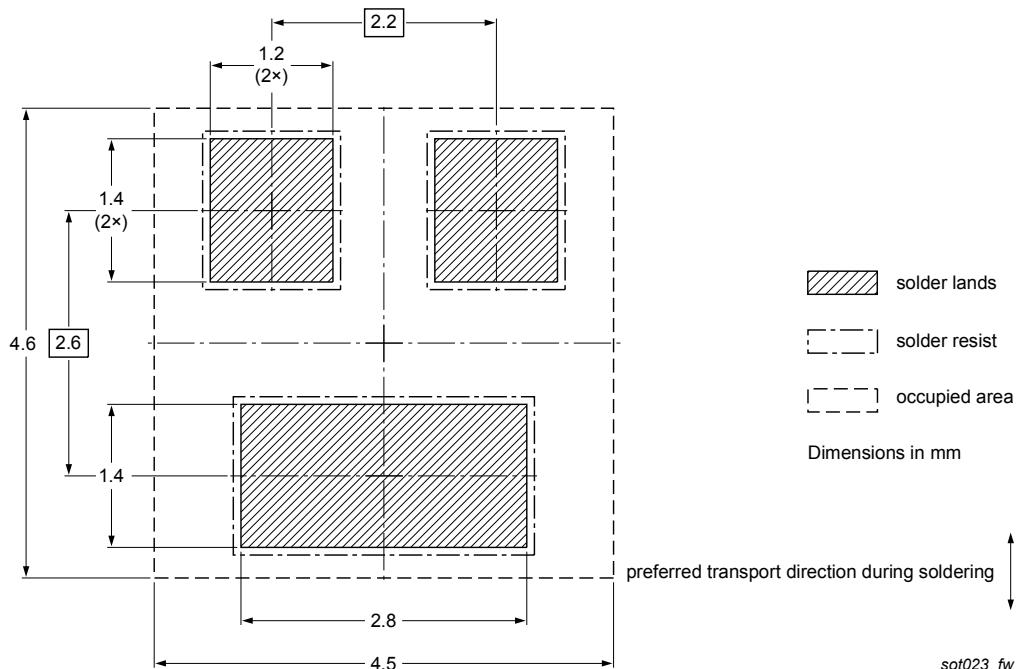


Fig. 20. Wave soldering footprint for TO-236AB (SOT23)

## 14. Revision history

**Table 8. Revision history**

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
BSN20BK v.1	20141218	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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