



# BSH111BK

55 V, N-channel Trench MOSFET

26 November 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

- Low threshold voltage
- Very fast switching
- Trench MOSFET technology
- ElectroStatic Discharge (ESD) protection > 3 kV HBM

## 3. Applications

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

## 4. Quick reference data

Table 1. Quick reference data

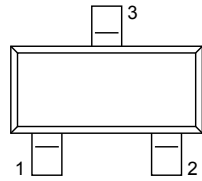
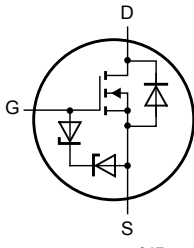
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j = 25\text{ °C}$	-	-	55	V
$V_{GS}$	gate-source voltage		-10	-	10	V
$I_D$	drain current	$V_{GS} = 4.5\text{ V}; T_{amb} = 25\text{ °C}$	[1]	-	210	mA
		$V_{GS} = 4.5\text{ V}; T_{sp} = 25\text{ °C}$		-	335	mA
<b>Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 4.5\text{ V}; I_D = 200\text{ mA}; T_j = 25\text{ °C}$	-	2.3	4	$\Omega$

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and mounting pad for drain  $1\text{ cm}^2$ .

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## 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
BSH111BK	TO-236AB	plastic surface-mounted package; 3 leads	SOT23

## 7. Marking

Table 4. Marking codes

Type number	Marking code
BSH111BK	%4T

[1] % = placeholder for manufacturing site code

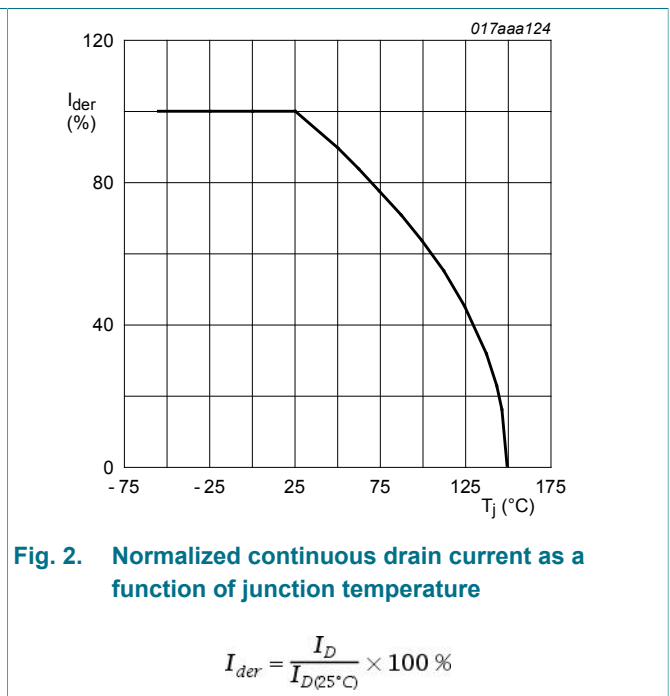
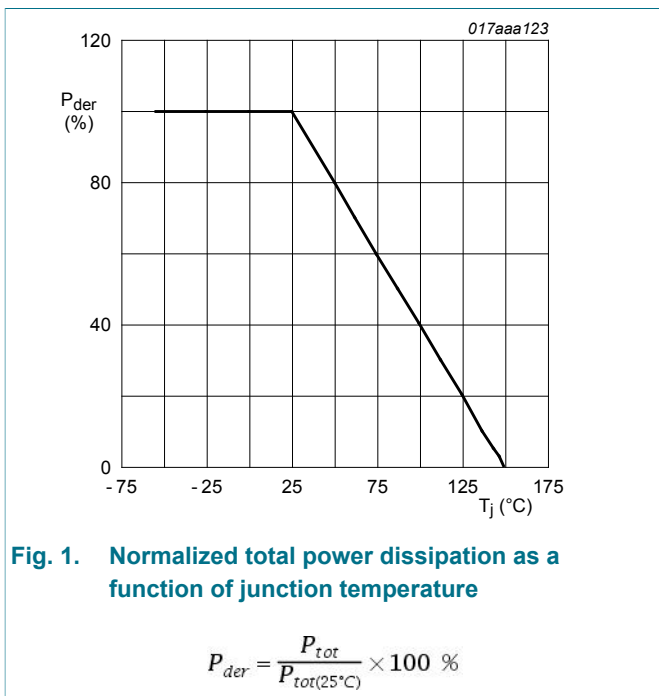
## 8. Limiting values

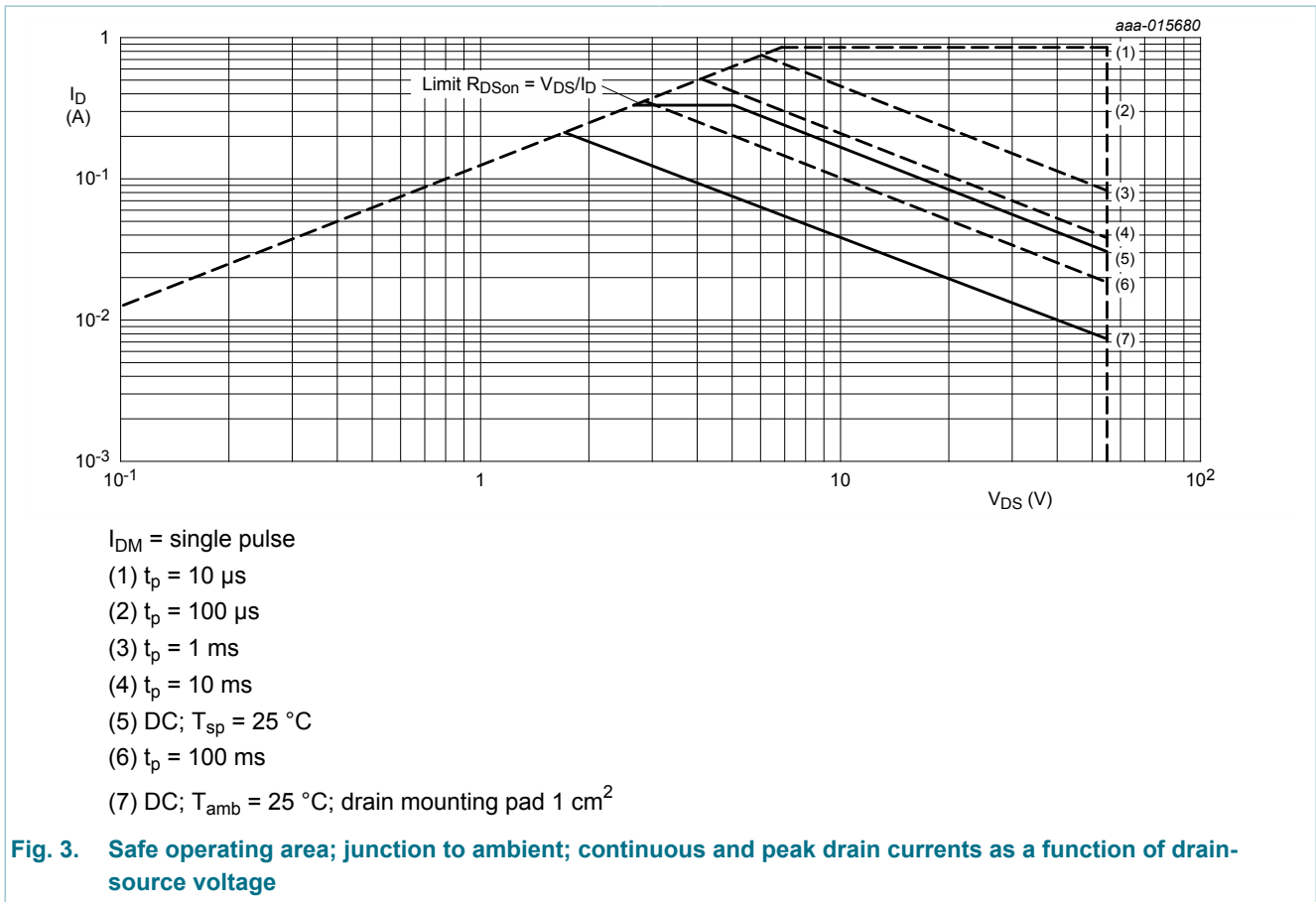
**Table 5. Limiting values**

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

Symbol	Parameter	Conditions		Min	Max	Unit
V <sub>DS</sub>	drain-source voltage	T <sub>j</sub> = 25 °C		-	55	V
V <sub>GS</sub>	gate-source voltage			-10	10	V
I <sub>D</sub>	drain current	V <sub>GS</sub> = 4.5 V; T <sub>amb</sub> = 25 °C	[1]	-	210	mA
		V <sub>GS</sub> = 4.5 V; T <sub>amb</sub> = 100 °C	[1]	-	130	mA
		V <sub>GS</sub> = 4.5 V; T <sub>sp</sub> = 25 °C		-	335	mA
I <sub>DM</sub>	peak drain current	T <sub>amb</sub> = 25 °C; single pulse; t <sub>p</sub> ≤ 10 μs		-	0.85	A
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = 25 °C	[2]	-	302	mW
			[1]	-	364	mW
		T <sub>sp</sub> = 25 °C		-	1449	mW
T <sub>j</sub>	junction temperature			-55	150	°C
T <sub>amb</sub>	ambient temperature			-55	150	°C
T <sub>stg</sub>	storage temperature			-65	150	°C
<b>Source-drain diode</b>						
I <sub>S</sub>	source current	T <sub>amb</sub> = 25 °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.





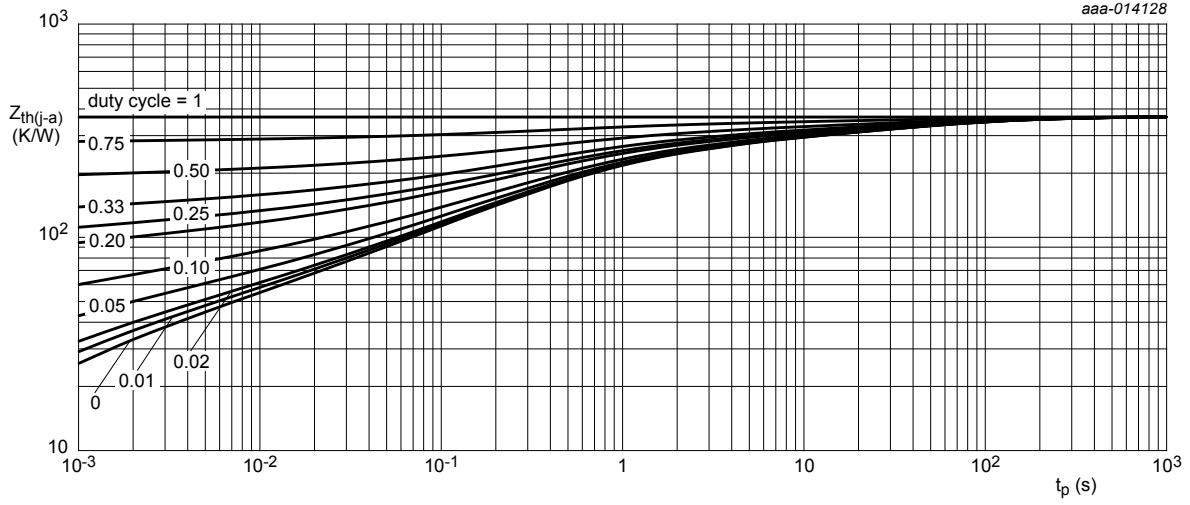
## 9. Thermal characteristics

**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
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	65	75	K/W

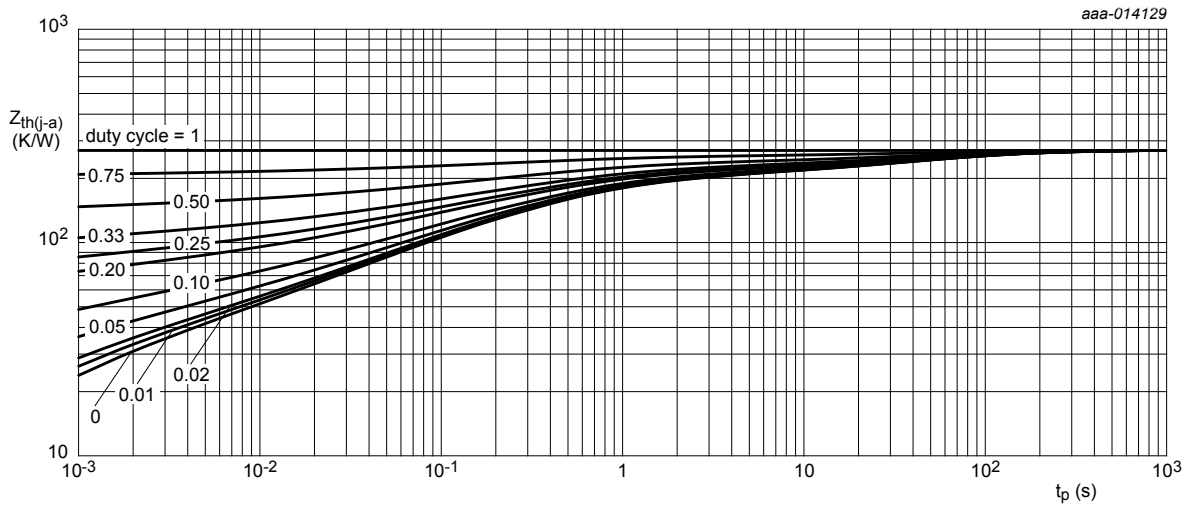
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated and mounting pad for drain  $1 \text{ cm}^2$ .



FR4 PCB, standard footprint

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



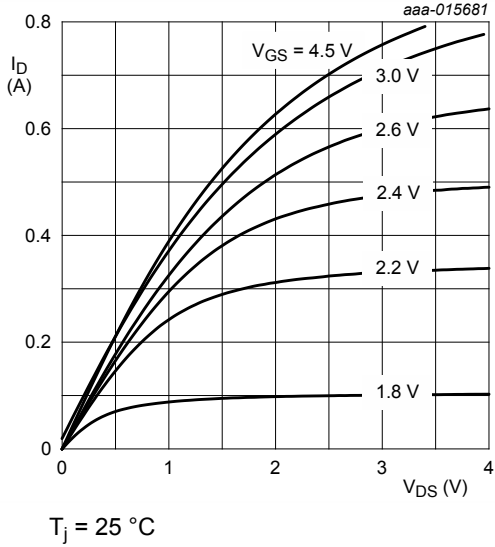
FR4 PCB, mounting pad for drain  $1 \text{ cm}^2$

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

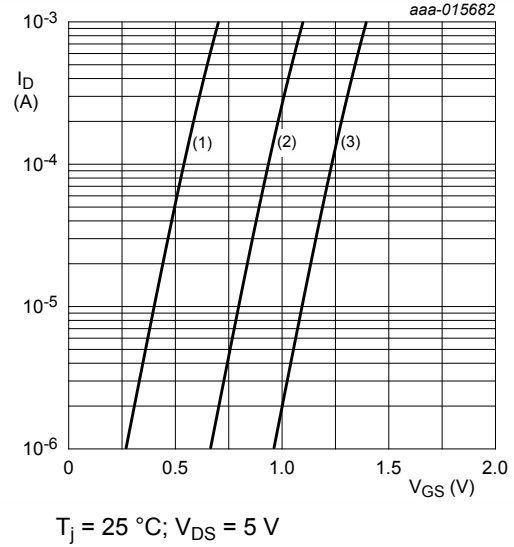
## 10. Characteristics

Table 7. Characteristics

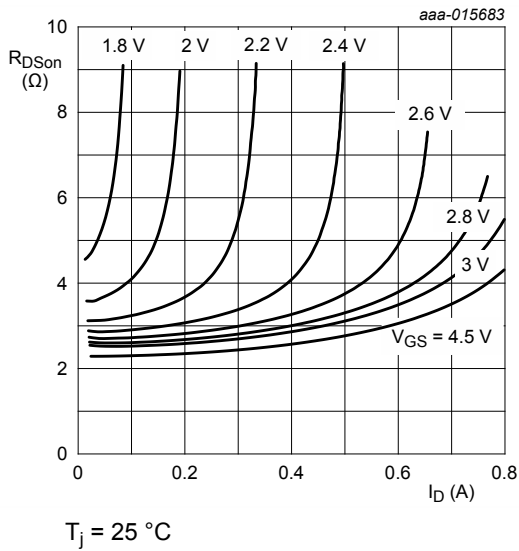
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	55	-	-	V
$V_{GSth}$	gate-source threshold voltage	$I_D = 250 \mu\text{A}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C}$	0.6	1	1.3	V
$I_{DSS}$	drain leakage current	$V_{DS} = 55 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	1	$\mu\text{A}$
$I_{GSS}$	gate leakage current	$V_{GS} = 10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	5	$\mu\text{A}$
		$V_{GS} = -10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	-5	$\mu\text{A}$
		$V_{GS} = 4.5 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	0.3	$\mu\text{A}$
		$V_{GS} = -4.5 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	-0.3	$\mu\text{A}$
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 4.5 \text{ V}; I_D = 200 \text{ mA}; T_j = 25 \text{ }^\circ\text{C}$	-	2.3	4	$\Omega$
		$V_{GS} = 4.5 \text{ V}; I_D = 200 \text{ mA}; T_j = 150 \text{ }^\circ\text{C}$	-	4.7	8.1	$\Omega$
		$V_{GS} = 2.5 \text{ V}; I_D = 75 \text{ mA}; T_j = 25 \text{ }^\circ\text{C}$	-	2.7	5	$\Omega$
		$V_{GS} = 1.8 \text{ V}; I_D = 30 \text{ mA}; T_j = 25 \text{ }^\circ\text{C}$	-	4.8	-	$\Omega$
$g_{fs}$	forward transconductance	$V_{DS} = 10 \text{ V}; I_D = 200 \text{ mA}; T_j = 25 \text{ }^\circ\text{C}$	-	0.64	-	S
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$V_{DS} = 30 \text{ V}; I_D = 200 \text{ mA}; V_{GS} = 4.5 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.5	-	nC
$Q_{GS}$	gate-source charge		-	0.08	-	nC
$Q_{GD}$	gate-drain charge		-	0.16	-	nC
$C_{iss}$	input capacitance	$V_{DS} = 30 \text{ V}; f = 1 \text{ MHz}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	19.1	30	pF
$C_{oss}$	output capacitance		-	2.7	10	pF
$C_{riss}$	reverse transfer capacitance		-	1.5	7	pF
$t_{d(on)}$	turn-on delay time		$V_{DS} = 30 \text{ V}; I_D = 200 \text{ mA}; V_{GS} = 4.5 \text{ V}; R_{G(ext)} = 6 \text{ } \Omega; T_j = 25 \text{ }^\circ\text{C}$	-	8.3	12
$t_r$	rise time	-		8.4	-	ns
$t_{d(off)}$	turn-off delay time	-		12.6	16	ns
$t_f$	fall time	-		4.8	-	ns
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 200 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.86	1.2	V



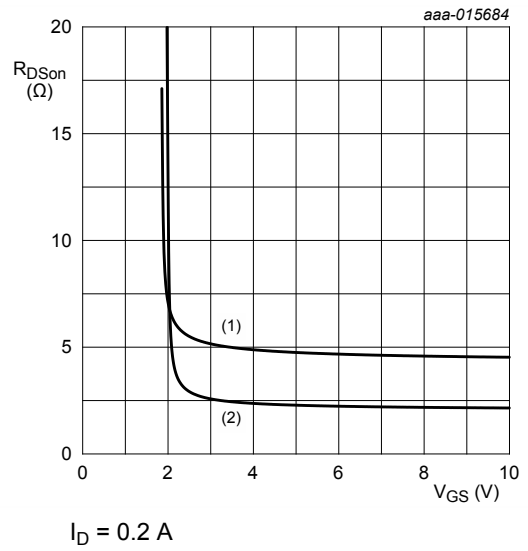
**Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values**



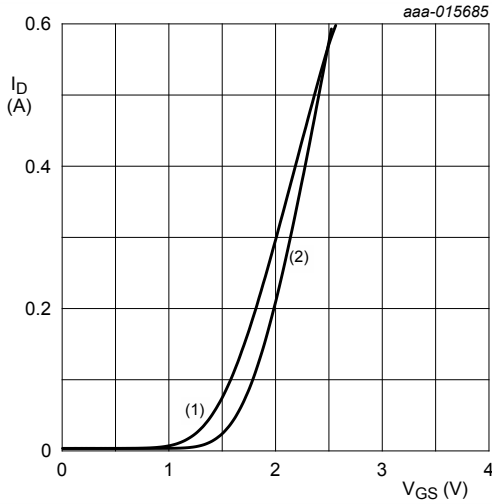
**Fig. 7. Sub-threshold drain current as a function of gate-source voltage**  
 (1) minimum values  
 (2) typical values  
 (3) maximum values



**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**

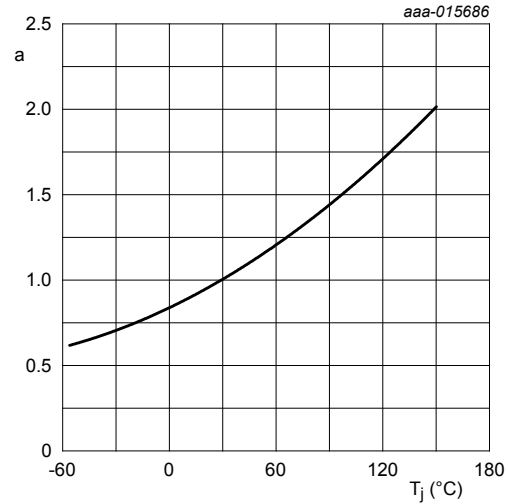


$$V_{DS} > I_D \times R_{DS(on)}$$

(1)  $T_j = 25\text{ °C}$

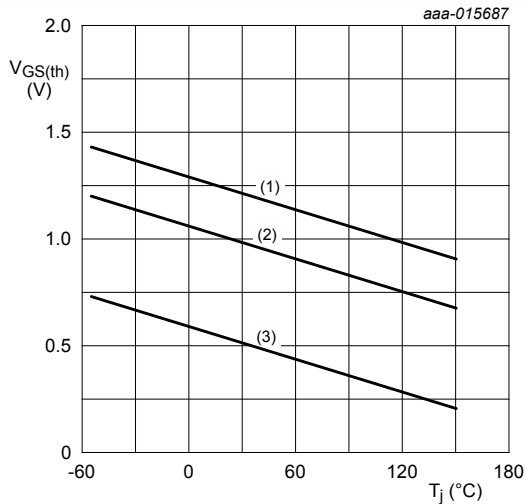
(2)  $T_j = 150\text{ °C}$

**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**

$$a = \frac{R_{DS(on)}}{R_{DS(on)@25^\circ\text{C}}}$$



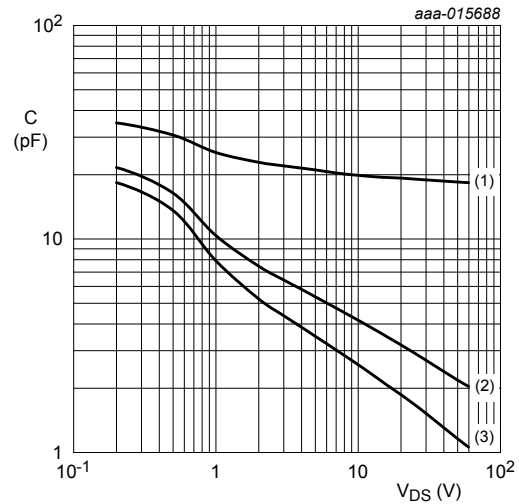
$$I_D = 0.25\text{ mA}; V_{DS} = V_{GS}$$

(1) maximum values

(2) typical values

(3) minimum values

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



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

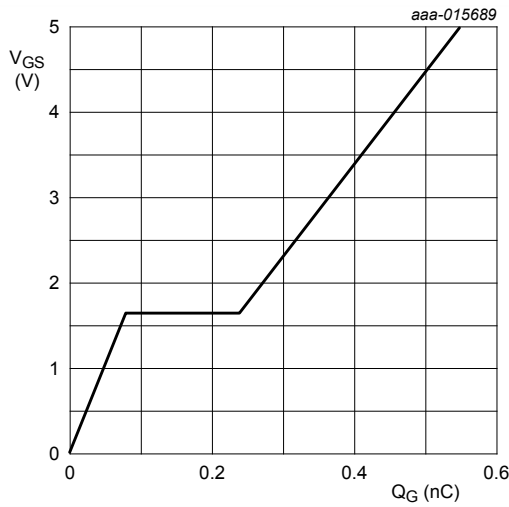
(1)  $C_{iss}$

(2)  $C_{oss}$

(3)  $C_{rss}$

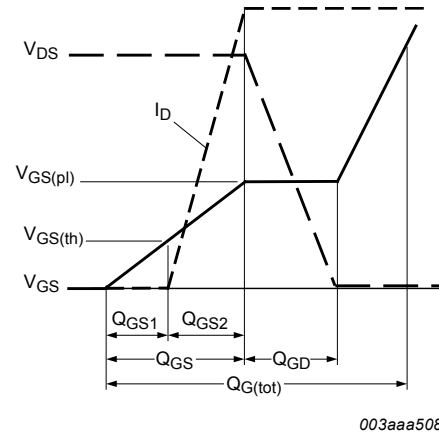
**Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**



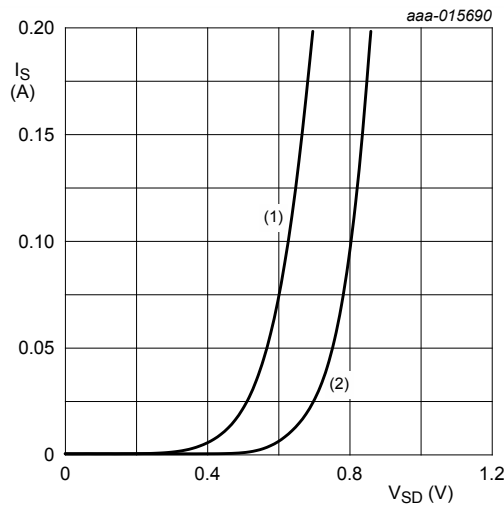


$I_D = 0.2 \text{ A}; V_{DS} = 30 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$

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



**Fig. 15. MOSFET transistor: Gate charge waveform definitions**



$V_{GS} = 0 \text{ V}$   
 (1)  $T_j = 150 \text{ }^\circ\text{C}$   
 (2)  $T_j = 25 \text{ }^\circ\text{C}$

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

## 11. Test information

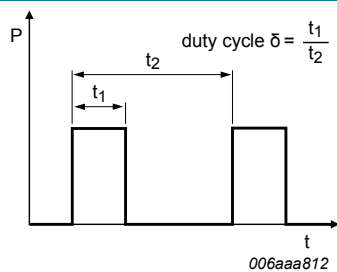


Fig. 17. Duty cycle definition

## 12. Package outline



**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
BSH111BK v.1	20141126	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.

- [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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## 16. Contents

1	General description .....	1
2	Features and benefits .....	1
3	Applications .....	1
4	Quick reference data .....	1
5	Pinning information .....	2
6	Ordering information .....	2
7	Marking .....	2
8	Limiting values .....	3
9	Thermal characteristics .....	4
10	Characteristics .....	6
11	Test information .....	10
12	Package outline .....	11
13	Soldering .....	12
14	Revision history .....	13
15	Legal information .....	14
15.1	Data sheet status .....	14
15.2	Definitions .....	14
15.3	Disclaimers .....	14
15.4	Trademarks .....	15

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