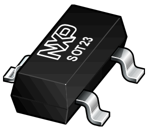

BSH111BK

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 °C		-	-	55	V
V_{GS}	gate-source voltage			-10	-	10	V
I_D	drain current	V_{GS} = 4.5 V; T_{amb} = 25 °C	[1]	-	-	210	mA
		V_{GS} = 4.5 V; T_{sp} = 25 °C		-	-	335	mA
Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = 4.5 V; I_D = 200 mA; T_j = 25 °C		-	2.3	4	Ω

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

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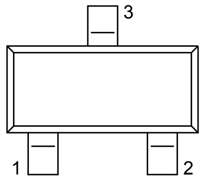
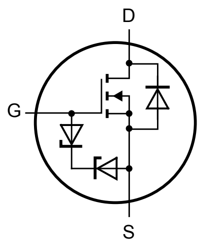
5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 TO-236AB (SOT23)	 017aaa255
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 [1]
BSH111BK	%4T

[1] % = placeholder for manufacturing site code

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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 °C		-	55	V
V_{GS}	gate-source voltage			-10	10	V
I_D	drain current	V_{GS} = 4.5 V; T_{amb} = 25 °C	[1]	-	210	mA
		V_{GS} = 4.5 V; T_{amb} = 100 °C	[1]	-	130	mA
		V_{GS} = 4.5 V; T_{sp} = 25 °C		-	335	mA
I_{DM}	peak drain current	T_{amb} = 25 °C; single pulse; t_p ≤ 10 µs		-	0.85	A
P_{tot}	total power dissipation	T_{amb} = 25 °C	[2]	-	302	mW
			[1]	-	364	mW
		T_{sp} = 25 °C		-	1449	mW
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]	-	200	mA

[1] Device mounted on an FR4 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.

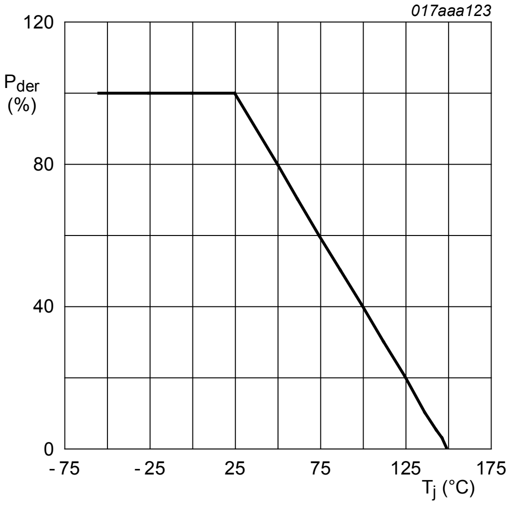

Fig. 1. Normalized total power dissipation as a function of junction temperature

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

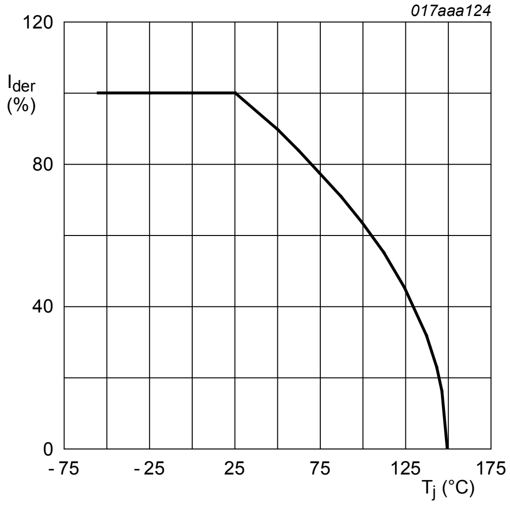

Fig. 2. Normalized continuous drain current as a function of junction temperature

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

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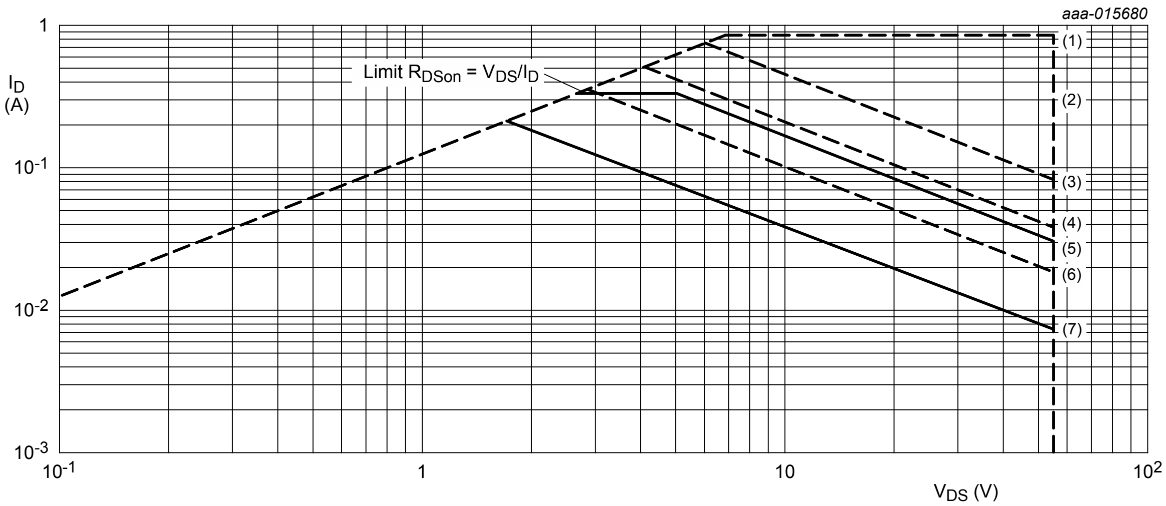

I_{DM} = single pulse

(1) t_p = 10 µs

(2) t_p = 100 µs

(3) t_p = 1 ms

(4) t_p = 10 ms

(5) DC; T_{sp} = 25 °C

(6) t_p = 100 ms

(7) DC; T_{amb} = 25 °C; drain mounting pad 1 cm^2

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]	-	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 cm^2.

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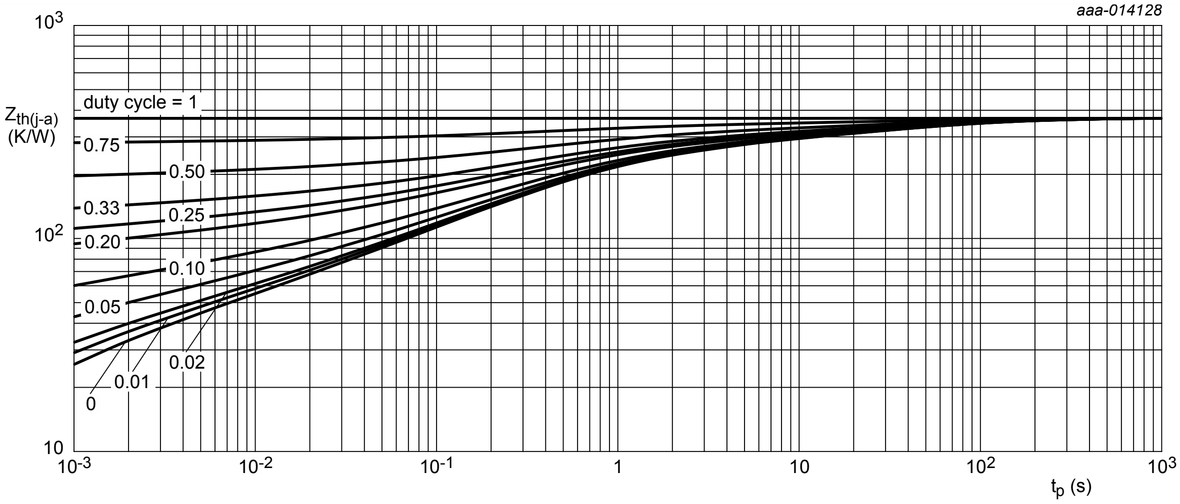
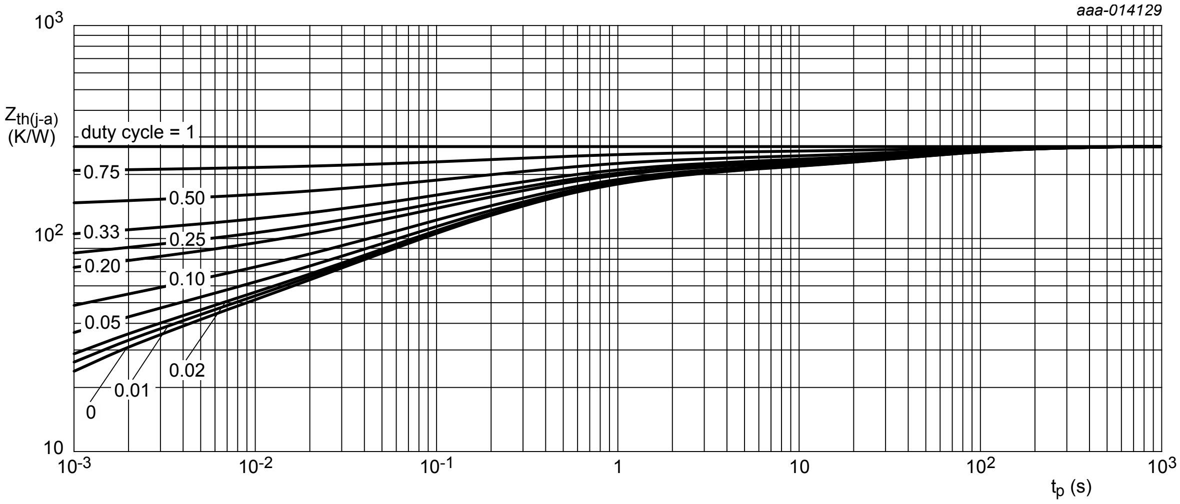


FR4 PCB, standard footprint

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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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		55	-	-	V
V_{GSth}	gate-source threshold voltage	I_D = 250 µA; V_{DS} = V_{GS}; T_j = 25 °C		0.6	1	1.3	V
I_{DSS}	drain leakage current	V_{DS} = 55 V; V_{GS} = 0 V; T_j = 25 °C		-	-	1	µA
I_{GSS}	gate leakage current	V_{GS} = 10 V; V_{DS} = 0 V; T_j = 25 °C		-	-	5	µA
		V_{GS} = -10 V; V_{DS} = 0 V; T_j = 25 °C		-	-	-5	µA
		V_{GS} = 4.5 V; V_{DS} = 0 V; T_j = 25 °C		-	-	0.3	µA
		V_{GS} = -4.5 V; V_{DS} = 0 V; T_j = 25 °C		-	-	-0.3	µA
R_{DSon}	drain-source on-state resistance	V_{GS} = 4.5 V; I_D = 200 mA; T_j = 25 °C		-	2.3	4	Ω
		V_{GS} = 4.5 V; I_D = 200 mA; T_j = 150 °C		-	4.7	8.1	Ω
		V_{GS} = 2.5 V; I_D = 75 mA; T_j = 25 °C		-	2.7	5	Ω
		V_{GS} = 1.8 V; I_D = 30 mA; T_j = 25 °C		-	4.8	-	Ω
g_{fs}	forward transconductance	V_{DS} = 10 V; I_D = 200 mA; T_j = 25 °C		-	0.64	-	S
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	V_{DS} = 30 V; I_D = 200 mA; V_{GS} = 4.5 V; T_j = 25 °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 V; f = 1 MHz; V_{GS} = 0 V; T_j = 25 °C		-	19.1	30	pF
C_{oss}	output capacitance			-	2.7	10	pF
C_{rss}	reverse transfer capacitance			-	1.5	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 Ω; T_j = 25 °C		-	8.3	12	ns
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
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 200 mA; V_{GS} = 0 V; T_j = 25 °C		-	0.86	1.2	V

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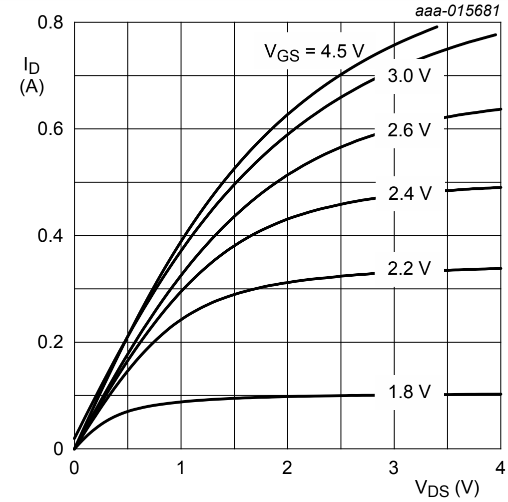
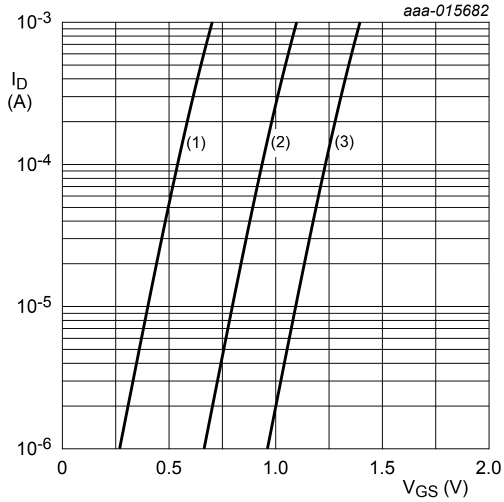


T_j = 25 °C

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



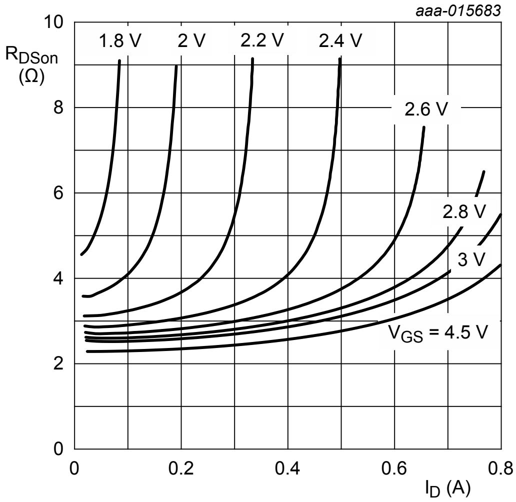
T_j = 25 °C; V_{DS} = 5 V

(1) minimum values

(2) typical values

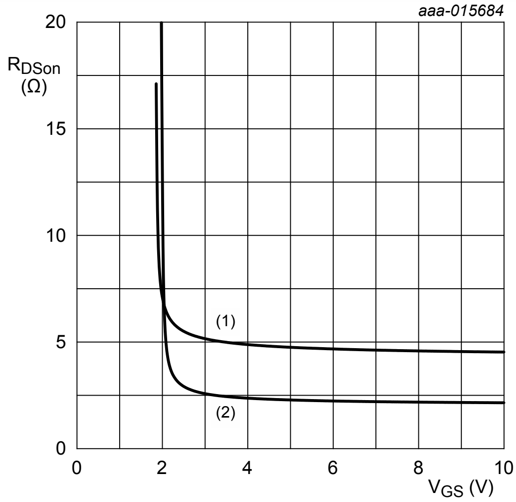
(3) maximum values

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

(1) T_j = 150 °C

(2) T_j = 25 °C

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

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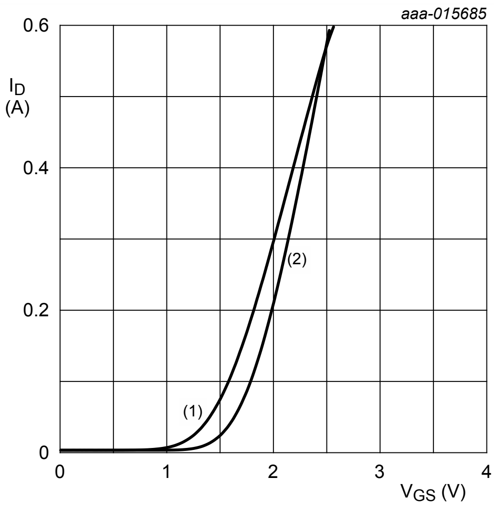


$V_{DS} > I_D \times R_{DSon}$

(1) T_j = 25 °C

(2) T_j = 150 °C

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

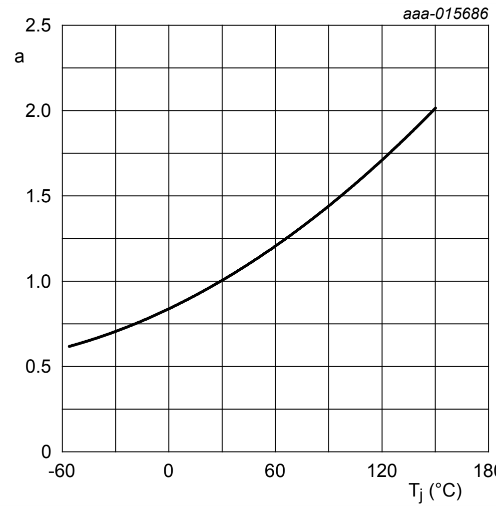
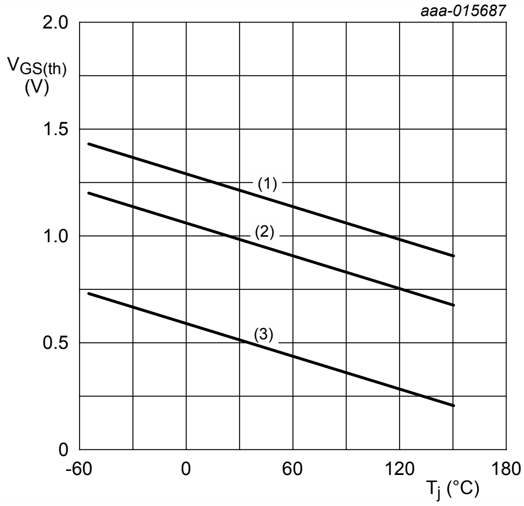


Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values

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



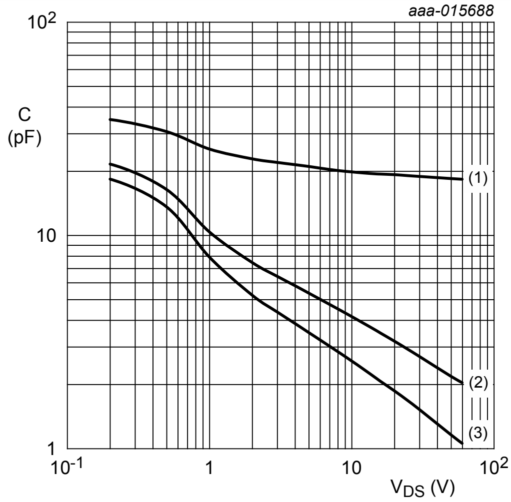
I_D = 0.25 mA; $V_{DS} = V_{GS}$

(1) maximum values

(2) typical values

(3) minimum values

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



f = 1 MHz; V_{GS} = 0 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

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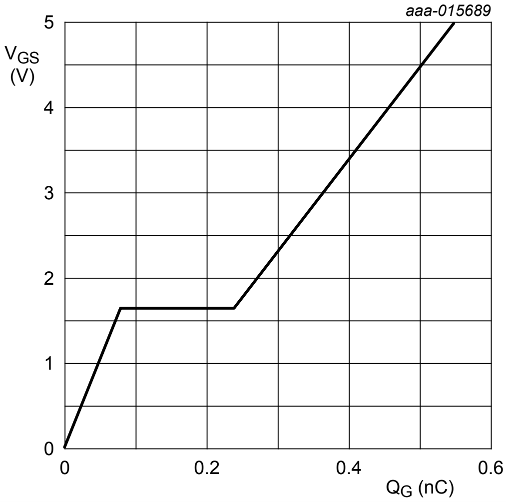


I_D = 0.2 A; V_{DS} = 30 V; T_{amb} = 25 °C

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

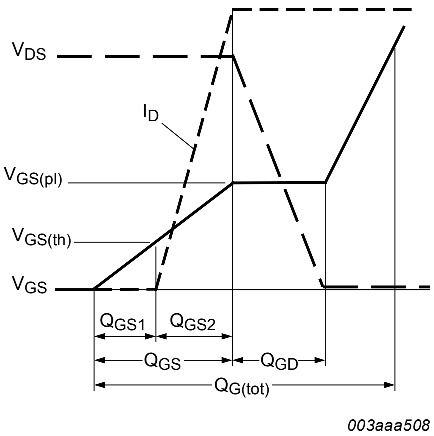
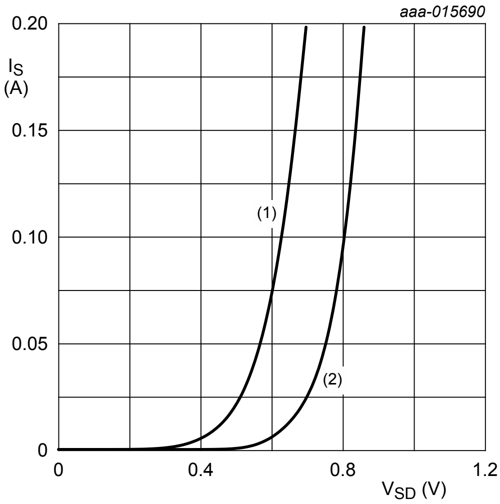


Fig. 15. MOSFET transistor: Gate charge waveform definitions



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

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11. Test information

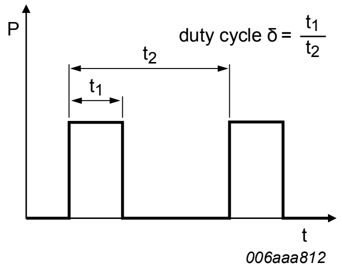

Fig. 17. Duty cycle definition

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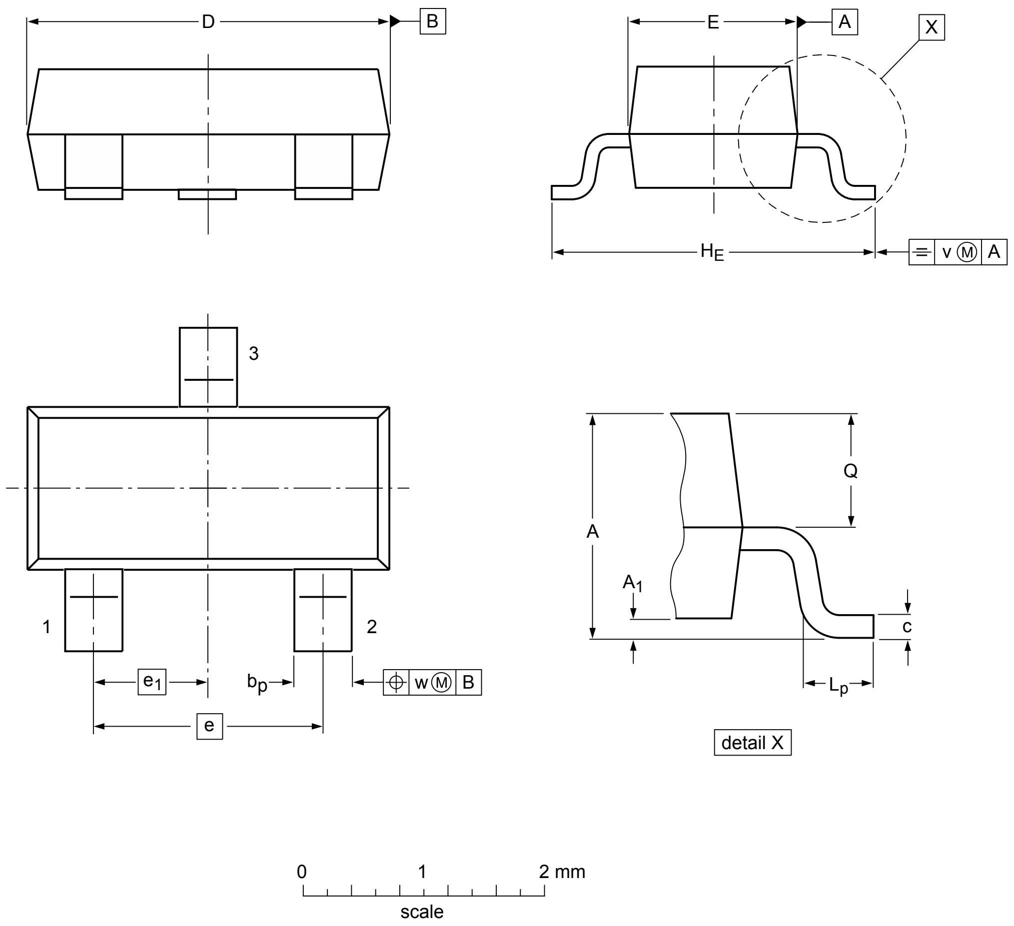
12. Package outline

Plastic surface-mounted package; 3 leads **SOT23**



Dimensions (mm are the original dimensions)

Unit		A	A_1	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w
mm	max	1.1	0.1	0.48	0.15	3.0	1.4			2.5	0.45	0.55		
	nom							1.9	0.95				0.2	0.1
	min	0.9		0.38	0.09	2.8	1.2			2.1	0.15	0.45		

sot023_po

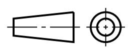
Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT23		TO-236AB				~~14-06-19~~ 14-09-22

Fig. 18. Package outline TO-236AB (SOT23)

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13. Soldering

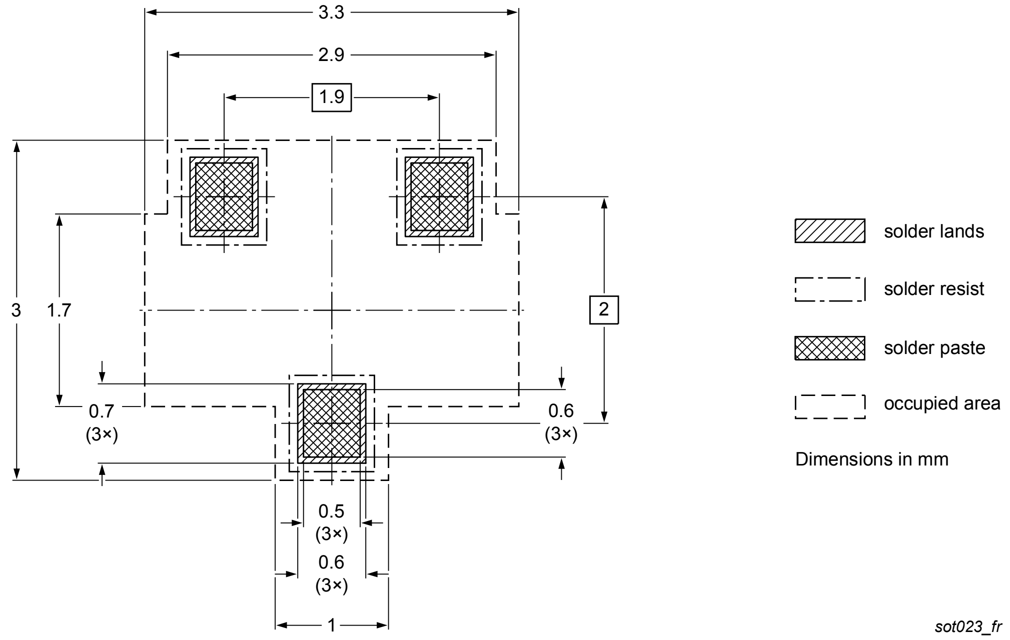

Fig. 19. Reflow soldering footprint for TO-236AB (SOT23)

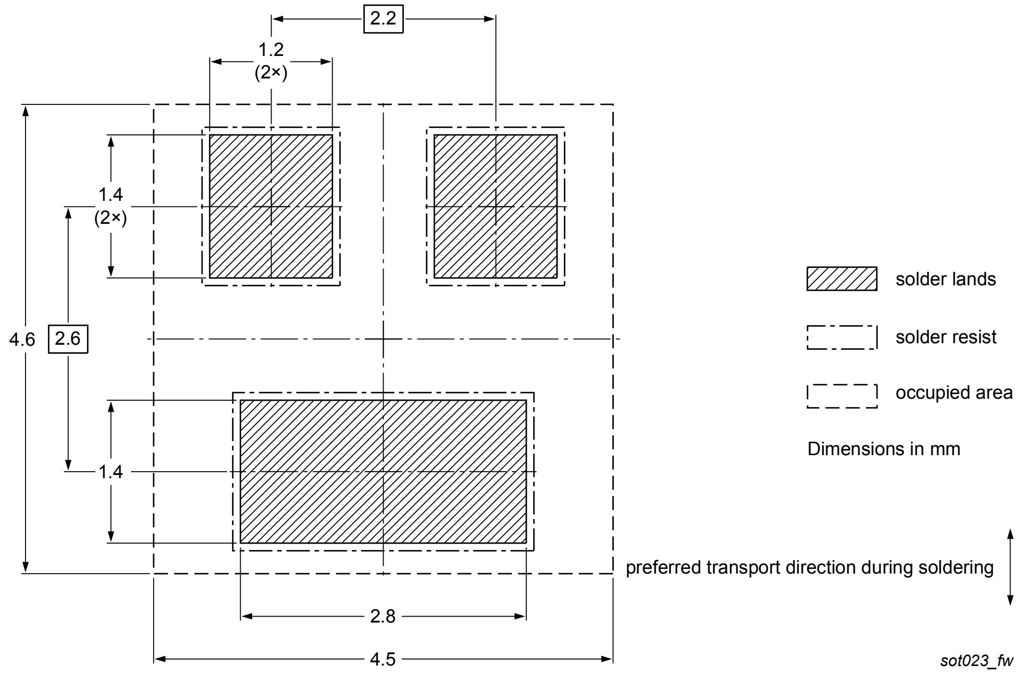

Fig. 20. Wave soldering footprint for TO-236AB (SOT23)

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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	-	-

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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".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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