

BSS138AKQB-Q

60 V, N-channel Trench MOSFET

2 September 2024 **Product data sheet**

1. General description

N-channel enhancement mode Field-Effect Transistor (FET) in a leadless ultra small DFN1110D-3 (SOT8015) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

2. Features and benefits

- Logic-level compatible
- Extended temperature range T_j = 175 °C
- Trench MOSFET technology
- ElectroStatic Discharge (ESD) protection
- Side wettable flanks for optical solder inspection
- AEC-Q101 qualified

3. Applications

- Relay driver
- High-speed line driver
- Low-side load switch
- 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		-	-	60	V
V_{GS}	gate-source voltage			-20	-	20	V
I_D	drain current	V_{GS} = 10 V; T_{amb} = 25 °C	[1]	-	-	340	mA
Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 100 mA; T_j = 25 °C		-	2.1	2.8	Ω

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

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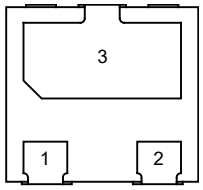
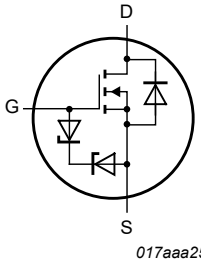
5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 Transparent top view **DFN1110D-3 (SOT8015)**	
2	S	source		
3	D	drain		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BSS138AKQB-Q	DFN1110D-3	plastic, leadless extremely thin small outline package with side-wettable flanks (SWF); 3 terminals; 0.65 mm pitch; 1.1 mm x 1 mm x 0.48 mm body	SOT8015

7. Marking

Table 4. Marking codes

Type number	Marking code
BSS138AKQB-Q	QL

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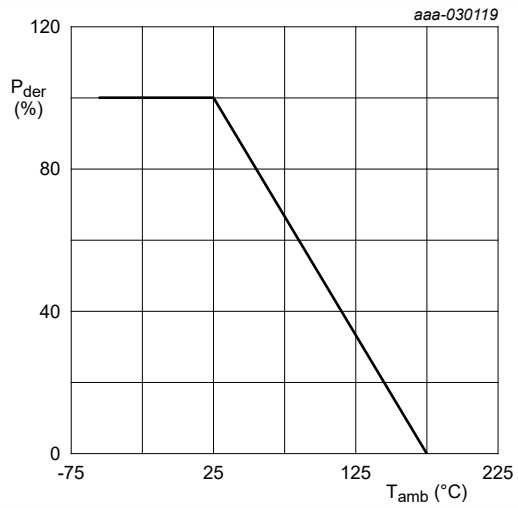
8. Limiting values

Table 5. Limiting values

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

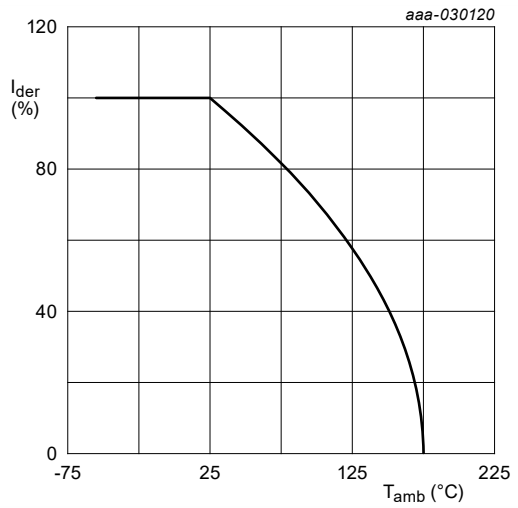
Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	T_j = 25 °C		-	60	V
V_{GS}	gate-source voltage			-20	20	V
I_D	drain current	V_{GS} = 10 V; T_{amb} = 25 °C	[1]	-	340	mA
		V_{GS} = 10 V; T_{amb} = 100 °C	[1]	-	240	mA
I_{DM}	peak drain current	T_{amb} = 25 °C; single pulse; $t_p \leq$ 10 µs		-	4	A
P_{tot}	total power dissipation	T_{amb} = 25 °C	[2]	-	490	mW
			[1]	-	760	mW
		T_{sp} = 25 °C		-	6.9	W
T_j	junction temperature			-55	175	°C
T_{amb}	ambient temperature			-55	175	°C
T_{stg}	storage temperature			-65	175	°C
Source-drain diode						
I_S	source current	T_{amb} = 25 °C	[1]	-	340	mA
ESD maximum rating						
V_{ESD}	electrostatic discharge voltage	HBM		-	500	V
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$T_{j(init)}$ = 25 °C; I_D = 20 mA; DUT in avalanche (unclamped)		-	6.6	mJ

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



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

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



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

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

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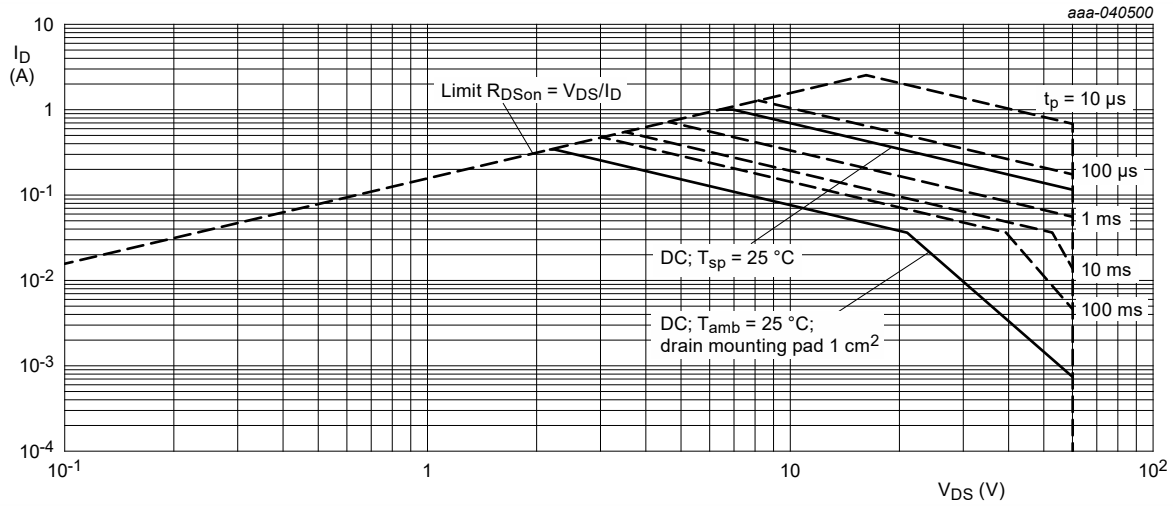

Fig. 3. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage

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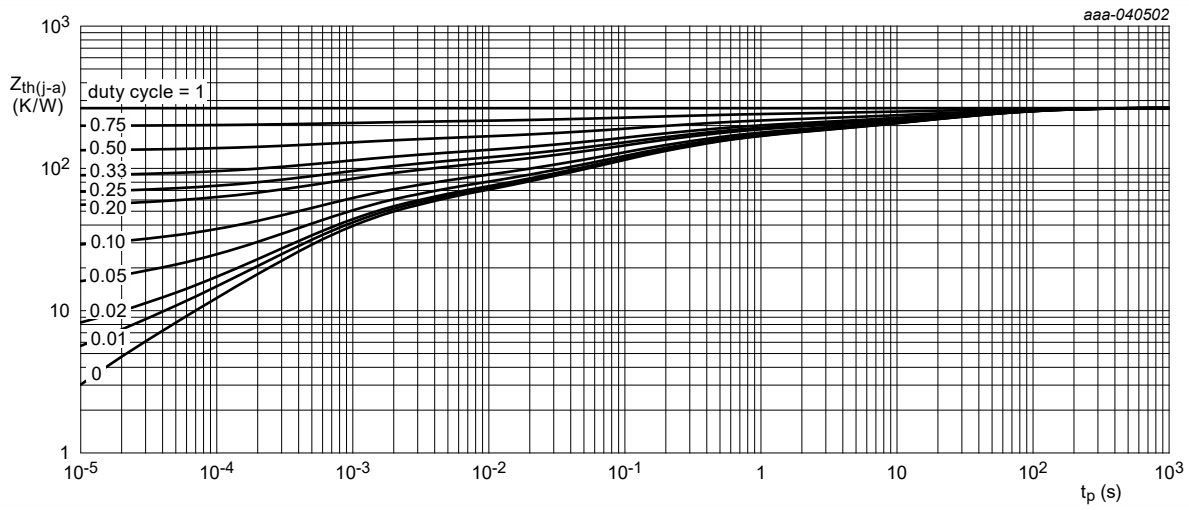
9. Thermal characteristics

Table 6. Thermal characteristics

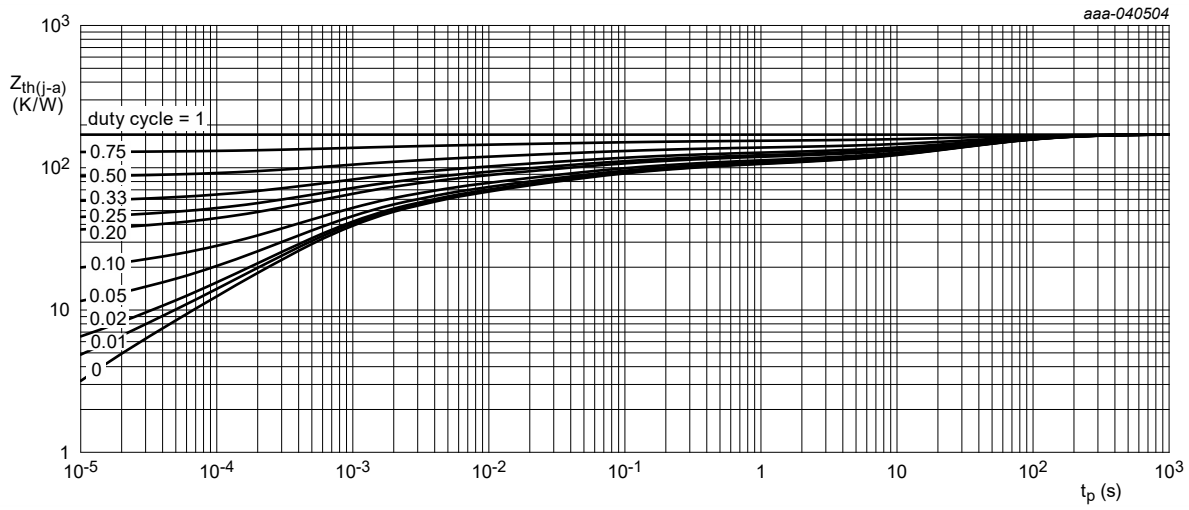
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	265	305	K/W
			[2]	-	171	197	K/W
$R_{th(j-sp)}$	thermal resistance from junction to solder point			-	17	22	K/W

[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, mounting pad for drain 1 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 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		60	-	-	V
V_{GSth}	gate-source threshold voltage	I_D = 250 µA; V_{DS} = V_{GS}; T_j = 25 °C		0.8	1.1	1.5	V
I_{DSS}	drain leakage current	V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25 °C		-	-	500	nA
		V_{DS} = 60 V; V_{GS} = 0 V; T_j = 125 °C		-	-	5	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} = 4.5 V; V_{DS} = 0 V; T_j = 25 °C		-	-	500	nA
		V_{GS} = -4.5 V; V_{DS} = 0 V; T_j = 25 °C		-	-	-500	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 100 mA; T_j = 25 °C		-	2.1	2.8	Ω
		V_{GS} = 10 V; I_D = 100 mA; T_j = 175 °C		-	4.8	6.4	Ω
		V_{GS} = 4.5 V; I_D = 50 mA; T_j = 25 °C		-	2.5	3.6	Ω
		V_{GS} = 2.5 V; I_D = 10 mA; T_j = 25 °C		-	3.4	12	Ω
g_{fs}	forward transconductance	V_{DS} = 5 V; I_D = 100 mA; T_j = 25 °C		-	0.3	-	S
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	V_{DS} = 30 V; I_D = 100 mA; V_{GS} = 10 V; T_j = 25 °C		-	0.21	0.315	nC
Q_{GS}	gate-source charge			-	0.022	-	nC
Q_{GD}	gate-drain charge			-	0.051	-	nC
C_{iss}	input capacitance	V_{DS} = 30 V; f = 1 MHz; V_{GS} = 0 V; T_j = 25 °C		-	9	-	pF
C_{oss}	output capacitance			-	1.8	-	pF
C_{rss}	reverse transfer capacitance			-	1.1	-	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 30 V; I_D = 100 mA; V_{GS} = 10 V; $R_{G(ext)}$ = 6 Ω; T_j = 25 °C		-	1	-	ns
t_r	rise time			-	1	-	ns
$t_{d(off)}$	turn-off delay time			-	2	-	ns
t_f	fall time			-	3	-	ns
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 210 mA; V_{GS} = 0 V; T_j = 25 °C		-	1	1.6	V
t_{rr}	reverse recovery time	I_S = 210 mA; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 30 V; T_j = 25 °C		-	7	-	ns
Q_r	recovered charge			-	1	-	nC

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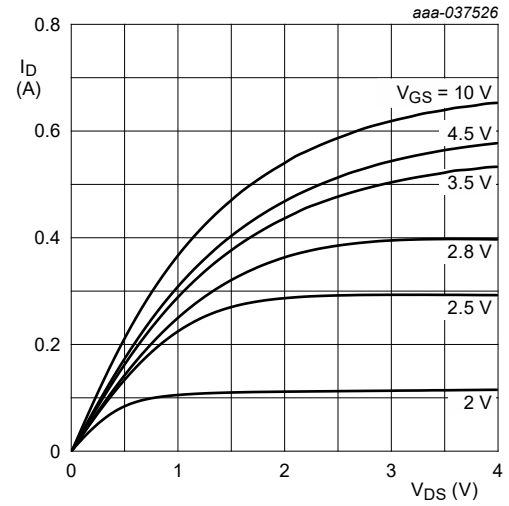
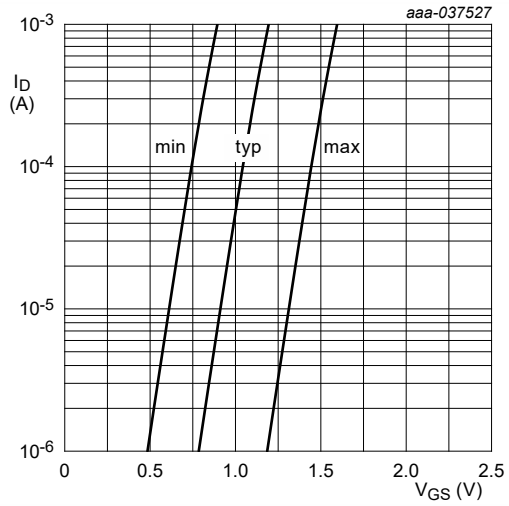


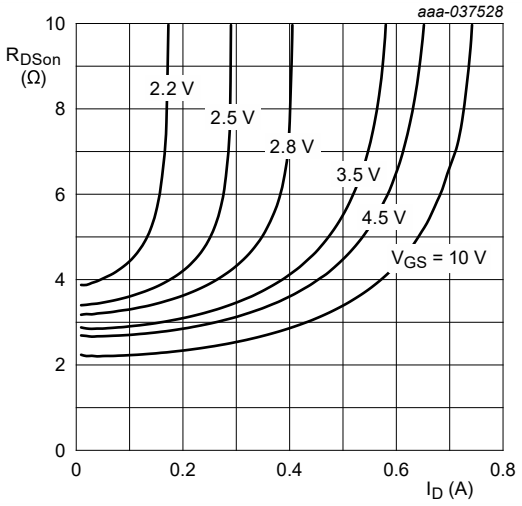
T_j = 25 °C

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



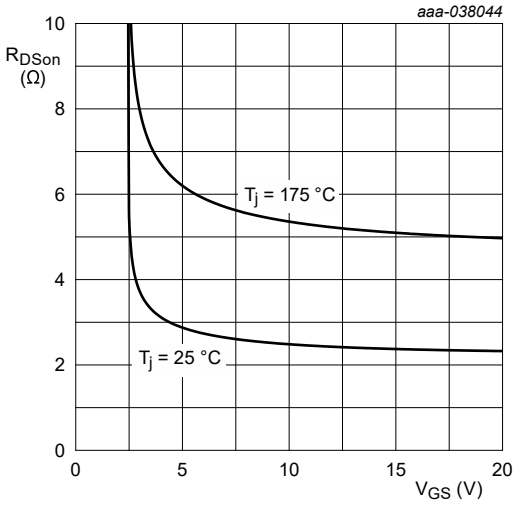
V_{DS} = 5 V; T_j = 25 °C

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 = 200 mA

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

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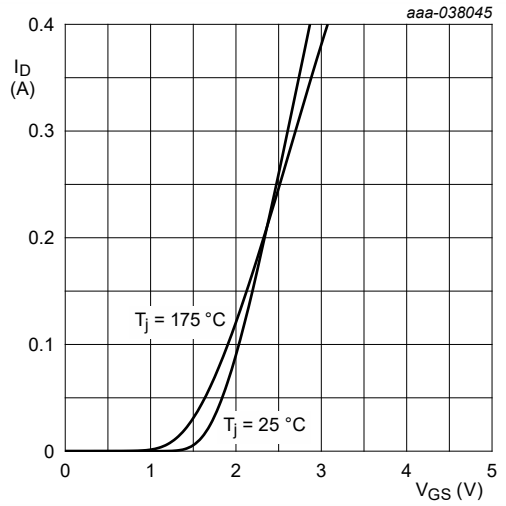
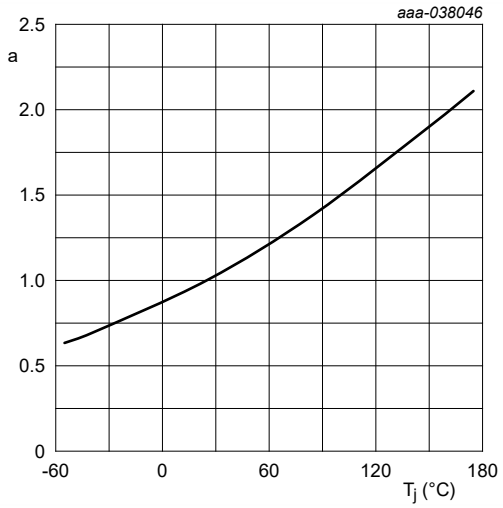


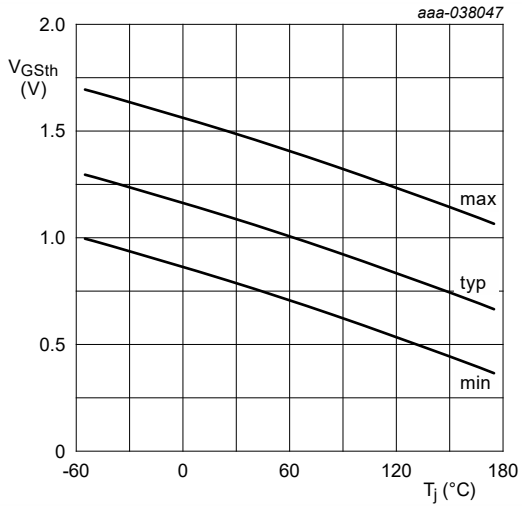
V_{DS} = 10 V

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



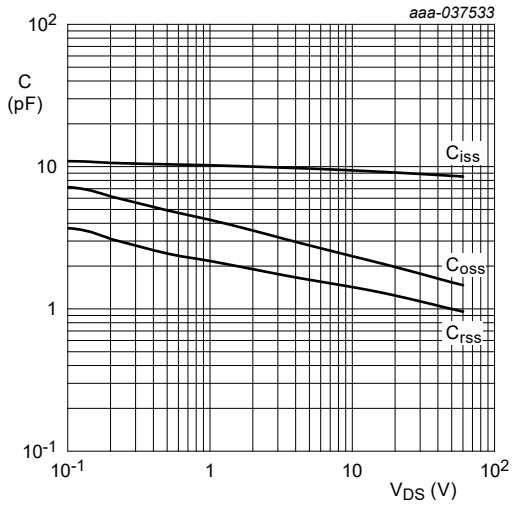
$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

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



I_D = 250 µA; V_{DS} = V_{GS}

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



f = 1 MHz; V_{GS} = 0 V

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

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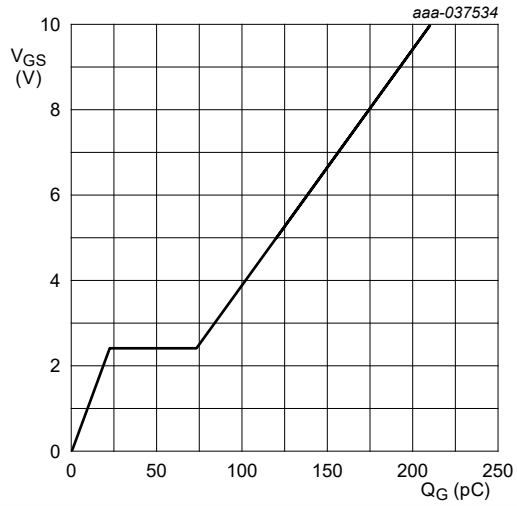


I_D = 0.23 A; V_{DS} = 30 V; T_j = 25 °C

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

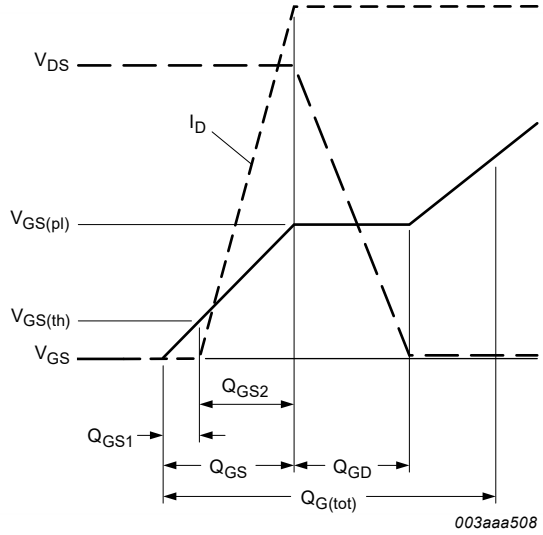
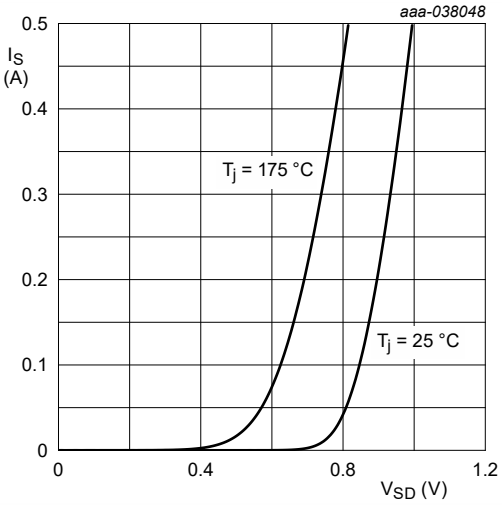


Fig. 15. Gate charge waveform definitions



V_{GS} = 0 V

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

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11. Test information

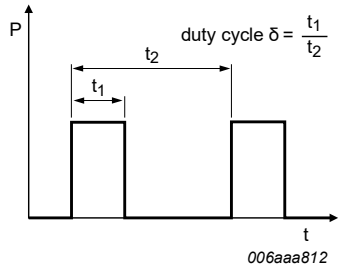

Fig. 17. Duty cycle definition

Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard *Q101 - Stress test qualification for discrete semiconductors*, and is suitable for use in automotive applications.

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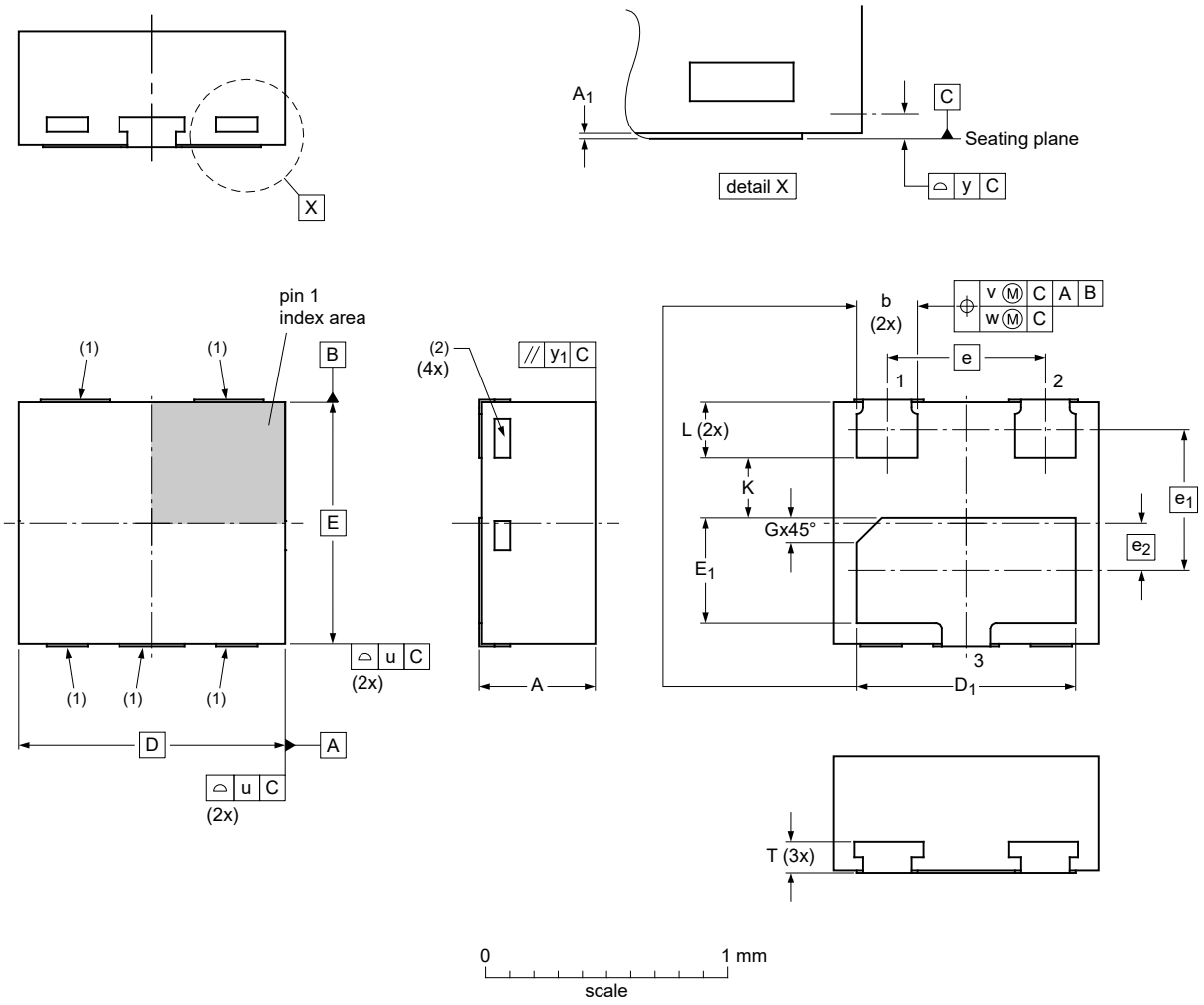
12. Package outline

DFN1110D-3: plastic, leadless extremely thin small outline package with side-wettable flanks (SWF); 3 terminals; 0.65 mm pitch; 1.1 mm x 1 mm x 0.48 mm body **SOT8015**



Dimensions (mm are the original dimensions)

Unit		A	A_1	b	D	D_1	E	E_1	e	e_1	e_2	G	K	L	T	u	v	w	y	y1
mm	max	0.50	0.040	0.30		0.95		0.48						0.27	0.22					
	nom	0.47	0.020	0.25	1.1	0.90	1	0.43	0.65	0.58	0.19	0.09 (ref)		0.23	0.16	0.05	0.1	0.05	0.05	0.05
	min	0.44	0.005	0.22		0.87		0.40					0.2	0.20	0.10					

Note
1. Side Wettable Flank, protrusion max. 0.02 mm.
2. Visible depend upon used manufacturing technology.
Dimension A and T are including plating thickness.

sot8015_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT8015		MO-340BA				~~19-12-02~~ 19-12-04

Fig. 18. Package outline DFN1110D-3 (SOT8015)

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13. Soldering

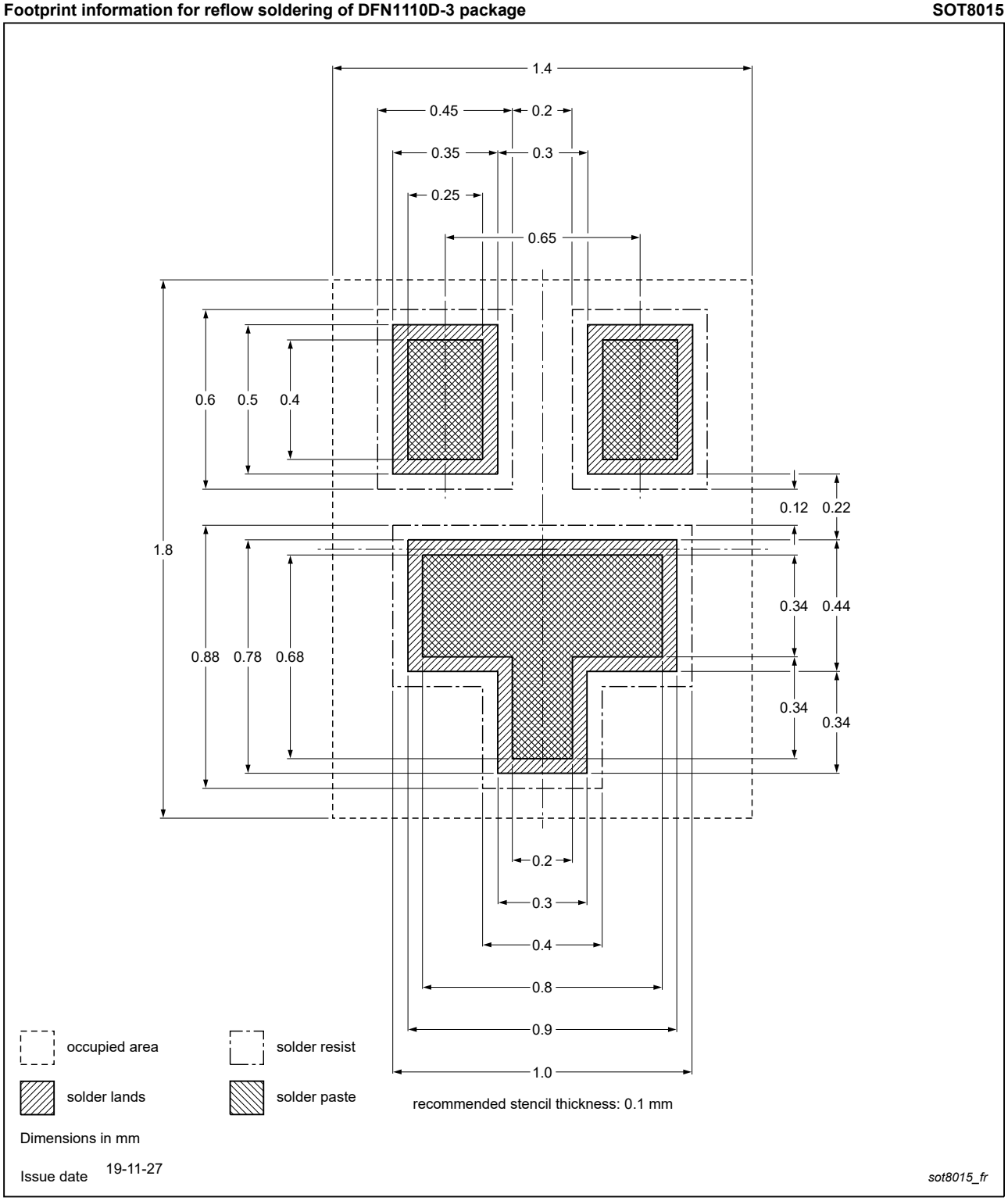

Fig. 19. Reflow soldering footprint for DFN1110D-3 (SOT8015)

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14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
BSS138AKQB-Q v.1	20240902	Product data sheet	-	-

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15. Legal information

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 https://www.nexperia.com.

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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....5
10. Characteristics....6
11. Test information....10
12. Package outline....11
13. Soldering....12
14. Revision history....13
15. Legal information....14

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