



BXK9Q29-60A

60 V, N-channel Trench MOSFET

2 January 2024

Product data sheet

1. General description

N-channel enhancement mode Field-Effect Transistor (FET) in a small SOT8002-3 (MLPAK33) Surface-Mounted Device (SMD) plastic package using Trench MOSFET technology.

2. Features and benefits

- Logic-level compatible
- Very fast switching
- Trench MOSFET technology
- Fully automotive qualified to AEC-Q101 at 175°C
- Side-wettable flanks for optical solder inspection

3. Applications

- LED Lighting
- Switching circuits
- DC-DC conversion

4. Quick reference data

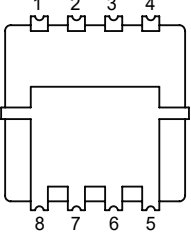
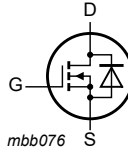
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	-	60	V
I_D	drain current	$V_{GS} = 10\text{ V}; T_{mb} = 25\text{ °C}$	[1]	-	21	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$	-	-	27	W
Static characteristics						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 5.6\text{ A}; T_j = 25\text{ °C}$	-	23.7	29	mΩ
Dynamic characteristics						
Q_{GD}	gate-drain charge	$V_{DS} = 30\text{ V}; I_D = 5.6\text{ A}; V_{GS} = 10\text{ V}; T_j = 25\text{ °C}$	-	2.4	-	nC

[1] 21 A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source	 <p>MLPAK33 (SOT8002-3)</p>	
2	S	source		
3	S	source		
4	G	gate		
5	D	drain		
6	D	drain		
7	D	drain		
8	D	drain		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BXK9Q29-60A	MLPAK33	plastic thermal enhanced surface mounted package with side-wettable flanks (SWF); mini leads; 8 terminals; pitch 0.65 mm; 3.3 x 3.3 x 0.8 mm body	SOT8002-3

7. Marking

Table 4. Marking codes

Type number	Marking code
BXK9Q29-60A	7AA

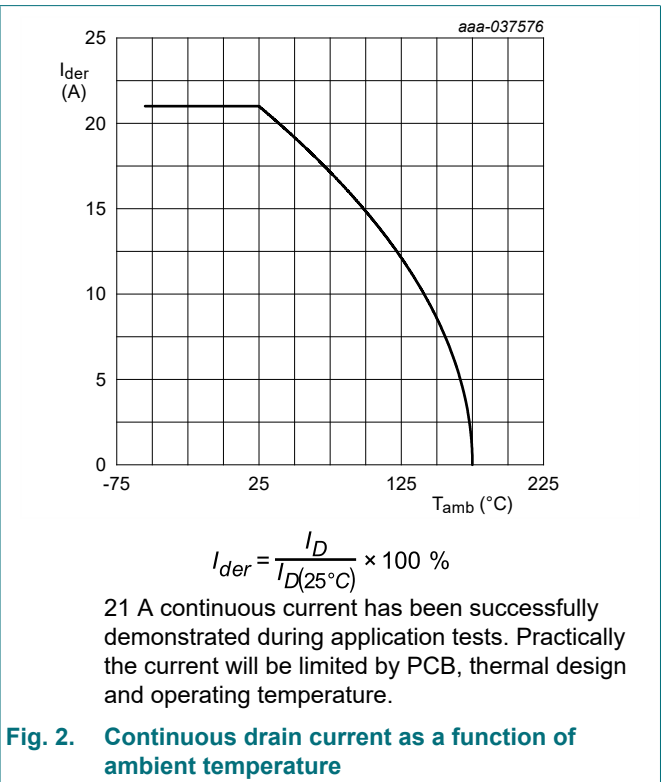
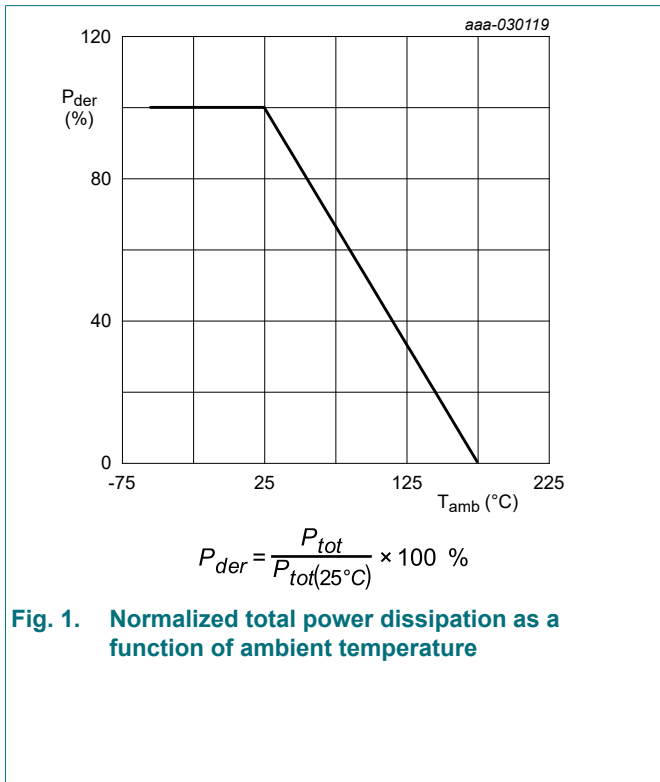
8. Limiting values

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	25 °C ≤ T _j ≤ 175 °C		-	60	V
V _{GS}	gate-source voltage	DC; T _j ≤ 175 °C		-20	20	V
I _D	drain current	V _{GS} = 10 V; T _{mb} = 25 °C	[1]	-	21	A
		V _{GS} = 10 V; T _{mb} = 100 °C		-	14.5	A
I _{DM}	peak drain current	single pulse; t _p ≤ 10 μs; T _{mb} = 25 °C		-	84	A
P _{tot}	total power dissipation	T _{mb} = 25 °C		-	27	W
T _j	junction temperature			-55	175	°C
T _{stg}	storage temperature			-55	175	°C
Source-drain diode						
I _S	source current	T _{mb} = 25 °C	[1]	-	21	A
I _{SM}	peak source current	single pulse; t _p ≤ 10 μs; T _{mb} = 25 °C	[1]	-	84	A
Avalanche ruggedness						
E _{DS(AL)S}	non-repetitive drain-source avalanche energy	V _{sup} < 60 V; V _{GS} = 10 V; T _{j(init)} = 25 °C; R _{GS} = 50 Ω; I _D = 15.8 A; unclamped	[2] [3]	-	25	mJ
I _{AS}	non-repetitive avalanche current	T _{j(init)} = 25 °C	[4]	-	15.8	A

- [1] 21 A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.
- [2] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
- [3] Refer to application note AN10273 for further information.
- [4] Protected by 100% test.



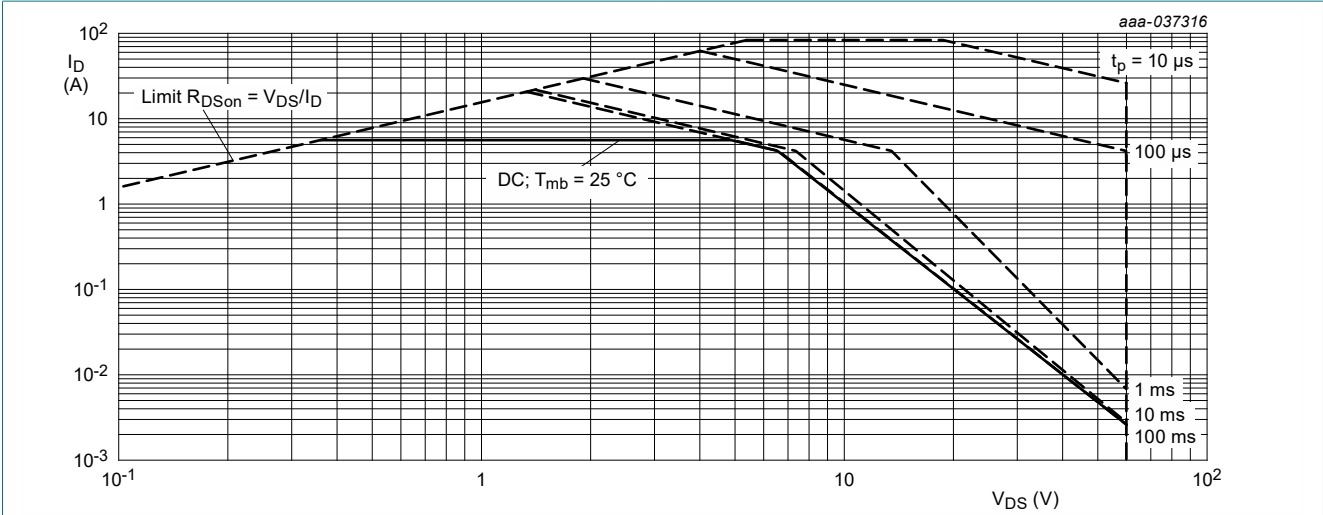
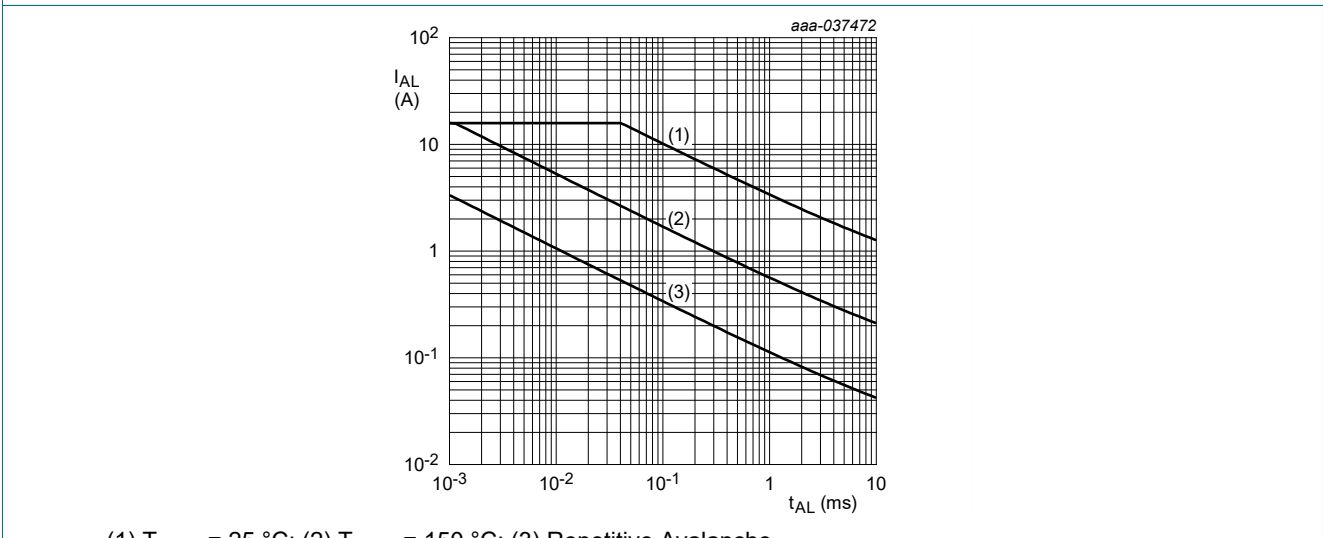


Fig. 3. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage



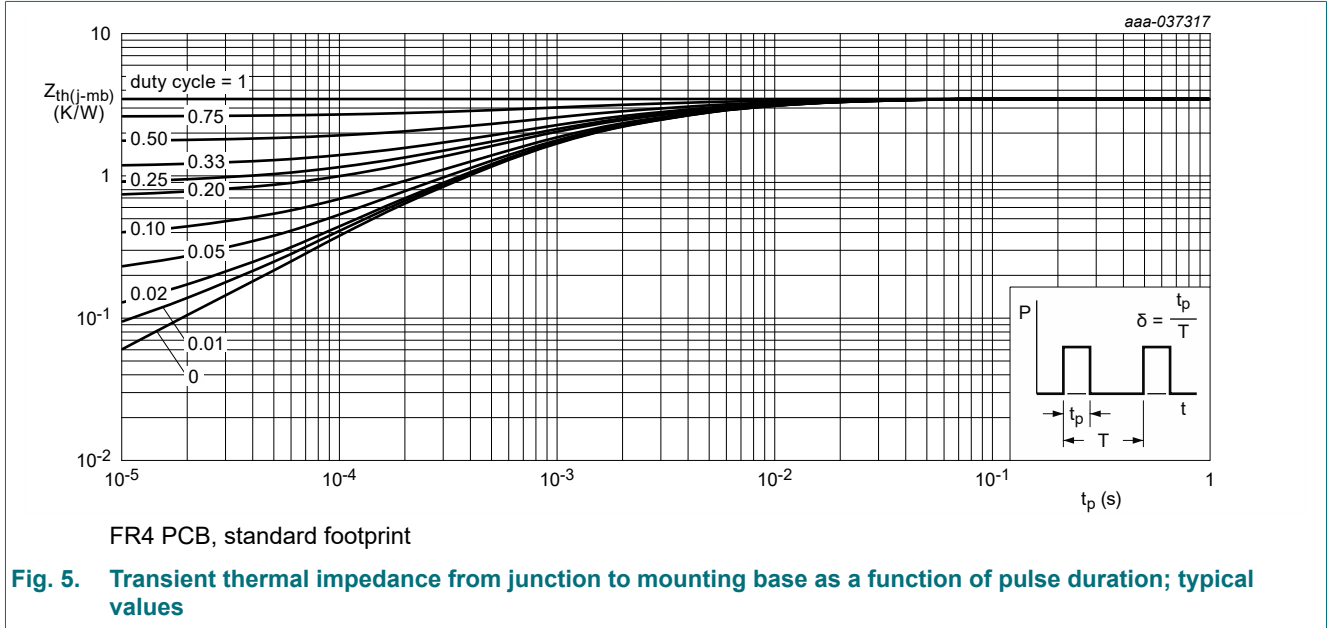
(1) $T_{j\text{(init)}} = 25\text{ °C}$; (2) $T_{j\text{(init)}} = 150\text{ °C}$; (3) Repetitive Avalanche

Fig. 4. Avalanche rating; avalanche current as a function of avalanche time

9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base		-	3.5	5.5	K/W



10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$	60	-	-	V
V_{GSth}	gate-source threshold voltage	$I_D = 1 mA$; $V_{DS} = V_{GS}$; $T_j = 25 \text{ }^\circ C$	1.3	1.7	2.1	V
I_{DSS}	drain leakage current	$V_{DS} = 60 V$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$	-	-	1	μA
		$V_{DS} = 60 V$; $V_{GS} = 0 V$; $T_j = 125 \text{ }^\circ C$	-	-	20	μA
		$V_{DS} = 60 V$; $V_{GS} = 0 V$; $T_j = 175 \text{ }^\circ C$	-	-	400	μA
I_{GSS}	gate leakage current	$V_{GS} = 20 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$	-	-	0.1	μA
		$V_{GS} = -20 V$; $V_{DS} = 0 V$; $T_j = 25 \text{ }^\circ C$	-	-	-0.1	μA
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10 V$; $I_D = 5.6 A$; $T_j = 25 \text{ }^\circ C$	-	23.7	29	m Ω
		$V_{GS} = 10 V$; $I_D = 5.6 A$; $T_j = 105 \text{ }^\circ C$	-	39	51.4	m Ω
		$V_{GS} = 10 V$; $I_D = 5.6 A$; $T_j = 125 \text{ }^\circ C$	-	42.4	55.9	m Ω
		$V_{GS} = 10 V$; $I_D = 5.6 A$; $T_j = 175 \text{ }^\circ C$	-	52	64	m Ω
		$V_{GS} = 4.5 V$; $I_D = 4.9 A$; $T_j = 25 \text{ }^\circ C$	-	28	38	m Ω
		$V_{GS} = 4.5 V$; $I_D = 4.9 A$; $T_j = 105 \text{ }^\circ C$	-	45.3	63.9	m Ω
		$V_{GS} = 4.5 V$; $I_D = 4.9 A$; $T_j = 125 \text{ }^\circ C$	-	49.2	69.5	m Ω
g_{fs}	forward transconductance	$V_{DS} = 5 V$; $I_D = 5.6 A$	-	18.6	-	S
			-		-	
R_G	gate resistance	$f = 1 MHz$	-	2	-	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$V_{DS} = 30 V$; $I_D = 5.6 A$; $V_{GS} = 10 V$; $T_j = 25 \text{ }^\circ C$	-	12	18	nC
Q_{GS}	gate-source charge		-	1.6	-	nC
Q_{GD}	gate-drain charge		-	2.4	-	nC
C_{iss}	input capacitance	$V_{DS} = 30 V$; $f = 1 MHz$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$	-	660	-	pF
C_{oss}	output capacitance		-	67	-	pF
C_{rss}	reverse transfer capacitance		-	40	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30 V$; $I_D = 5.6 A$; $V_{GS} = 10 V$; $R_{G(ext)} = 5 \Omega$; $T_j = 25 \text{ }^\circ C$	-	3	-	ns
t_r	rise time		-	4	-	ns
$t_{d(off)}$	turn-off delay time		-	13	-	ns
t_f	fall time		-	5	-	ns
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 2.5 A$; $V_{GS} = 0 V$; $T_j = 25 \text{ }^\circ C$	-	0.8	1	V
t_{rr}	reverse recovery time	$I_S = 2.5 A$; $di_S/dt = -100 A/\mu s$;	-	13	-	ns
Q_r	recovered charge	$V_{GS} = 10 V$; $V_{DS} = 30 V$; $T_j = 25 \text{ }^\circ C$	-	7	-	nC

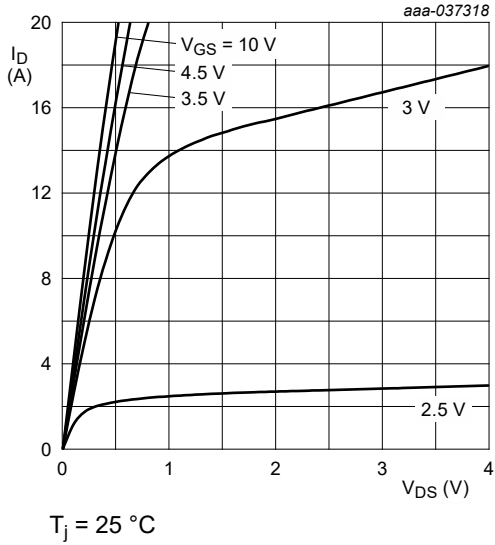


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

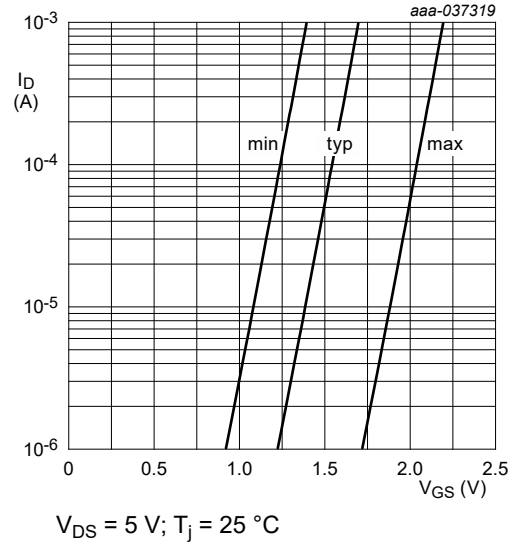


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

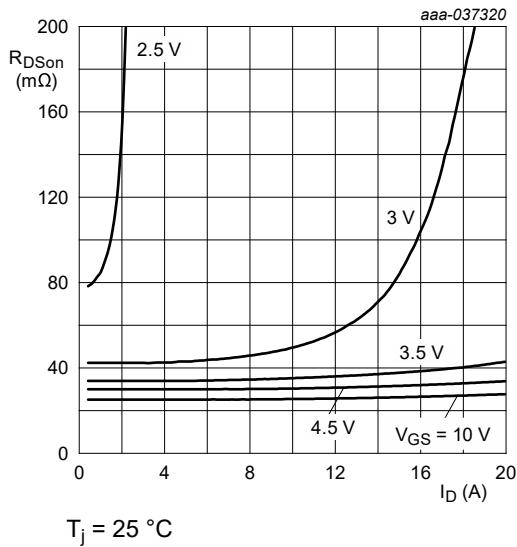


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

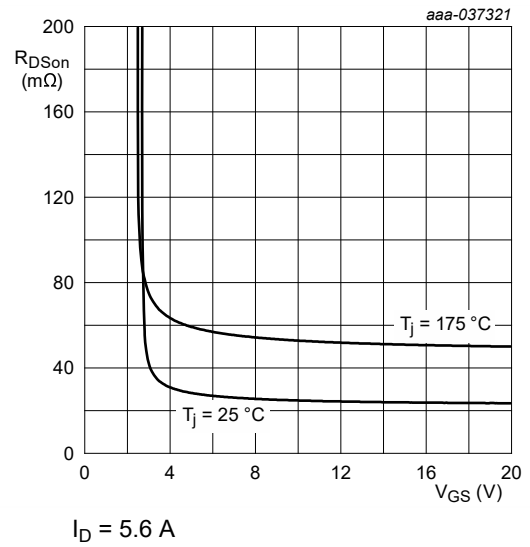


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

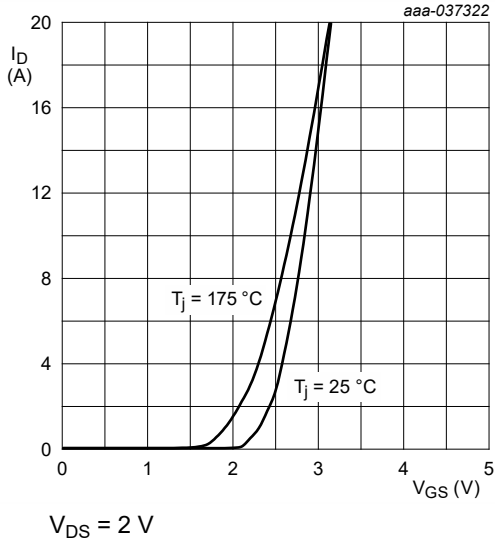
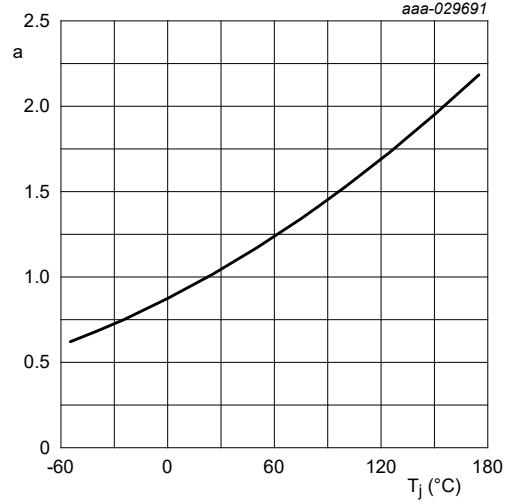


Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values



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

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

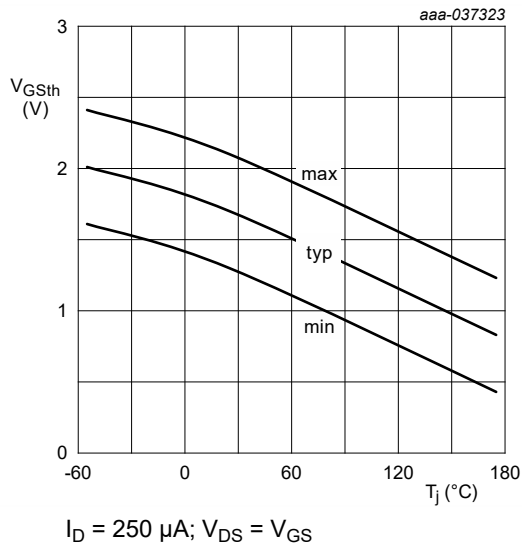


Fig. 12. Gate-source threshold voltage as a function of junction temperature

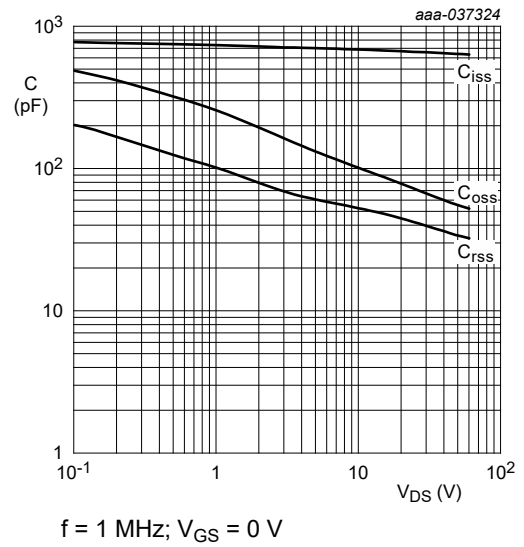
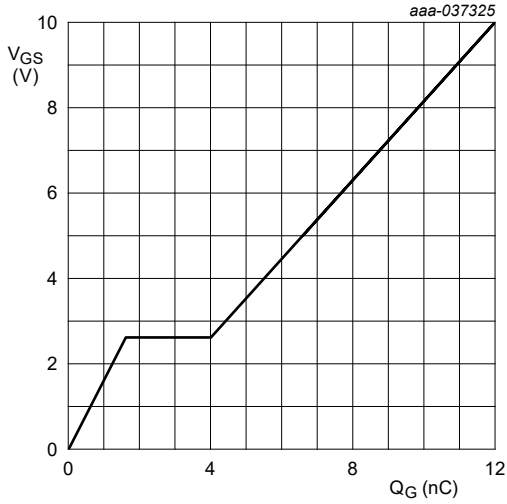


Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



$I_D = 5.6 \text{ A}$; $V_{DS} = 30 \text{ V}$; $T_{amb} = 25 \text{ }^\circ\text{C}$

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

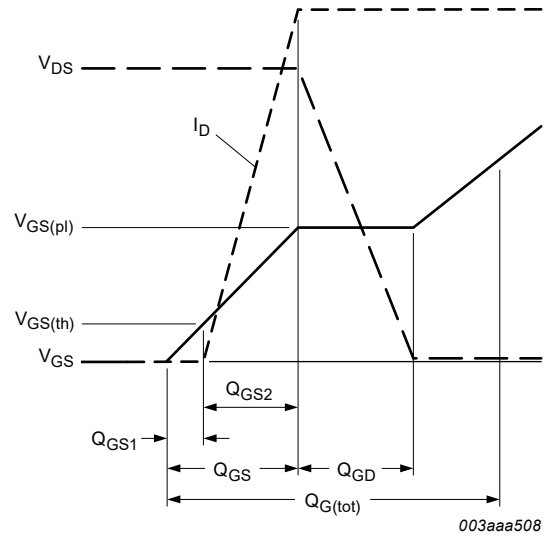
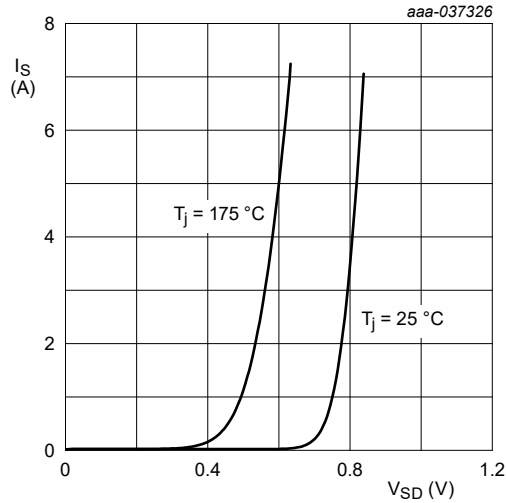


Fig. 15. Gate charge waveform definitions



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

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

11. Test information

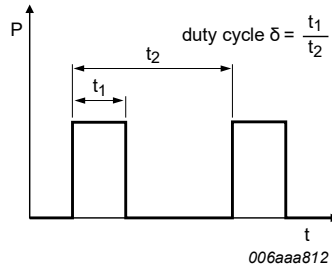


Fig. 17. Duty cycle definition

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.

12. Package outline

MLPAK33: plastic thermal enhanced surface mounted package with side-wettable flanks (SWF); mini leads; 8 terminals; pitch 0.65 mm; 3.3 x 3.3 x 0.8 mm body

SOT8002-3

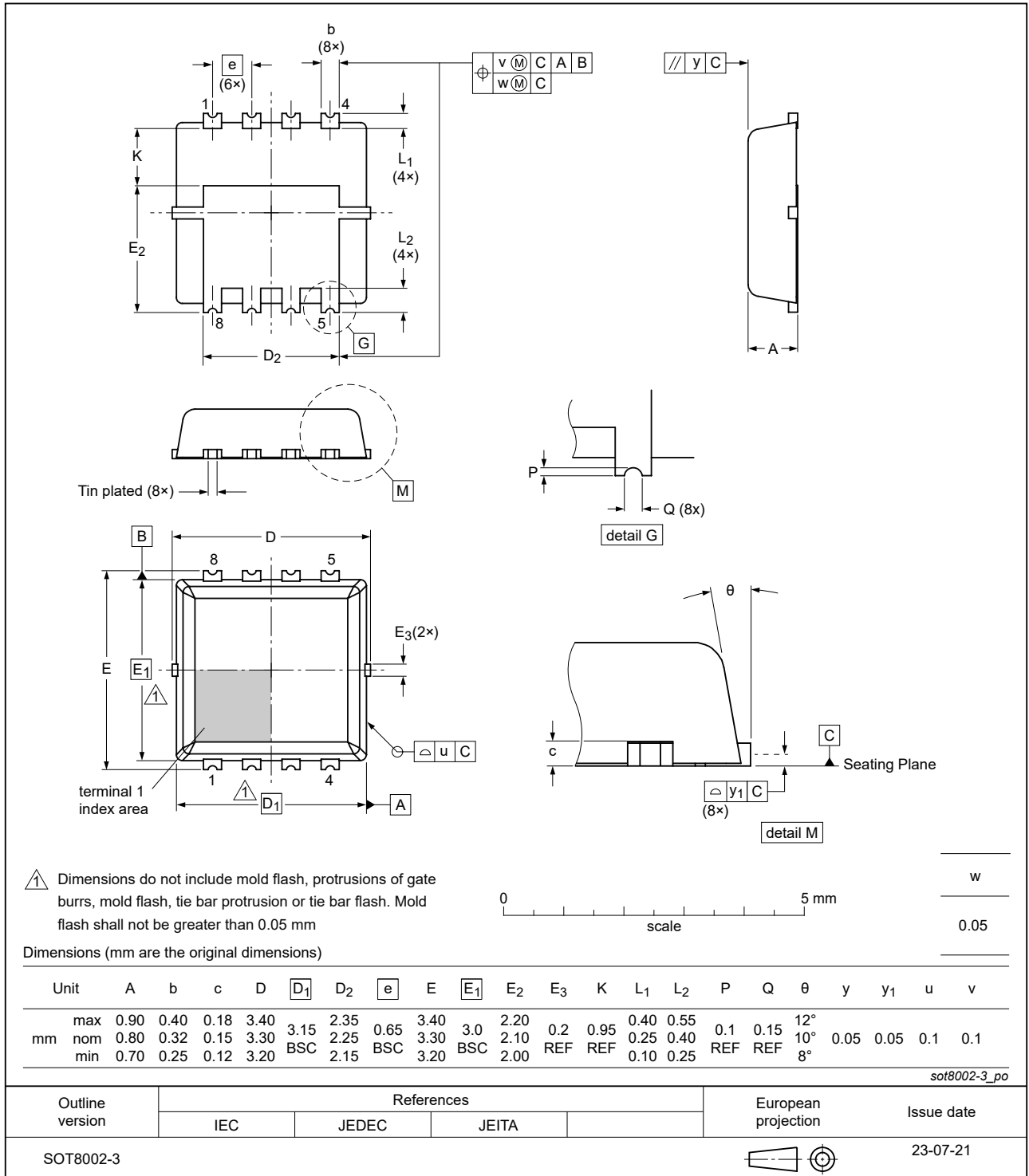


Fig. 18. Package outline MLPAK33 (SOT8002-3)

13. Soldering

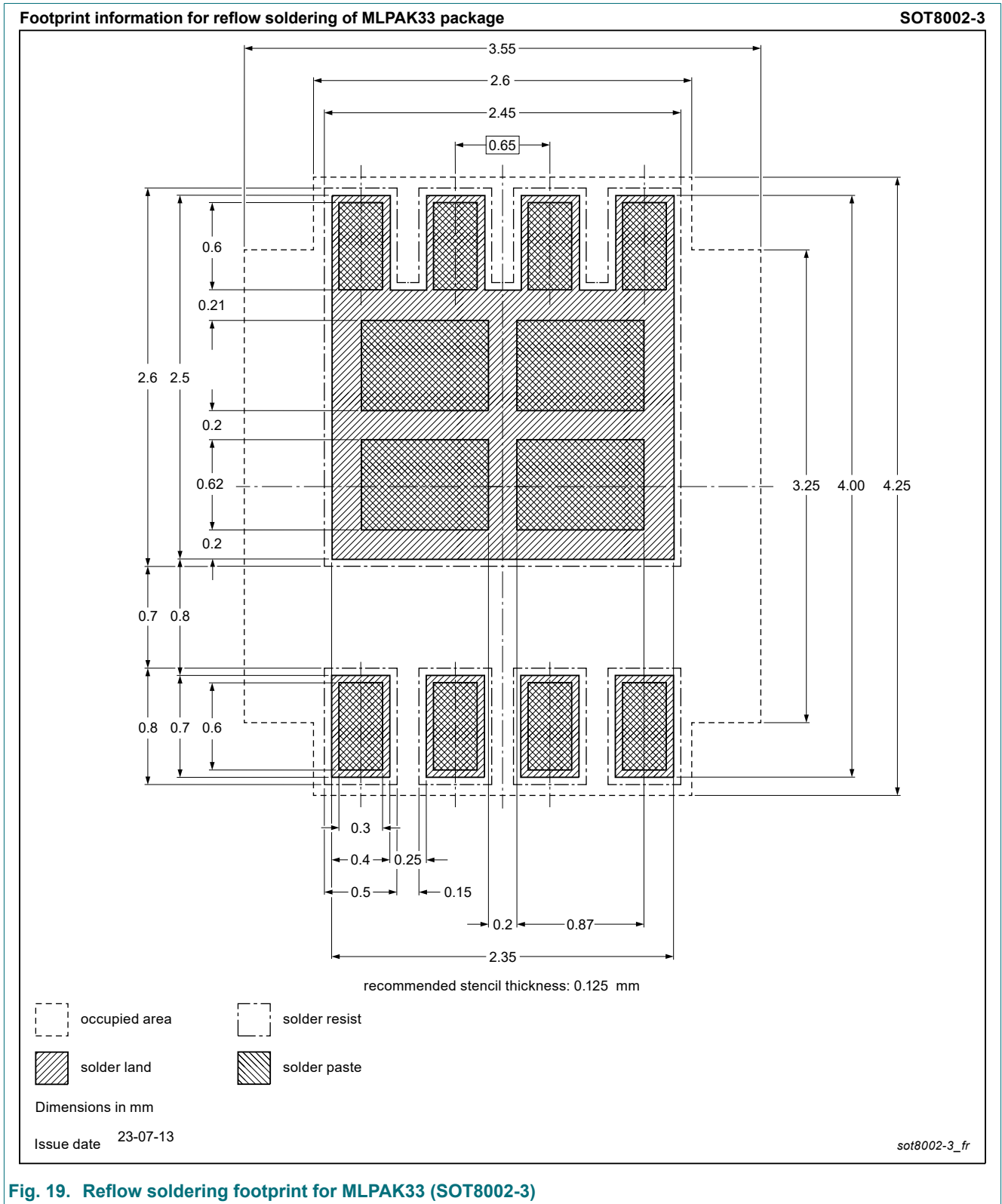


Fig. 19. Reflow soldering footprint for MLPAK33 (SOT8002-3)

14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
BXK9Q29-60A v.2	20240102	Product data sheet	-	BXK9Q29-60A v.1
Modifications:	• Changed document status to "Product data sheet"			
BXK9Q29-60A v.1	20231011	Preliminary data sheet	-	-

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.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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