BUK9Y7R0-60EL

Single N-channel 60 V, 4.5 mOhm logic level MOSFET in LFPAK56 using Enhanced SOA technology

7 April 2022 — Product data sheet

1. General description

Single, logic level, N-channel MOSFET in LFPAK56 using Application specific (ASFET) Enhanced SOA technology. This product has been designed and qualified to AEC-Q101 for use in linear mode in airbag applications.

2. Features and benefits

- Fully automotive qualified to AEC-Q101 at 175 °C
- Enhanced SOA technology for improved linear mode performance
- LFPAK copper clip package technology:
  - High robustness and current handling capability
  - Gull wing leads for easy AOI inspection and exceptional board level reliability

3. Applications

- 12 V automotive systems
- Airbag squib voltage regulator MOSFET

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	25 °C ≤ T_j ≤ 175 °C		-	-	60	V
I_D	drain current	V_{GS} = 10 V; T_{mb} = 25 °C; Fig. 2	[1]	-	-	125	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 1		-	-	238.4	W
Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; Fig. 13		2.5	3.6	4.5	mΩ
Dynamic characteristics							
Q_{GD}	gate-drain charge	I_D = 25 A; V_{DS} = 48 V; V_{GS} = 4.5 V; T_j = 25 °C; Fig. 15; Fig. 16		-	22	44	nC

[1] 125 A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.

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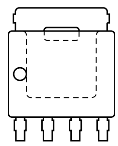
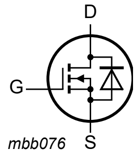
5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source	 **LFPAK56; Power-SO8 (SOT669)**	
2	S	source		
3	S	source		
4	G	gate		
mb	D	mounting base; connected to drain		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BUK9Y7R0-60EL	LFPAK56; Power-SO8	plastic, single-ended surface-mounted package; 4 terminals	SOT669

7. Marking

Table 4. Marking codes

Type number	Marking code
BUK9Y7R0-60EL	97E060L

8. Limiting values

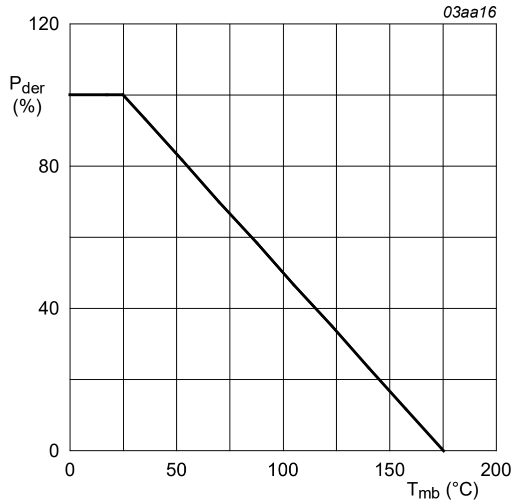
Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).Tj = 25 °C unless otherwise stated.

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		-10	10	V
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 1		-	238.4	W
I_D	drain current	V_{GS} = 10 V; T_{mb} = 25 °C; Fig. 2	[1]	-	125	A
		V_{GS} = 10 V; T_{mb} = 100 °C; Fig. 2		-	108	A
I_{DM}	peak drain current	pulsed; t_p ≤ 10 µs; T_{mb} = 25 °C; Fig. 3; Fig. 4		-	612	A
T_{stg}	storage temperature			-55	175	°C
T_j	junction temperature			-55	175	°C
Source-drain diode						
I_S	source current	T_{mb} = 25 °C		-	125	A
I_{SM}	peak source current	pulsed; t_p ≤ 10 µs; T_{mb} = 25 °C		-	612	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 73 A; V_{sup} ≤ 60 V; R_{GS} = 50 Ω; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; unclamped; t_p = 87 µs; Fig. 5	[2] [3]	-	261	mJ

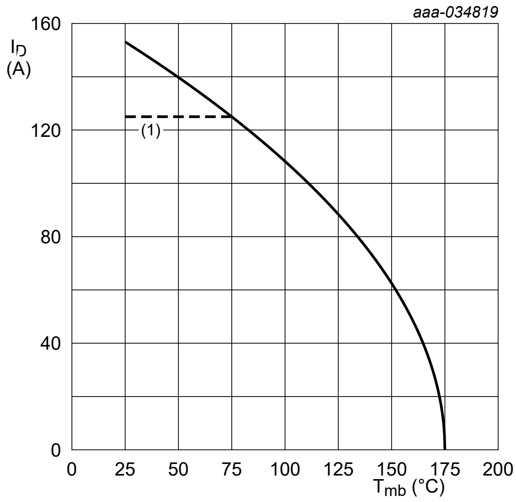
Symbol	Parameter	Conditions		Min	Max	Unit
I_{AS}	non-repetitive avalanche current	$V_{sup} \leq$ 60 V; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; R_{GS} = 50 Ω; Fig. 5	[2] [3] [4]	-	73	A

[1] 125 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.



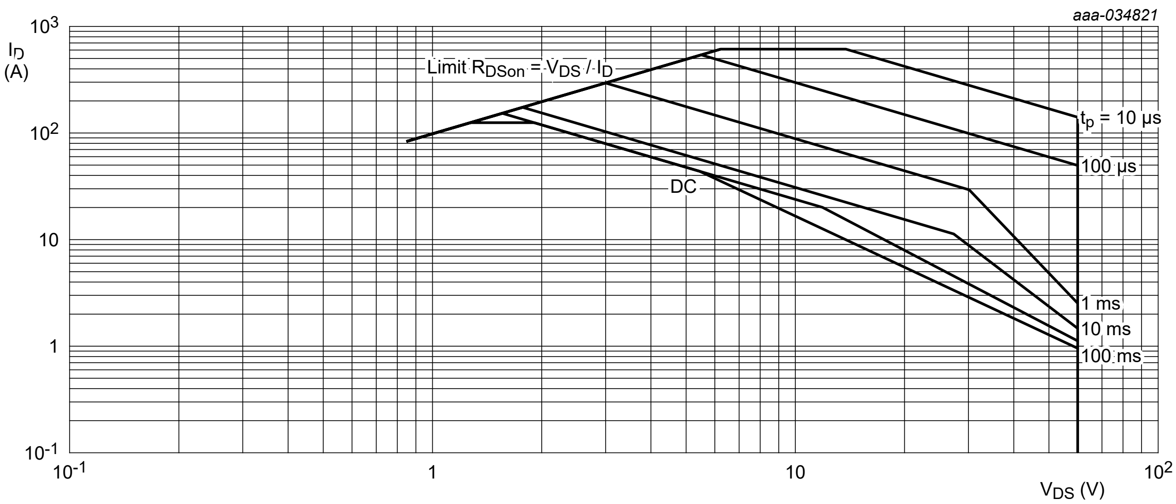
$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\,\%$$

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



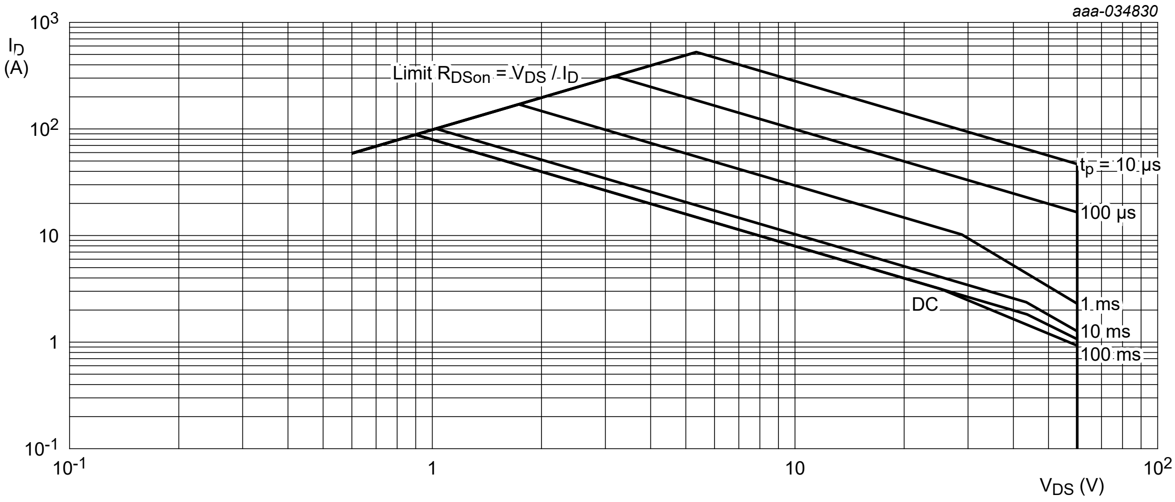
$V_{GS} \geq$ 10 V
(1) 125 A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.

Fig. 2. Continuous drain current as a function of mounting base temperature



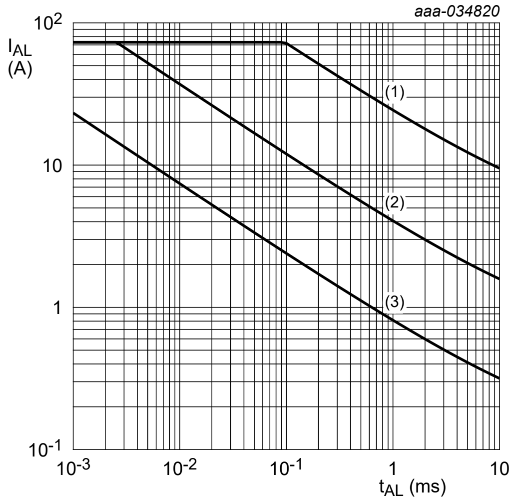
T_{mb} = 25 °C; I_{DM} is a single pulse

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



T_{mb} = 125 °C; I_{DM} is a single pulse

Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage



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

Fig. 5. 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	Fig. 6		-	0.56	0.63	K/W

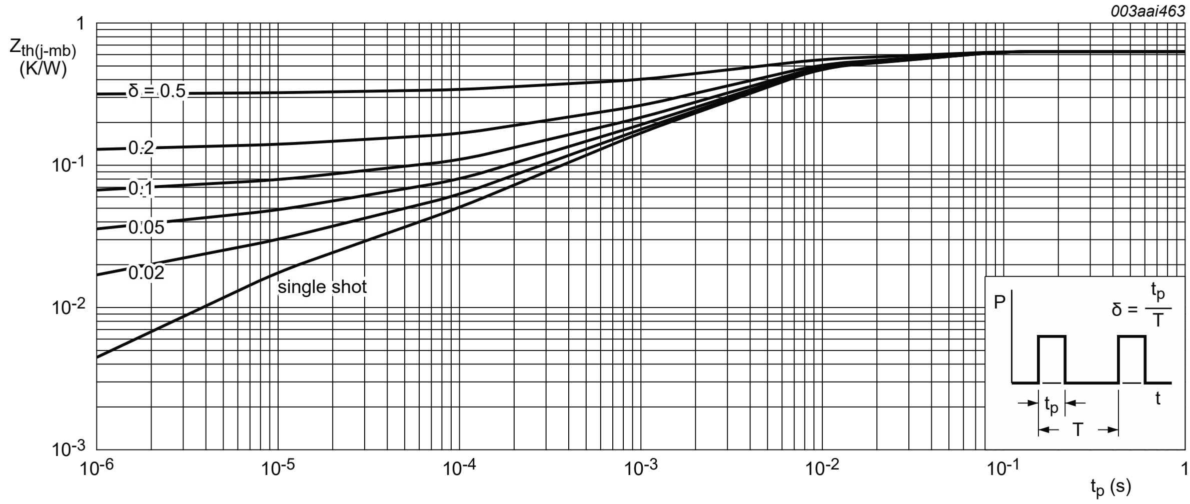


Fig. 6. Transient thermal impedance from junction to mounting base as a function of pulse duration

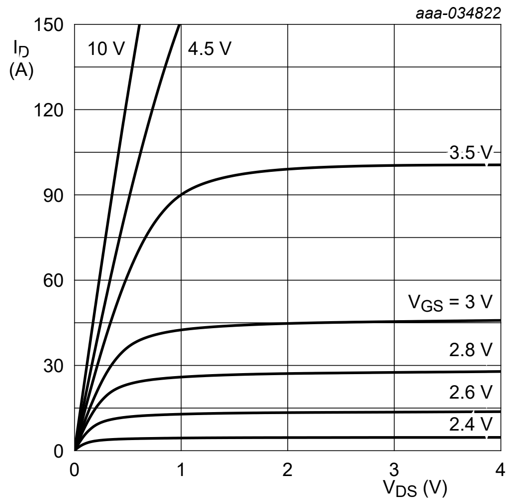
10. Characteristics

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	66	-	V
		I_D = 250 µA; V_{GS} = 0 V; T_j = -40 °C		-	62	-	V
		I_D = 250 µA; V_{GS} = 0 V; T_j = -55 °C		54	61.7	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS}=V_{GS}; T_j = 25 °C; Fig. 11; Fig. 12		1.4	1.75	2.1	V
		I_D = 1 mA; V_{DS}=V_{GS}; T_j = -55 °C; Fig. 12		-	-	2.45	V
		I_D = 1 mA; V_{DS}=V_{GS}; T_j = 175 °C; Fig. 12		0.5	-	-	V
I_{DSS}	drain leakage current	V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25 °C		-	0.032	1	µA
		V_{DS} = 60 V; V_{GS} = 0 V; T_j = 175 °C		-	91	500	µA
I_{GSS}	gate leakage current	V_{GS} = 10 V; V_{DS} = 0 V; T_j = 25 °C		-	2	100	nA
		V_{GS} = -10 V; V_{DS} = 0 V; T_j = 25 °C		-	2	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; Fig. 13		2.5	3.6	4.5	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 105 °C; Fig. 14		3.8	5.7	7.3	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 125 °C; Fig. 14		4.2	6.3	8.1	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 175 °C; Fig. 14		5.2	7.8	10.3	mΩ
		V_{GS} = 4.5 V; I_D = 25 A; T_j = 25 °C; Fig. 13		3.6	5.2	7	mΩ
		V_{GS} = 4.5 V; I_D = 25 A; T_j = 105 °C; Fig. 14		5.4	8	11	mΩ
		V_{GS} = 4.5 V; I_D = 25 A; T_j = 125 °C; Fig. 14		5.9	8.8	12.2	mΩ
		V_{GS} = 4.5 V; I_D = 25 A; T_j = 175 °C; Fig. 14		7.2	10.9	15.4	mΩ

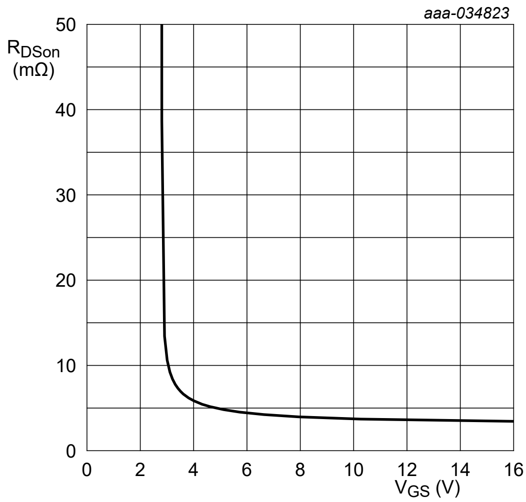
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
R_G	gate resistance	f = 1 MHz; T_j = 25 °C		-	2.39	-	Ω
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 25 A; V_{DS} = 48 V; V_{GS} = 4.5 V; T_j = 25 °C; Fig. 15; Fig. 16		-	53	74	nC
		I_D = 25 A; V_{DS} = 48 V; V_{GS} = 10 V; T_j = 25 °C; Fig. 15; Fig. 16		-	109	152	nC
Q_{GS}	gate-source charge	I_D = 25 A; V_{DS} = 48 V; V_{GS} = 4.5 V; T_j = 25 °C; Fig. 15; Fig. 16		-	14	22	nC
Q_{GD}	gate-drain charge			-	22	44	nC
C_{iss}	input capacitance	V_{DS} = 25 V; V_{GS} = 0 V; f = 1 MHz; T_j = 25 °C; Fig. 17		-	5948	8327	pF
C_{oss}	output capacitance			-	517	620	pF
C_{rss}	reverse transfer capacitance			-	280	383	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 48 V; R_L = 1.92 Ω; V_{GS} = 5 V; $R_{G(ext)}$ = 5 Ω; T_j = 25 °C		-	27	-	ns
t_r	rise time			-	67	-	ns
$t_{d(off)}$	turn-off delay time			-	72	-	ns
t_f	fall time			-	53	-	ns
g_{fs}	transfer conductance	V_{DS} = 8 V; I_D = 25 A; T_j = 25 °C; Fig. 9		-	90	-	S
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 25 A; V_{GS} = 0 V; T_j = 25 °C; Fig. 18		-	0.81	1	V
t_{rr}	reverse recovery time	I_S = 25 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 30 V; T_j = 25 °C; Fig. 19		-	32	-	ns
Q_r	recovered charge		[1]	-	38.5	-	nC

[1] includes capacitive recovery



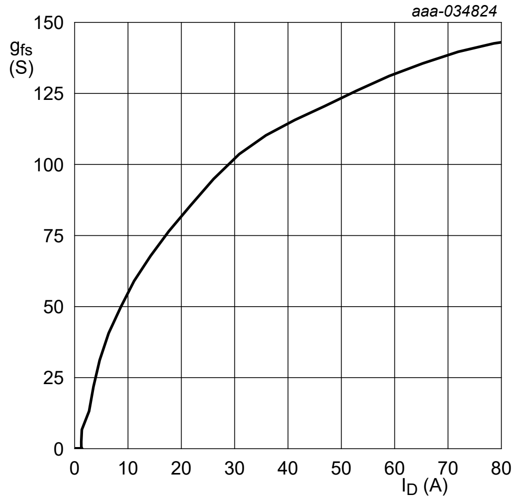
T_j = 25 °C

Fig. 7. Output characteristics; drain current as a function of drain-source voltage; typical values



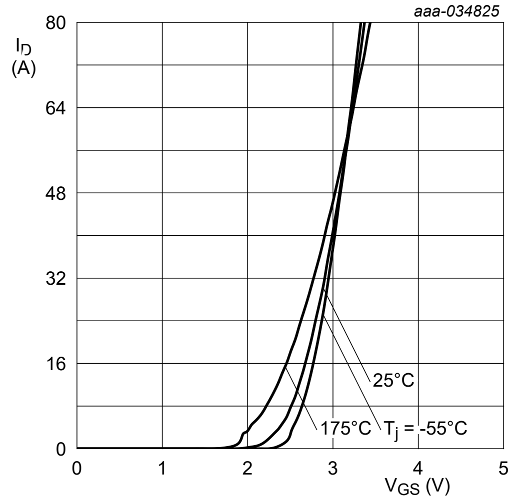
T_j = 25 °C; I_D = 25 A

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



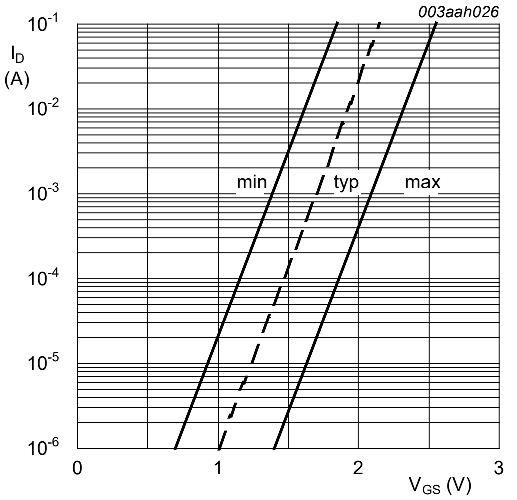
T_j = 25 °C; V_{DS} = 8 V

Fig. 9. Forward transconductance as a function of drain current; typical values



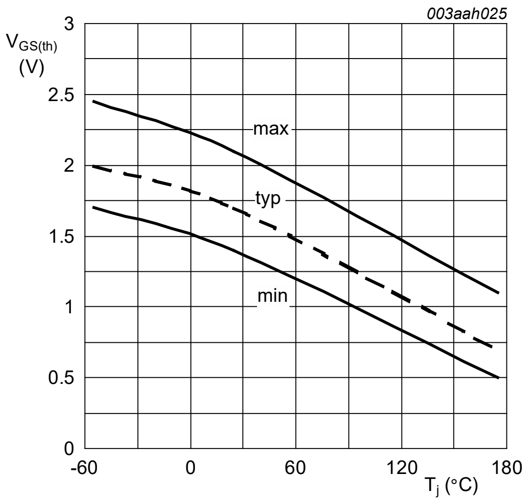
V_{DS} = 8 V

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



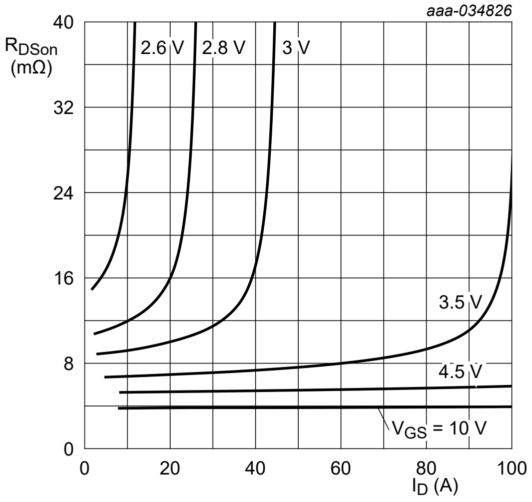
T_j = 25 °C; V_{DS} = 5 V

Fig. 11. Sub-threshold drain current as a function of gate-source voltage



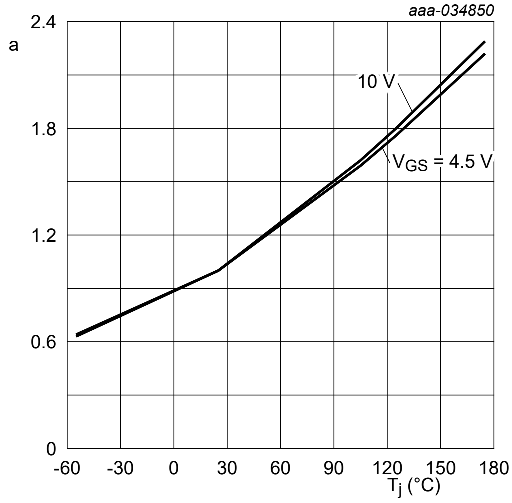
I_D = 1 mA ; V_{DS} = V_{GS}

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



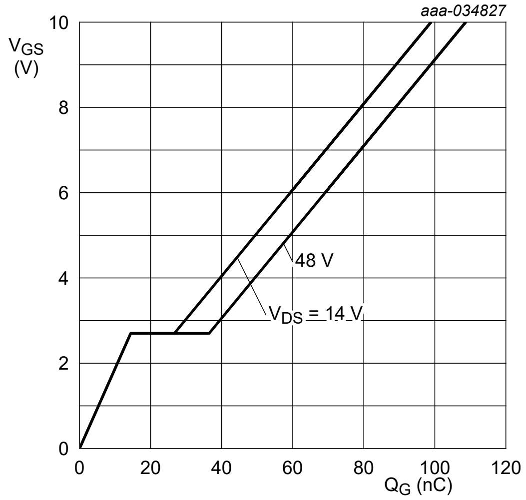
T_j = 25 °C

Fig. 13. Drain-source on-state resistance as a function of drain current; typical values



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

Fig. 14. Normalized drain-source on-state resistance factor as a function of junction temperature



Tj = 25 °C; ID = 25 A

Fig. 15. Gate-source voltage as a function of gate charge; typical values

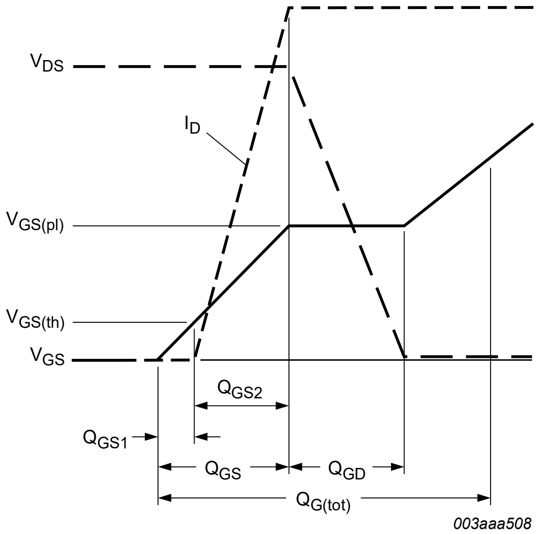
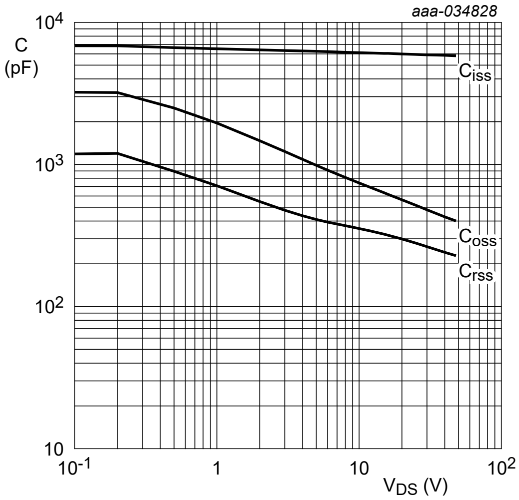
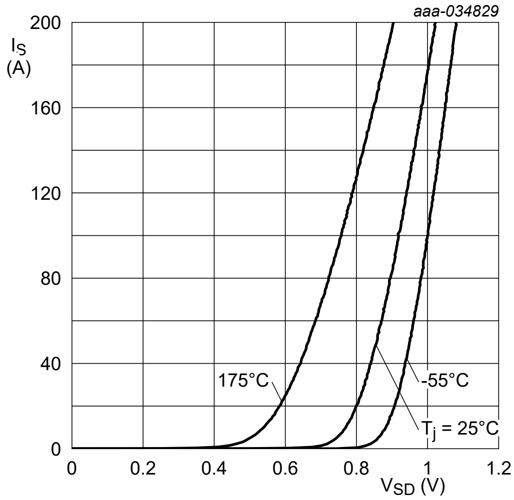


Fig. 16. Gate charge waveform definitions



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

Fig. 17. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



V_{GS} = 0 V

Fig. 18. Source-drain (diode forward) current as a function of source-drain (diode forward) voltage; typical values

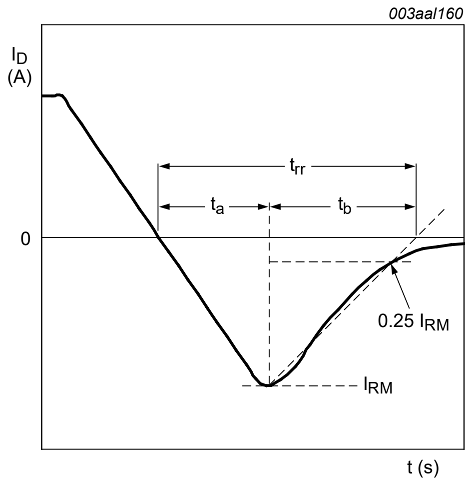
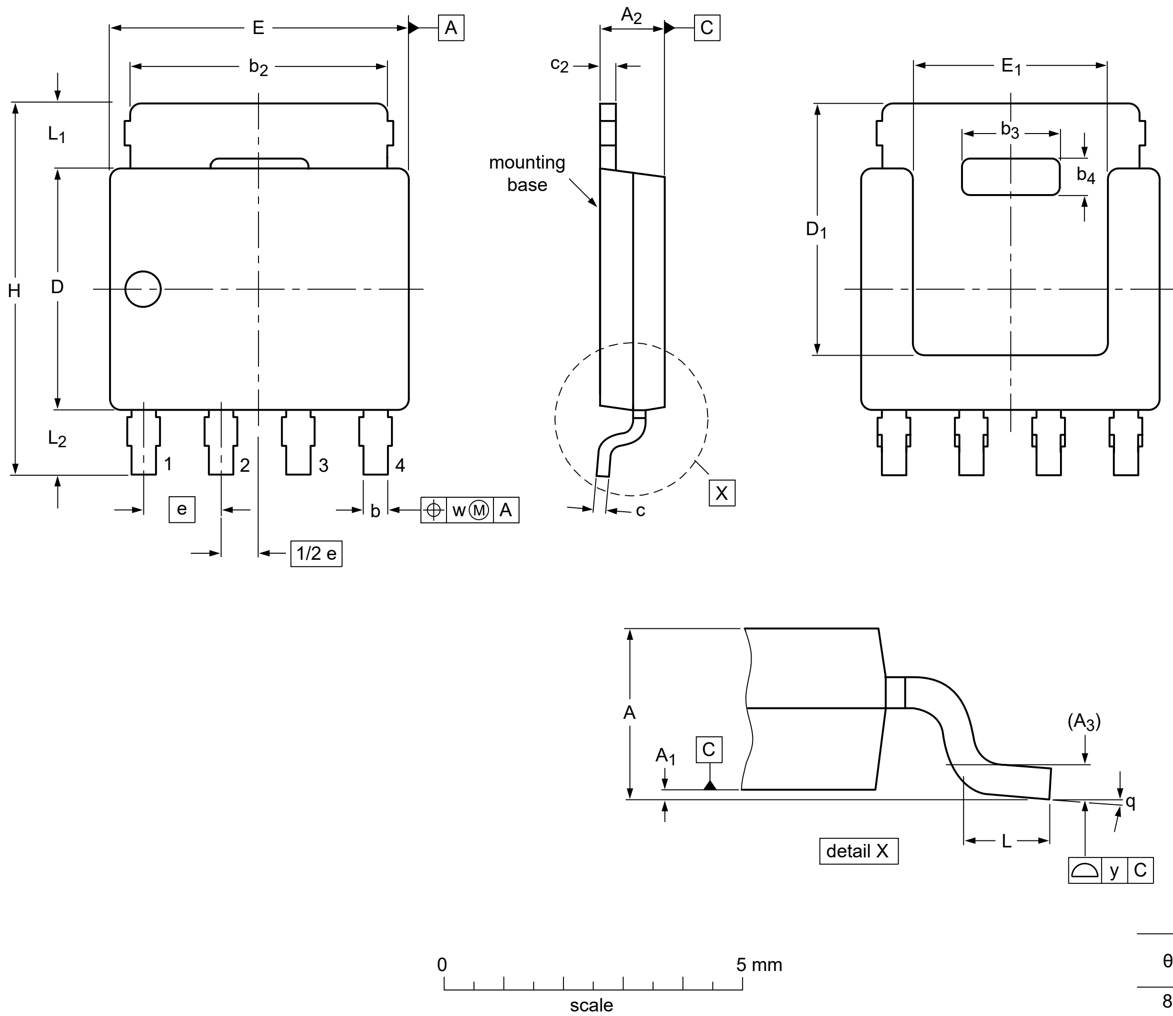


Fig. 19. Reverse recovery timing definition

11. Package outline

Plastic single-ended surface-mounted package (LFPAK56; Power-SO8); 4 leads **SOT669**



Dimensions (mm are the original dimensions)

Unit(1)		A	A_1	A_2	A_3	b	b_2	b_3	b_4	c	c_2	D(1)	D_1(1)	E(1)	E_1(1)	e	H	L	L_1	L_2	w	y	θ
mm	max	1.20	0.15	1.10		0.50	4.41	2.2	0.9	0.25	0.30	4.10	4.20	5.0	3.3		6.2	0.85	1.3	1.3			8°
	nom				0.25											1.27					0.25	0.1	
	min	1.01	0.00	0.95		0.35	3.62	2.0	0.7	0.19	0.24	3.80		4.8	3.1		5.8	0.40	0.8	0.8			0°

Note
1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

sot669_po

Outline version	References IEC	References JEDEC	References JEITA		European projection	Issue date
SOT669		MO-235				~~11-03-25~~ 13-02-27

Fig. 20. Package outline LFPAK56; Power-SO8 (SOT669)

12. 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".
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Contents

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