



BUK7Y2R5-40H

N-channel 40 V, 2.5 mΩ standard level MOSFET in LFPAK56

10 May 2018

Product data sheet

1. General description

Automotive qualified N-channel MOSFET using the latest Trench 9 low ohmic superjunction technology, housed in a robust LFPAK56 package. This product has been fully designed and qualified to meet AEC-Q101 requirements delivering high performance and endurance.

2. Features and benefits

- Fully automotive qualified to AEC-Q101:
 - 175 °C rating suitable for thermally demanding environments
- Trench 9 Superjunction technology:
 - Reduced cell pitch enables enhanced power density and efficiency with lower R_{DSon} in same footprint
 - Improved SOA and avalanche capability compared to standard TrenchMOS
 - Tight $V_{GS(th)}$ limits enable easy paralleling of MOSFETs
- LFPAK Gull Wing leads:
 - High Board Level Reliability absorbing mechanical stress during thermal cycling, unlike traditional QFN packages
 - Visual (AOI) soldering inspection, no need for expensive x-ray equipment
 - Easy solder wetting for good mechanical solder joint
- LFPAK copper clip technology:
 - Improved reliability, with reduced R_{th} and R_{DSon}
 - Increases maximum current capability and improved current spreading

3. Applications

- 12 V automotive systems
- Motors, lamps and solenoid control
- Start-Stop micro-hybrid applications
- Transmission control
- Ultra high performance power switching

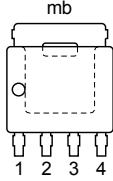
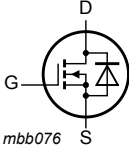
4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	-	40	V
I_D	drain current	$V_{GS} = 10\text{ V}; T_{mb} = 25\text{ °C}$	-	-	120	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C};$ Fig. 1	-	-	190	W
Static characteristics						
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 25\text{ A}; T_j = 25\text{ °C};$ Fig. 10	1.5	2.13	2.5	mΩ
Dynamic characteristics						
Q_{GD}	gate-drain charge	$I_D = 25\text{ A}; V_{DS} = 32\text{ V}; V_{GS} = 10\text{ V};$ $T_j = 25\text{ °C};$ Fig. 12 ; Fig. 13	-	8.9	22	nC
Source-drain diode						
Q_r	recovered charge	$I_S = 25\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 20\text{ V}; T_j = 25\text{ °C}$	-	22.7	-	nC
S	softness factor	$I_S = 25\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 20\text{ V}; T_j = 25\text{ °C};$ Fig. 16	-	0.79	-	

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source	 <p>LFPAK56; Power-SO8 (SOT669)</p>	
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
BUK7Y2R5-40H	LFPAK56; Power-SO8	plastic, single-ended surface-mounted package; 4 terminals	SOT669

7. Marking

Table 4. Marking codes

Type number	Marking code
BUK7Y2R5-40H	72H540

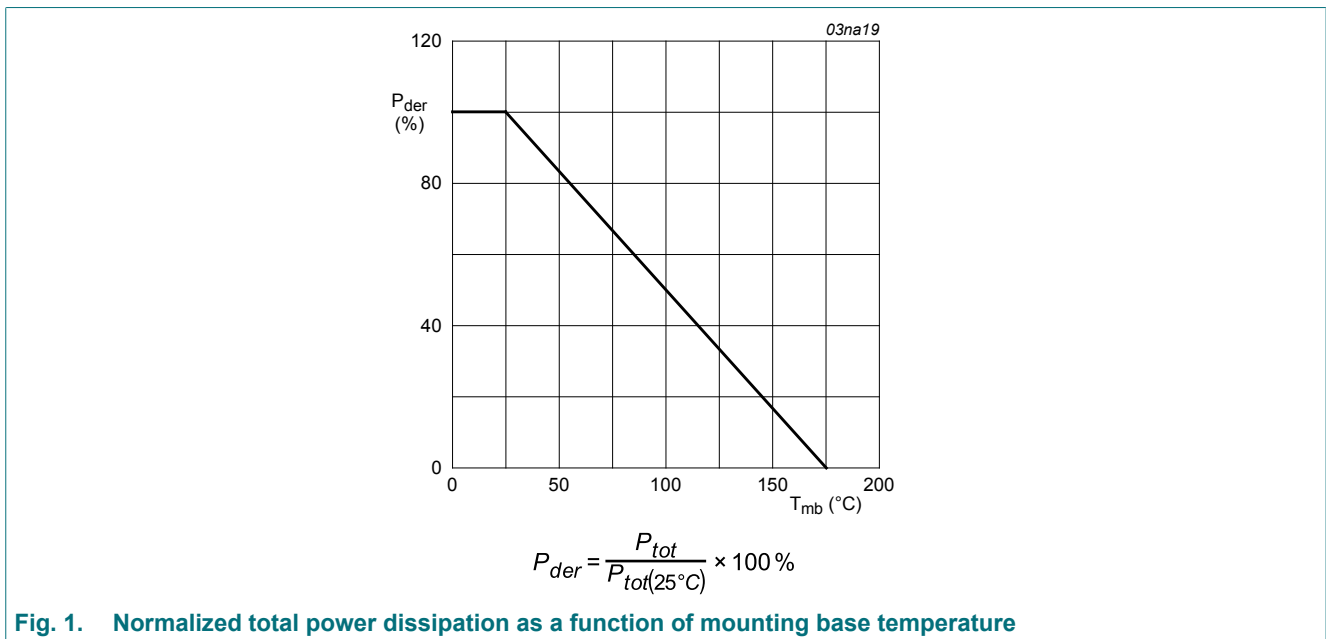
8. Limiting values

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		-	40	V
V _{GS}	gate-source voltage	DC; T _j ≤ 175 °C		-10	20	V
P _{tot}	total power dissipation	T _{mb} = 25 °C; Fig. 1		-	190	W
I _D	drain current	V _{GS} = 10 V; T _{mb} = 25 °C		-	120	A
I _{DM}	peak drain current	pulsed; t _p ≤ 10 μs; T _{mb} = 25 °C; Fig. 2		-	600	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	[1]	-	120	A
I _{SM}	peak source current	pulsed; t _p ≤ 10 μs; T _{mb} = 25 °C		-	600	A
Avalanche ruggedness						
E _{DS(AL)S}	non-repetitive drain-source avalanche energy	I _D = 120 A; V _{sup} ≤ 40 V; R _{GS} = 50 Ω; V _{GS} = 10 V; T _{j(init)} = 25 °C; unclamped; Fig. 3	[2] [3]	-	82.1	mJ

- [1] 120A 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.



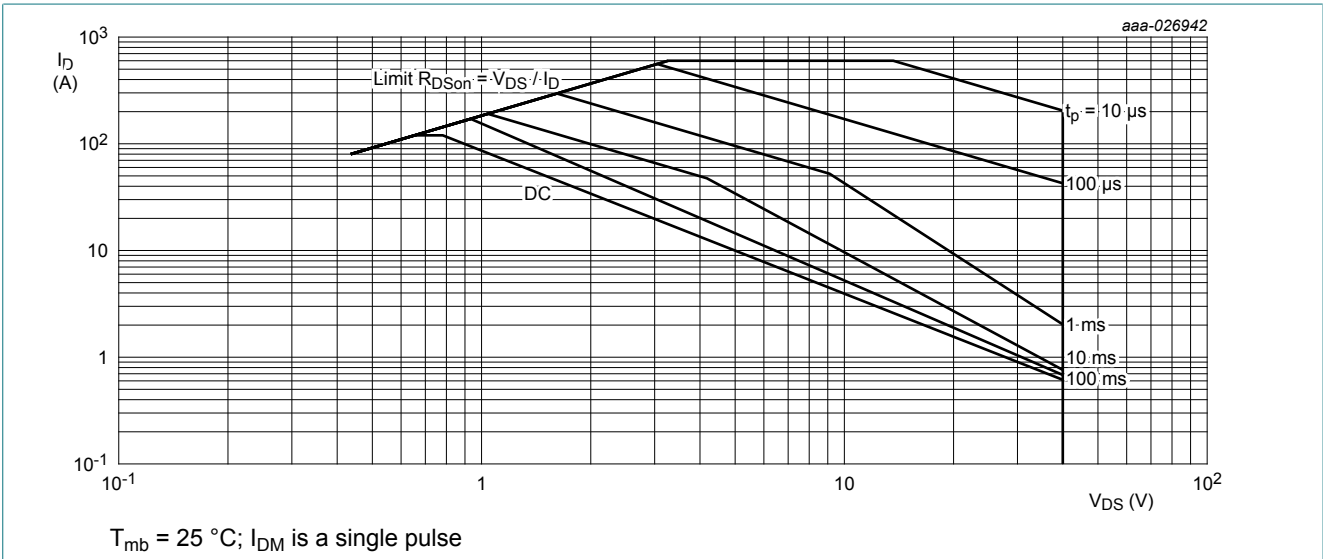


Fig. 2. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

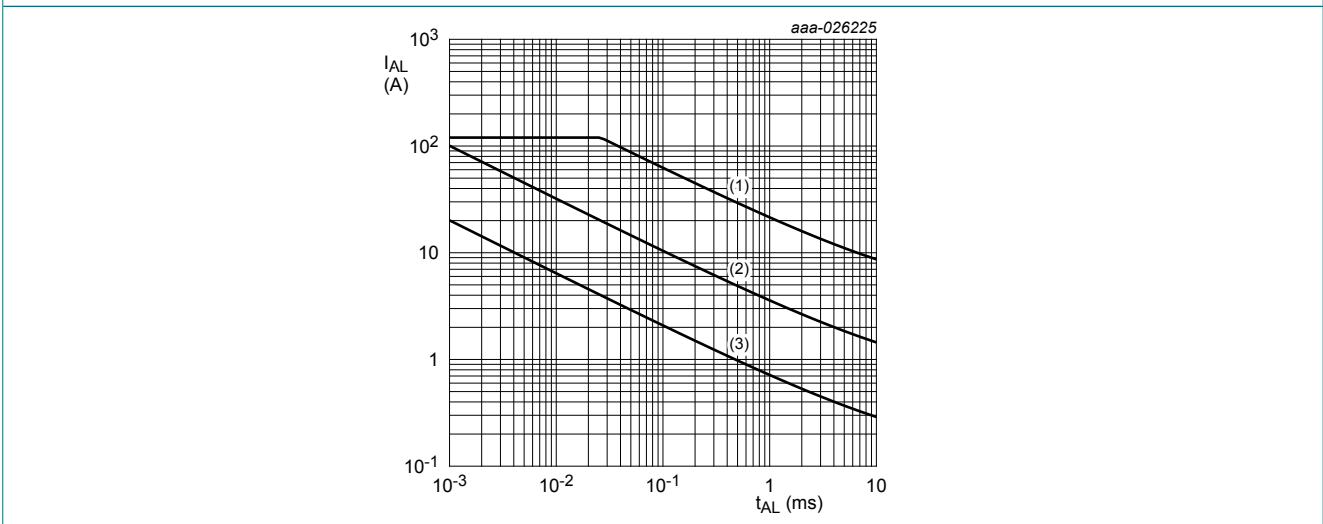


Fig. 3. Avalanche rating; avalanche current as a function of avalanche time

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. 4	-	0.63	0.79	K/W

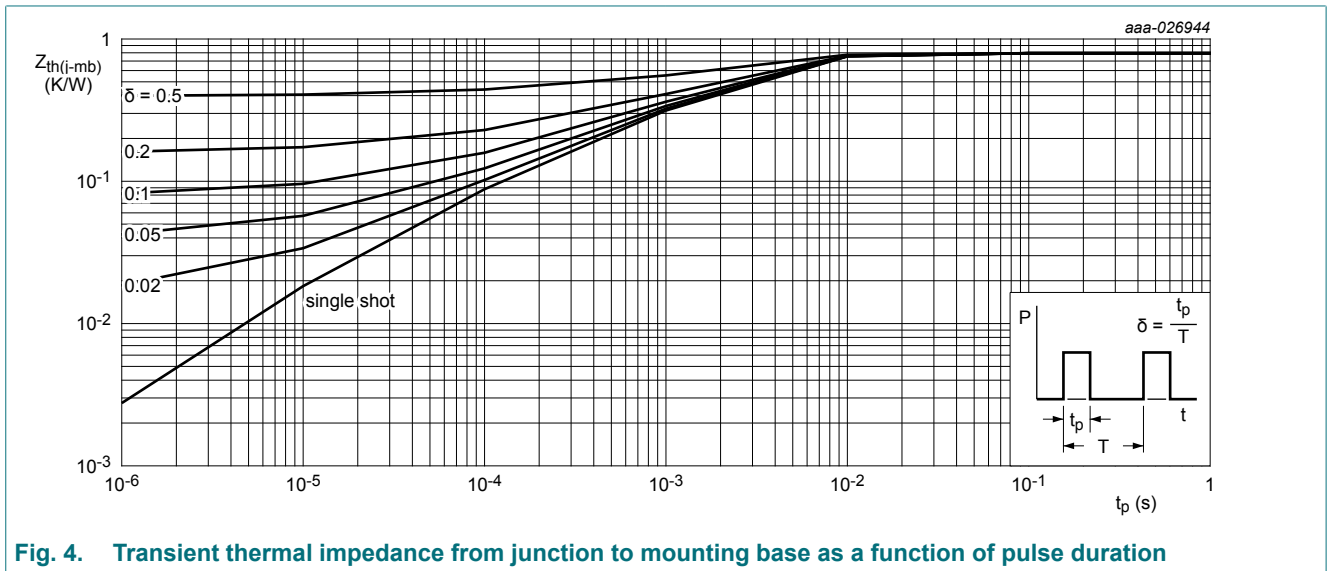


Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	40	43	-	V
		$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = -40 \text{ }^\circ\text{C}$	-	40.7	-	V
		$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$	36	40	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ Fig. 8 ; Fig. 9	2.4	3	3.6	V
		$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ Fig. 8	-	-	4.3	V
		$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = 175 \text{ }^\circ\text{C};$ Fig. 8	1	-	-	V
I_{DSS}	drain leakage current	$V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.02	1	μA
		$V_{DS} = 16 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \text{ }^\circ\text{C}$	-	1.2	10	μA
		$V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ\text{C}$	-	113	500	μA
I_{GSS}	gate leakage current	$V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	2	100	nA
		$V_{GS} = -10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ Fig. 10	1.5	2.13	2.5	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 105 \text{ }^\circ\text{C};$ Fig. 11	2.12	2.82	3.98	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 125 \text{ }^\circ\text{C};$ Fig. 11	2.34	3.18	4.38	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 175 \text{ }^\circ\text{C};$ Fig. 11	2.94	4.07	5.45	mΩ
R_G	gate resistance	$f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ\text{C}$	0.3	0.74	1.85	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 25 \text{ A}; V_{DS} = 32 \text{ V}; V_{GS} = 10 \text{ V};$ $T_j = 25 \text{ }^\circ\text{C};$ Fig. 12 ; Fig. 13	-	45.8	79	nC
Q_{GS}	gate-source charge		-	12.7	19	nC
Q_{GD}	gate-drain charge		-	8.9	22	nC
C_{iss}	input capacitance	$V_{DS} = 25 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz};$ $T_j = 25 \text{ }^\circ\text{C};$ Fig. 14	-	3193	4790	pF
C_{oss}	output capacitance		-	831	1163	pF
C_{rss}	reverse transfer capacitance		-	150	330	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30 \text{ V}; R_L = 1.2 \text{ } \Omega; V_{GS} = 10 \text{ V};$ $R_{G(ext)} = 5 \text{ } \Omega; T_j = 25 \text{ }^\circ\text{C}$	-	12.3	-	ns
t_r	rise time		-	10.3	-	ns
$t_{d(off)}$	turn-off delay time		-	27.5	-	ns
t_f	fall time		-	13	-	ns
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 25 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C};$ Fig. 15	-	0.8	1.2	V

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t_{rr}	reverse recovery time	$I_S = 25\text{ A}$; $dI_S/dt = -100\text{ A}/\mu\text{s}$; $V_{GS} = 0\text{ V}$; $V_{DS} = 20\text{ V}$; $T_J = 25\text{ }^\circ\text{C}$	-	29.3	-	ns
Q_r	recovered charge		-	22.7	-	nC
S	softness factor	$I_S = 25\text{ A}$; $dI_S/dt = -100\text{ A}/\mu\text{s}$; $V_{GS} = 0\text{ V}$; $V_{DS} = 20\text{ V}$; $T_J = 25\text{ }^\circ\text{C}$; Fig. 16	-	0.79	-	
		$I_S = 25\text{ A}$; $dI_S/dt = -500\text{ A}/\mu\text{s}$; $V_{GS} = 0\text{ V}$; $V_{DS} = 20\text{ V}$; $T_J = 25\text{ }^\circ\text{C}$; Fig. 16	-	0.65	-	

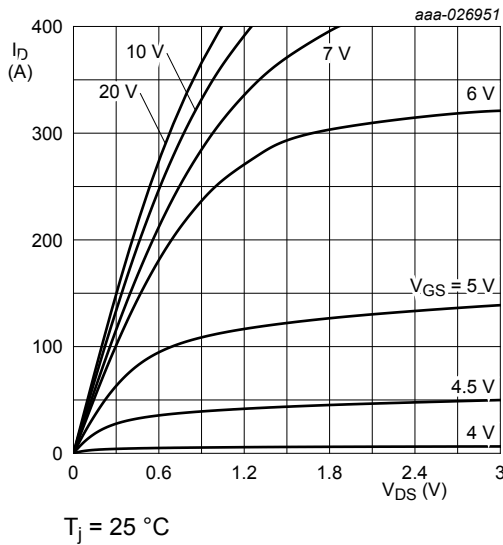


Fig. 5. Output characteristics; drain current as a function of drain-source voltage; typical values

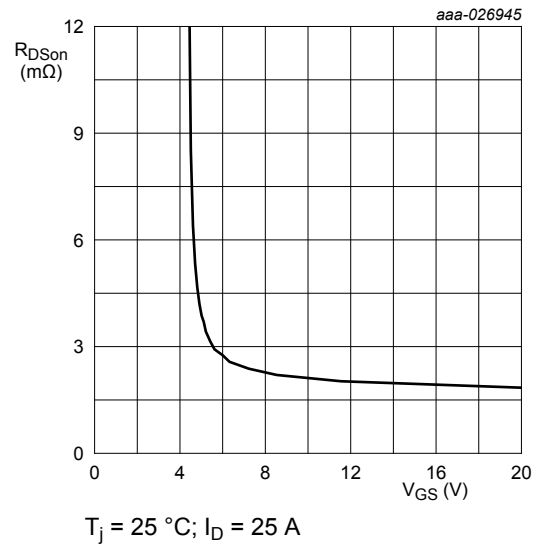


Fig. 6. Drain-source on-state resistance as a function of gate-source voltage; typical values

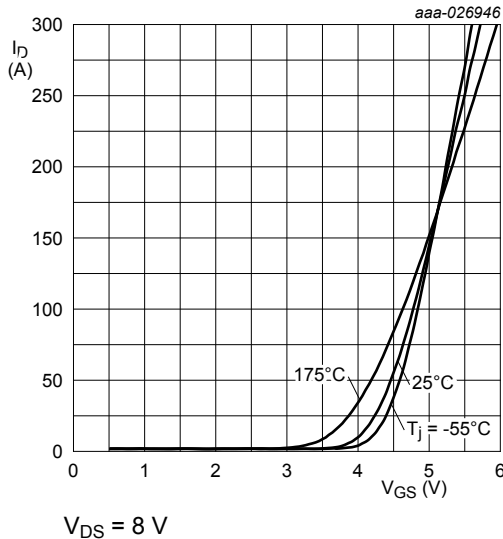


Fig. 7. Transfer characteristics; drain current as a function of gate-source voltage; typical values

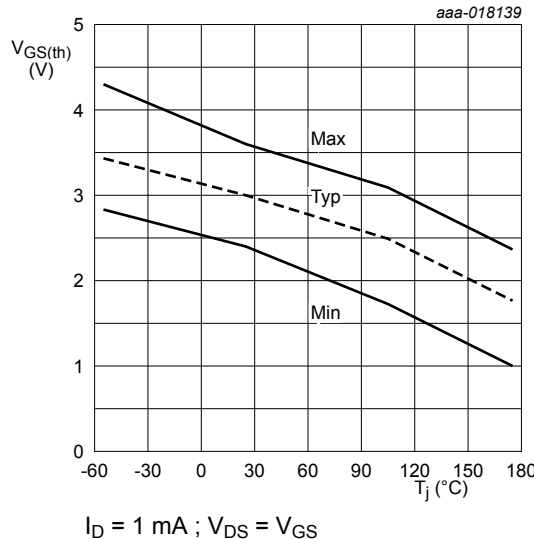
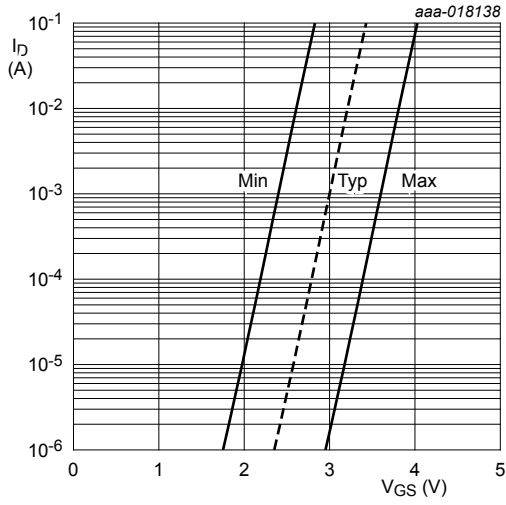
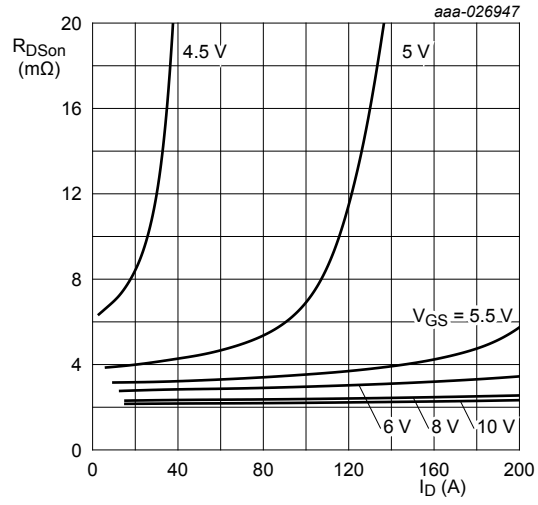


Fig. 8. Gate-source threshold voltage as a function of junction temperature



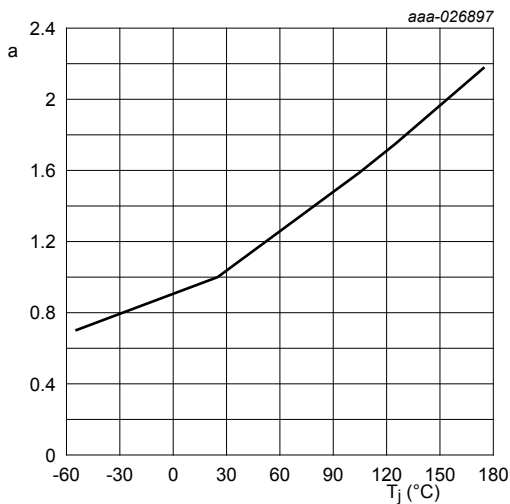
$T_j = 25\text{ °C}; V_{DS} = 5\text{ V}$

Fig. 9. Sub-threshold drain current as a function of gate-source voltage



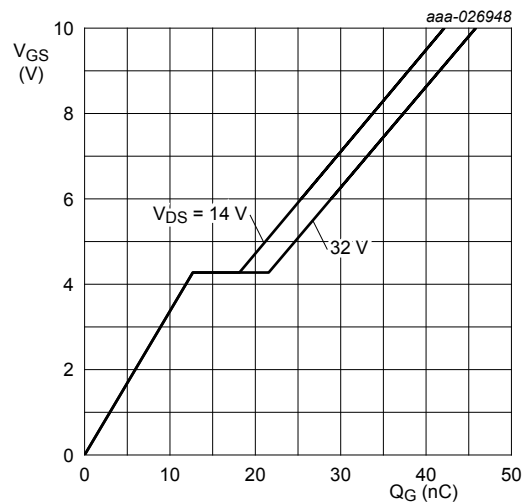
$T_j = 25\text{ °C}$

Fig. 10. Drain-source on-state resistance as a function of drain current; typical values



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

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



$T_j = 25\text{ °C}; I_D = 25\text{ A}$

Fig. 12. Gate-source voltage as a function of gate charge; typical values

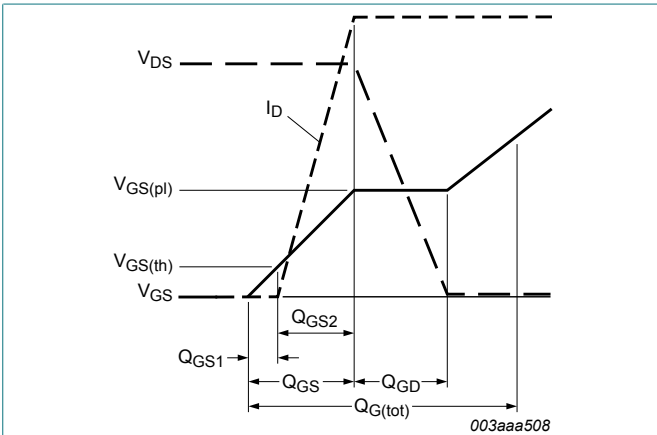
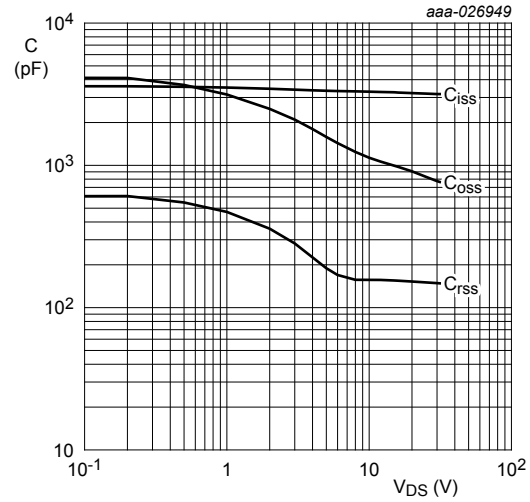
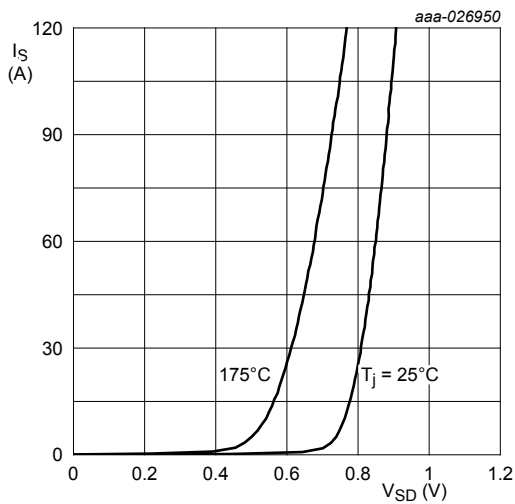


Fig. 13. Gate charge waveform definitions



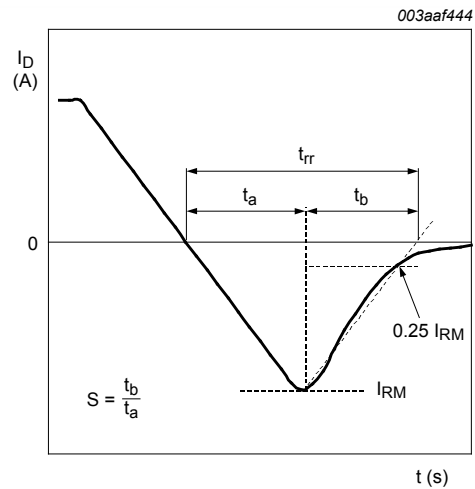
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

Fig. 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



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

Fig. 15. Source-drain (diode forward) current as a function of source-drain (diode forward) voltage; typical values

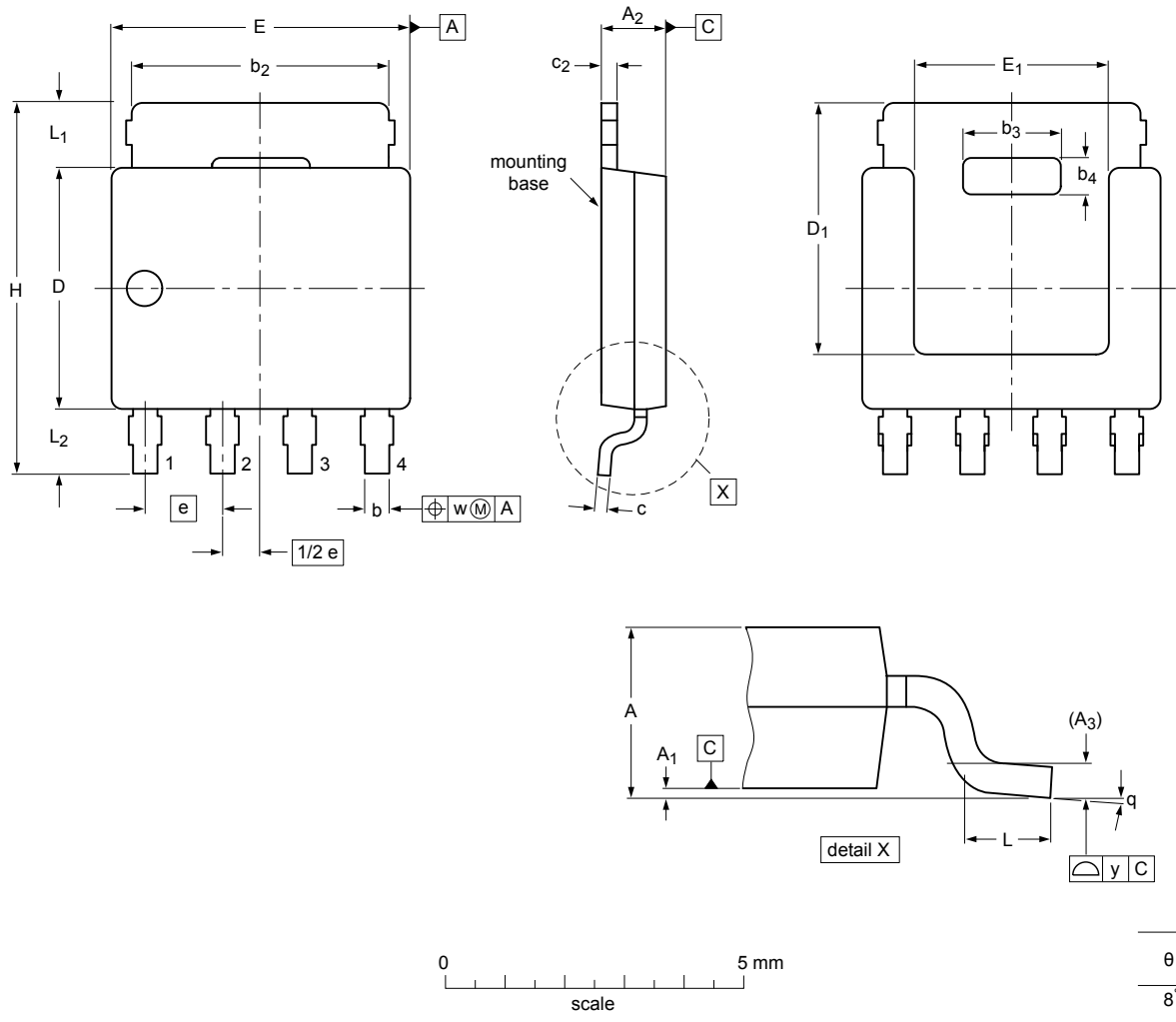


$$t_{rr} = t_a + t_b$$

Fig. 16. Reverse recovery waveform definitions

11. Package outline

Plastic single-ended surface-mounted package (LPAK56; 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
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	1.27	6.2	0.85	1.3	1.3		
nom				0.25																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		

Note

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

sot669_po

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

Fig. 17. Package outline LPAK56; 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.

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Contents

1. General description.....	1
2. Features and benefits.....	1
3. Applications.....	1
4. Quick reference data.....	2
5. Pinning information.....	3
6. Ordering information.....	3
7. Marking.....	3
8. Limiting values.....	4
9. Thermal characteristics.....	6
10. Characteristics.....	7
11. Package outline.....	11
12. Legal information.....	12

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