



BUK9Y1R6-40H

N-channel 40 V, 1.6 mΩ logic level MOSFET in LFPAK56

10 January 2025

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

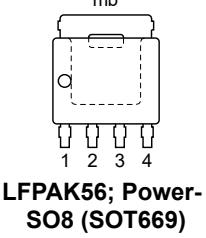
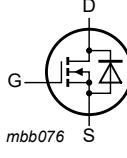
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$25^{\circ}\text{C} \leq T_j \leq 175^{\circ}\text{C}$		-	-	40	V
I_D	drain current	$V_{GS} = 10 \text{ V}; T_{mb} = 25^{\circ}\text{C}$	[1]	-	-	120	A
P_{tot}	total power dissipation	$T_{mb} = 25^{\circ}\text{C}$; Fig. 1		-	-	294	W
Static characteristics							
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25^{\circ}\text{C}$; Fig. 10		0.86	1.23	1.6	mΩ

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Dynamic characteristics							
Q _{GD}	gate-drain charge	I _D = 25 A; V _{DS} = 20 V; V _{GS} = 4.5 V; Fig. 12 ; Fig. 13		-	8.3	16.6	nC
Source-drain diode							
Q _r	recovered charge	I _S = 25 A; dI _S /dt = -100 A/μs; V _{GS} = 0 V;		-	30.6	-	nC
S	softness factor	V _{DS} = 20 V; T _j = 25 °C		-	0.84	-	

[1] 120A 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		
2	S	source		
3	S	source		
4	G	gate		
mb	D	mounting base; connected to drain	 LFPACK56; Power-SO8 (SOT669)	 mbb076

6. Ordering information

Table 3. Ordering information

Type number	Package			Version
	Name	Description		
BUK9Y1R6-40H	LFPAK56; Power-SO8	plastic, single-ended surface-mounted package; 4 terminals		SOT669

7. Marking

Table 4. Marking codes

Type number	Marking code
BUK9Y1R6-40H	91H640

8. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V _{DS}	drain-source voltage	25 °C ≤ T _j ≤ 175 °C		-	40	V
V _{GS}	gate-source voltage		[1]	-20	20	V
P _{tot}	total power dissipation	T _{mb} = 25 °C; Fig. 1		-	294	W
I _D	drain current	V _{GS} = 10 V; T _{mb} = 25 °C	[2]	-	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

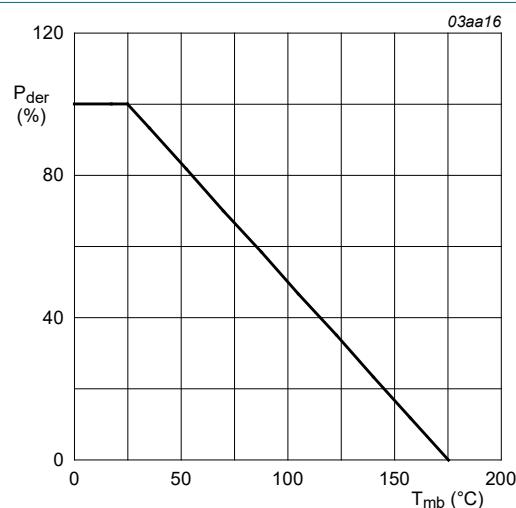
Symbol	Parameter	Conditions		Min	Max	Unit
T _j	junction temperature			-55	175	°C
Source-drain diode						
I _S	source current	T _{mb} = 25 °C	[2]	-	120	A
I _{SM}	peak source current	pulsed; t _p ≤ 10 µs; T _{mb} = 25 °C		-	600	A
Avalanche ruggedness						
E _{DS(AL)S}	non-repetitive drain-source avalanche 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	[3] [4]	-	158	mJ

[1] Refer to application note AN90001 for further information.

[2] 120A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature

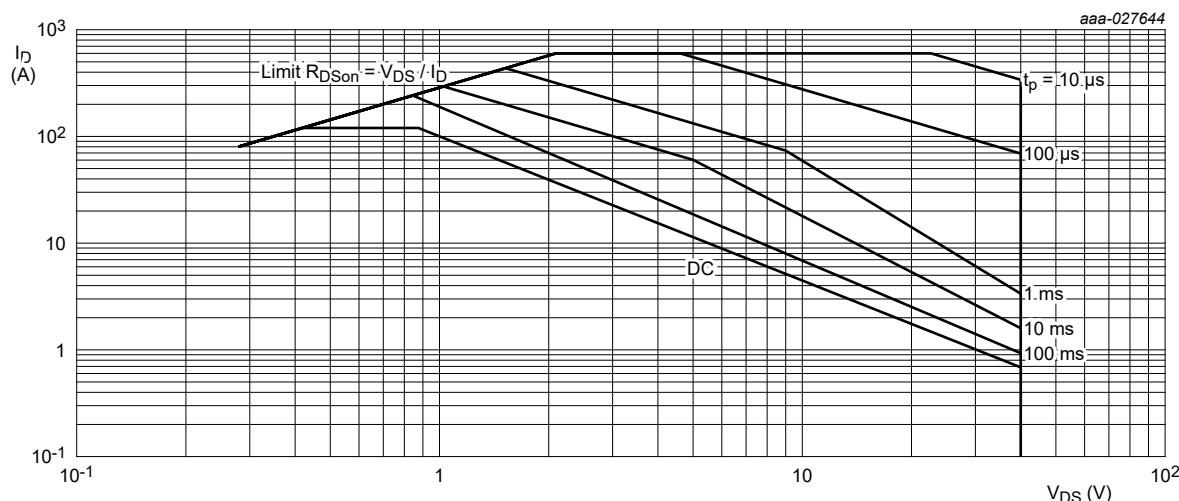
[3] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C

[4] Refer to application note AN10273 for further information



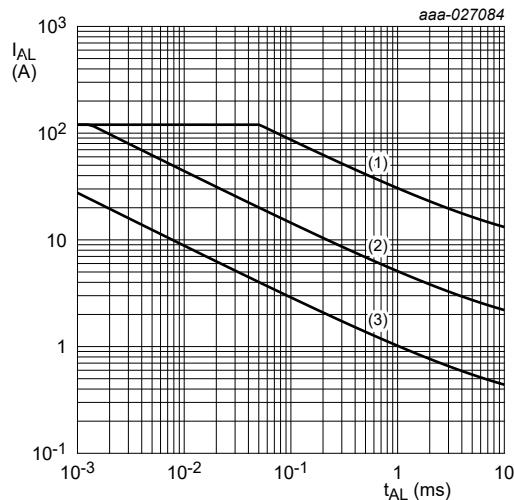
$$P_{der} = \frac{P_{tot}}{P_{tot}(25^{\circ}C)} \times 100 \%$$

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



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

Fig. 2. 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. 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	-	0.39	0.51	K/W

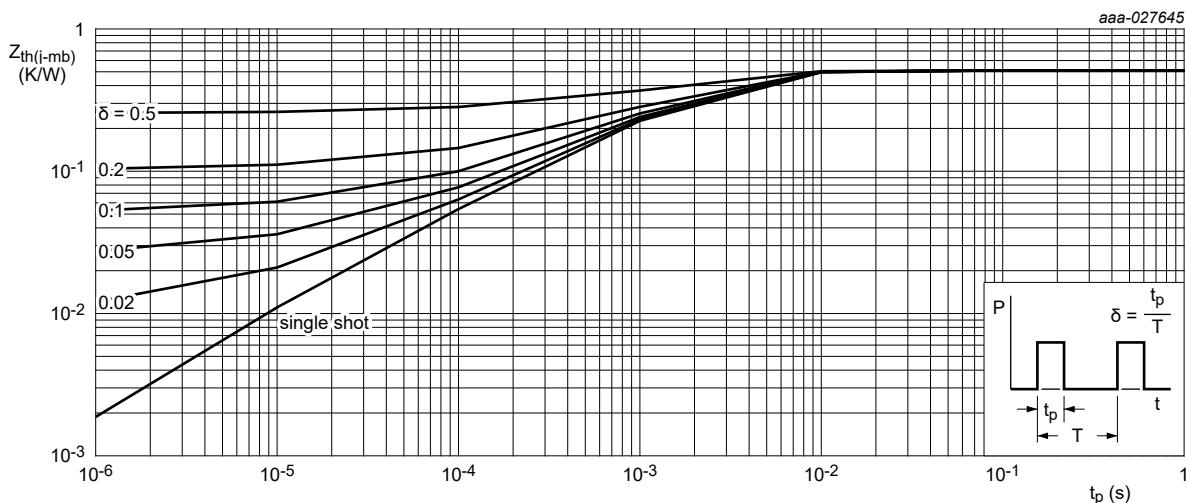


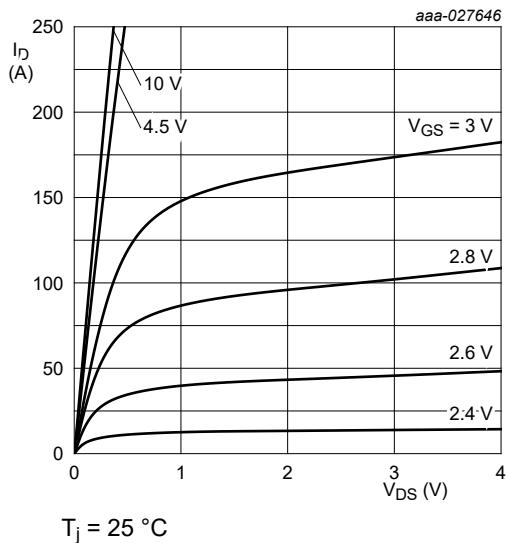
Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Characteristics

Table 7. Characteristics

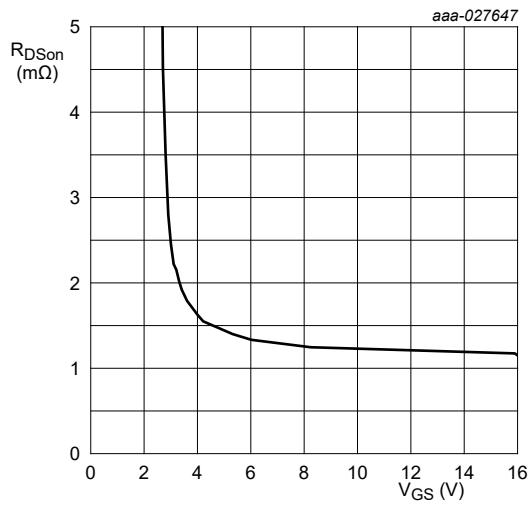
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25^\circ C$ $I_D = 250 \mu A; V_{GS} = 0 V; T_j = -40^\circ C$ $I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55^\circ C$		40	43	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 mA; V_{DS}=V_{GS}; T_j = 25^\circ C$; Fig. 8 ; Fig. 9 $I_D = 1 mA; V_{DS}=V_{GS}; T_j = 175^\circ C$; Fig. 9 $I_D = 1 mA; V_{DS}=V_{GS}; T_j = -55^\circ C$; Fig. 9		1.35	1.62	2.05	V
I_{DSS}	drain leakage current	$V_{DS} = 40 V; V_{GS} = 0 V; T_j = 25^\circ C$		-	0.11	5	μA
		$V_{DS} = 16 V; V_{GS} = 0 V; T_j = 125^\circ C$		-	1.8	10	μA
		$V_{DS} = 40 V; V_{GS} = 0 V; T_j = 175^\circ C$		-	220	500	μA
I_{GSS}	gate leakage current	$V_{GS} = 16 V; V_{DS} = 0 V; T_j = 25^\circ C$		-	2	100	nA
		$V_{GS} = -16 V; V_{DS} = 0 V; T_j = 25^\circ C$		-	2	100	nA
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10 V; I_D = 25 A; T_j = 25^\circ C$; Fig. 10		0.86	1.23	1.6	$m\Omega$
		$V_{GS} = 10 V; I_D = 25 A; T_j = 105^\circ C$; Fig. 11		1.3	1.89	2.5	$m\Omega$
		$V_{GS} = 10 V; I_D = 25 A; T_j = 125^\circ C$; Fig. 11		1.4	2.08	2.8	$m\Omega$
		$V_{GS} = 10 V; I_D = 25 A; T_j = 175^\circ C$; Fig. 11		1.8	2.62	3.5	$m\Omega$
		$V_{GS} = 4.5 V; I_D = 25 A; T_j = 25^\circ C$; Fig. 10		1.1	1.55	2.2	$m\Omega$
		$V_{GS} = 4.5 V; I_D = 25 A; T_j = 105^\circ C$; Fig. 11		1.6	2.34	3.5	$m\Omega$
		$V_{GS} = 4.5 V; I_D = 25 A; T_j = 125^\circ C$; Fig. 11		1.8	2.57	3.8	$m\Omega$
		$V_{GS} = 4.5 V; I_D = 25 A; T_j = 175^\circ C$; Fig. 11		2.3	3.21	4.8	$m\Omega$
R_G	gate resistance	$f = 1 \text{ MHz}; T_j = 25^\circ C$		0.36	0.9	2.25	Ω
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	$I_D = 25 A; V_{DS} = 20 V; V_{GS} = 10 V$; Fig. 12 ; Fig. 13		-	77	107.8	nC
		$I_D = 25 A; V_{DS} = 20 V; V_{GS} = 4.5 V$; Fig. 12 ; Fig. 13		-	34.9	48.9	nC
Q_{GS}	gate-source charge			-	12.4	18.6	nC
				-	8.3	16.6	nC
Q_{GD}	gate-drain charge						
C_{iss}	input capacitance	$V_{DS} = 25 V; V_{GS} = 0 V; f = 1 \text{ MHz}$ $T_j = 25^\circ C$; Fig. 14		-	5402	7563	pF
C_{oss}	output capacitance			-	1022	1431	pF
C_{rss}	reverse transfer capacitance			-	208	458	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 20 V; R_L = 0.8 \Omega; V_{GS} = 4.5 V$ $R_{G(ext)} = 5 \Omega$		-	27.6	-	ns
t_r	rise time			-	30.3	-	ns
$t_{d(off)}$	turn-off delay time			-	39.4	-	ns
t_f	fall time			-	22.9	-	ns

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
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
t_{rr}	reverse recovery time	$I_S = 25 \text{ A}; dI_S/dt = -100 \text{ A}/\mu\text{s}; V_{GS} = 0 \text{ V}$		-	34.7	-	ns
Q_r	recovered charge	$V_{DS} = 20 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$		-	30.6	-	nC
S	softness factor	$I_S = 25 \text{ A}; dI_S/dt = -500 \text{ A}/\mu\text{s}; V_{GS} = 0 \text{ V}$		-	0.84	-	
		$V_{DS} = 20 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$		-	0.66	-	



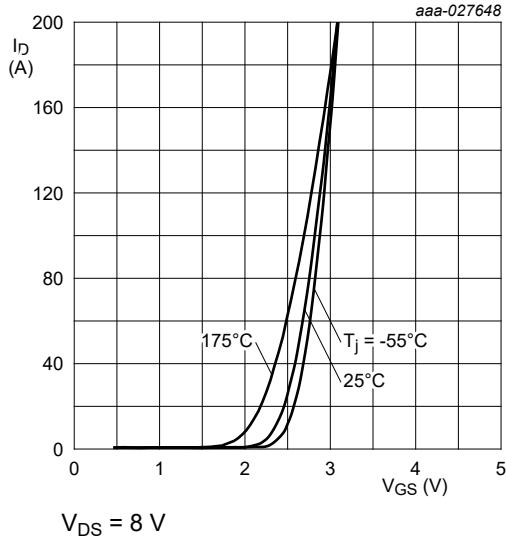
$T_j = 25 \text{ }^\circ\text{C}$

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



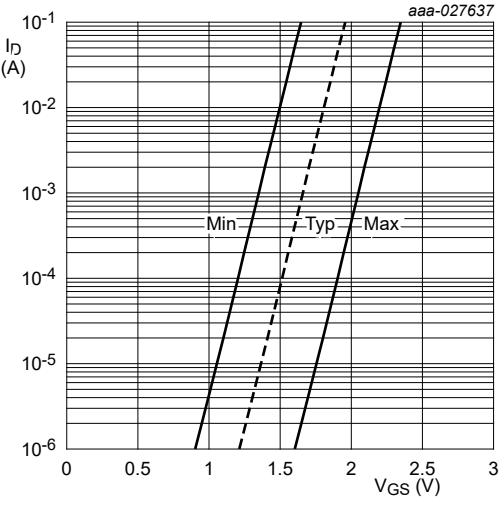
$T_j = 25 \text{ }^\circ\text{C}; I_D = 25 \text{ A}$

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



$V_{DS} = 8 \text{ V}$

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



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

Fig. 8. Sub-threshold drain current as a function of gate-source voltage

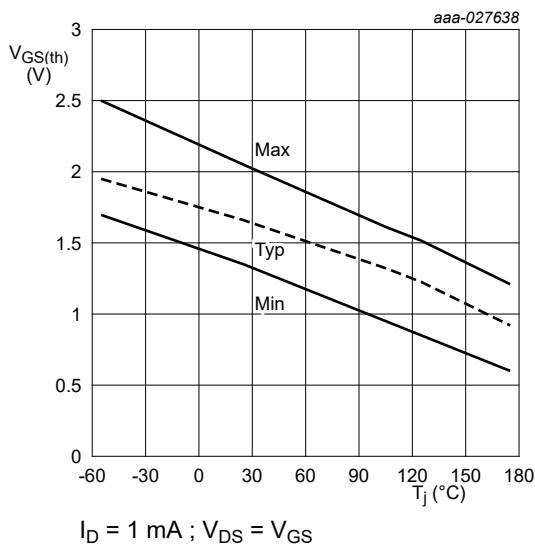


Fig. 9. Gate-source threshold voltage as a function of junction temperature

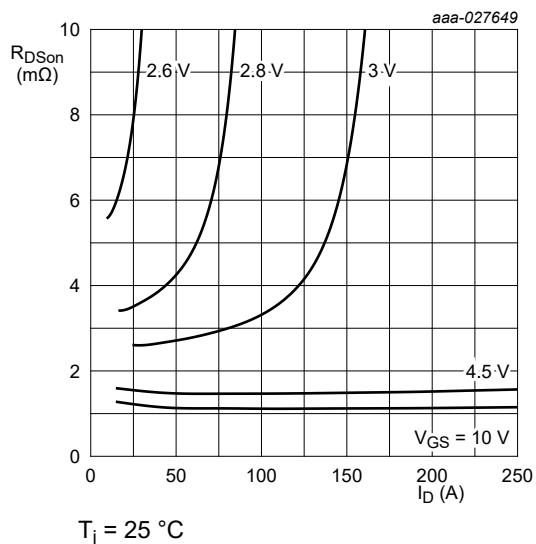


Fig. 10. Drain-source on-state resistance as a function of drain current; typical values

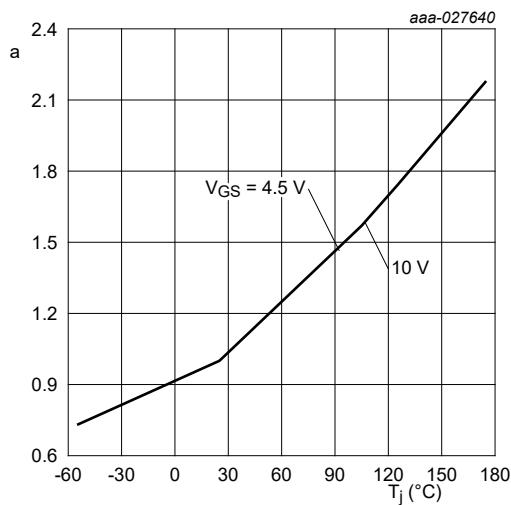


Fig. 11. Normalized drain-source on-state resistance factor as a function of junction temperature

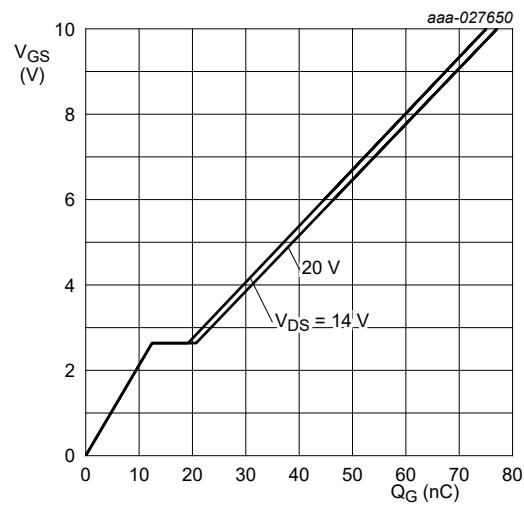


Fig. 12. Gate-source voltage as a function of gate charge; typical values

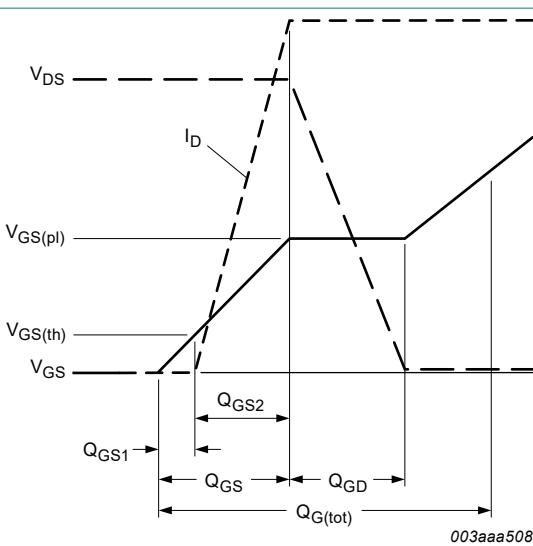


Fig. 13. Gate charge waveform definitions

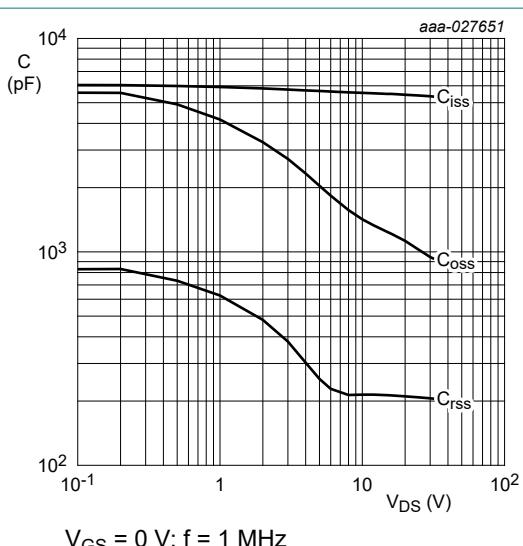


Fig. 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

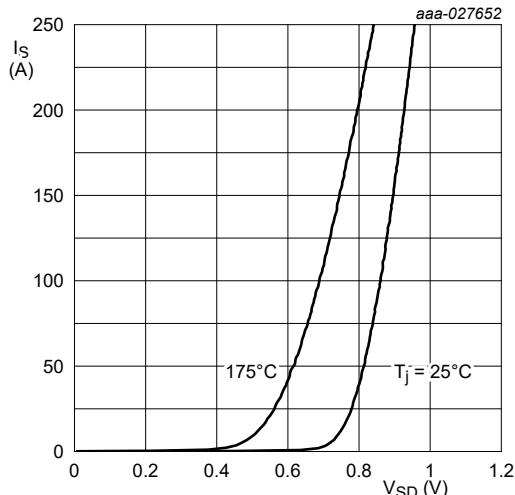
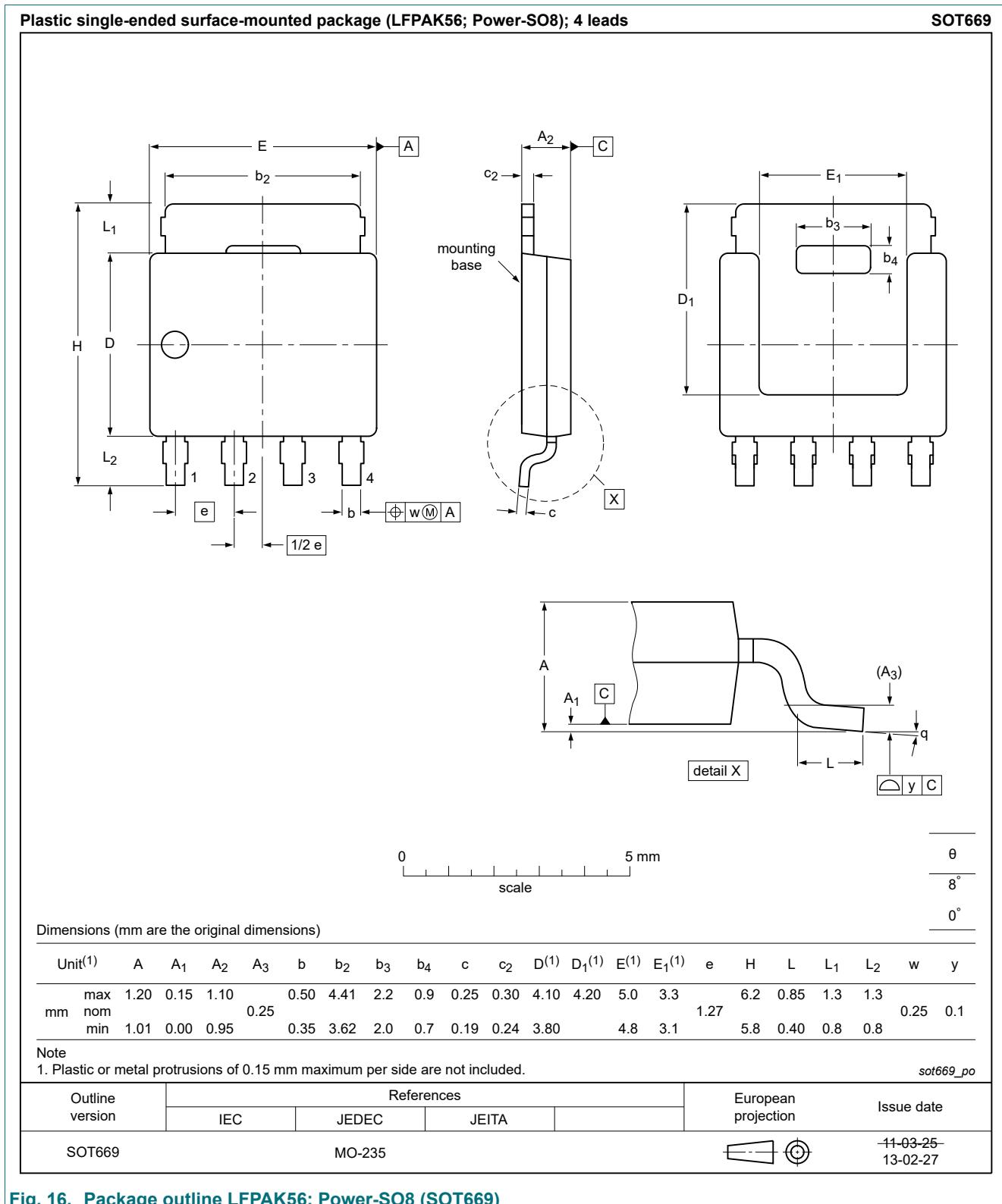


Fig. 15. Source-drain (diode forward) current as a function of source-drain (diode forward) voltage; typical values

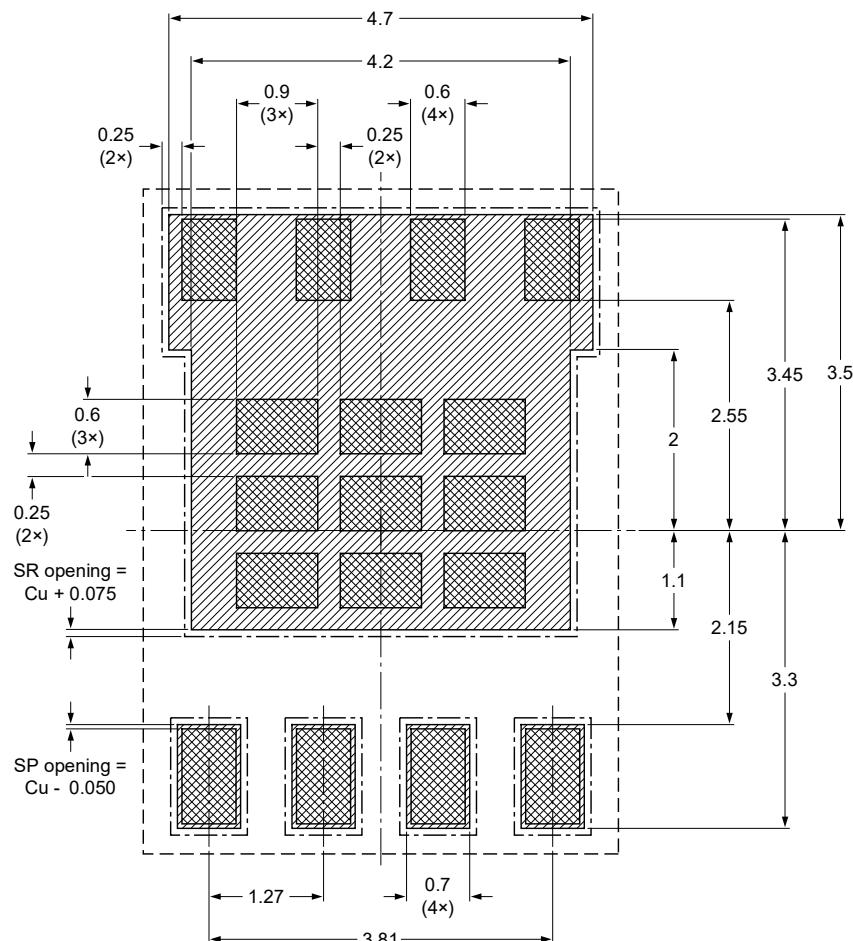
11. Package outline



12. Soldering

Footprint information for reflow soldering

SOT669



solder lands solder paste
125 µm stencil

solder resist occupied area

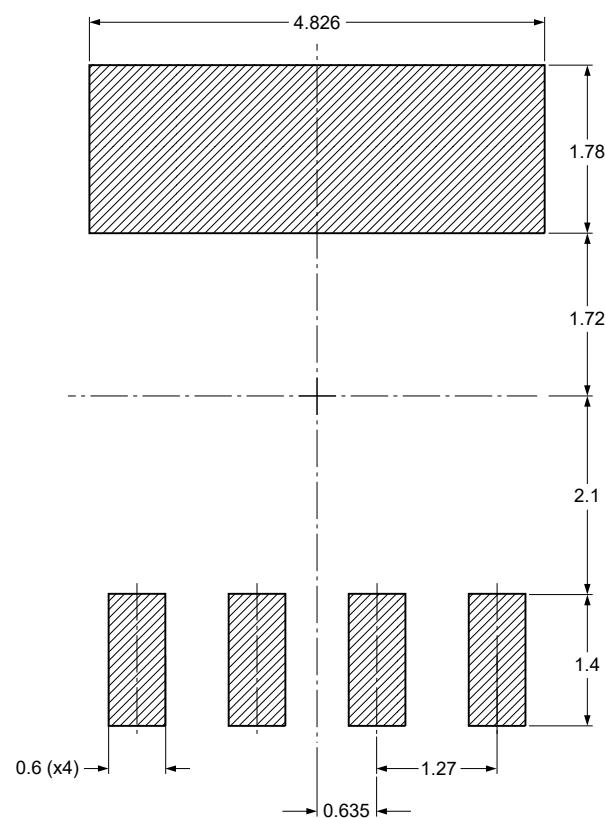
Dimensions in mm

sot669_fr

Fig. 17. Reflow soldering footprint for LFPAK56; Power-SO8 (SOT669)

Wave soldering footprint information for LFPAK56 package

SOT669

 solder lands

Dimensions in mm

Issue date 15-04-13
15-04-16

sot669_fw

Fig. 18. Wave soldering footprint for LFPAK56; Power-SO8 (SOT669)

13. 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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