BUK9K52-60E

Dual N-channel 60 V, 55 mΩ logic level MOSFET

24 February 2015 — Product data sheet

1. General description

Dual logic level N-channel MOSFET in an LFPAK56D (Dual Power-SO8) package using TrenchMOS technology. This product has been designed and qualified to AEC Q101 standard for use in high performance automotive applications.

2. Features and benefits

- Dual MOSFET
- Q101 Compliant
- Repetitive avalanche rated
- Suitable for thermally demanding environments due to 175 °C rating
- True logic level gate with $V_{GS(th)}$ rating of greater than 0.5 V at 175 °C

3. Applications

- 12 V Automotive systems
- Motors, lamps and solenoid control
- Transmission control
- Ultra high performance power switching

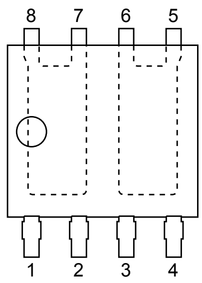
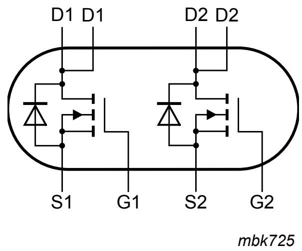
4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25$ °C; $T_j \leq 175$ °C		-	-	60	V
I_D	drain current	$V_{GS} = 5$ V; $T_{mb} = 25$ °C; Fig. 2		-	-	16	A
P_{tot}	total power dissipation	$T_{mb} = 25$ °C; Fig. 1		-	-	32	W
Static characteristics FET1 and FET2							
R_{DSon}	drain-source on-state resistance	$V_{GS} = 5$ V; $I_D = 5$ A; $T_j = 25$ °C; Fig. 12		-	47.3	55	mΩ
Dynamic characteristics FET1 and FET2							
Q_{GD}	gate-drain charge	$I_D = 5$ A; $V_{DS} = 48$ V; $V_{GS} = 5$ V; $T_j = 25$ °C; Fig. 14; Fig. 15		-	2.3	-	nC

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S1	source1	 LFPAK56D (SOT1205)	
2	G1	gate1		
3	S2	source2		
4	G2	gate2		
5	D2	drain2		
6	D2	drain2		
7	D1	drain1		
8	D1	drain1		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BUK9K52-60E	LFPAK56D	Plastic single ended surface mounted package (LFPAK56D); 8 leads	SOT1205

7. Marking

Table 4. Marking codes

Type number	Marking code
BUK9K52-60E	95260E

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	$T_j \geq 25$ °C; $T_j \leq 175$ °C		-	60	V
V_{DGR}	drain-gate voltage	$R_{GS} = 20$ kΩ; $T_j \geq 25$ °C; $T_j \leq 175$ °C		-	60	V
V_{GS}	gate-source voltage	$T_j \leq 175$ °C; DC		-10	10	V
		$T_j \leq 175$ °C; Pulsed	[1][2]	-15	15	V
P_{tot}	total power dissipation	$T_{mb} = 25$ °C; Fig. 1		-	32	W
I_D	drain current	$T_{mb} = 25$ °C; $V_{GS} = 5$ V; Fig. 2		-	16	A
		$T_{mb} = 100$ °C; $V_{GS} = 5$ V; Fig. 2		-	11	A

Symbol	Parameter	Conditions		Min	Max	Unit
I_{DM}	peak drain current	T_{mb} = 25 °C; pulsed; t_p ≤ 10 µs; Fig. 3		-	64	A
T_{stg}	storage temperature			-55	175	°C
T_j	junction temperature			-55	175	°C
$T_{sld(M)}$	peak soldering temperature			-	260	°C
Source-drain diode FET1 and FET2						
I_S	source current	T_{mb} = 25 °C		-	16	A
I_{SM}	peak source current	pulsed; t_p ≤ 10 µs; T_{mb} = 25 °C		-	64	A
Avalanche ruggedness FET1 and FET2						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 16 A; V_{sup} ≤ 60 V; V_{GS} = 5 V; $T_{j(init)}$ = 25 °C; Fig. 4	[3][4]	-	11.9	mJ

[1] Accumulated Pulse duration up to 50 hours delivers zero defect ppm
[2] Significantly longer life times are achieved by lowering T_j and or V_{GS}
[3] Refer to application note AN10273 for further information
[4] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C

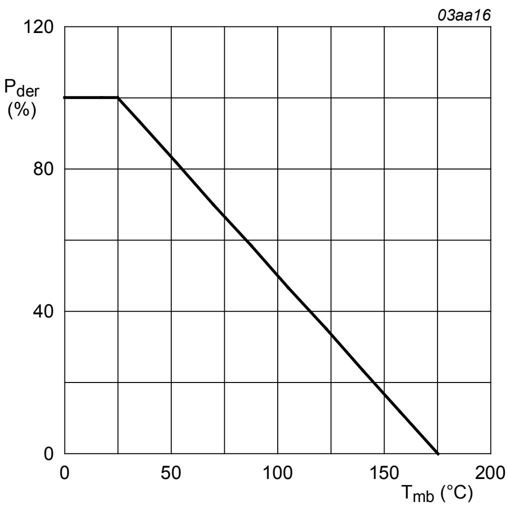


Fig. 1. Normalized total power dissipation as a function of mounting base temperature

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

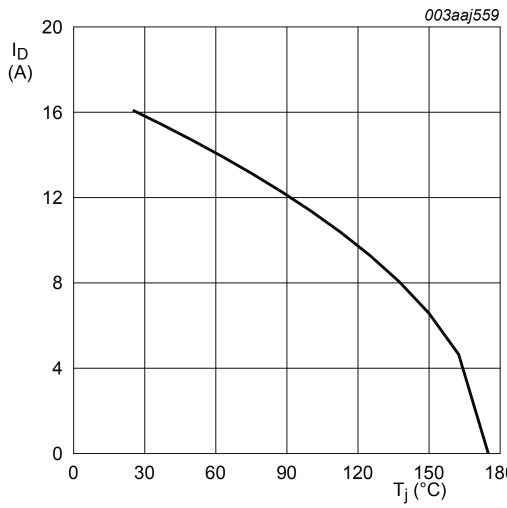


Fig. 2. Continuous drain current as a function of mounting base temperature

$$V_{GS} \geq 5V$$

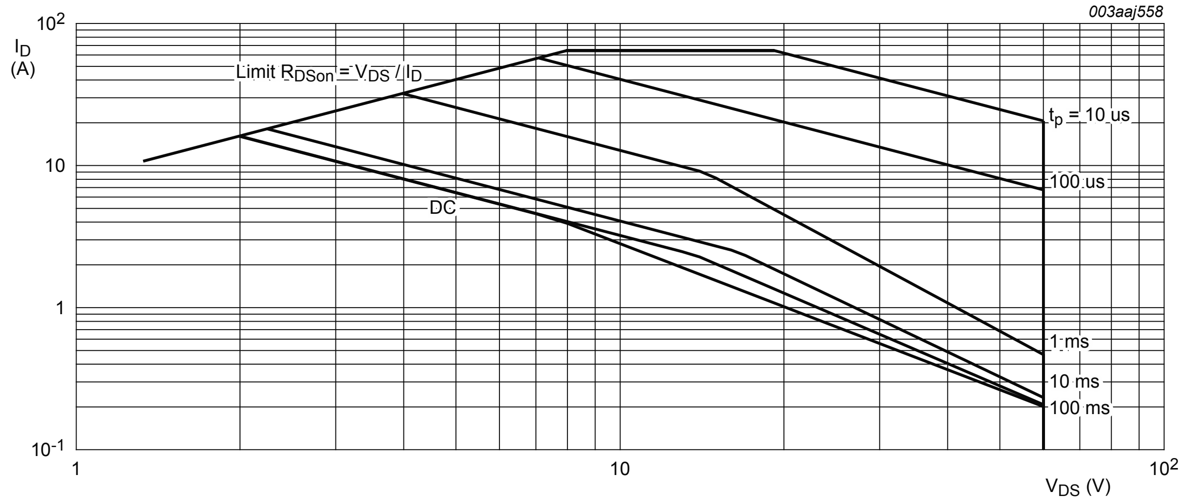


Fig. 3. Safe operating area; continuous and peak drain current as a function of drain-source voltage

$T_{mb} = 25\,°C$; I_{DM} is single pulse

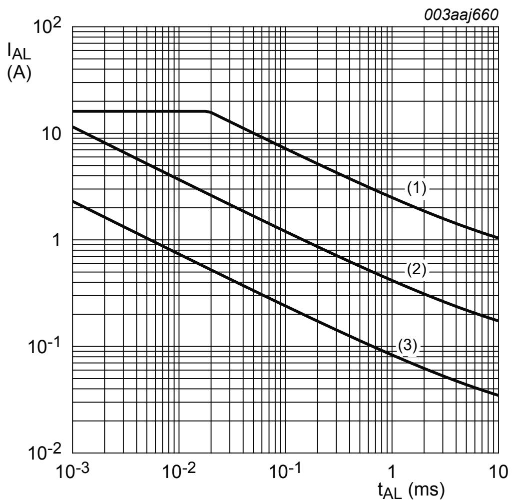


Fig. 4. Single-pulse and repetitive avalanche rating; avalanche current as a function of avalanche time, FET1 and FET2

(1) Single-pulse; $T_j = 25\,°C$.
(2) Single-pulse; $T_j = 150\,°C$.
(3) Repetitive.

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. 5		-	-	4.68	K/W

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	Minimum footprint; mounted on a printed circuit board		-	95	-	K/W

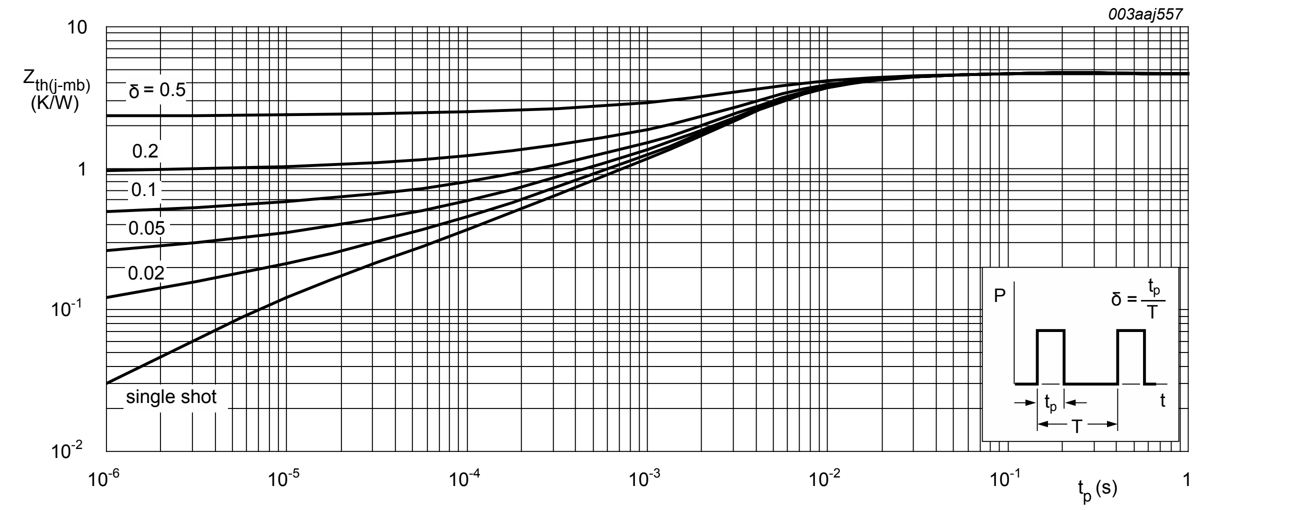


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics FET1 and FET2							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 µA; V_{GS} = 0 V; T_j = -55 °C		54	-	-	V
		I_D = 250 µA; V_{GS} = 0 V; T_j = 25 °C		60	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; T_j = 25 °C; Fig. 10; Fig. 11		1.4	1.7	2.1	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = 175 °C; Fig. 10; Fig. 11		0.5	-	-	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = -55 °C; Fig. 10; Fig. 11		-	-	2.45	V
I_{DSS}	drain leakage current	V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25 °C		-	0.02	1	µA
		V_{DS} = 60 V; V_{GS} = 0 V; T_j = 175 °C		-	-	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} = 5 V; I_D = 5 A; T_j = 25 °C; Fig. 12		-	47.3	55	mΩ
		V_{GS} = 5 V; I_D = 5 A; T_j = 175 °C; Fig. 12; Fig. 13		-	106.9	124.3	mΩ
		V_{GS} = 10 V; I_D = 5 A; T_j = 25 °C; Fig. 12		-	41.4	49	mΩ

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Dynamic characteristics FET1 and FET2							
$Q_{G(tot)}$	total gate charge	I_D = 5 A; V_{DS} = 48 V; V_{GS} = 5 V; T_j = 25 °C; Fig. 14; Fig. 15		-	5.6	-	nC
Q_{GS}	gate-source charge			-	1.1	-	nC
Q_{GD}	gate-drain charge			-	2.3	-	nC
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz; T_j = 25 °C; Fig. 16		-	544	725	pF
C_{oss}	output capacitance			-	74	89	pF
C_{rss}	reverse transfer capacitance			-	40	55	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 48 V; R_L = 10 Ω; V_{GS} = 5 V; $R_{G(ext)}$ = 5 Ω; T_j = 25 °C; I_D = 5 A		-	6.2	-	ns
t_r	rise time			-	10.1	-	ns
$t_{d(off)}$	turn-off delay time			-	10.7	-	ns
t_f	fall time			-	9	-	ns
Source-drain diode FET1 and FET2							
V_{SD}	source-drain voltage	I_S = 5 A; V_{GS} = 0 V; T_j = 25 °C; Fig. 17		-	0.78	1.2	V
t_{rr}	reverse recovery time	I_S = 5 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 30 V; T_j = 25 °C		-	17.7	-	ns
Q_r	recovered charge			-	11.6	-	nC

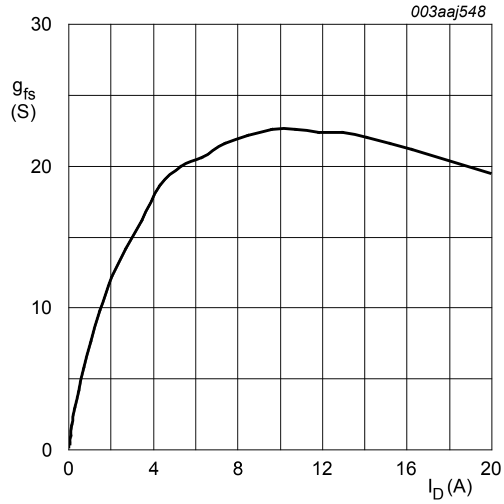


Fig. 6. Forward transconductance as a function of drain current; typical values

$T_j = 25\,°C; V_{DS} = 15\,V$

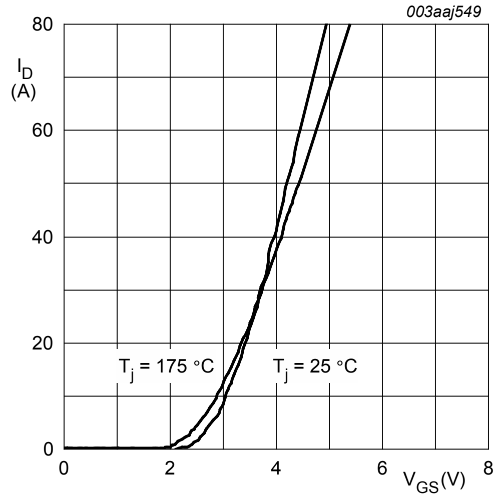


Fig. 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values

$V_{DS} = 10\,V$

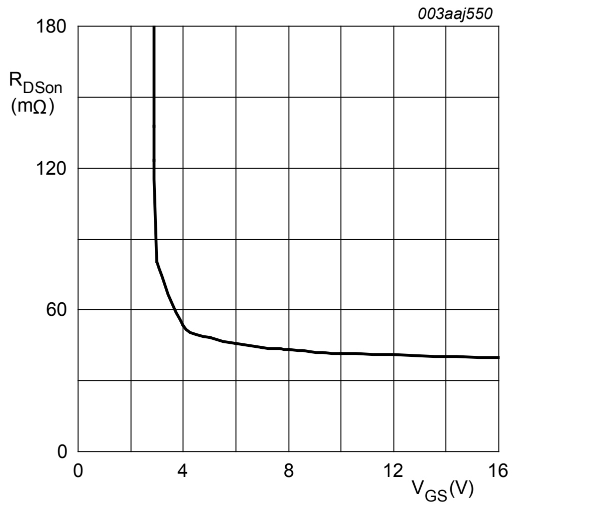


Fig. 8. Drain-source on-state resistance as a function of gate-source voltage; typical values

$T_j = 25\,°C;\ I_D = 5\,A$

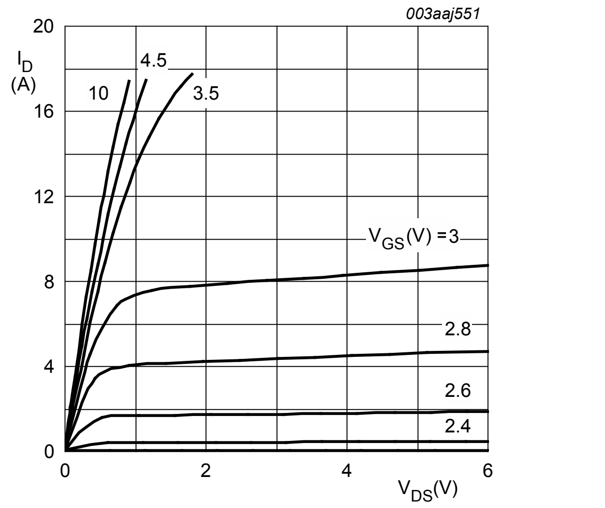


Fig. 9. Output characteristics: drain current as a function of drain-source voltage; typical values

$T_j = 25\,°C$

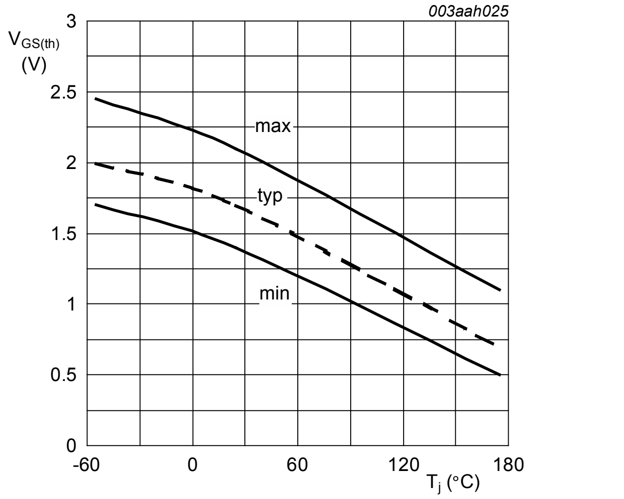


Fig. 10. Gate-source threshold voltage as a function of junction temperature

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

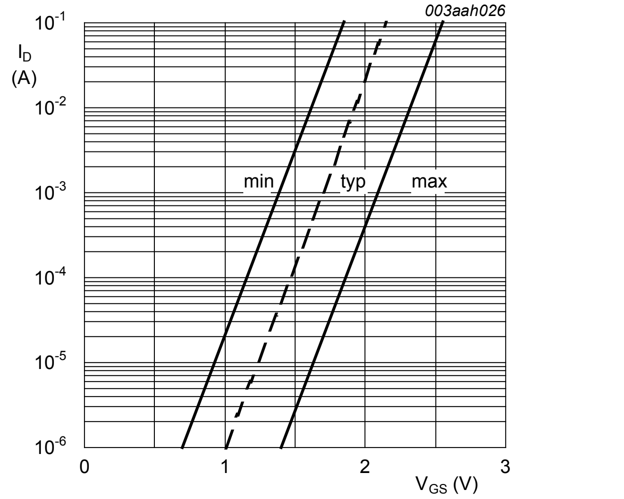


Fig. 11. Sub-threshold drain current as a function of gate-source voltage

$T_j = 25°C;\ V_{DS} = 5V$

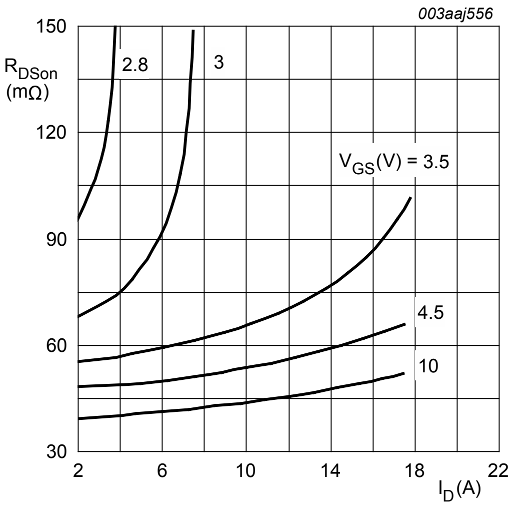


Fig. 12. Drain-source on-state resistance as a function of drain current; typical values

$T_j = 25\,°C$

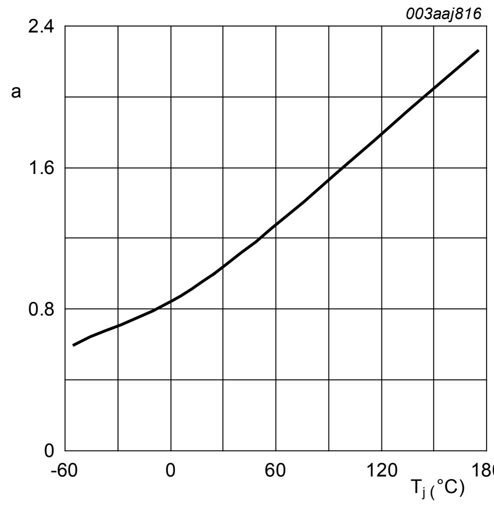


Fig. 13. Normalized drain-source on-state resistance factor as a function of junction temperature

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

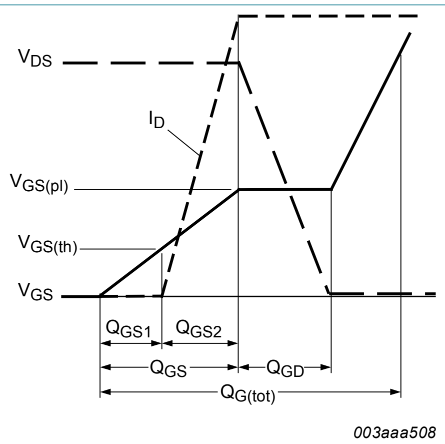


Fig. 14. Gate charge waveform definitions

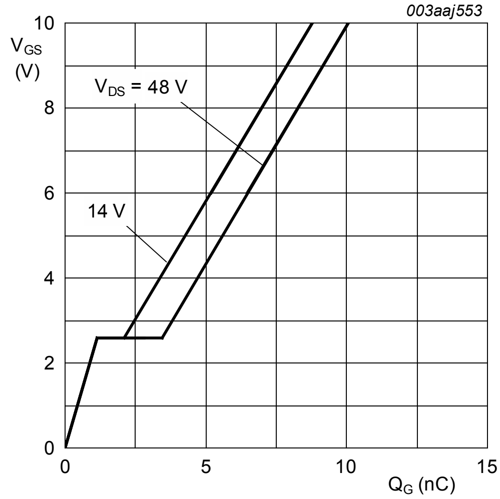


Fig. 15. Gate-source voltage as a function of gate charge; typical values

$T_j = 25\,°C; I_D = 5\,A$

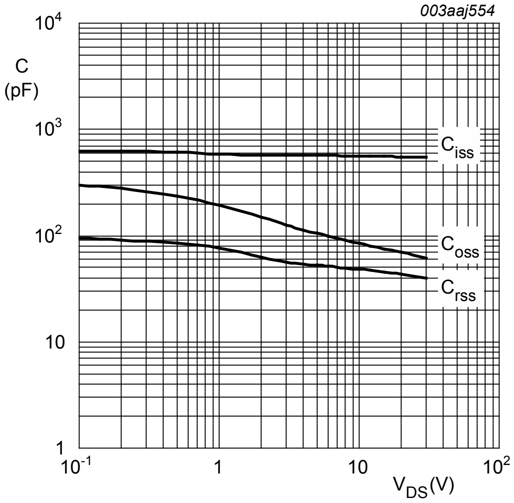


Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

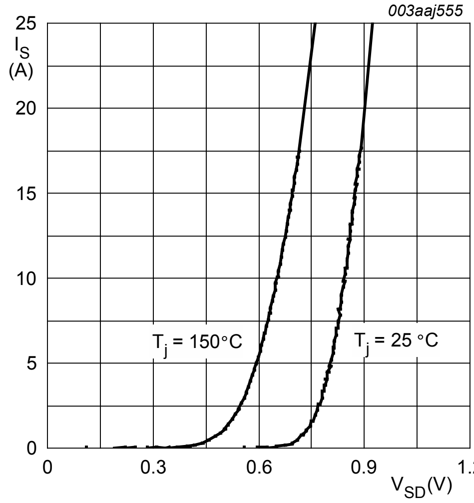
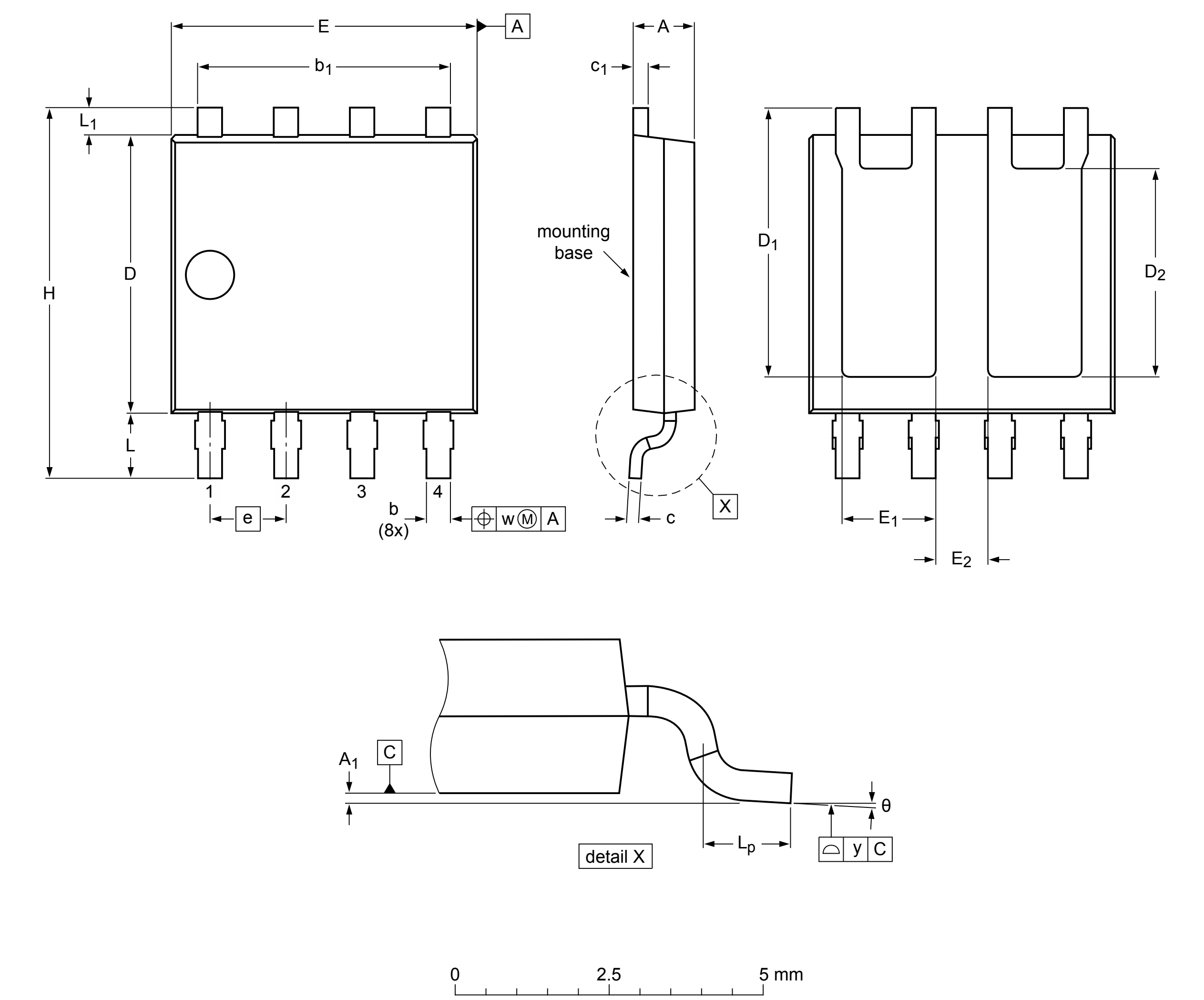


Fig. 17. Source current as a function of source-drain voltage; typical values

$V_{GS} = 0\ V$

11. Package outline

Plastic single ended surface mounted package LFPAK56D; 8 leads **SOT1205**



Dimensions

Unit		A	A_1	b	b_1	c	c_1	D(1)	D_1(1)	D_2 (ref)	E(1)	E_1(1)	E_2	e	H	L	L_1	L_p	w	y	θ
mm	max	1.05	0.1	0.50	4.4	0.25	0.30	4.70	4.55	3.5	5.30	1.8	0.85		6.2	1.3	0.55	0.85			8°
	nom													1.27					0.25	0.1	
	min	1.02	0.0	0.35	4.1	0.19	0.24	4.45	4.35	3.4	4.95	1.6	0.60		5.9	0.8	0.30	0.40			0°

Note
1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

sot1205_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1205						~~14-08-21~~ 14-10-28

Fig. 18. Package outline LFPAK56D (SOT1205)

12. Legal information

12.1 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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13. Contents

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Date of release: 24 February 2015

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