



# BUK9M156-100E

N-channel 100 V, 156 mΩ logic level MOSFET in LFPAK33

19 September 2016

Product data sheet

## 1. General description

Logic level N-channel MOSFET in an LFPAK33 (Power33) 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

- 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, 24 V and 48 V automotive systems
- Motors, lamps and solenoid control
- Transmission control
- Ultra high performance power switching

## 4. Quick reference data

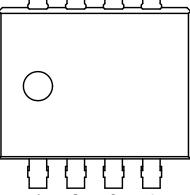
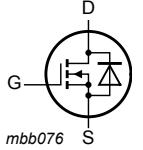
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$25 \text{ }^\circ\text{C} \leq T_j \leq 175 \text{ }^\circ\text{C}$		-	-	100	V
$I_D$	drain current	$V_{GS} = 5 \text{ V}$ ; $T_{mb} = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 2</a>		-	-	9.3	A
$P_{tot}$	total power dissipation	$T_{mb} = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 1</a>		-	-	36	W
<b>Static characteristics</b>							
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 5 \text{ V}$ ; $I_D = 5 \text{ A}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 11</a>		-	124	156	$\text{m}\Omega$
<b>Dynamic characteristics</b>							
$Q_{GD}$	gate-drain charge	$I_D = 5 \text{ A}$ ; $V_{DS} = 80 \text{ V}$ ; $V_{GS} = 5 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a>		-	3.2	-	nC

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## 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	 LFPAK33 (SOT1210)	

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BUK9M156-100E	LFPAK33	Plastic single ended surface mounted package (LFPAK33); 8 leads	SOT1210

## 7. Marking

Table 4. Marking codes

Type number	Marking code
BUK9M156-100E	915610

## 8. Limiting values

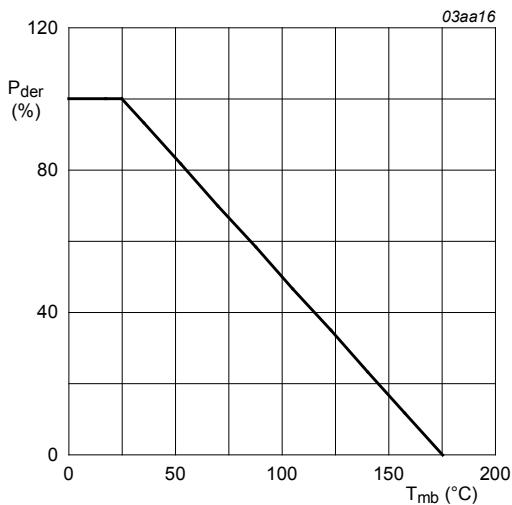
Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	$25^{\circ}\text{C} \leq T_j \leq 175^{\circ}\text{C}$	-	100	V
$V_{DGR}$	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$	-	100	V
$V_{GS}$	gate-source voltage	DC; $T_j \leq 175^{\circ}\text{C}$	-10	10	V
		Pulsed; $T_j \leq 175^{\circ}\text{C}$	[1][2]	-15	V
$P_{\text{tot}}$	total power dissipation	$T_{mb} = 25^{\circ}\text{C}$ ; <a href="#">Fig. 1</a>	-	36	W
$I_D$	drain current	$V_{GS} = 5\text{ V}$ ; $T_{mb} = 25^{\circ}\text{C}$ ; <a href="#">Fig. 2</a>	-	9.3	A
		$V_{GS} = 5\text{ V}$ ; $T_{mb} = 100^{\circ}\text{C}$ ; <a href="#">Fig. 2</a>	-	6.5	A
$I_{DM}$	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25^{\circ}\text{C}$ ; <a href="#">Fig. 3</a>	-	37	A

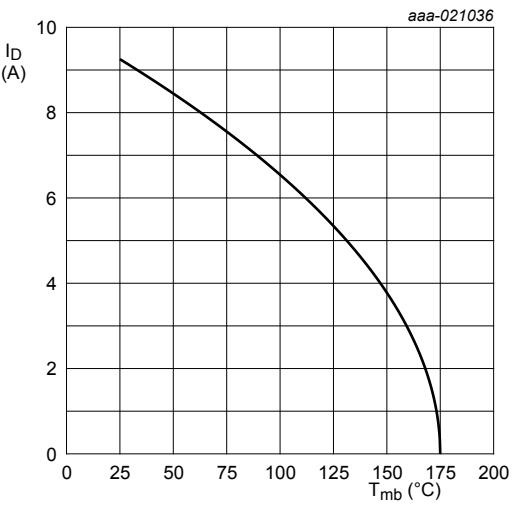
Symbol	Parameter	Conditions		Min	Max	Unit
T <sub>stg</sub>	storage temperature			-55	175	°C
T <sub>j</sub>	junction temperature			-55	175	°C
<b>Source-drain diode</b>						
I <sub>S</sub>	source current	T <sub>mb</sub> = 25 °C		-	9.3	A
I <sub>SM</sub>	peak source current	pulsed; t <sub>p</sub> ≤ 10 µs; T <sub>mb</sub> = 25 °C		-	37	A
<b>Avalanche ruggedness</b>						
E <sub>DS(AL)S</sub>	non-repetitive drain-source avalanche energy	I <sub>D</sub> = 9.3 A; V <sub>sup</sub> ≤ 100 V; R <sub>GS</sub> = 50 Ω; V <sub>GS</sub> = 5 V; T <sub>j(init)</sub> = 25 °C; unclamped; <a href="#">Fig. 4</a>	[3][4]	-	9.6	mJ

- [1] Accumulated pulse duration up to 50 hours delivers zero defect ppm.
- [2] Significantly longer life times are achieved by lowering T<sub>j</sub> and or V<sub>GS</sub>
- [3] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
- [4] Refer to application note AN10273 for further information.



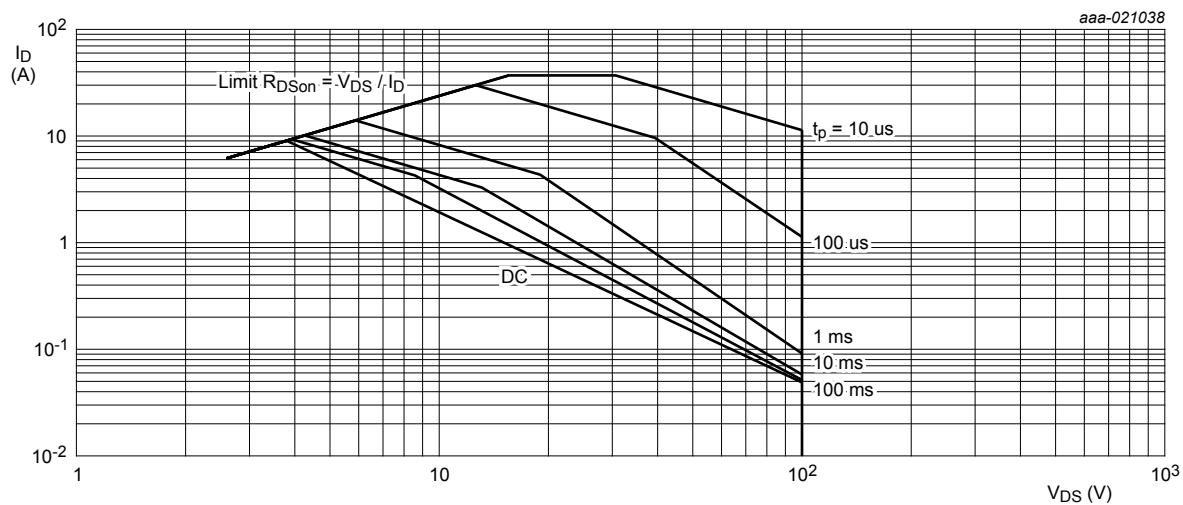
**Fig. 1. Normalized total power dissipation as a function of mounting base temperature**

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



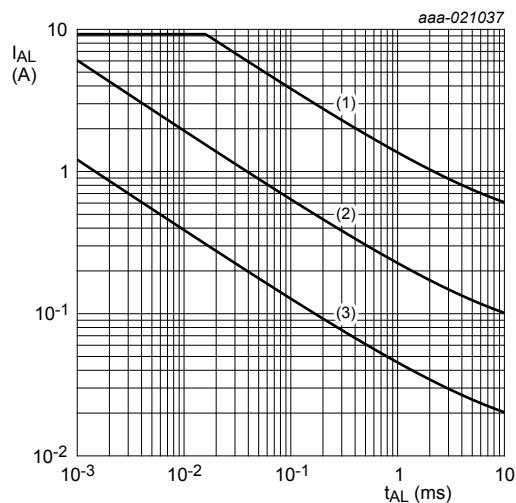
**Fig. 2. Continuous drain current as a function of mounting base temperature**

$$I_D = 9.3A \times \sqrt{\frac{175^\circ C - T_{mb}}{150^\circ C}} \text{ for } T_{mb} \geq 25^\circ C$$



$T_{mb} = 25^\circ\text{C}$ ;  $I_{DM}$  is a single pulse

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



(1)  $T_{j\text{ (init)}} = 25^\circ\text{C}$ ; (2)  $T_{j\text{ (init)}} = 150^\circ\text{C}$ ; (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	<a href="#">Fig. 5</a>		-	3.61	4.17	K/W

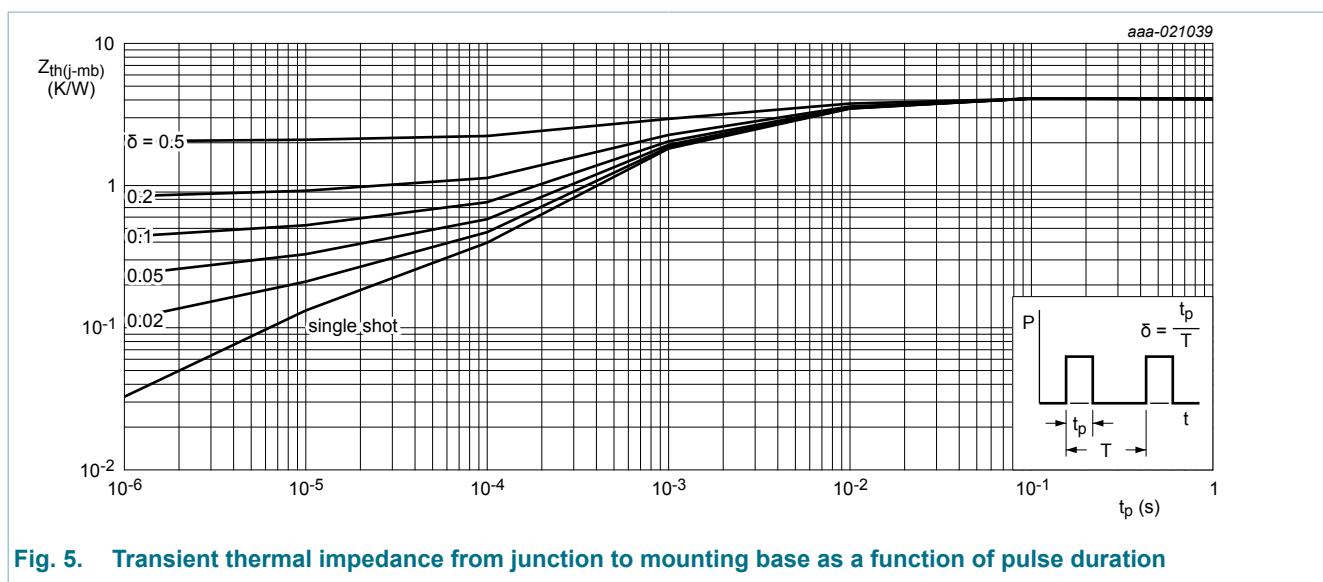


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 10. Characteristics

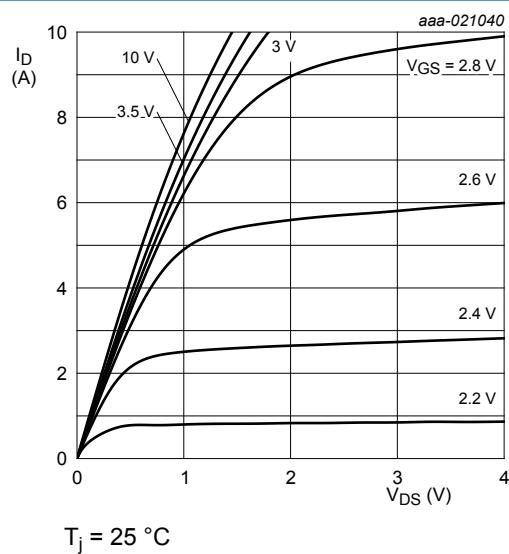
Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<b>Static characteristics</b>							
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A$ ; $V_{GS} = 0 V$ ; $T_j = 25^\circ C$		100	-	-	V
		$I_D = 250 \mu A$ ; $V_{GS} = 0 V$ ; $T_j = -55^\circ C$		90	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 mA$ ; $V_{DS} = V_{GS}$ ; $T_j = 25^\circ C$ ; <a href="#">Fig. 9</a> ; <a href="#">Fig. 10</a>		1.4	1.7	2.1	V
		$I_D = 1 mA$ ; $V_{DS} = V_{GS}$ ; $T_j = -55^\circ C$ ; <a href="#">Fig. 10</a>		-	-	2.45	V
		$I_D = 1 mA$ ; $V_{DS} = V_{GS}$ ; $T_j = 175^\circ C$ ; <a href="#">Fig. 10</a>		0.5	-	-	V
$I_{DSS}$	drain leakage current	$V_{DS} = 100 V$ ; $V_{GS} = 0 V$ ; $T_j = 25^\circ C$		-	0.01	1	$\mu A$
		$V_{DS} = 100 V$ ; $V_{GS} = 0 V$ ; $T_j = 175^\circ C$		-	-	500	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 10 V$ ; $V_{DS} = 0 V$ ; $T_j = 25^\circ C$		-	2	100	nA
		$V_{GS} = -10 V$ ; $V_{DS} = 0 V$ ; $T_j = 25^\circ C$		-	2	100	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 5 V$ ; $I_D = 5 A$ ; $T_j = 25^\circ C$ ; <a href="#">Fig. 11</a>		-	124	156	$m\Omega$
		$V_{GS} = 10 V$ ; $I_D = 5 A$ ; $T_j = 25^\circ C$ ; <a href="#">Fig. 11</a>		-	120	150	$m\Omega$
		$V_{GS} = 5 V$ ; $I_D = 5 A$ ; $T_j = 175^\circ C$ ; <a href="#">Fig. 12</a>		-	-	420	$m\Omega$
<b>Dynamic characteristics</b>							
$Q_{G(tot)}$	total gate charge	$I_D = 5 A$ ; $V_{DS} = 80 V$ ; $V_{GS} = 5 V$ ; $T_j = 25^\circ C$ ; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a>		-	7.4	-	nC
$Q_{GS}$	gate-source charge			-	1.4	-	nC
$Q_{GD}$	gate-drain charge			-	3.2	-	nC

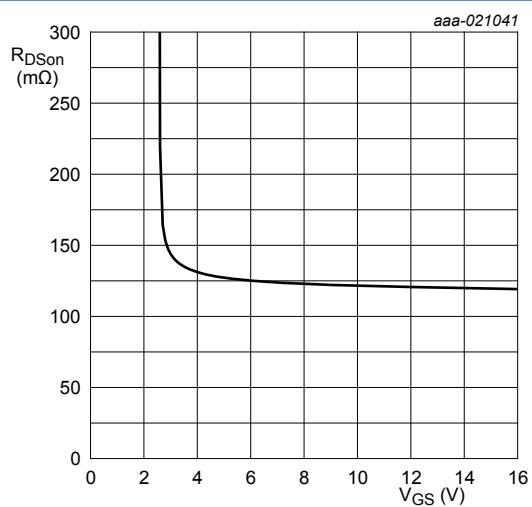
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$C_{iss}$	input capacitance	$V_{DS} = 25 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz};$ $T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 15</a>		-	523	695	pF
$C_{oss}$	output capacitance			-	42	50	pF
$C_{rss}$	reverse transfer capacitance			-	28	39	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 80 \text{ V}; R_L = 10 \Omega; V_{GS} = 5 \text{ V};$ $R_{G(ext)} = 5 \Omega; T_j = 25 \text{ }^\circ\text{C}$		-	5.6	-	ns
$t_r$	rise time			-	8.8	-	ns
$t_{d(off)}$	turn-off delay time			-	11.8	-	ns
$t_f$	fall time			-	7.2	-	ns

**Source-drain diode**

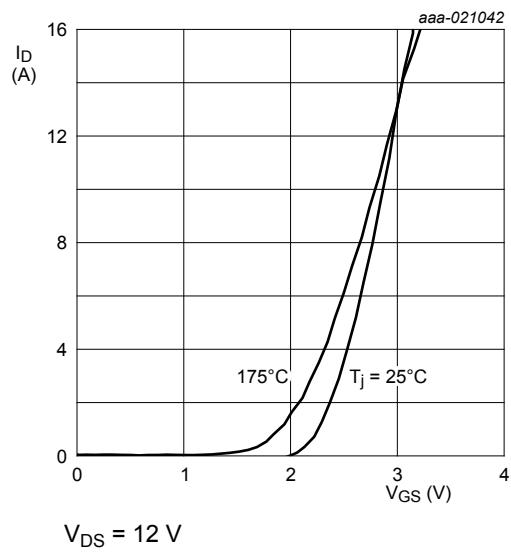
$V_{SD}$	source-drain voltage	$I_S = 10 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$ ; <a href="#">Fig. 16</a>		-	0.92	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 5 \text{ A}; dI_S/dt = -100 \text{ A}/\mu\text{s}; V_{GS} = 0 \text{ V};$ $V_{DS} = 25 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$		-	27.6	-	ns
$Q_r$	recovered charge			-	33.9	-	nC



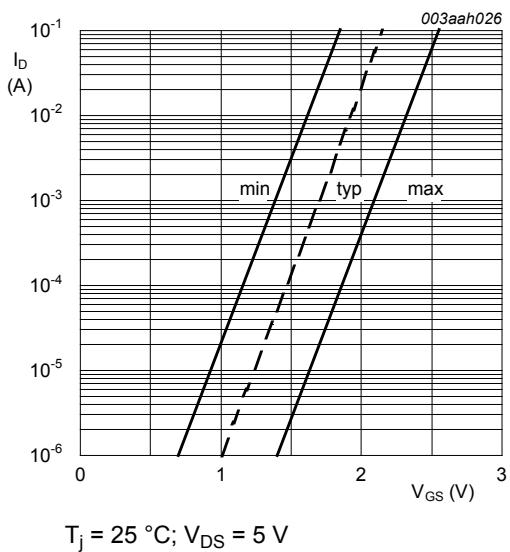
**Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values**



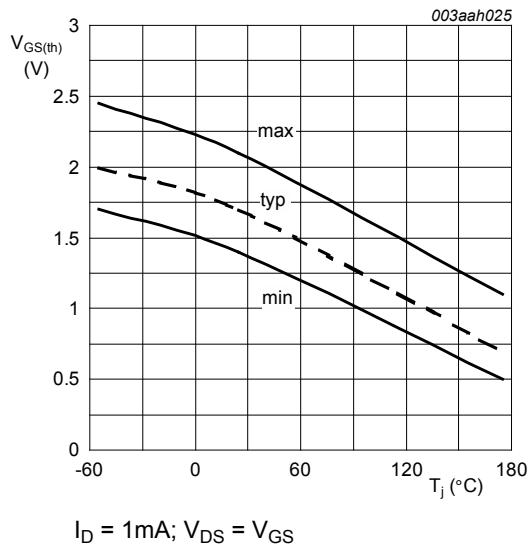
**Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values**



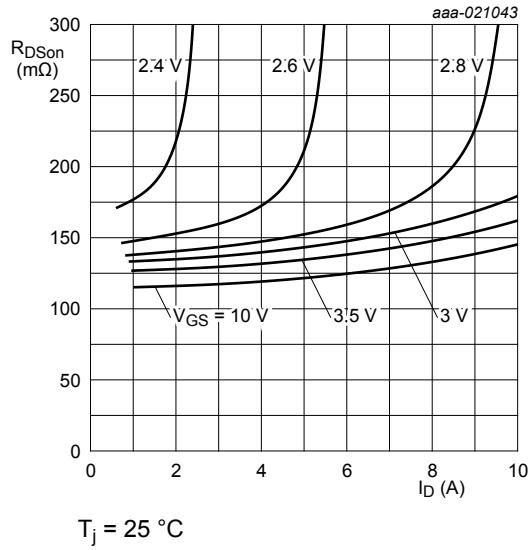
**Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values**



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



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



**Fig. 11. Drain-source on-state resistance as a function of drain current; typical values**

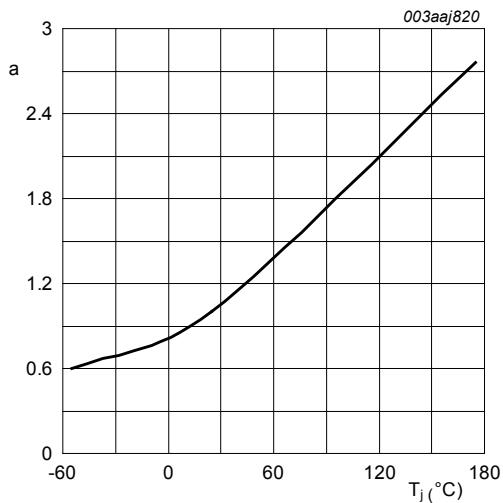


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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

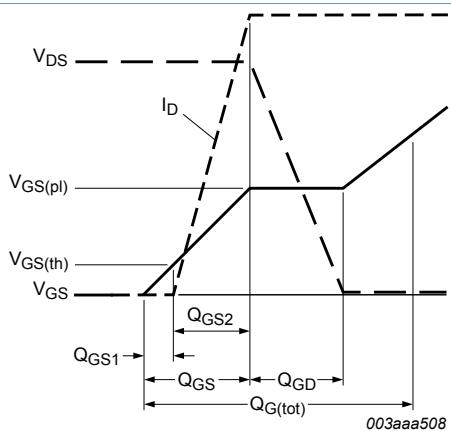


Fig. 14. Gate charge waveform definitions

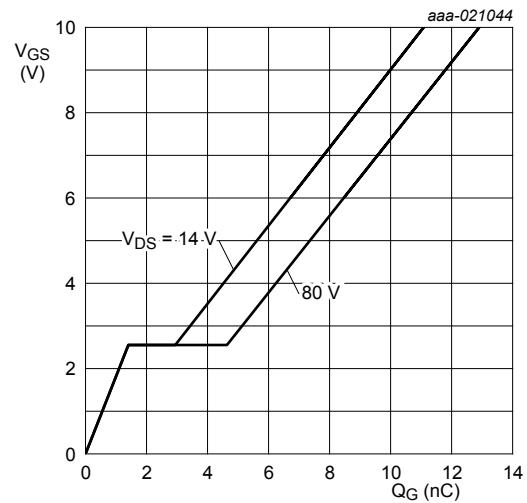


Fig. 13. Gate-source voltage as a function of gate charge; typical values

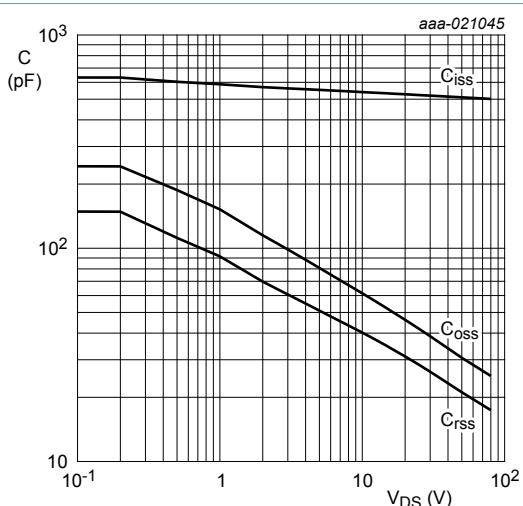
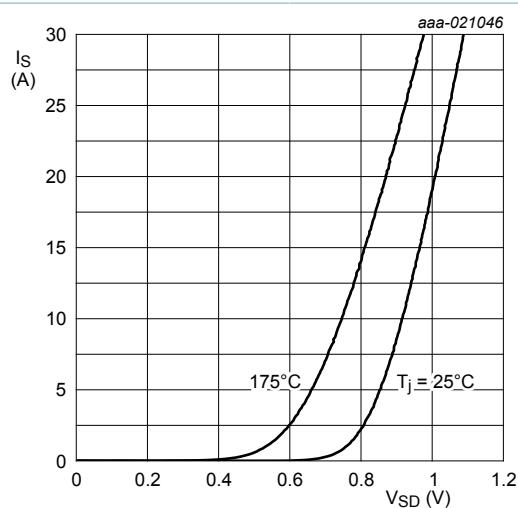


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



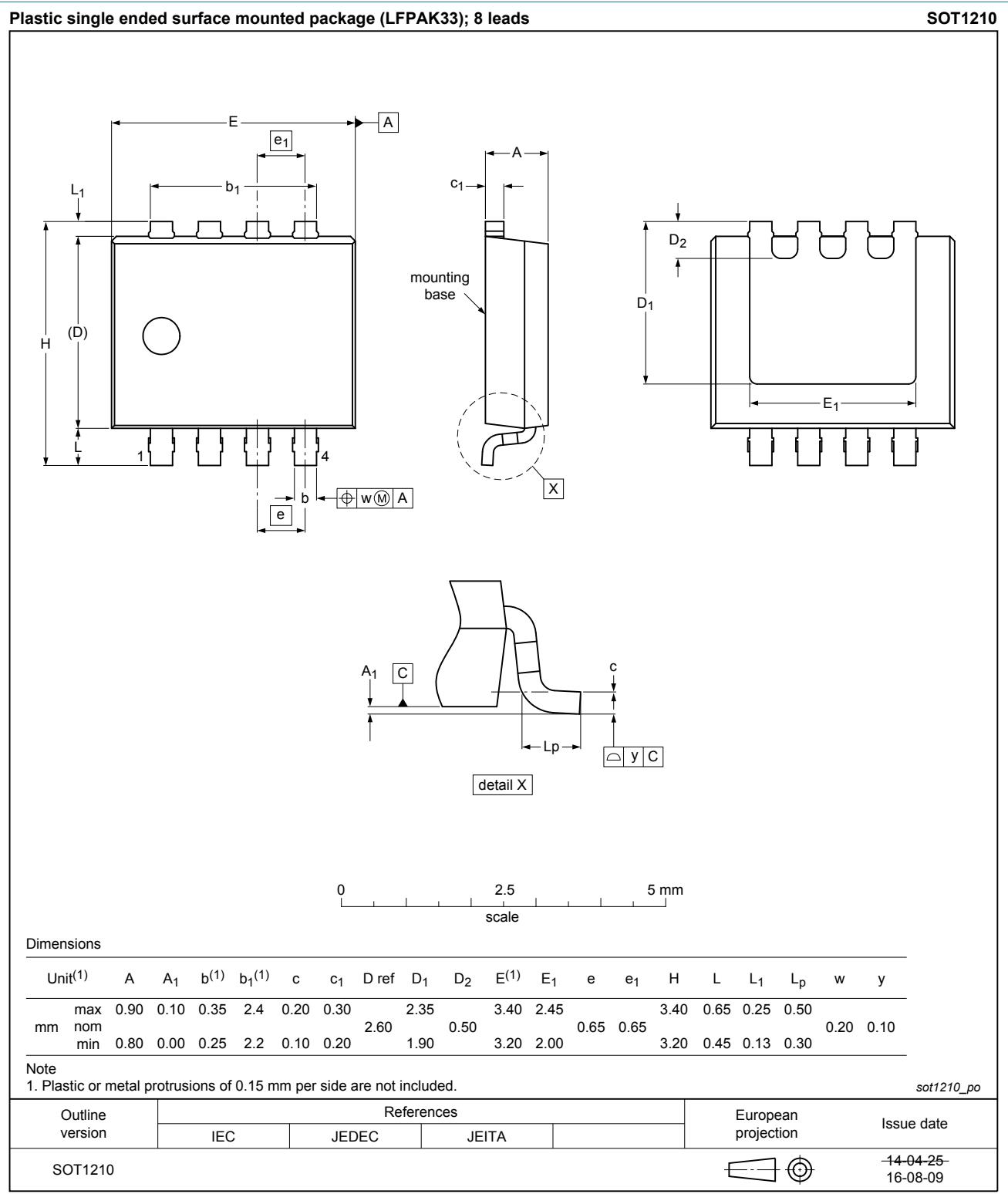
$V_{GS} = 0 \text{ V}$

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

## 11. Application information

For guidance on how to use and understand this datasheet, please refer to application note [AN11158](#) "Understanding power MOSFET datasheet parameters".

## 12. Package outline



## 13. Legal information

### 13.1 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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