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BUK7613-60E

N-channel TrenchMOS standard level FET

28 July 2016

1. General description

Standard level N-channel MOSFET in a SOT404 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

- AEC Q101 compliant
- Repetitive avalanche rated
- Suitable for thermally demanding environments due to 175 °C rating
- True standard level gate with VGS(th) rating of greater than 1V at 175 °C

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

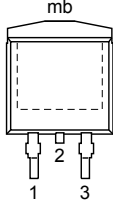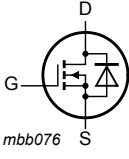| Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25$ °C; $T_j \leq 175$ °C		-	-	60	V
I_D	drain current	$V_{GS} = 10$ V; $T_{mb} = 25$ °C; Fig. 2		-	-	58	A
P_{tot}	total power dissipation	$T_{mb} = 25$ °C; Fig. 1		-	-	96	W
Static characteristics							
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10$ V; $I_D = 15$ A; $T_j = 25$ °C; Fig. 11		-	9.44	13	mΩ
Dynamic characteristics							
Q_{GD}	gate-drain charge	$I_D = 15$ A; $V_{DS} = 48$ V; $V_{GS} = 10$ V; Fig. 13; Fig. 14		-	6.9	-	nC

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5. Pinning information

Table 2.   Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	mb	D
2	D	drain		G
3	S	source		
mb	D	mounting base; connected to drain	**D2PAK (SOT404)**	mbb076 S

6. Ordering information

Table 3.   Ordering information

Type number	Package		
	Name	**Description**	**Version**
BUK7613-60E	D2PAK	plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)	SOT404

7. Marking

Table 4.   Marking codes

Type number	Marking code
BUK7613-60E	BUK7613-60E

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		-	60	V
V_{GS}	gate-source voltage	$T_j \leq 175$ °C; DC		-20	20	V
P_{tot}	total power dissipation	$T_{mb} = 25$ °C; [Fig. 1](#)		-	96	W
I_D	drain current	$T_{mb} = 25$ °C; $V_{GS} = 10$ V; [Fig. 2](#)		-	58	A
		$T_{mb} = 100$ °C; $V_{GS} = 10$ V; [Fig. 2](#)		-	41	A
I_{DM}	peak drain current	$T_{mb} = 25$ °C; pulsed; $t_p \leq 10$ µs; [Fig. 3](#)		-	234	A
T_{stg}	storage temperature			-55	175	°C
T_j	junction temperature			-55	175	°C

Symbol	Parameter	Conditions		Min	Max	Unit
Source-drain diode						
I_S	source current	T_{mb} = 25 °C	[1]	-	58	A
I_{SM}	peak source current	pulsed; t_p ≤ 10 µs; T_{mb} = 25 °C		-	234	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 58 A; V_{sup} ≤ 60 V; R_{GS} = 50 Ω; V_{GS} = 60 V; $T_{j(init)}$ = 25 °C; unclamped; Fig. 4	[2][3]	-	37	mJ

[1] Continuous current is limited by package.

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

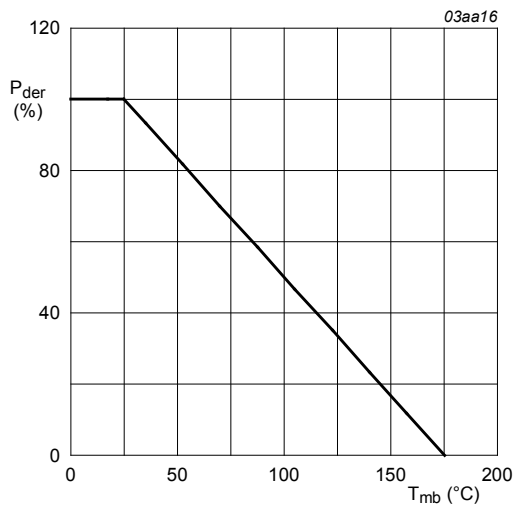[3] Refer to application note AN10273 for further information.

Fig. 1. Normalized total power dissipation as a function of mounting base temperature
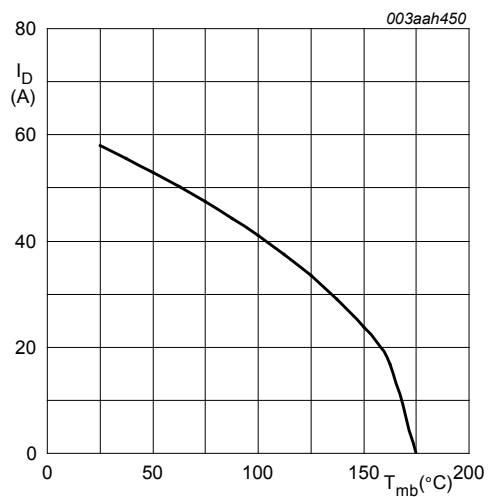
$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\%$$

Fig. 2. Continuous drain current as a function of mounting base temperature
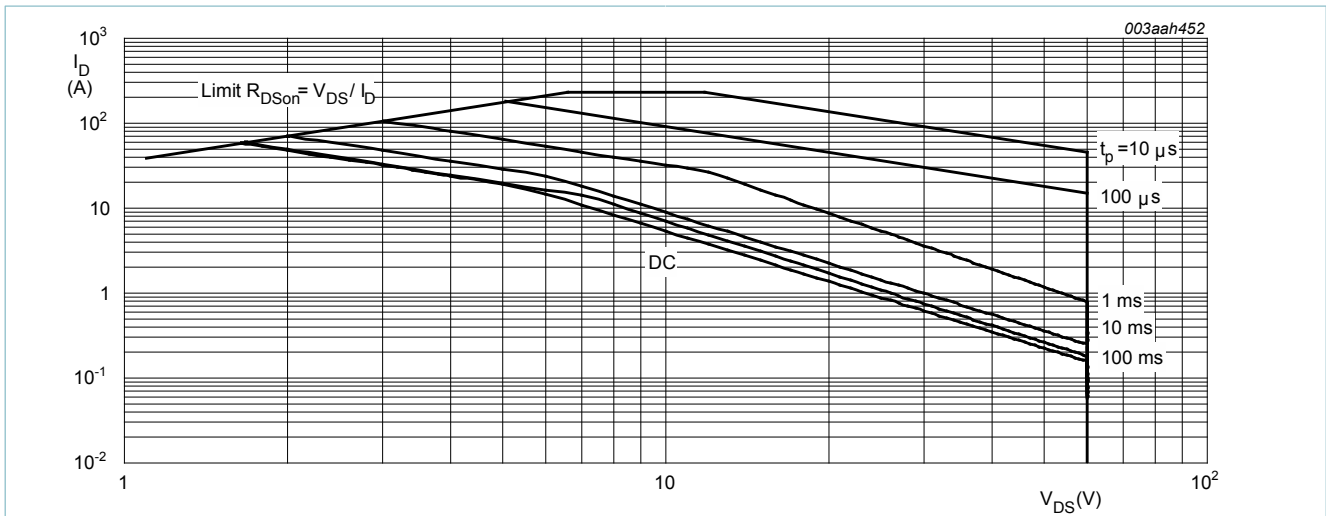
$$V_{GS} \geq 10V$$

003aah452

Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage
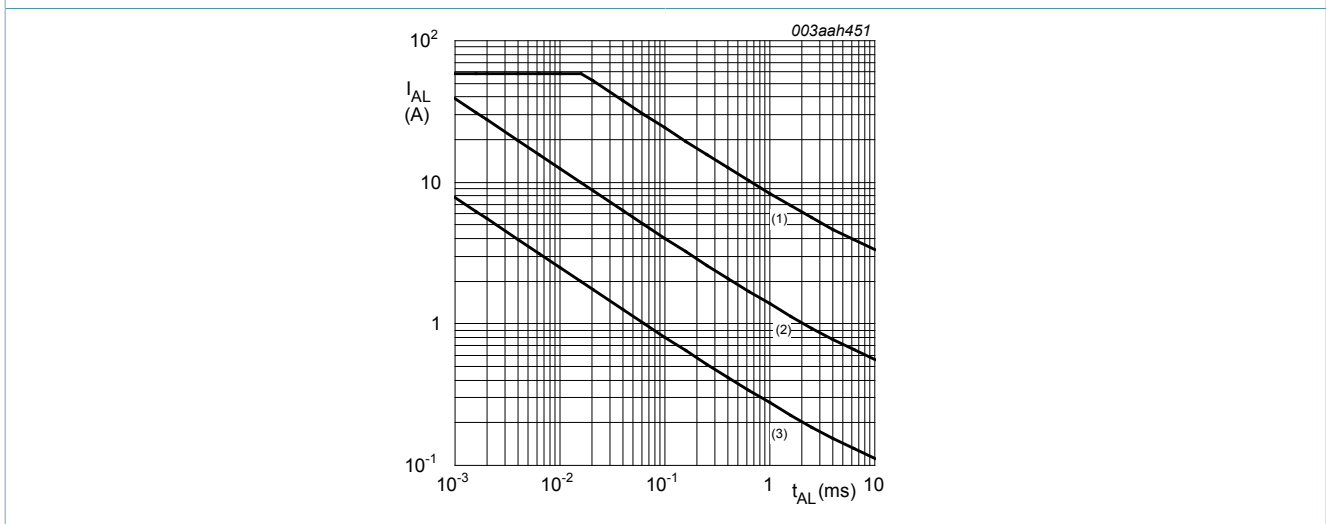
$$T_{mb} = 25°C; \ I_{DM} \ is \ a \ single \ pulse$$

003aah451

Fig. 4. Single pulse avalanche rating; avalanche current as a function of avalanche time

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

9. Thermal characteristics

Table 6.   **Thermal characteristics**

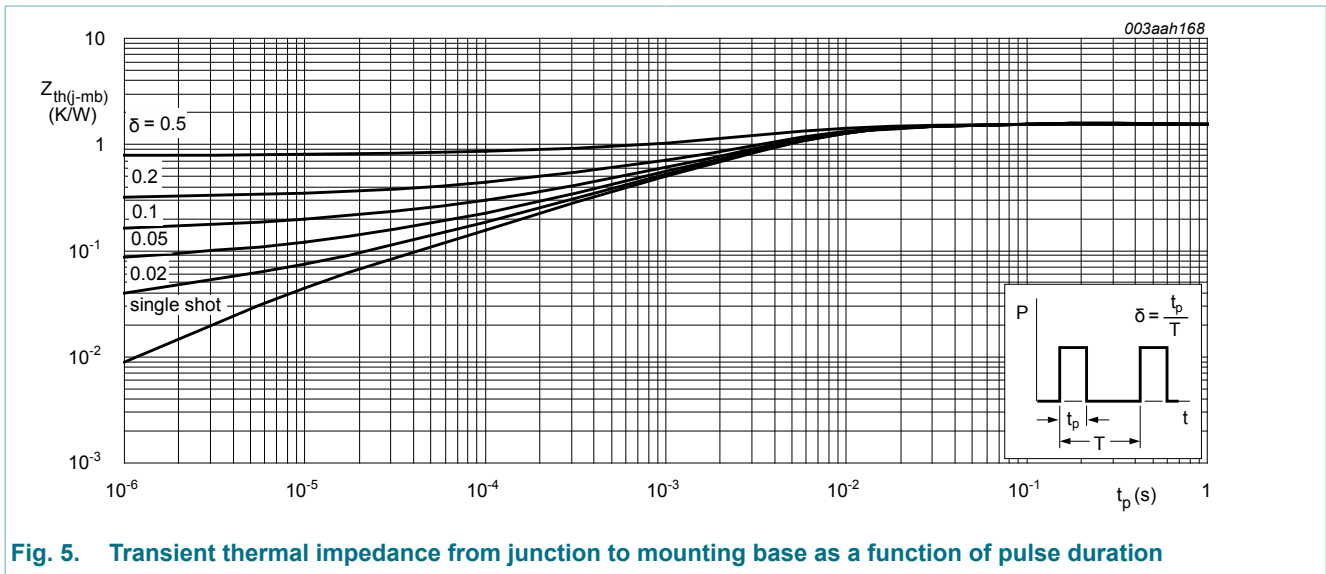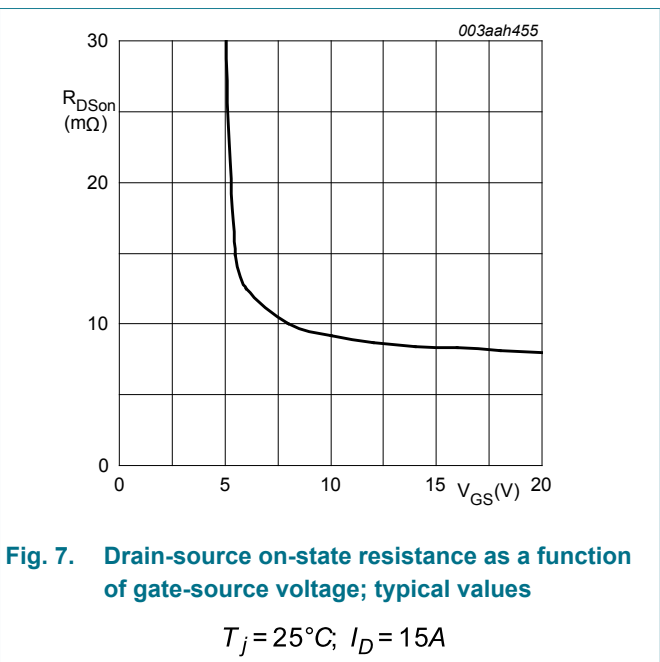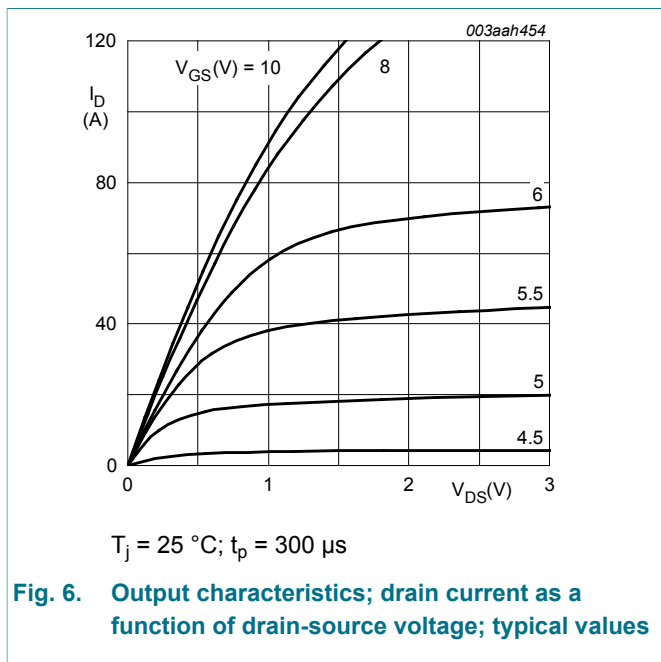| Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j\text{-}mb)}$	thermal resistance from junction to mounting base	Fig. 5		-	-	1.56	K/W
$R_{th(j\text{-}a)}$	thermal resistance from junction to ambient	minimum footprint ; mounted on a printed-circuit board		-	50	-	K/W

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							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 μA; V_{GS} = 0 V; T_j = 25 °C		60	-	-	V
		I_D = 250 μA; V_{GS} = 0 V; T_j = -55 °C		54	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; T_j = 25 °C; Fig. 9; Fig. 10		2.4	3	4	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = 175 °C; Fig. 9		1	-	-	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = -55 °C; Fig. 9		-	-	4.5	V
I_{DSS}	drain leakage current	V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25 °C		-	0.025	1	μA
		V_{DS} = 60 V; V_{GS} = 0 V; T_j = 175 °C		-	-	500	μA
I_{GSS}	gate leakage current	V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25 °C		-	2	100	nA
		V_{GS} = -20 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 = 15 A; T_j = 25 °C; Fig. 11		-	9.44	13	mΩ
		V_{GS} = 10 V; I_D = 15 A; T_j = 175 °C; Fig. 11; Fig. 12		-	-	28.2	mΩ
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 15 A; V_{DS} = 48 V; V_{GS} = 10 V; Fig. 13; Fig. 14		-	22.9	-	nC
Q_{GS}	gate-source charge			-	5	-	nC
Q_{GD}	gate-drain charge			-	6.9	-	nC

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz; T_j = 25 °C; Fig. 15		-	1298	1730	pF
C_{oss}	output capacitance			-	197	237	pF
C_{rss}	reverse transfer capacitance			-	122	162	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 45 V; R_L = 3 Ω; V_{GS} = 10 V; $R_{G(ext)}$ = 5 Ω		-	10.8	-	ns
t_r	rise time			-	9.2	-	ns
$t_{d(off)}$	turn-off delay time			-	21.9	-	ns
t_f	fall time			-	9.8	-	ns
L_D	internal drain inductance	from upper edge of mounting base to centre of die		-	2.5	-	nH
L_S	internal source inductance	measured from source lead to source bond pad		-	7.5	-	nH
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 15 A; V_{GS} = 0 V; T_j = 25 °C; Fig. 16		-	0.84	1.2	V
t_{rr}	reverse recovery time	I_S = 15 A; dI_S/dt = -100 A/μs; V_{GS} = 0 V; V_{DS} = 25 V		-	21.3	-	ns
Q_r	recovered charge			-	18.1	-	nC

T_j = 25 °C; t_p = 300 μs

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**
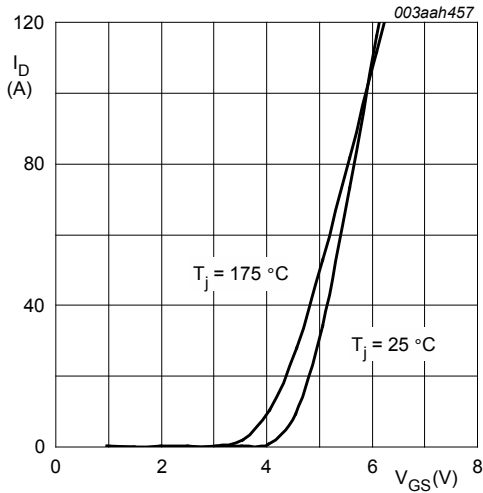
$T_j = 25°C;\ I_D = 15A$

Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values
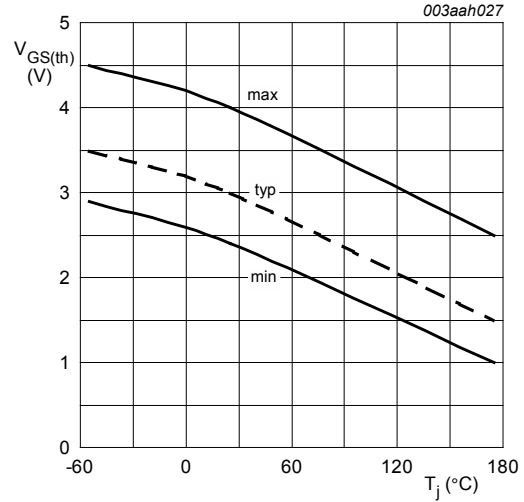
$V_{DS} = 10V$

Fig. 9. Gate-source threshold voltage as a function of junction temperature
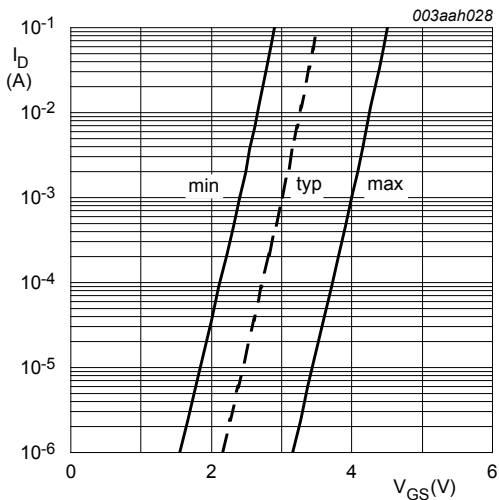
$I_D = 1$ mA; $V_{DS} = V_{GS}$

Fig. 10. Sub-threshold drain current as a function of gate-source voltage
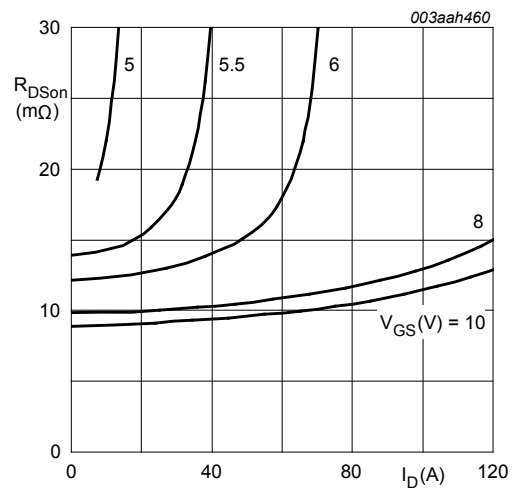
$T_j = 25°C$; $V_{DS} = 5V$

$T_j = 25 °C$; $t_p = 300$ µs

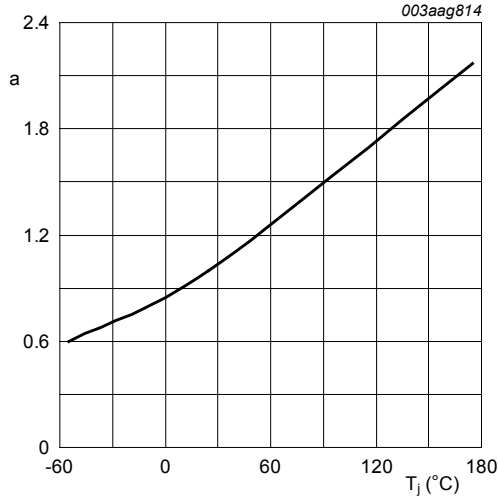**Fig. 11.** Drain-source on-state resistance as a function of drain current; typical values

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

$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$
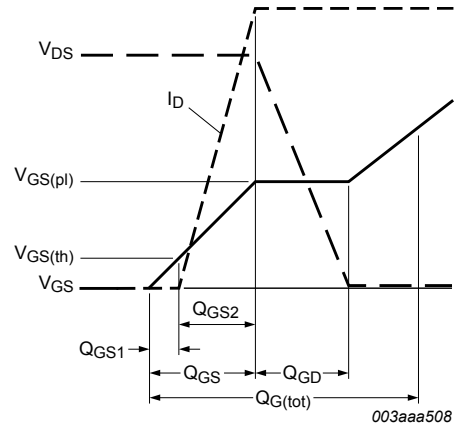
Fig. 13. Gate charge waveform definitions
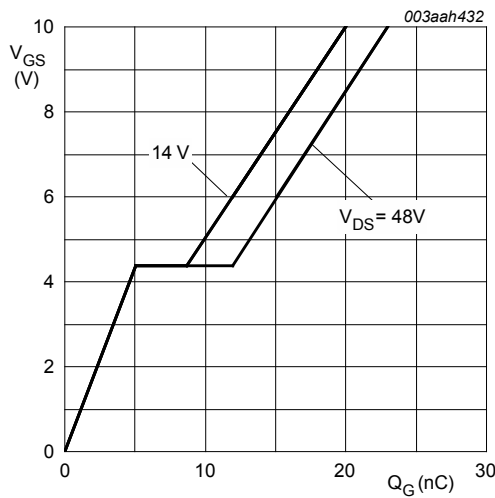

Fig. 14. Gate-source voltage as a function of gate charge; typical values
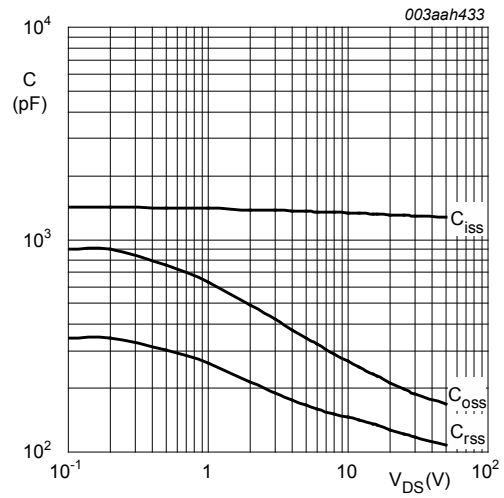
$$T_j = 25°C; \; I_D = 15A$$

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

$$V_{GS} = 0V; \; f = 1MHz$$
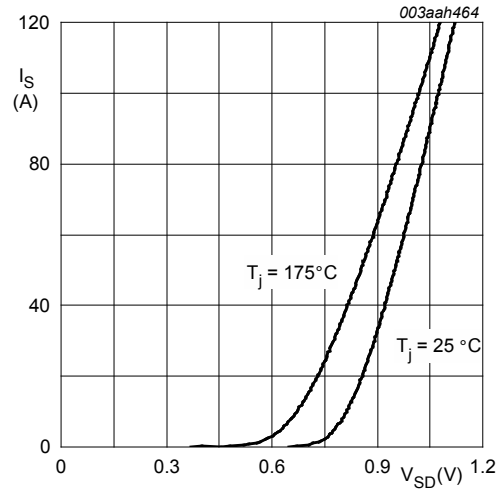
Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$$V_{GS} = 0V$$

11. Package outline

Plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)   **SOT404**

Dimensions (mm are the original dimensions)

Unit		A	A₁	b	b₂	c	D	D₁	E	e	H_D	L_p	Q
mm	max	4.5	1.40	0.85	1.45	0.64	11	1.6	10.3		15.8	2.9	2.6
	nom									2.54			
	min	4.1	1.27	0.60	1.05	0.46		1.2	9.7		14.8	2.1	2.2

sot404_po

Outline version	References				European projection	Issue date
		IEC	JEDEC	JEITA		
SOT404						~~06-03-16~~ 13-02-25

Fig. 17. Package outline D2PAK (SOT404)

12. Legal information

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