

## **BUK768R3-60E**

# N-channel TrenchMOS standard level FET

13 July 2012

**Product data sheet** 

#### 1. Product profile

#### 1.1 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.

#### 1.2 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

#### 1.3 Applications

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

#### 1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Тур	Max	Unit
V <sub>DS</sub>	drain-source voltage	T <sub>j</sub> ≥ 25 °C; T <sub>j</sub> ≤ 175 °C		-	-	60	V
I <sub>D</sub>	drain current	V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 25 °C; <u>Fig. 1</u>	[1]	-	-	75	Α
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C; <u>Fig. 2</u>		-	-	137	W
Static charact	eristics						,
R <sub>DSon</sub>	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 20 \text{ A}; T_j = 25 \text{ °C};$ Fig. 11		-	5.9	8.3	mΩ
Dynamic characteristics							
$Q_{GD}$	gate-drain charge	I <sub>D</sub> = 20 A; V <sub>DS</sub> = 48 V; V <sub>GS</sub> = 10 V; Fig. 14		-	14.6	-	nC

[1] Continuous current is limited by package.



## 2. Pinning information

Table 2. Pinning information

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

## 3. Ordering information

Table 3. Ordering information

Type number	Package					
	Name	Description	Version			
BUK768R3-60E	D2PAK	plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)	SOT404			

## 4. Limiting values

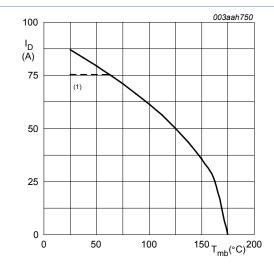
Table 4. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{DS}$	drain-source voltage	T <sub>j</sub> ≥ 25 °C; T <sub>j</sub> ≤ 175 °C		-	60	V
$V_{DGR}$	drain-gate voltage	$R_{GS} = 20 \text{ k}\Omega$		-	60	V
$V_{GS}$	gate-source voltage	T <sub>j</sub> = 25 °C		-20	20	V
I <sub>D</sub>	drain current	T <sub>mb</sub> = 25 °C; V <sub>GS</sub> = 10 V; <u>Fig. 1</u>	[1]	-	75	Α
		T <sub>mb</sub> = 100 °C; V <sub>GS</sub> = 10 V; <u>Fig. 1</u>		-	61.5	Α
I <sub>DM</sub>	peak drain current	$T_{mb}$ = 25 °C; pulsed; $t_p \le 10 \mu s$ ; Fig. 4		-	349	Α
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C; <u>Fig. 2</u>		-	137	W
T <sub>stg</sub>	storage temperature			-55	175	°C
T <sub>j</sub>	junction temperature			-55	175	°C
Source-drain diode						
Is	source current	T <sub>mb</sub> = 25 °C	[1]	-	75	Α
I <sub>SM</sub>	peak source current	pulsed; $t_p \le 10 \ \mu s$ ; $T_{mb} = 25 \ ^{\circ}C$		-	349	Α

Symbol	Parameter	Conditions		Min	Max	Unit
Avalanche rug	gedness					
E <sub>DS(AL)</sub> S	non-repetitive drain-source avalanche energy	$I_D$ = 75 A; $V_{sup} \le$ 60 V; $R_{GS}$ = 50 Ω; $V_{GS}$ = 60 V; $T_{j(init)}$ = 25 °C; unclamped; Fig. 3	[2][3]	-	86	mJ

- [1]
- Continuous current is limited by package. Single-pulse avalanche rating limited by maximum junction temperature of 175  $^{\circ}\text{C}.$
- Refer to application note AN10273 for further information.



(1) Capped at 75A due to package

Continuous drain current as a function of mounting base temperature

$$V_{GS} \ge 10V$$

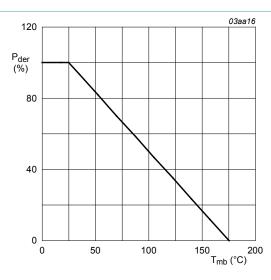
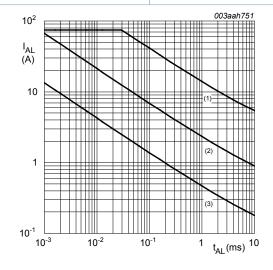


Fig. 2. Normalized total power dissipation as a function of mounting base temperature

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



Single pulse avalanche rating; avalanche current as a function of avalanche time

(1) 
$$T_{j (int)} = 25^{\circ}C$$
; (2)  $T_{j (int)} = 150^{\circ}C$ ; (3) Repetitive Avalanche

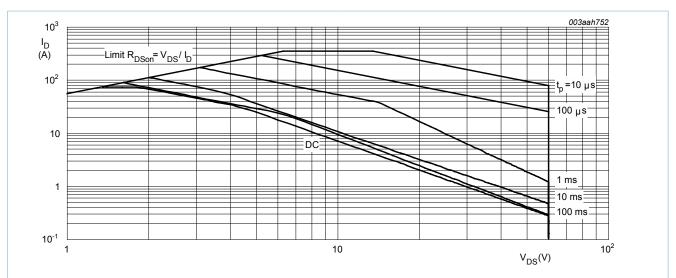


Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

#### 5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
R <sub>th(j-mb)</sub>	thermal resistance from junction to mounting base	Fig. 5	-	-	1.09	K/W
R <sub>th(j-a)</sub>	thermal resistance from junction to ambient	minimum footprint ; mounted on a printed-circuit board	-	50	-	K/W

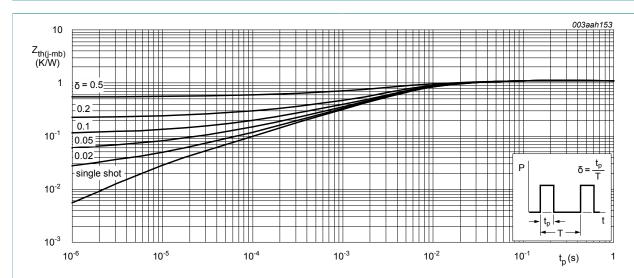


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

BUK768R3-60E

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### 6. Characteristics

Table 6 Characteristics

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
Static char	racteristics					
V <sub>(BR)DSS</sub>	drain-source	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 °C$	60	-	-	V
	breakdown voltage	$I_D = 250 \ \mu A; \ V_{GS} = 0 \ V; \ T_j = -55 \ ^{\circ}C$	54	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ °C};$ Fig. 9; Fig. 10	2.4	3	4	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ °C};$ Fig. 9	1	-	-	V
		$I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$ ; $T_j$ = -55 °C; Fig. 9	-	-	4.5	V
I <sub>DSS</sub>	drain leakage current	V <sub>DS</sub> = 60 V; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C	-	0.04	1	μA
	V <sub>DS</sub> = 60 V; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 175 °C	-	-	500	μA	
I <sub>GSS</sub>	gate leakage current	V <sub>GS</sub> = 20 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C	-	2	100	nA
		V <sub>GS</sub> = -20 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C	-	2	100	nA
R <sub>DSon</sub> drain-source on-state resistance		$V_{GS}$ = 10 V; $I_D$ = 20 A; $T_j$ = 25 °C; Fig. 11	-	5.9	8.3	mΩ
	V <sub>GS</sub> = 10 V; I <sub>D</sub> = 20 A; T <sub>j</sub> = 175 °C; Fig. 11; Fig. 12	-	-	18	mΩ	
Dynamic c	characteristics					
$Q_{G(tot)}$	total gate charge	I <sub>D</sub> = 20 A; V <sub>DS</sub> = 48 V; V <sub>GS</sub> = 10 V; Fig. 13; Fig. 14	-	43.1	-	nC
Q <sub>GS</sub>	gate-source charge	I <sub>D</sub> = 20 A; V <sub>DS</sub> = 48 V; V <sub>GS</sub> = 10 V;	-	10.9	-	nC
Q <sub>GD</sub>	gate-drain charge	<u>Fig. 14</u>	-	14.6	-	nC
C <sub>iss</sub>	input capacitance	V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 25 V; f = 1 MHz;	-	2188	2920	pF
C <sub>oss</sub>	output capacitance	T <sub>j</sub> = 25 °C; <u>Fig. 15</u>	-	319	383	pF
C <sub>rss</sub>	reverse transfer capacitance		-	205	281	pF
t <sub>d(on)</sub>	turn-on delay time	$V_{DS}$ = 45 V; $R_L$ = 2 $\Omega$ ; $V_{GS}$ = 10 V;	-	14	-	ns
t <sub>r</sub>	rise time	$R_{G(ext)} = 5 \Omega$	-	27	-	ns
t <sub>d(off)</sub>	turn-off delay time		-	27	-	ns
t <sub>f</sub>	fall time		-	27	-	ns
L <sub>D</sub>	internal drain inductance	from upper edge of mounting base to centre of die	-	2.5	-	nH
L <sub>S</sub>	internal source inductance	measured from source lead to source bond pad	-	7.5	-	nH

Symbol	Parameter	Conditions		Min	Тур	Max	Unit
Source-drain diode							
$V_{SD}$	source-drain voltage	$I_S = 20 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 ^{\circ}\text{C}; Fig. 16$		-	0.84	1.2	V
t <sub>rr</sub>	reverse recovery time	$I_S = 20 \text{ A}; dI_S/dt = -100 \text{ A/}\mu\text{s}; V_{GS} = 0 \text{ V};$		-	27	-	ns
Q <sub>r</sub>	recovered charge	V <sub>DS</sub> = 25 V		-	24	-	nC

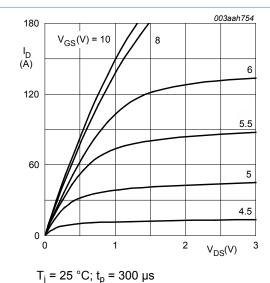


Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values

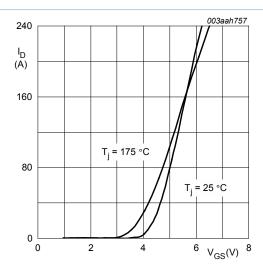


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values



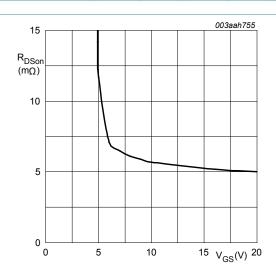


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

$$T_j = 20 \,^{\circ}C; I_D = 20A$$

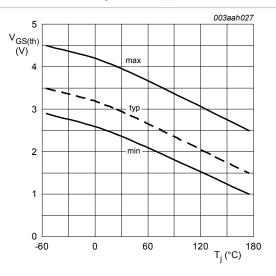


Fig. 9. Gate-source threshold voltage as a function of junction temperature

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

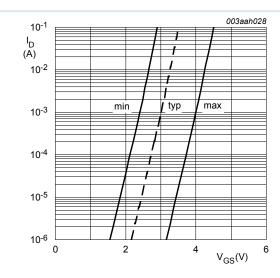


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

$$T_j = 25$$
°C;  $V_{DS} = 5V$ 

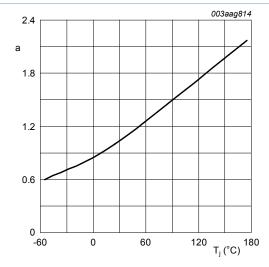
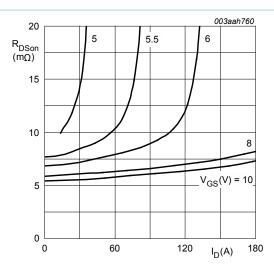


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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



$$T_j = 25 \, ^{\circ}C; t_p = 300 \, \mu s$$

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

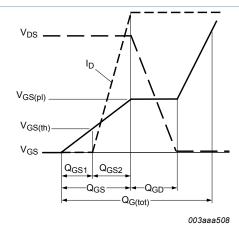


Fig. 13. Gate charge waveform definitions

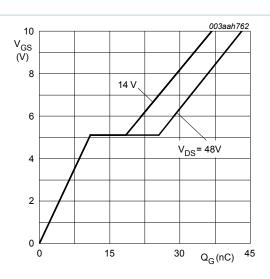


Fig. 14. Gate-source voltage as a function of gate charge; typical values

$$T_j = 25^{\circ}C; I_D = 20A$$

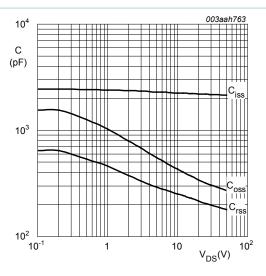


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

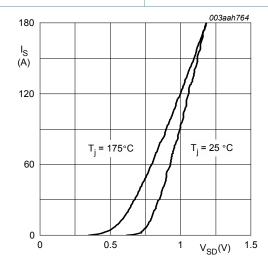


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$$V_{GS} = 0V$$

## 7. Package outline

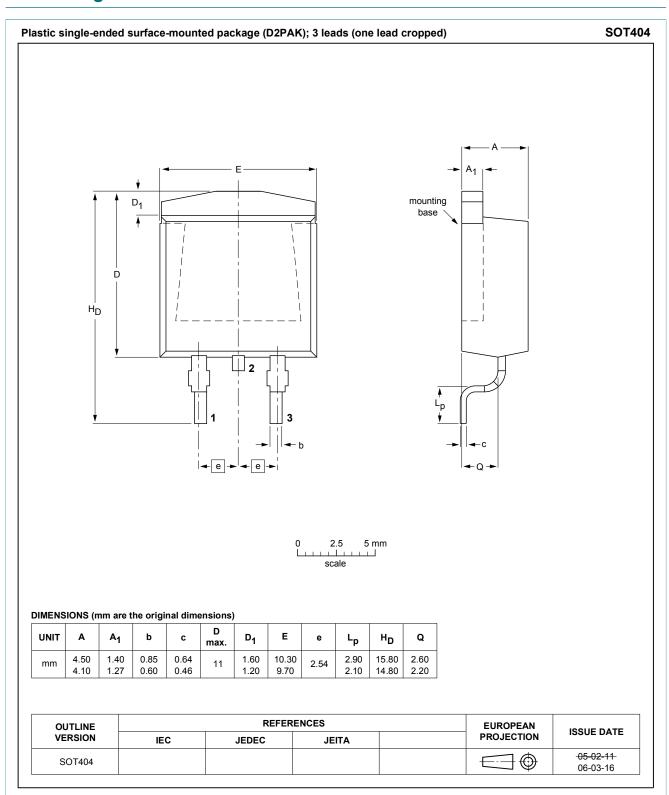


Fig. 17. D2PAK (SOT404)

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#### N-channel TrenchMOS standard level FET

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#### N-channel TrenchMOS standard level FET

#### 9. Contents

1	Product profile	1
1.1	General description	1
1.2	Features and benefits	1
1.3	Applications	1
1.4	Quick reference data	1
2	Pinning information	2
3	Ordering information	2
4	Limiting values	2
5	Thermal characteristics	4
6	Characteristics	5
7	Package outline	9
8	Legal information	10
8.1	Data sheet status	
8.2	Definitions	10
8.3	Disclaimers	10
8.4	Trademarks	11

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#### Офис по работе с юридическими лицами:

105318, г. Москва, ул. Щербаковская д. 3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:

moschip.ru moschip.ru\_6 moschip.ru\_4 moschip.ru\_9