

BUK7E4R6-60E

N-channel TrenchMOS standard level FET 11 September 2012

Product data sheet

Product profile 1.

1.1 General description

Standard level N-channel MOSFET in a SOT226 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

Quick reference data Table 1.

Symbol	Parameter	Conditions		Min	Тур	Max	Unit
V _{DS}	drain-source voltage	T _j ≥ 25 °C; T _j ≤ 175 °C		-	-	60	V
I _D	drain current	V _{GS} = 10 V; T _{mb} = 25 °C; <u>Fig. 1</u>	[1]	-	-	100	Α
P _{tot}	total power dissipation	T _{mb} = 25 °C; <u>Fig. 2</u>		-	-	234	W
Static characte	eristics						
R _{DSon}	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 ^{\circ}\text{C};$ Fig. 11		-	3.36	4.6	mΩ
Dynamic characteristics							
Q_{GD}	gate-drain charge	I _D = 25 A; V _{DS} = 48 V; V _{GS} = 10 V; Fig. 13; Fig. 14		-	26.1	-	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 US 44
mb	D	mounting base; connected to drain		mbb076 S
			12PAK (SOT226)	

3. Ordering information

Table 3. Ordering information

Type number	Package					
	Name	Description	Version			
BUK7E4R6-60E	I2PAK	plastic single-ended package (I2PAK); TO-262	SOT226			

4. Limiting values

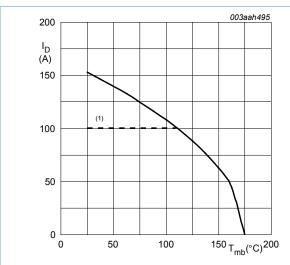
Table 4. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	T _j ≥ 25 °C; T _j ≤ 175 °C		-	60	V
V_{DGR}	drain-gate voltage	R_{GS} = 20 k Ω		-	60	V
V _{GS}	gate-source voltage	T _j ≤ 175 °C; DC		-20	20	V
I _D	drain current	T _{mb} = 25 °C; V _{GS} = 10 V; <u>Fig. 1</u>	[1]	-	100	Α
		T _{mb} = 100 °C; V _{GS} = 10 V; <u>Fig. 1</u>	[1]	-	100	Α
I _{DM}	peak drain current	T_{mb} = 25 °C; pulsed; $t_p \le 10 \mu s$; Fig. 4		-	613	Α
P _{tot}	total power dissipation	T _{mb} = 25 °C; <u>Fig. 2</u>		-	234	W
T _{stg}	storage temperature			-55	175	°C
Tj	junction temperature			-55	175	°C
Source-dra	in diode					,
Is	source current	T _{mb} = 25 °C	[1]	-	100	Α
I _{SM}	peak source current	pulsed; $t_p \le 10 \ \mu s$; $T_{mb} = 25 \ ^{\circ}C$		-	613	Α

Symbol	Parameter	Conditions		Min	Max	Unit
Avalanche rug	gedness					
E _{DS(AL)} S	non-repetitive drain-source avalanche energy	I_D = 100 A; $V_{sup} \le$ 60 V; R_{GS} = 50 Ω; V_{GS} = 60 V; $T_{j(init)}$ = 25 °C; unclamped; Fig. 3	[2][3]	-	273	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 100A due to package

Continuous drain current as a function of Fig. 1. mounting base temperature

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

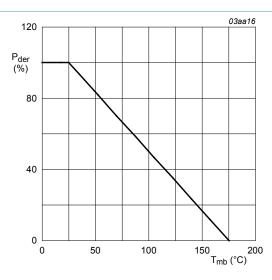
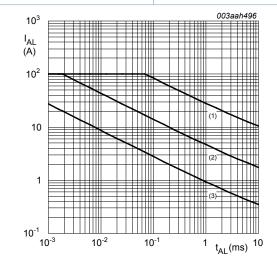


Fig. 2. Normalized total power dissipation as a function of mounting base temperature

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



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

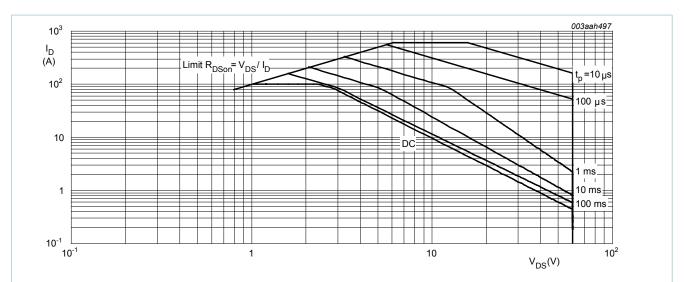


Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
R _{th(j-mb)}	thermal resistance from junction to mounting base	Fig. 5	-	-	0.64	K/W
R _{th(j-a)}	thermal resistance from junction to ambient	vertical in still air	-	65	-	K/W

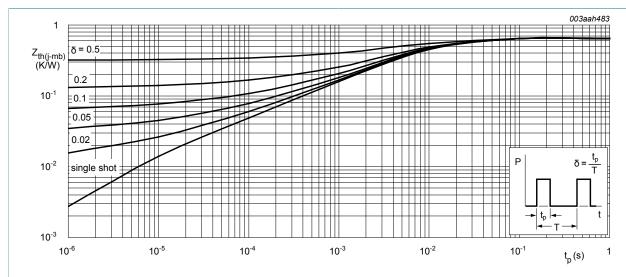


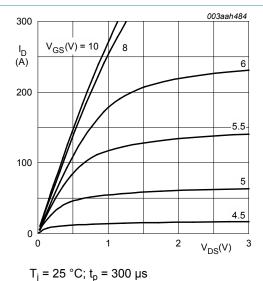
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

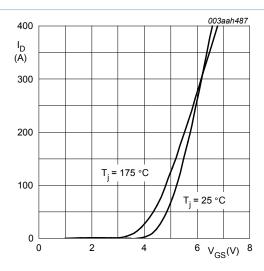
Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
Static chara	cteristics					
V _{(BR)DSS}	drain-source	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 °C$	60	-	-	V
	breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 °C$	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
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ °C};$ Fig. 9	1	-	-	V
		I_D = 1 mA; V_{DS} = V_{GS} ; T_j = -55 °C; Fig. 9	-	-	4.5	V
I _{DSS}	drain leakage current	$V_{DS} = 60 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 ^{\circ}\text{C}$	-	0.08	1	μA
		V _{DS} = 60 V; V _{GS} = 0 V; T _j = 175 °C	-	-	500	μΑ
I _{GSS} gate leakag	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-stat resistance	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; Fig. 11	-	3.36	4.6	mΩ
		V _{GS} = 10 V; I _D = 25 A; T _j = 175 °C; Fig. 11; Fig. 12	-	-	10	mΩ
Dynamic ch	aracteristics					
Q _{G(tot)}	total gate charge	I _D = 25 A; V _{DS} = 48 V; V _{GS} = 10 V; Fig. 13; Fig. 14	-	82	-	nC
Q _{GS}	gate-source charge		-	18.5	-	nC
Q_{GD}	gate-drain charge		-	26.1	-	nC
C _{iss}	input capacitance	V _{GS} = 0 V; V _{DS} = 25 V; f = 1 MHz;	-	4670	6230	pF
C _{oss}	output capacitance	T _j = 25 °C; <u>Fig. 15</u>	-	637	765	pF
C _{rss}	reverse transfer capacitance		-	377	516	pF
t _{d(on)}	turn-on delay time	V_{DS} = 45 V; R_L = 1.8 Ω ; V_{GS} = 10 V;	-	23	-	ns
t _r	rise time	$R_{G(ext)} = 5 \Omega$	-	39	-	ns
t _{d(off)}	turn-off delay time		-	50	-	ns
t _f	fall time		-	40	-	ns
L _D	internal drain inductance	T _j = 25 °C; from drain lead 6mm from package to centre of die	-	4.5	-	nH
		from upper edge of mounting base to centre of die ; $T_j = 25 ^{\circ}\text{C}$	-	2.5	-	nH
L _S	internal source inductance	measured from source lead to source bond pad ; T _i = 25 °C	-	7.5	-	nH

Symbol	Parameter	Conditions		Min	Тур	Max	Unit
Source-drain diode							
V _{SD}	source-drain voltage	$I_S = 25 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 ^{\circ}\text{C}; Fig. 16$		-	0.81	1.2	V
t _{rr}	reverse recovery time	$I_S = 20 \text{ A}; dI_S/dt = -100 \text{ A/}\mu\text{s}; V_{GS} = 0 \text{ V};$		-	38.2	-	ns
Q _r	recovered charge	V _{DS} = 25 V		-	49.6	-	nC



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



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



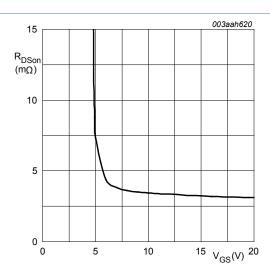
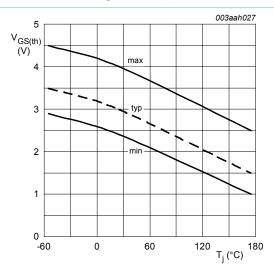


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

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



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

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

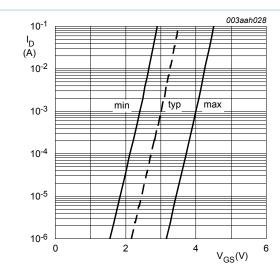


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

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

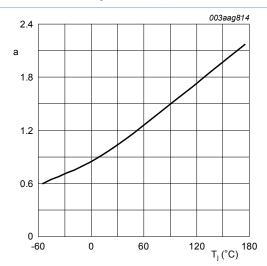
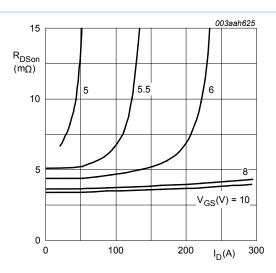


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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



 T_j = 25 °C; t_p = 300 μ s

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

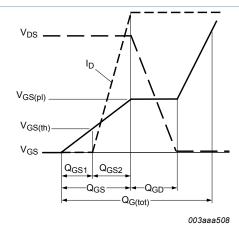


Fig. 13. Gate charge waveform definitions

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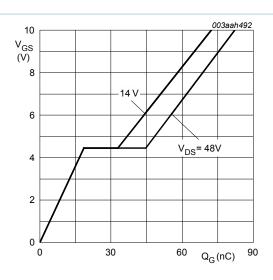


Fig. 14. Gate-source voltage as a function of gate charge; typical values

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

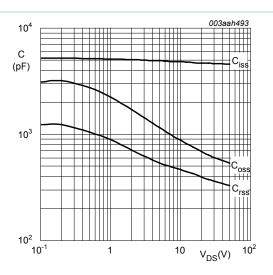


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

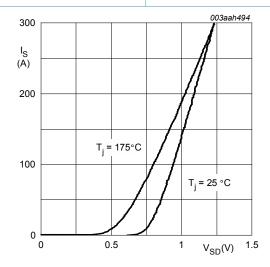


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$$V_{GS} = 0V$$

7. Package outline

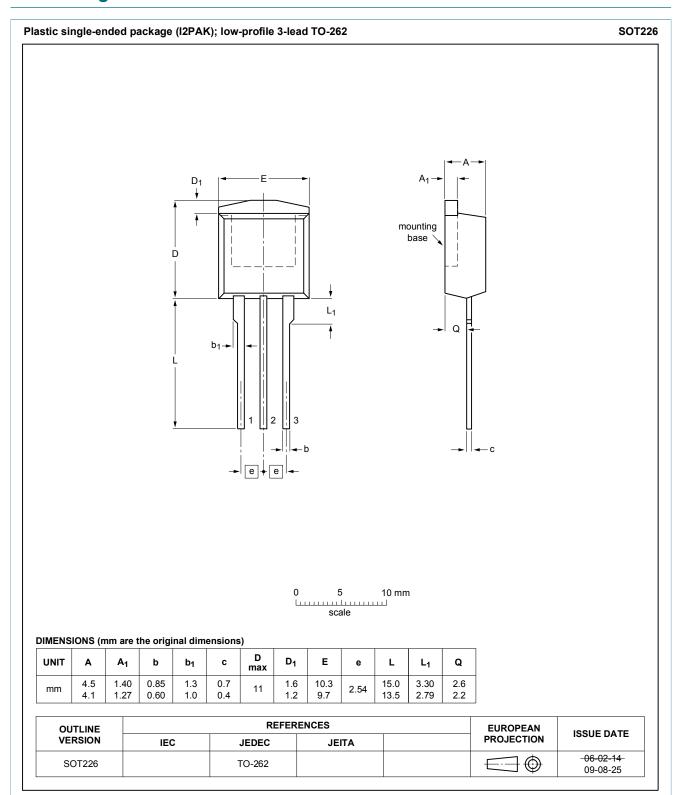


Fig. 17. Package outline I2PAK (SOT226)

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