



BUK961R6-40E

N-channel TrenchMOS logic level FET

28 July 2016

Product data sheet

1. General description

Logic 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 logic level gate with $V_{gs(th)}$ rating of greater than 0.5V 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

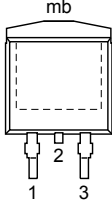
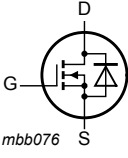
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$		-	-	40	V
I_D	drain current	$V_{GS} = 5\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2	[1]	-	-	120	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 1		-	-	349	W
Static characteristics							
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 5\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25\text{ °C}$; Fig. 11		-	1.35	1.6	mΩ
Dynamic characteristics							
Q_{GD}	gate-drain charge	$V_{GS} = 5\text{ V}$; $I_D = 25\text{ A}$; $V_{DS} = 32\text{ V}$; Fig. 13 ; Fig. 14		-	40.9	-	nC

[1] Continuous current is limited by package.

5. Pinning information

Table 2. Pinning information

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

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BUK961R6-40E	D2PAK	plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)	SOT404

7. Marking

Table 4. Marking codes

Type number	Marking code
BUK961R6-40E	BUK961R6-40E

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	$T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$		-	40	V
V_{DGR}	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$		-	40	V
V_{GS}	gate-source voltage	$T_j \leq 175\text{ °C}$; DC		-10	10	V
		$T_j \leq 175\text{ °C}$; Pulsed	[1][2]	-15	15	V
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 1		-	349	W
I_D	drain current	$T_{mb} = 25\text{ °C}$; $V_{GS} = 5\text{ V}$; Fig. 2	[3]	-	120	A
		$T_{mb} = 100\text{ °C}$; $V_{GS} = 5\text{ V}$; Fig. 2	[3]	-	120	A
I_{DM}	peak drain current	$T_{mb} = 25\text{ °C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$; Fig. 3		-	1348	A
T_{stg}	storage temperature			-55	175	°C

Symbol	Parameter	Conditions		Min	Max	Unit
T_j	junction temperature			-55	175	°C
Source-drain diode						
I_S	source current	$T_{mb} = 25\text{ °C}$	[3]	-	120	A
I_{SM}	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$		-	1348	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 120\text{ A}$; $V_{sup} \leq 40\text{ V}$; $R_{GS} = 50\text{ }\Omega$; $V_{GS} = 5\text{ V}$; $T_{j(init)} = 25\text{ °C}$; unclamped; Fig. 4	[4][5]	-	1008	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] Continuous current is limited by package.
 [4] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
 [5] Refer to application note AN10273 for further information.

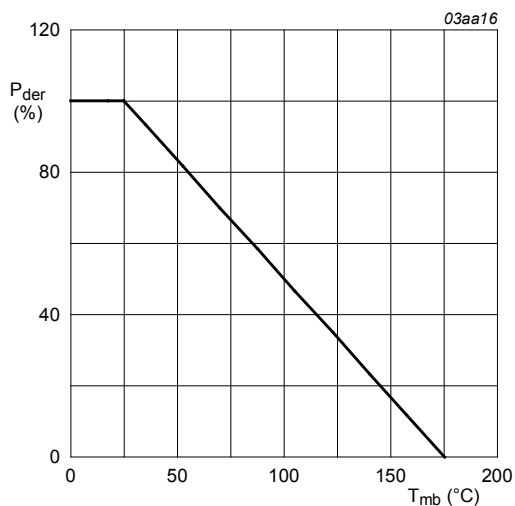


Fig. 1. Normalized total power dissipation as a function of mounting base temperature

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

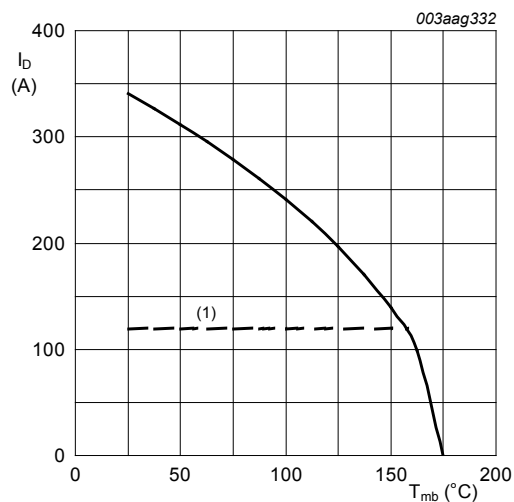


Fig. 2. Continuous drain current as a function of mounting base temperature

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

(1) Capped at 120 A due to package.

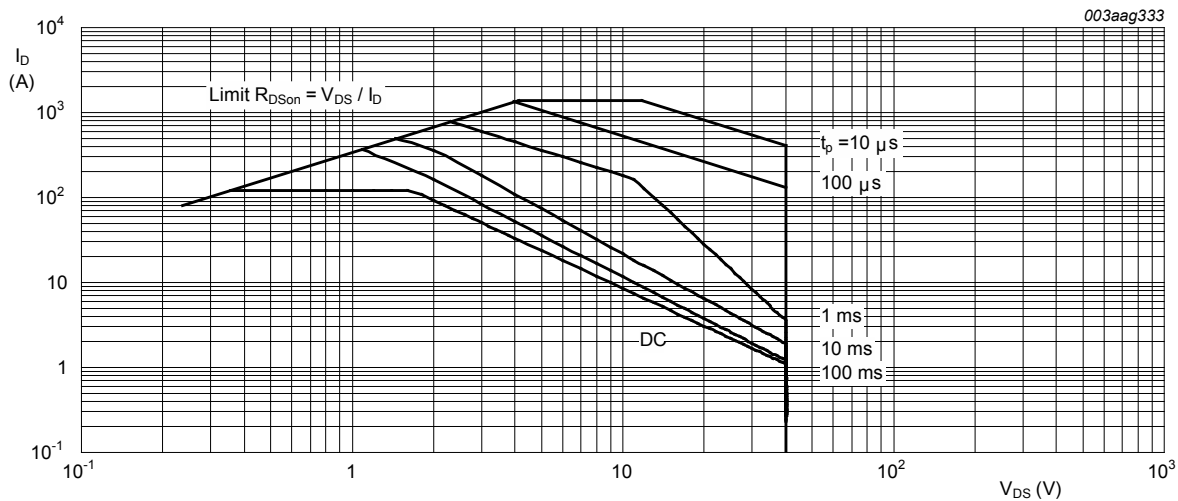


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

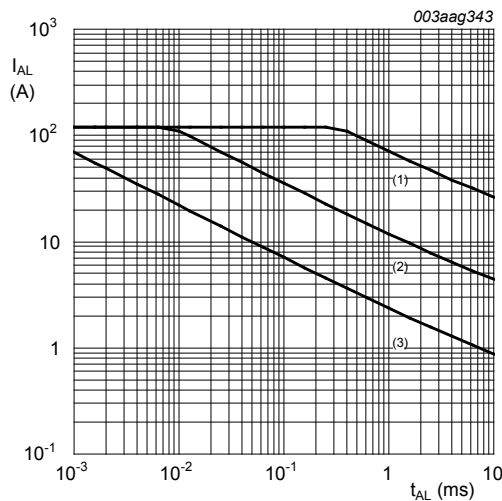


Fig. 4. Single-pulse and repetitive avalanche rating; avalanche current as a function of avalanche time

(1) $T_j(init) = 25^{\circ}C$; (2) $T_j(init) = 150^{\circ}C$; (3) Repetitive Avalanche

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	-	-	0.43	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	minimum footprint ; mounted on a printed-circuit board	-	50	-	K/W

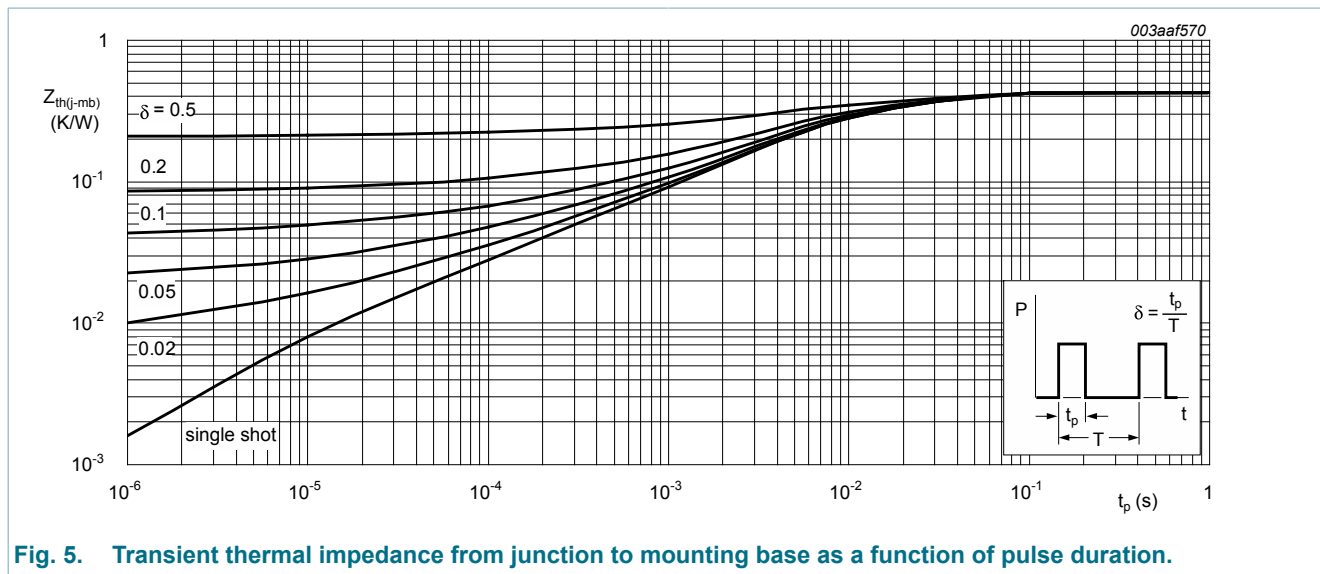


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration.

10. Characteristics

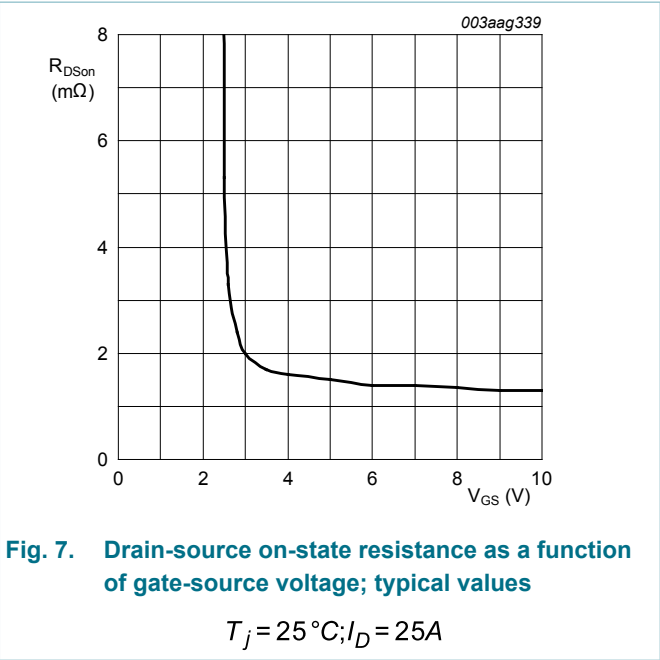
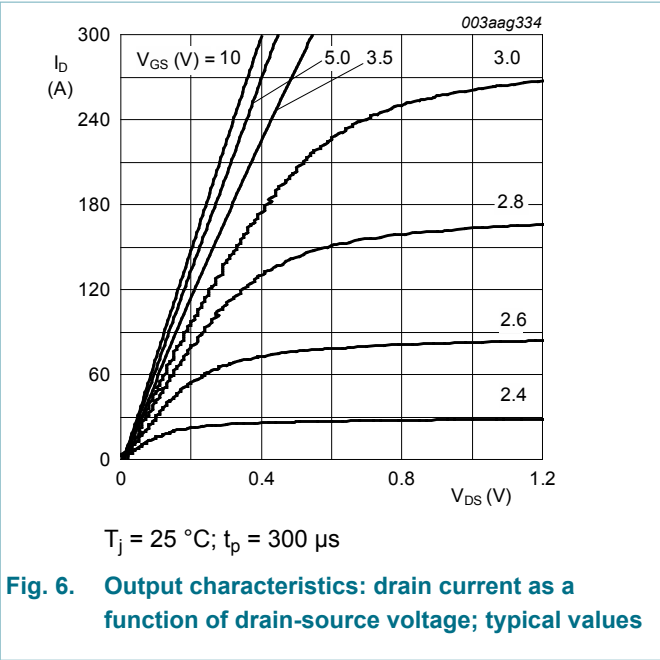
Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250\text{ }\mu\text{A}$; $V_{GS} = 0\text{ V}$; $T_j = 25\text{ }^\circ\text{C}$		40	-	-	V
		$I_D = 250\text{ }\mu\text{A}$; $V_{GS} = 0\text{ V}$; $T_j = -55\text{ }^\circ\text{C}$		36	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\text{ mA}$; $V_{DS} = V_{GS}$; $T_j = 25\text{ }^\circ\text{C}$; Fig. 9 ; Fig. 10		1.4	1.7	2.1	V
		$I_D = 1\text{ mA}$; $V_{DS} = V_{GS}$; $T_j = -55\text{ }^\circ\text{C}$; Fig. 9		-	-	2.45	V
		$I_D = 1\text{ mA}$; $V_{DS} = V_{GS}$; $T_j = 175\text{ }^\circ\text{C}$; Fig. 9		0.5	-	-	V
I_{DSS}	drain leakage current	$V_{DS} = 40\text{ V}$; $V_{GS} = 0\text{ V}$; $T_j = 25\text{ }^\circ\text{C}$		-	0.13	1	μA
		$V_{DS} = 40\text{ V}$; $V_{GS} = 0\text{ V}$; $T_j = 175\text{ }^\circ\text{C}$		-	-	500	μA
I_{GSS}	gate leakage current	$V_{GS} = 10\text{ V}$; $V_{DS} = 0\text{ V}$; $T_j = 25\text{ }^\circ\text{C}$		-	2	100	nA
		$V_{GS} = -10\text{ V}$; $V_{DS} = 0\text{ V}$; $T_j = 25\text{ }^\circ\text{C}$		-	2	100	nA
R_{DSon}	drain-source on-state resistance	$V_{GS} = 5\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25\text{ }^\circ\text{C}$; Fig. 11		-	1.35	1.6	m Ω
		$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25\text{ }^\circ\text{C}$; Fig. 11		-	1.17	1.4	m Ω
		$V_{GS} = 5\text{ V}$; $I_D = 25\text{ A}$; $T_j = 175\text{ }^\circ\text{C}$; Fig. 12 ; Fig. 11		-	-	3.1	m Ω
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	$I_D = 25\text{ A}$; $V_{DS} = 32\text{ V}$; $V_{GS} = 5\text{ V}$; Fig. 13 ; Fig. 14		-	120	-	nC
Q_{GS}	gate-source charge			-	26.9	-	nC

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Q_{GD}	gate-drain charge			-	40.9	-	nC
C_{iss}	input capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}; f = 1\text{ MHz};$ $T_j = 25\text{ }^{\circ}\text{C};$ Fig. 15		-	12300	16400	pF
C_{oss}	output capacitance			-	1530	1840	pF
C_{rss}	reverse transfer capacitance			-	740	1020	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30\text{ V}; R_L = 1.2\text{ }\Omega; V_{GS} = 5\text{ V};$ $R_{G(ext)} = 5\text{ }\Omega$		-	95	-	ns
t_r	rise time			-	118	-	ns
$t_{d(off)}$	turn-off delay time			-	195	-	ns
t_f	fall time			-	119	-	ns
L_D	internal drain inductance	from upper edge of drain mounting base to center of die		-	2.5	-	nH
L_S	internal source inductance	from source lead to source bonding pad		-	7.5	-	nH

Source-drain diode

V_{SD}	source-drain voltage	$I_S = 25\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^{\circ}\text{C};$ Fig. 16	-	0.77	1.2	V
t_{rr}	reverse recovery time	$I_S = 20\text{ A}; dI_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 25\text{ V}$	-	57	-	ns
Q_r	recovered charge		-	97	-	nC



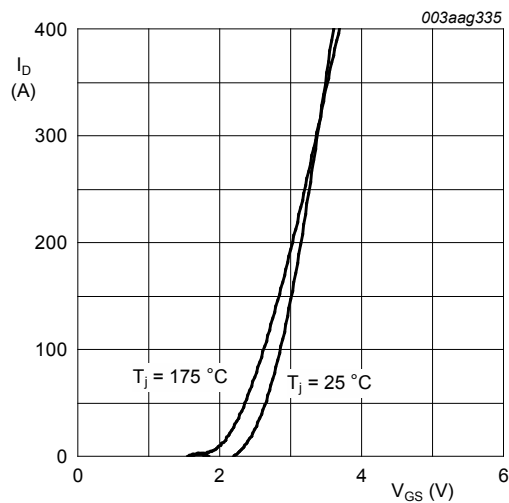


Fig. 8. Transfer characteristics: drain current as a function of gate-source voltage; typical values

$V_{DS} = 12\text{ V}$

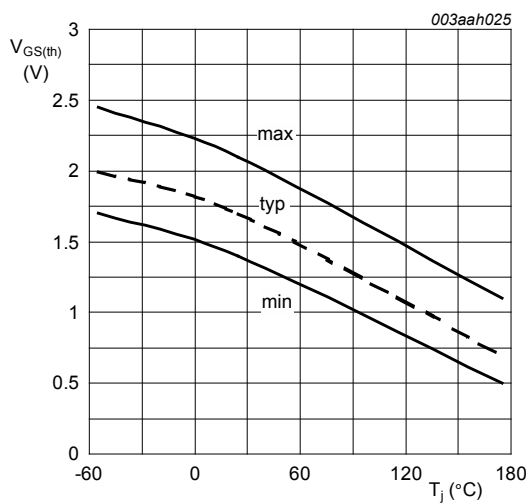


Fig. 9. Gate-source threshold voltage as a function of junction temperature

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

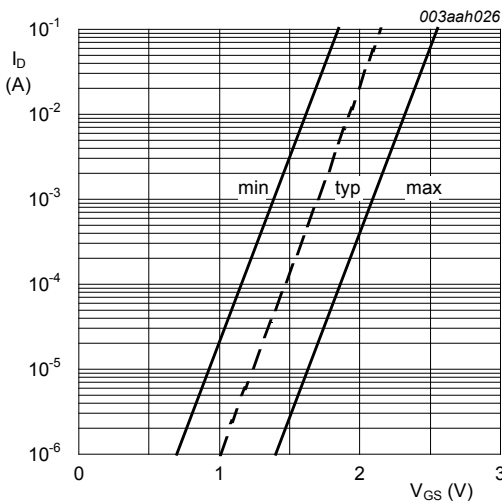


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

$T_J = 25\text{ °C}; V_{DS} = 5\text{ V}$

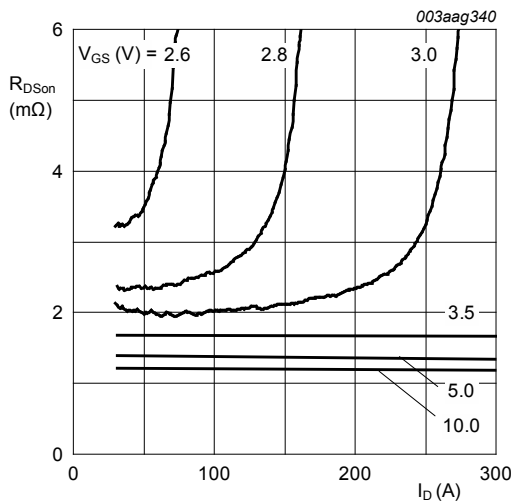


Fig. 11. Drain-source on-state resistance as a function of drain current; typical values

$T_J = 25\text{ °C}; t_p = 300\text{ }\mu\text{s}$

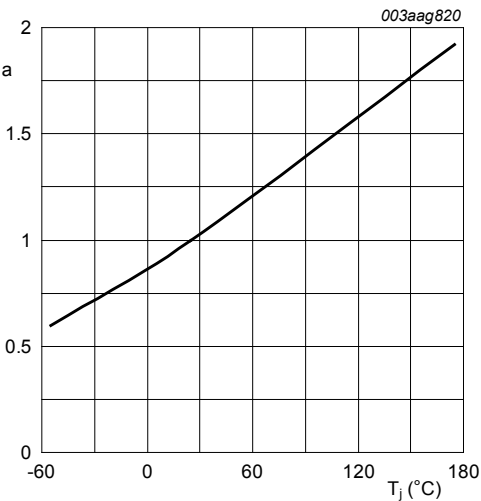


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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

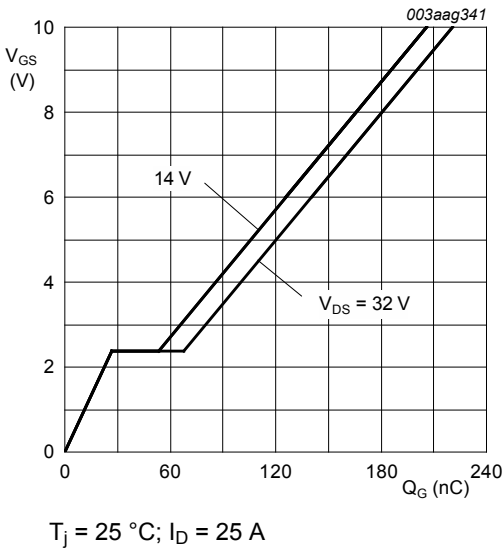


Fig. 14. Gate-source voltage as a function of gate charge; typical values

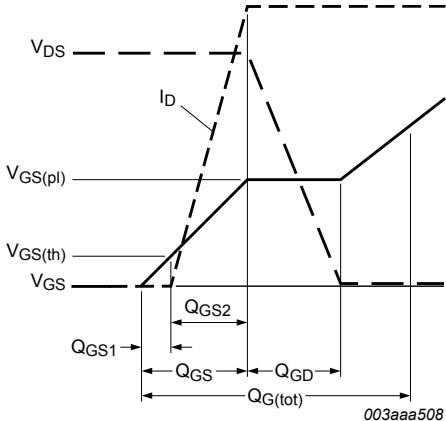


Fig. 13. Gate charge waveform definitions

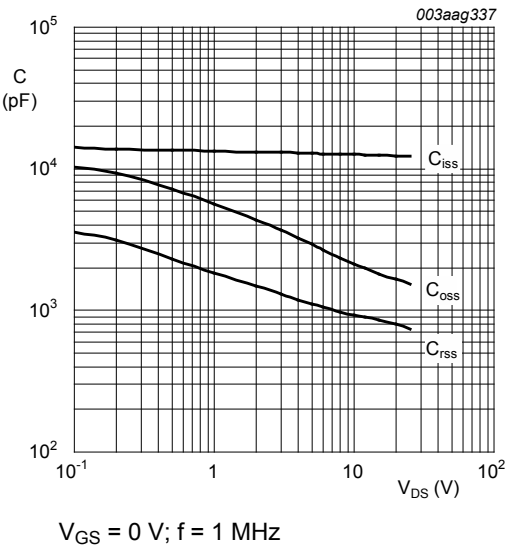
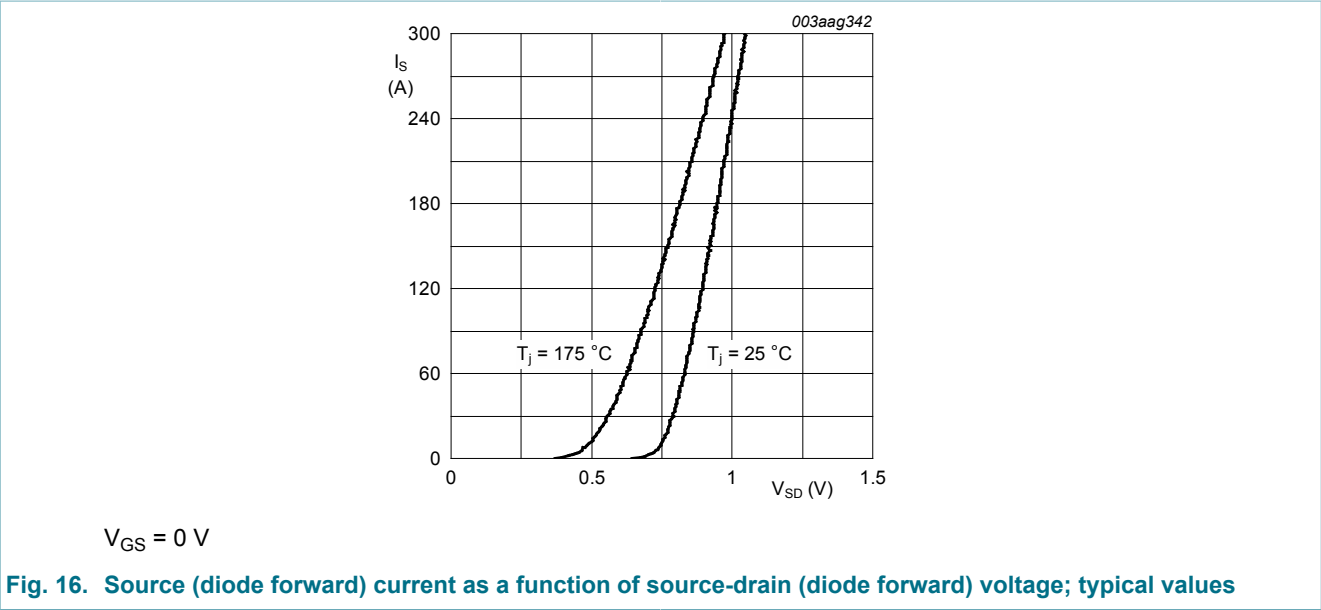


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



11. Package outline

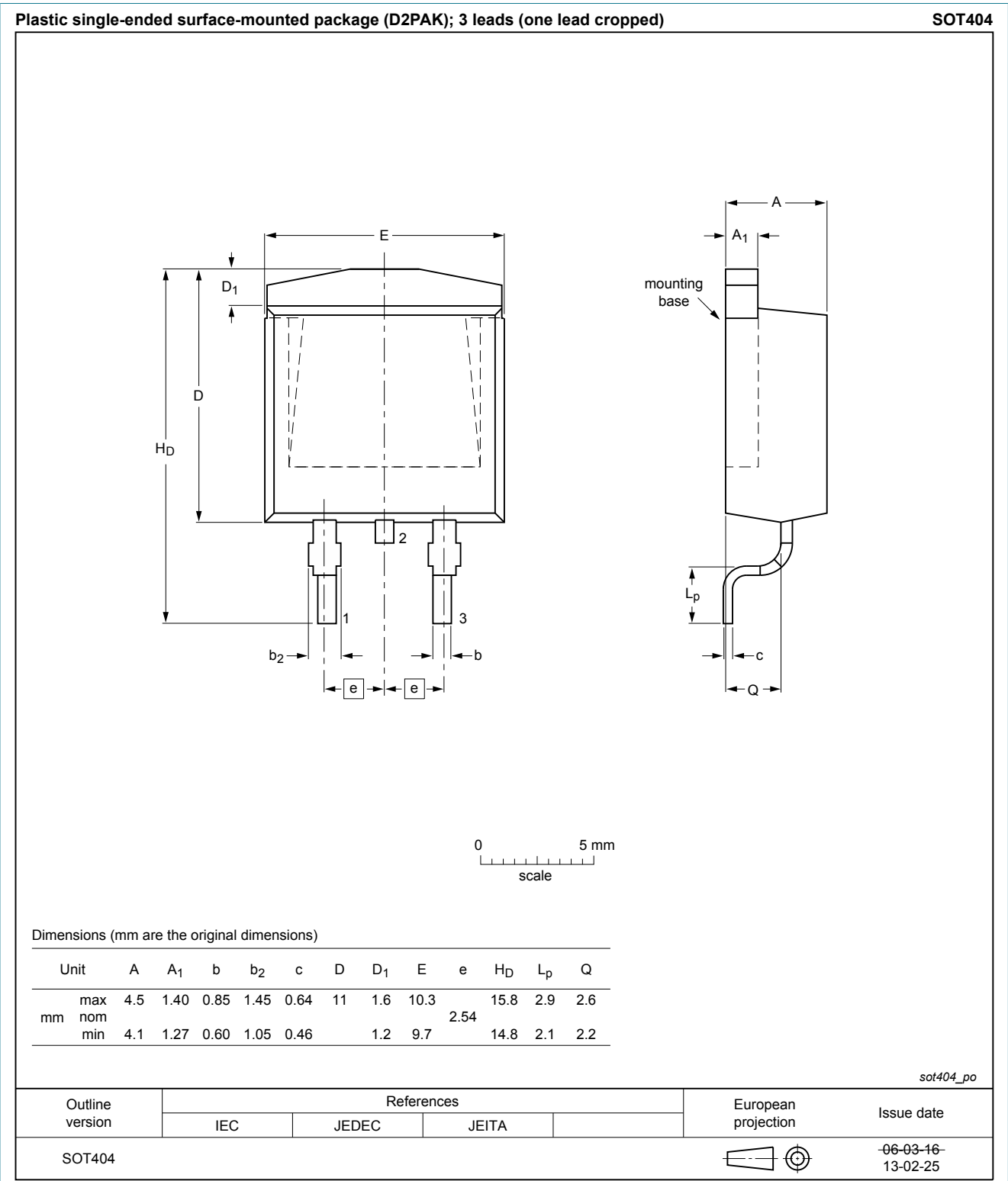


Fig. 17. Package outline D2PAK (SOT404)

12. Legal information

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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.
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