

BUK969R0-60E

N-channel TrenchMOS logic level FET

13 July 2012

Product data sheet

1. Product profile

1.1 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.

1.2 Features and benefits

- AEC Q101 compliant
- Repetitive avalanche rated
- Suitable for thermally demanding environments due to 175 °C rating
- True logic level gate with VGS(th) rating of greater than 0.5V 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 | Typ | Max | Unit |
|--------------------------------|----------------------------------|---|-----|------|-----|------|
| V _{DS} | drain-source voltage | T _j ≥ 25 °C; T _j ≤ 175 °C | - | - | 60 | V |
| I _D | drain current | V _{GS} = 5 V; T _{mb} = 25 °C; Fig. 1 | [1] | - | 75 | A |
| P _{tot} | total power dissipation | T _{mb} = 25 °C; Fig. 2 | - | - | 137 | W |
| Static characteristics | | | | | | |
| R _{DSon} | drain-source on-state resistance | V _{GS} = 5 V; I _D = 20 A; T _j = 25 °C; Fig. 11 | - | 7.53 | 9 | mΩ |
| Dynamic characteristics | | | | | | |
| Q _{GD} | gate-drain charge | V _{GS} = 5 V; I _D = 20 A; V _{DS} = 48 V; Fig. 13 ; Fig. 14 | - | 9.7 | - | 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 |  <p>D2PAK (SOT404)</p> |  |
| 2 | D | drain | | |
| 3 | S | source | | |
| mb | D | mounting base; connected to drain | | |

3. Ordering information

Table 3. Ordering information

| Type number | Package | | |
|--------------|---------|--|---------|
| | Name | Description | Version |
| BUK969R0-60E | D2PAK | plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped) | SOT404 |

4. Limiting values

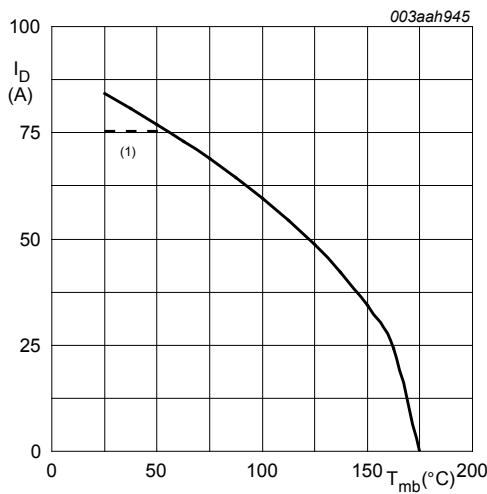
Table 4. Limiting values

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

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---------------------------|-------------------------|---|-----|-----|-----|------|
| V_{DS} | drain-source voltage | $T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$ | | - | 60 | V |
| V_{DGR} | drain-gate voltage | $R_{GS} = 20\text{ k}\Omega$ | | - | 60 | V |
| V_{GS} | gate-source voltage | $T_j = 25\text{ °C}$; lifetime = 100 hours | | -15 | 15 | V |
| | | $T_j = 25\text{ °C}$ | | -10 | 10 | V |
| I_D | drain current | $T_{mb} = 25\text{ °C}$; $V_{GS} = 5\text{ V}$; Fig. 1 | [1] | - | 75 | A |
| | | $T_{mb} = 100\text{ °C}$; $V_{GS} = 5\text{ V}$; Fig. 1 | | - | 59 | A |
| I_{DM} | peak drain current | $T_{mb} = 25\text{ °C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$; Fig. 4 | | - | 333 | A |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C}$; Fig. 2 | | - | 137 | W |
| T_{stg} | storage temperature | | | -55 | 175 | °C |
| T_j | junction temperature | | | -55 | 175 | °C |
| Source-drain diode | | | | | | |
| I_S | source current | $T_{mb} = 25\text{ °C}$ | [1] | - | 75 | A |
| I_{SM} | peak source current | pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$ | | - | 333 | A |

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------------------------|--|--|--------|-----|-------|
| Avalanche ruggedness | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D = 75\text{ A}$; $V_{sup} \leq 60\text{ V}$; $R_{GS} = 50\ \Omega$; $V_{GS} = 5\text{ V}$; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$; unclamped; Fig. 3 | [2][3] | - | 86 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.



(1) Capped at 75A due to package

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

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

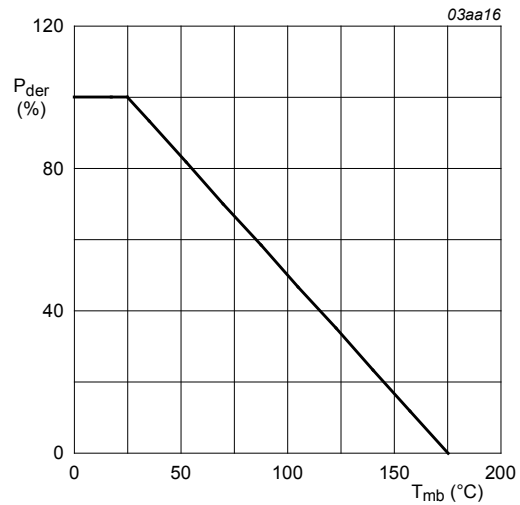


Fig. 2. Normalized total power dissipation as a function of mounting base temperature

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

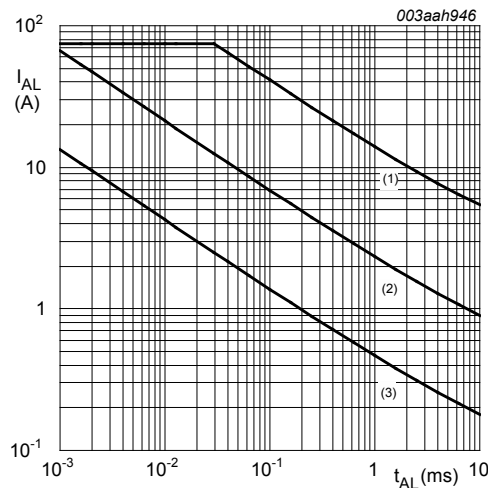
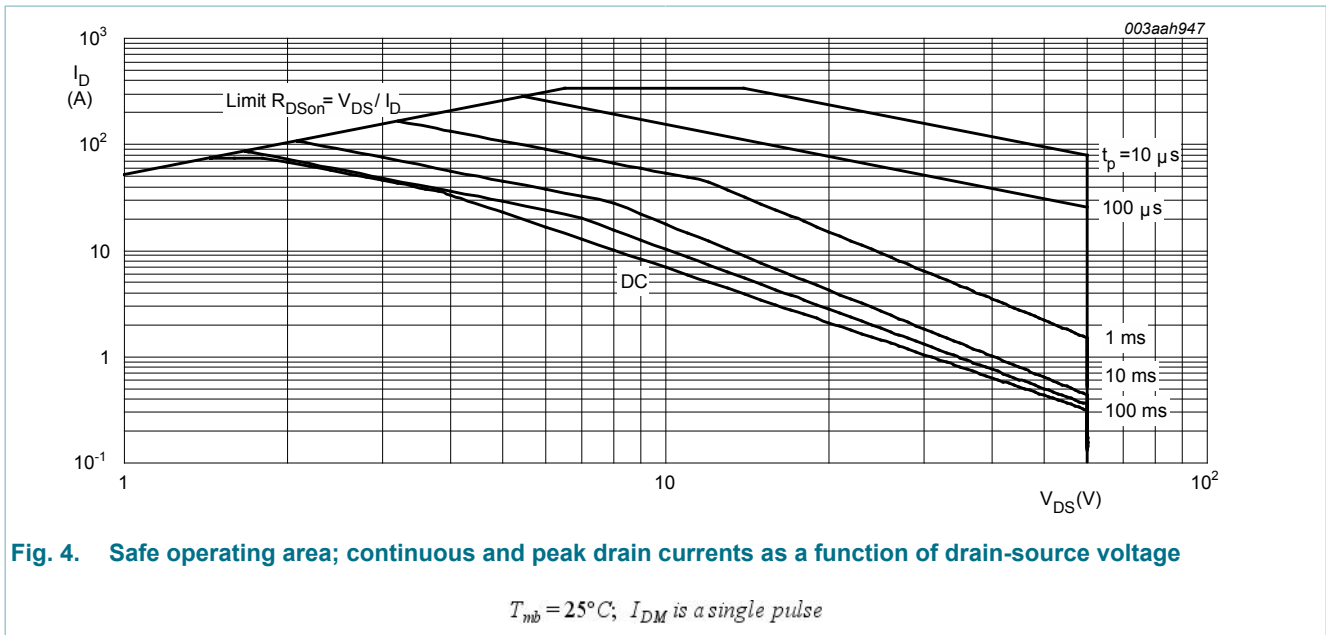


Fig. 3. Single pulse avalanche rating; avalanche current as a function of avalanche time

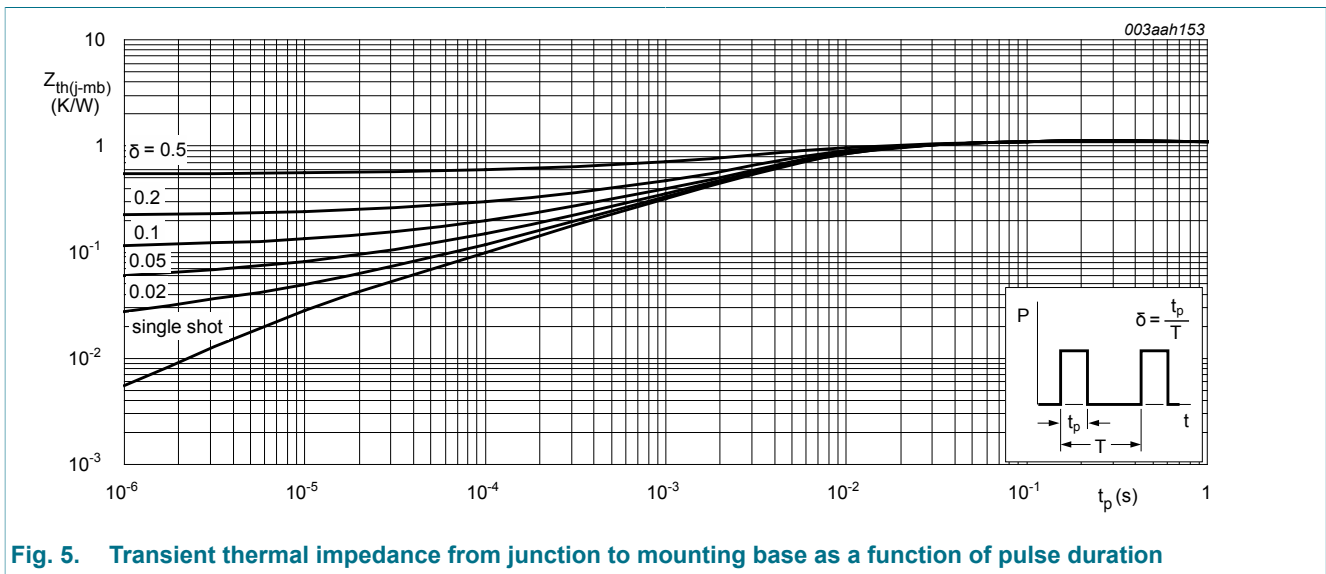
- (1) $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$; (2) $T_{j(\text{init})} = 150\text{ }^\circ\text{C}$; (3) Repetitive Avalanche



5. Thermal characteristics

Table 5. Thermal characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|----------------|---|--|-----|-----|------|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | Fig. 5 | - | - | 1.09 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | minimum footprint ; mounted on a printed-circuit board | - | 50 | - | K/W |



6. Characteristics

Table 6. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|---|-----|------|------|------------|
| Static characteristics | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$ | 60 | - | - | V |
| | | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$ | 54 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C;$ Fig. 9; Fig. 10 | 1.4 | 1.7 | 2.1 | V |
| | | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ C;$ Fig. 9 | - | - | 2.45 | V |
| | | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ C;$ Fig. 9 | 0.5 | - | - | V |
| I_{DSS} | drain leakage current | $V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$ | - | 0.04 | 1 | μA |
| | | $V_{DS} = 60 V; V_{GS} = 0 V; T_j = 175 \text{ }^\circ C$ | - | - | 500 | μA |
| I_{GSS} | gate leakage current | $V_{GS} = 10 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$ | - | 2 | 100 | nA |
| | | $V_{GS} = -10 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$ | - | 2 | 100 | nA |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = 5 V; I_D = 20 A; T_j = 25 \text{ }^\circ C;$ Fig. 11 | - | 7.53 | 9 | m Ω |
| | | $V_{GS} = 10 V; I_D = 20 A; T_j = 25 \text{ }^\circ C;$ Fig. 11 | - | 6.74 | 8 | m Ω |
| | | $V_{GS} = 5 V; I_D = 20 A; T_j = 175 \text{ }^\circ C;$ Fig. 12; Fig. 11 | - | - | 19.8 | m Ω |
| Dynamic characteristics | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D = 20 A; V_{DS} = 48 V; V_{GS} = 5 V;$ Fig. 13; Fig. 14 | - | 29.8 | - | nC |
| Q_{GS} | gate-source charge | | - | 7.9 | - | nC |
| Q_{GD} | gate-drain charge | | - | 9.7 | - | nC |
| C_{iss} | input capacitance | $V_{GS} = 0 V; V_{DS} = 25 V; f = 1 \text{ MHz};$ $T_j = 25 \text{ }^\circ C;$ Fig. 15 | - | 3263 | 4350 | pF |
| C_{oss} | output capacitance | | - | 305 | 366 | pF |
| C_{rss} | reverse transfer capacitance | | - | 160 | 219 | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = 45 V; R_L = 2 \Omega; V_{GS} = 5 V;$ $R_{G(ext)} = 5 \Omega$ | - | 21 | - | ns |
| t_r | rise time | | - | 56 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 32 | - | ns |
| t_f | fall time | | - | 46 | - | 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 |

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------------|-----------------------|--|-----|------|-----|------|
| Source-drain diode | | | | | | |
| V_{SD} | source-drain voltage | $I_S = 20\text{ A}$; $V_{GS} = 0\text{ V}$; $T_j = 25\text{ }^\circ\text{C}$; Fig. 16 | - | 0.83 | 1.2 | V |
| t_{rr} | reverse recovery time | $I_S = 20\text{ A}$; $di_S/dt = -100\text{ A}/\mu\text{s}$; $V_{GS} = 0\text{ V}$; | - | 27 | - | ns |
| Q_r | recovered charge | $V_{DS} = 25\text{ V}$ | - | 28 | - | nC |

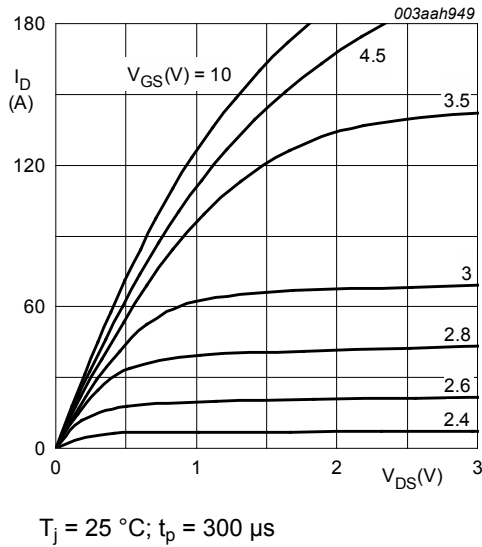


Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values

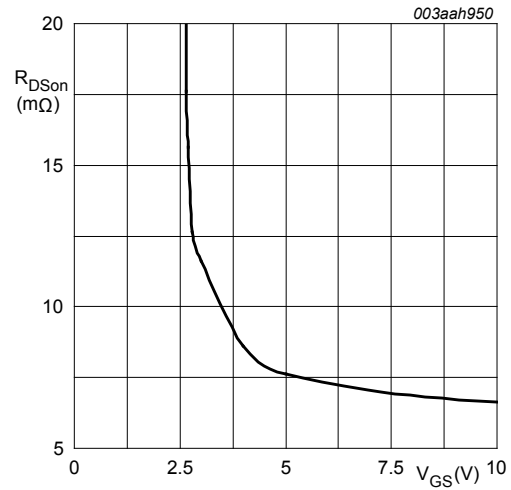


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

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

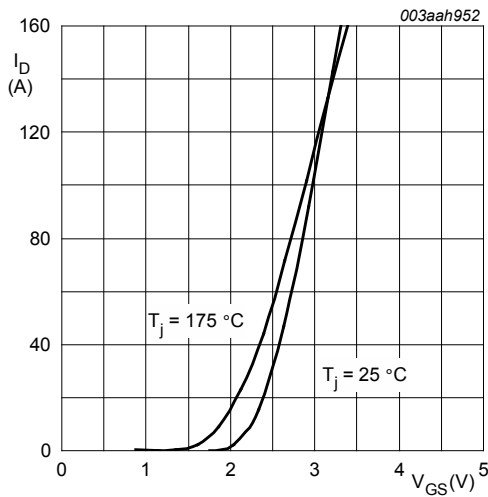


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

$V_{DS} = 10\text{ V}$

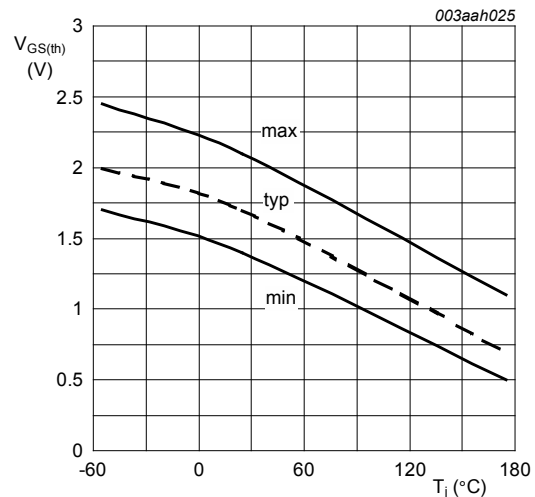


Fig. 9. Gate-source threshold voltage as a function of junction temperature

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

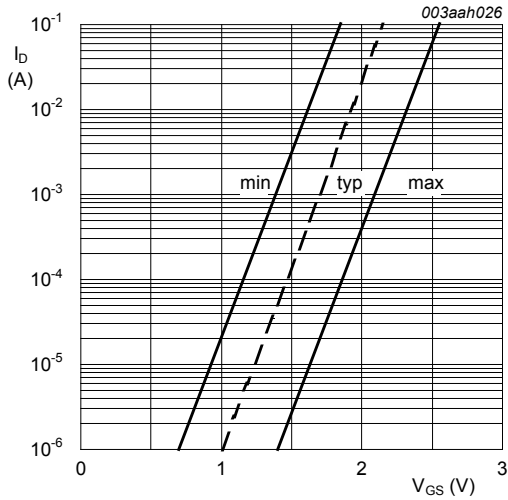


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

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

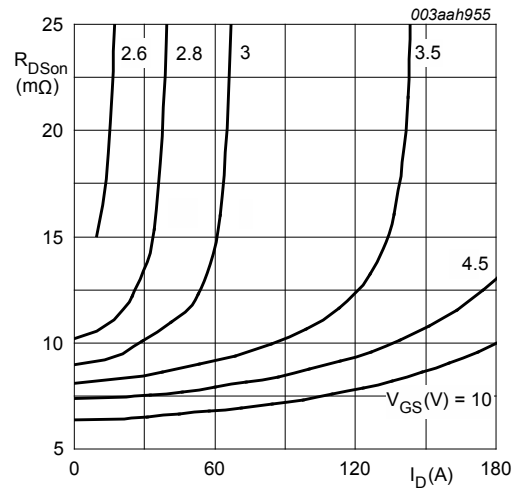


Fig. 11. Drain-source on-state resistance as a function of drain current; typical values

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

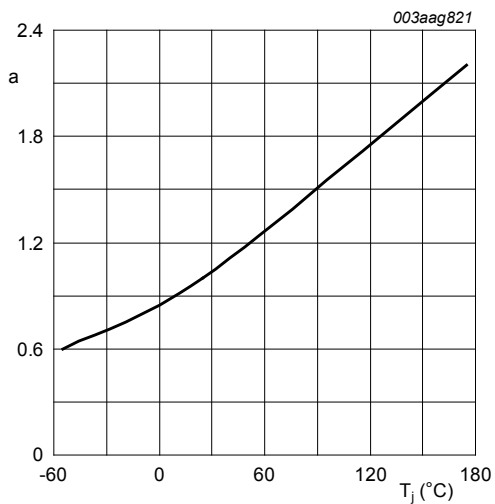


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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

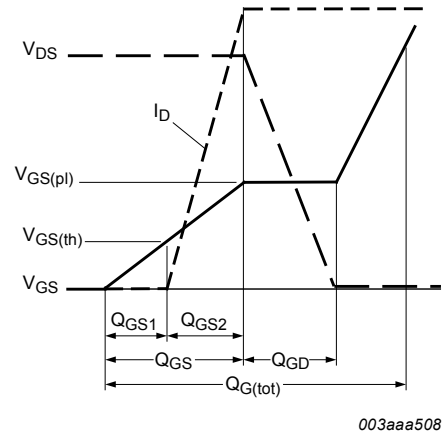


Fig. 13. Gate charge waveform definitions

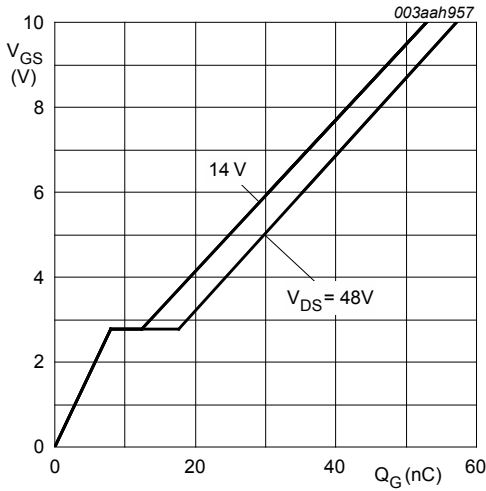


Fig. 14. Gate-source voltage as a function of gate charge; typical values

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

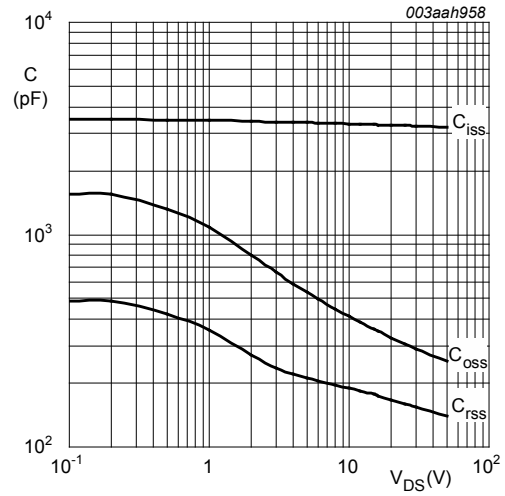


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

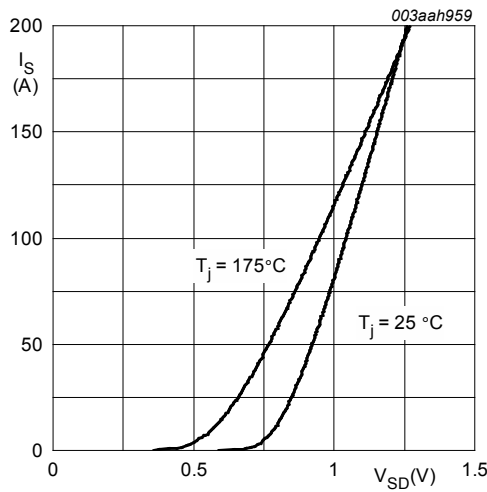


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

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

7. Package outline

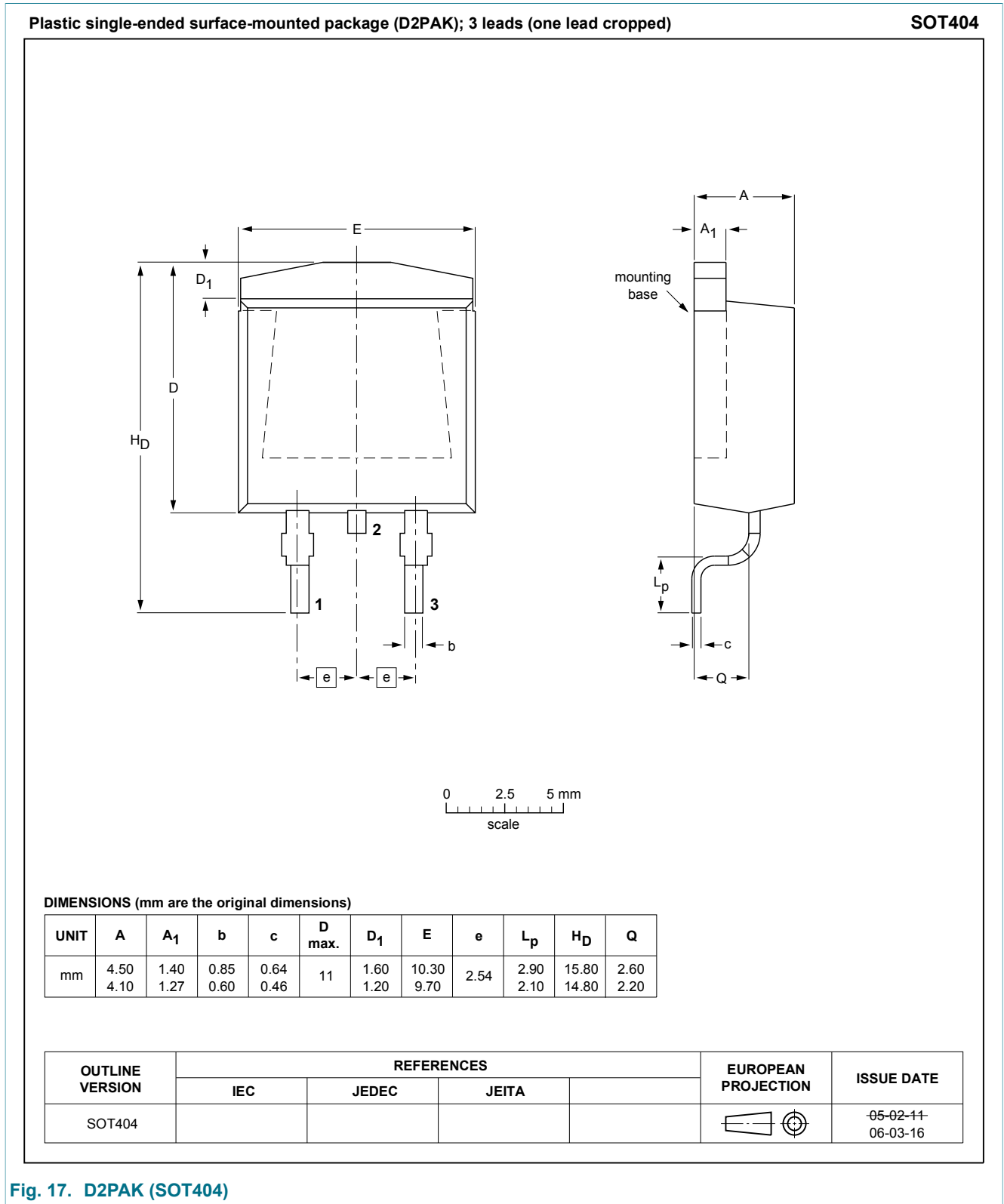


Fig. 17. D2PAK (SOT404)

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8.1 Data sheet status

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