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BUK962R1-40E

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 $V_{GS(th)}$ 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 | $T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$ | | - | - | 40 | V |
| I_D | drain current | $V_{GS} = 5\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 1 | [1] | - | - | 120 | A |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C}$; Fig. 2 | | - | - | 293 | 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 | | - | 1.7 | 2.1 | 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 | | - | 29.6 | - | nC |

[1] Continuous current is limited by package.



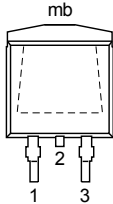
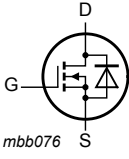
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2. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|-----|--------|-----------------------------------|--|---|
| 1 | G | gate |  <p>D2PAK (SOT404)</p> |  <p>mbb076</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 |
| BUK962R1-40E | D2PAK | plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped) | SOT404 |

4. Marking

Table 4. Marking codes

| Type number | Marking code |
|--------------|--------------|
| BUK962R1-40E | BUK962R1-40E |

5. 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 | $T_j \geq 25\text{ }^{\circ}\text{C}$; $T_j \leq 175\text{ }^{\circ}\text{C}$ | | - | 40 | V |
| V_{DGR} | drain-gate voltage | $R_{GS} = 20\text{ k}\Omega$ | | - | 40 | V |
| V_{GS} | gate-source voltage | $T_j = 25\text{ }^{\circ}\text{C}$ | | -10 | 10 | V |
| | | $T_j = 25\text{ }^{\circ}\text{C}$; lifetime = 100 hours | | -15 | 15 | V |
| I_D | drain current | $T_{mb} = 25\text{ }^{\circ}\text{C}$; $V_{GS} = 5\text{ V}$; Fig. 1 | [1] | - | 120 | A |
| | | $T_{mb} = 100\text{ }^{\circ}\text{C}$; $V_{GS} = 5\text{ V}$; Fig. 1 | [1] | - | 120 | A |
| I_{DM} | peak drain current | $T_{mb} = 25\text{ }^{\circ}\text{C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$; Fig. 4 | | - | 1078 | A |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ }^{\circ}\text{C}$; Fig. 2 | | - | 293 | W |
| T_{stg} | storage temperature | | | -55 | 175 | $^{\circ}\text{C}$ |

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| Symbol | Parameter | Conditions | | Min | Max | Unit |
|-----------------------------|--|---|--------|-----|------|------|
| T_j | junction temperature | | | -55 | 175 | °C |
| Source-drain diode | | | | | | |
| I_S | source current | $T_{mb} = 25\text{ °C}$ | [1] | - | 120 | A |
| I_{SM} | peak source current | pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$ | | - | 1078 | 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. 3 | [2][3] | - | 622 | 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.

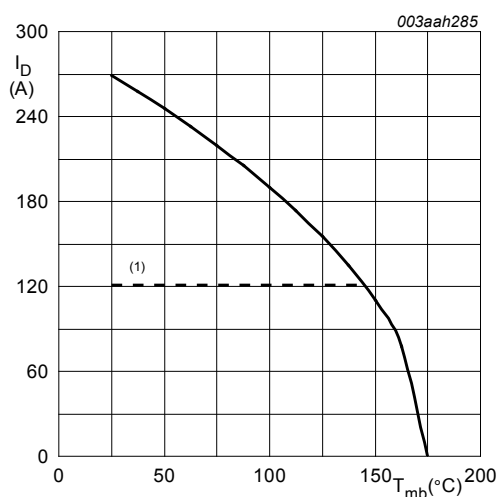


Fig. 1. Continuous drain current as a function of mounting base temperature

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

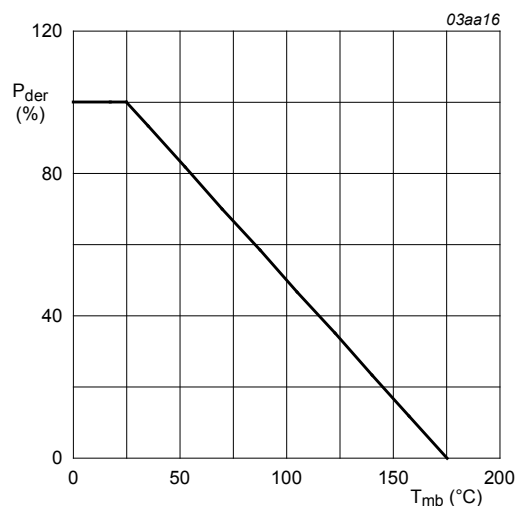


Fig. 2. Normalized total power dissipation as a function of mounting base temperature

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

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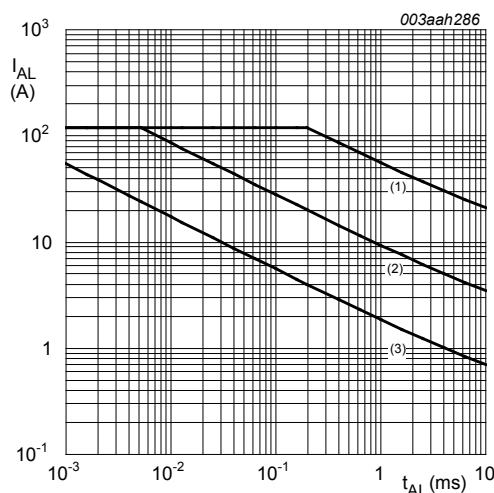


Fig. 3. Single pulse avalanche rating; avalanche current as a function of avalanche time

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

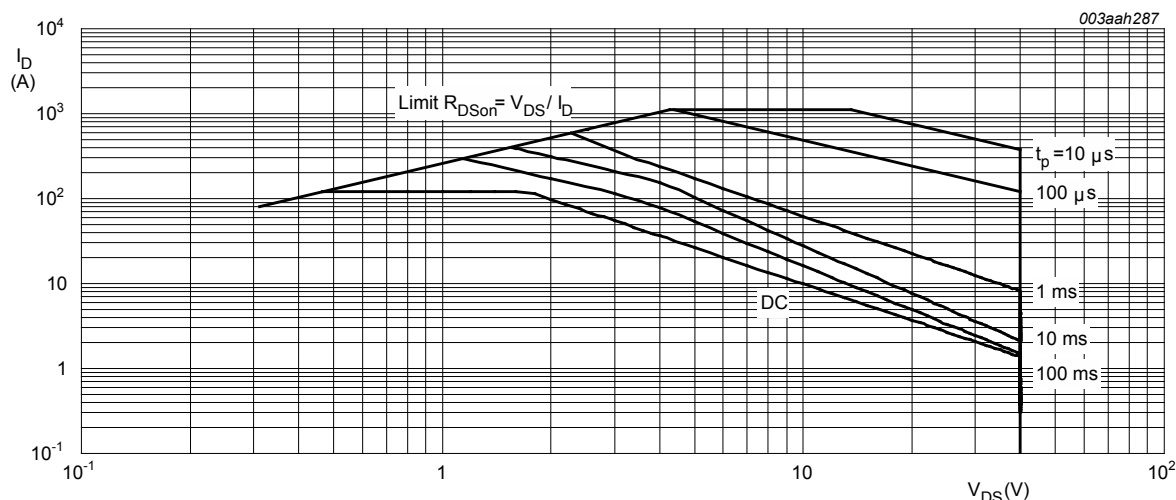


Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

6. Thermal characteristics

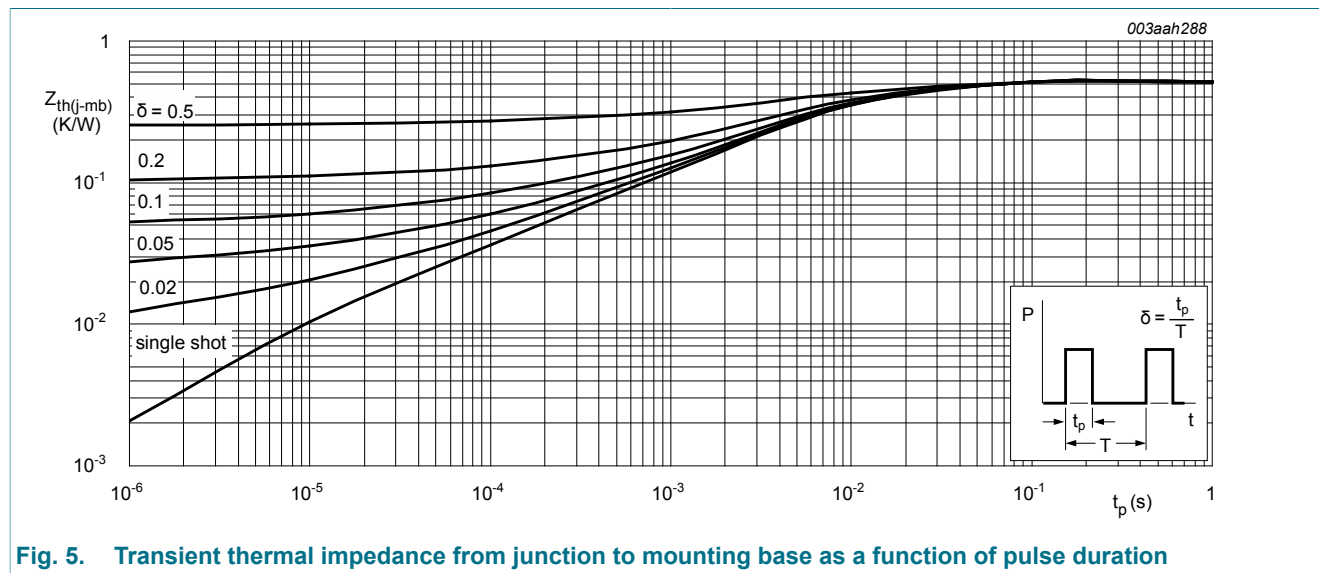
Table 6. Thermal characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|----------------|---|--|-----|-----|------|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | Fig. 5 | - | - | 0.51 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | minimum footprint ; mounted on a printed-circuit board | - | 50 | - | K/W |

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7. Characteristics

Table 7. Characteristics

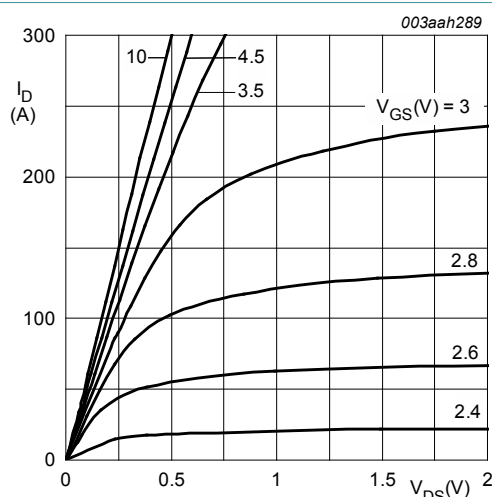
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|-------------------------|----------------------------------|---|--|-----|------|------|---------------|
| Static characteristics | | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D = 250\text{ }\mu\text{A}; V_{GS} = 0\text{ V}; T_J = 25\text{ }^\circ\text{C}$ | | 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 | $V_{DS} = 40\text{ V}; V_{GS} = 0\text{ V}; T_J = 25\text{ }^\circ\text{C}$ | | - | 0.15 | 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 | | - | 1.7 | 2.1 | m Ω |
| | | $V_{GS} = 10\text{ V}; I_D = 25\text{ A}; T_J = 25\text{ }^\circ\text{C};$ Fig. 11 | | - | 1.5 | 1.8 | m Ω |
| | | $V_{GS} = 5\text{ V}; I_D = 25\text{ A}; T_J = 175\text{ }^\circ\text{C};$ Fig. 12 ; Fig. 11 | | - | - | 4 | 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 | | - | 87.8 | - | nC |

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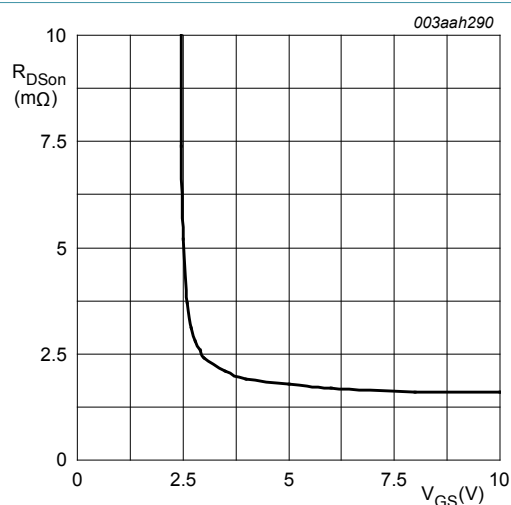
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| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------------|------------------------------|---|-----|------|-------|------|
| Q_{GS} | gate-source charge | $I_D = 25\text{ A}$; $V_{DS} = 32\text{ V}$; $V_{GS} = 5\text{ V}$; Fig. 14 ; Fig. 13 | - | 20.8 | - | nC |
| Q_{GD} | gate-drain charge | $I_D = 25\text{ A}$; $V_{DS} = 32\text{ V}$; $V_{GS} = 5\text{ V}$; Fig. 13 ; Fig. 14 | - | 29.6 | - | nC |
| C_{iss} | input capacitance | $V_{GS} = 0\text{ V}$; $V_{DS} = 25\text{ V}$; $f = 1\text{ MHz}$; $T_j = 25^\circ\text{C}$; Fig. 15 | - | 9880 | 13160 | pF |
| C_{oss} | output capacitance | | - | 1187 | 1425 | pF |
| C_{rss} | reverse transfer capacitance | | - | 600 | 820 | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = 30\text{ V}$; $R_L = 1.2\ \Omega$; $V_{GS} = 5\text{ V}$; $R_{G(ext)} = 5\ \Omega$ | - | 56 | - | ns |
| t_r | rise time | | - | 96 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 151 | - | ns |
| t_f | fall time | | - | 93 | - | 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 | $I_S = 25\text{ A}$; $V_{GS} = 0\text{ V}$; $T_j = 25^\circ\text{C}$; Fig. 16 | - | 0.8 | 1.2 | V |
| t_{rr} | reverse recovery time | $I_S = 20\text{ A}$; $dI_S/dt = -100\text{ A}/\mu\text{s}$; $V_{GS} = 0\text{ V}$; $V_{DS} = 25\text{ V}$ | - | 45 | - | ns |
| Q_r | recovered charge | | - | 62 | - | nC |



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

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



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

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

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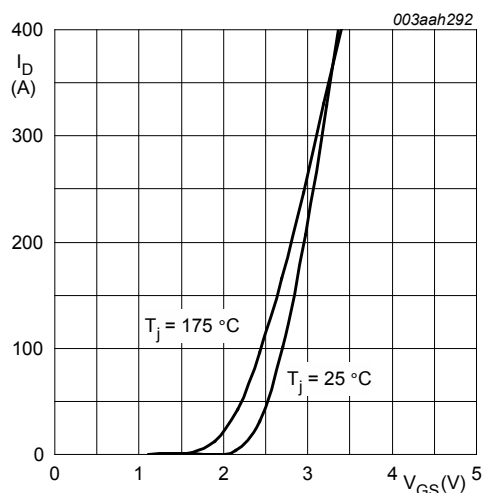


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

$$V_{DS} = 10V$$

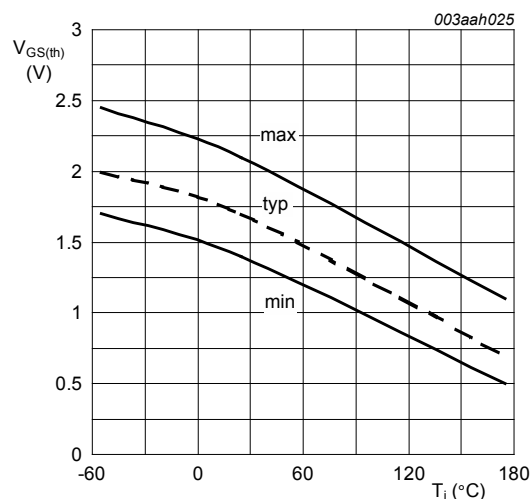


Fig. 9. Gate-source threshold voltage as a function of junction temperature

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

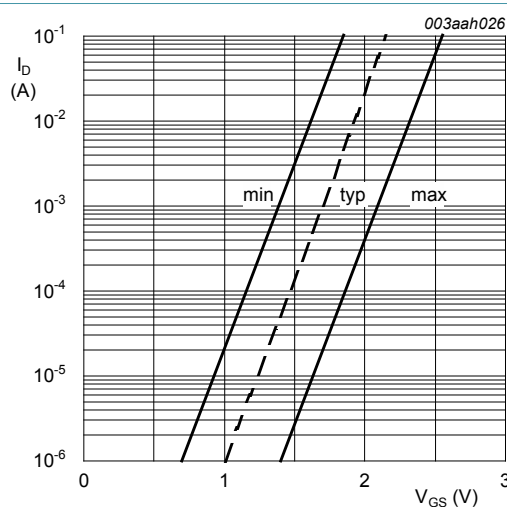


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

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

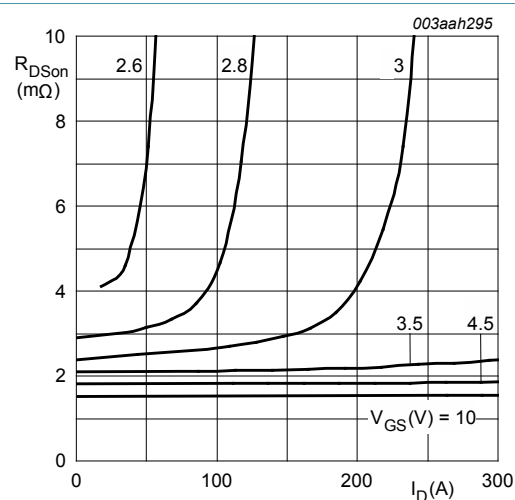


Fig. 11. Drain-source on-state resistance as a function of drain current; typical values

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

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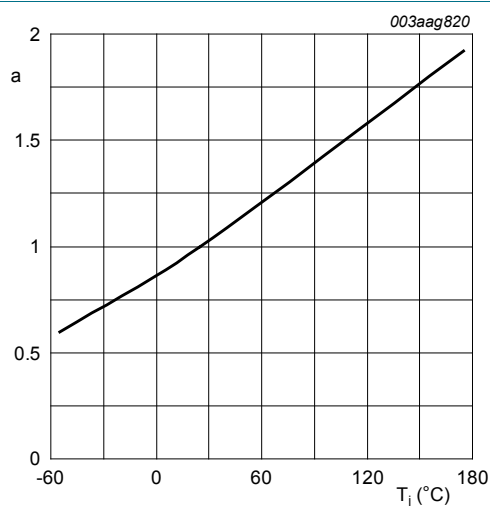


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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

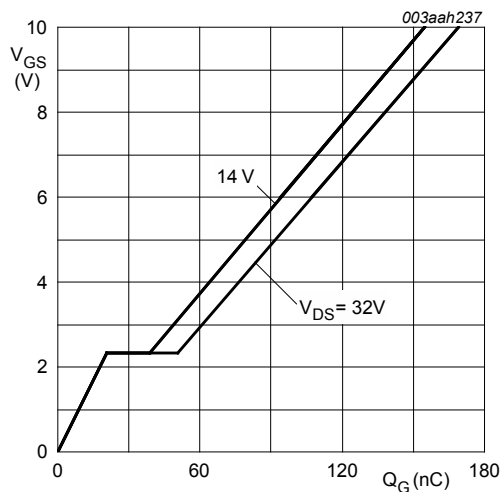


Fig. 14. Gate-source voltage as a function of gate charge; typical values

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

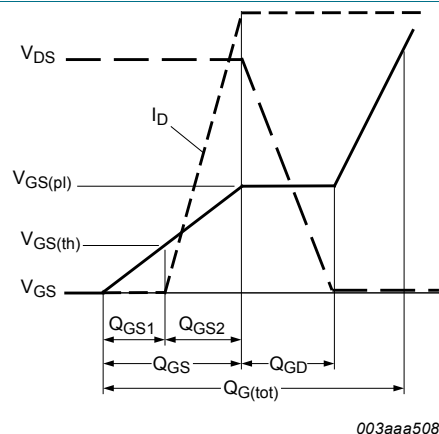


Fig. 13. Gate charge waveform definitions

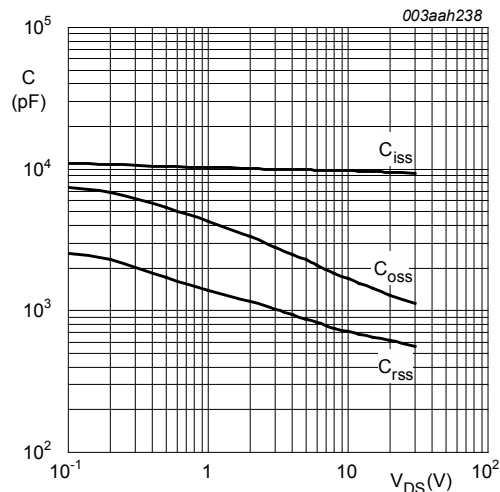


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

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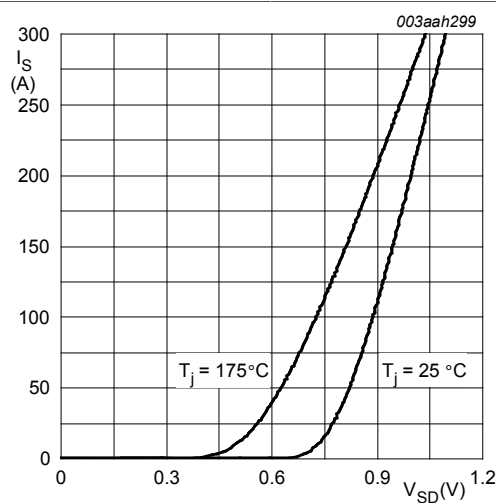


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$$V_{GS} = 0V$$

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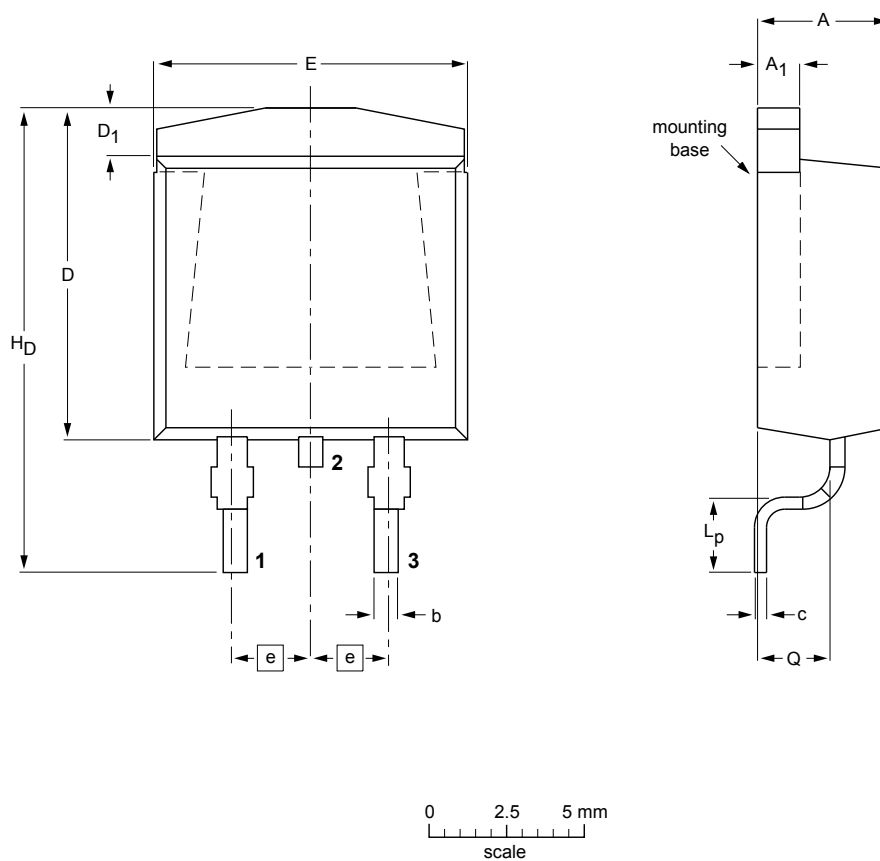
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8. Package outline

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

SOT404



DIMENSIONS (mm are the original dimensions)

| UNIT | A | A ₁ | b | c | D max. | D ₁ | E | e | L _p | H _D | Q |
|------|--------------|----------------|--------------|--------------|-----------|----------------|---------------|------|----------------|----------------|--------------|
| mm | 4.50 4.10 | 1.40 1.27 | 0.85 0.60 | 0.64 0.46 | 11 | 1.60 1.20 | 10.30 9.70 | 2.54 | 2.90 2.10 | 15.80 14.80 | 2.60 2.20 |


| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|--------------------|------------|-------|-------|--|---|----------------------|
| | IEC | JEDEC | JEITA | | | |
| SOT404 | | | | |  | 05-02-11 06-03-16 |

Fig. 17. D2PAK (SOT404)

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9. Legal information

9.1 Data sheet status

| 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. |
| Product [short] data sheet | Production | This document contains the product specification. |

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
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