



BUK7E1R9-40E

N-channel TrenchMOS standard level FET

19 May 2016

Product data sheet

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.

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 $V_{GS(th)}$ rating of greater than 1 V at 175 °C

3. Applications

- 12 V Automotive systems
- Electric and electro-hydraulic power steering
- 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

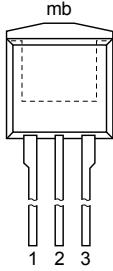
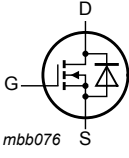
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|---|-----|-----|------|-----|------|
| V_{DS} | drain-source voltage | $25\text{ °C} \leq T_j \leq 175\text{ °C}$ | | - | - | 40 | V |
| I_D | drain current | $V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2 | [1] | - | - | 120 | A |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C}$; Fig. 1 | | - | - | 324 | W |
| Static characteristics | | | | | | | |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25\text{ °C}$; Fig. 11 | | - | 1.5 | 1.9 | mΩ |
| Dynamic characteristics | | | | | | | |
| Q_{GD} | gate-drain charge | $I_D = 25\text{ A}$; $V_{DS} = 32\text{ V}$; $V_{GS} = 10\text{ V}$; Fig. 13 ; Fig. 14 | | - | 34.7 | - | nC |

[1] Continuous current is limited by package.

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5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|-----|--------|-----------------------------------|---|---|
| 1 | G | gate |  <p>I2PAK (SOT226)</p> |  |
| 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 |
| BUK7E1R9-40E | I2PAK | plastic single-ended package (I2PAK); TO-262 | SOT226 |

7. Marking

Table 4. Marking codes

| Type number | Marking code |
|--------------|--------------|
| BUK7E1R9-40E | BUK7E1R9-40E |

8. Limiting values

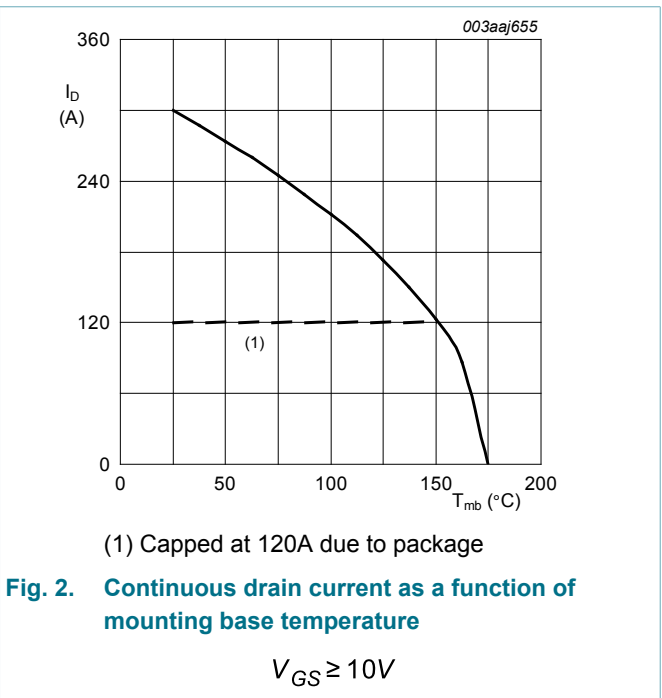
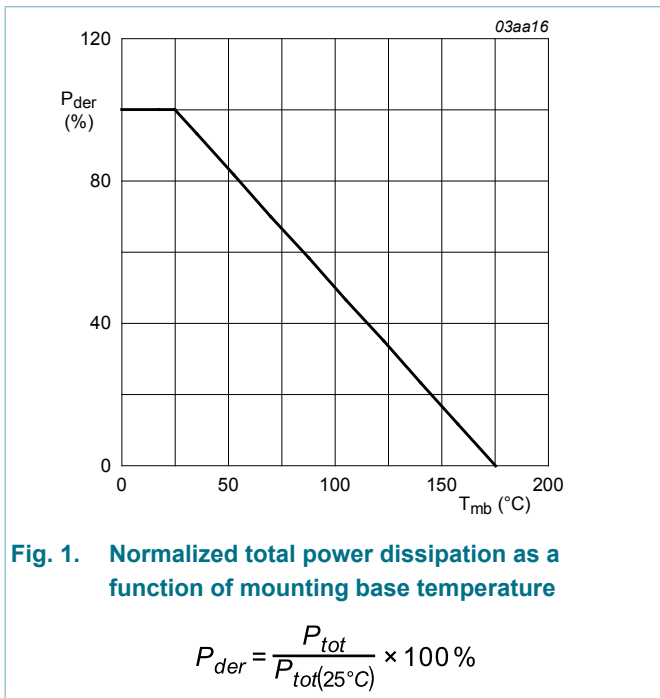
Table 5. Limiting values

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

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|-----------|-------------------------|---|-----|-----|------|------|
| V_{DS} | drain-source voltage | $25\text{ °C} \leq T_j \leq 175\text{ °C}$ | | - | 40 | V |
| V_{DGR} | drain-gate voltage | $R_{GS} = 20\text{ k}\Omega$ | | - | 40 | V |
| V_{GS} | gate-source voltage | DC; $T_j \leq 175\text{ °C}$ | | -20 | 20 | V |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C}$; Fig. 1 | | - | 324 | W |
| I_D | drain current | $V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2 | [1] | - | 120 | A |
| | | $V_{GS} = 10\text{ V}$; $T_{mb} = 100\text{ °C}$; Fig. 2 | [1] | - | 120 | A |
| I_{DM} | peak drain current | pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$; Fig. 3 | | - | 1198 | 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 °C | [1] | - | 120 | A |
| I _{SM} | peak source current | pulsed; t _p ≤ 10 μs; T _{mb} = 25 °C | | - | 1198 | A |
| Avalanche ruggedness | | | | | | |
| E _{DS(AL)S} | non-repetitive drain-source avalanche energy | I _D = 120 A; V _{sup} ≤ 40 V; R _{GS} = 50 Ω; V _{GS} = 10 V; T _{j(init)} = 25 °C; unclamped; Fig. 4 | [2][3] | - | 801 | 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.



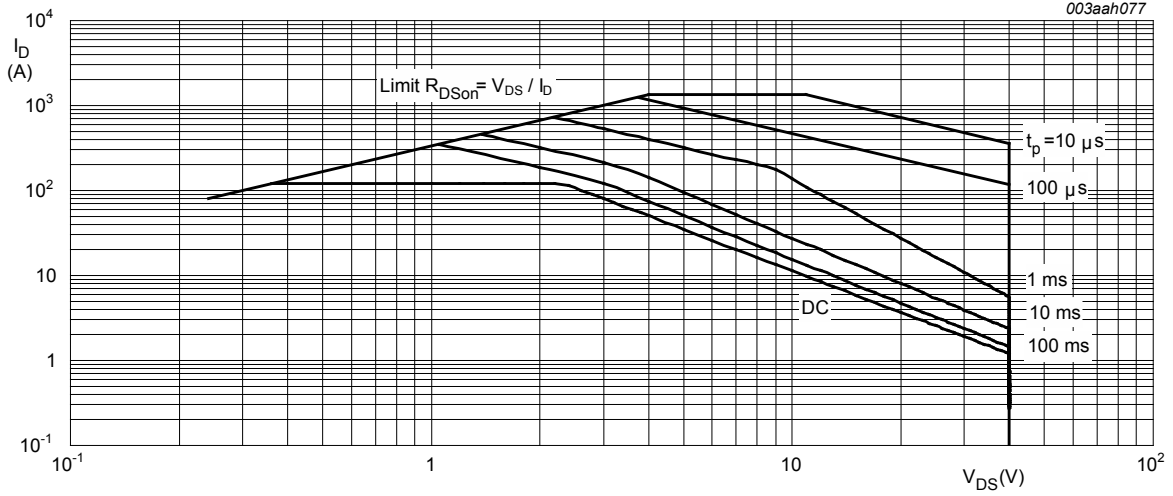


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

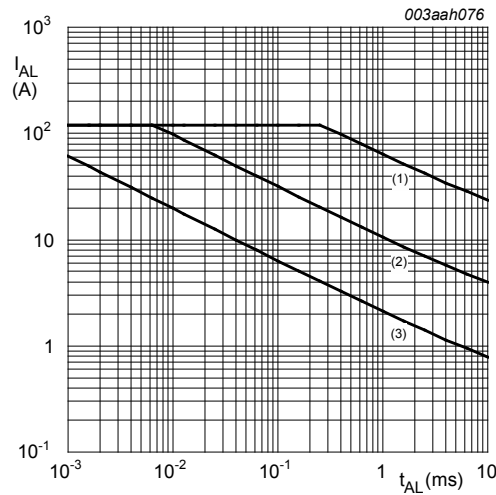


Fig. 4. Single pulse avalanche rating; avalanche current as a function of avalanche time

(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 | - | - | 0.46 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | vertical in still air | - | 65 | - | K/W |

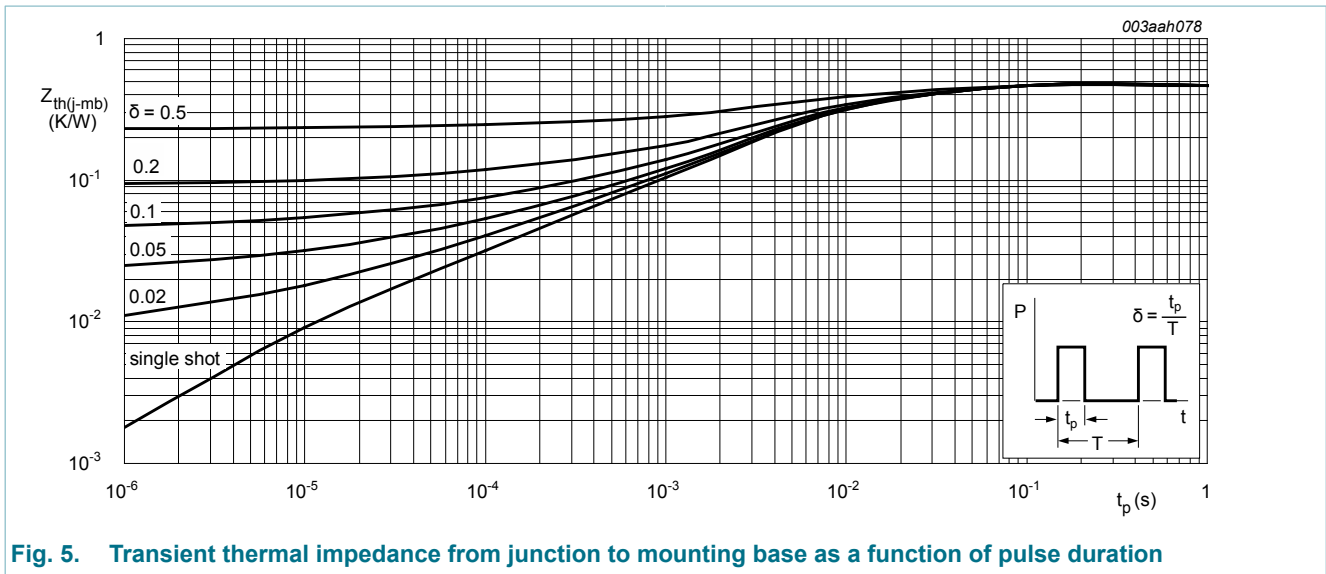


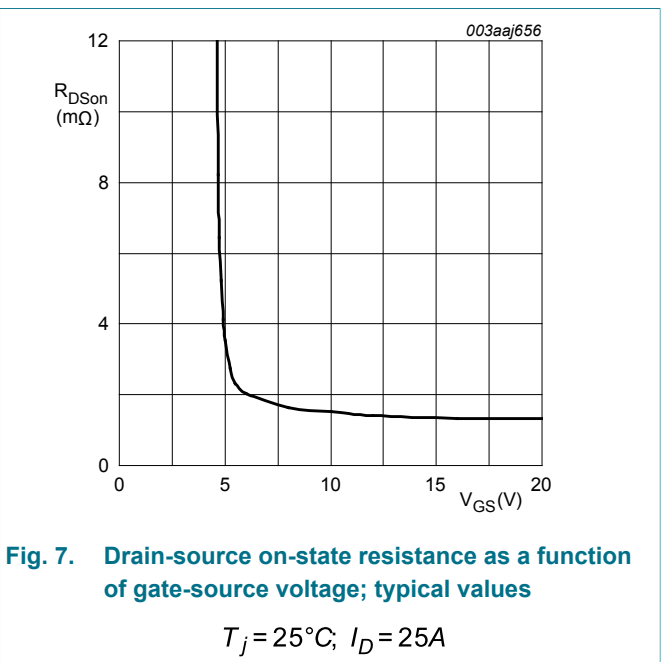
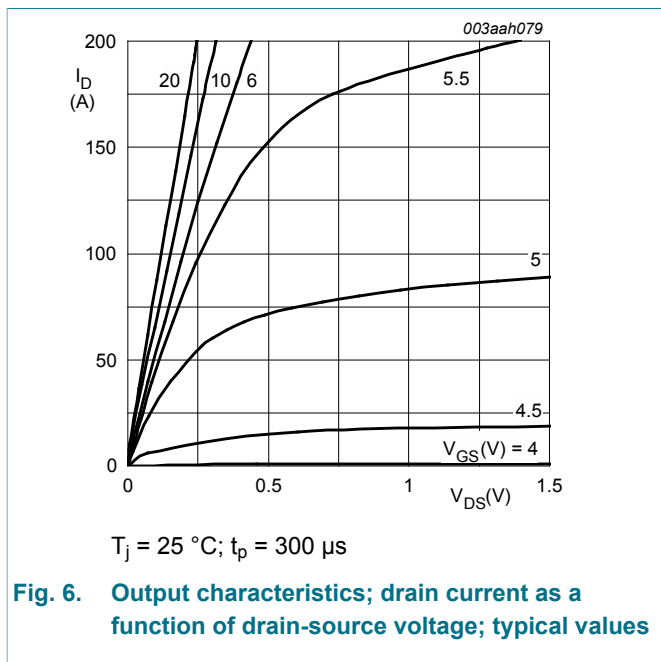
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Characteristics

Table 7. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|---|-----|------|-----|------------|
| Static characteristics | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$ | 40 | - | - | V |
| | | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$ | 36 | - | - | 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 | 2.4 | 3 | 4 | V |
| | | $I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = -55 \text{ }^\circ C$; Fig. 10 | - | - | 4.5 | V |
| | | $I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = 175 \text{ }^\circ C$; Fig. 10 | 1 | - | - | V |
| I_{DSS} | drain leakage current | $V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | 0.27 | 3 | μA |
| | | $V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ C$ | - | - | 500 | μA |
| I_{GSS} | gate leakage current | $V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | 2 | 100 | nA |
| | | $V_{GS} = -20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | 2 | 100 | nA |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ C$; Fig. 11 | - | 1.5 | 1.9 | m Ω |
| | | $V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 175 \text{ }^\circ C$; Fig. 12 ; Fig. 11 | - | - | 3.6 | m Ω |
| Dynamic characteristics | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D = 25 \text{ A}; V_{DS} = 32 \text{ V}; V_{GS} = 10 \text{ V}$; Fig. 13 ; Fig. 14 | - | 118 | - | nC |
| Q_{GS} | gate-source charge | | - | 29.3 | - | nC |
| Q_{GD} | gate-drain charge | | - | 34.7 | - | nC |

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------------|------------------------------|---|-----|------|-------|------|
| C_{iss} | input capacitance | $V_{DS} = 25\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz};$ | - | 7873 | 10472 | pF |
| C_{oss} | output capacitance | $T_j = 25\text{ }^\circ\text{C};$ Fig. 15 | - | 1410 | 1692 | pF |
| C_{rss} | reverse transfer capacitance | | - | 851 | 1165 | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = 30\text{ V}; R_L = 1.2\text{ }\Omega; V_{GS} = 10\text{ V};$ | - | 35 | - | ns |
| t_r | rise time | $R_{G(ext)} = 5\text{ }\Omega$ | - | 49 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 87 | - | ns |
| t_f | fall time | | - | 52 | - | 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 | - | 0.79 | 1.2 | V |
| t_{rr} | reverse recovery time | $I_S = 20\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ | - | 46 | - | ns |
| Q_r | recovered charge | $V_{DS} = 25\text{ V}$ | - | 62 | - | nC |



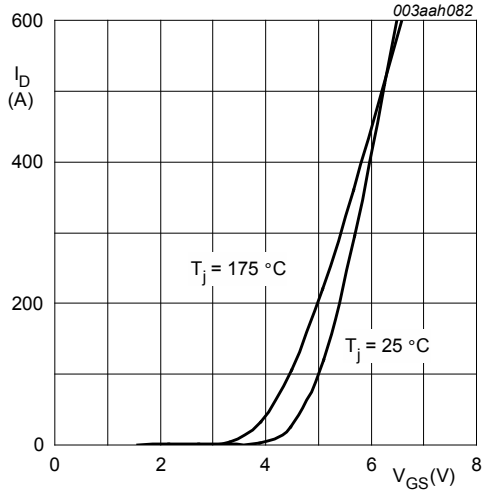


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

$V_{DS} = 10V$

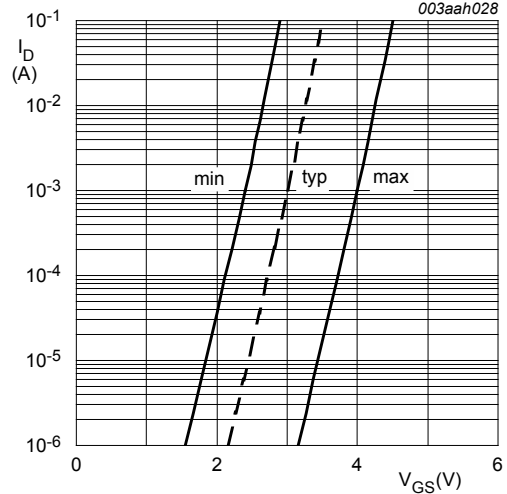


Fig. 9. Sub-threshold drain current as a function of gate-source voltage

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

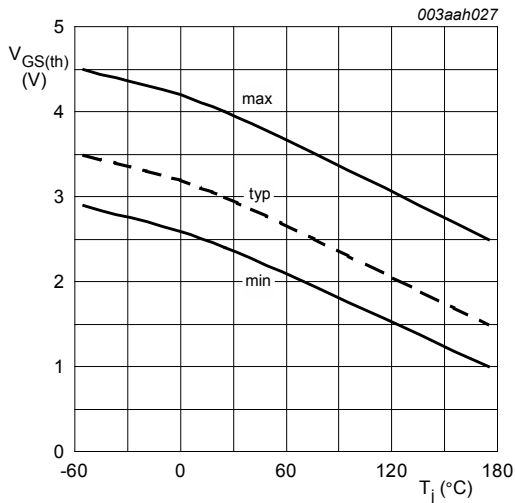


Fig. 10. Gate-source threshold voltage as a function of junction temperature

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

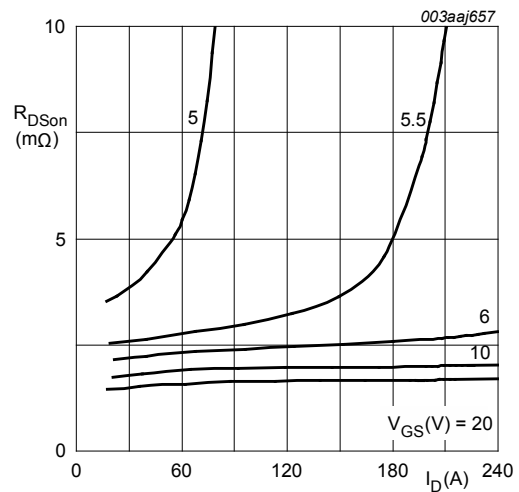


Fig. 11. Drain-source on-state resistance as a function of drain current; typical values

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

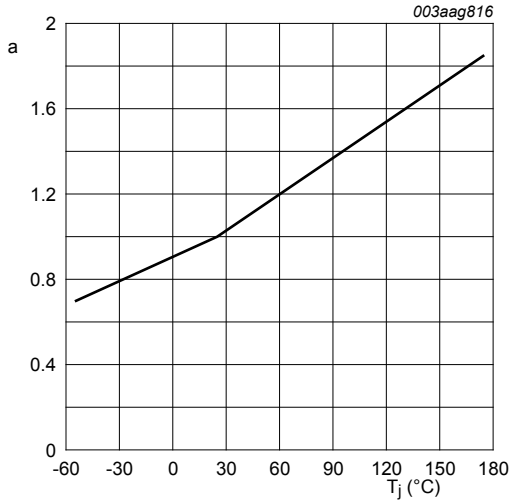


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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



Fig. 13. Gate charge waveform definitions

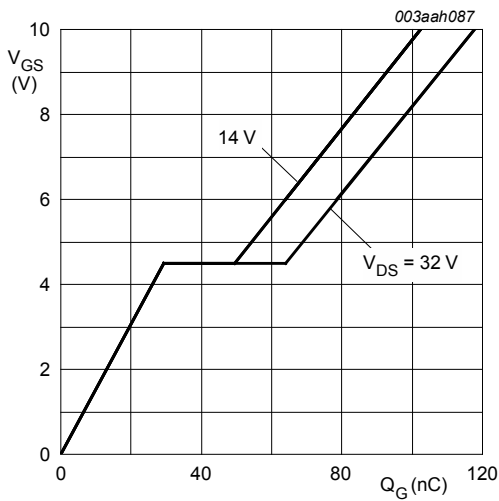


Fig. 14. Gate-source voltage as a function of gate charge; typical values

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

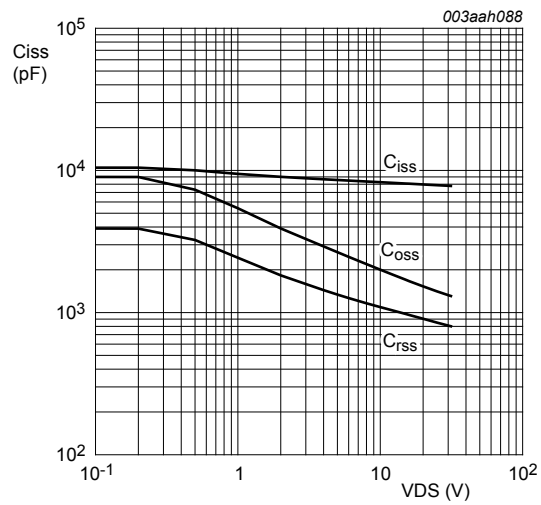


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

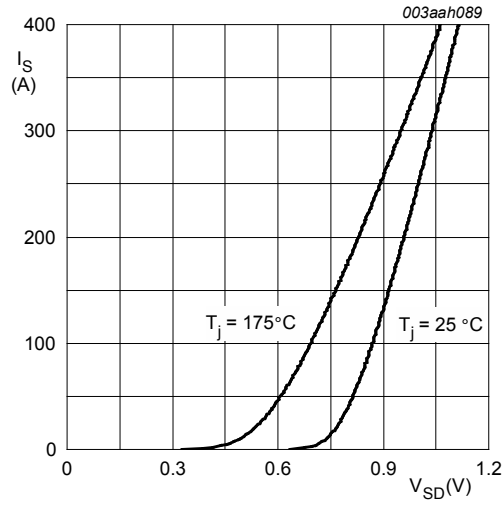


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$$V_{GS} = 0V$$

11. Package outline

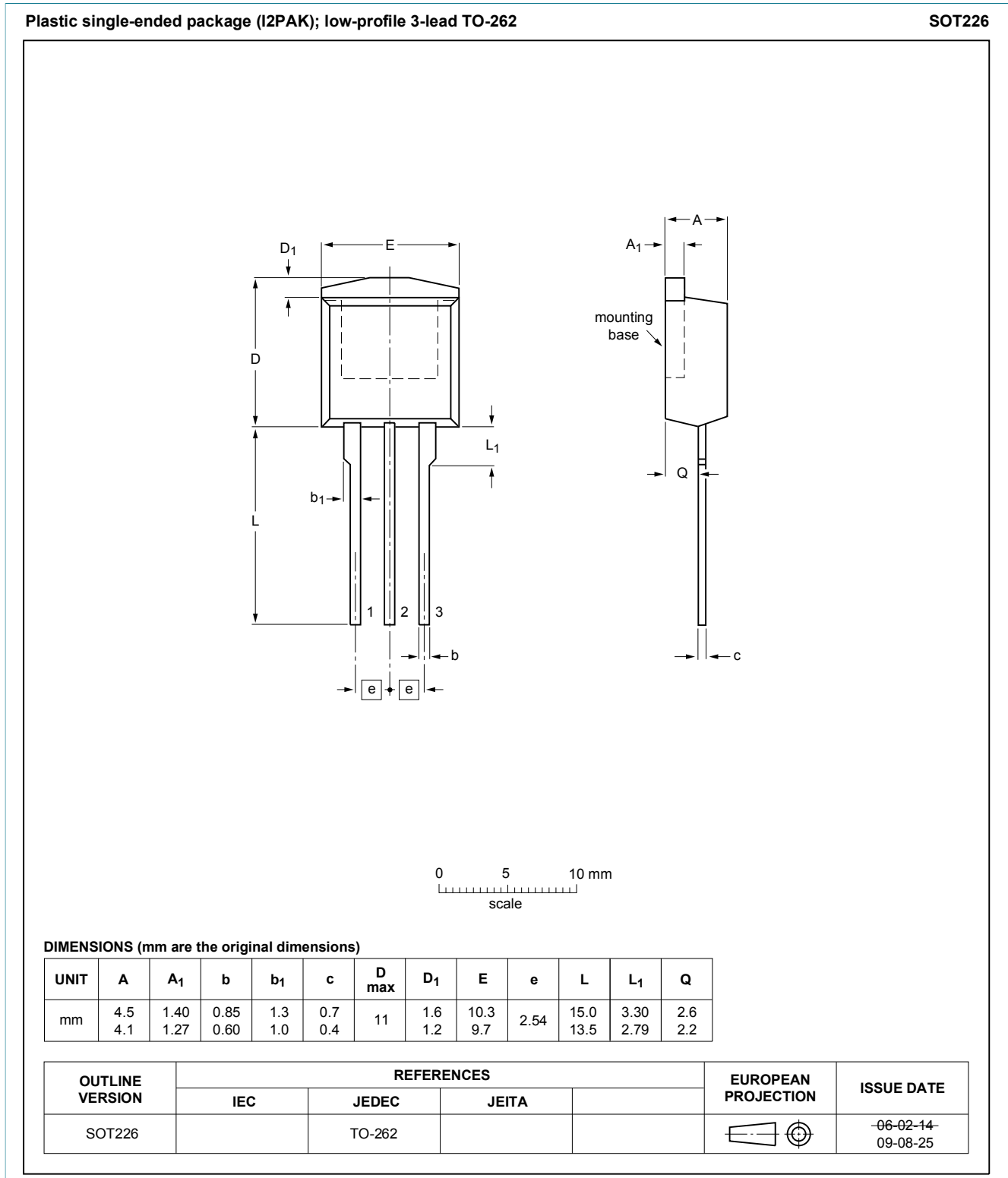


Fig. 17. Package outline I2PAK (SOT226)

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|--------------------------------|--------------------|---|
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