

BUK956R1-100E

N-channel TrenchMOS logic level FET

11 September 2012

Product data sheet

1. Product profile

1.1 General description

Logic level N-channel MOSFET in a SOT78 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 $V_{gst(th)}$ rating of greater than 0.5V at 175 °C

1.3 Applications

- 12V, 24V and 48V 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

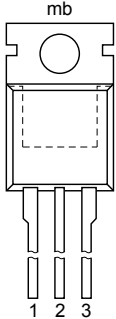
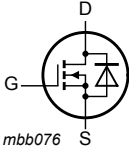
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|---|-----|------|-----|------------|
| V_{DS} | drain-source voltage | $T_j \geq 25\text{ °C}; T_j \leq 175\text{ °C}$ | - | - | 100 | V |
| I_D | drain current | $V_{GS} = 5\text{ V}; T_{mb} = 25\text{ °C};$ Fig. 1 | [1] | - | 120 | A |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C};$ Fig. 2 | - | - | 349 | W |
| Static characteristics | | | | | | |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = 5\text{ V}; I_D = 25\text{ A}; T_j = 25\text{ °C};$ Fig. 11 | - | 4.85 | 6.1 | m Ω |
| Dynamic characteristics | | | | | | |
| Q_{GD} | gate-drain charge | $V_{GS} = 5\text{ V}; I_D = 25\text{ A}; V_{DS} = 80\text{ V};$ Fig. 13; Fig. 14 | - | 51 | - | 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>TO-220AB (SOT78A)</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 |
| BUK956R1-100E | TO-220AB | plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB | SOT78A |

4. Marking

Table 4. Marking codes

| Type number | Marking code |
|---------------|---------------|
| BUK956R1-100E | BUK956R1-100E |

5. Limiting values

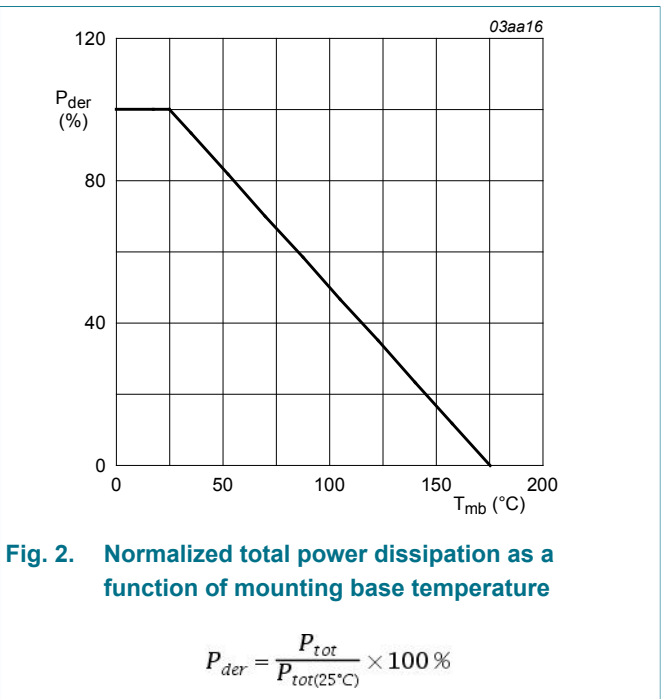
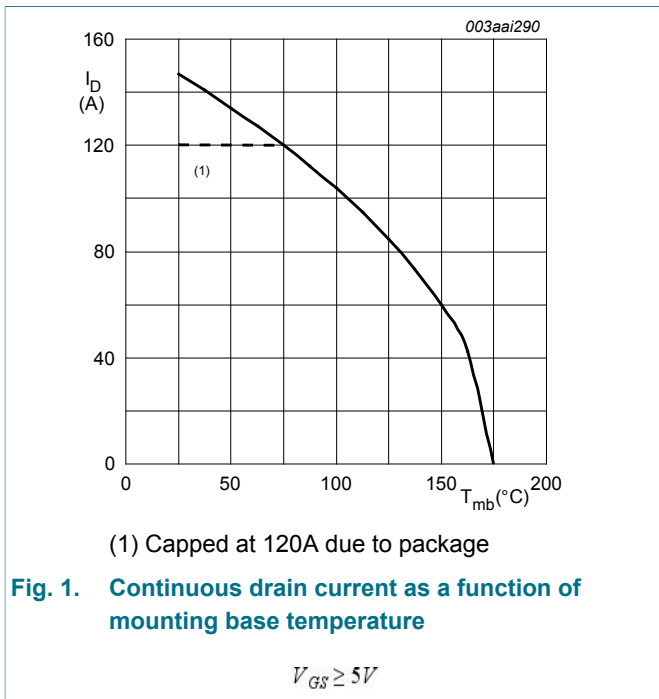
Table 5. Limiting values

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

| Symbol | Parameter | Conditions | Min | Max | Unit | |
|-----------|----------------------|---|--------|-----|------|---|
| V_{DS} | drain-source voltage | $T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$ | - | 100 | V | |
| V_{DGR} | drain-gate voltage | $R_{GS} = 20\text{ k}\Omega$ | - | 100 | 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 |
| I_D | drain current | $T_{mb} = 25\text{ °C}$; $V_{GS} = 5\text{ V}$; Fig. 1 | [3] | - | 120 | A |
| | | $T_{mb} = 100\text{ °C}$; $V_{GS} = 5\text{ V}$; Fig. 1 | | - | 101 | A |

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------------------------|--|--|------------------------|-----|--------------------|
| I_{DM} | peak drain current | $T_{mb} = 25\text{ }^{\circ}\text{C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$; Fig. 4 | - | 576 | A |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ }^{\circ}\text{C}$; Fig. 2 | - | 349 | W |
| T_{stg} | storage temperature | | -55 | 175 | $^{\circ}\text{C}$ |
| T_j | junction temperature | | -55 | 175 | $^{\circ}\text{C}$ |
| Source-drain diode | | | | | |
| I_S | source current | $T_{mb} = 25\text{ }^{\circ}\text{C}$ | [3] | 120 | A |
| I_{SM} | peak source current | pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ }^{\circ}\text{C}$ | - | 576 | A |
| Avalanche ruggedness | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D = 120\text{ A}$; $V_{sup} \leq 100\text{ V}$; $R_{GS} = 50\text{ }\Omega$; $V_{GS} = 5\text{ V}$; $T_{j(\text{init})} = 25\text{ }^{\circ}\text{C}$; unclamped; Fig. 3 | [4][5] | 387 | 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 $^{\circ}\text{C}$.
- [5] Refer to application note AN10273 for further information.



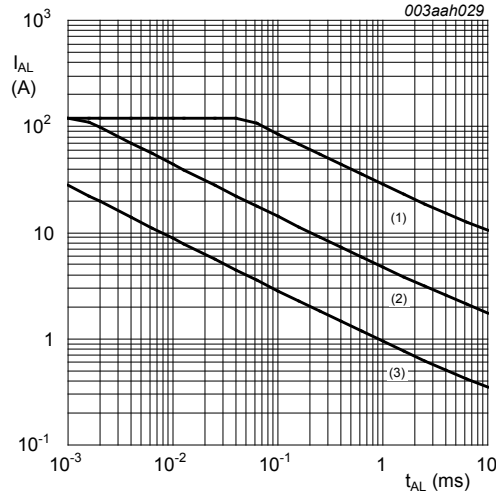


Fig. 3. Single-pulse and repetitive avalanche rating; avalanche current as a function of avalanche time

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

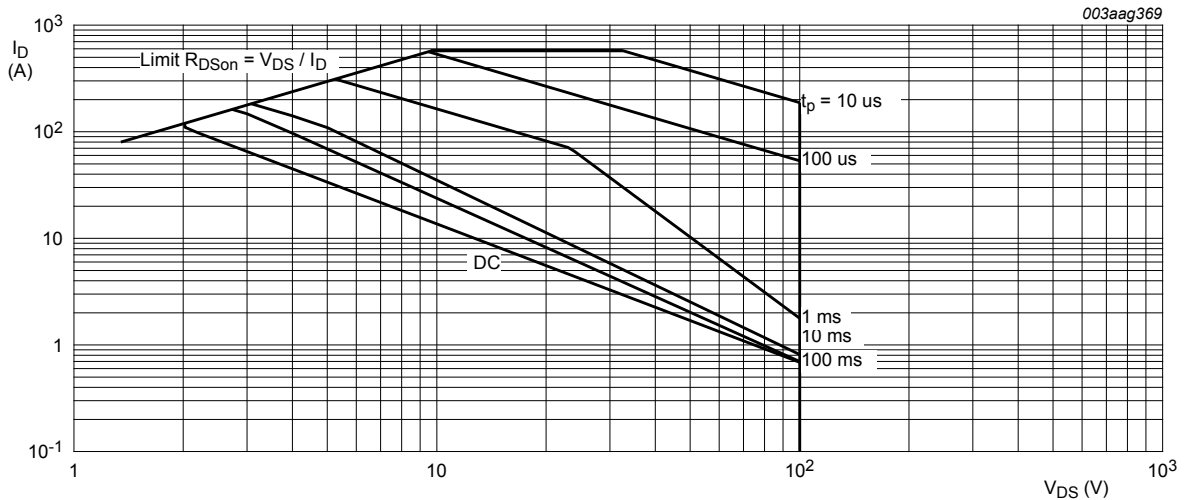


Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

$T_{mb} = 25^{\circ}C$; 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 | - | - | 0.43 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | vertical in still air | - | 60 | - | K/W |

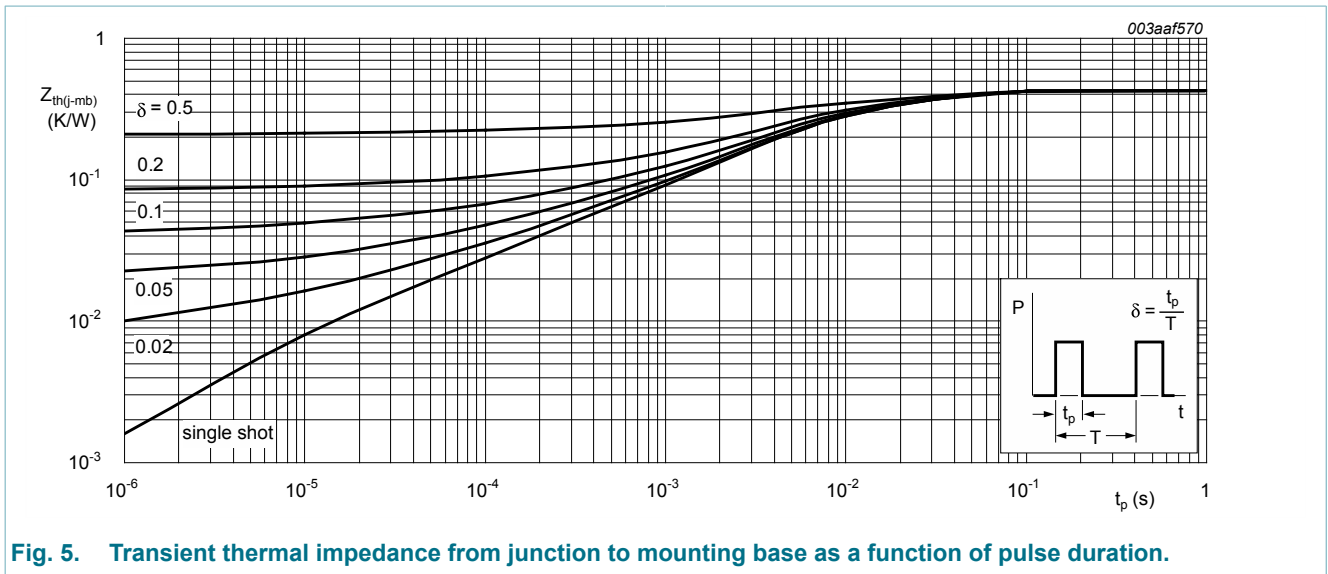


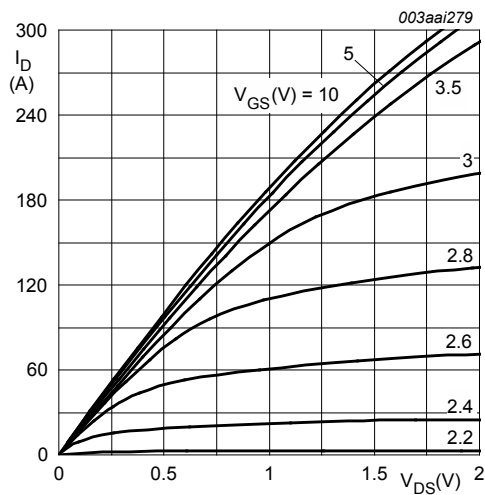
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration.

7. Characteristics

Table 7. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|---|-----|------|------|------------|
| Static characteristics | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$ | 100 | - | - | V |
| | | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$ | 90 | - | - | 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 | $V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | 0.05 | 1 | μA |
| | | $V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ C$ | - | - | 500 | μA |
| I_{GSS} | gate leakage current | $V_{GS} = 10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | 2 | 100 | nA |
| | | $V_{GS} = -10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | 2 | 100 | nA |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = 5 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ C;$ Fig. 11 | - | 4.85 | 6.1 | m Ω |
| | | $V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ C;$ Fig. 11 | - | 4.7 | 5.9 | m Ω |
| | | $V_{GS} = 5 \text{ V}; I_D = 25 \text{ A}; T_j = 175 \text{ }^\circ C;$ Fig. 12; Fig. 11 | - | - | 16.8 | m Ω |
| Dynamic characteristics | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D = 25 \text{ A}; V_{DS} = 80 \text{ V}; V_{GS} = 5 \text{ V};$ Fig. 13; Fig. 14 | - | 133 | - | nC |
| Q_{GS} | gate-source charge | | - | 23 | - | nC |

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------------|------------------------------|--|-----|-------|-------|------|
| Q_{GD} | gate-drain charge | | - | 51 | - | nC |
| C_{iss} | input capacitance | $V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}; f = 1\text{ MHz};$ | - | 13100 | 17460 | pF |
| C_{oss} | output capacitance | $T_j = 25\text{ }^\circ\text{C}; \text{Fig. 15}$ | - | 725 | 870 | pF |
| C_{rss} | reverse transfer capacitance | | - | 450 | 620 | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = 80\text{ V}; R_L = 3.2\text{ }\Omega; V_{GS} = 5\text{ V};$ | - | 81 | - | ns |
| t_r | rise time | $R_{G(ext)} = 5\text{ }\Omega$ | - | 168 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 237 | - | ns |
| t_f | fall time | | - | 148 | - | ns |
| L_D | internal drain inductance | from drain lead 6mm from package to centre of die | - | 4.5 | - | nH |
| | | 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 | $I_S = 25\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C}; \text{Fig. 16}$ | - | 0.77 | 1.2 | V |
| t_{rr} | reverse recovery time | $I_S = 20\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ | - | 70 | - | ns |
| Q_r | recovered charge | $V_{DS} = 25\text{ V}$ | - | 202 | - | nC |



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

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

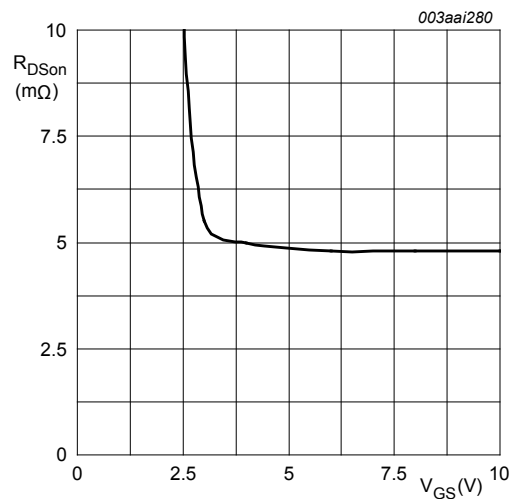


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

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

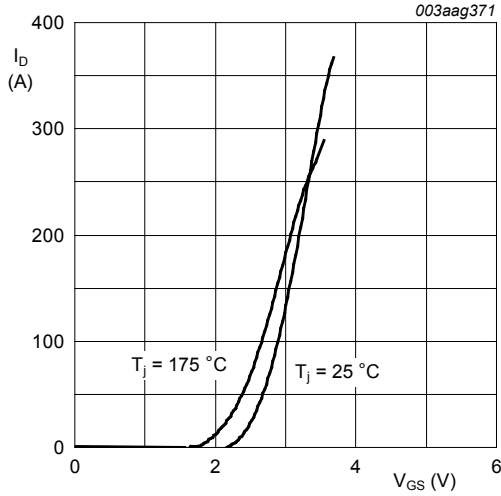


Fig. 8. Transfer characteristics: drain current as a function of gate-source voltage; typical values

$V_{DS} = 12V$



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

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

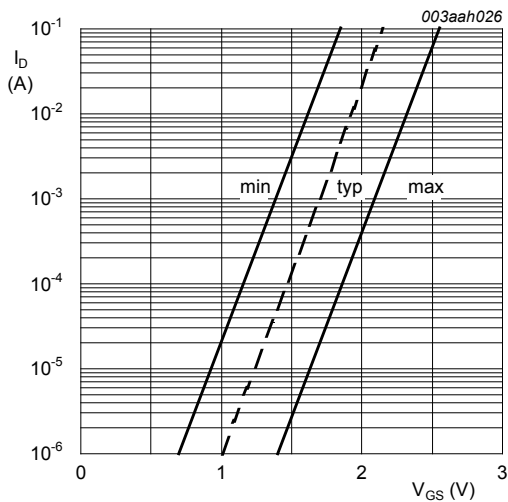
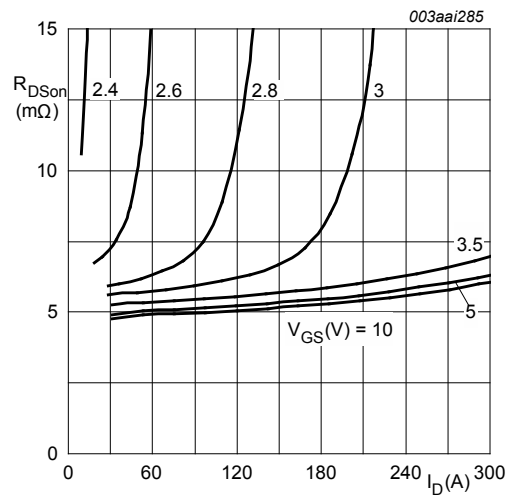


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

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



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

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

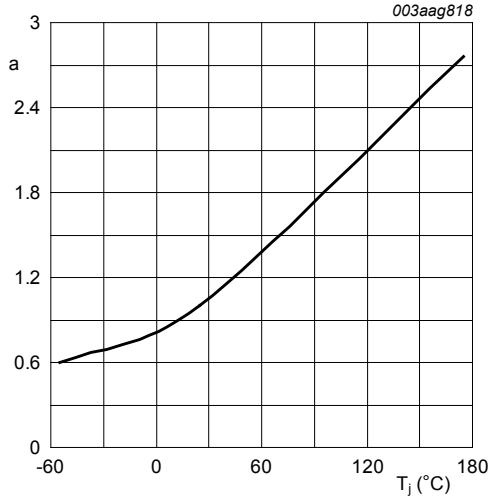
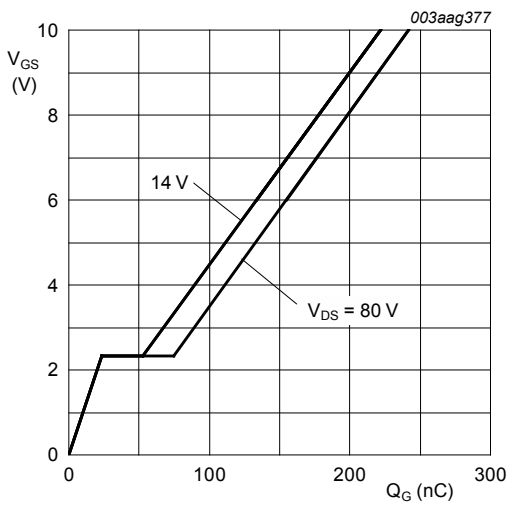


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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

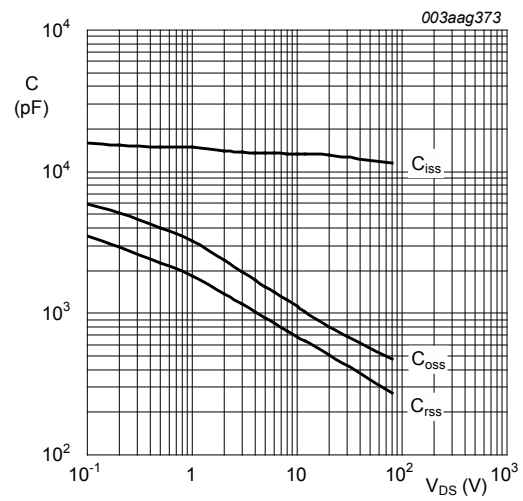


Fig. 13. Gate charge waveform definitions



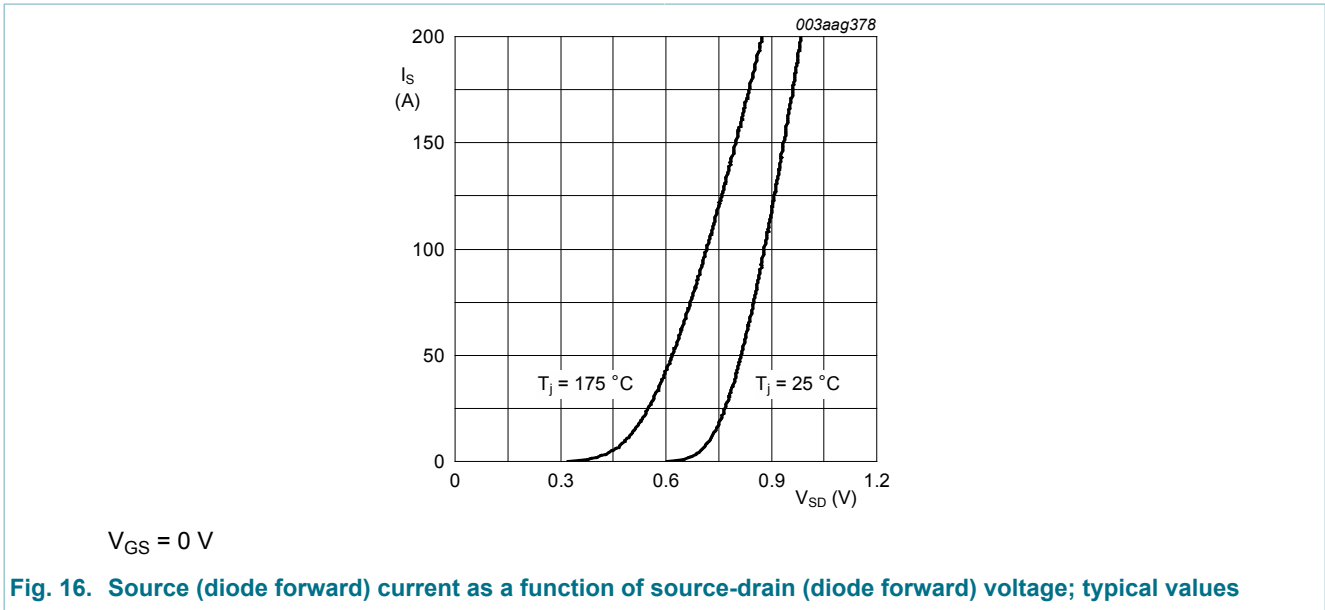
$T_j = 25\text{ }^\circ\text{C}; I_D = 25\text{ A}$

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



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

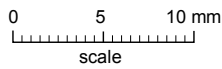
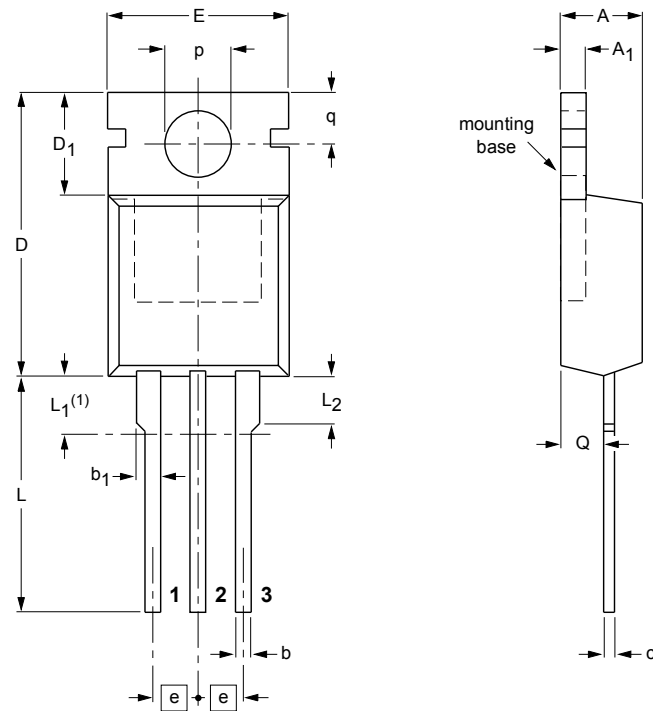
Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



8. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB

SOT78A



DIMENSIONS (mm are the original dimensions)

| UNIT | A | A ₁ | b | b ₁ | c | D | D ₁ | E | e | L | L ₁ ⁽¹⁾ | L ₂ max. | p | q | Q |
|------|------------|----------------|------------|----------------|------------|--------------|----------------|-------------|------|--------------|-------------------------------|------------------------|------------|------------|------------|
| mm | 4.5 4.1 | 1.39 1.27 | 0.9 0.6 | 1.3 1.0 | 0.7 0.4 | 15.8 15.2 | 6.4 5.9 | 10.3 9.7 | 2.54 | 15.0 13.5 | 3.30 2.79 | 3.0 | 3.8 3.6 | 3.0 2.7 | 2.6 2.2 |

Note

1. Terminals in this zone are not tinned.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|--------------------|------------|-----------------|-------|--|------------------------|----------------------|
| | IEC | JEDEC | JEITA | | | |
| SOT78A | | 3-lead TO-220AB | SC-46 | | | 03-01-22 05-03-14 |

Fig. 17. Package outline TO-220AB (SOT78A)

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. |
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