

BSS87

200 V, N-channel vertical D-MOS transistor

9 December 2014

Product data sheet

1. General description

N-channel enhancement mode vertical Double-Diffused Field-Effect Transistor (D-MOSFET) in a SOT89 (SC-62) medium power and flat lead Surface-Mounted Device (SMD) plastic package.

2. Features and benefits

- Direct interface to Complementary (C-MOS) transistor and Transistor-Transistor Logic (TTL) devices.
- Very fast switching
- No secondary breakdown

3. Applications

- Relay driver
- High-speed line driver
- Load-side loadswitch
- Switching circuits

4. Quick reference data

Table 1. Quick reference data

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-------------------------------|----------------------------------|--|-----|-----|-----|----------|
| V_{DS} | drain-source voltage | $T_j = 25\text{ °C}$ | - | - | 200 | V |
| V_{GS} | gate-source voltage | | -20 | - | 20 | V |
| I_D | drain current | $V_{GS} = 10\text{ V}; T_{amb} = 25\text{ °C}$ | [1] | - | 0.4 | A |
| Static characteristics | | | | | | |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = 10\text{ V}; I_D = 0.4\text{ A}; T_j = 25\text{ °C}$ | - | 1.6 | 3 | Ω |

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 1 cm².

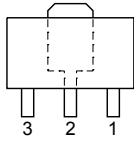
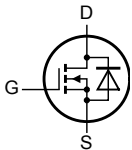


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5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|-----|--------|-------------|---|---|
| 1 | S | source |  <p style="text-align: center;">SOT89</p> |  <p style="text-align: center;"><i>017aaa253</i></p> |
| 2 | D | drain | | |
| 3 | G | gate | | |

6. Ordering information

Table 3. Ordering information

| Type number | Package | | |
|-------------|---------|--|---------|
| | Name | Description | Version |
| BSS87 | SOT89 | plastic surface-mounted package; die pad for good heat transfer; 3 leads | SOT89 |

7. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| BSS87 | KA |

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 | $T_j = 25\text{ °C}$ | | - | 200 | V |
| V_{GS} | gate-source voltage | | | -20 | 20 | V |
| I_D | drain current | $V_{GS} = 10\text{ V}; T_{amb} = 25\text{ °C}; t \leq 5\text{ s}$ | [1] | - | 0.7 | A |
| | | $V_{GS} = 10\text{ V}; T_{amb} = 25\text{ °C}$ | [1] | - | 0.4 | A |
| | | $V_{GS} = 10\text{ V}; T_{amb} = 100\text{ °C}$ | [1] | - | 0.2 | A |
| I_{DM} | peak drain current | $T_{amb} = 25\text{ °C}; \text{single pulse}; t_p \leq 10\text{ }\mu\text{s}$ | | - | 1.6 | A |
| P_{tot} | total power dissipation | $T_{amb} = 25\text{ °C}$ | [2] | - | 0.58 | W |
| | | | [1] | - | 1 | W |
| | | $T_{sp} = 25\text{ °C}$ | | - | 12.5 | W |
| T_j | junction temperature | | | -55 | 150 | °C |
| T_{amb} | ambient temperature | | | -55 | 150 | °C |
| T_{stg} | storage temperature | | | -65 | 150 | °C |
| Source-drain diode | | | | | | |
| I_S | source current | $T_{amb} = 25\text{ °C}$ | [1] | - | 0.4 | A |

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 1 cm².

[2] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.

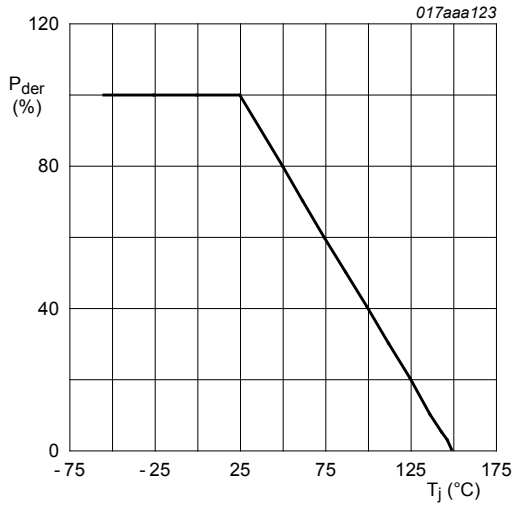


Fig. 1. MOSFET transistor: Normalized total power dissipation as a function of junction temperature

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

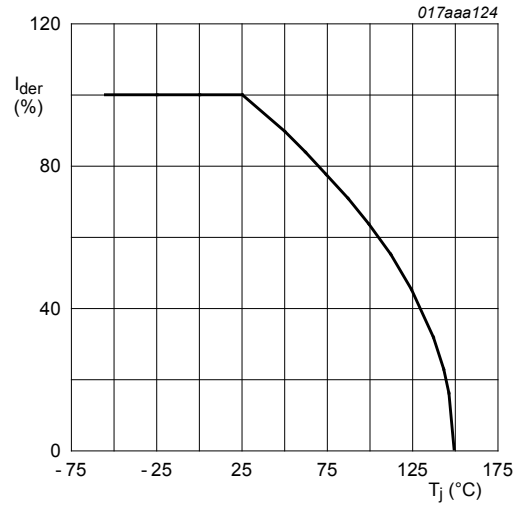
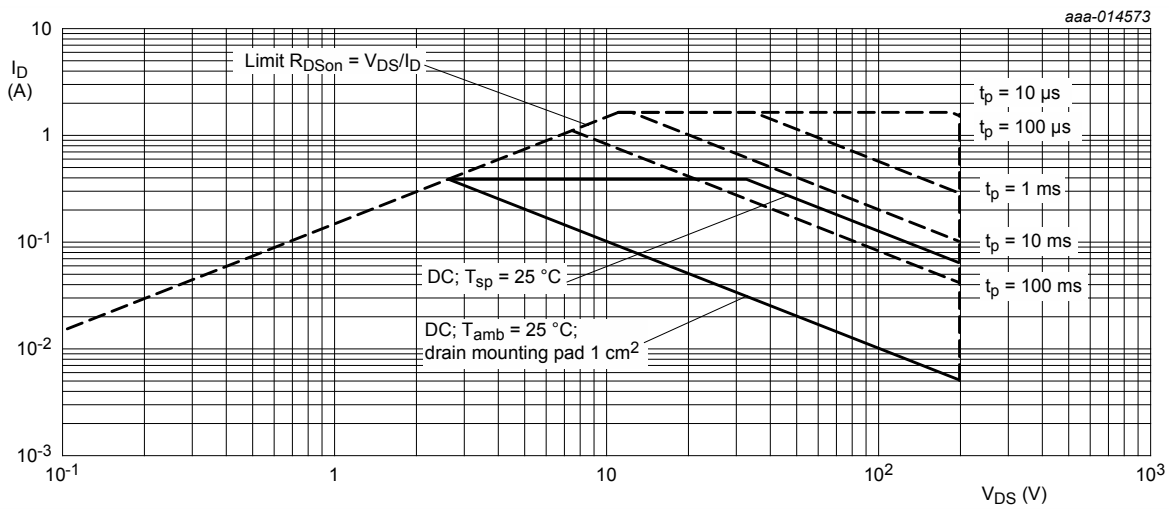


Fig. 2. MOSFET transistor: Normalized continuous drain current as a function of junction temperature

$$I_{der} = \frac{I_D}{I_{D(25^\circ C)}} \times 100 \%$$



I_{DM} = single pulse

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

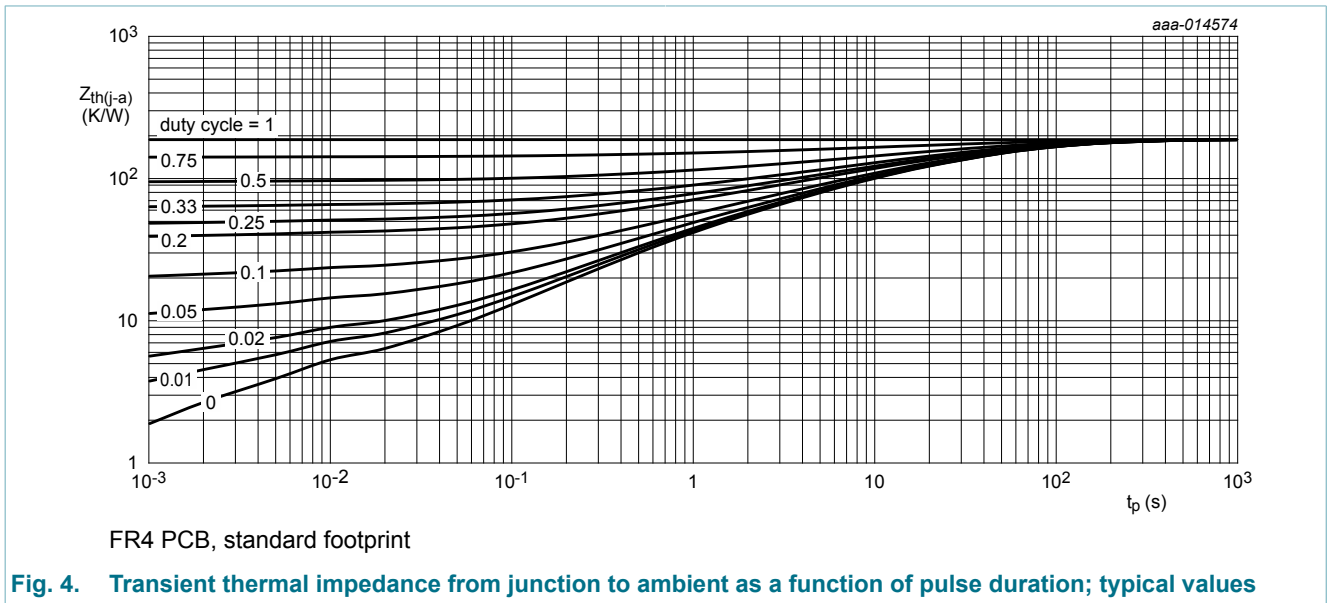
9. Thermal characteristics

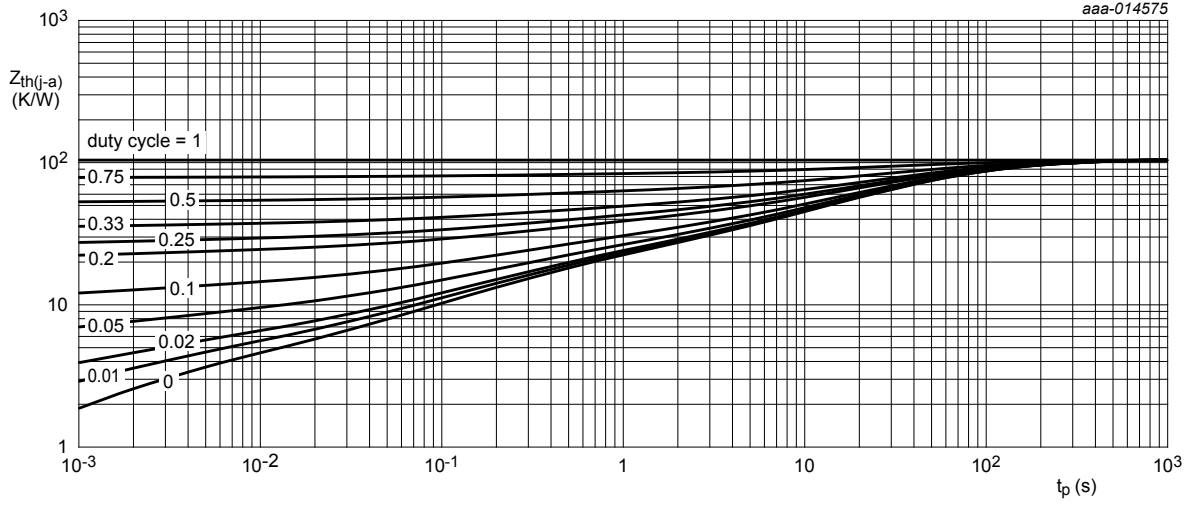
Table 6. Thermal characteristics

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|----------------|--|---------------------------|-----|-----|-----|-----|------|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | [1] | - | 190 | 216 | K/W |
| | | | [2] | - | 105 | 125 | K/W |
| | | in free air; $t \leq 5$ s | [2] | - | 36 | 42 | K/W |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | | - | 6 | 10 | K/W |

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 1 cm².





FR4 PCB, mounting pad for drain 1 cm²

Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|---|---|------|------|----------|
| Static characteristics | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$ | 200 | - | - | V |
| V_{GSth} | gate-source threshold voltage | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$ | 0.8 | - | 2.8 | V |
| I_{DSS} | drain leakage current | $V_{DS} = 60 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | - | 200 | nA |
| | | $V_{DS} = 200 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | - | 60 | μA |
| I_{GSS} | gate leakage current | $V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | - | 100 | nA |
| | | $V_{GS} = -20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | - | -100 | nA |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = 10 \text{ V}; I_D = 0.4 \text{ A}; T_j = 25 \text{ }^\circ C$ | - | 1.6 | 3 | Ω |
| | | $V_{GS} = 10 \text{ V}; I_D = 0.4 \text{ A}; T_j = 150 \text{ }^\circ C$ | - | 3.7 | 7 | Ω |
| | | $V_{GS} = 4.5 \text{ V}; I_D = 0.3 \text{ A}; T_j = 25 \text{ }^\circ C$ | - | 1.9 | 4 | Ω |
| g_{fs} | forward transconductance | $V_{DS} = 25 \text{ V}; I_D = 0.4 \text{ A}; T_j = 25 \text{ }^\circ C$ | - | 0.8 | - | S |
| Dynamic characteristics | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $V_{DS} = 50 \text{ V}; I_D = 0.25 \text{ A}; V_{GS} = 10 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | 5.5 | 10 | nC |
| Q_{GS} | gate-source charge | | - | 0.3 | - | nC |
| Q_{GD} | gate-drain charge | | - | 1.4 | - | nC |
| C_{iss} | input capacitance | $V_{DS} = 25 \text{ V}; f = 1 \text{ MHz}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | 100 | 120 | pF |
| C_{oss} | output capacitance | | - | 20 | 30 | pF |
| C_{rss} | reverse transfer capacitance | | - | 10 | 15 | pF |
| $t_{d(on)}$ | turn-on delay time | | $V_{DS} = 50 \text{ V}; I_D = 0.25 \text{ A}; V_{GS} = 10 \text{ V}; R_{G(ext)} = 6 \text{ } \Omega; T_j = 25 \text{ }^\circ C$ | - | 2.7 | 6 |
| t_r | rise time | - | | 3.7 | 6 | ns |
| $t_{d(off)}$ | turn-off delay time | - | | 16.4 | 30 | ns |
| t_f | fall time | - | | 7.5 | 20 | ns |
| Source-drain diode | | | | | | |
| V_{SD} | source-drain voltage | $I_S = 0.4 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | 0.8 | 1.2 | V |

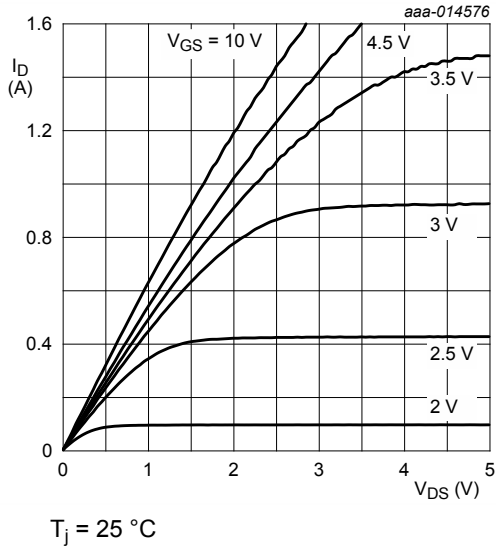


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

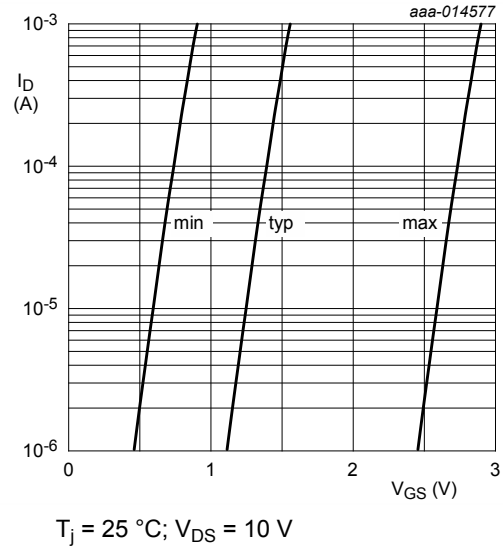


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

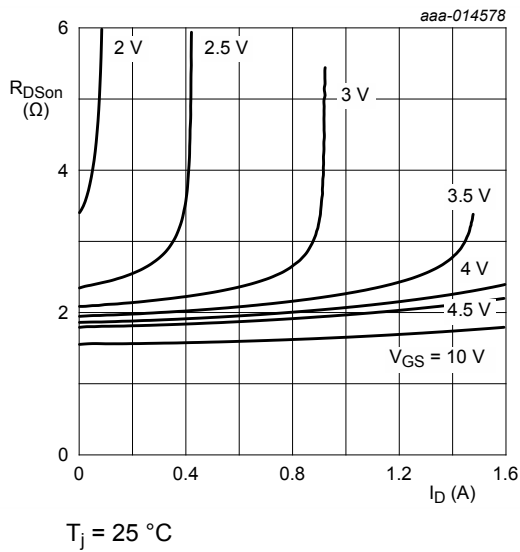


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

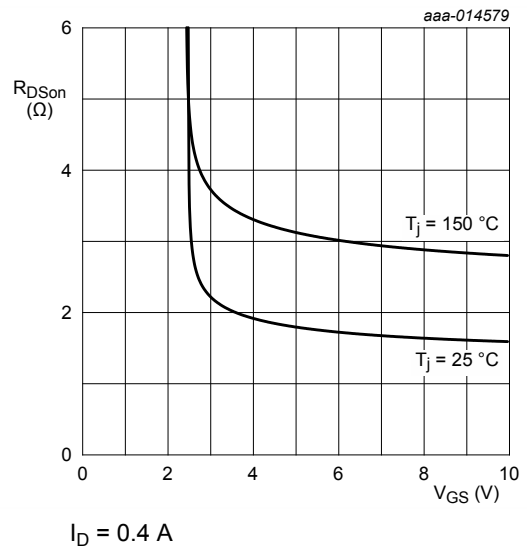
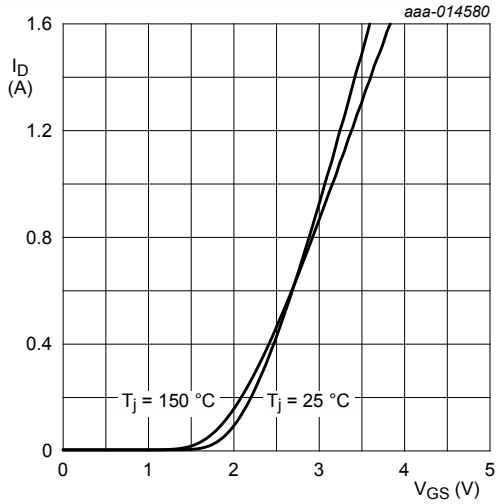


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values



$$V_{DS} > I_D \times R_{DSon}$$

Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values

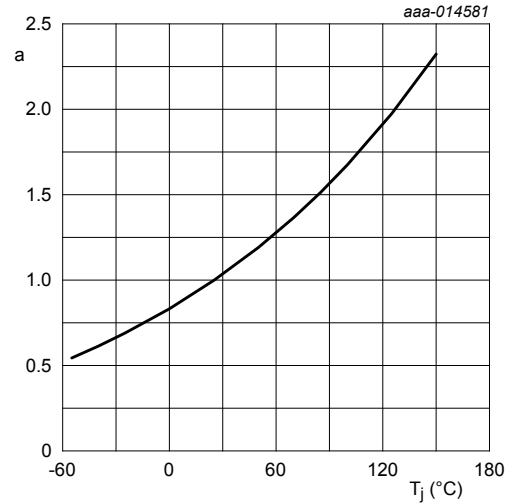
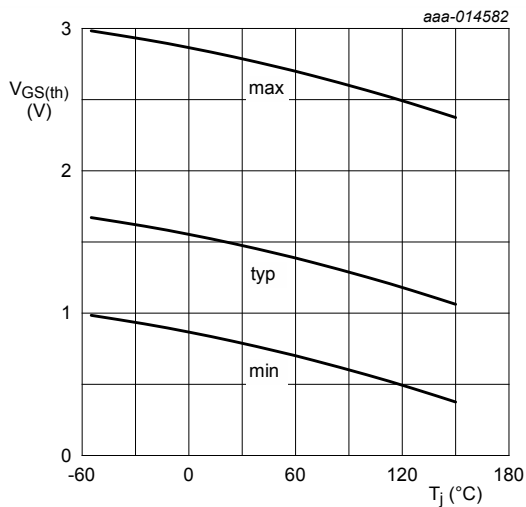


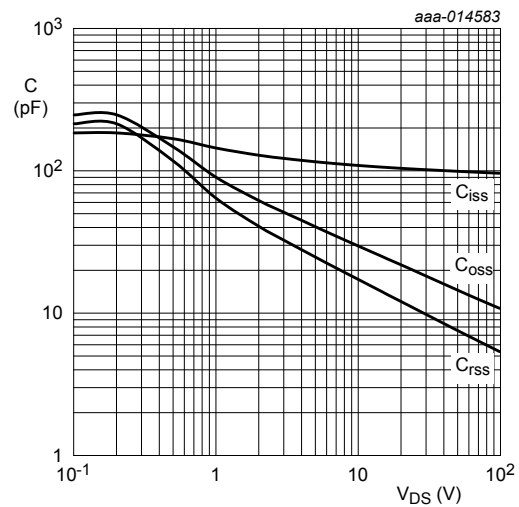
Fig. 11. Normalized drain-source on-state resistance as a function of junction temperature; typical values

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



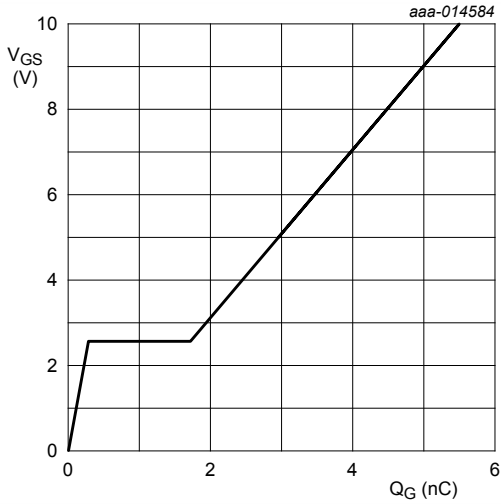
$$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$$

Fig. 12. Gate-source threshold voltage as a function of junction temperature



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

Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



$I_D = 0.25 \text{ A}; V_{DS} = 50 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}$

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

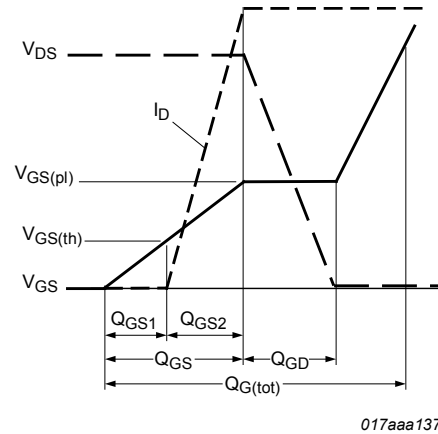
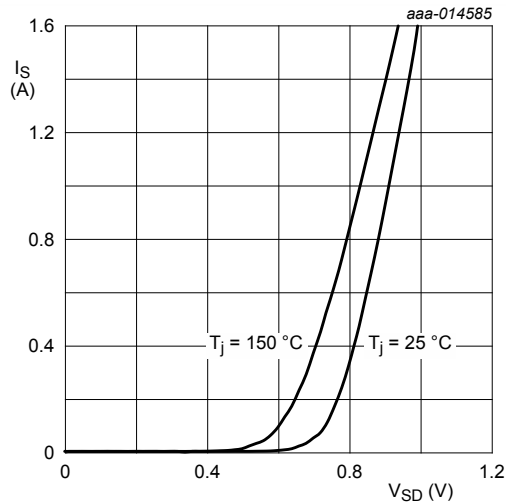


Fig. 15. MOSFET transistor: Gate charge waveform definitions



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

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

11. Test information

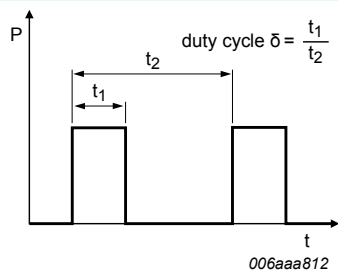


Fig. 17. Duty cycle definition

12. Package outline

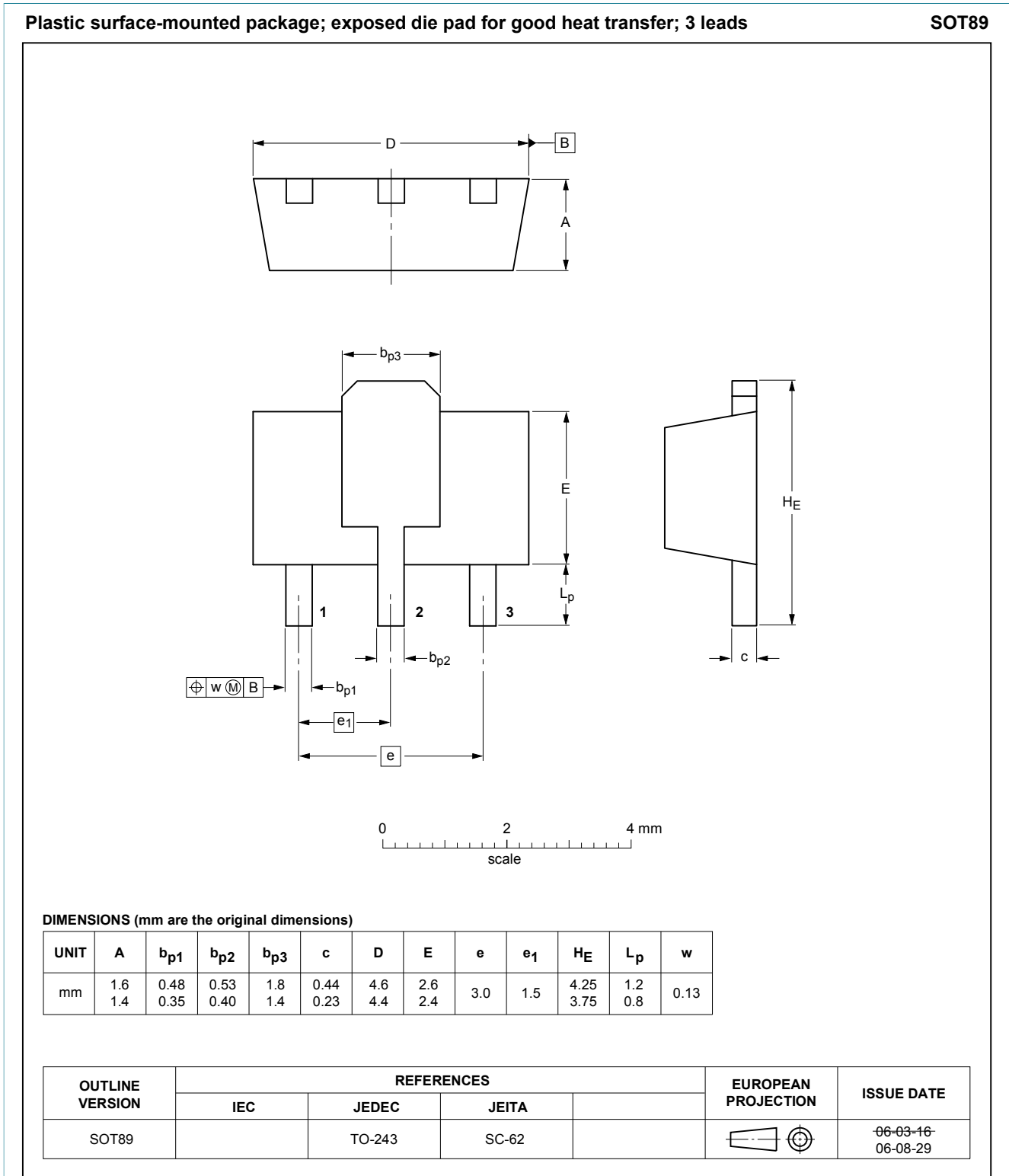


Fig. 18. Package outline SOT89

13. Soldering

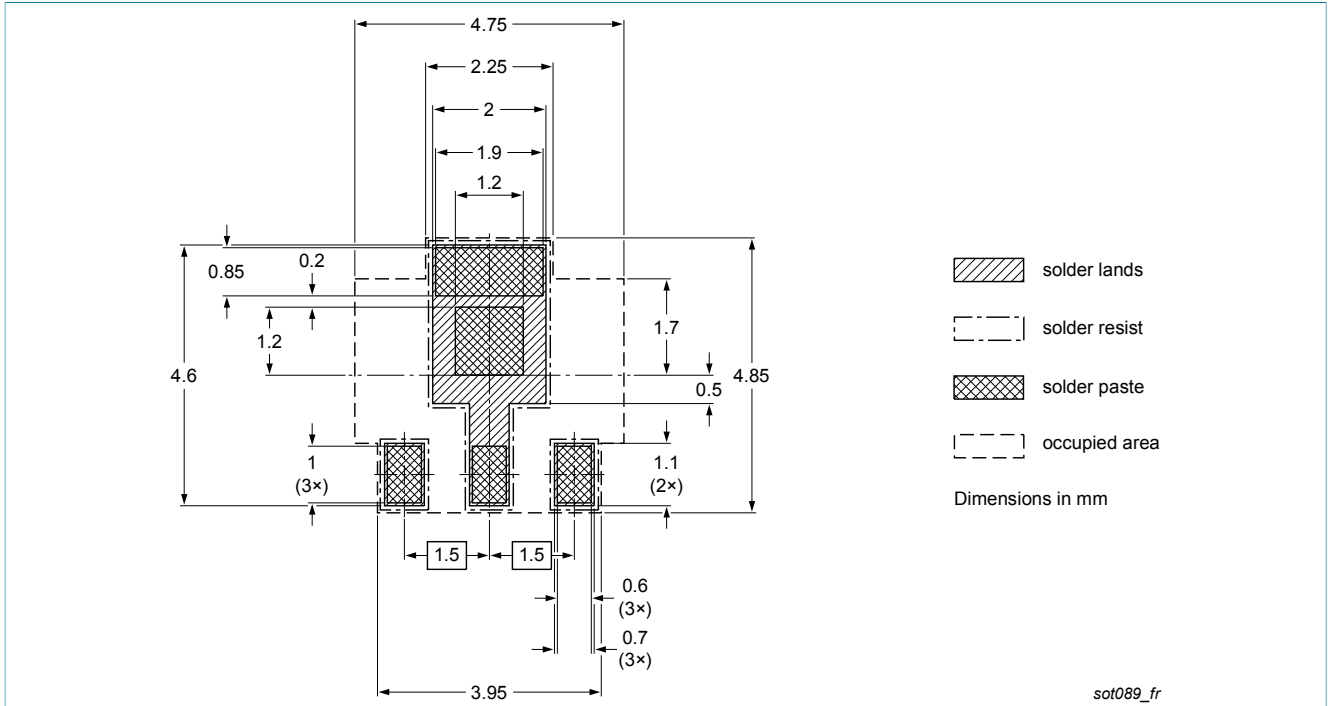


Fig. 19. Reflow soldering footprint for SOT89

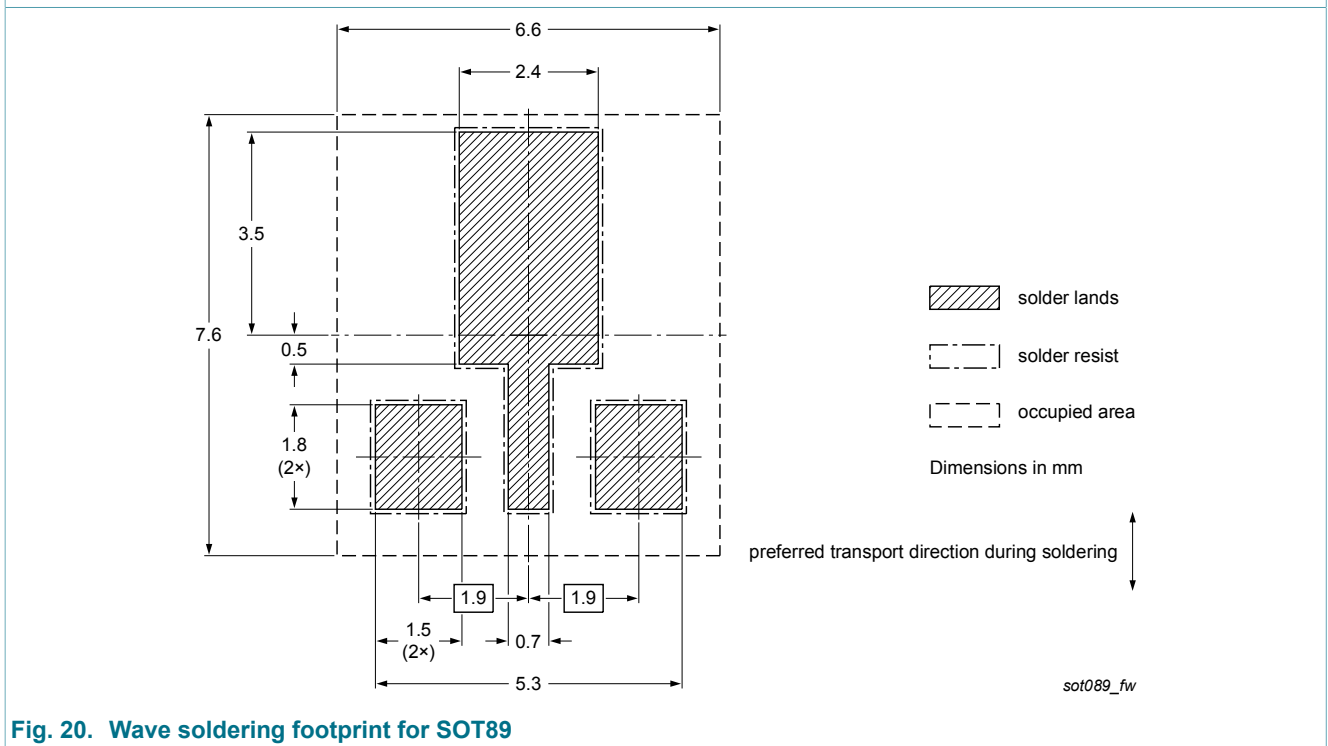


Fig. 20. Wave soldering footprint for SOT89

14. Revision history

Table 8. Revision history

| Data sheet ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|---|-----------------------|---------------|------------|
| BSS87 v.5 | 20141209 | Product data sheet | - | BSS87 v.4 |
| Modifications: | <ul style="list-style-type: none">• Figure 3 corrected. | | | |
| BSS87 v.4 | 20140815 | Product data sheet | - | BSS87 v.3 |
| BSS87 v.3 | 20010518 | Product specification | - | BSS87 v.2 |
| BSS87 v.2 | 19970623 | Product specification | - | BSS87 v.1 |

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15.1 Data sheet status

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

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