



# PSMN5R2-60YL

N-channel 60 V, 5.2 mΩ logic level MOSFET in LFPAK56

3 June 2016

Product data sheet

## 1. General description

Logic level N-channel MOSFET in an LFPAK56 (Power SO8) package using TrenchMOS technology. This product is designed and qualified for use in a wide range of power supply & motor control equipment.

## 2. Features and benefits

- Advanced TrenchMOS provides low  $R_{DS(on)}$  and low gate charge
- Logic level gate operation
- Avalanche rated, 100% tested
- LFPAK provides maximum power density in a Power SO8 package

## 3. Applications

- Synchronous rectifier in LLC topology
- Chargers & adaptors with  $V_{out} < 10$  V
- Fast charge & USB-PD applications
- Battery powered motor control
- LED lighting & TV backlight

## 4. Quick reference data

Table 1. Quick reference data

| Symbol                         | Parameter                        | Conditions   | Min | Typ  | Max | Unit |
|--------------------------------|----------------------------------|--|-----|------|-----|------|
| $V_{DS}$                       | drain-source voltage             | $25\text{ °C} \leq T_j \leq 175\text{ °C}$   | -   | -    | 60  | V    |
| $I_D$                          | drain current                    | $V_{GS} = 5\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>   | [1] | -    | 100 | A    |
| $P_{tot}$                      | total power dissipation          | $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>   | -   | -    | 195 | W    |
| <b>Static characteristics</b>  |                                  |  |     |      |     |      |
| $R_{DS(on)}$                   | drain-source on-state resistance | $V_{GS} = 5\text{ V}$ ; $I_D = 25\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 11</a>                             | -   | 4.6  | 6   | mΩ   |
| <b>Dynamic characteristics</b> |                                  |  |     |      |     |      |
| $Q_{GD}$                       | gate-drain charge                | $I_D = 25\text{ A}$ ; $V_{DS} = 48\text{ V}$ ; $V_{GS} = 5\text{ V}$ ; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a> | -   | 11.1 | -   | 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   | S      | source                            |  <p><b>LPAK56; Power-SO8 (SOT669)</b></p> |  <p>mbb076</p> |
| 2   | S      | source                            |  |   |
| 3   | S      | source                            |  |   |
| 4   | G      | gate                              |  |   |
| mb  | D      | mounting base; connected to drain |  |   |

## 6. Ordering information

Table 3. Ordering information

| Type number  | Package              |   |         |
|--------------|----------------------|---|---------|
|              | Name                 | Description   | Version |
| PSMN5R2-60YL | LPAK56;<br>Power-SO8 | Plastic single-ended surface-mounted package (LPAK56; Power-SO8); 4 leads | SOT669  |

## 7. Limiting values

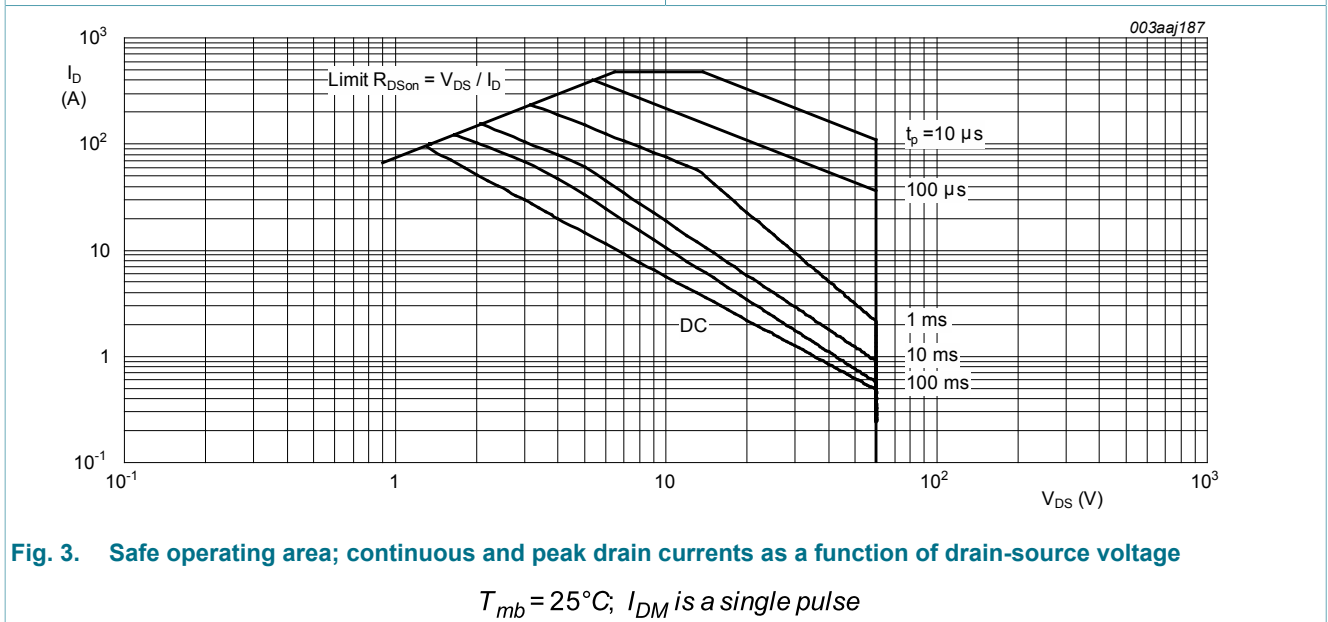
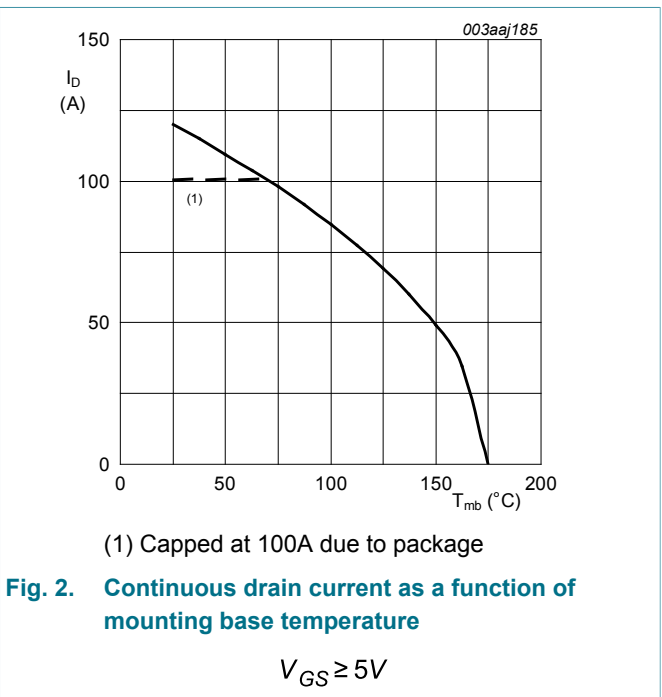
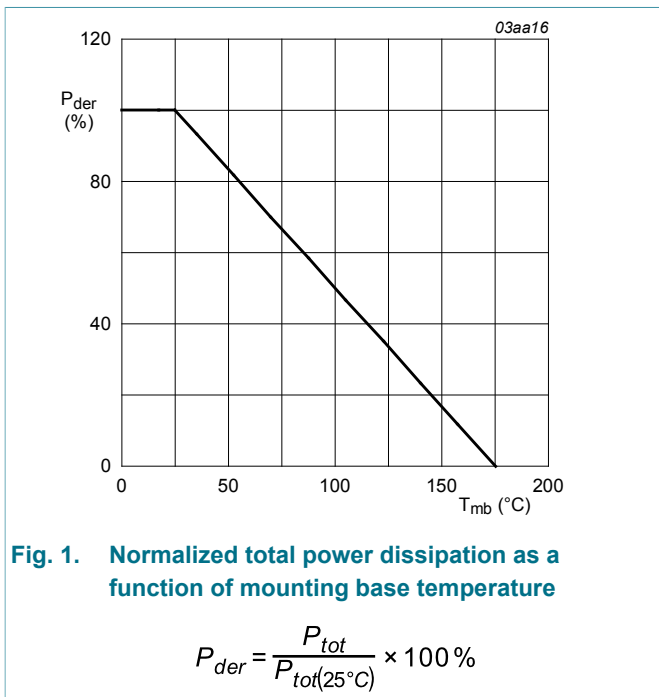
Table 4. Limiting values

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

| Symbol                    | Parameter               | Conditions  |     | Min | Max | Unit |
|---------------------------|-------------------------|---|-----|-----|-----|------|
| $V_{DS}$                  | drain-source voltage    | $25\text{ °C} \leq T_j \leq 175\text{ °C}$  |     | -   | 60  | V    |
| $V_{DGR}$                 | drain-gate voltage      | $R_{GS} = 20\text{ k}\Omega$  |     | -   | 60  | V    |
| $V_{GS}$                  | gate-source voltage     |   |     | -20 | 20  | V    |
| $P_{tot}$                 | total power dissipation | $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>  |     | -   | 195 | W    |
| $I_D$                     | drain current           | $V_{GS} = 5\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>                    | [1] | -   | 100 | A    |
|                           |                         | $V_{GS} = 5\text{ V}$ ; $T_{mb} = 100\text{ °C}$ ; <a href="#">Fig. 2</a>                   |     | -   | 85  | A    |
| $I_{DM}$                  | peak drain current      | pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 3</a> |     | -   | 479 | A    |
| $T_{stg}$                 | storage temperature     |   |     | -55 | 175 | °C   |
| $T_j$                     | junction temperature    |   |     | -55 | 175 | °C   |
| <b>Source-drain diode</b> |                         |   |     |     |     |      |
| $I_S$                     | source current          | $T_{mb} = 25\text{ °C}$   | [1] | -   | 100 | A    |
| $I_{SM}$                  | peak source current     | pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$                          |     | -   | 479 | A    |

| Symbol                      | Parameter                                    | Conditions  | Min                    | Max | Unit   |
|-----------------------------|--|---|------------------------|-----|--------|
| <b>Avalanche ruggedness</b> |  |   |                        |     |        |
| $E_{DS(AL)S}$               | non-repetitive drain-source avalanche energy | $I_D = 100\text{ A}$ ; $V_{sup} \leq 60\text{ V}$ ; $R_{GS} = 50\ \Omega$ ;<br>$V_{GS} = 5\text{ V}$ ; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$ ; unclamped;<br><a href="#">Fig. 4</a> | <a href="#">[2][3]</a> | -   | 127 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.



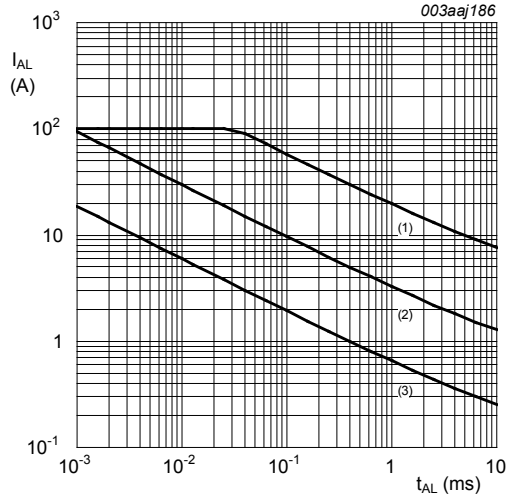


Fig. 4. Avalanche rating; avalanche current as a function of avalanche time

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

### 8. 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     | -   | -   | 0.77 | K/W  |

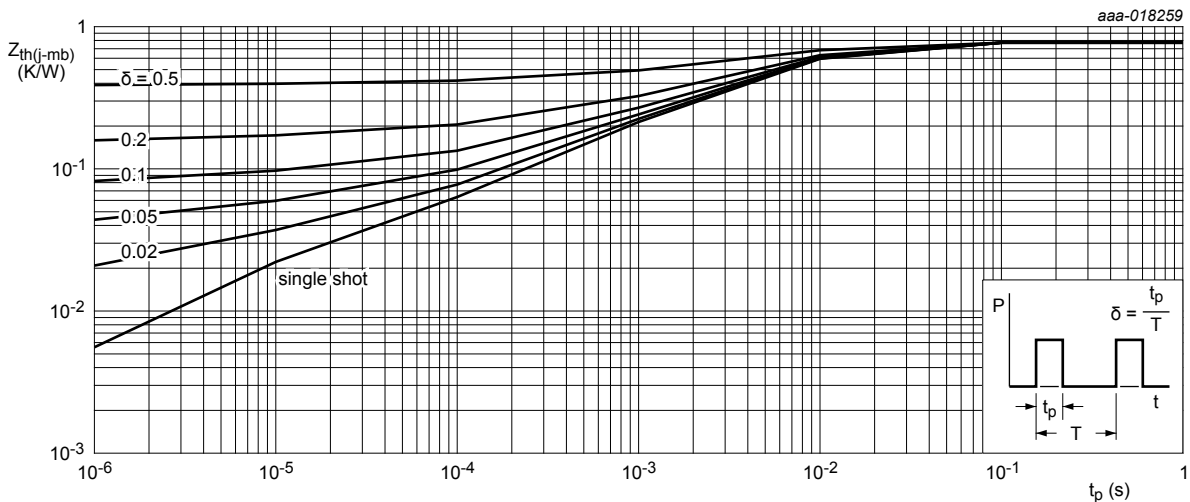


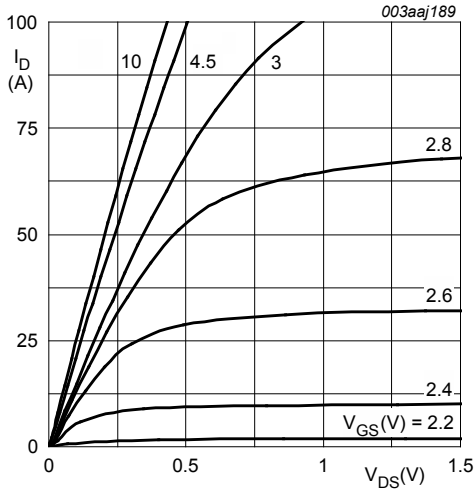
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration.

## 9. Characteristics

Table 6. Characteristics

| Symbol                         | Parameter                        | Conditions  | Min | Typ  | Max  | Unit          |
|--------------------------------|----------------------------------|---|-----|------|------|---------------|
| <b>Static characteristics</b>  |                                  |   |     |      |      |               |
| $V_{(BR)DSS}$                  | drain-source breakdown voltage   | $I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$  | 60  | -    | -    | V             |
|                                |                                  | $I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$   | 54  | -    | -    | V             |
| $V_{GS(th)}$                   | gate-source threshold voltage    | $I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 9</a> ; <a href="#">Fig. 10</a>          | 1.4 | 1.7  | 2.1  | V             |
|                                |                                  | $I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ <a href="#">Fig. 9</a>                                   | -   | -    | 2.45 | V             |
|                                |                                  | $I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = 175 \text{ }^\circ\text{C};$ <a href="#">Fig. 9</a>                                   | 0.5 | -    | -    | V             |
| $I_{DSS}$                      | drain leakage current            | $V_{DS} = 60 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ\text{C}$   | -   | -    | 500  | $\mu\text{A}$ |
|                                |                                  | $V_{DS} = 60 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$  | -   | 0.07 | 10   | $\mu\text{A}$ |
| $I_{GSS}$                      | gate leakage current             | $V_{GS} = 16 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$  | -   | 2    | 100  | nA            |
|                                |                                  | $V_{GS} = -16 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$   | -   | 2    | 100  | nA            |
| $R_{DS(on)}$                   | drain-source on-state resistance | $V_{GS} = 5 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 11</a>                            | -   | 4.6  | 6    | mΩ            |
|                                |                                  | $V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 11</a>                           | -   | 4    | 5.2  | mΩ            |
|                                |                                  | $V_{GS} = 5 \text{ V}; I_D = 25 \text{ A}; T_j = 175 \text{ }^\circ\text{C};$ <a href="#">Fig. 11</a> ; <a href="#">Fig. 12</a> | -   | -    | 13.6 | mΩ            |
| <b>Dynamic characteristics</b> |                                  |   |     |      |      |               |
| $Q_{G(tot)}$                   | total gate charge                | $I_D = 25 \text{ A}; V_{DS} = 48 \text{ V}; V_{GS} = 5 \text{ V};$ <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a>            | -   | 39.4 | -    | nC            |
|                                |                                  | $I_D = 25 \text{ A}; V_{DS} = 48 \text{ V}; V_{GS} = 10 \text{ V};$ <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a>           | -   | 78.4 | -    | nC            |
| $Q_{GS}$                       | gate-source charge               | $I_D = 25 \text{ A}; V_{DS} = 48 \text{ V}; V_{GS} = 5 \text{ V};$ <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a>            | -   | 12.3 | -    | nC            |
| $Q_{GD}$                       | gate-drain charge                |   | -   | 11.1 | -    | nC            |
| $C_{iss}$                      | input capacitance                | $V_{DS} = 25 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz};$ <a href="#">Fig. 15</a>                                       | -   | 4739 | 6319 | pF            |
| $C_{oss}$                      | output capacitance               | $T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 15</a>  | -   | 391  | 469  | pF            |
| $C_{rss}$                      | reverse transfer capacitance     |   | -   | 202  | 277  | pF            |
| $t_{d(on)}$                    | turn-on delay time               | $V_{DS} = 45 \text{ V}; R_L = 1.8 \text{ }^\Omega; V_{GS} = 5 \text{ V};$ <a href="#">Fig. 15</a>                               | -   | 24   | -    | ns            |
| $t_r$                          | rise time                        | $R_{G(ext)} = 5 \text{ }^\Omega$  | -   | 44   | -    | ns            |
| $t_{d(off)}$                   | turn-off delay time              |   | -   | 60   | -    | ns            |
| $t_f$                          | fall time                        |   | -   | 37   | -    | ns            |
| <b>Source-drain diode</b>      |                                  |   |     |      |      |               |
| $V_{SD}$                       | source-drain voltage             | $I_S = 25 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 16</a>                            | -   | 0.8  | 1.2  | V             |

| Symbol   | Parameter             | Conditions  | Min | Typ | Max | Unit |
|----------|-----------------------|---|-----|-----|-----|------|
| $t_{rr}$ | reverse recovery time | $I_S = 20\text{ A}$ ; $di_S/dt = -100\text{ A}/\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ; | -   | 26  | -   | ns   |
| $Q_r$    | recovered charge      | $V_{DS} = 25\text{ V}$  | -   | 23  | -   | 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

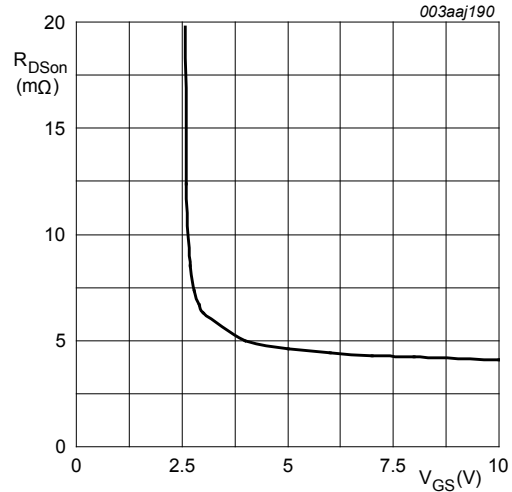


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

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

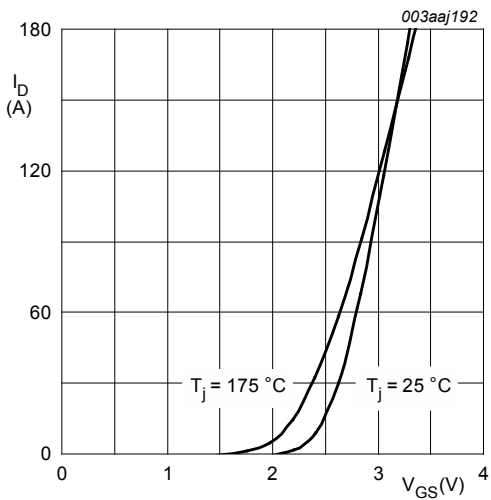


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

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

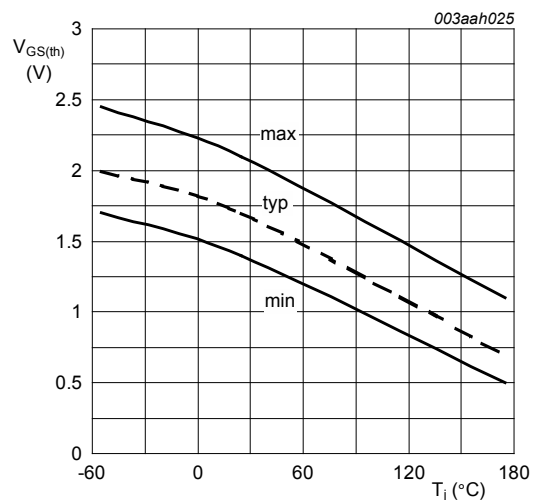
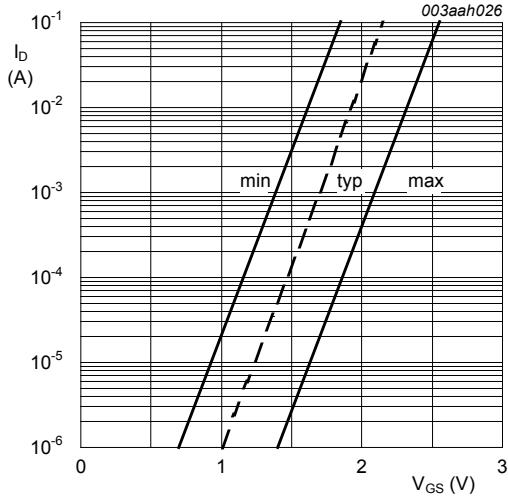


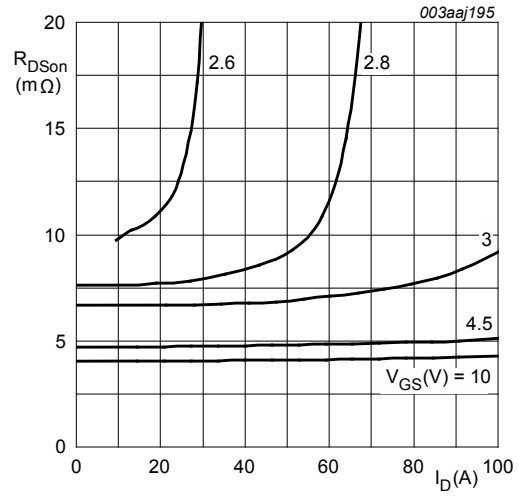
Fig. 9. Gate-source threshold voltage as a function of junction temperature

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



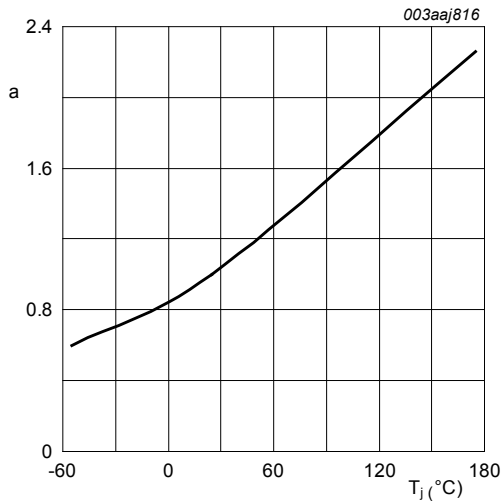
**Fig. 10. Sub-threshold drain current as a function of gate-source voltage**

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



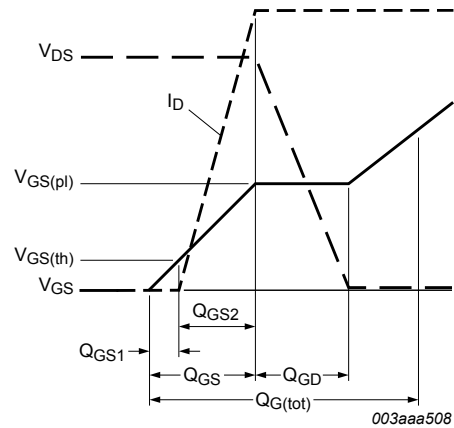
$$T_j = 25^\circ\text{C}; t_p = 300 \mu\text{s}$$

**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**

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



**Fig. 13. Gate charge waveform definitions**

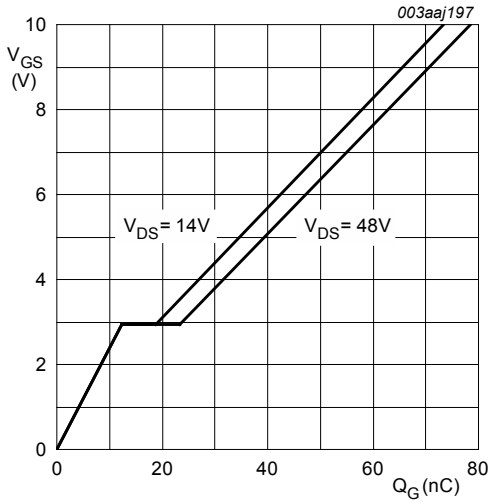


Fig. 14. Gate-source voltage as a function of gate charge; typical values

$T_j = 25^\circ C; I_D = 25A$

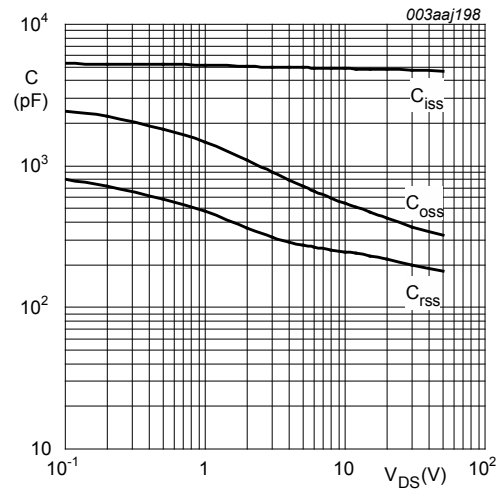


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

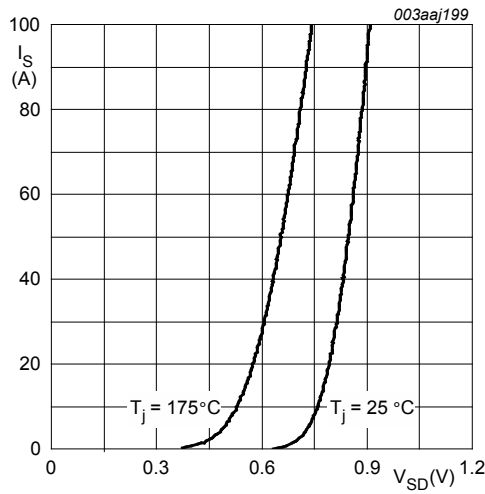


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$V_{GS} = 0V$



### 10. Package outline

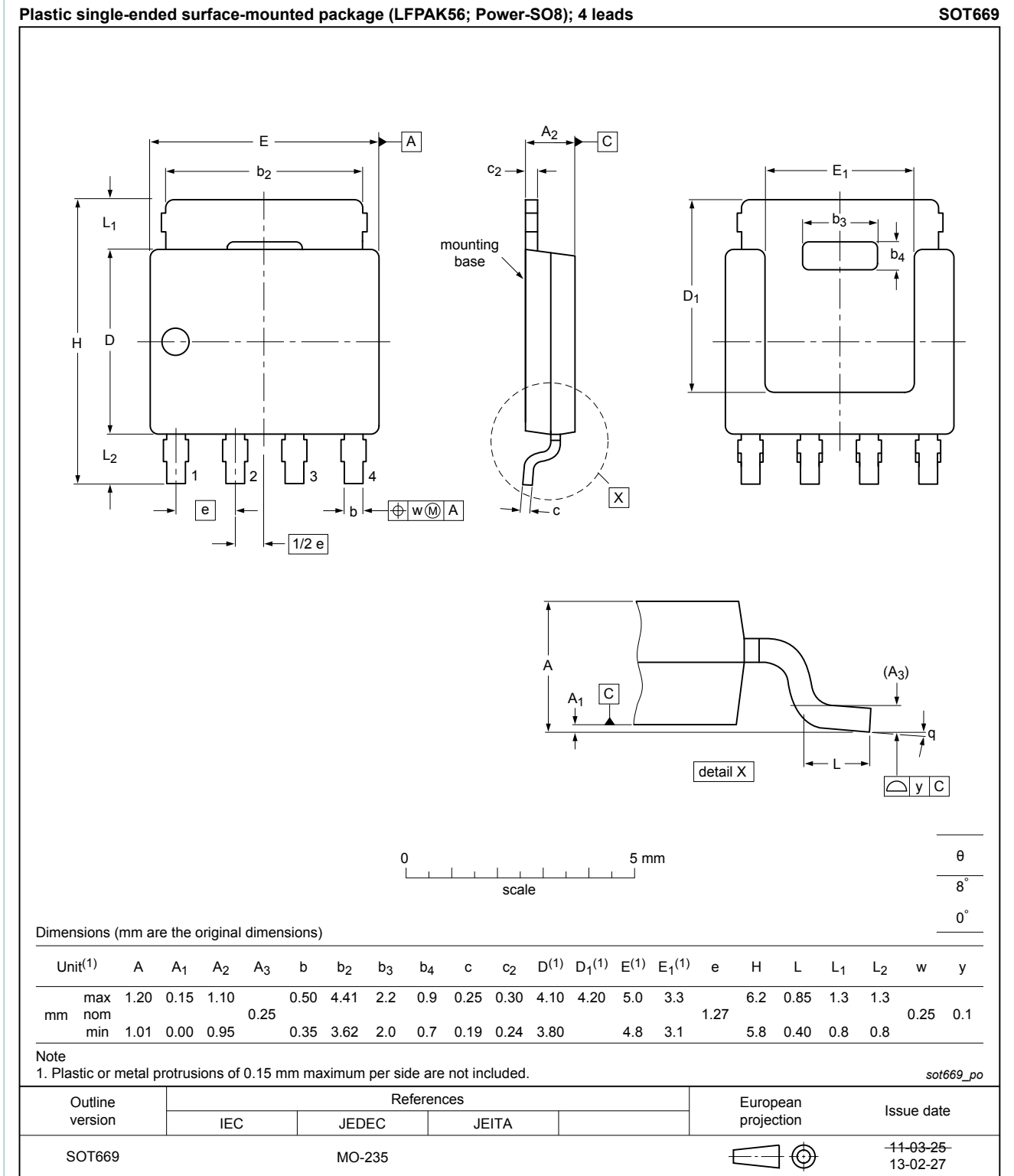


Fig. 17. Package outline LPAK56; Power-SO8 (SOT669)

## 11. Legal information

### 11.1 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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