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Kind regards,

Team Nexperia


# PSMN4R0-60YS

## N-channel LFPAK 60 V, 4.0 mΩ standard level FET

**14 May 2015** **Product data sheet**

## 1. General description

Standard level N-channel MOSFET in LFPAK package qualified to 175 °C. This product is designed and qualified for use in a wide range of telecom, industrial and domestic equipment.

## 2. Features and benefits

- Advanced TrenchMOS provides low $R_{DSon}$ and low gate charge
- High efficiency in switching power converters
- Improved mechanical and thermal characteristics
- LFPAK provides maximum power density in a Power SO8 package

## 3. Applications

- DC-to-DC converters
- Lithium-ion battery protection
- Load switching
- Motor control
- Server power supplies
- Telecom power

## 4. Quick reference data

**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j \geq 25$ °C; $T_j \leq 175$ °C | | - | - | 60 | V |
| $I_D$ | drain current | $T_{mb}$ = 25 °C; Fig. 2 | [1] | - | - | 100 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C; Fig. 1 | | - | - | 130 | W |
| $T_j$ | junction temperature | | | -55 | - | 175 | °C |
| **Static characteristics** | | | | | | | |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 100 °C; Fig. 12 | | - | - | 8.3 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 25 °C; Fig. 13 | | - | 3.6 | 4 | mΩ |

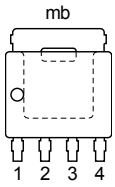
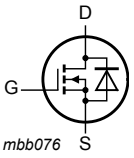
Scan or click this QR code to view the latest information for this product

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Dynamic characteristics** | | | | | | | |
| $Q_{GD}$ | gate-drain charge | $V_{GS}$ = 10 V; $I_D$ = 75 A; $V_{DS}$ = 30 V; Fig. 14; Fig. 15 | | - | 11.2 | - | nC |
| $Q_{G(tot)}$ | total gate charge | | | - | 56 | - | nC |
| **Avalanche ruggedness** | | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $V_{GS}$ = 10 V; $T_{j(init)}$ = 25 °C; $I_D$ = 100 A; $V_{sup} \leq$ 60 V; $R_{GS}$ = 50 Ω; unclamped | | - | - | 170 | mJ |

[1] Continuous current is limited by package.

## 5. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | S | source |  **LFPAK56; Power-SO8 (SOT669)** |  |
| 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 |
| PSMN4R0-60YS | LFPAK56; Power-SO8 | Plastic single-ended surface-mounted package (LFPAK56; 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 | $T_j \geq$ 25 °C; $T_j \leq$ 175 °C | | - | 60 | V |
| $V_{DGR}$ | drain-gate voltage | $T_j \geq$ 25 °C; $T_j \leq$ 175 °C; $R_{GS}$ = 20 kΩ | | - | 60 | V |
| $V_{GS}$ | gate-source voltage | | | -20 | 20 | V |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C; Fig. 1 | | - | 130 | W |
| $I_D$ | drain current | $T_{mb}$ = 100 °C; Fig. 2 | | - | 74 | A |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| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| | | $T_{mb}$ = 25 °C; Fig. 2 | [1] | - | 100 | A |
| $I_{DM}$ | peak drain current | pulsed; $t_p \leq 10$ µs; $T_{mb}$ = 25 °C; Fig. 3 | | - | 418 | A |
| $T_{stg}$ | storage temperature | | | -55 | 175 | °C |
| $T_j$ | junction temperature | | | -55 | 175 | °C |
| $T_{sld(M)}$ | peak soldering temperature | | | - | 260 | °C |
| **Source-drain diode** | | | | | | |
| $I_S$ | source current | $T_{mb}$ = 25 °C | [1] | - | 100 | A |
| $I_{SM}$ | peak source current | pulsed; $t_p \leq 10$ µs; $T_{mb}$ = 25 °C | | - | 418 | A |
| **Avalanche ruggedness** | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $V_{GS}$ = 10 V; $T_{j(init)}$ = 25 °C; $I_D$ = 100 A; $V_{sup} \leq 60$ V; $R_{GS}$ = 50 Ω; unclamped | | - | 170 | mJ |

[1] Continuous current is limited by package.

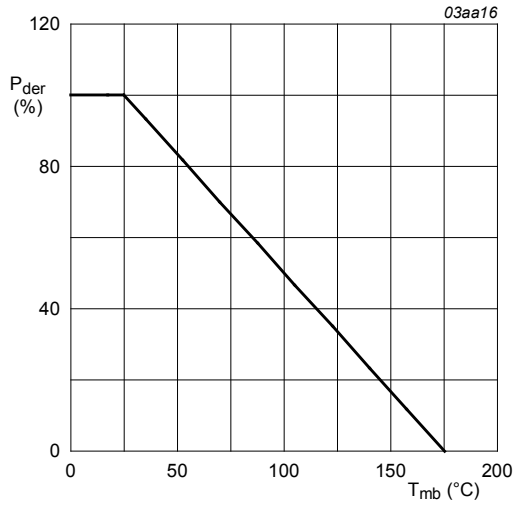


**Fig. 1. Normalized total power dissipation as a function of mounting base temperature**

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

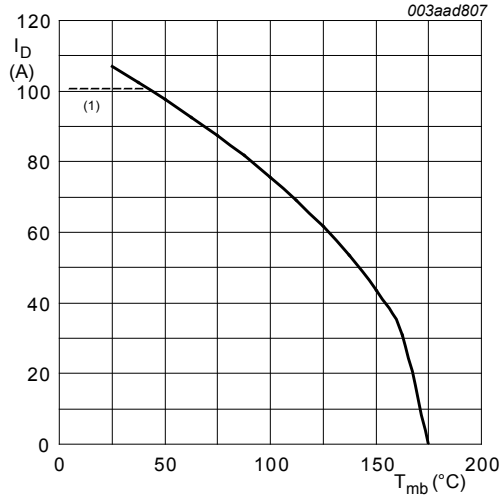


**Fig. 2. Continuous drain current as a function of mounting base temperature**

$V_{GS} \geq$ 10 V; (1) capped at 100 A due to package


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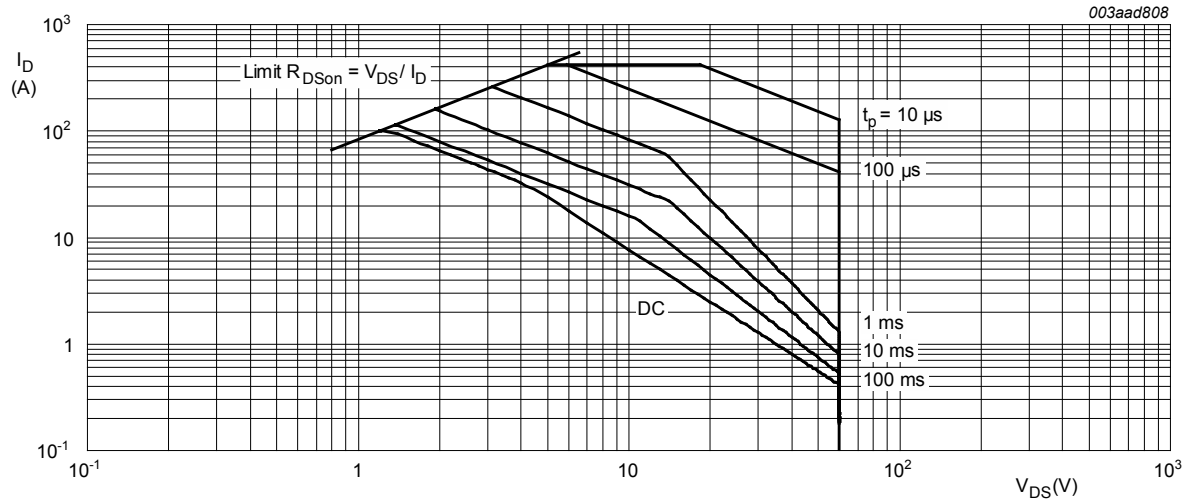


**Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage**

$T_{mb} = 25$ °C; $I_{DM}$ is a single pulse

## 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. 4 | | - | 0.5 | 1.1 | K/W |

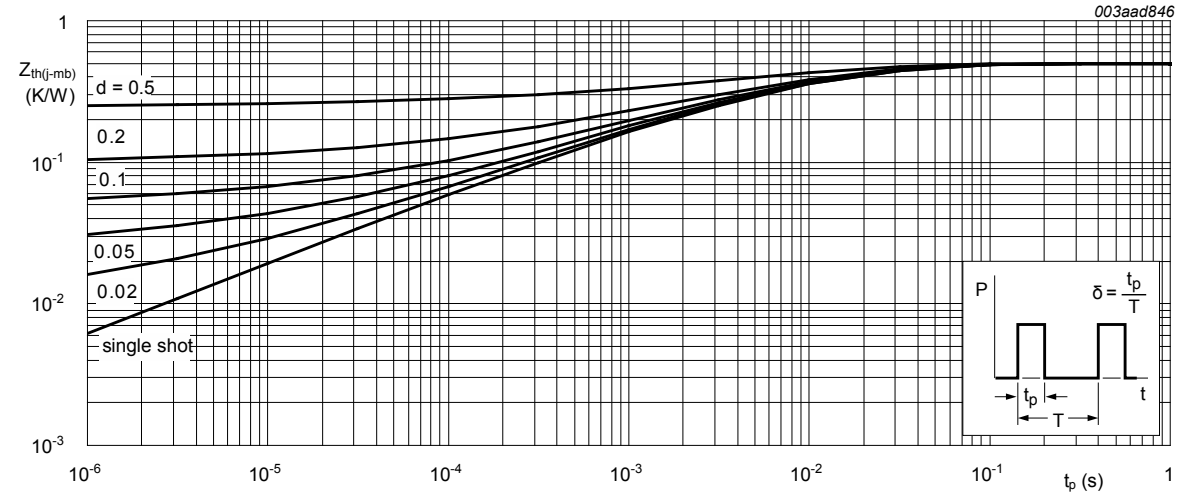


**Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration; typical values**


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# 9. Characteristics

**Table 6. Characteristics**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D$ = 250 µA; $V_{GS}$ = 0 V; $T_j$ = -55 °C | | 54 | - | - | V |
| | | $I_D$ = 250 µA; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | 63 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 25 °C; Fig. 10; Fig. 11 | | 2 | 3 | 4 | V |
| $V_{GSth}$ | gate-source threshold voltage | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = -55 °C; Fig. 11 | | - | - | 4.6 | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 175 °C; Fig. 11 | | 0.95 | - | - | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = 60 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | 0.05 | 5 | µA |
| | | $V_{DS}$ = 63 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | 0.07 | 7 | µA |
| | | $V_{DS}$ = 60 V; $V_{GS}$ = 0 V; $T_j$ = 125 °C | | - | - | 100 | µA |
| | | $V_{DS}$ = 63 V; $V_{GS}$ = 0 V; $T_j$ = 125 °C | | - | 3.25 | 150 | µA |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = 20 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | 2 | 100 | nA |
| | | $V_{GS}$ = -20 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | 2 | 100 | nA |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 175 °C; Fig. 12 | | - | 7.6 | 12 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 100 °C; Fig. 12 | | - | - | 8.3 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 25 °C; Fig. 13 | | - | 3.6 | 4 | mΩ |
| $R_G$ | gate resistance | f = 1 MHz | | - | 0.7 | - | Ω |
| **Dynamic characteristics** | | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D$ = 75 A; $V_{DS}$ = 30 V; $V_{GS}$ = 10 V; Fig. 14; Fig. 15 | | - | 56 | - | nC |
| | | $I_D$ = 0 A; $V_{DS}$ = 0 V; $V_{GS}$ = 10 V | | - | 47.5 | - | nC |
| $Q_{GS}$ | gate-source charge | $I_D$ = 75 A; $V_{DS}$ = 30 V; $V_{GS}$ = 10 V; Fig. 14; Fig. 15 | | - | 18.7 | - | nC |
| $Q_{GS(th)}$ | pre-threshold gate-source charge | $I_D$ = 75 A; $V_{DS}$ = 30 V; $V_{GS}$ = 10 V; Fig. 14 | | - | 10.3 | - | nC |
| $Q_{GS(th-pl)}$ | post-threshold gate-source charge | | | - | 8.4 | - | nC |
| $Q_{GD}$ | gate-drain charge | $I_D$ = 75 A; $V_{DS}$ = 30 V; $V_{GS}$ = 10 V; Fig. 14; Fig. 15 | | - | 11.2 | - | nC |
| $V_{GS(pl)}$ | gate-source plateau voltage | $V_{DS}$ = 30 V; Fig. 14; Fig. 15 | | - | 4.9 | - | V |


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| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $C_{iss}$ | input capacitance | $V_{DS}$ = 30 V; $V_{GS}$ = 0 V; f = 1 MHz; $T_j$ = 25 °C; Fig. 16 | | - | 3501 | - | pF |
| $C_{oss}$ | output capacitance | | | - | 457 | - | pF |
| $C_{rss}$ | reverse transfer capacitance | | | - | 240 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = 30 V; $R_L$ = 0.4 Ω; $V_{GS}$ = 10 V; $R_{G(ext)}$ = 4.7 Ω | | - | 23 | - | ns |
| $t_r$ | rise time | | | - | 24 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | | - | 44 | - | ns |
| $t_f$ | fall time | | | - | 14 | - | ns |
| **Source-drain diode** | | | | | | | |
| $V_{SD}$ | source-drain voltage | $I_S$ = 15 A; $V_{GS}$ = 0 V; $T_j$ = 25 °C; Fig. 17 | | - | 0.8 | 1.2 | V |
| $t_{rr}$ | reverse recovery time | $I_S$ = 25 A; $dI_S/dt$ = -100 A/µs; $V_{GS}$ = 0 V; $V_{DS}$ = 30 V | | - | 43 | - | ns |
| $Q_r$ | recovered charge | | | - | 58 | - | nC |

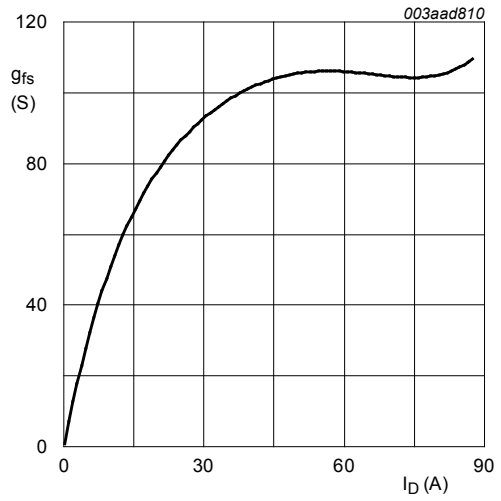


**Fig. 5. Forward transconductance as a function of drain current; typical values**

$T_j = 25\ °C;\ V_{DS} = 15\ V$

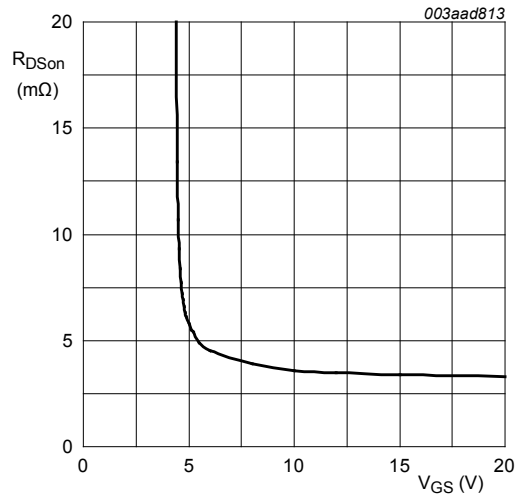


**Fig. 6. Drain-source on-state resistance as a function of gate-source voltage; typical values**

$T_j = 25\ °C;\ I_D = 25\ A$


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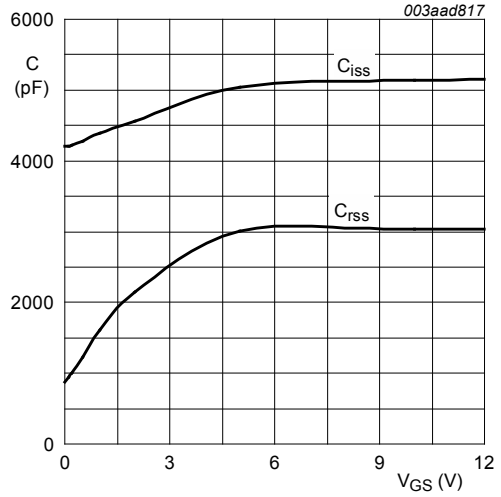


**Fig. 7. Input and reverse transfer capacitances as a function of gate-source voltage, typical values**

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

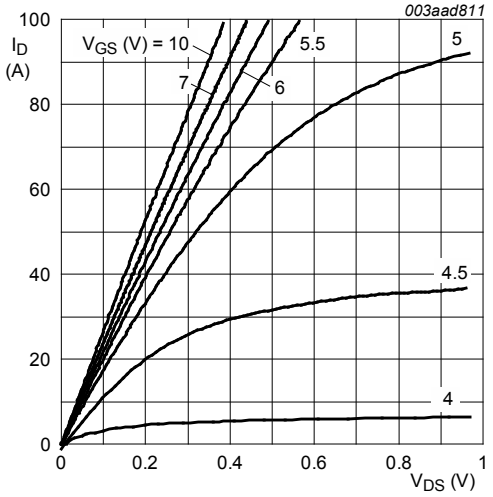


**Fig. 8. Output characteristics: drain current as a function of drain-source voltage; typical values**

$T_j = 25\,°C$

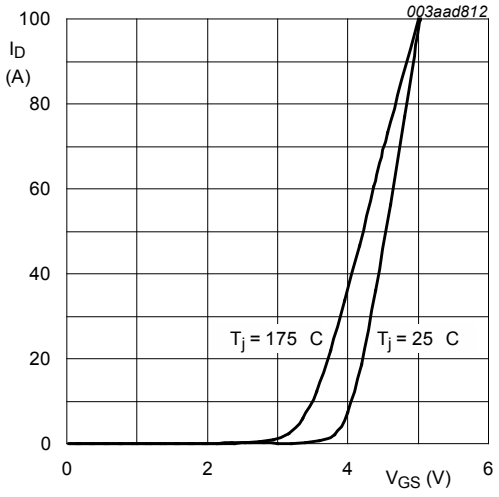


**Fig. 9. Transfer characteristics: drain current as a function of gate-source voltage; typical values**

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

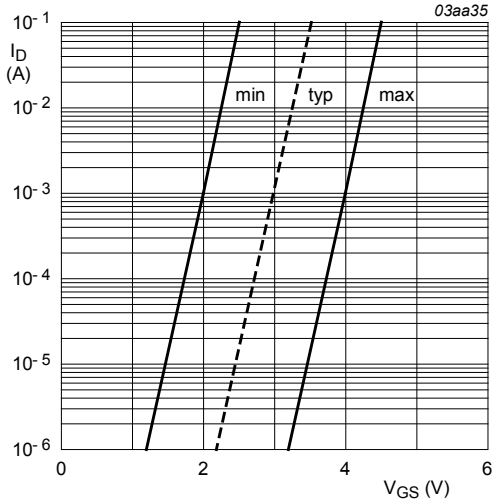


**Fig. 10. Sub-threshold drain current as a function of gate-source voltage**

$T_j = 25\,°C; V_{DS} = 5V$


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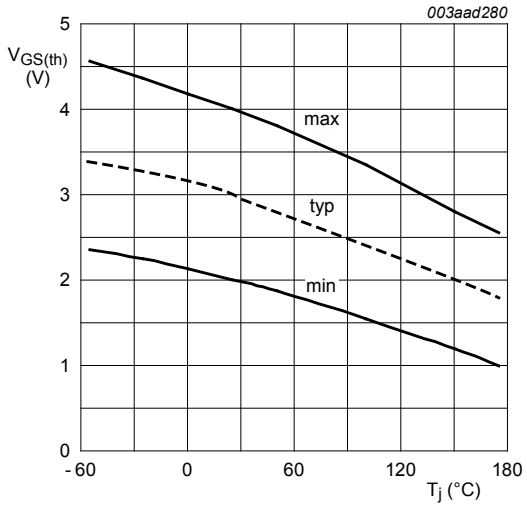


**Fig. 11. Gate-source threshold voltage as a function of junction temperature**

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

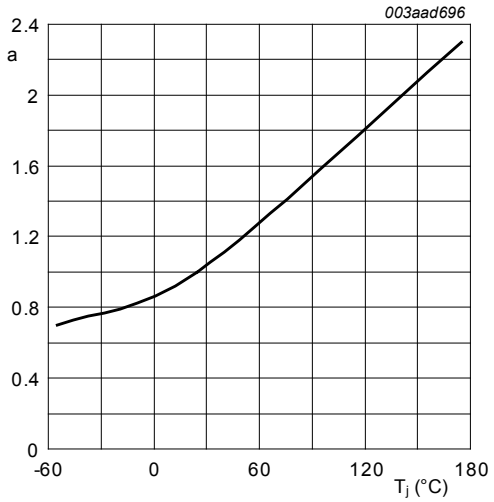


**Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature.**

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

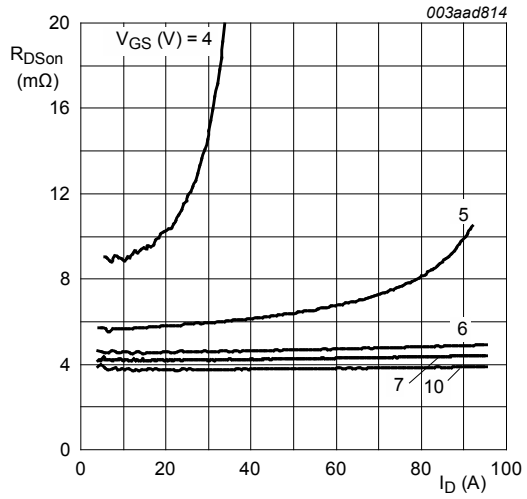


**Fig. 13. Drain-source on-state resistance as a function of drain current; typical values**

$T_j = 25\,°C$

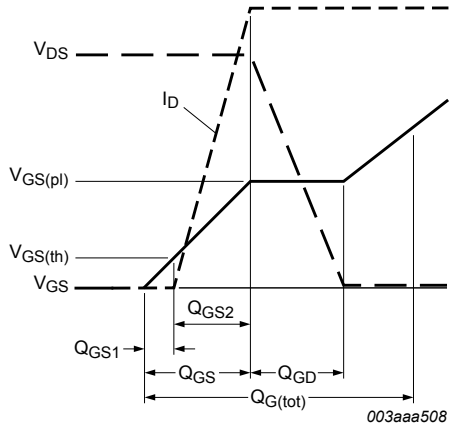


**Fig. 14. Gate charge waveform definitions**


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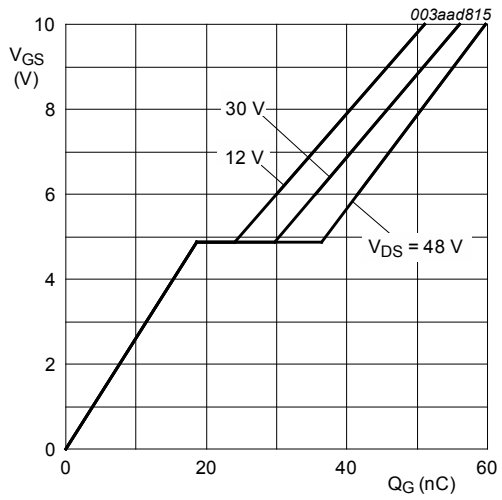


**Fig. 15. Gate-source voltage as a function of gate charge; typical values**

$T_J = 25\ °C; I_D = 75\ A$

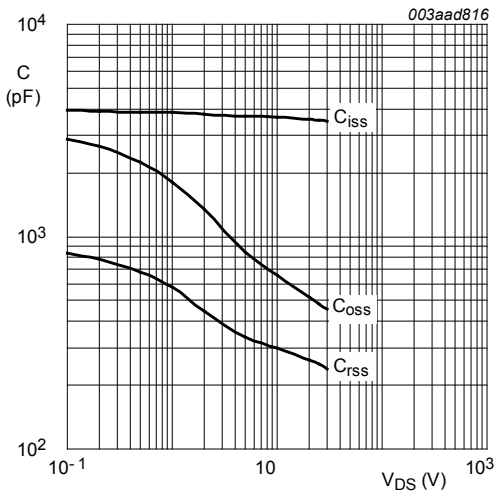


**Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**

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

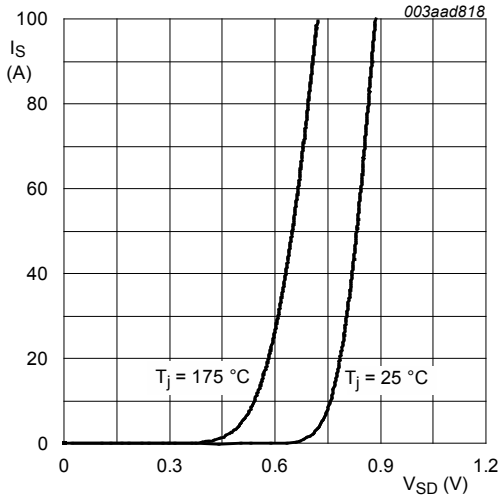


**Fig. 17. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values**

$V_{GS} = 0\ V$


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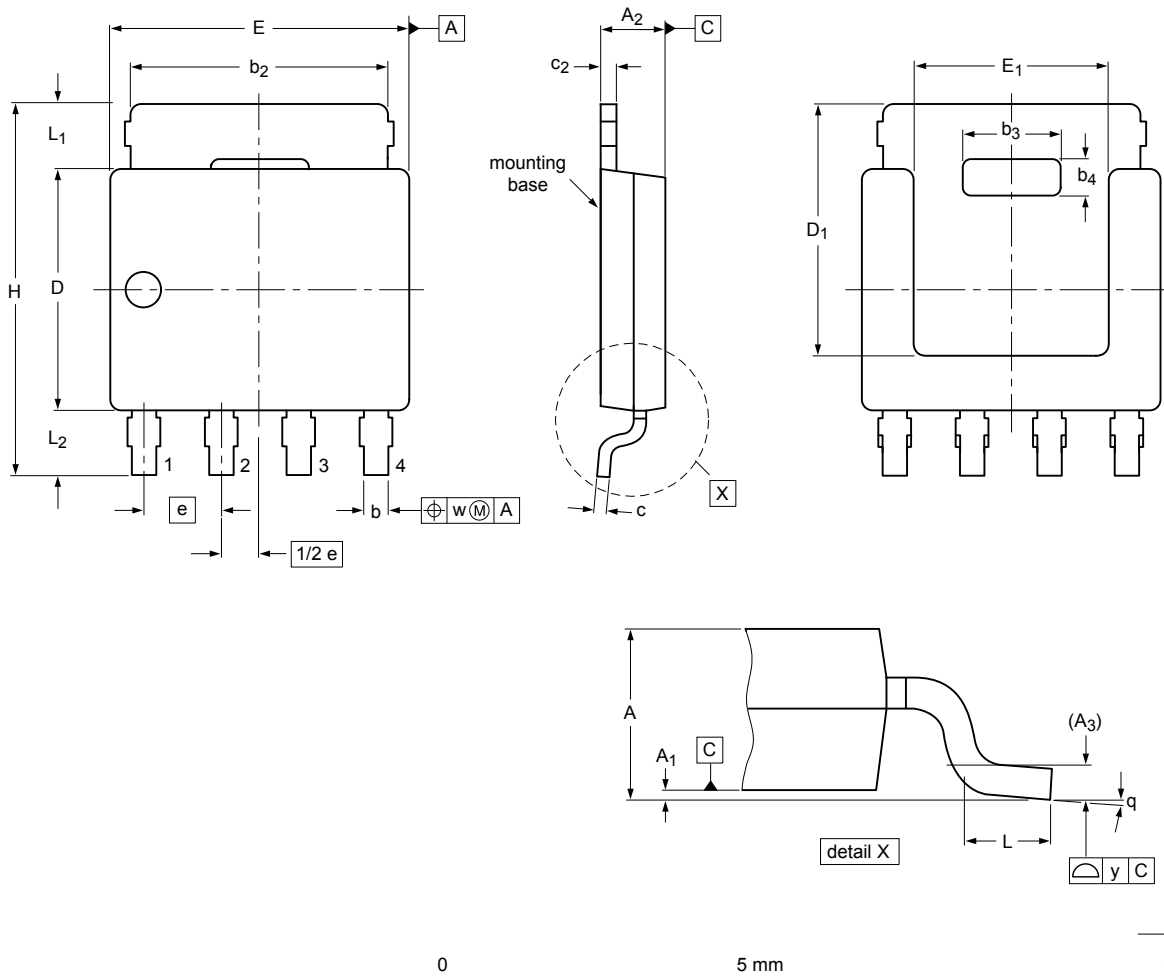
## 10. Package outline

**Plastic single-ended surface-mounted package (LFPAK56; Power-SO8); 4 leads** **SOT669**




| θ |
|---|
| 8° |
| 0° |

Dimensions (mm are the original dimensions)

| Unit[1] | | A | $A_1$ | $A_2$ | $A_3$ | b | $b_2$ | $b_3$ | $b_4$ | c | $c_2$ | $D^{(1)}$ | $D_1{}^{(1)}$ | $E^{(1)}$ | $E_1{}^{(1)}$ | e | H | L | $L_1$ | $L_2$ | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 1.20 | 0.15 | 1.10 | | 0.50 | 4.41 | 2.2 | 0.9 | 0.25 | 0.30 | 4.10 | 4.20 | 5.0 | 3.3 | | 6.2 | 0.85 | 1.3 | 1.3 | | |
| | nom | | | | 0.25 | | | | | | | | | | | 1.27 | | | | | 0.25 | 0.1 |
| | min | 1.01 | 0.00 | 0.95 | | 0.35 | 3.62 | 2.0 | 0.7 | 0.19 | 0.24 | 3.80 | | 4.8 | 3.1 | | 5.8 | 0.40 | 0.8 | 0.8 | | |

Note
1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

*sot669_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT669 | | MO-235 | | | | ~~11-03-25~~ 13-02-27 |

**Fig. 18. Package outline LFPAK56; Power-SO8 (SOT669)**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# 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. |
| 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".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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