



PSMN6R1-30YLD

N-channel 30 V, 6.1 mΩ logic level MOSFET in LFPK56
using NextPowerS3 Technology

19 September 2014

Product data sheet

1. General description

Logic level gate drive N-channel enhancement mode MOSFET in LFPK56 package. NextPowerS3 portfolio utilising NXP's unique "SchottkyPlus" technology delivers high efficiency, low spiking performance usually associated with MOSFETs with an integrated Schottky or Schottky-like diode but without problematic high leakage current. NextPowerS3 is particularly suited to high efficiency applications at high switching frequencies.

2. Features and benefits

- Ultra low Q_G , Q_{GD} and Q_{OSS} for high system efficiency, especially at higher switching frequencies
- Superfast switching with soft-recovery; s-factor > 1
- Low spiking and ringing for low EMI designs
- Unique "SchottkyPlus" technology; Schottky-like performance with < 1 μA leakage at 25 °C
- Optimised for 4.5 V gate drive
- Low parasitic inductance and resistance
- High reliability clip bonded and solder die attach Power SO8 package; no glue, no wire bonds, qualified to 175 °C
- Wave solderable; exposed leads for optimal visual solder inspection

3. Applications

- On-board DC-to-DC solutions for server and telecommunications
- Secondary-side synchronous rectification in telecommunication applications
- Voltage regulator modules (VRM)
- Point-of-Load (POL) modules
- Power delivery for V-core, ASIC, DDR, GPU, VGA and system components
- Brushed and brushless motor control

4. Quick reference data

Table 1. Quick reference data

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------|-------------------------|---|-----|-----|-----|------|
| V_{DS} | drain-source voltage | 25 °C $\leq T_j \leq$ 175 °C | - | - | 30 | V |
| I_D | drain current | $T_{mb} = 25$ °C; $V_{GS} = 10$ V; Fig. 2 | - | - | 66 | A |
| P_{tot} | total power dissipation | $T_{mb} = 25$ °C; Fig. 1 | - | - | 47 | W |

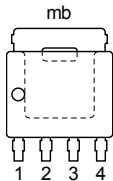
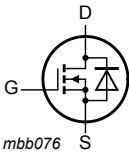


N-channel 30 V, 6.1 mΩ logic level MOSFET in LFAK56 using NextPowerS3 Technology

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|---|-----|------|------|------|
| T _j | junction temperature | | -55 | - | 175 | °C |
| Static characteristics | | | | | | |
| R _{DSon} | drain-source on-state resistance | V _{GS} = 4.5 V; I _D = 15 A; T _j = 25 °C; Fig. 10 | - | 6.5 | 8.35 | mΩ |
| | | V _{GS} = 10 V; I _D = 15 A; T _j = 25 °C; Fig. 10 | - | 5.05 | 6 | mΩ |
| Dynamic characteristics | | | | | | |
| Q _{GD} | gate-drain charge | V _{GS} = 4.5 V; I _D = 15 A; V _{DS} = 15 V; Fig. 12 ; Fig. 13 | - | 2.1 | 3.15 | nC |
| Q _{G(tot)} | total gate charge | V _{GS} = 4.5 V; I _D = 15 A; V _{DS} = 15 V; Fig. 12 ; Fig. 13 | - | 6.8 | 10.2 | nC |
| Source-drain diode | | | | | | |
| S | softness factor | I _S = 15 A; V _{GS} = 0 V; dI _S /dt = -100 A/μs; V _{DS} = 15 V; Fig. 16 | - | 1.3 | - | |

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|-----|--------|-----------------------------------|---|---|
| 1 | S | source |  <p>LFAK56; Power-SO8 (SOT669)</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 |
| PSMN6R1-30YLD | LFAK56; Power-SO8 | Plastic single-ended surface-mounted package (LFAK56; Power-SO8); 4 leads | SOT669 |

7. Marking

Table 4. Marking codes

| Type number | Marking code |
|---------------|--------------|
| PSMN6R1-30YLD | 6D130L |

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 | $25\text{ °C} \leq T_j \leq 175\text{ °C}$ | | - | 30 | V |
| V_{DGR} | drain-gate voltage | $25\text{ °C} \leq T_j \leq 175\text{ °C}$; $R_{GS} = 20\text{ k}\Omega$ | | - | 30 | V |
| V_{GS} | gate-source voltage | | | -20 | 20 | V |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C}$; Fig. 1 | | - | 47 | W |
| I_D | drain current | $V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2 | | - | 66 | A |
| | | $V_{GS} = 10\text{ V}$; $T_{mb} = 100\text{ °C}$; Fig. 2 | | - | 46 | A |
| I_{DM} | peak drain current | pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$; Fig. 3 | | - | 263 | A |
| T_{stg} | storage temperature | | | -55 | 175 | °C |
| T_j | junction temperature | | | -55 | 175 | °C |
| $T_{sld(M)}$ | peak soldering temperature | | | - | 260 | °C |
| V_{ESD} | electrostatic discharge voltage | HBM | | 250 | - | V |
| Source-drain diode | | | | | | |
| I_S | source current | $T_{mb} = 25\text{ °C}$ | | - | 39 | A |
| I_{SM} | peak source current | pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$ | | - | 250 | A |
| Avalanche ruggedness | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $V_{GS} = 10\text{ V}$; $T_{j(\text{init})} = 25\text{ °C}$; $I_D = 15\text{ A}$; $V_{sup} \leq 30\text{ V}$; $R_{GS} = 50\text{ }\Omega$; unclamped; $t_p = 145\text{ }\mu\text{s}$ | [1] | - | 42 | mJ |

[1] Protected by 100% test

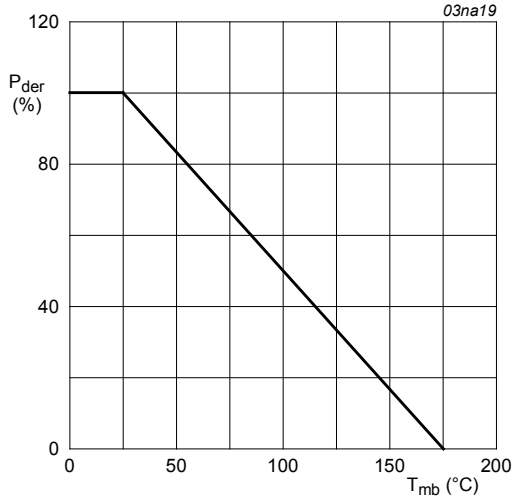


Fig. 1. Normalized total power dissipation as a function of mounting base temperature

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

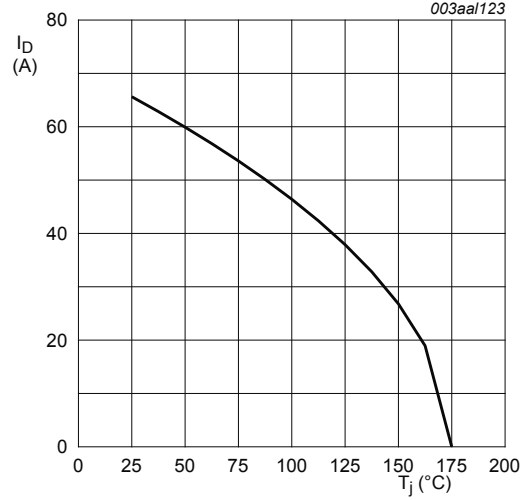


Fig. 2. Continuous drain current as a function of mounting base temperature

$$V_{GS} \geq 10V$$

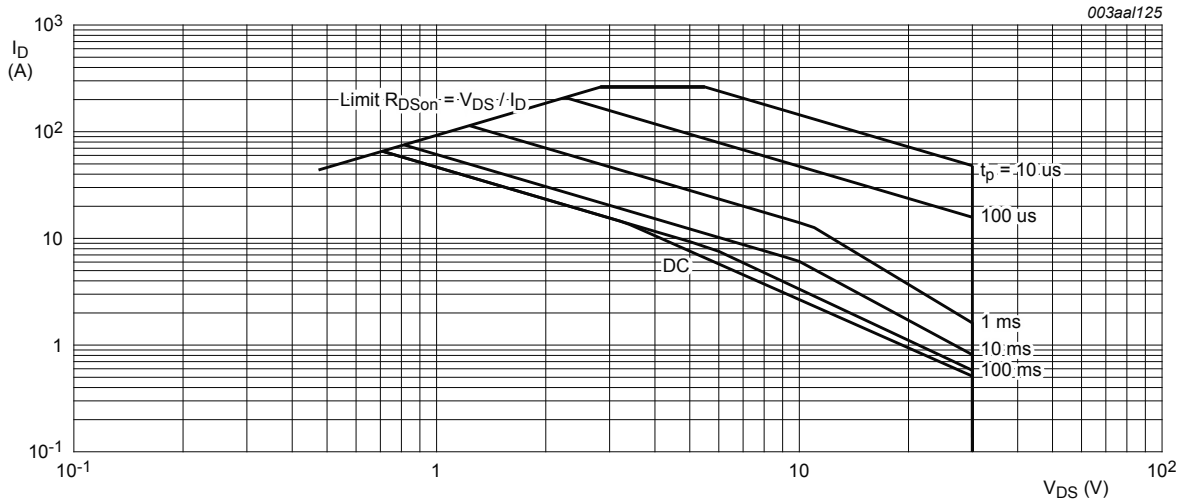


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

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. 4 | - | 3 | 3.22 | K/W |

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------|---|------------------------|-----|-----|-----|------|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | Fig. 5 | - | 50 | - | K/W |
| | | Fig. 6 | - | 125 | - | K/W |

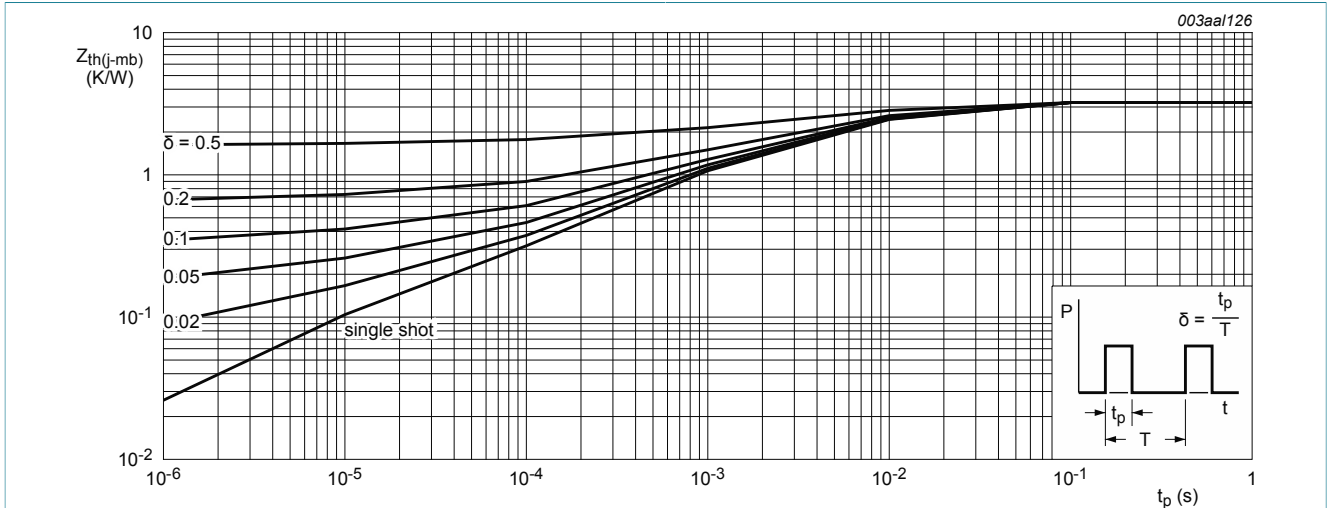


Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

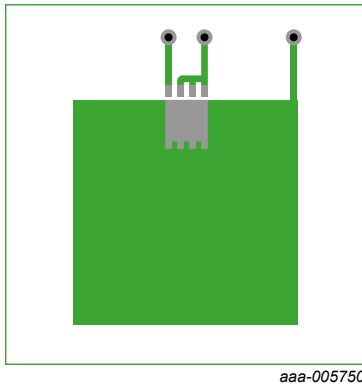


Fig. 5. PCB layout for thermal resistance junction to ambient 1” square pad; FR4 Board; 2oz copper

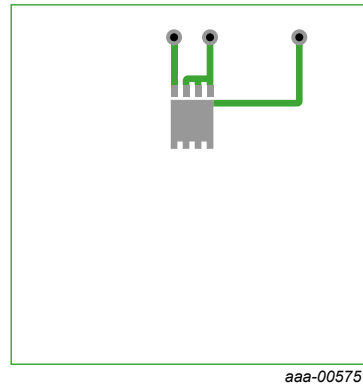


Fig. 6. PCB layout for thermal resistance junction to ambient minimum footprint; FR4 Board; 2oz copper

10. Characteristics

Table 7. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-------------------------------|--------------------------------|--|-----|------|-----|------|
| Static characteristics | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D = 250 \mu A; V_{GS} = 0 V; T_J = 25 \text{ }^\circ C$ | 30 | - | - | V |
| | | $I_D = 250 \mu A; V_{GS} = 0 V; T_J = -55 \text{ }^\circ C$ | 27 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_J = 25 \text{ }^\circ C$ | 1.2 | 1.68 | 2.2 | V |

N-channel 30 V, 6.1 mΩ logic level MOSFET in LPAK56 using NextPowerS3 Technology

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|--|---|-----|------|------|---------------|
| $\Delta V_{GS(th)}/\Delta T$ | gate-source threshold voltage variation with temperature | $25\text{ }^{\circ}\text{C} \leq T_j \leq 150\text{ }^{\circ}\text{C}$ | - | -3.9 | - | mV/K |
| I_{DSS} | drain leakage current | $V_{DS} = 24\text{ V}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^{\circ}\text{C}$ | - | - | 1 | μA |
| | | $V_{DS} = 24\text{ V}; V_{GS} = 0\text{ V}; T_j = 150\text{ }^{\circ}\text{C}$ | - | - | 100 | μA |
| I_{GSS} | gate leakage current | $V_{GS} = 16\text{ V}; V_{DS} = 0\text{ V}; T_j = 25\text{ }^{\circ}\text{C}$ | - | - | 100 | nA |
| | | $V_{GS} = -16\text{ V}; V_{DS} = 0\text{ V}; T_j = 25\text{ }^{\circ}\text{C}$ | - | - | 100 | nA |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = 4.5\text{ V}; I_D = 15\text{ A}; T_j = 25\text{ }^{\circ}\text{C};$ Fig. 10 | - | 6.5 | 8.35 | mΩ |
| | | $V_{GS} = 4.5\text{ V}; I_D = 15\text{ A}; T_j = 150\text{ }^{\circ}\text{C};$ Fig. 11; Fig. 10 | - | - | 13.8 | mΩ |
| | | $V_{GS} = 10\text{ V}; I_D = 15\text{ A}; T_j = 25\text{ }^{\circ}\text{C};$ Fig. 10 | - | 5.05 | 6 | mΩ |
| | | $V_{GS} = 10\text{ V}; I_D = 15\text{ A}; T_j = 150\text{ }^{\circ}\text{C};$ Fig. 11; Fig. 10 | - | - | 9.9 | mΩ |
| R_G | gate resistance | $f = 1\text{ MHz}$ | - | 0.44 | 0.88 | Ω |
| Dynamic characteristics | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D = 15\text{ A}; V_{DS} = 15\text{ V}; V_{GS} = 10\text{ V};$ Fig. 12; Fig. 13 | - | 14.2 | 21.3 | nC |
| | | $I_D = 15\text{ A}; V_{DS} = 15\text{ V}; V_{GS} = 4.5\text{ V};$ Fig. 12; Fig. 13 | - | 6.8 | 10.2 | nC |
| | | $I_D = 0\text{ A}; V_{DS} = 0\text{ V}; V_{GS} = 10\text{ V}$ | - | 13.3 | - | nC |
| Q_{GS} | gate-source charge | $I_D = 15\text{ A}; V_{DS} = 15\text{ V}; V_{GS} = 4.5\text{ V};$ Fig. 12; Fig. 13 | - | 2.2 | - | nC |
| $Q_{GS(th)}$ | pre-threshold gate-source charge | | - | 1.3 | - | nC |
| $Q_{GS(th-pl)}$ | post-threshold gate-source charge | | - | 0.9 | - | nC |
| Q_{GD} | gate-drain charge | | - | 2.1 | 3.15 | nC |
| $V_{GS(pl)}$ | gate-source plateau voltage | $I_D = 15\text{ A}; V_{DS} = 15\text{ V};$ Fig. 12; Fig. 13 | - | 2.7 | - | V |
| C_{iss} | input capacitance | $V_{DS} = 15\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz};$ $T_j = 25\text{ }^{\circ}\text{C};$ Fig. 14 | - | 817 | 1225 | pF |
| C_{oss} | output capacitance | | - | 605 | 908 | pF |
| C_{rss} | reverse transfer capacitance | | - | 62 | 93 | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = 15\text{ V}; R_L = 1\text{ }^{\Omega}; V_{GS} = 4.5\text{ V};$ $R_{G(ext)} = 5\text{ }^{\Omega}$ | - | 7.5 | - | ns |
| t_r | rise time | | - | 11 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 9.8 | - | ns |
| t_f | fall time | | - | 7.2 | - | ns |

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| Symbol | Parameter | Conditions | Min | Typ | Max | Unit | |
|---------------------------|----------------------------|---|-----|------|------|------|----|
| Q_{oss} | output charge | $V_{GS} = 0\text{ V}; V_{DS} = 15\text{ V}; f = 1\text{ MHz}; T_j = 25\text{ }^\circ\text{C}$ | - | 11.8 | - | nC | |
| Source-drain diode | | | | | | | |
| V_{SD} | source-drain voltage | $I_S = 10\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C}; \text{Fig. 15}$ | - | 0.78 | 1.2 | V | |
| t_{rr} | reverse recovery time | $I_S = 15\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V}; V_{DS} = 15\text{ V}; \text{Fig. 16}$ | - | 23.8 | 47.6 | ns | |
| Q_r | recovered charge | | [1] | - | 12.6 | 25.2 | nC |
| t_a | reverse recovery rise time | | - | 10.3 | - | ns | |
| t_b | reverse recovery fall time | | - | 13.5 | - | ns | |
| S | softness factor | | - | 1.3 | - | | |

[1] includes capacitive recovery

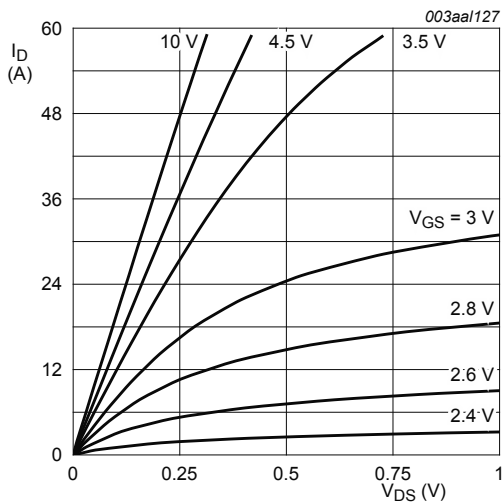


Fig. 7. Output characteristics; drain current as a function of drain-source voltage; typical values

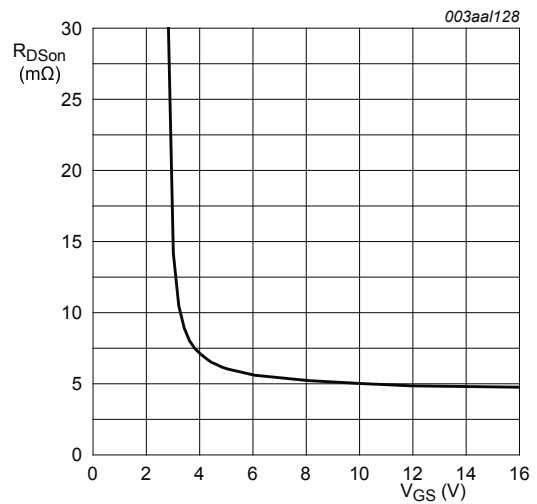


Fig. 8. Drain-source on-state resistance as a function of gate-source voltage; typical values

$T_j = 25^\circ\text{C}; I_D = 15\text{ A}$

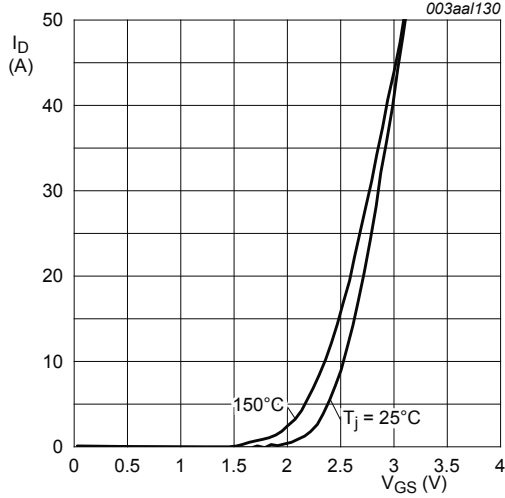


Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values

$$V_{DS} = 12V$$

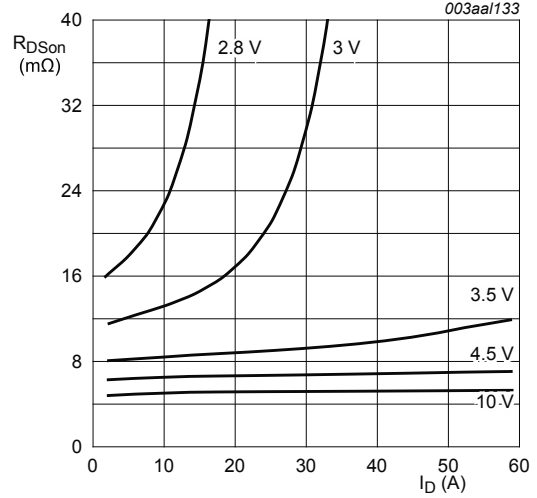


Fig. 10. Drain-source on-state resistance as a function of drain current; typical values

$$T_j = 25^\circ C$$

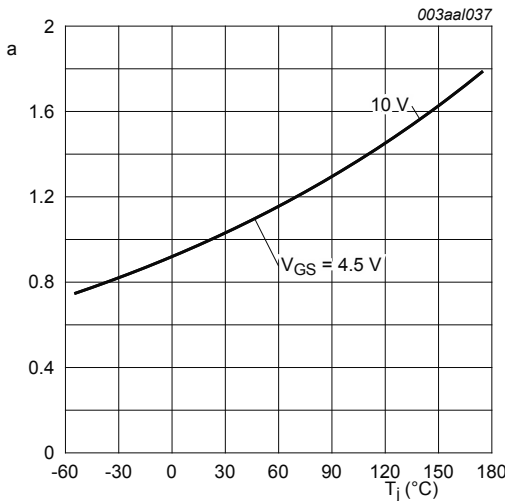


Fig. 11. Normalized drain-source on-state resistance factor as a function of junction temperature

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

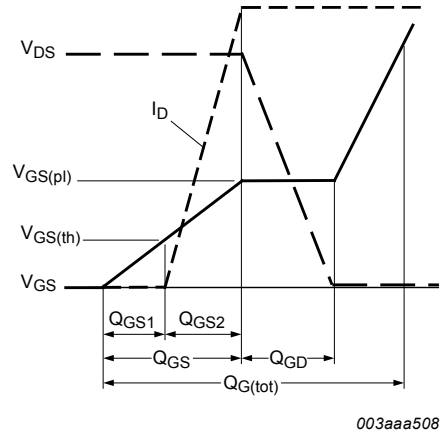


Fig. 12. Gate charge waveform definitions

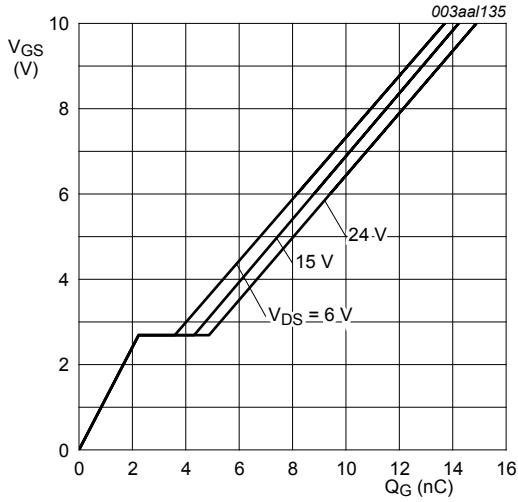


Fig. 13. Gate-source voltage as a function of gate charge; typical values

$$T_j = 25^\circ\text{C}; I_D = 15\text{A}$$

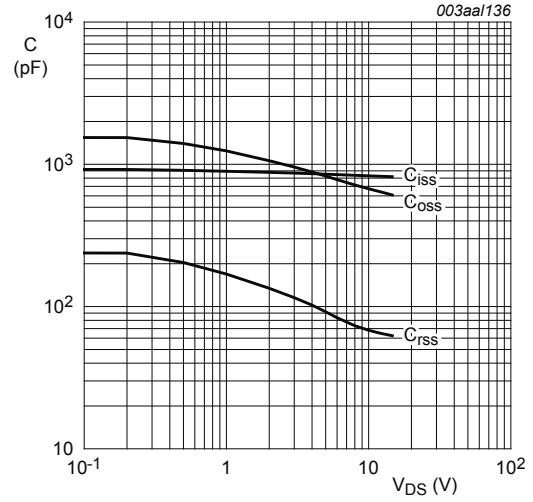


Fig. 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

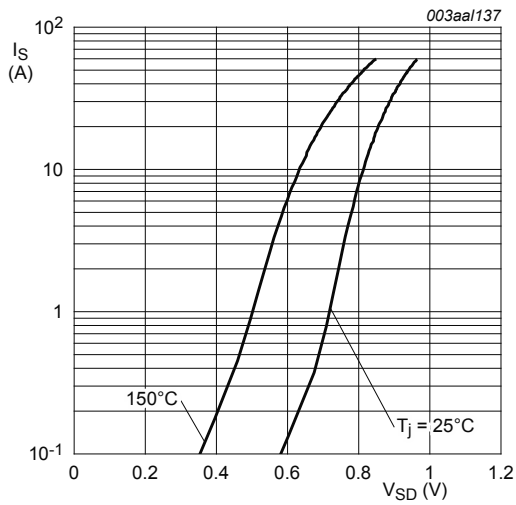


Fig. 15. Source current as a function of source-drain voltage; typical values

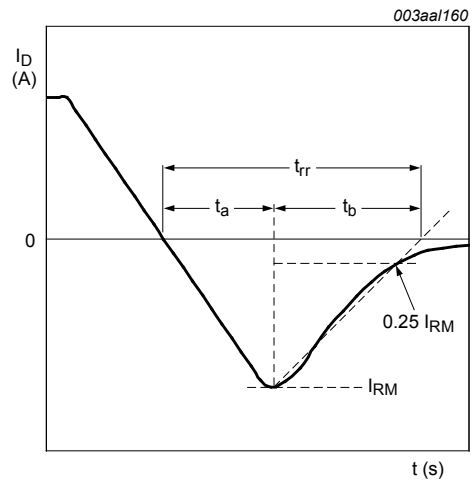


Fig. 16. Reverse recovery timing definition

11. Package outline

Plastic single-ended surface-mounted package (LPAK56; Power-SO8); 4 leads SOT669



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

12. Legal information

12.1 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. |

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- [2] The term 'short data sheet' is explained in section "Definitions".
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13. Contents

| | | |
|------|-------------------------------|----|
| 1 | General description | 1 |
| 2 | Features and benefits | 1 |
| 3 | Applications | 1 |
| 4 | Quick reference data | 1 |
| 5 | Pinning information | 2 |
| 6 | Ordering information | 2 |
| 7 | Marking | 2 |
| 8 | Limiting values | 3 |
| 9 | Thermal characteristics | 4 |
| 10 | Characteristics | 5 |
| 11 | Package outline | 10 |
| 12 | Legal information | 11 |
| 12.1 | Data sheet status | 11 |
| 12.2 | Definitions | 11 |
| 12.3 | Disclaimers | 11 |
| 12.4 | Trademarks | 12 |

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