



# PSMN2R0-25MLD

N-channel 25 V, 2.1 m $\Omega$  logic level MOSFET in LPAK33  
using NextPowerS3 Technology

8 April 2016

Product data sheet

## 1. General description

Logic level gate drive N-channel enhancement mode MOSFET in LPAK33 package. NextPowerS3 portfolio utilising Nexperia'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  $\mu$ A leakage at 25 °C
- Optimised for 4.5 V gate drive
- Low parasitic inductance and resistance
- High reliability clip bonded and solder die attach Mini Power SO8 package; no glue, no wire bonds, qualified to 175 °C
- Exposed leads for optimal visual solder inspection

## 3. Applications

- On-board DC: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

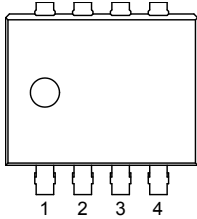
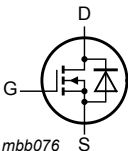
| Symbol    | Parameter               | Conditions                                                | Min | Typ | Max | Unit |
|-----------|-------------------------|-----------------------------------------------------------|-----|-----|-----|------|
| $V_{DS}$  | drain-source voltage    | 25 °C $\leq T_J \leq$ 175 °C                              | -   | -   | 25  | V    |
| $I_D$     | drain current           | $V_{GS} = 10$ V; $T_{mb} = 25$ °C; <a href="#">Fig. 2</a> | -   | -   | 70  | A    |
| $P_{tot}$ | total power dissipation | $T_{mb} = 25$ °C; <a href="#">Fig. 1</a>                  | -   | -   | 74  | W    |

N-channel 25 V, 2.1 mΩ logic level MOSFET in LFAK33 using  
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| Symbol                  | Parameter                        | Conditions                                                                                                                        |  | Min | Typ  | Max  | Unit |
|-------------------------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|--|-----|------|------|------|
| T <sub>j</sub>          | junction temperature             |                                                                                                                                   |  | -55 | -    | 175  | °C   |
| Static characteristics  |                                  |                                                                                                                                   |  |     |      |      |      |
| R <sub>DSon</sub>       | drain-source on-state resistance | V <sub>GS</sub> = 4.5 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C;<br><a href="#">Fig. 10</a>                                |  | -   | 2.5  | 3.06 | mΩ   |
|                         |                                  | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C;<br><a href="#">Fig. 10</a>                                 |  | -   | 1.86 | 2.27 | mΩ   |
| Dynamic characteristics |                                  |                                                                                                                                   |  |     |      |      |      |
| Q <sub>G(tot)</sub>     | total gate charge                | I <sub>D</sub> = 25 A; V <sub>DS</sub> = 12 V; V <sub>GS</sub> = 10 V;<br><a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>       |  | -   | 34.4 | -    | nC   |
|                         |                                  | I <sub>D</sub> = 25 A; V <sub>DS</sub> = 12 V; V <sub>GS</sub> = 4.5 V;<br><a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>      |  | -   | 15.9 | -    | nC   |
|                         |                                  | I <sub>D</sub> = 0 A; V <sub>DS</sub> = 0 V; V <sub>GS</sub> = 10 V                                                               |  | -   | 18.9 | -    | nC   |
| Q <sub>GD</sub>         | gate-drain charge                | I <sub>D</sub> = 25 A; V <sub>DS</sub> = 12 V; V <sub>GS</sub> = 4.5 V;<br><a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>      |  | -   | 3.8  | -    | nC   |
| Source-drain diode      |                                  |                                                                                                                                   |  |     |      |      |      |
| S                       | softness factor                  | I <sub>S</sub> = 25 A; dI <sub>S</sub> /dt = -100 A/μs; V <sub>GS</sub> = 0 V;<br>V <sub>DS</sub> = 12 V; <a href="#">Fig. 16</a> |  | -   | 0.9  | -    |      |

## 5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description                       | Simplified outline                                                                                          | Graphic symbol                                                                                      |
|-----|--------|-----------------------------------|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| 1   | S      | source                            |  <p>LFAK33 (SOT1210)</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 |
| PSMN2R0-25MLD | LFAK33  | Plastic single ended surface mounted package (LFAK33); 8 leads | SOT1210 |

## 7. Marking

Table 4. Marking codes

| Type number   | Marking code |
|---------------|--------------|
| PSMN2R0-25MLD | 2D025L       |

## 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                         | $25\text{ °C} \leq T_J \leq 175\text{ °C}$                                                                                                                                 |                     | -   | 25  | V    |
| $V_{DGR}$                   | drain-gate voltage                           | $25\text{ °C} \leq T_J \leq 175\text{ °C}$ ; $R_{GS} = 20\text{ k}\Omega$                                                                                                  |                     | -   | 25  | V    |
| $V_{GS}$                    | gate-source voltage                          |                                                                                                                                                                            |                     | -20 | 20  | V    |
| $P_{tot}$                   | total power dissipation                      | $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>                                                                                                                           |                     | -   | 74  | W    |
| $I_D$                       | drain current                                | $V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>                                                                                                  |                     | -   | 70  | A    |
|                             |                                              | $V_{GS} = 10\text{ V}$ ; $T_{mb} = 100\text{ °C}$ ; <a href="#">Fig. 2</a>                                                                                                 |                     | -   | 70  | 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>                                                                                |                     | -   | 555 | 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                                                                                                                                                                        |                     | 800 | -   | V    |
| <b>Source-drain diode</b>   |                                              |                                                                                                                                                                            |                     |     |     |      |
| $I_S$                       | source current                               | $T_{mb} = 25\text{ °C}$                                                                                                                                                    |                     | -   | 62  | A    |
| $I_{SM}$                    | peak source current                          | pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$                                                                                                         |                     | -   | 555 | A    |
| <b>Avalanche ruggedness</b> |                                              |                                                                                                                                                                            |                     |     |     |      |
| $E_{DS(AL)S}$               | non-repetitive drain-source avalanche energy | $I_D = 25\text{ A}$ ; $V_{sup} \leq 25\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; $V_{GS} = 10\text{ V}$ ; $T_{J(init)} = 25\text{ °C}$ ; unclamped; $t_p = 0.89\text{ ms}$ | <a href="#">[1]</a> | -   | 361 | mJ   |

[1] Protected by 100% test

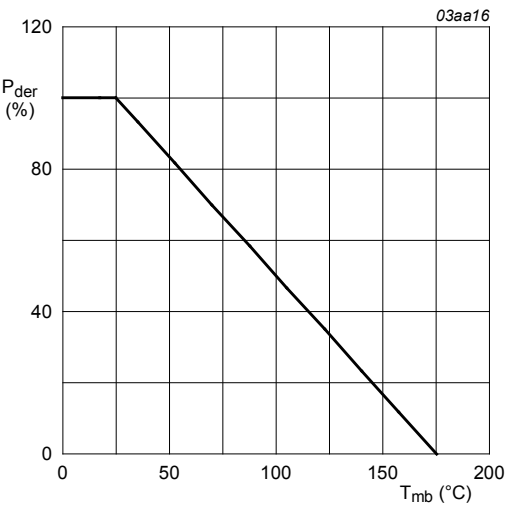
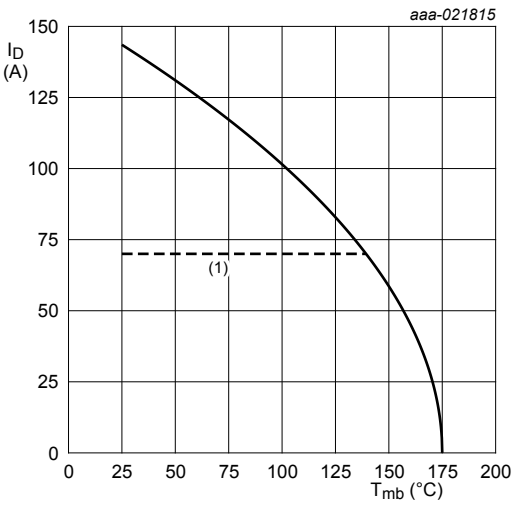


Fig. 1. Normalized total power dissipation as a function of mounting base temperature

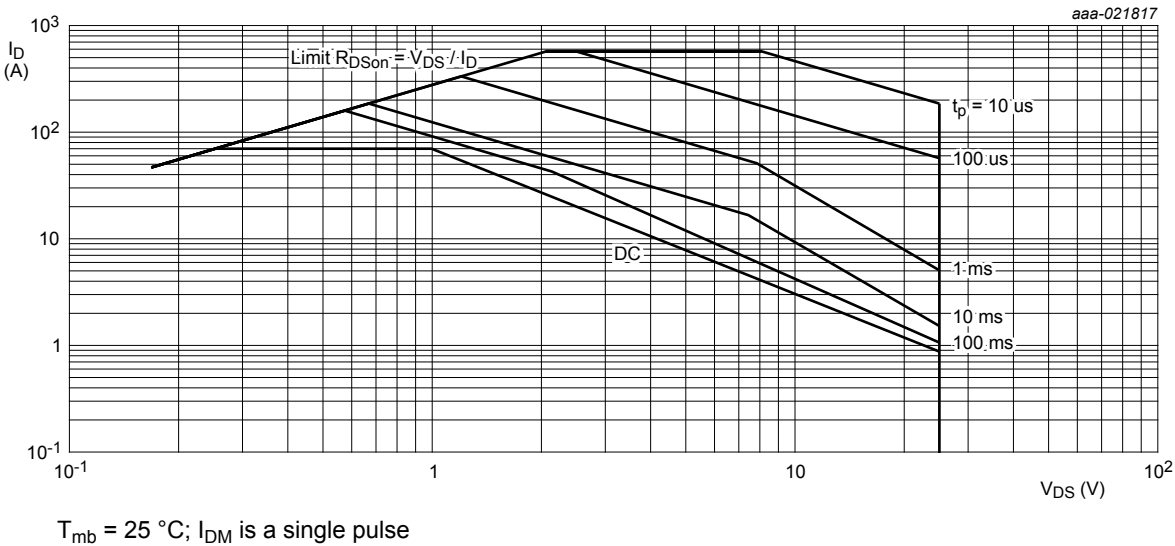
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$



$V_{GS} \geq 10$  V  
(1) Capped at 70A due to package

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

$$I_D = 144A \times \sqrt{\frac{175^{\circ}C - T_{mb}}{150^{\circ}C}} \quad \text{for } T_{mb} \geq 25^{\circ}C$$



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

Fig. 3. Safe operating area; 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 |
|----------------|---------------------------------------------------|------------|-----|------|------|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | Fig. 4     | -   | 1.56 | 2.02 | K/W  |

| Symbol        | Parameter                                         | Conditions             |  | Min | Typ | Max | Unit |
|---------------|---------------------------------------------------|------------------------|--|-----|-----|-----|------|
| $R_{th(j-a)}$ | thermal resistance<br>from junction to<br>ambient | <a href="#">Fig. 5</a> |  | -   | 57  | -   | K/W  |
|               |                                                   | <a href="#">Fig. 6</a> |  | -   | 178 | -   | K/W  |

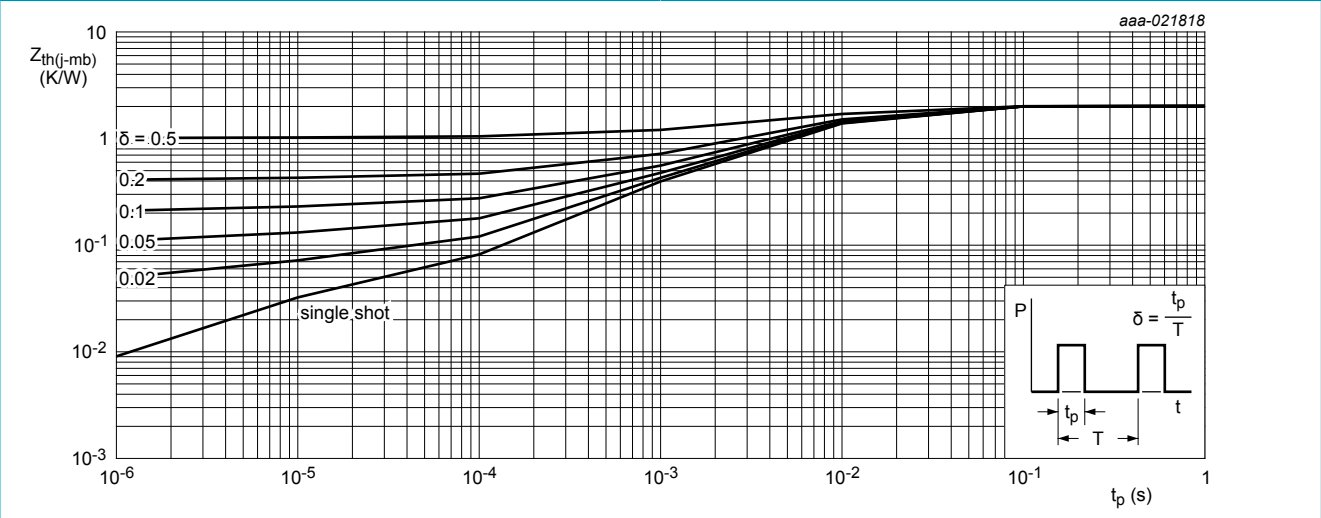


Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

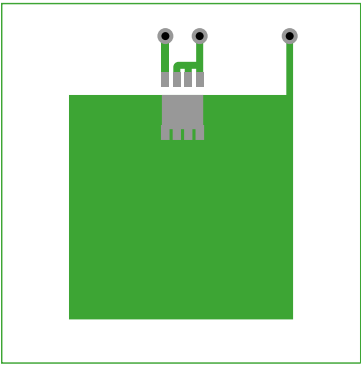


Fig. 5. PCB layout for thermal resistance junction to ambient 1" square pad; FR4 Board; 2oz copper

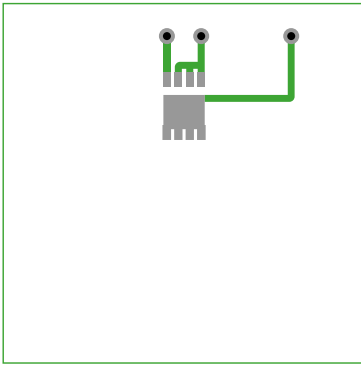


Fig. 6. PCB layout for thermal resistance junction to ambient minimum footprint; FR4 Board; 2oz copper

10. Characteristics

Table 7. Characteristics

| Symbol                 | Parameter                         | Conditions                                             |  | Min  | Typ  | Max | Unit |
|------------------------|-----------------------------------|--------------------------------------------------------|--|------|------|-----|------|
| Static characteristics |                                   |                                                        |  |      |      |     |      |
| $V_{(BR)DSS}$          | drain-source<br>breakdown voltage | $I_D = 250\ \mu A; V_{GS} = 0\ V; T_J = 25\ ^\circ C$  |  | 25   | -    | -   | V    |
|                        |                                   | $I_D = 250\ \mu A; V_{GS} = 0\ V; T_J = -55\ ^\circ C$ |  | 22.5 | -    | -   | V    |
| $V_{GS(th)}$           | gate-source threshold<br>voltage  | $I_D = 1\ mA; V_{DS}=V_{GS}; T_J = 25\ ^\circ C$       |  | 1.2  | 1.65 | 2.2 | V    |

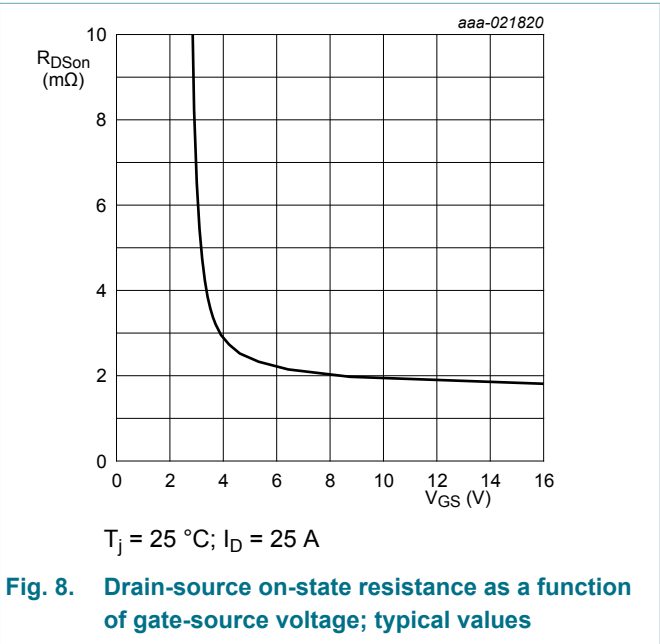
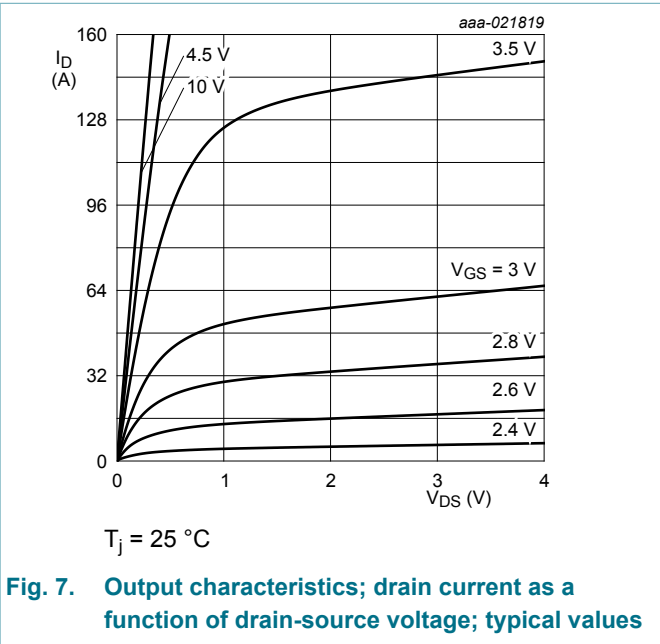
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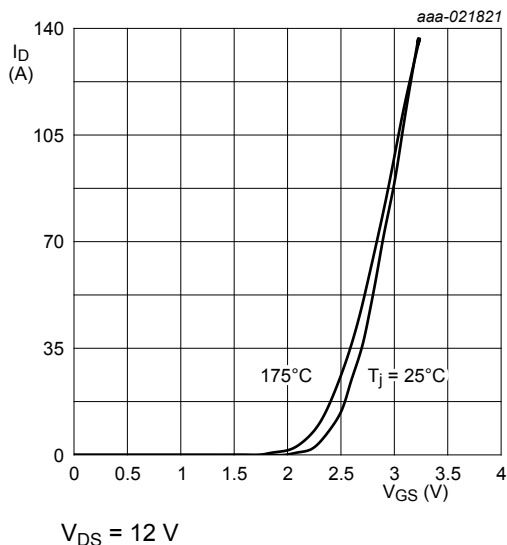
| Symbol                         | Parameter                                                | Conditions                                                                                                                    | Min | Typ  | Max  | Unit          |
|--------------------------------|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-----|------|------|---------------|
| $\Delta V_{GS(th)}/\Delta T$   | gate-source threshold voltage variation with temperature | $25\text{ }^{\circ}\text{C} \leq T_j \leq 175\text{ }^{\circ}\text{C}$                                                        | -   | -4.5 | -    | mV/K          |
| $I_{DSS}$                      | drain leakage current                                    | $V_{DS} = 20\text{ V}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^{\circ}\text{C}$                                                 | -   | -    | 1    | $\mu\text{A}$ |
|                                |                                                          | $V_{DS} = 20\text{ V}; V_{GS} = 0\text{ V}; T_j = 125\text{ }^{\circ}\text{C}$                                                | -   | 9.9  | -    | $\mu\text{A}$ |
| $I_{GSS}$                      | gate leakage current                                     | $V_{GS} = 20\text{ V}; V_{DS} = 0\text{ V}; T_j = 25\text{ }^{\circ}\text{C}$                                                 | -   | -    | 100  | nA            |
|                                |                                                          | $V_{GS} = -20\text{ V}; V_{DS} = 0\text{ V}; T_j = 25\text{ }^{\circ}\text{C}$                                                | -   | -    | 100  | nA            |
| $R_{DS(on)}$                   | drain-source on-state resistance                         | $V_{GS} = 4.5\text{ V}; I_D = 25\text{ A}; T_j = 25\text{ }^{\circ}\text{C};$<br><a href="#">Fig. 10</a>                      | -   | 2.5  | 3.06 | mΩ            |
|                                |                                                          | $V_{GS} = 4.5\text{ V}; I_D = 25\text{ A}; T_j = 175\text{ }^{\circ}\text{C};$<br><a href="#">Fig. 10; Fig. 11</a>            | -   | -    | 5.2  | mΩ            |
|                                |                                                          | $V_{GS} = 10\text{ V}; I_D = 25\text{ A}; T_j = 25\text{ }^{\circ}\text{C};$<br><a href="#">Fig. 10</a>                       | -   | 1.86 | 2.27 | mΩ            |
|                                |                                                          | $V_{GS} = 10\text{ V}; I_D = 25\text{ A}; T_j = 175\text{ }^{\circ}\text{C};$<br><a href="#">Fig. 10; Fig. 11</a>             | -   | -    | 3.86 | mΩ            |
| $R_G$                          | gate resistance                                          | $f = 1\text{ MHz}$                                                                                                            | -   | 0.75 | -    | Ω             |
| <b>Dynamic characteristics</b> |                                                          |                                                                                                                               |     |      |      |               |
| $Q_{G(tot)}$                   | total gate charge                                        | $I_D = 25\text{ A}; V_{DS} = 12\text{ V}; V_{GS} = 10\text{ V};$<br><a href="#">Fig. 12; Fig. 13</a>                          | -   | 34.4 | -    | nC            |
|                                |                                                          | $I_D = 25\text{ A}; V_{DS} = 12\text{ V}; V_{GS} = 4.5\text{ V};$<br><a href="#">Fig. 12; Fig. 13</a>                         | -   | 15.9 | -    | nC            |
|                                |                                                          | $I_D = 0\text{ A}; V_{DS} = 0\text{ V}; V_{GS} = 10\text{ V}$                                                                 | -   | 18.9 | -    | nC            |
| $Q_{GS}$                       | gate-source charge                                       | $I_D = 25\text{ A}; V_{DS} = 12\text{ V}; V_{GS} = 4.5\text{ V};$<br><a href="#">Fig. 12; Fig. 13</a>                         | -   | 6.4  | -    | nC            |
| $Q_{GS(th)}$                   | pre-threshold gate-source charge                         |                                                                                                                               | -   | 3.8  | -    | nC            |
| $Q_{GS(th-pl)}$                | post-threshold gate-source charge                        |                                                                                                                               | -   | 2.6  | -    | nC            |
| $Q_{GD}$                       | gate-drain charge                                        |                                                                                                                               | -   | 3.8  | -    | nC            |
| $V_{GS(pl)}$                   | gate-source plateau voltage                              | $I_D = 25\text{ A}; V_{DS} = 12\text{ V};$ <a href="#">Fig. 12; Fig. 13</a>                                                   | -   | 2.8  | -    | V             |
| $C_{iss}$                      | input capacitance                                        | $V_{DS} = 12\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz};$<br>$T_j = 25\text{ }^{\circ}\text{C};$ <a href="#">Fig. 14</a> | -   | 2490 | -    | pF            |
| $C_{oss}$                      | output capacitance                                       |                                                                                                                               | -   | 1132 | -    | pF            |
| $C_{rss}$                      | reverse transfer capacitance                             |                                                                                                                               | -   | 167  | -    | pF            |
| $t_{d(on)}$                    | turn-on delay time                                       | $V_{DS} = 12\text{ V}; R_L = 0.6\text{ }^{\circ}\Omega; V_{GS} = 4.5\text{ V};$<br>$R_{G(ext)} = 5\text{ }^{\circ}\Omega$     | -   | 15.7 | -    | ns            |
| $t_r$                          | rise time                                                |                                                                                                                               | -   | 18.4 | -    | ns            |
| $t_{d(off)}$                   | turn-off delay time                                      |                                                                                                                               | -   | 17.8 | -    | ns            |
| $t_f$                          | fall time                                                |                                                                                                                               | -   | 11.7 | -    | ns            |

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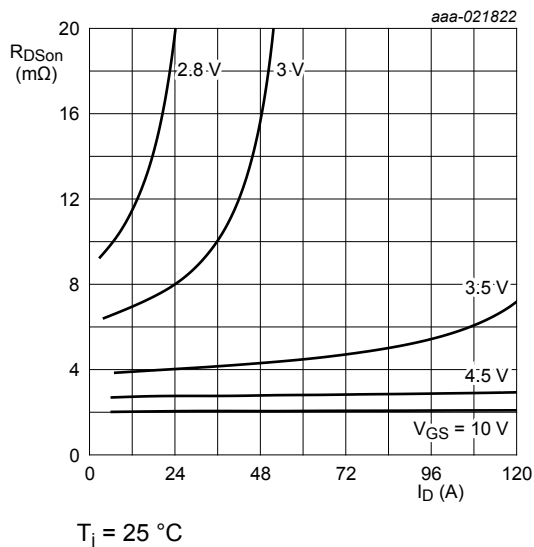
| Symbol             | Parameter                  | Conditions                                                                                                                                |                     | Min | Typ  | Max | Unit |
|--------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----|------|-----|------|
| $Q_{oss}$          | output charge              | $V_{GS} = 0\text{ V}$ ; $V_{DS} = 12\text{ V}$ ; $f = 1\text{ MHz}$ ;<br>$T_j = 25\text{ °C}$                                             |                     | -   | 19.7 | -   | nC   |
| Source-drain diode |                            |                                                                                                                                           |                     |     |      |     |      |
| $V_{SD}$           | source-drain voltage       | $I_S = 20\text{ A}$ ; $V_{GS} = 0\text{ V}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 15</a>                                              |                     | -   | 0.8  | 1.2 | V    |
| $t_{rr}$           | reverse recovery time      | $I_S = 25\text{ A}$ ; $dI_S/dt = -100\text{ A/}\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ;<br>$V_{DS} = 12\text{ V}$ ; <a href="#">Fig. 16</a> |                     | -   | 26.7 | -   | ns   |
| $Q_r$              | recovered charge           |                                                                                                                                           | <a href="#">[1]</a> | -   | 16.3 | -   | nC   |
| $t_a$              | reverse recovery rise time |                                                                                                                                           |                     | -   | 14   | -   | ns   |
| $t_b$              | reverse recovery fall time |                                                                                                                                           |                     | -   | 12.8 | -   | ns   |
| S                  | softness factor            |                                                                                                                                           |                     | -   | 0.9  | -   |      |

[1] includes capacitive recovery

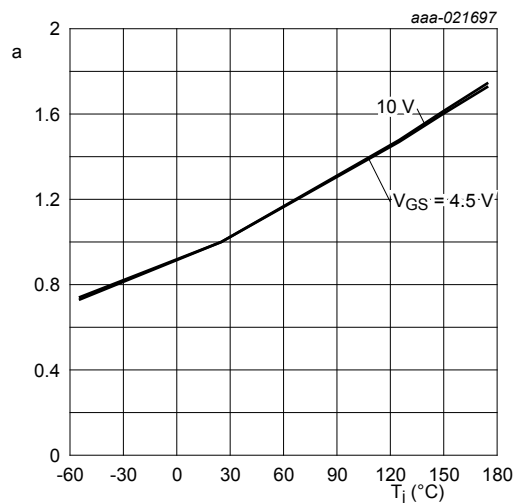




**Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values**

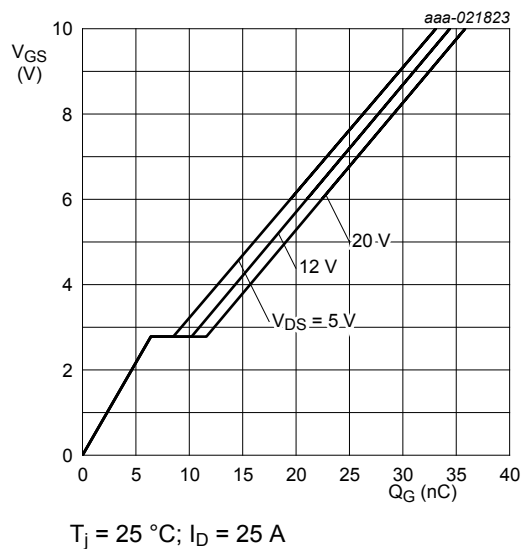


**Fig. 10. Drain-source on-state resistance as a function of drain current; typical values**



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

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



**Fig. 12. Gate-source voltage as a function of gate charge; typical values**



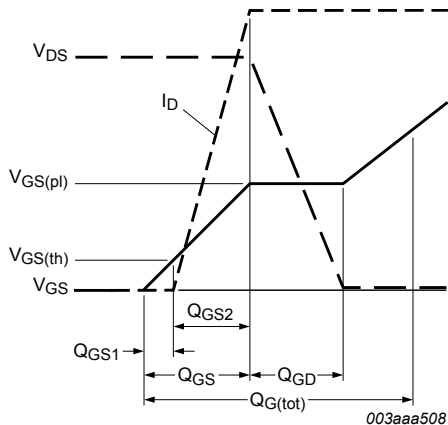
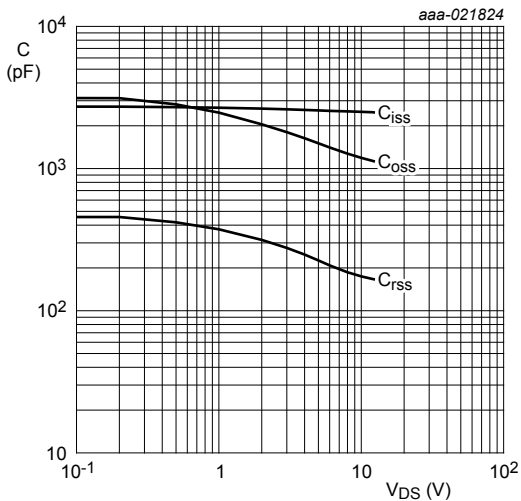
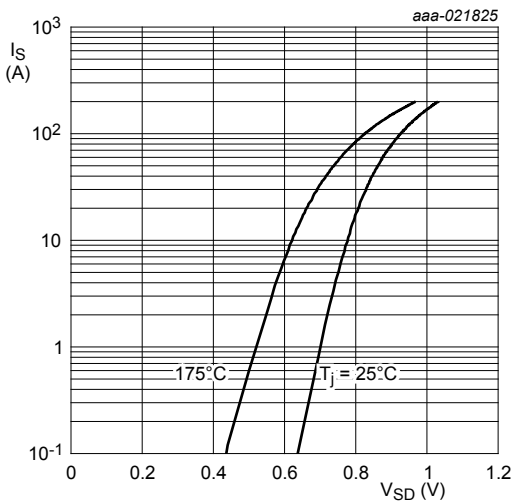


Fig. 13. Gate charge waveform definitions



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

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



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

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

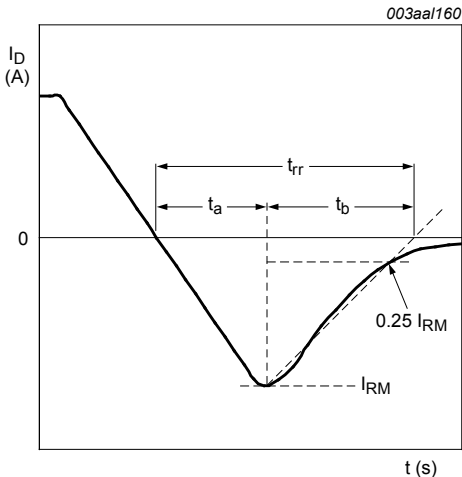


Fig. 16. Reverse recovery timing definition

11. Package outline

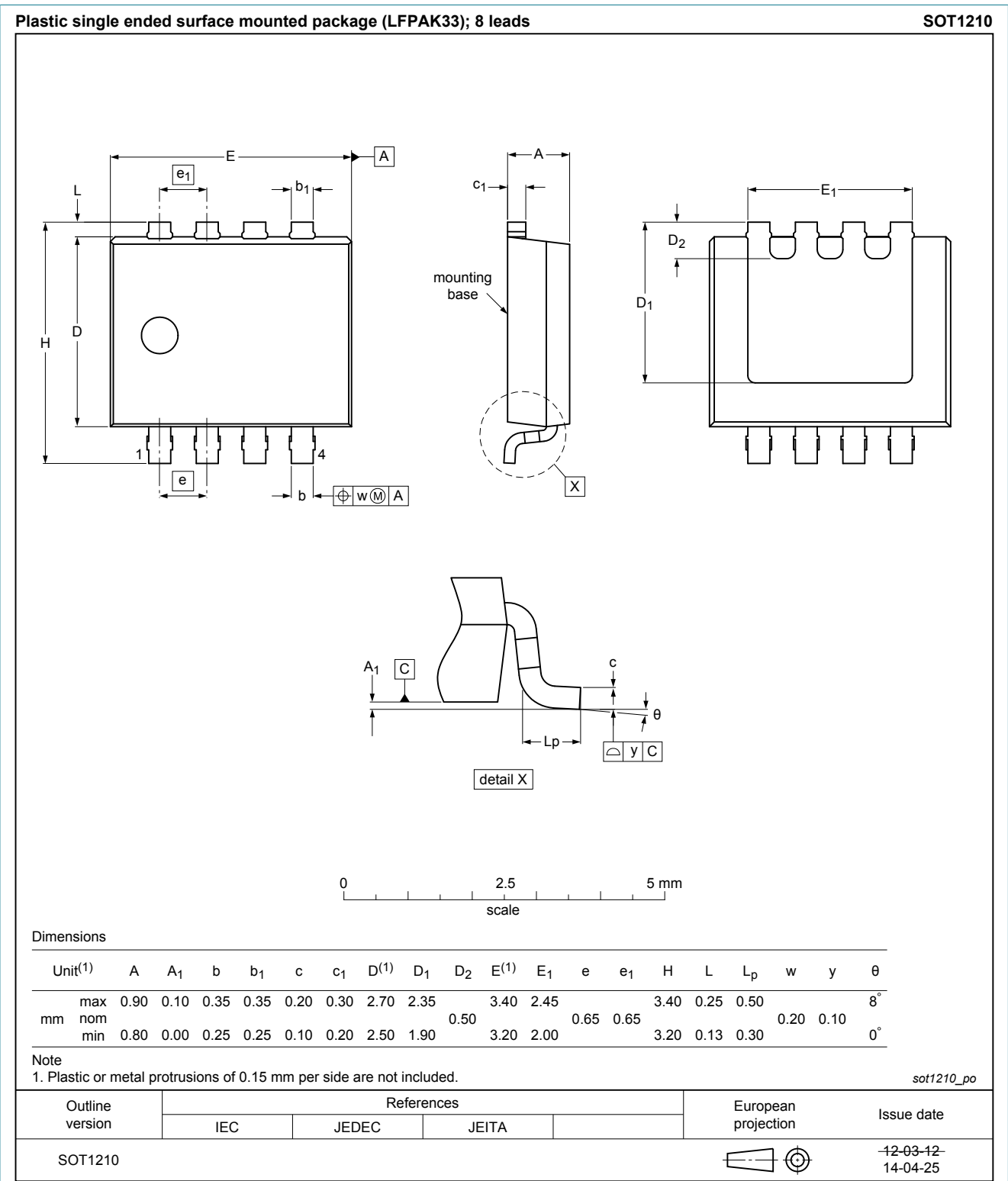


Fig. 17. Package outline LPAK33 (SOT1210)

## 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.                                     |

- [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.nexperia.com>.

### 12.2 Definitions

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For sales office addresses, please send an email to: [salesaddresses@nexperia.com](mailto:salesaddresses@nexperia.com)  
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Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: [ocean@oceanchips.ru](mailto:ocean@oceanchips.ru)

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А