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Kind regards,

Team Nexperia



# BUK9M7R2-40E

N-channel 40 V, 7.2 mΩ logic level MOSFET in LPAK33

19 September 2016

Product data sheet

## 1. General description

Logic level N-channel MOSFET in an LPAK33 (Power33) package using TrenchMOS technology. This product has been designed and qualified to AEC Q101 standard for use in high performance automotive applications.

## 2. Features and benefits

- Q101 compliant
- Repetitive avalanche rated
- Suitable for thermally demanding environments due to 175 °C rating
- True logic level gate with  $V_{GS(th)}$  rating of greater than 0.5 V at 175 °C

## 3. Applications

- 12 V automotive systems
- Motors, lamps and solenoid control
- Transmission control
- Ultra high performance power switching

## 4. Quick reference data

Table 1. Quick reference data

| Symbol                         | Parameter                        | Conditions  |     | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|---|-----|-----|-----|-----|------|
| $V_{DS}$                       | drain-source voltage             | $25\text{ °C} \leq T_j \leq 175\text{ °C}$  |     | -   | -   | 40  | V    |
| $I_D$                          | drain current                    | $V_{GS} = 5\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>  | [1] | -   | -   | 70  | A    |
| $P_{tot}$                      | total power dissipation          | $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>  |     | -   | -   | 79  | W    |
| <b>Static characteristics</b>  |                                  |   |     |     |     |     |      |
| $R_{DS(on)}$                   | drain-source on-state resistance | $V_{GS} = 5\text{ V}$ ; $I_D = 20\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 11</a>  |     | -   | 5.9 | 7.2 | mΩ   |
| <b>Dynamic characteristics</b> |                                  |   |     |     |     |     |      |
| $Q_{GD}$                       | gate-drain charge                | $I_D = 20\text{ A}$ ; $V_{DS} = 32\text{ V}$ ; $V_{GS} = 5\text{ V}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a> |     | -   | 7.4 | -   | nC   |

[1] Continuous current is limited by package

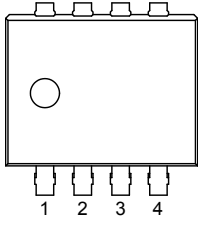
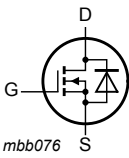


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## 5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description                       | Simplified outline  | Graphic symbol  |
|-----|--------|-----------------------------------|---|---|
| 1   | S      | Source                            | <br>LPAK33 (SOT1210) | <br>mbb076 |
| 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 |
| BUK9M7R2-40E | LPAK33  | Plastic single ended surface mounted package (LPAK33); 8 leads | SOT1210 |

## 7. Marking

Table 4. Marking codes

| Type number  | Marking code |
|--------------|--------------|
| BUK9M7R2-40E | 97E240       |

## 8. Limiting values

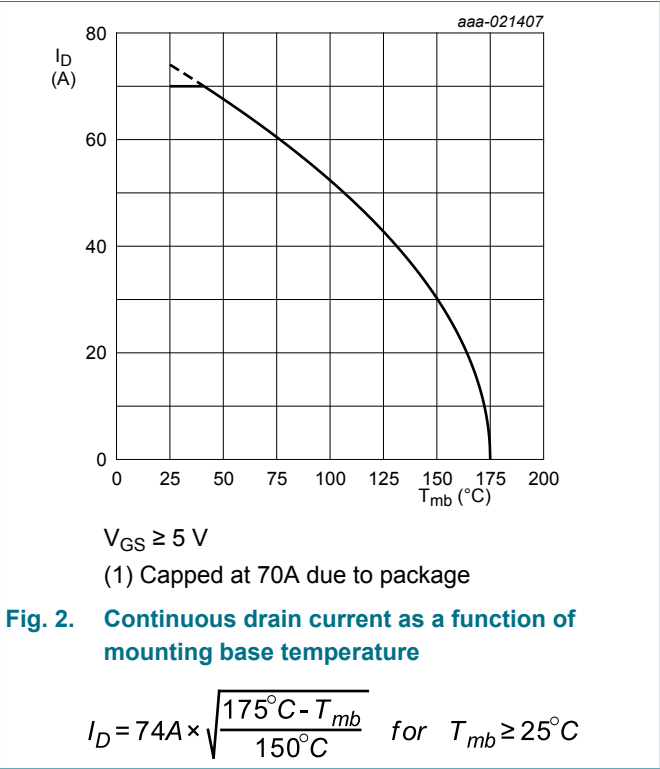
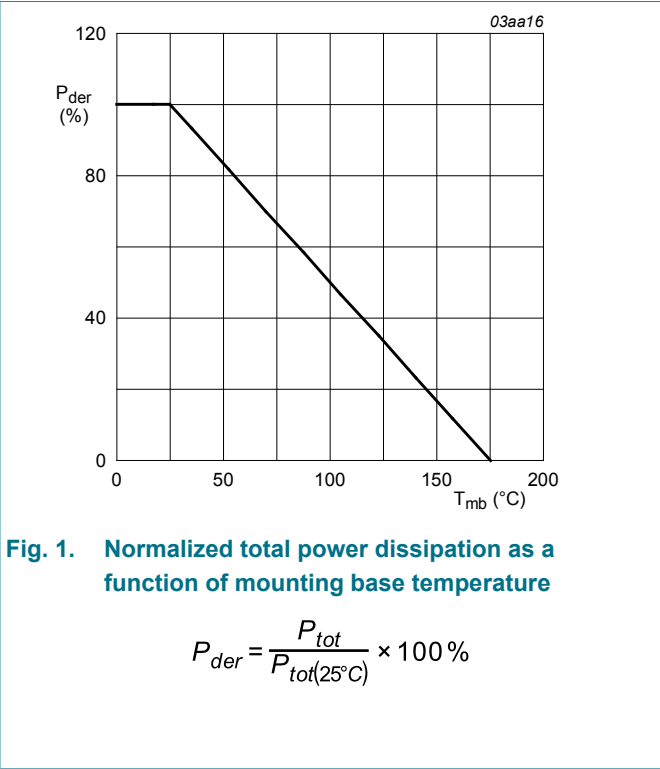
Table 5. Limiting values

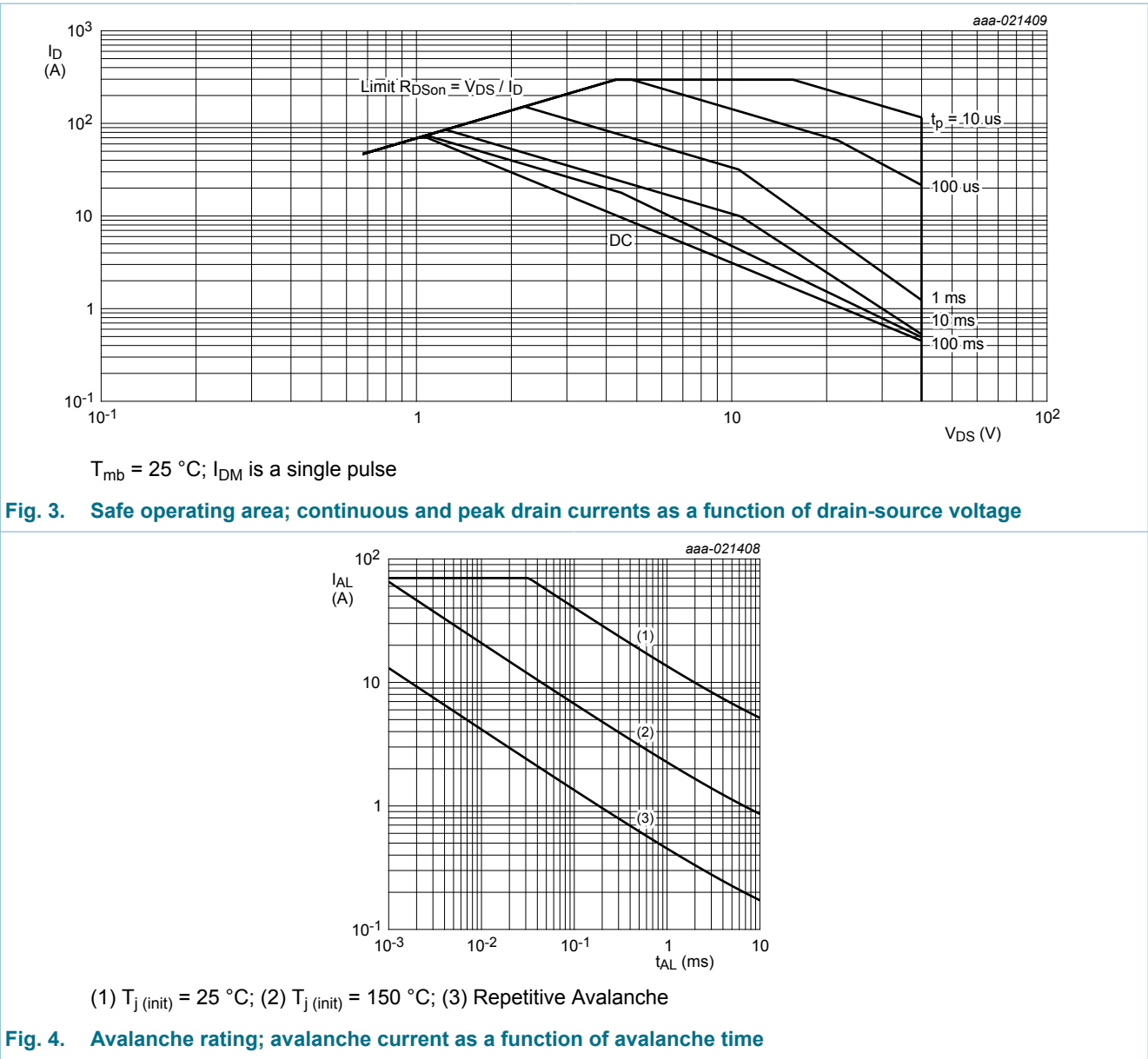
In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol    | Parameter               | Conditions  |        | Min | Max | Unit |
|-----------|-------------------------|---|--------|-----|-----|------|
| $V_{DS}$  | drain-source voltage    | $25\text{ °C} \leq T_j \leq 175\text{ °C}$                                  |        | -   | 40  | V    |
| $V_{DGR}$ | drain-gate voltage      | $R_{GS} = 20\text{ k}\Omega$  |        | -   | 40  | V    |
| $V_{GS}$  | gate-source voltage     | DC; $T_j \leq 175\text{ °C}$  |        | -10 | 10  | V    |
|           |                         | pulsed; $T_j \leq 175\text{ °C}$  | [1][2] | -15 | 15  | V    |
| $P_{tot}$ | total power dissipation | $T_{mb} = 25\text{ °C}$ ; Fig. 1  |        | -   | 79  | W    |
| $I_D$     | drain current           | $V_{GS} = 5\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; Fig. 2                    | [3]    | -   | 70  | A    |
|           |                         | $V_{GS} = 5\text{ V}$ ; $T_{mb} = 100\text{ °C}$ ; Fig. 2                   |        | -   | 52  | A    |
| $I_{DM}$  | peak drain current      | pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$ ; Fig. 3 |        | -   | 296 | A    |

| Symbol               | Parameter                                    | Conditions   |        | Min | Max  | Unit |
|----------------------|--|--|--------|-----|------|------|
| T <sub>stg</sub>     | storage temperature                          |  |        | -55 | 175  | °C   |
| T <sub>j</sub>       | junction temperature                         |  |        | -55 | 175  | °C   |
| Source-drain diode   |  |  |        |     |      |      |
| I <sub>S</sub>       | source current                               | T <sub>mb</sub> = 25 °C  | [3]    | -   | 66   | A    |
| I <sub>SM</sub>      | peak source current                          | pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C  |        | -   | 296  | A    |
| Avalanche ruggedness |  |  |        |     |      |      |
| E <sub>DS(AL)S</sub> | non-repetitive drain-source avalanche energy | I <sub>D</sub> = 70 A; V <sub>sup</sub> ≤ 40 V; R <sub>GS</sub> = 50 Ω;<br>V <sub>GS</sub> = 5 V; T <sub>j(init)</sub> = 25 °C; unclamped;<br><a href="#">Fig. 4</a> | [4][5] | -   | 58.8 | mJ   |

- [1] Accumulated pulse duration up to 50 hours delivers zero defect ppm.
- [2] Significantly longer life times are achieved by lowering T<sub>j</sub> and or V<sub>GS</sub>
- [3] Continuous current is limited by package
- [4] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
- [5] Refer to application note AN10273 for further information.





## 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. 5     | -   | 1.58 | 1.89 | K/W  |

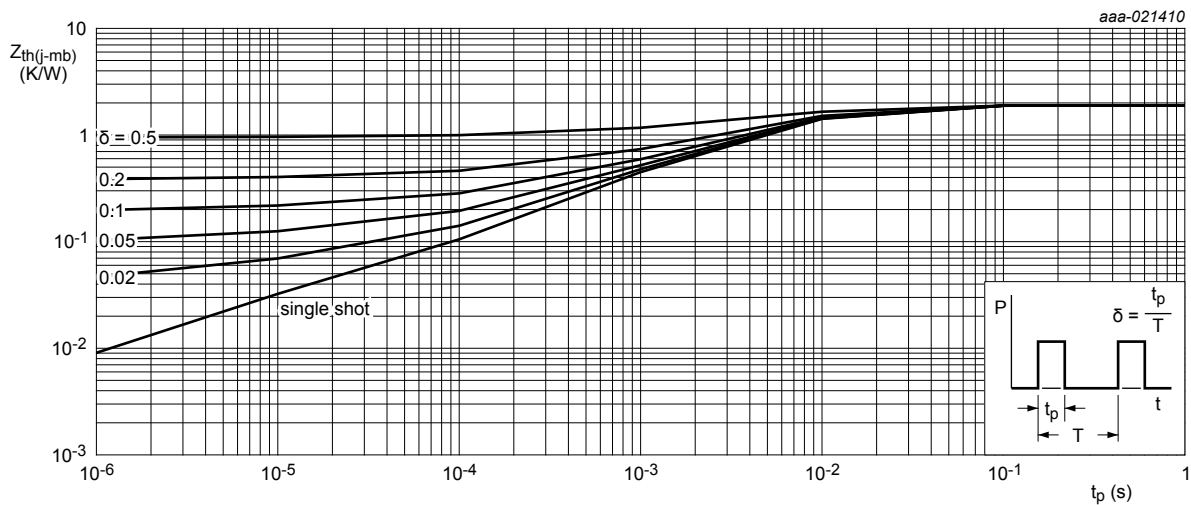


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 10. Characteristics

Table 7. Characteristics

| Symbol                  | Parameter                        | Conditions  |  | Min | Typ  | Max  | Unit       |
|-------------------------|----------------------------------|---|--|-----|------|------|------------|
| Static characteristics  |                                  |   |  |     |      |      |            |
| $V_{(BR)DSS}$           | drain-source breakdown voltage   | $I_D = 250\ \mu A$ ; $V_{GS} = 0\ V$ ; $T_j = 25\ ^\circ C$   |  | 40  | -    | -    | V          |
|                         |                                  | $I_D = 250\ \mu A$ ; $V_{GS} = 0\ V$ ; $T_j = -55\ ^\circ C$  |  | 36  | -    | -    | V          |
| $V_{GS(th)}$            | gate-source threshold voltage    | $I_D = 1\ mA$ ; $V_{DS} = V_{GS}$ ; $T_j = 25\ ^\circ C$ ; <a href="#">Fig. 9</a> ; <a href="#">Fig. 10</a>                   |  | 1.4 | 1.7  | 2.1  | V          |
|                         |                                  | $I_D = 1\ mA$ ; $V_{DS} = V_{GS}$ ; $T_j = -55\ ^\circ C$ ; <a href="#">Fig. 10</a>   |  | -   | -    | 2.45 | V          |
|                         |                                  | $I_D = 1\ mA$ ; $V_{DS} = V_{GS}$ ; $T_j = 175\ ^\circ C$ ; <a href="#">Fig. 10</a>   |  | 0.5 | -    | -    | V          |
| $I_{DSS}$               | drain leakage current            | $V_{DS} = 40\ V$ ; $V_{GS} = 0\ V$ ; $T_j = 25\ ^\circ C$   |  | -   | 0.01 | 1    | $\mu A$    |
|                         |                                  | $V_{DS} = 40\ V$ ; $V_{GS} = 0\ V$ ; $T_j = 175\ ^\circ C$  |  | -   | -    | 500  | $\mu A$    |
| $I_{GSS}$               | gate leakage current             | $V_{GS} = 10\ V$ ; $V_{DS} = 0\ V$ ; $T_j = 25\ ^\circ C$   |  | -   | 2    | 100  | nA         |
|                         |                                  | $V_{GS} = -10\ V$ ; $V_{DS} = 0\ V$ ; $T_j = 25\ ^\circ C$  |  | -   | 2    | 100  | nA         |
| $R_{DSon}$              | drain-source on-state resistance | $V_{GS} = 5\ V$ ; $I_D = 20\ A$ ; $T_j = 25\ ^\circ C$ ; <a href="#">Fig. 11</a>  |  | -   | 5.9  | 7.2  | m $\Omega$ |
|                         |                                  | $V_{GS} = 10\ V$ ; $I_D = 20\ A$ ; $T_j = 25\ ^\circ C$ ; <a href="#">Fig. 11</a>   |  | -   | 4.7  | 5.8  | m $\Omega$ |
|                         |                                  | $V_{GS} = 5\ V$ ; $I_D = 20\ A$ ; $T_j = 175\ ^\circ C$ ; <a href="#">Fig. 12</a>   |  | -   | -    | 14.5 | m $\Omega$ |
| Dynamic characteristics |                                  |   |  |     |      |      |            |
| $Q_{G(tot)}$            | total gate charge                | $I_D = 20\ A$ ; $V_{DS} = 32\ V$ ; $V_{GS} = 5\ V$ ; $T_j = 25\ ^\circ C$ ; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a> |  | -   | 19.7 | -    | nC         |
| $Q_{GS}$                | gate-source charge               |   |  | -   | 5    | -    | nC         |

| Symbol              | Parameter                    | Conditions   |   | Min | Typ  | Max  | Unit |
|---------------------|------------------------------|--|---|-----|------|------|------|
| Q <sub>GD</sub>     | gate-drain charge            |  |   | -   | 7.4  | -    | nC   |
| C <sub>iss</sub>    | input capacitance            | V <sub>DS</sub> = 25 V; V <sub>GS</sub> = 0 V; f = 1 MHz;<br>T <sub>j</sub> = 25 °C; <a href="#">Fig. 15</a>                     |   | -   | 1930 | 2567 | pF   |
| C <sub>oss</sub>    | output capacitance           |  |   | -   | 263  | 315  | pF   |
| C <sub>rss</sub>    | reverse transfer capacitance |  |   | -   | 133  | 183  | pF   |
| t <sub>d(on)</sub>  | turn-on delay time           |  | V <sub>DS</sub> = 30 V; R <sub>L</sub> = 1.5 Ω; V <sub>GS</sub> = 5 V;<br>R <sub>G(ext)</sub> = 5 Ω; T <sub>j</sub> = 25 °C |     | -    | 13.8 | -    |
| t <sub>r</sub>      | rise time                    |  |   | -   | 28.5 | -    | ns   |
| t <sub>d(off)</sub> | turn-off delay time          |  |   | -   | 29.9 | -    | ns   |
| t <sub>f</sub>      | fall time                    |  |   | -   | 22   | -    | ns   |
| Source-drain diode  |                              |  |   |     |      |      |      |
| V <sub>SD</sub>     | source-drain voltage         | I <sub>S</sub> = 20 A; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C; <a href="#">Fig. 16</a>                                    |   | -   | 0.83 | 1.2  | V    |
| t <sub>rr</sub>     | reverse recovery time        | I <sub>S</sub> = 20 A; dI <sub>S</sub> /dt = -100 A/μs; V <sub>GS</sub> = 0 V;<br>V <sub>DS</sub> = 25 V; T <sub>j</sub> = 25 °C |   | -   | 18.1 | -    | ns   |
| Q <sub>r</sub>      | recovered charge             |  |   | -   | 9.1  | -    | nC   |

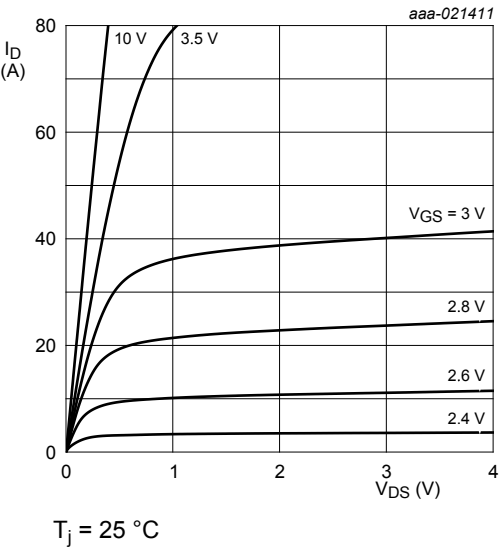


Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values

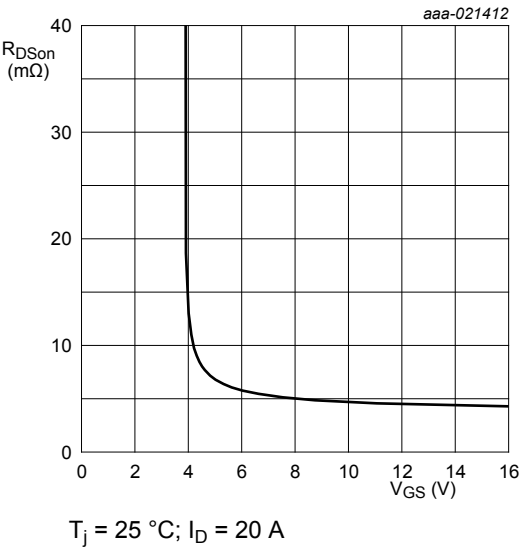


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

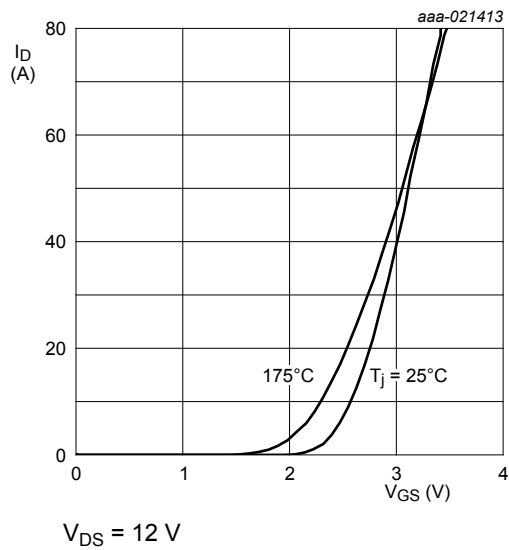


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

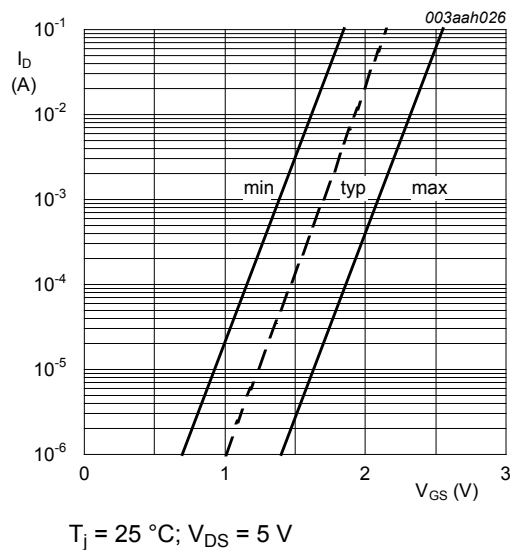


Fig. 9. Sub-threshold drain current as a function of gate-source voltage

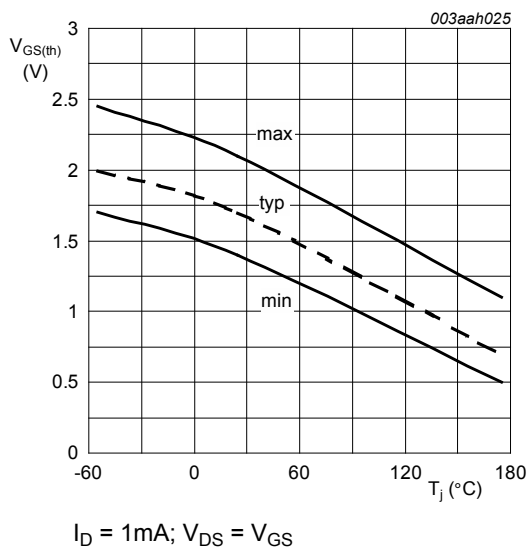


Fig. 10. Gate-source threshold voltage as a function of junction temperature

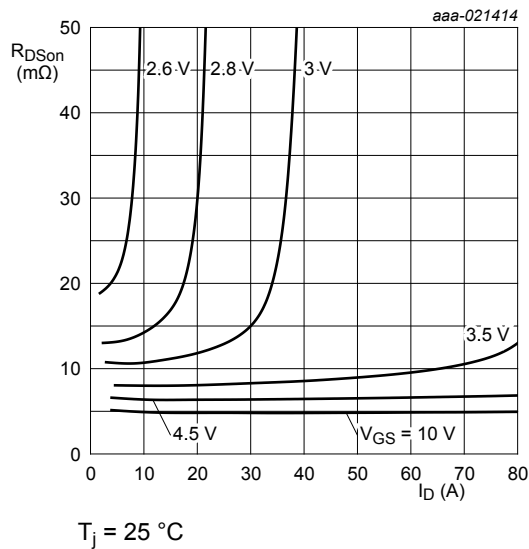


Fig. 11. Drain-source on-state resistance as a function of drain current; typical values



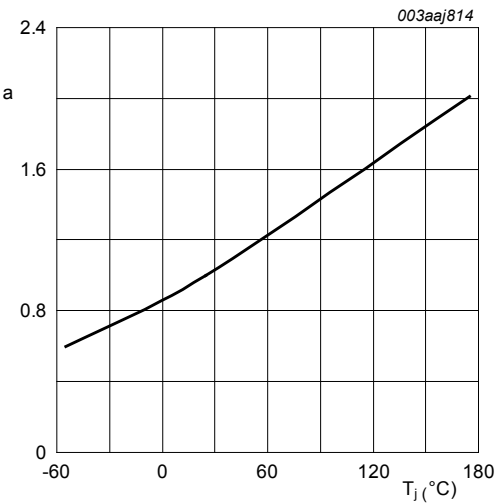
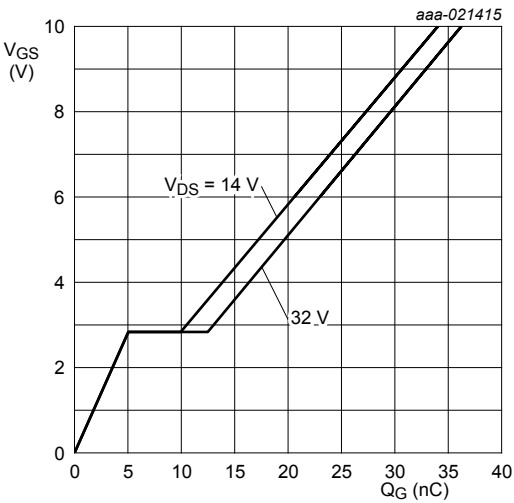


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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



$T_j = 25^{\circ}\text{C}; I_D = 20\text{ A}$

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

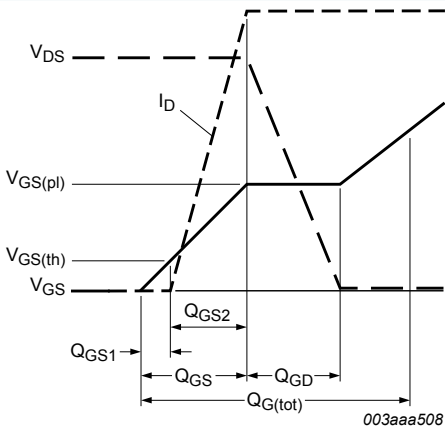
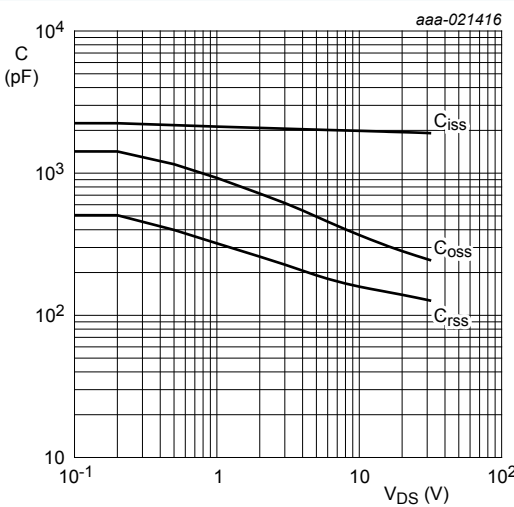
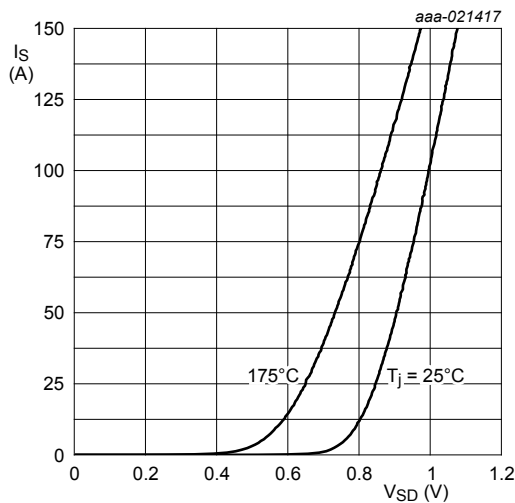


Fig. 14. Gate charge waveform definitions



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

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



$V_{GS} = 0$  V

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

## 11. Application information

For guidance on how to use and understand this datasheet, please refer to application note [AN11158](#) "Understanding power MOSFET datasheet parameters".

12. Package outline

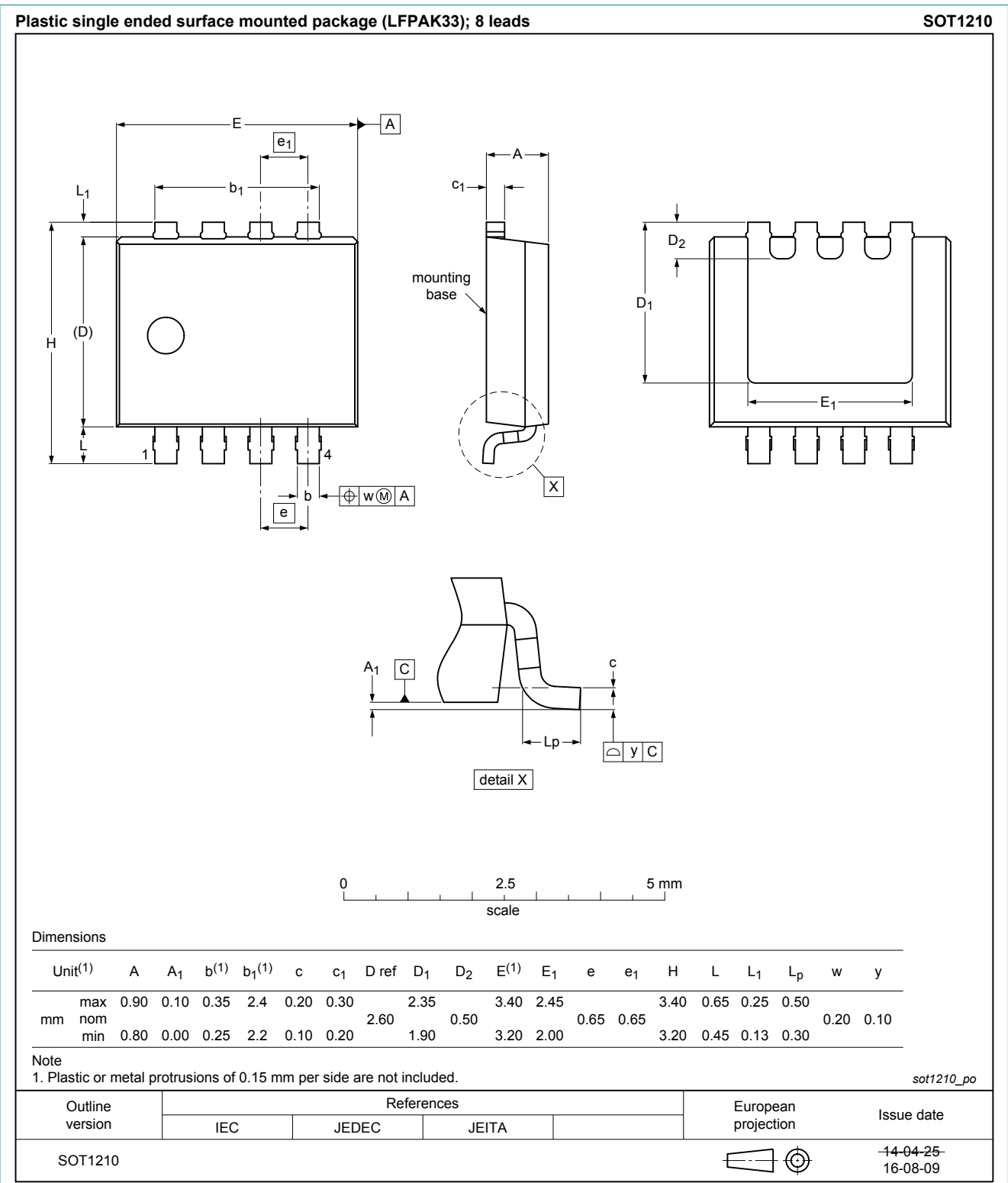


Fig. 17. Package outline LPAK33 (SOT1210)

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### 13.1 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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