



BUK7M21-40E

N-channel 40 V, 21 mΩ standard level MOSFET in LFPAK33

19 September 2016

Product data sheet

1. General description

Standard level N-channel MOSFET in an LFPAK33 (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 standard level gate with $V_{GS(th)}$ rating of greater than 1 V at 175 °C

3. Applications

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

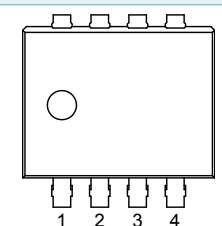
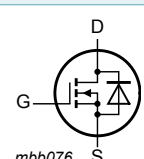
4. Quick reference data

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 | $V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2 | - | - | 33 | A |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C}$; Fig. 1 | - | - | 44 | W |
| Static characteristics | | | | | | |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = 10\text{ V}$; $I_D = 10\text{ A}$; $T_j = 25\text{ °C}$; Fig. 11 | - | 17 | 21 | mΩ |
| Dynamic characteristics | | | | | | |
| Q_{GD} | gate-drain charge | $I_D = 10\text{ A}$; $V_{DS} = 32\text{ V}$; $V_{GS} = 10\text{ V}$; $T_j = 25\text{ °C}$; Fig. 13 ; Fig. 14 | - | 3.8 | - | nC |

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|-----|--------|-----------------------------------|---|---|
| 1 | S | Source |  <p>LFAK33 (SOT1210)</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 |
| BUK7M21-40E | LFAK33 | Plastic single ended surface mounted package (LFAK33); 8 leads | SOT1210 |

7. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| BUK7M21-40E | 72140E |

8. Limiting values

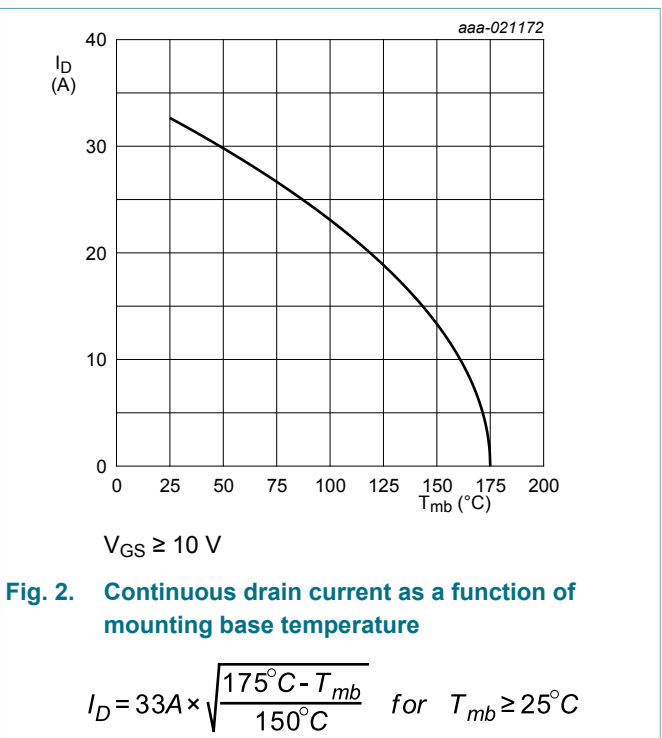
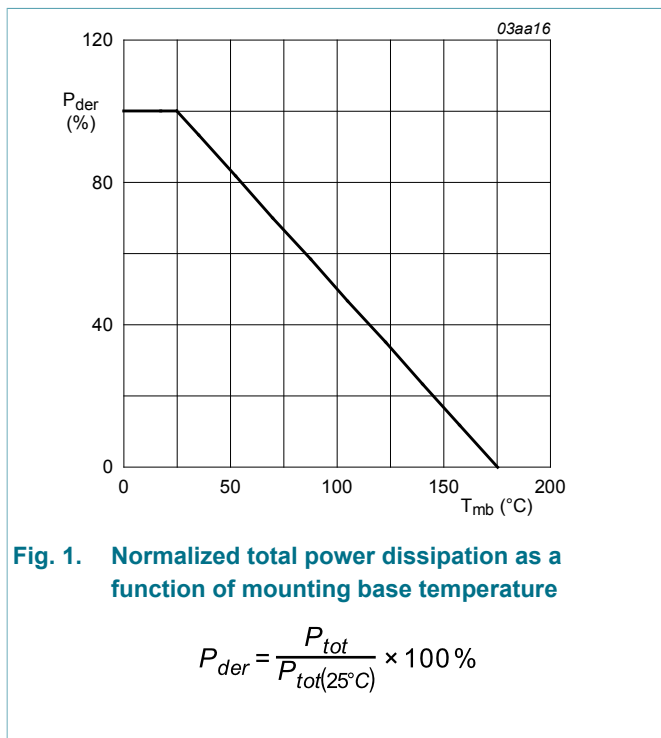
Table 5. Limiting values

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; $T_j \leq 175\text{ °C}$ | -20 | 20 | V |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C}$; Fig. 1 | - | 44 | W |
| I_D | drain current | $V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2 | - | 33 | A |
| | | $V_{GS} = 10\text{ V}$; $T_{mb} = 100\text{ °C}$; Fig. 2 | - | 23.1 | A |
| I_{DM} | peak drain current | pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$; Fig. 3 | - | 131 | A |
| T_{stg} | storage temperature | | -55 | 175 | °C |

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------------------------|--|---|--------|-----|---------|
| T _j | junction temperature | | -55 | 175 | °C |
| Source-drain diode | | | | | |
| I _S | source current | T _{mb} = 25 °C | - | 33 | A |
| I _{SM} | peak source current | pulsed; t _p ≤ 10 μs; T _{mb} = 25 °C | - | 131 | A |
| Avalanche ruggedness | | | | | |
| E _{DS(AL)S} | non-repetitive drain-source avalanche energy | I _D = 33 A; V _{sup} ≤ 40 V; R _{GS} = 50 Ω; V _{GS} = 10 V; T _{j(init)} = 25 °C; unclamped; Fig. 4 | [1][2] | - | 11.6 mJ |

- [1] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
- [2] Refer to application note AN10273 for further information.



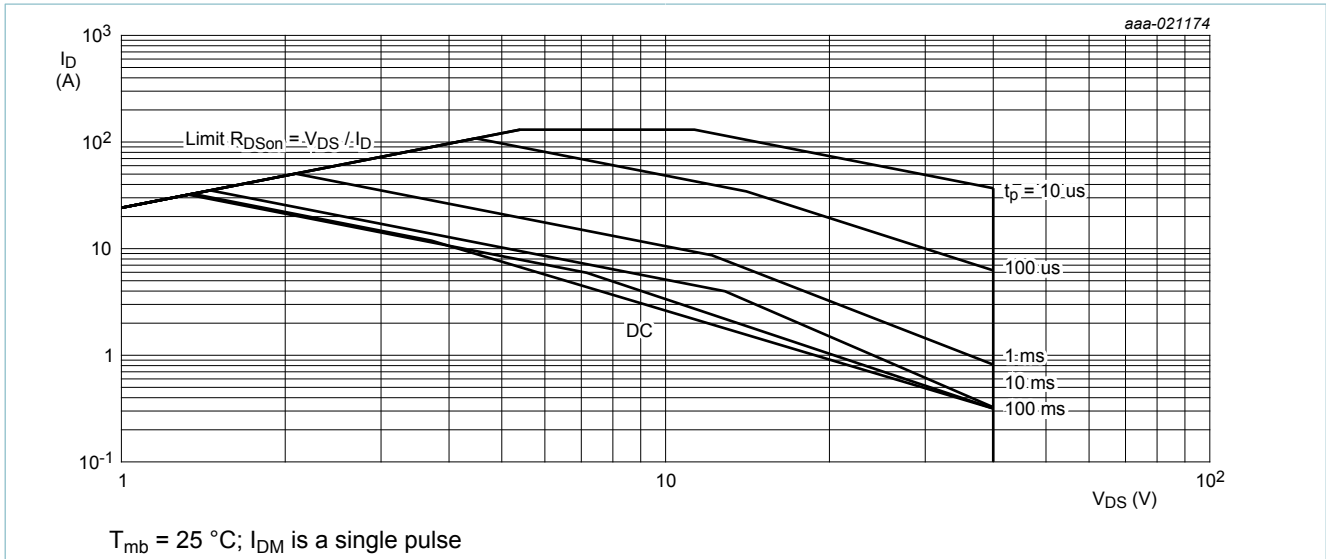


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

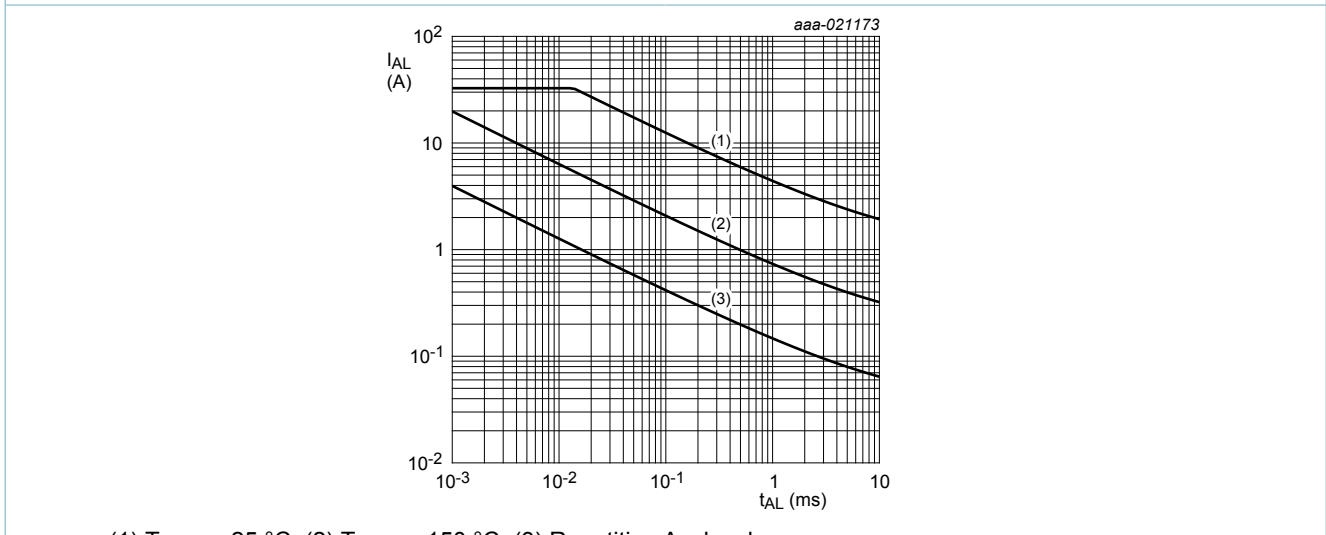


Fig. 4. Avalanche rating; avalanche current as a function of avalanche time

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 | - | 2.77 | 3.4 | K/W |

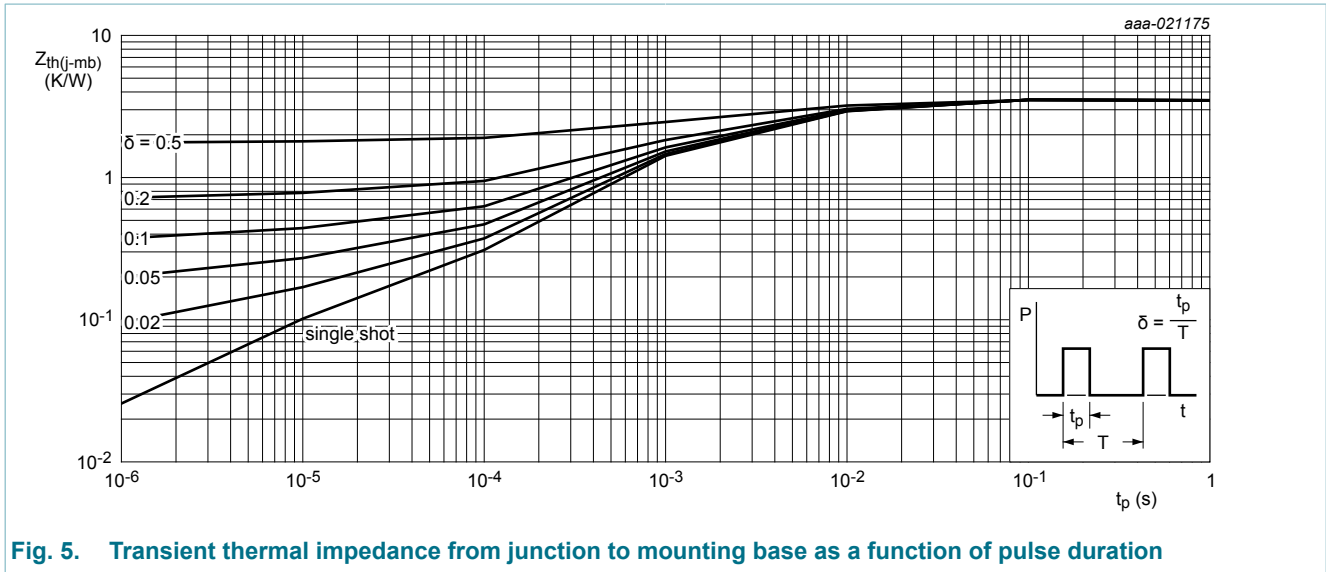


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Characteristics

Table 7. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|--|-----|------|-----|---------|
| Static characteristics | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$ | 40 | - | - | V |
| | | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$ | 36 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C;$ Fig. 9; Fig. 10 | 2.4 | 3 | 4 | V |
| | | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ C;$ Fig. 9 | - | - | 4.5 | V |
| | | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ C;$ Fig. 9 | 1 | - | - | V |
| I_{DSS} | drain leakage current | $V_{DS} = 40 V; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$ | - | 0.01 | 1 | μA |
| | | $V_{DS} = 40 V; V_{GS} = 0 V; T_j = 175 \text{ }^\circ C$ | - | - | 500 | μA |
| I_{GSS} | gate leakage current | $V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$ | - | 2 | 100 | nA |
| | | $V_{GS} = -20 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$ | - | 2 | 100 | nA |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = 10 V; I_D = 10 A; T_j = 25 \text{ }^\circ C;$ Fig. 11 | - | 17 | 21 | mΩ |
| | | $V_{GS} = 10 V; I_D = 10 A; T_j = 175 \text{ }^\circ C;$ Fig. 12 | - | - | 41 | mΩ |
| Dynamic characteristics | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D = 10 A; V_{DS} = 32 V; V_{GS} = 10 V;$ $T_j = 25 \text{ }^\circ C;$ Fig. 13; Fig. 14 | - | 10.7 | - | nC |
| Q_{GS} | gate-source charge | | - | 2.5 | - | nC |
| Q_{GD} | gate-drain charge | | - | 3.8 | - | nC |

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------------|------------------------------|---|-----|------|-----|------|
| C_{iss} | input capacitance | $V_{DS} = 25\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz}; T_j = 25\text{ }^\circ\text{C};$ Fig. 15 | - | 446 | 593 | pF |
| C_{oss} | output capacitance | | - | 99 | 119 | pF |
| C_{rss} | reverse transfer capacitance | | - | 70 | 95 | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = 20\text{ V}; R_L = 3.5\text{ }\Omega; V_{GS} = 10\text{ V}; R_{G(ext)} = 5\text{ }\Omega; T_j = 25\text{ }^\circ\text{C}$ | - | 4.1 | - | ns |
| t_r | rise time | | - | 3.8 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 9.1 | - | ns |
| t_f | fall time | | - | 3.8 | - | ns |
| Source-drain diode | | | | | | |
| V_{SD} | source-drain voltage | $I_S = 10\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C};$ Fig. 16 | - | 0.87 | 1.2 | V |
| t_{rr} | reverse recovery time | $I_S = 10\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}; T_j = 25\text{ }^\circ\text{C}$ | - | 12.6 | - | ns |
| Q_r | recovered charge | | - | 5.8 | - | nC |

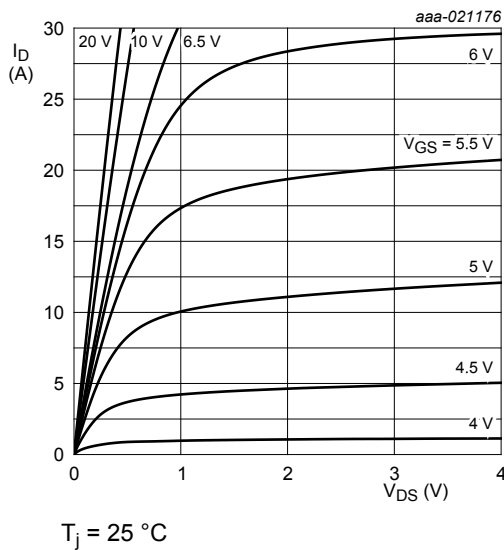


Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values

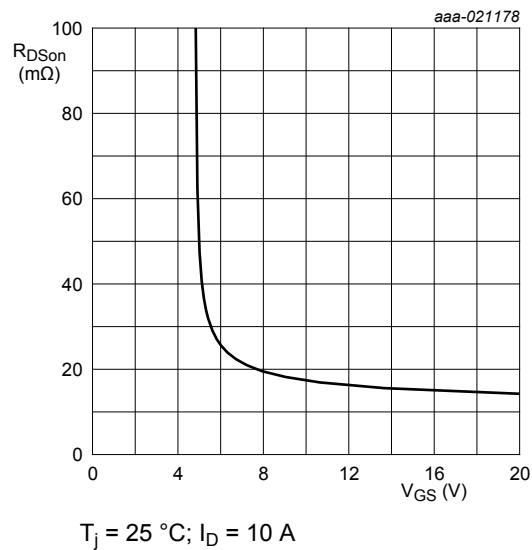


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

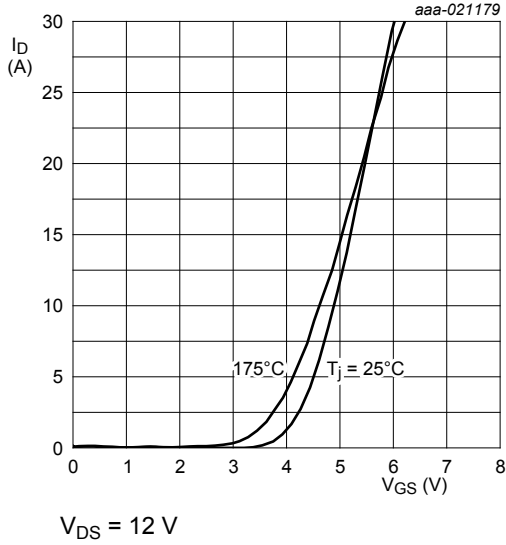


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

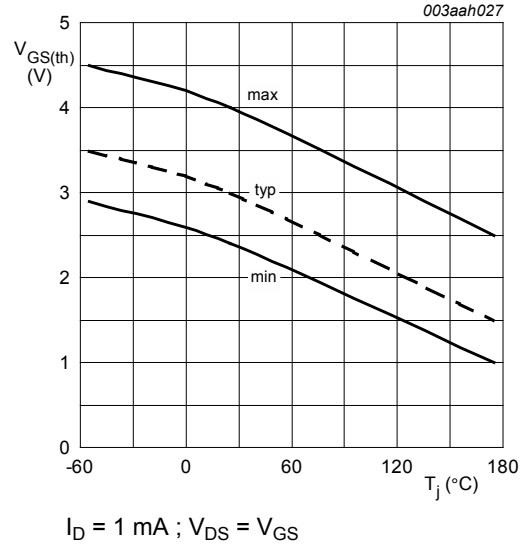


Fig. 9. Gate-source threshold voltage as a function of junction temperature

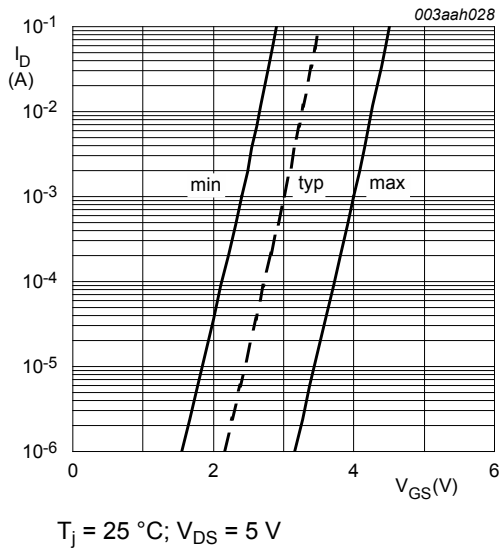


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

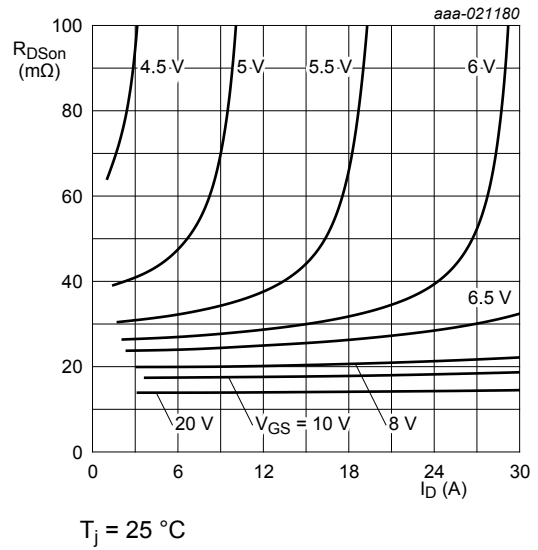


Fig. 11. Drain-source on-state resistance as a function of drain current; typical values

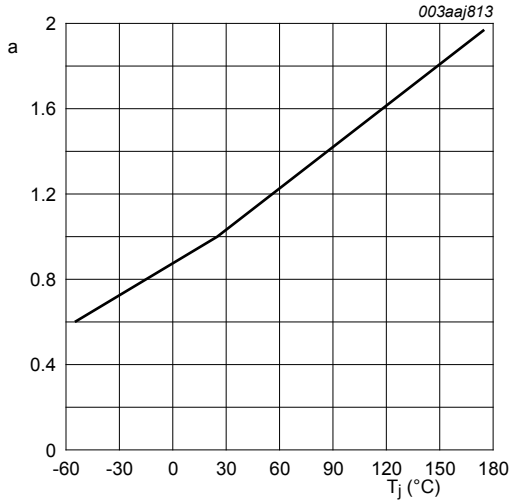
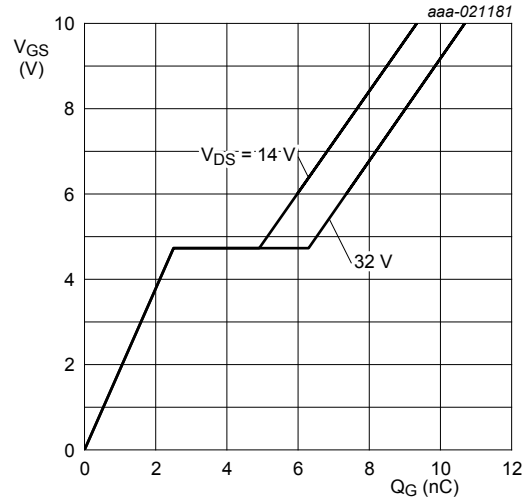


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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



$T_j = 25^{\circ}\text{C}; I_D = 10\text{ A}$

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

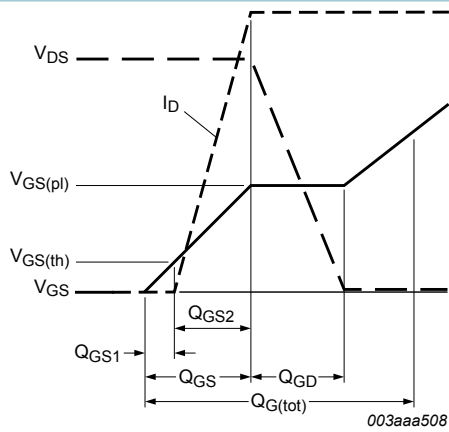
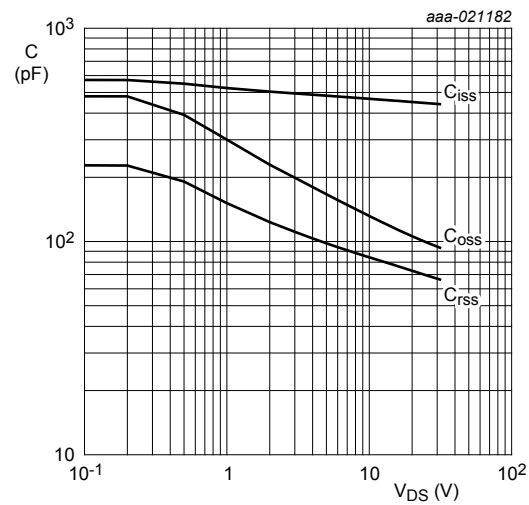
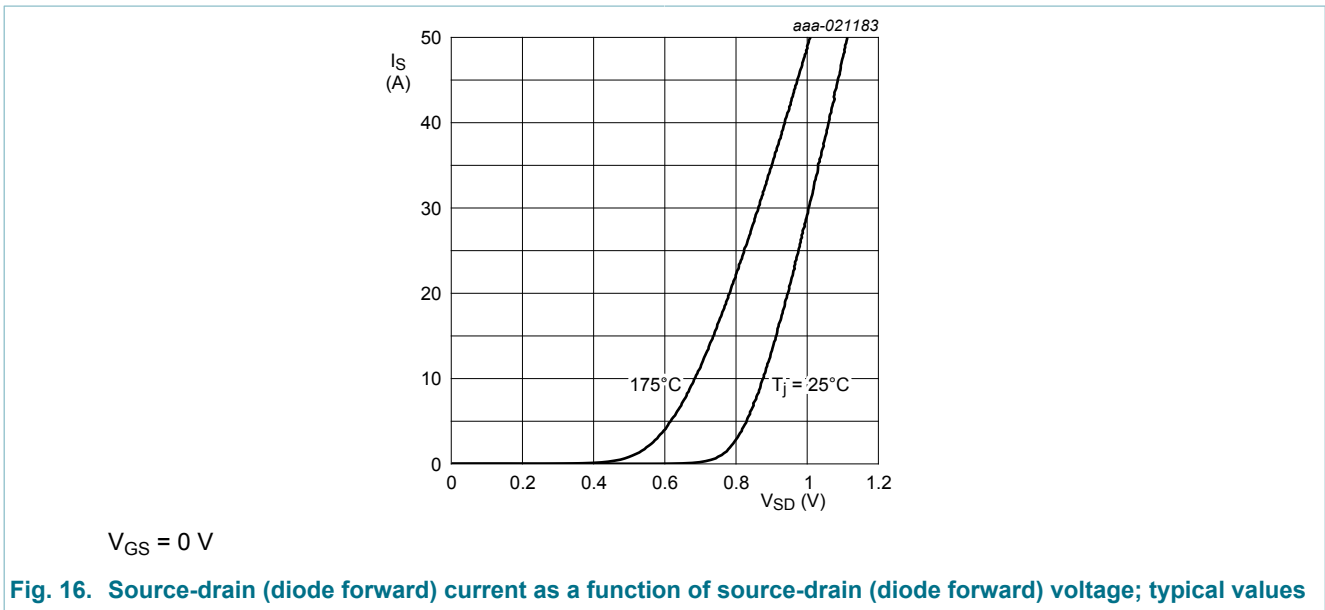


Fig. 14. Gate charge waveform definitions



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

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



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 LFAK33 (SOT1210)

13. Legal information

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. |
| 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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