



BUK7M4R3-40H

N-channel 40 V, 4.3 mΩ standard level MOSFET in LFPAK33

13 March 2020

Product data sheet

1. General description

Automotive qualified standard level N-channel MOSFET in an LFPAK33 package using Trench 9 TrenchMOS technology. This product has been designed and qualified to AEC-Q101 for use in high performance automotive applications.

2. Features and benefits

- Fully automotive qualified to AEC-Q101 at 175 °C
- Trench 9 superjunction technology:
 - Low power losses, high power density
- LFPAK copper clip package technology:
 - High robustness and reliability
 - Gull wing leads for high manufacturability and AOI
- Repetitive avalanche rated

3. Applications

- 12 V automotive systems
- Powertrain, chassis, body and infotainment applications
- Medium/Low power motor drive
- DC-DC systems
- LED lighting

4. Quick reference data

Table 1. Quick reference data

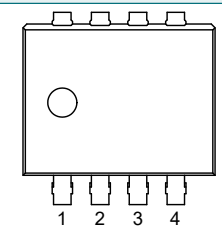
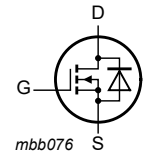
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|--------------------------------|----------------------------------|---|-----|-----|-----|-----|------|
| V_{DS} | drain-source voltage | $25\text{ °C} \leq T_j \leq 175\text{ °C}$ | | - | - | 40 | V |
| I_D | drain current | $V_{GS} = 10\text{ V}; T_{mb} = 25\text{ °C};$ Fig. 2 | [1] | - | - | 95 | A |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C};$ Fig. 1 | | - | - | 90 | W |
| Static characteristics | | | | | | | |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = 10\text{ V}; I_D = 25\text{ A}; T_j = 25\text{ °C};$ Fig. 11 | | 2.4 | 3.5 | 4.3 | mΩ |
| Dynamic characteristics | | | | | | | |
| Q_{GD} | gate-drain charge | $I_D = 25\text{ A}; V_{DS} = 32\text{ V}; V_{GS} = 10\text{ V};$ Fig. 13; Fig. 14 | | - | 5 | 10 | nC |
| Source-drain diode | | | | | | | |
| Q_r | recovered charge | $I_S = 25\text{ A}; dI_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 20\text{ V}$ | | - | 20 | - | nC |

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------|-----------------|---|-----|------|-----|------|
| S | softness factor | $I_S = 25\text{ A}$; $di_S/dt = -100\text{ A}/\mu\text{s}$; $V_{GS} = 0\text{ V}$; $V_{DS} = 20\text{ V}$; $T_j = 25\text{ °C}$; Fig. 17 | - | 0.66 | - | |

[1] 95A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.

5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|-----|--------|-----------------------------------|--|---|
| 1 | S | source |  <p>LFPAK33 (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 |
| BUK7M4R3-40H | LFPAK33 | Plastic, single ended surface mounted package (LFPAK33); 8 leads; 0.65 mm pitch | SOT1210 |

7. Marking

Table 4. Marking codes

| Type number | Marking code |
|--------------|--------------|
| BUK7M4R3-40H | 74H340 |

8. Limiting values

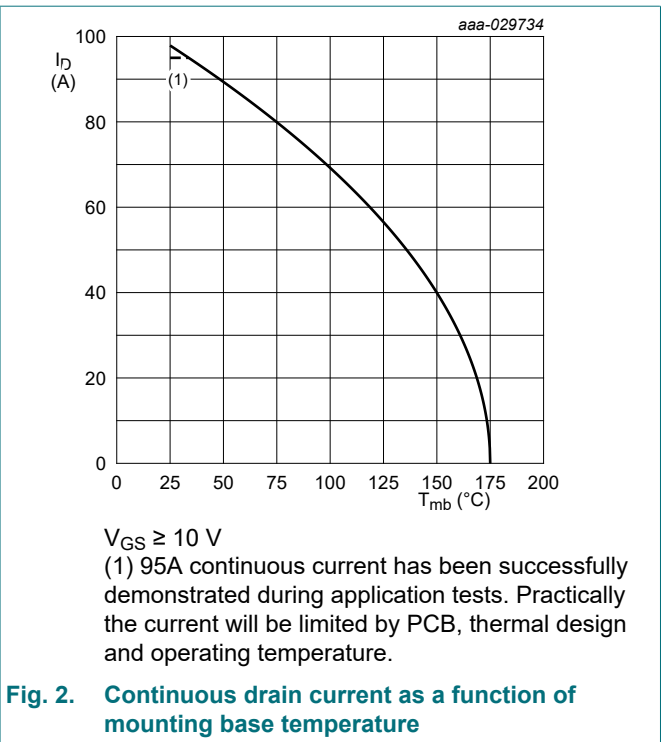
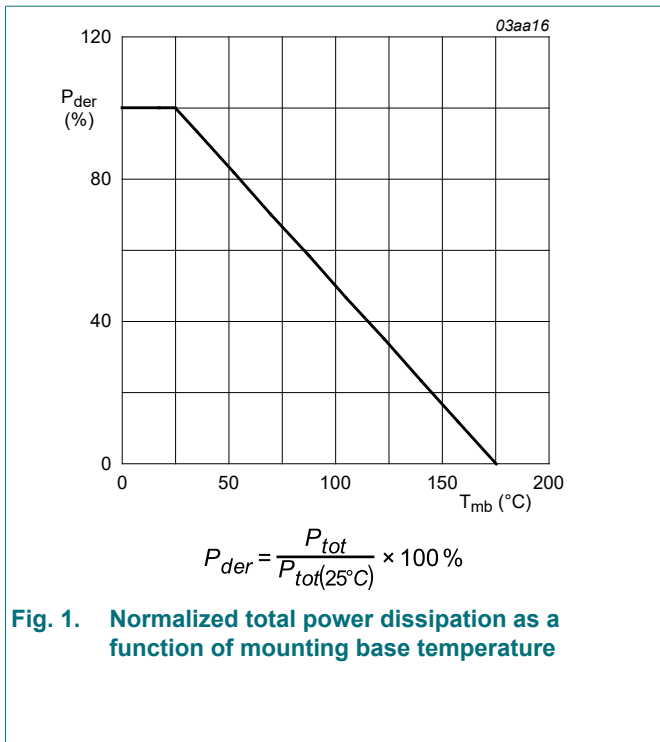
Table 5. Limiting values

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_{GS} | gate-source voltage | DC; $T_j = 175\text{ °C}$ | -10 | 20 | V |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C}$; Fig. 1 | - | 90 | W |
| I_D | drain current | $V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2 | [1] | 95 | A |
| | | $V_{GS} = 10\text{ V}$; $T_{mb} = 100\text{ °C}$; Fig. 2 | - | 69 | A |
| I_{DM} | peak drain current | pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$; Fig. 3 | - | 392 | A |
| T_{stg} | storage temperature | | -55 | 175 | °C |
| T_j | junction temperature | | -55 | 175 | °C |

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------------------------|--|---|-------------|-----|------|
| Source-drain diode | | | | | |
| I_S | source current | $T_{mb} = 25\text{ °C}$ | - | 95 | A |
| I_{SM} | peak source current | pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$ | - | 392 | A |
| Avalanche ruggedness | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D = 70\text{ A}$; $V_{sup} \leq 40\text{ V}$; $R_{GS} = 50\text{ }\Omega$; $V_{GS} = 10\text{ V}$; $T_{j(\text{init})} = 25\text{ °C}$; unclamped; Fig. 4 | [2] [3] [4] | 44 | mJ |
| I_{AS} | non-repetitive avalanche current | $V_{sup} \leq 40\text{ V}$; $V_{GS} = 10\text{ V}$; $T_{j(\text{init})} = 25\text{ °C}$; $R_{GS} = 50\text{ }\Omega$ | [4] | 70 | A |

- [1] 95A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.
- [2] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
- [3] Refer to application note AN10273 for further information.
- [4] Protected by 100% test.



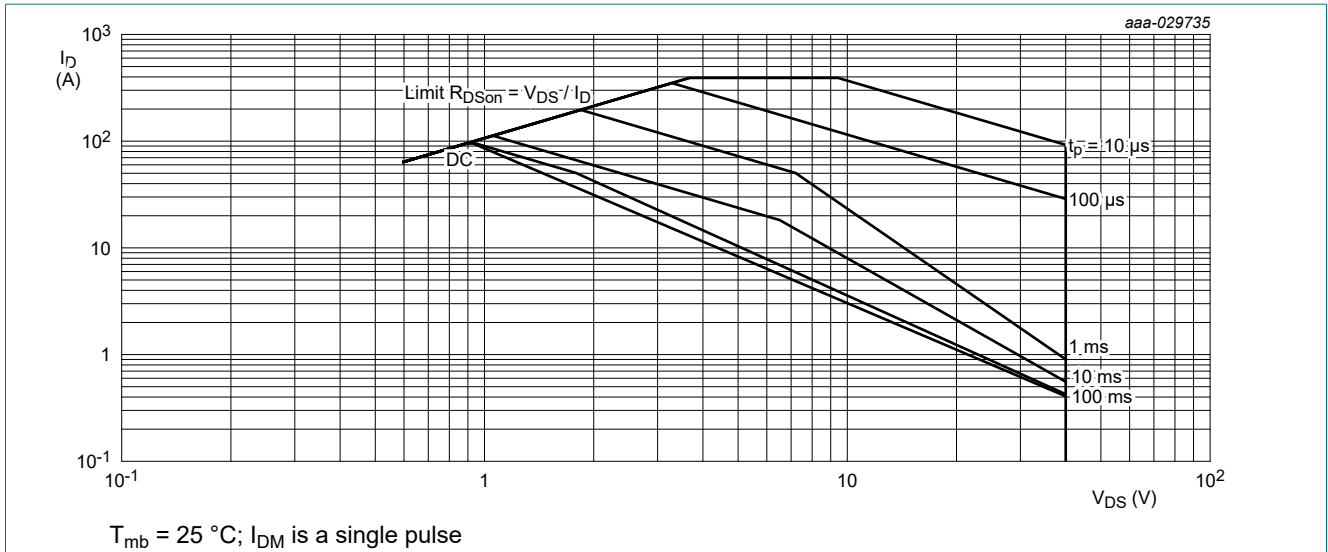


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

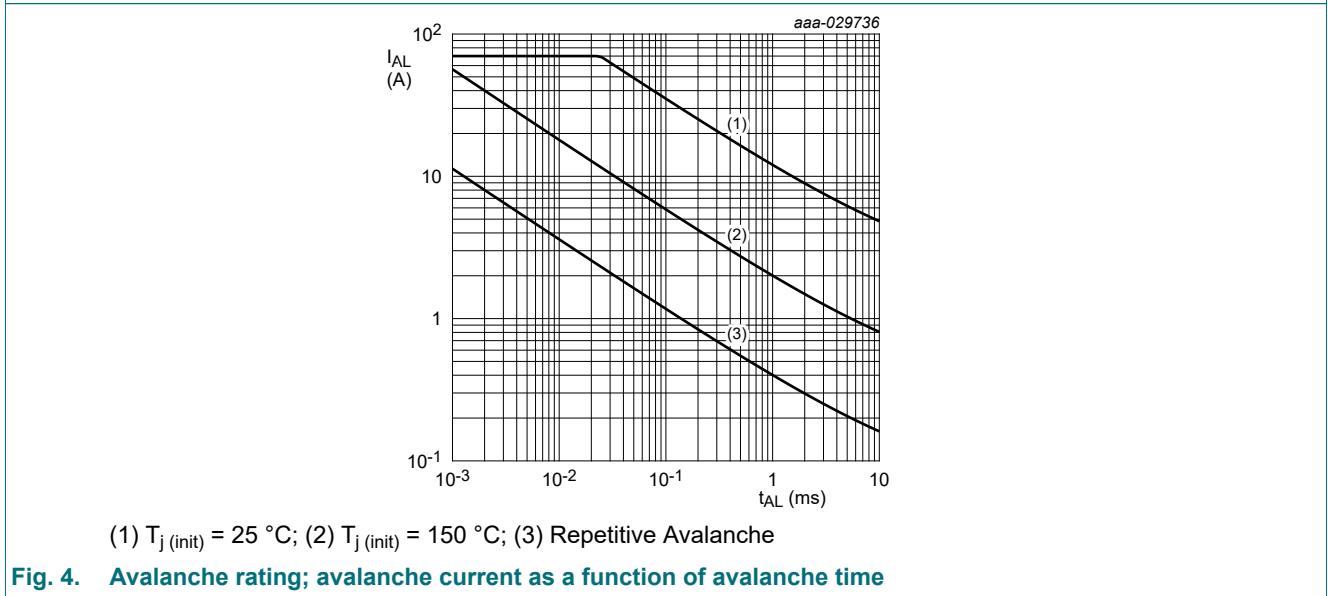


Fig. 4. Avalanche rating; avalanche current as a function of avalanche time

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 | - | 1.48 | 1.67 | K/W |

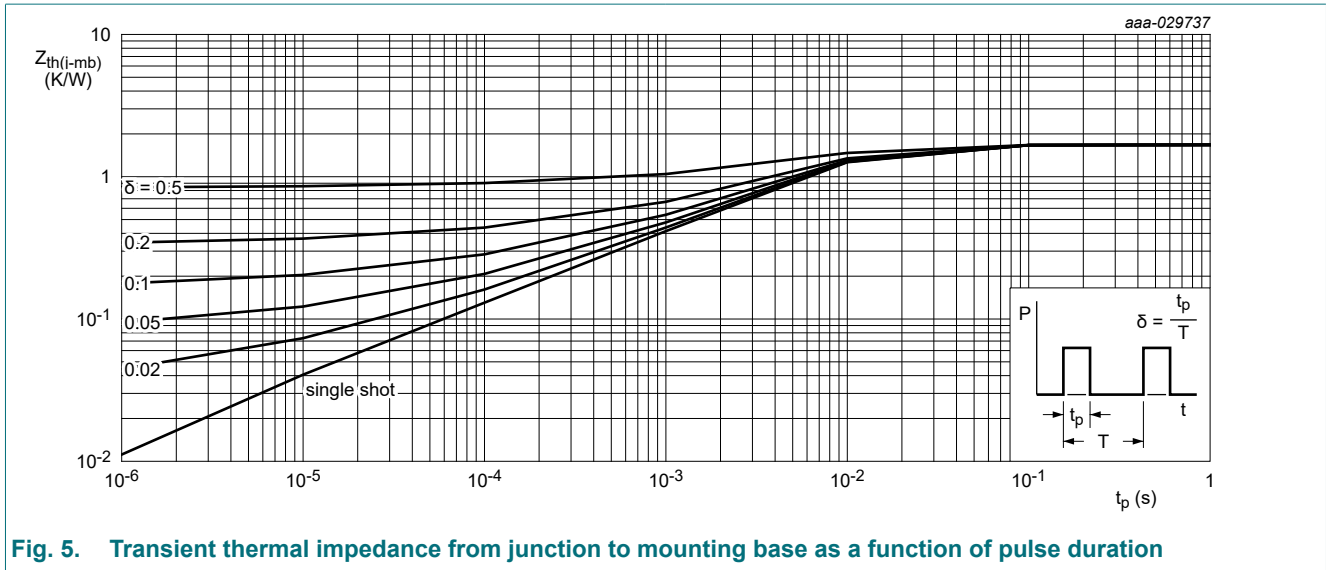


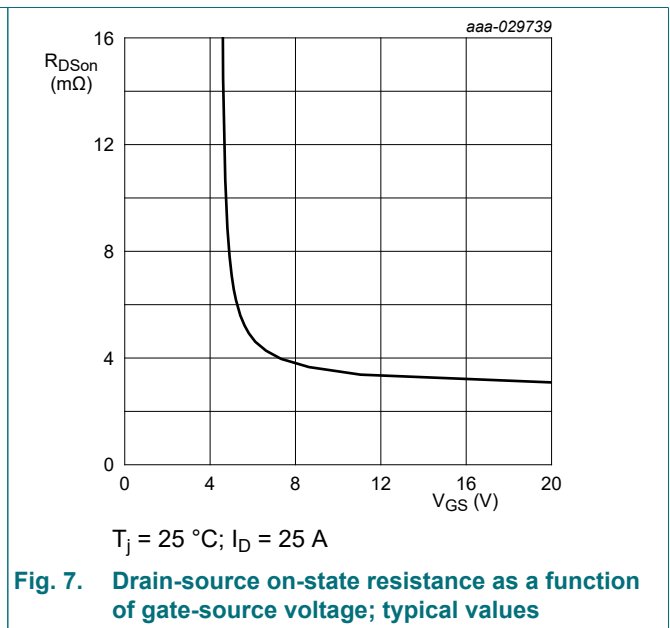
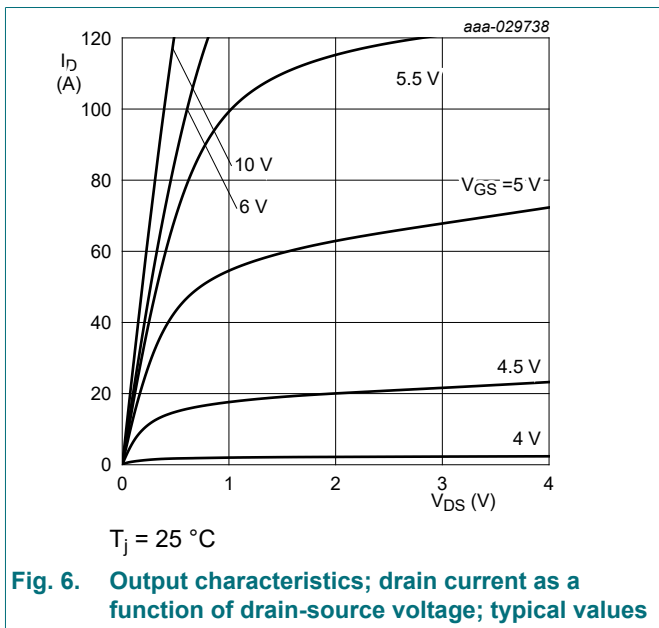
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

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 | 43 | - | V |
| | | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = -40 \text{ }^\circ C$ | - | 40.5 | - | V |
| | | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$ | 36 | 40 | - | 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 | 3.6 | V |
| | | $I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = -55 \text{ }^\circ C$; Fig. 10 | - | - | 4.3 | V |
| | | $I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = 175 \text{ }^\circ C$; Fig. 10 | 1 | - | - | V |
| I_{DSS} | drain leakage current | $V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | 0.07 | 1 | μA |
| | | $V_{DS} = 16 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \text{ }^\circ C$ | - | 0.76 | 10 | μA |
| | | $V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ C$ | - | 70 | 500 | μA |
| I_{GSS} | gate leakage current | $V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | 2 | 100 | nA |
| | | $V_{GS} = -10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$ | - | 2 | 100 | nA |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ C$; Fig. 11 | 2.4 | 3.5 | 4.3 | mΩ |
| | | $V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 105 \text{ }^\circ C$; Fig. 12 | 3.4 | 5.3 | 6.8 | mΩ |
| | | $V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 125 \text{ }^\circ C$; Fig. 12 | 3.8 | 5.8 | 7.5 | mΩ |
| | | $V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 175 \text{ }^\circ C$; Fig. 12 | 4.7 | 7.2 | 9.4 | mΩ |
| R_G | gate resistance | $f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$ | 0.3 | 0.8 | 2 | Ω |
| Dynamic characteristics | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D = 25 \text{ A}; V_{DS} = 32 \text{ V}; V_{GS} = 10 \text{ V}$; Fig. 13; Fig. 14 | - | 24 | 34 | nC |
| Q_{GS} | gate-source charge | | - | 7 | 11 | nC |
| Q_{GD} | gate-drain charge | | - | 5 | 10 | nC |

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------------|------------------------------|---|-----|------|------|------|
| C_{iss} | input capacitance | $V_{DS} = 25\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz};$ | - | 1657 | 2320 | pF |
| C_{oss} | output capacitance | $T_j = 25\text{ }^\circ\text{C};$ Fig. 15 | - | 516 | 722 | pF |
| C_{rss} | reverse transfer capacitance | | - | 82 | 180 | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = 30\text{ V}; R_L = 1.2\text{ } \Omega; V_{GS} = 10\text{ V};$ | - | 7 | - | ns |
| t_r | rise time | $R_{G(ext)} = 5\text{ } \Omega$ | - | 5.5 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 15 | - | ns |
| t_f | fall time | | - | 6.5 | - | ns |
| Source-drain diode | | | | | | |
| V_{SD} | source-drain voltage | $I_S = 25\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C};$ Fig. 16 | - | 0.83 | 1.2 | V |
| t_{rr} | reverse recovery time | $I_S = 25\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 20\text{ V};$ Fig. 17 | - | 26 | - | ns |
| Q_r | recovered charge | $I_S = 25\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 20\text{ V}$ | - | 20 | - | nC |
| S | softness factor | $I_S = 25\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 20\text{ V}; T_j = 25\text{ }^\circ\text{C};$ Fig. 17 | - | 0.66 | - | |
| | | $I_S = 25\text{ A}; di_S/dt = -500\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 20\text{ V}; T_j = 25\text{ }^\circ\text{C};$ Fig. 17 | - | 0.45 | - | |



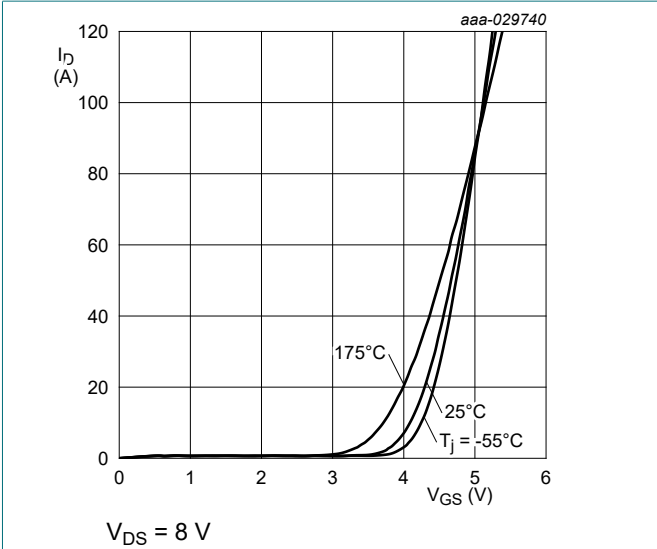


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

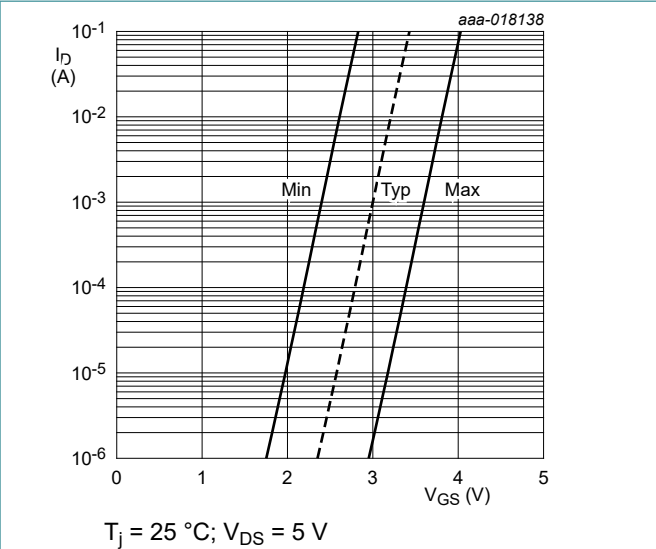


Fig. 9. Sub-threshold drain current as a function of gate-source voltage

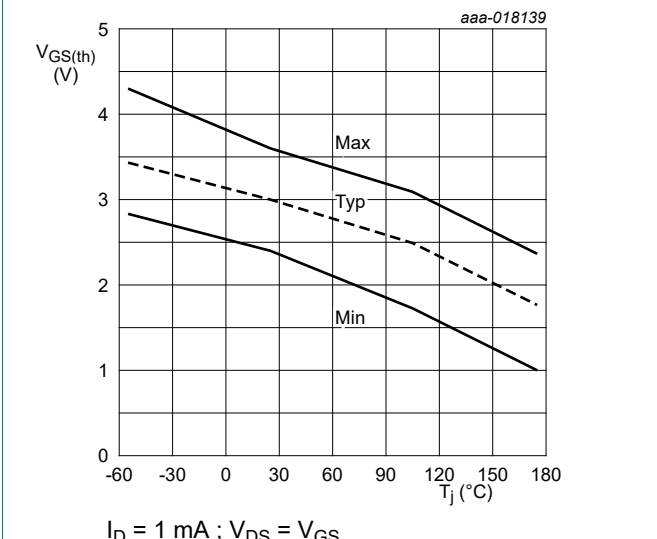


Fig. 10. Gate-source threshold voltage as a function of junction temperature

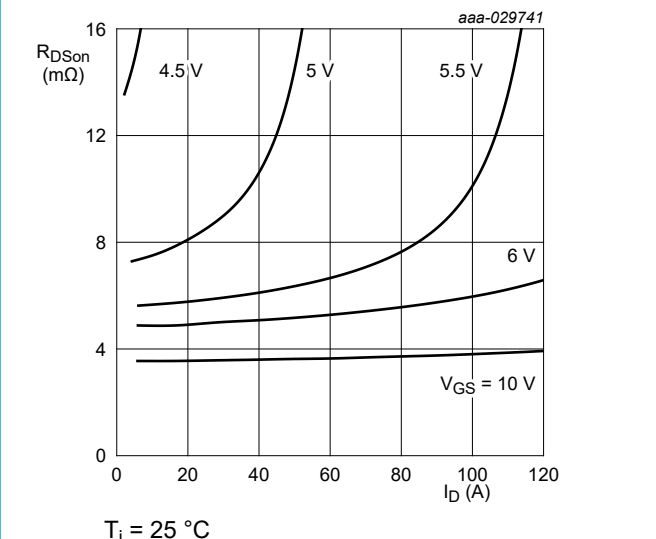
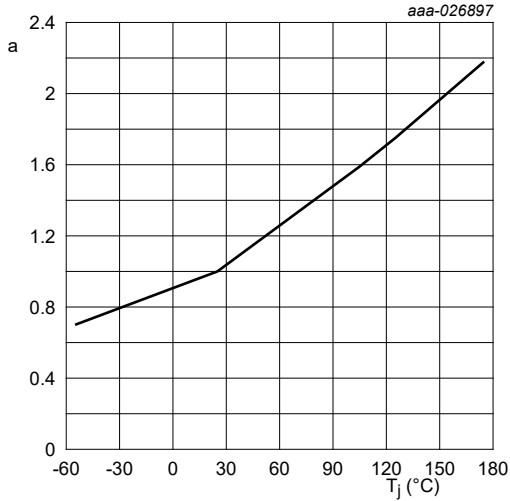
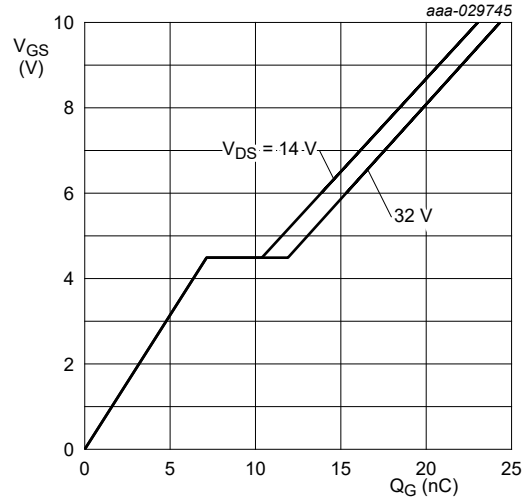


Fig. 11. Drain-source on-state resistance as a function of drain current; typical values



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

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



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

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

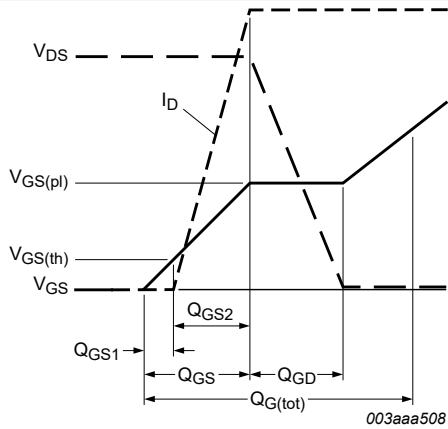
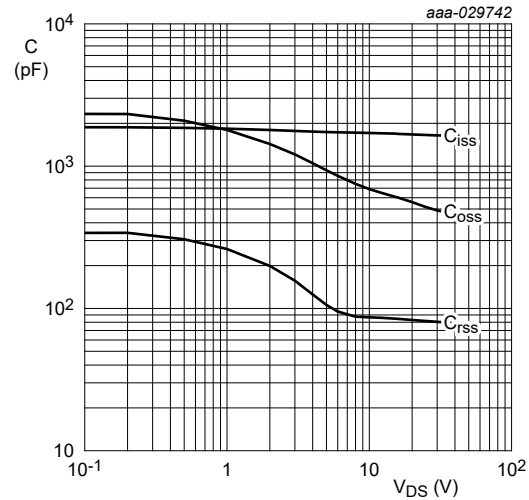
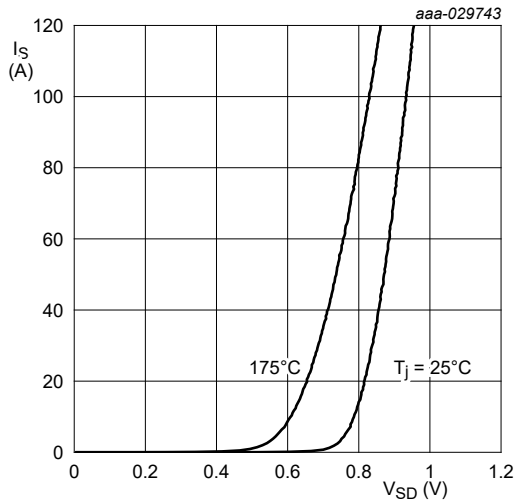


Fig. 14. Gate charge waveform definitions



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

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



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

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

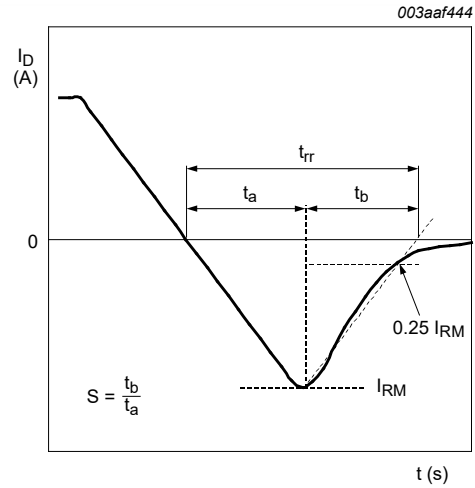


Fig. 17. Reverse recovery timing definition

11. Package outline

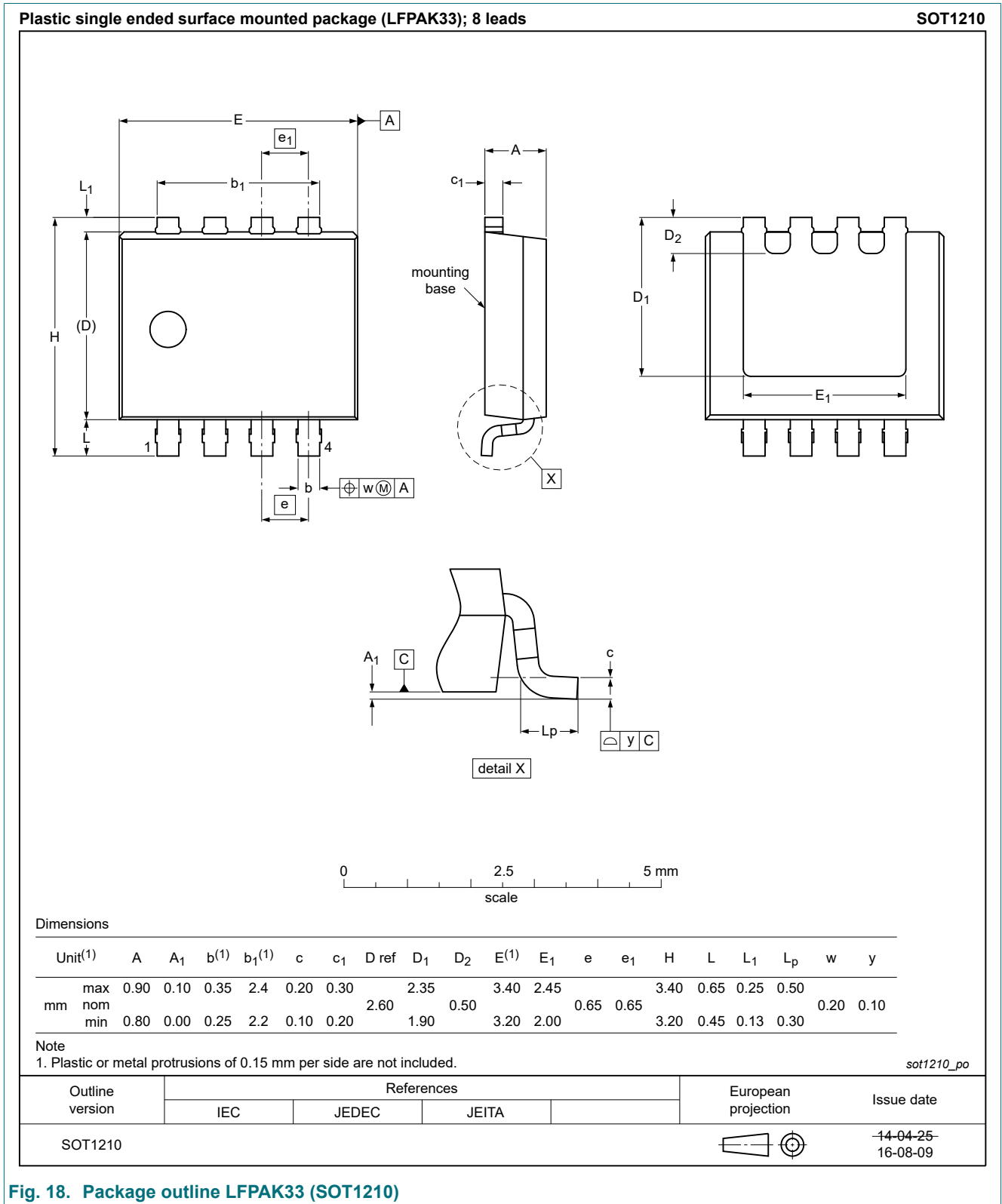


Fig. 18. Package outline LPAK33 (SOT1210)

12. Soldering

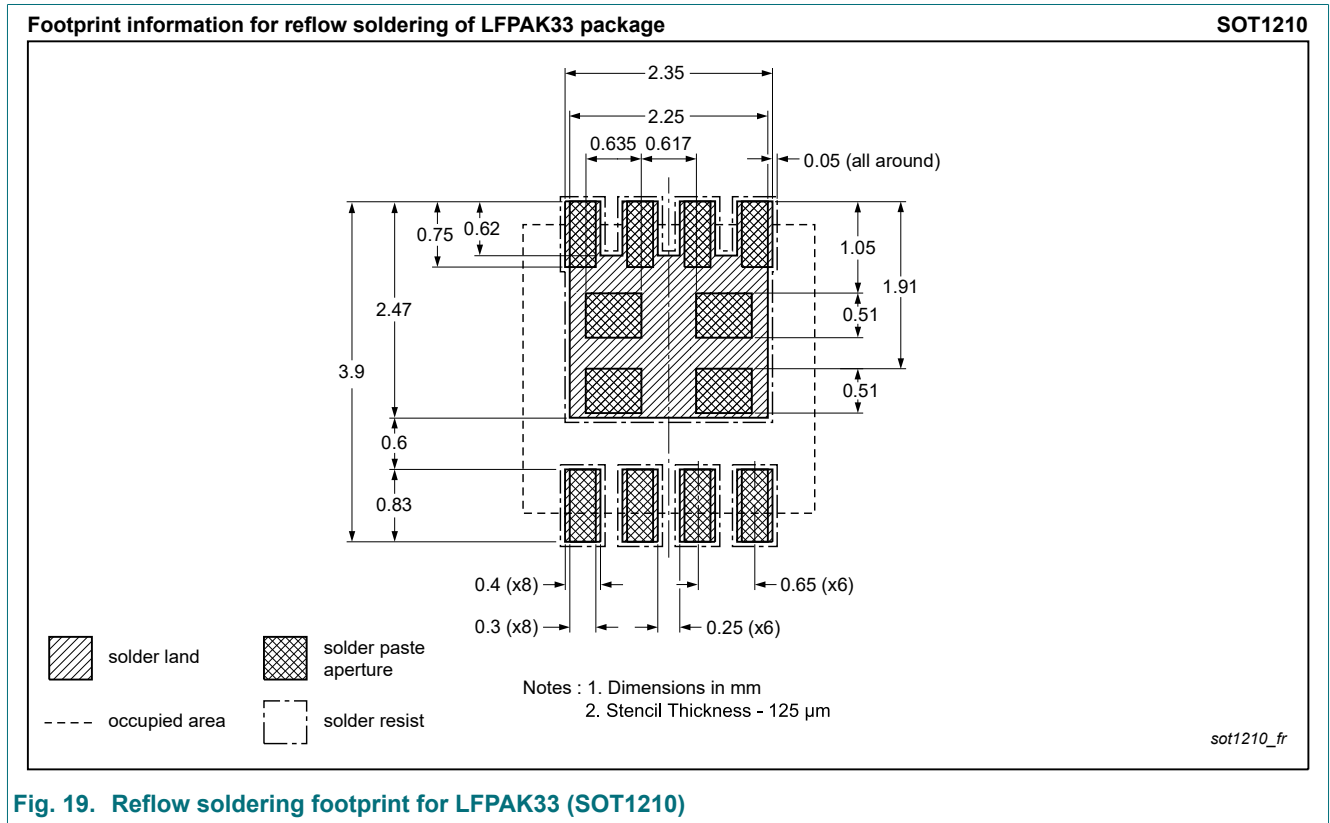


Fig. 19. Reflow soldering footprint for LFPAK33 (SOT1210)

13. Legal information

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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