

BUK9M15-60E

N-channel 60 V, 15 m Ω logic level MOSFET in LFPAK33 19 September 2016

Product data sheet

1. **General description**

Logic 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 logic level gate with V_{GS(th)} rating of greater than 0.5 V at 175 °C

Applications 3.

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

Quick reference data

Table 1. Quick reference data

| Symbol | Parameter | Conditions | Min | Тур | Max | Unit |
|-------------------|----------------------------------|--|-----|------|-----|------|
| V_{DS} | drain-source voltage | 25 °C ≤ T _j ≤ 175 °C | - | - | 60 | V |
| I _D | drain current | V _{GS} = 5 V; T _{mb} = 25 °C; <u>Fig. 2</u> | - | - | 47 | Α |
| P _{tot} | total power dissipation | T _{mb} = 25 °C; <u>Fig. 1</u> | - | - | 75 | W |
| Static chara | acteristics | | | | | |
| R _{DSon} | drain-source on-state resistance | $V_{GS} = 5 \text{ V}; I_D = 10 \text{ A}; T_j = 25 ^{\circ}\text{C}; Fig. 11$ | - | 12.5 | 15 | mΩ |
| Dynamic ch | naracteristics | | | | | |
| Q_{GD} | gate-drain charge | I _D = 10 A; V _{DS} = 48 V; V _{GS} = 5 V; T _j = 25 °C; <u>Fig. 13</u> ; <u>Fig. 14</u> | - | 6.4 | - | nC |



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5. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description | Simplified outline | | | Graphic symbol |
|-----|--------|-----------------------------------|--------------------|---------------------------------------|--|----------------|
| 1 | S | Source | | | | D I |
| 2 | S | Source | | | | |
| 3 | S | Source | | | | G T A |
| 4 | G | Gate | | | | mbb076 S |
| mb | D | Mounting base; connected to drain | L | ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ | | |

6. Ordering information

Table 3. Ordering information

| Type number | Package | | | | | |
|-------------|---------|---|---------|--|--|--|
| | Name | Description | Version | | | |
| BUK9M15-60E | LFPAK33 | Plastic single ended surface mounted package (LFPAK33); 8 leads | SOT1210 | | | |

7. Marking

Table 4. Marking codes

| Type number | Marking code |
|-------------|--------------|
| BUK9M15-60E | 91560E |

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 °C ≤ T _j ≤ 175 °C | | - | 60 | V |
| V_{DGR} | drain-gate voltage | R_{GS} = 20 k Ω | | - | 60 | V |
| V_{GS} | gate-source voltage | DC; T _j ≤ 175 °C | | -10 | 10 | V |
| | | Pulsed; T _j ≤ 175 °C | [1][2] | -15 | 15 | V |
| P _{tot} | total power dissipation | T _{mb} = 25 °C; <u>Fig. 1</u> | | - | 75 | W |
| I _D | drain current | V _{GS} = 5 V; T _{mb} = 25 °C; <u>Fig. 2</u> | | - | 47 | Α |
| | | V _{GS} = 5 V; T _{mb} = 100 °C; <u>Fig. 2</u> | | - | 33 | Α |
| I _{DM} | peak drain current | pulsed; $t_p \le 10 \mu s$; $T_{mb} = 25 \text{ °C}$; Fig. 3 | | - | 188 | Α |

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| Symbol | Parameter | Conditions | | Min | Max | Unit |
|----------------------|--|---|--------|-----|-----|------|
| T _{stg} | storage temperature | | | -55 | 175 | °C |
| T _j | junction temperature | | | -55 | 175 | °C |
| Source-drain diode | | | | | | |
| I _S | source current | T _{mb} = 25 °C | | - | 47 | А |
| I _{SM} | peak source current | pulsed; $t_p \le 10 \ \mu s$; $T_{mb} = 25 \ ^{\circ}C$ | | - | 188 | Α |
| Avalanche ru | ggedness | | | | | |
| E _{DS(AL)S} | non-repetitive drain-source avalanche energy | I_D = 47 A; $V_{sup} \le$ 60; R_{GS} = 50 Ω; V_{GS} = 5 V; $T_{j(init)}$ = 25 °C; unclamped; Fig. 4 | [3][4] | - | 39 | mJ |

- [1] Accumulated pulse duration up to 50 hours delivers zero defect ppm.
- [2] Significantly longer life times are achieved by lowering T_i and or V_{GS}
- [3] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
- [4] Refer to application note AN10273 for further information.

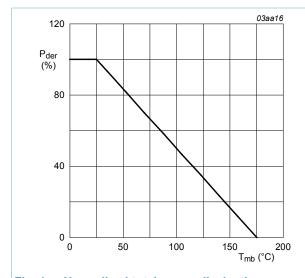
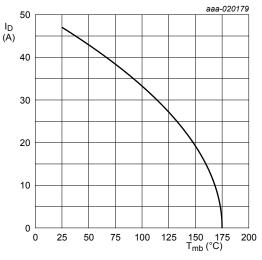


Fig. 1. Normalized total power dissipation as a function of mounting base temperature

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

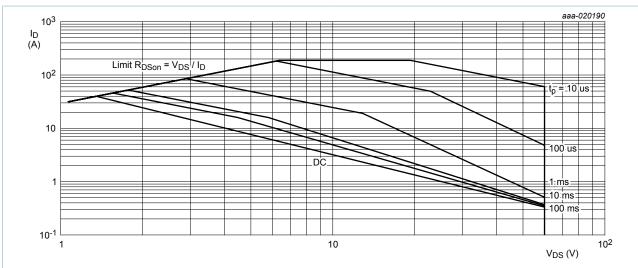


 $V_{GS} \ge 5 \text{ V}$

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

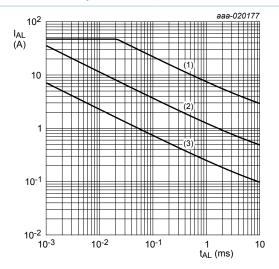
$$I_D = 47 \times \sqrt{\frac{175^{\circ}C - T_{mb}}{150^{\circ}C}} \text{ for } T_{mb} \ge 25^{\circ}C$$

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 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



(1) $T_{j \text{ (init)}}$ = 25 °C; (2) $T_{j \text{ (init)}}$ = 150 °C; (3) Repetitive Avalanche

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

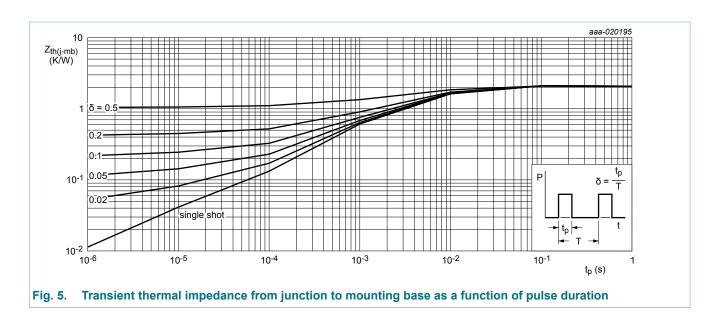
9. Thermal characteristics

Table 6. Thermal characteristics

| Symbol | Parameter | Conditions | Min | Тур | Max | Unit |
|-----------------------|---|------------|-----|------|-----|------|
| R _{th(j-mb)} | thermal resistance from junction to mounting base | Fig. 5 | - | 1.82 | 2 | K/W |

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10. Characteristics

Table 7. Characteristics

| Symbol | Parameter | Conditions | Min | Тур | Max | Unit |
|---------------------------|-------------------------------|---|-----|------|------|------|
| Static chara | acteristics | | , | ' | | |
| $V_{(BR)DSS}$ | drain-source | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 °C$ | 60 | - | - | V |
| | breakdown voltage | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 ^{\circ}C$ | 54 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | I _D = 1 mA; V _{DS} = V _{GS} ; T _j = 25 °C; Fig. 9; Fig. 10 | 1.4 | 1.7 | 2.1 | V |
| | | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ °C};$ Fig. 10 | - | - | 2.45 | V |
| | | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ °C};$ Fig. 10 | 0.5 | - | - | V |
| I _{DSS} drain le | drain leakage current | V _{DS} = 60 V; V _{GS} = 0 V; T _j = 25 °C | - | 0.01 | 1 | μA |
| | | V _{DS} = 60 V; V _{GS} = 0 V; T _j = 175 °C | - | - | 500 | μΑ |
| I _{GSS} | gate leakage current | V _{GS} = 10 V; V _{DS} = 0 V; T _j = 25 °C | - | 2 | 100 | nA |
| | | V _{GS} = -10 V; V _{DS} = 0 V; T _j = 25 °C | - | 2 | 100 | nA |
| R _{DSon} | drain-source on-state | V _{GS} = 5 V; I _D = 10 A; T _j = 25 °C; <u>Fig. 11</u> | - | 12.5 | 15 | mΩ |
| | resistance | V _{GS} = 10 V; I _D = 10 A; T _j = 25 °C; Fig. 11 | - | 11 | 13 | mΩ |
| | | V _{GS} = 5 V; I _D = 10 A; T _j = 175 °C; Fig. 12 | - | - | 34 | mΩ |
| Dynamic ch | naracteristics | | 1 | 1 | 1 | |
| Q _{G(tot)} | total gate charge | I _D = 10 A; V _{DS} = 48 V; V _{GS} = 5 V; | - | 17 | - | nC |
| Q _{GS} | gate-source charge | T _j = 25 °C; <u>Fig. 13</u> ; <u>Fig. 14</u> | - | 4.1 | - | nC |

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| Symbol | Parameter | Conditions | Min | Тур | Max | Unit |
|---------------------|------------------------------|---|-----|------|------|------|
| Q_{GD} | gate-drain charge | | - | 6.4 | - | nC |
| C _{iss} | input capacitance | $V_{DS} = 25 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz};$ | - | 1677 | 2230 | pF |
| C _{oss} | output capacitance | T _j = 25 °C; <u>Fig. 15</u> | - | 160 | 192 | pF |
| C _{rss} | reverse transfer capacitance | | - | 85 | 116 | pF |
| t _{d(on)} | turn-on delay time | V_{DS} = 45 V; R_L = 4.3 Ω ; V_{GS} = 5 V; $R_{G(ext)}$ = 5 Ω ; T_j = 25 °C | - | 10.3 | - | ns |
| t _r | rise time | | - | 16.9 | - | ns |
| t _{d(off)} | turn-off delay time | | - | 24 | - | ns |
| t _f | fall time | | - | 15.4 | - | ns |
| Source-dra | in diode | | | | | |
| V_{SD} | source-drain voltage | $I_S = 10 \text{ A}$; $V_{GS} = 0 \text{ V}$; $T_j = 25 ^{\circ}\text{C}$; Fig. 16 | - | 0.81 | 1.2 | V |
| t _{rr} | reverse recovery time | I_S = 10 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 25 V; T_j = 25 °C | - | 19.3 | - | ns |
| Q _r | recovered charge | | - | 17.3 | - | nC |

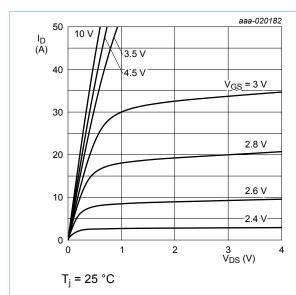


Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values

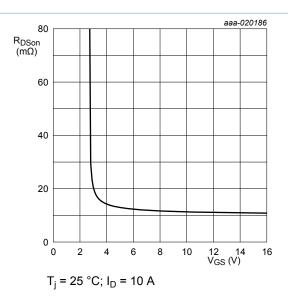


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

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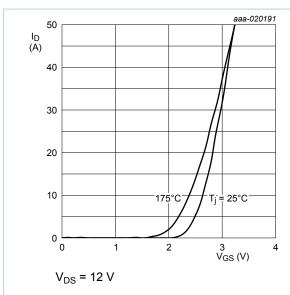


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

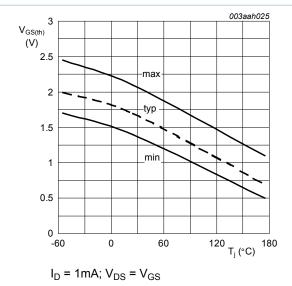
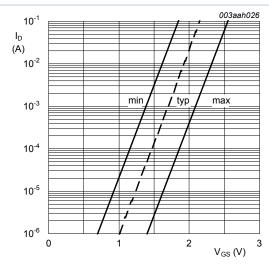


Fig. 10. Gate-source threshold voltage as a function of junction temperature



 $T_i = 25 \,^{\circ}C; V_{DS} = 5 \,^{\circ}V$

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

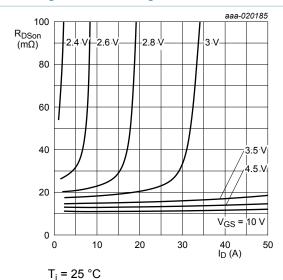


Fig. 11. Drain-source on-state resistance as a function of drain current; typical values

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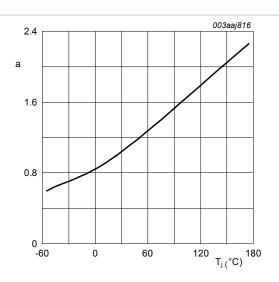


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

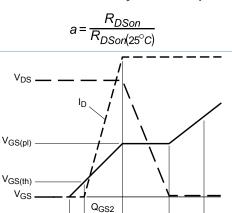


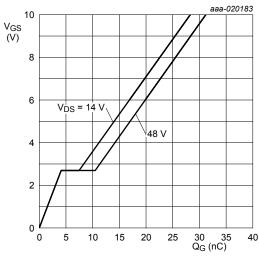
Fig. 14. Gate charge waveform definitions

-Q_{GS}

-Q_{G(tot)}

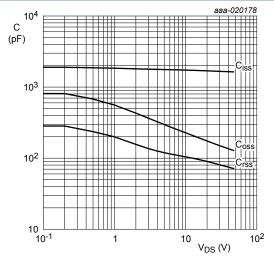
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Q_{GS1}-



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

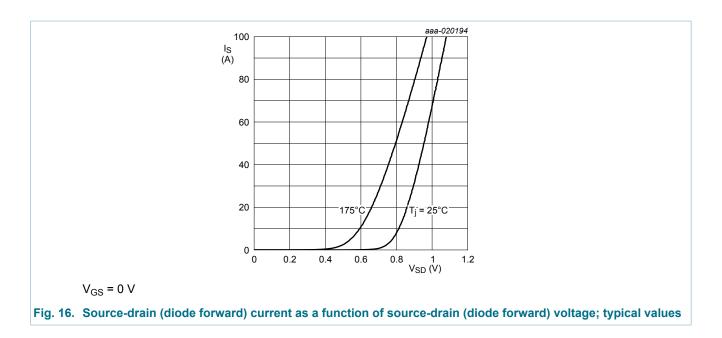
Fig. 13. Gate-source voltage as a function of gate charge; typical values



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

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

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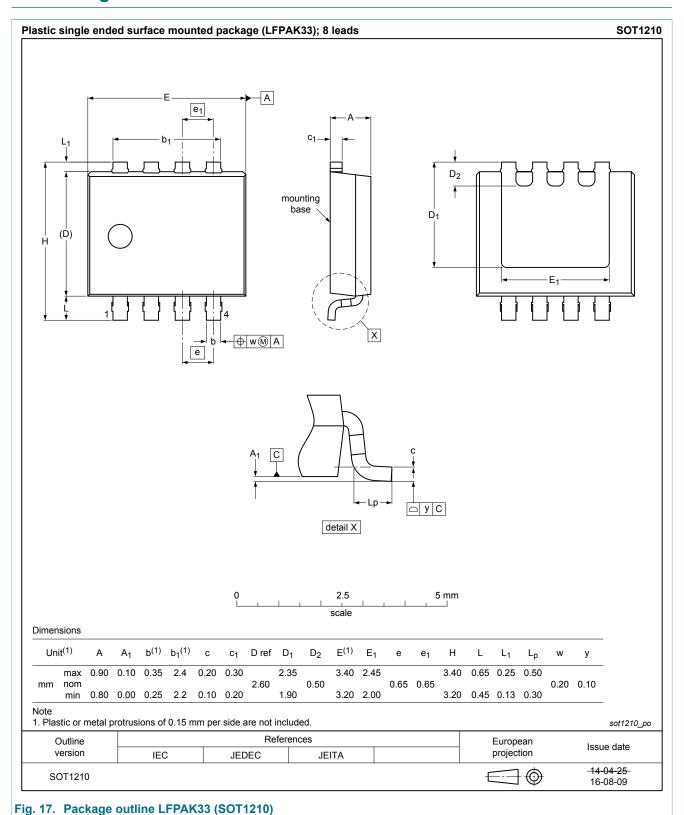


11. Application information

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

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12. Package outline



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13. Legal information

13.1 Data sheet status

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|--------------------------------------|--------------------|---|
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