

## BUK453-60A-VB Datasheet N-Channel 60 V(D-S) MOSFET

| PRODUCT SUMMARY          |                        |       |
|--------------------------|------------------------|-------|
| V <sub>DS</sub> (V)      | 60                     |       |
| R <sub>DS(on)</sub> (Ω)  | V <sub>GS</sub> = 10 V | 0.072 |
| Q <sub>g</sub> max. (nC) | 25                     |       |
| Q <sub>gs</sub> (nC)     | 5.8                    |       |
| Q <sub>gd</sub> (nC)     | 11                     |       |
| Configuration            | Single                 |       |

### FEATURES

- Dynamic dV/dt rating
  - Fast switching
  - Ease of paralleling
- Simple drive requirements



N-Channel MOSFET

| ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted) |                         |                                   |                         |          |   |
|---|-------------------------|-----------------------------------|-------------------------|----------|---|
| PARAMETER   |                         | SYMBOL                            | LIMIT                   | UNIT     |   |
| Drain-Source Voltage  |                         | V <sub>DS</sub>                   | 60                      | V        |   |
| Gate-Source Voltage   |                         | V <sub>GS</sub>                   | ± 20                    |          |   |
| Continuous Drain Current  | V <sub>GS</sub> at 10 V | I <sub>D</sub>                    | T <sub>C</sub> = 25 °C  | 20       | A |
|   |                         |                                   | T <sub>C</sub> = 100 °C | 12       |   |
| Pulsed Drain Current <sup>a</sup>   |                         | I <sub>DM</sub>                   | 68                      |          |   |
| Linear Derating Factor  |                         |                                   | 0.40                    | W/°C     |   |
| Single Pulse Avalanche Energy <sup>b</sup>                                |                         | E <sub>AS</sub>                   | 100                     | mJ       |   |
| Maximum Power Dissipation   | T <sub>C</sub> = 25 °C  | P <sub>D</sub>                    | 60                      | W        |   |
| Peak Diode Recovery dV/dt <sup>c</sup>                                    |                         | dV/dt                             | 4.5                     | V/ns     |   |
| Operating Junction and Storage Temperature Range                          |                         | T <sub>J</sub> , T <sub>stg</sub> | -55 to +175             | °C       |   |
| Soldering Recommendations (Peak temperature) <sup>d</sup>                 | for 10 s                |                                   | 300                     |          |   |
| Mounting Torque   | 6-32 or M3 screw        |                                   | 10                      | lbf · in |   |
|   |                         |                                   | 1.1                     | N · m    |   |

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- V<sub>DD</sub> = 25 V, starting T<sub>J</sub> = 25 °C, L = 403 μH, R<sub>g</sub> = 25 Ω, I<sub>AS</sub> = 17 A (see fig. 12).
- I<sub>SD</sub> ≤ 17 A, dI/dt ≤ 140 A/μs, V<sub>DD</sub> ≤ V<sub>DS</sub>, T<sub>J</sub> ≤ 175 °C.
- 1.6 mm from case.

| THERMAL RESISTANCE RATINGS          |            |      |      |      |
|-------------------------------------|------------|------|------|------|
| PARAMETER                           | SYMBOL     | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient         | $R_{thJA}$ | -    | 62   | °C/W |
| Case-to-Sink, Flat, Greased Surface | $R_{thCS}$ | 0.50 | -    |      |
| Maximum Junction-to-Case (Drain)    | $R_{thJC}$ | -    | 2.5  |      |

| SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted) |                     |  |  |      |       |           |               |
|---|---------------------|--|--|------|-------|-----------|---------------|
| PARAMETER   | SYMBOL              | TEST CONDITIONS  |  | MIN. | TYP.  | MAX.      | UNIT          |
| <b>Static</b>   |                     |  |  |      |       |           |               |
| Drain-Source Breakdown Voltage  | $V_{DS}$            | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$  |  | 60   | -     | -         | V             |
| $V_{DS}$ Temperature Coefficient  | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$  |  | -    | 0.061 | -         | V/°C          |
| Gate-Source Threshold Voltage   | $V_{GS(th)}$        | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$  |  | 1.0  | -     | 3.0       | V             |
| Gate-Source Leakage   | $I_{GSS}$           | $V_{GS} = \pm 20\text{ V}$   |  | -    | -     | $\pm 100$ | nA            |
| Zero Gate Voltage Drain Current   | $I_{DSS}$           | $V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$  |  | -    | -     | 25        | $\mu\text{A}$ |
|   |                     | $V_{DS} = 48\text{ V}, V_{GS} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$   |  | -    | -     | 250       |               |
| Drain-Source On-State Resistance  | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$   | $I_D = 10\text{ A}^b$  | -    | 0.072 | -         | $\Omega$      |
| Forward Transconductance  | $g_{fs}$            | $V_{DS} = 25\text{ V}, I_D = 10\text{ A}$  |  | 5.5  | -     | -         | S             |
| <b>Dynamic</b>  |                     |  |  |      |       |           |               |
| Input Capacitance   | $C_{iss}$           | $V_{GS} = 0\text{ V},$<br>$V_{DS} = 25\text{ V},$<br>$f = 1.0\text{ MHz}$ , see fig. 5                                     |  | -    | 640   | -         | pF            |
| Output Capacitance  | $C_{oss}$           |  |  | -    | 360   | -         |               |
| Reverse Transfer Capacitance  | $C_{rss}$           |  |  | -    | 79    | -         |               |
| Total Gate Charge   | $Q_g$               | $V_{GS} = 10\text{ V}$   | $I_D = 17\text{ A}, V_{DS} = 48\text{ V},$<br>see fig. 6 and 13 <sup>b</sup> | -    | -     | 25        | nC            |
| Gate-Source Charge  | $Q_{gs}$            |  |  | -    | -     | 5.8       |               |
| Gate-Drain Charge   | $Q_{gd}$            |  |  | -    | -     | 11        |               |
| Turn-On Delay Time  | $t_{d(on)}$         | $V_{DD} = 30\text{ V}, I_D = 17\text{ A},$<br>$R_g = 18\text{ }\Omega, R_D = 1.7\text{ }\Omega$ , see fig. 10 <sup>b</sup> |  | -    | 13    | -         | ns            |
| Rise Time   | $t_r$               |  |  | -    | 58    | -         |               |
| Turn-Off Delay Time   | $t_{d(off)}$        |  |  | -    | 25    | -         |               |
| Fall Time   | $t_f$               |  |  | -    | 42    | -         |               |
| Internal Drain Inductance   | $L_D$               | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact   |  | -    | 4.5   | -         | nH            |
| Internal Source Inductance  | $L_S$               |  |  | -    | 7.5   | -         |               |
| <b>Drain-Source Body Diode Characteristics</b>                              |                     |  |  |      |       |           |               |
| Continuous Source-Drain Diode Current                                       | $I_S$               | MOSFET symbol<br>showing the<br>integral reverse<br>p - n junction diode   |  | -    | -     | 20        | A             |
| Pulsed Diode Forward Current <sup>a</sup>                                   | $I_{SM}$            |  |  | -    | -     | 68        |               |
| Body Diode Voltage  | $V_{SD}$            | $T_J = 25\text{ }^\circ\text{C}, I_S = 17\text{ A}, V_{GS} = 0\text{ V}^b$   |  | -    | -     | 1.5       | V             |
| Body Diode Reverse Recovery Time  | $t_{rr}$            | $T_J = 25\text{ }^\circ\text{C}, I_F = 17\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$                                      |  | -    | 88    | 180       | ns            |
| Body Diode Reverse Recovery Charge  | $Q_{rr}$            |  |  | -    | 0.29  | 0.64      | $\mu\text{C}$ |
| Forward Turn-On Time  | $t_{on}$            | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )  |  |      |       |           |               |

**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\text{ }\%$ .

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



Fig. 1 - Typical Output Characteristics,  $T_C = 25\text{ }^\circ\text{C}$



Fig. 4 - Normalized On-Resistance vs. Temperature



Fig. 2 - Typical Output Characteristics,  $T_C = 175\text{ }^\circ\text{C}$

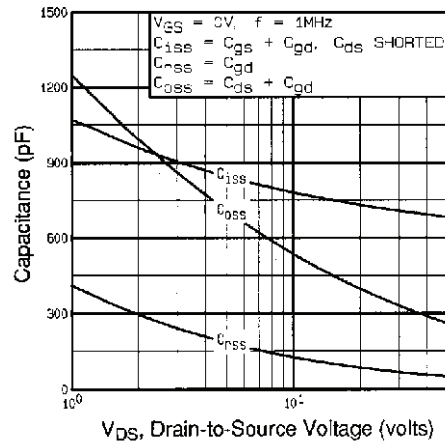


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage



Fig. 3 - Typical Transfer Characteristics



Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage



Fig. 7 - Typical Source-Drain Diode Forward Voltage



Fig. 9 - Maximum Drain Current vs. Case Temperature



Fig. 8 - Maximum Safe Operating Area



Fig. 10a - Switching Time Test Circuit



Fig. 10b - Switching Time Waveforms



Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



Fig. 12a - Unclamped Inductive Test Circuit



Fig. 12b - Unclamped Inductive Waveforms



Fig. 12c - Maximum Avalanche Energy vs. Drain Current

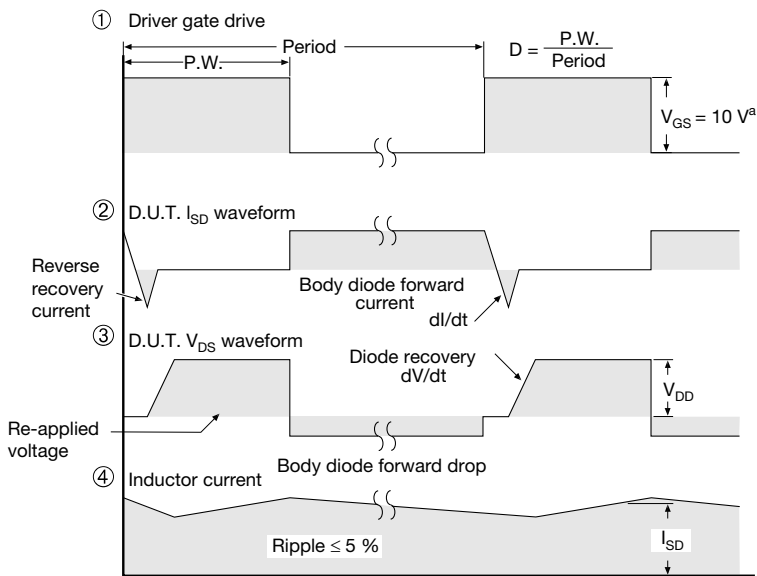
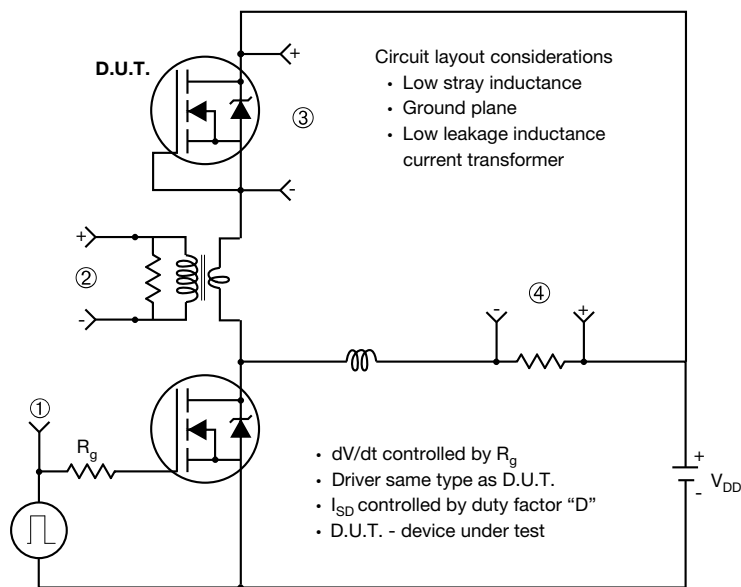


Fig. 13a - Basic Gate Charge Waveform



Fig. 13b - Gate Charge Test

Peak Diode Recovery dV/dt Test Circuit



Note

a.  $V_{GS} = 5 V$  for logic level devices

Fig. 14 - For N-Channel

TO-220



| DIM. | MILLIMETERS |       | INCHES |       |
|------|-------------|-------|--------|-------|
|      | MIN.        | MAX.  | MIN.   | MAX.  |
| A    | 4.24        | 4.65  | 0.167  | 0.183 |
| b    | 0.69        | 1.02  | 0.027  | 0.040 |
| b(1) | 1.14        | 1.78  | 0.045  | 0.070 |
| c    | 0.36        | 0.61  | 0.014  | 0.024 |
| D    | 14.33       | 15.85 | 0.564  | 0.624 |
| E    | 9.96        | 10.52 | 0.392  | 0.414 |
| e    | 2.41        | 2.67  | 0.095  | 0.105 |
| e(1) | 4.88        | 5.28  | 0.192  | 0.208 |
| F    | 1.14        | 1.40  | 0.045  | 0.055 |
| H(1) | 6.10        | 6.71  | 0.240  | 0.264 |
| J(1) | 2.41        | 2.92  | 0.095  | 0.115 |
| L    | 13.36       | 14.40 | 0.526  | 0.567 |
| L(1) | 3.33        | 4.04  | 0.131  | 0.159 |
| Ø P  | 3.53        | 3.94  | 0.139  | 0.155 |
| Q    | 2.54        | 3.00  | 0.100  | 0.118 |

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Note

- M\* = 0.052 inches to 0.064 inches (dimension including protrusion), heatsink hole for HVM

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