# PowerMOS transistor BUK417-500AE/BE

## GENERAL DESCRIPTION

N-channel enhancement mode field-effect power transistor in ISOTOP envelope.
The device is intended for use in Switched Mode Power Supplies (SMPS), motor control, welding, DC/DC and AC/DC converters, and in general purpose switching applications.

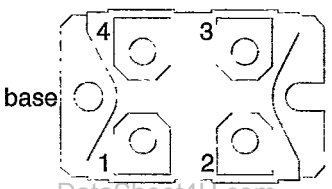
## QUICK REFERENCE DATA

| SYMBOL | PARAMETER | MAX. | MAX. | UNIT |
|---|---|---|---|---|
| | BUK417 | -500AE | -500BE | |
| $V_{DS}$ | Drain-source voltage | 500 | 500 | V |
| $I_D$ | Drain current (DC) | 32 | 28 | A |
| $P_{tot}$ | Total power dissipation | 310 | 310 | W |
| $R_{DS\ ON}$ | Drain-source on-state resistance | 0.13 | 0.16 | Ω |

## PINNING - SOT227B

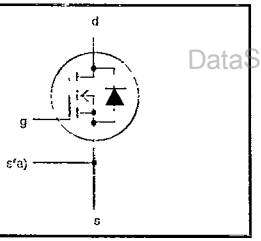
| PIN | DESCRIPTION |
|---|---|
| 1 | source |
| 2 | gate |
| 3 | drain |
| 4 | ancillary source |
| base | isolated |

## PIN CONFIGURATION






## SYMBOL






## LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | | UNIT |
|---|---|---|---|---|---|---|
| $V_{DS}$ | Drain-source voltage | - | - | 500 | | V |
| $V_{DGR}$ | Drain-gate voltage | $R_{GS}$ = 20 kΩ | - | 500 | | V |
| $\pm V_{GS}$ | Gate-source voltage | - | - | 30 | | V |
| | | | | -500AE | -500BE | |
| $I_D$ | Drain current (DC) | $T_{mb}$ = 25 °C | - | 32 | 28 | A |
| $I_D$ | Drain current (DC) | $T_{mb}$ = 100 °C | - | 20 | 18 | A |
| $I_{DM}$ | Drain current (pulse peak value) | $T_{mb}$ = 25 °C | - | 128 | 112 | A |
| $I_{S/A,M}$ | Ancillary source current (pulse peak value) | | - | 5.0 | | A |
| $P_{tot}$ | Total power dissipation | $T_{mb}$ = 25 °C | - | 310 | | W |
| $T_{stg}$ | Storage temperature | - | - 40 | 150 | | °C |
| $T_j$ | Junction Temperature | - | - | 150 | | °C |

## THERMAL RESISTANCES



| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $R_{th\ j\text{-}mb}$ | Thermal resistance junction to mounting base | | - | - | 0.40 | K/W |
| $R_{th\ mb\text{-}h's}$ | Thermal resistance mounting base to heatsink | with heatsink compound | - | 0.05 | - | K/W |

## STATIC CHARACTERISTICS

$T_{mb}$ = 25 °C unless otherwise specified

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $V_{GS}$ = 0 V; $I_D$ = 1.0 mA | 500 | - | - | V |
| $V_{GS(TO)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$; $I_D$ = 1 mA | 2.1 | 3.0 | 4.0 | V |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{DS}$ = 500 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | - | 20 | 100 | µA |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{DS}$ = 500 V; $V_{GS}$ = 0 V; $T_j$ =125 °C | - | 0.5 | 5.0 | mA |
| $I_{GSS}$ | Gate source leakage current | $V_{GS}$ = ±30 V; $V_{DS}$ = 0 V | - | 10 | 200 | nA |
| $R_{DS(ON)}$ | Drain-source on-state resistance | $V_{GS}$ = 10 V; **BUK417-500AE** | - | 0.11 | 0.13 | Ω |
| | | $I_D$ = 16 A **BUK417-500BE** | - | 0.14 | 0.16 | Ω |

## DYNAMIC CHARACTERISTICS

$T_{mb}$ = 25 °C unless otherwise specified

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $g_{fs}$ | Forward transconductance | $V_{DS}$ = 25 V; $I_D$ = 16 A | 15.0 | 30.0 | - | S |
| $C_{iss}$ | Input capacitance | $V_{GS}$ = 0 V; $V_{DS}$ = 25 V; f = 1 MHz | - | 7.5 | 9.0 | nF |
| $C_{oss}$ | Output capacitance | | - | 0.85 | 1.35 | nF |
| $C_{rss}$ | Feedback capacitance | | - | 350 | 600 | pF |
| $t_{d\,on}$ | Turn-on delay time | $V_{DD}$ = 30 V; $I_D$ = 2.8 A; | - | 80 | 120 | ns |
| $t_r$ | Turn-on rise time | $V_{GS}$ = 10 V; $R_{GS}$ = 50 Ω; | - | 200 | 300 | ns |
| $t_{d\,off}$ | Turn-off delay time | $R_{gen}$ = 50 Ω | - | 1100 | 1350 | ns |
| $t_f$ | Turn-off fall time | Resistive Load | - | 250 | 350 | ns |
| $t_{d\,on}$ | Turn-on delay time | $V_{DD}$ = 250 V; $I_D$ = 32 A; | - | 40 | 80 | ns |
| $t_r$ | Turn-on rise time | $V_{GS}$ = 10 V; $R_{gen}$ = 3.3 Ω | - | 70 | 100 | ns |
| $t_{d\,off}$ | Turn-off delay time | Resistive Load | - | 300 | 350 | ns |
| $t_f$ | Turn-off fall time | | - | 100 | 150 | ns |
| $L_d$ | Internal drain inductance | Measured from contact screw on terminal 3 to centre of die | - | 5 | - | nH |
| $L_s$ | Internal source inductance | Measured from contact screw on terminal 1 to source bond pad | - | 5 | - | nH |

## ISOLATION

$T_{mb}$ = 25 °C unless otherwise specified

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $V_{isol}$ | R.M.S. voltage from terminals to mounting base | Sinusoidal voltage waveform; f = 50 - 60 Hz | - | - | 2500 | V |
| $C_{isol}$ | Capacitance from T3 to mounting base | f = 1 MHz | - | 45 | - | pF |

## REVERSE DIODE LIMITING VALUES AND CHARACTERISTICS

$T_{mb}$ = 25 °C unless otherwise specified

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $I_{DR}$ | Continuous reverse drain current | - | - | - | 32 | A |
| $I_{DRM}$ | Pulsed reverse drain current | - | - | - | 128 | A |
| $V_{SD}$ | Diode forward voltage | $I_F$ = 32 A ;$V_{GS}$ = 0 V | - | 1.1 | 1.4 | V |
| $t_{rr}$ | Reverse recovery time | $I_F$ = 32 A; -$dI_F/dt$ = 100 A/µs; | - | 0.6 | - | µs |
| $Q_{rr}$ | Reverse recovery charge | $V_{GS}$ = 0 V; $V_R$ = 100 V | - | 12 | - | µC |

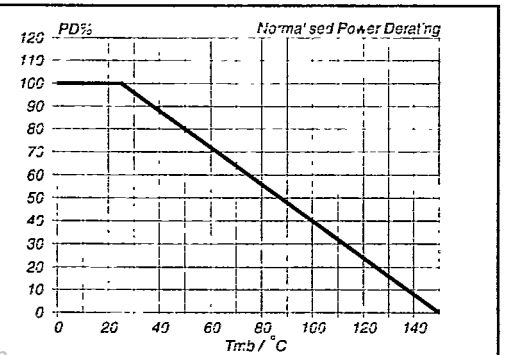



Fig.1. Normalised power dissipation.
$PD\% = 100 \cdot P_D / P_{D\,25\,°C} = f(T_{mb})$

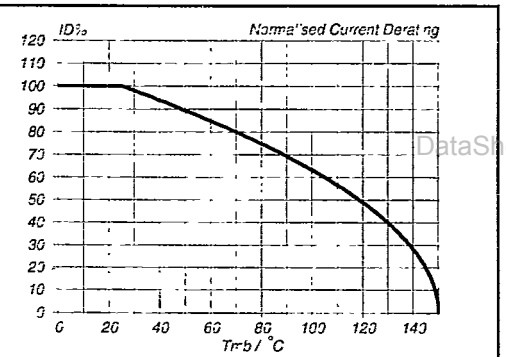



Fig.2. Normalised continuous drain current.
$ID\% = 100\ I_D / I_{D\,25\,°C} = f(T_{mb})$; conditions: $V_{GS} \geq 10$ V

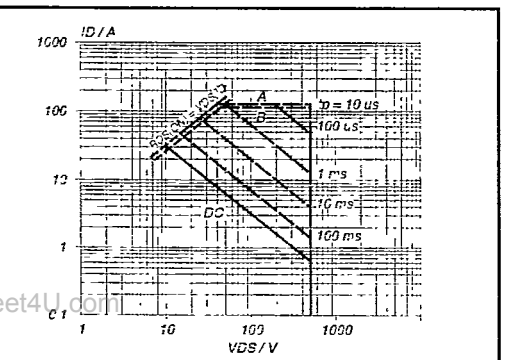



Fig.3. Safe operating area. $T_{mb} = 25$ °C
$I_D$ & $I_{DM} = f(V_{DS})$; $I_{DM}$ single pulse; parameter $t_p$

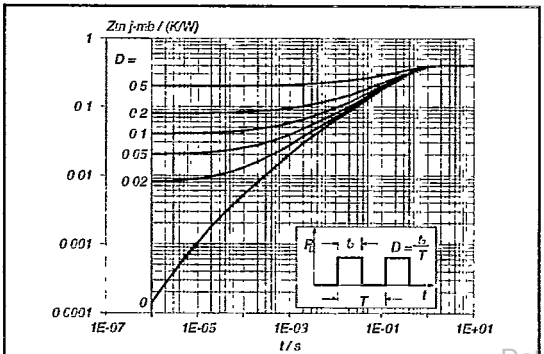



Fig.4. Transient thermal impedance.
$Z_{th\,j\text{-}mb} = f(t)$; parameter $D = t_p/T$

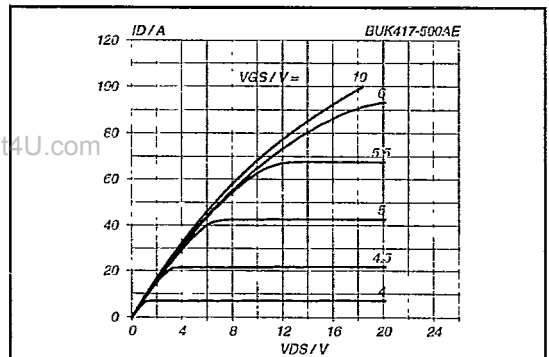



Fig.5. Typical output characteristics, $T_j = 25$ °C.
$I_D = f(V_{DS})$; parameter $V_{GS}$

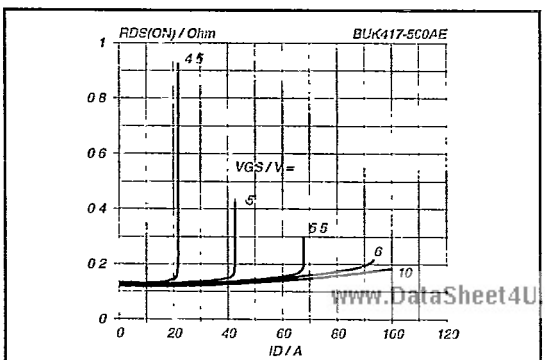



Fig.6. Typical on-state resistance, $T_j = 25$ °C.
$R_{DS(ON)} = f(I_D)$; parameter $V_{GS}$

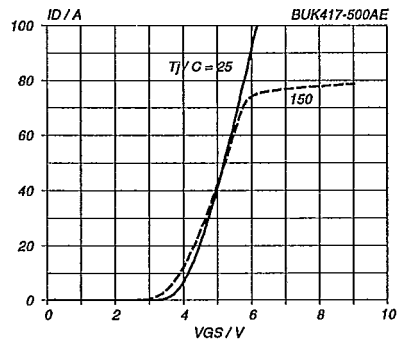



Fig.7. Typical transfer characteristics.
$I_D = f(V_{GS})$ ; conditions: $V_{DS} = 25$ V; parameter $T_j$

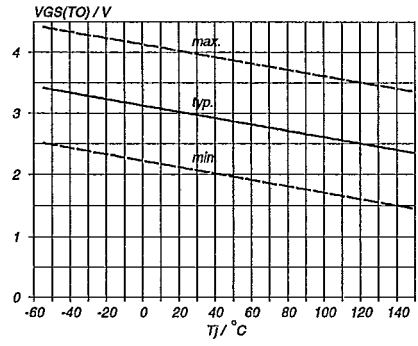



Fig.10. Gate threshold voltage.
$V_{GS(TO)} = f(T_j)$; conditions: $I_D = 1$ mA; $V_{DS} = V_{GS}$

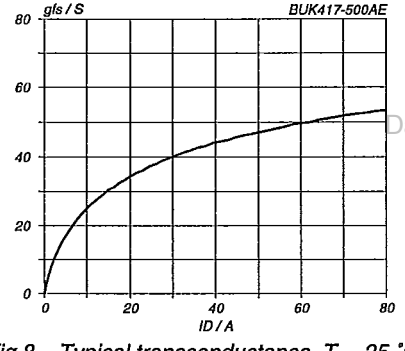



Fig.8. Typical transconductance, $T_j = 25$ °C.
$g_{fs} = f(I_D)$; conditions: $V_{DS} = 25$ V

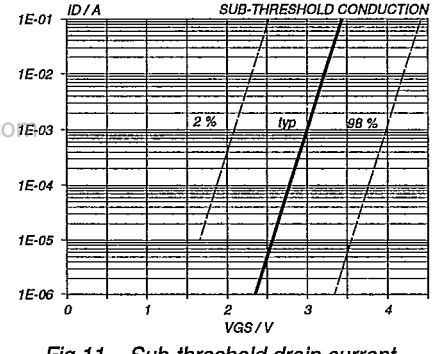



Fig.11. Sub-threshold drain current.
$I_D = f(V_{GS})$; conditions: $T_j = 25$ °C; $V_{DS} = V_{GS}$

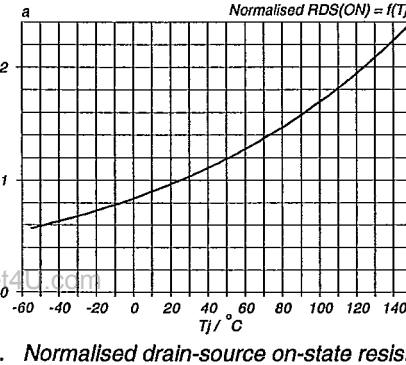



Fig.9. Normalised drain-source on-state resistance.
$a = R_{DS(ON)}/R_{DS(ON)25\,°C} = f(T_j)$; $I_D = 16$ A; $V_{GS} = 10$ V

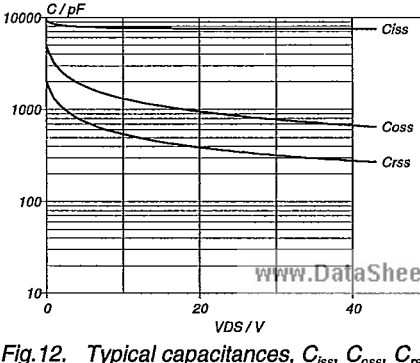



Fig.12. Typical capacitances, $C_{iss}$, $C_{oss}$, $C_{rss}$.
$C = f(V_{DS})$; conditions: $V_{GS} = 0$ V; $f = 1$ MHz

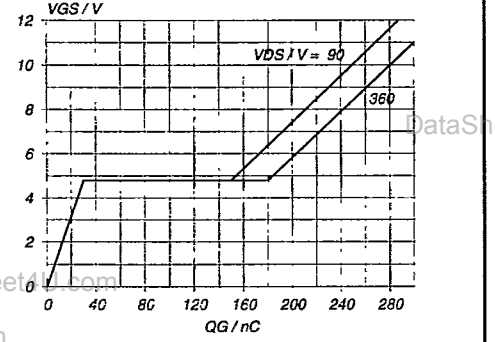



Fig.13. Typical turn-on gate-charge characteristics. $V_{GS} = f(Q_G)$; conditions: $I_D = 32$ A; parameter $V_{DS}$

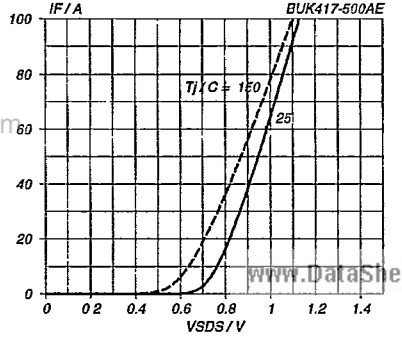



Fig.14. Typical reverse diode current. $I_F = f(V_{SDS})$; conditions: $V_{GS} = 0$ V; parameter $T_j$