## GENERAL DESCRIPTION

N-channel enhancement mode field-effect power transistor in a plastic envelope.
FREDFET with fast recovery reverse diode, particularly suitable for motor control applications, eg. in full bridge configurations for which faster recovery characteristics simplify design for inductive loads.
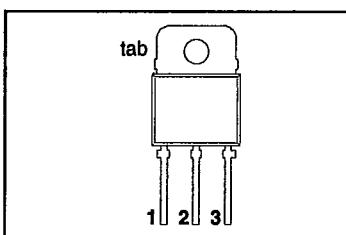
## QUICK REFERENCE DATA

| SYMBOL | PARAMETER | MAX. | UNIT |
|---|---|---|---|
| $V_{DS}$ | Drain-source voltage | 400 | V |
| $I_D$ | Drain current (DC) | 12 | A |
| $P_{tot}$ | Total power dissipation | 180 | W |
| $R_{DS(ON)}$ | Drain-source on-state resistance | 0.6 | Ω |
| $t_{rr}$ | Diode reverse recovery time | 250 | ns |
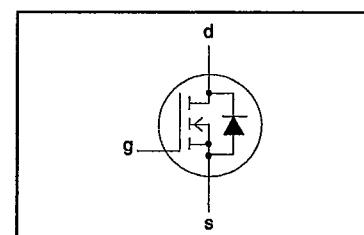
## PINNING - SOT93

| PIN | DESCRIPTION |
|---|---|
| 1 | gate |
| 2 | drain |
| 3 | source |
| tab | drain |

## 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 | - | - | 400 | V |
| $V_{DGR}$ | Drain-gate voltage | $R_{GS} = 20\ k\Omega$ | - | 400 | V |
| $\pm V_{GS}$ | Gate-source voltage | - | - | 30 | V |
| $I_D$ | Drain current (DC) | $T_{mb} = 25\ °C$ | - | 12 | A |
| $I_D$ | Drain current (DC) | $T_{mb} = 100\ °C$ | - | 7.6 | A |
| $I_{DM}$ | Drain current (pulse peak value) | $T_{mb} = 25\ °C$ | - | 48 | A |
| $P_{tot}$ | Total power dissipation | $T_{mb} = 25\ °C$ | - | 180 | W |
| $T_{stg}$ | Storage temperature | - | - 55 | 150 | °C |
| $T_j$ | Junction Temperature | - | - | 150 | °C |

## THERMAL RESISTANCES

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $R_{th\ j-mb}$ | Thermal resistance junction to mounting base | | - | - | 0.69 | K/W |
| $R_{th\ j-a}$ | Thermal resistance junction to ambient | | - | 45 | - | K/W |

## PowerMOS transistor
## Fast recovery diode FET

### 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; $I_D$ = 0.25 mA | 400 | - | - | 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 | $V_{DS}$ = 400 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | - | 2 | 20 | μA |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{DS}$ = 400 V; $V_{GS}$ = 0 V; $T_j$ =125 °C | - | 0.1 | 1.0 | mA |
| $I_{GSS}$ | Gate source leakage current | $V_{GS}$ = ±30 V; $V_{DS}$ = 0 V | - | 10 | 100 | nA |
| $R_{DS(ON)}$ | Drain-source on-state resistance | $V_{GS}$ = 10 V; $I_D$ = 6.5 A | - | 0.5 | 0.6 | 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; $I_D$ = 6.5 A | 5.0 | 8.0 | - | S |
| $C_{iss}$ | Input capacitance | $V_{GS}$ = 0 V; $V_{DS}$ = 25 V; f = 1 MHz | - | 1500 | 1800 | pF |
| $C_{oss}$ | Output capacitance | | - | 170 | 270 | pF |
| $C_{rss}$ | Feedback capacitance | | - | 70 | 120 | pF |
| $t_{d on}$ | Turn-on delay time | $V_{DD}$ = 30 V; $I_D$ = 2.8 A; | - | 20 | 40 | ns |
| $t_r$ | Turn-on rise time | $V_{GS}$ = 10 V; $R_{GS}$ = 50 Ω; | - | 60 | 90 | ns |
| $t_{d off}$ | Turn-off delay time | $R_{gen}$ = 50 Ω | - | 200 | 250 | ns |
| $t_f$ | Turn-off fall time | | - | 75 | 90 | ns |
| $L_d$ | Internal drain inductance | Measured from contact screw on tab to centre of die | - | 5 | - | nH |
| $L_d$ | Internal drain inductance | Measured from drain lead 6 mm from package to centre of die | - | 5 | - | nH |
| $L_s$ | Internal source inductance | Measured from source lead 6 mm from package to source bond pad | - | 12.5 | - | nH |
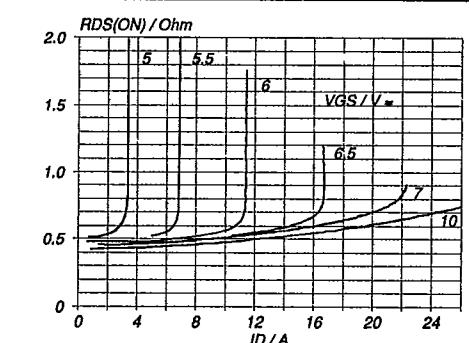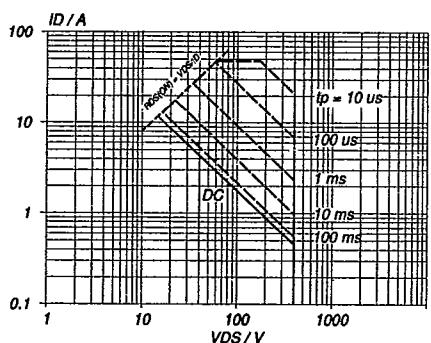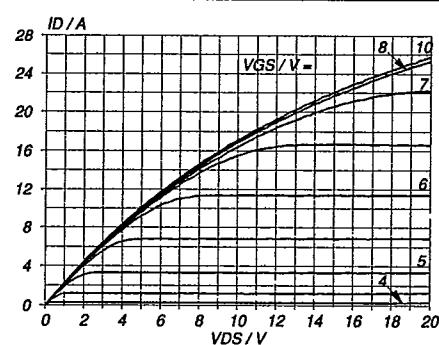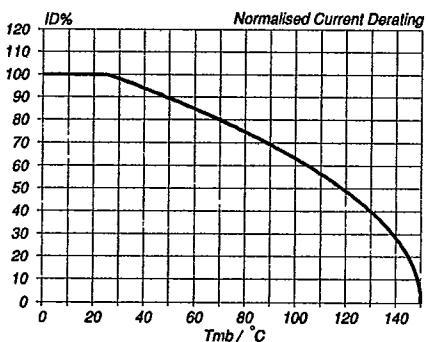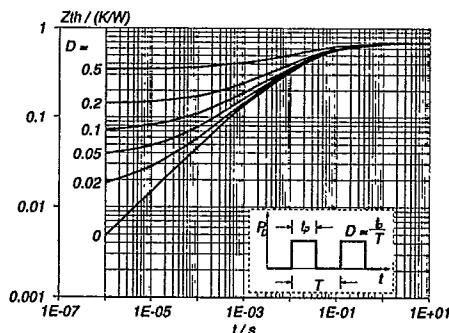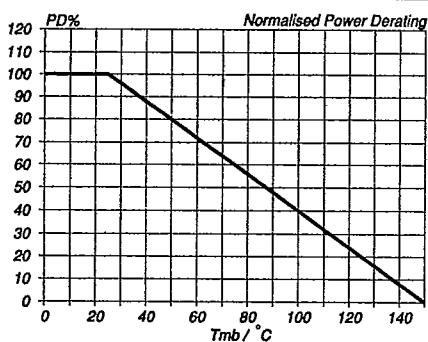
### REVERSE DIODE LIMITING VALUES AND CHARACTERISTICS

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

| SYMBOL | PARAMETER | CONDITIONS | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| $I_{DR}$ | Continuous reverse drain current | - | | - | - | 14 | A |
| $I_{DRM}$ | Pulsed reverse drain current | | | - | - | 56 | A |
| $V_{SD}$ | Diode forward voltage | $I_F$ = 14 A ; | $V_{GS}$ = 0 V | - | 1.1 | 1.5 | V |
| $t_{rr}$ | Reverse recovery time | $I_F$ = 14 A; | $T_j$ - 25 °C | - | 180 | 250 | ns |
| | | -$dI_F$/dt = | $T_j$ - 125 °C | - | 220 | 300 | ns |
| $Q_{rr}$ | Reverse recovery charge | 100 A/μs; | $T_j$ - 25 °C | - | 0.65 | 1.2 | μC |
| | | $V_{GS}$ = 0 V; | $T_j$ - 125 °C | - | 2.6 | 5.0 | μC |
| $I_{rrm}$ | Reverse recovery current | $V_R$ = 100 V | $T_j$ - 125 °C | - | 15 | - | A |

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## Fast recovery diode FET

BUK637-400B



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



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



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



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



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



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

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## BUK637-400B
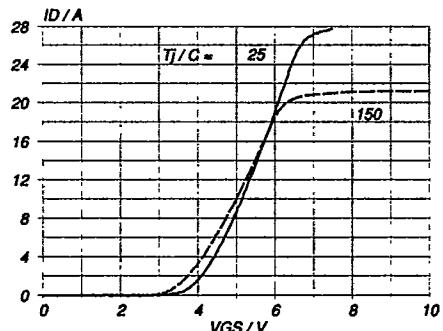


Fig.7. Typical transfer characteristics.
$I_D = f(V_{GS})$ ; conditions: $V_{DS} = 25$ V; parameter $T_j$
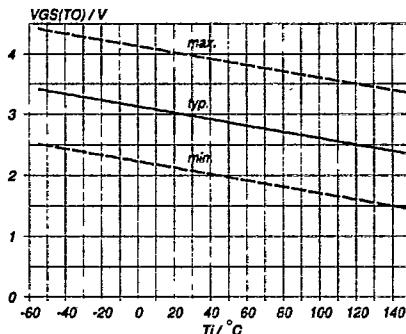


Fig.10. Gate threshold voltage.
$V_{GS(TO)} = f(T_j)$; conditions: $I_D = 1$ mA; $V_{DS} = V_{GS}$
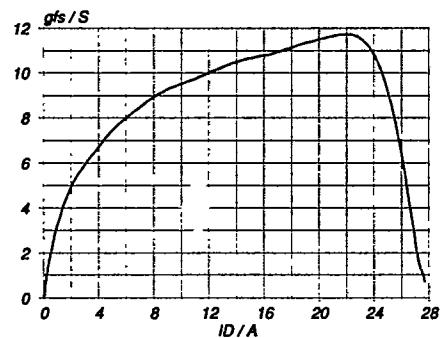


Fig.8. Typical transconductance, $T_j = 25$ °C.
$g_{fs} = f(I_D)$; conditions: $V_{DS} = 25$ V
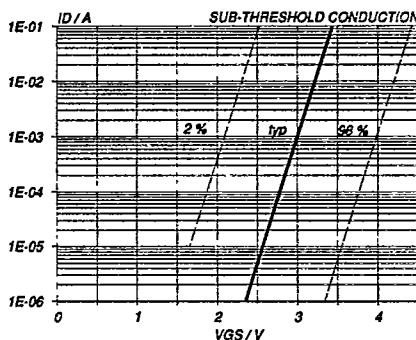


Fig.11. Sub-threshold drain current.
$I_D = f(V_{GS})$; conditions: $T_j = 25$ °C; $V_{DS} = V_{GS}$
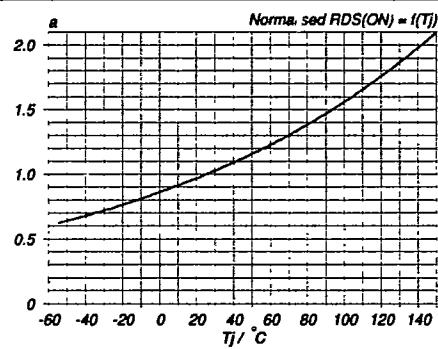


Fig.9. Normalised drain-source on-state resistance.
$a = R_{DS(ON)}/R_{DS(ON)25} °C = f(T_j)$; $I_D = 6.5$ A; $V_{GS} = 10$ V
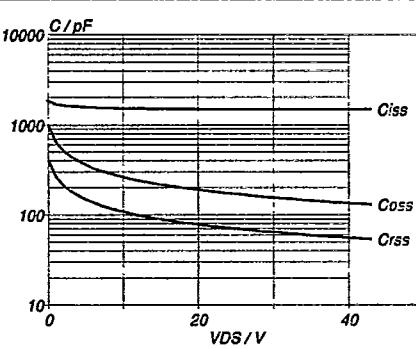


Fig.12. Typical capacitances, $C_{iss}$, $C_{oss}$, $C_{rss}$.
$C = f(V_{DS})$; conditions: $V_{GS} = 0$ V; $f = 1$ MHz
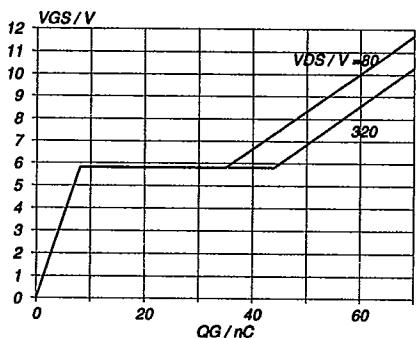
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Fig.13.   Typical turn-on gate-charge characteristics.
$V_{GS} = f(Q_G)$; conditions: $I_D = 14$ A; parameter $V_{DS}$
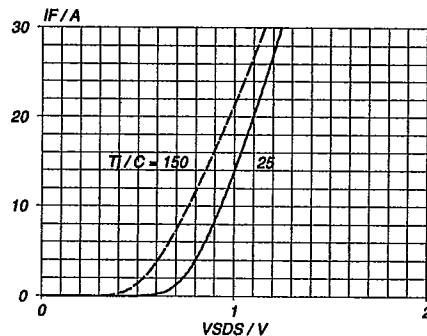


Fig.14.   Typical reverse diode current.
$I_F = f(V_{SDS})$; conditions: $V_{GS} = 0$ V; parameter $T_j$