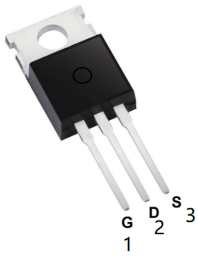
**40 V N-Channel MOSFET**

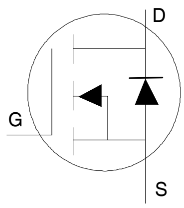
## Applications

- Brushed Motor drive applications
- BLDC Motor drive applications
- Battery powered circuits
- Half-bridge and full-bridge topologies
- Synchronous rectifier applications
- Resonant mode power supplies
- OR-ing and redundant power switches
- DC/DC and AC/DC converters
- DC/AC Inverters




## Benefits

- $V_{DS}$(V) =40V
- $I_D$ =100A ($V_{GS}$= 10V)
- $R_{DS(ON)}$ <2.0mΩ ($V_{GS}$ =10V)




**Static @ $T_J$ = 25°C (unless otherwise specified)**

| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | 40 | | | V | $V_{GS}$ = 0V, $I_D$ = 250μA |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | | 0.029 | | V/°C | Reference to 25°C, $I_D$ = 1mA② |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | | 1.5 | 2.0 | mΩ | $V_{GS}$ = 10V, $I_D$ = 100A |
| | | | 1.8 | | | $V_{GS}$ = 6.0V, $I_D$ = 50A |
| $V_{GS(th)}$ | Gate Threshold Voltage | 2.2 | 3.0 | 3.9 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 150μA |
| $I_{DSS}$ | Drain-to-Source Leakage Current | | | 1.0 | μA | $V_{DS}$ = 40V, $V_{GS}$ = 0V |
| | | | | 150 | | $V_{DS}$ = 40V, $V_{GS}$ = 0V, $T_J$ = 125°C |
| $I_{GSS}$ | Gate-to-Source Forward Leakage | | | 100 | nA | $V_{GS}$ = 20V |
| | Gate-to-Source Reverse Leakage | | | -100 | | $V_{GS}$ = -20V |
| $R_G$ | Internal Gate Resistance | | 2.2 | | Ω | |

## Absolute Maximum Ratings

| Symbol | Parameter | Max. | | Units |
|---|---|---|---|---|
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V (Silicon Limited) | 250① | | A |
| $I_D$ @ $T_C$ = 100°C | Continuous Drain Current, $V_{GS}$ @ 10V (Silicon Limited) | 180 | | |
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V (Wire Bond Limited) | 195 | | |
| $I_{DM}$ | Pulsed Drain Current ② | 1000 | | |
| $P_D$ @$T_C$ = 25°C | Maximum Power Dissipation | 230 | | W |
| | Linear Derating Factor | 1.5 | | W/°C |
| $V_{GS}$ | Gate-to-Source Voltage | ± 20 | | V |
| $T_J$<br>$T_{STG}$ | Operating Junction and<br>Storage Temperature Range | -55 to + 175 | | °C |
| | Soldering Temperature, for 10 seconds (1.6mm from case) | 300 | | |
| | Mounting torque, 6-32 or M3 screw | 10lbf· in (1.1N· m) | | |
| $E_{AS\ (Thermally\ limited)}$ | Single Pulse Avalanche Energy ③ | 350 | | mJ |
| $E_{AS\ (Thermally\ limited)}$ | Single Pulse Avalanche Energy ⑨ | 802 | | |
| $I_{AR}$ | Avalanche Current ② | See Fig. 14, 15, 22a, 22b | | A |
| $E_{AR}$ | Repetitive Avalanche Energy ② | | | mJ |
| $R_{\theta JC}$ | Junction-to-Case ⑧ | | 0.65 | °C/W |
| $R_{\theta CS}$ | Case-to-Sink, Flat Greased Surface | 0.50 | | |
| $R_{\theta JA}$ | Junction-to-Ambient ⑧ | | 62 | |

**Notes:**

① Calculated continuous current based on maximum allowable junction temperature. Bond wire current limit is 195A. Note that current limitations arising from heating of the device leads may occur with some lead mounting arrangements.

② Repetitive rating; pulse width limited by max. junction temperature.

③ Limited by $T_{Jmax}$, starting $T_J$ = 25°C, L = 0.069mH $R_G$ = 50Ω, $I_{AS}$ = 100A, $V_{GS}$ =10V.

④ $I_{SD} \leq$ 100A, di/dt ≤ 1166A/μs, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq$ 175°C.

⑤ Pulse width ≤ 400μs; duty cycle ≤ 2%.

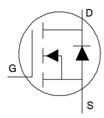
⑥ $C_{oss}$ eff. (TR) is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.

⑦ $C_{oss}$ eff. (ER) is a fixed capacitance that gives the same energy as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.

⑧ $R_\theta$ is measured at $T_J$ approximately 90°C.

⑨ Limited by $T_{Jmax}$ starting $T_J$ = 25°C, L= 1mH, $R_G$ = 50Ω, $I_{AS}$ = 40A, $V_{GS}$ =10V.

**Dynamic @ $T_J$ = 25°C (unless otherwise specified)**

| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| gfs | Forward Transconductance | 160 | | | S | $V_{DS}$ = 10V, $I_D$ = 100A |
| $Q_g$ | Total Gate Charge | | 150 | 225 | nC | $I_D$ = 100A |
| $Q_{gs}$ | Gate-to-Source Charge | | 41 | | | $V_{DS}$ =20V |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | | 51 | | | $V_{GS}$ = 10V ⑤ |
| $Q_{sync}$ | Total Gate Charge Sync. ($Q_g$ - $Q_{gd}$) | | 99 | | | $I_D$ = 100A, $V_{DS}$ =20V, $V_{GS}$ = 10V |
| $t_{d(on)}$ | Turn-On Delay Time | | 19 | | ns | $V_{DD}$ = 20V |
| $t_r$ | Rise Time | | 70 | | | $I_D$ = 30A |
| $t_{d(off)}$ | Turn-Off Delay Time | | 78 | | | $R_G$ = 2.7Ω |
| $t_f$ | Fall Time | | 53 | | | $V_{GS}$ = 10V ⑤ |
| $C_{iss}$ | Input Capacitance | | 7330 | | pF | $V_{GS}$ = 0V |
| $C_{oss}$ | Output Capacitance | | 1095 | | | $V_{DS}$ = 25V |
| $C_{rss}$ | Reverse Transfer Capacitance | | 745 | | | *f* = 1.0 MHz, See Fig. 5 |
| $C_{oss}$ eff. (ER) | Effective Output Capacitance (Energy Related) ⑦ | | 1310 | | | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 32V ⑦, See Fig. 11 |
| $C_{oss}$ eff. (TR) | Effective Output Capacitance (Time Related)⑥ | | 1735 | | | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 32V ⑥ |
| $I_S$ | Continuous Source Current (Body Diode) | | | 250① | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ② | | | 1000 | A | |
| $V_{SD}$ | Diode Forward Voltage | | 1.0 | 1.3 | V | $T_J$ = 25°C, $I_S$ = 100A, $V_{GS}$ = 0V ⑤ |
| dv/dt | Peak Diode Recovery ④ | | 3.1 | | V/ns | $T_J$ = 175°C, $I_S$ = 100A, $V_{DS}$ = 40V ⑤ |
| $t_{rr}$ | Reverse Recovery Time | | 30 | | ns | $T_J$ = 25°C  $V_R$ = 34V, |
| | | | 30 | | | $T_J$ = 125°C  $I_F$ = 100A |
| $Q_{rr}$ | Reverse Recovery Charge | | 24 | | nC | $T_J$ = 25°C  di/dt = 100A/μs ⑤ |
| | | | 25 | | | $T_J$ = 125°C |
| $I_{RRM}$ | Reverse Recovery Current | | 1.3 | | A | $T_J$ = 25°C |

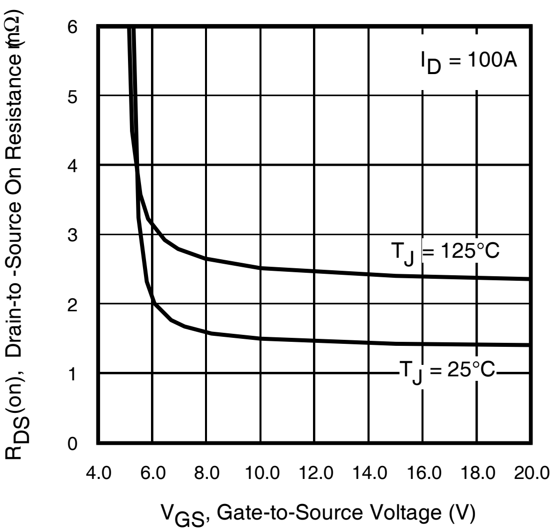



**Fig 1.** Typical On-Resistance vs. Gate Voltage

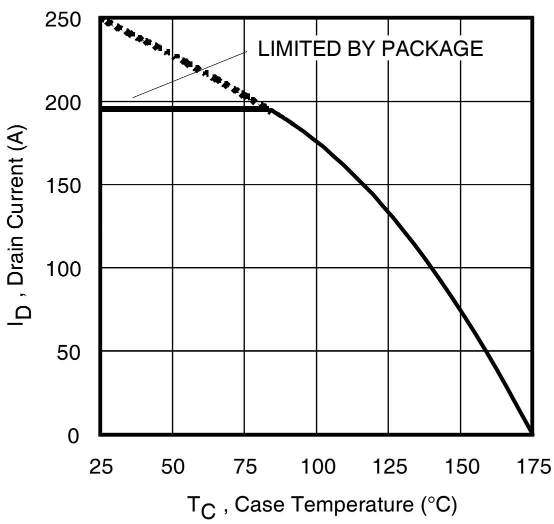



**Fig 2.** Maximum Drain Current vs. Case Temperature

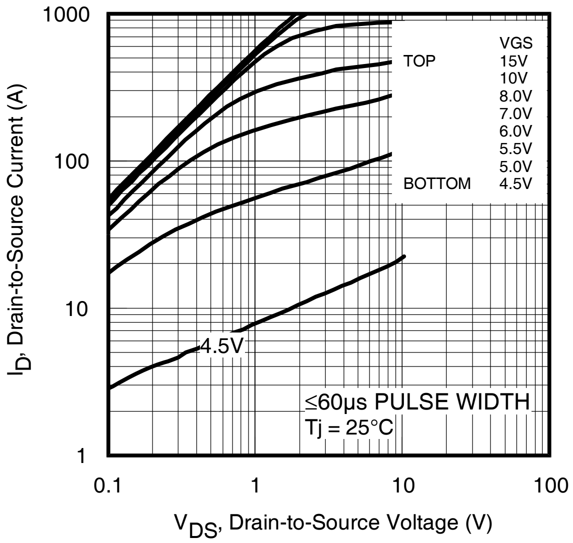



**Fig 3.** Typical Output Characteristics

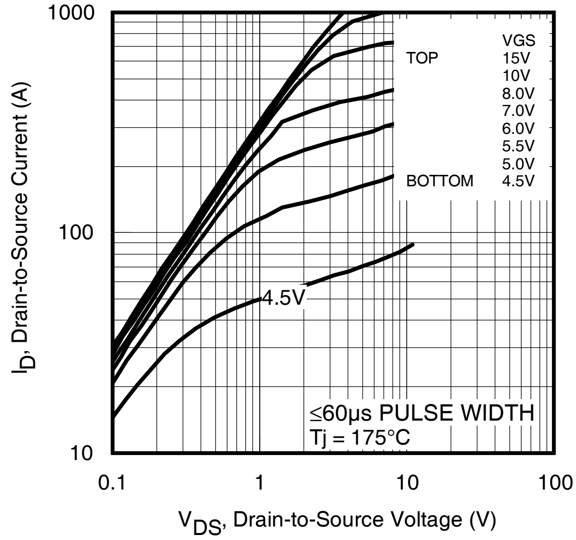



**Fig 4.** Typical Output Characteristics

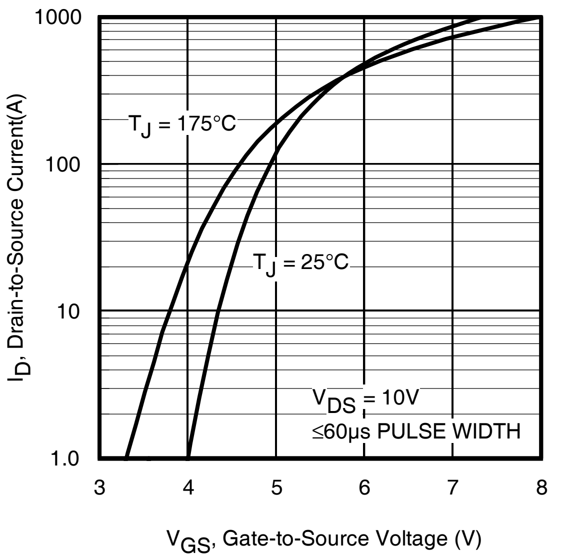



**Fig 5.** Typical Transfer Characteristics

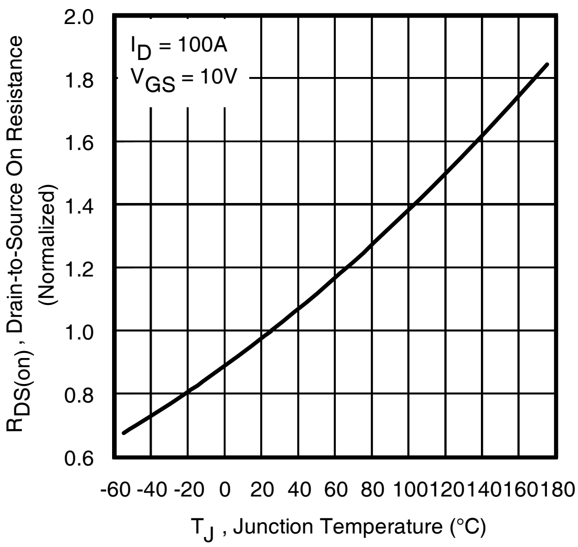



**Fig 6.** Normalized On-Resistance vs. Temperature

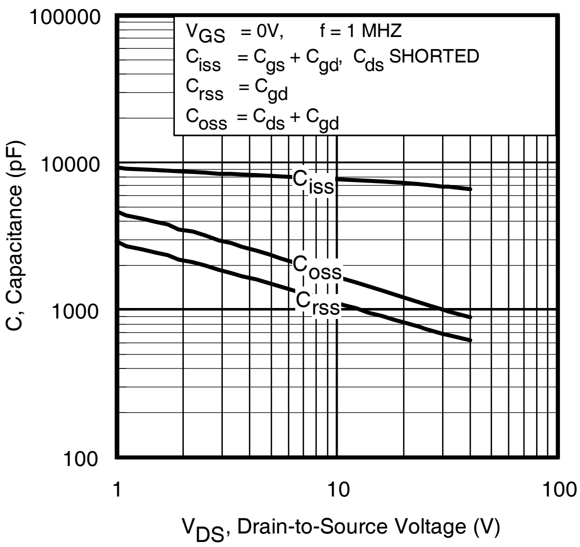



**Fig 7.** Typical Capacitance vs. Drain-to-Source Voltage

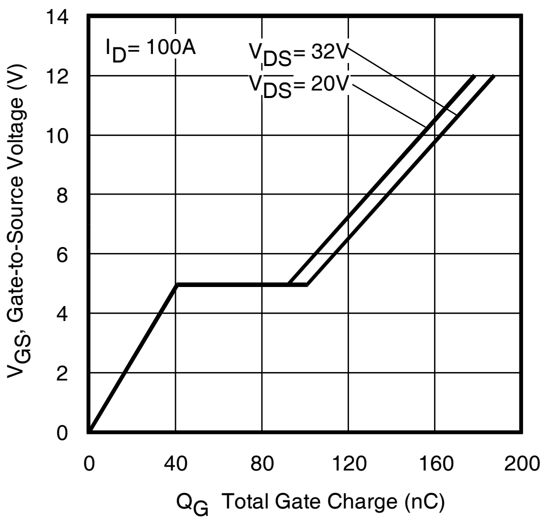



**Fig 8.** Typical Gate Charge vs. Gate-to-Source Voltage

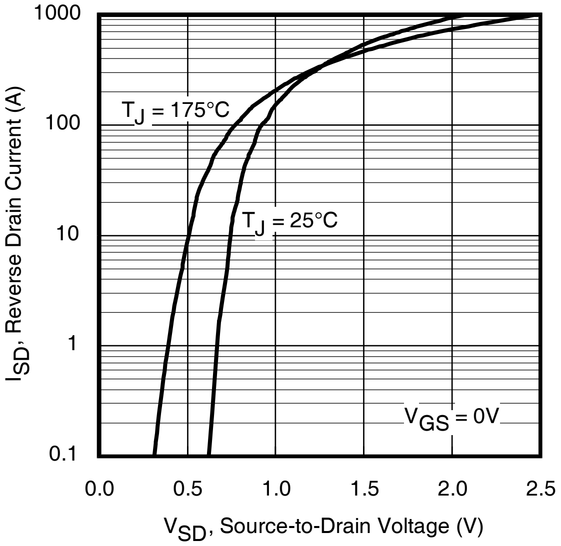



**Fig 9.** Typical Source-Drain Diode Forward Voltage

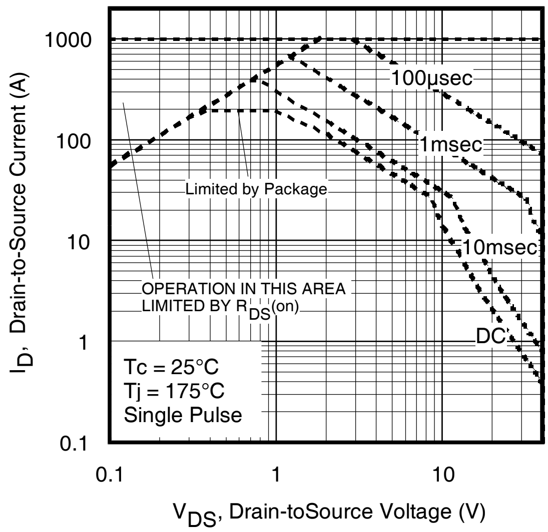



**Fig 10.** Maximum Safe Operating Area

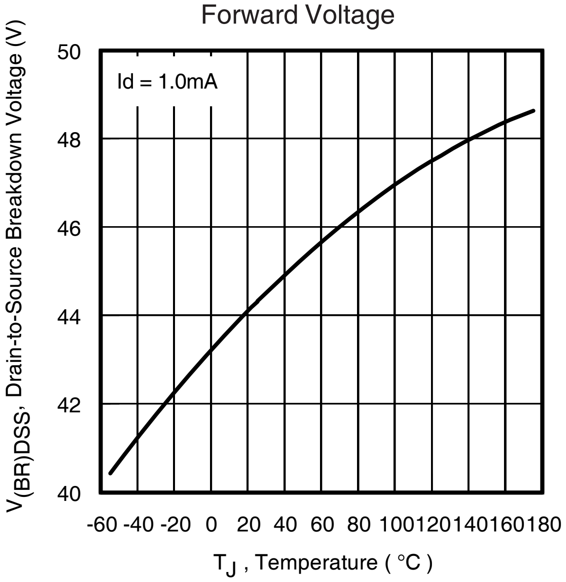



**Fig 11.** Drain-to-Source Breakdown Voltage

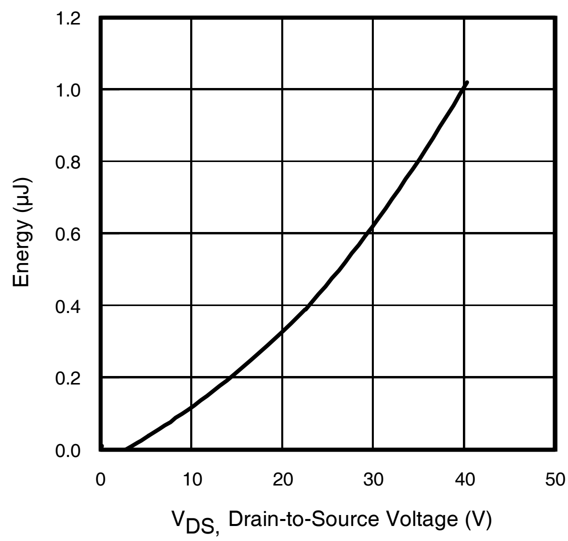



**Fig 12.** Typical $C_{OSS}$ Stored Energy

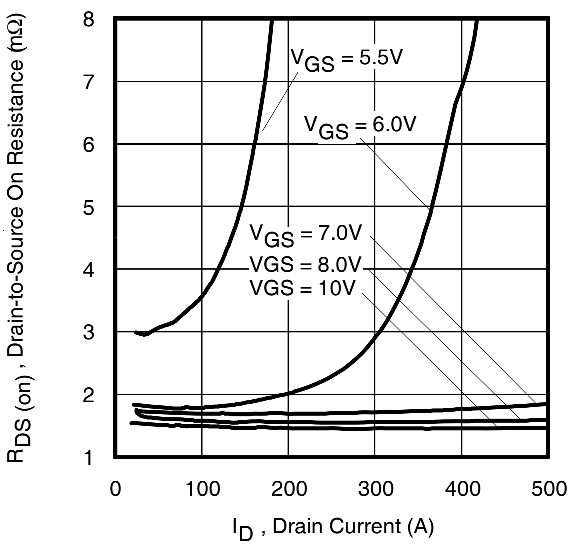



**Fig 13.** Typical On-Resistance vs. Drain Current

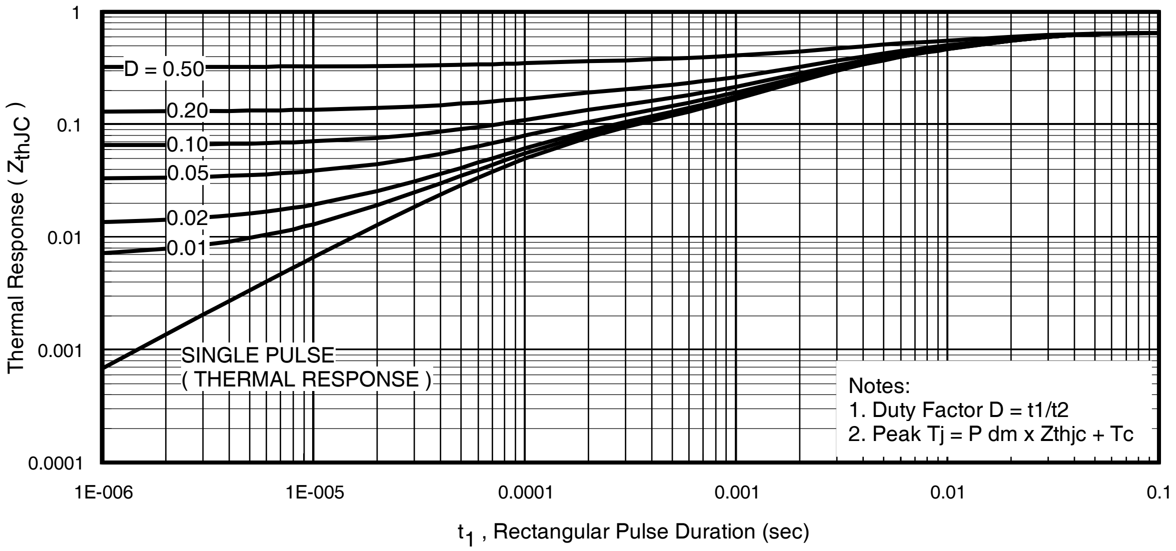



**Fig 14.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

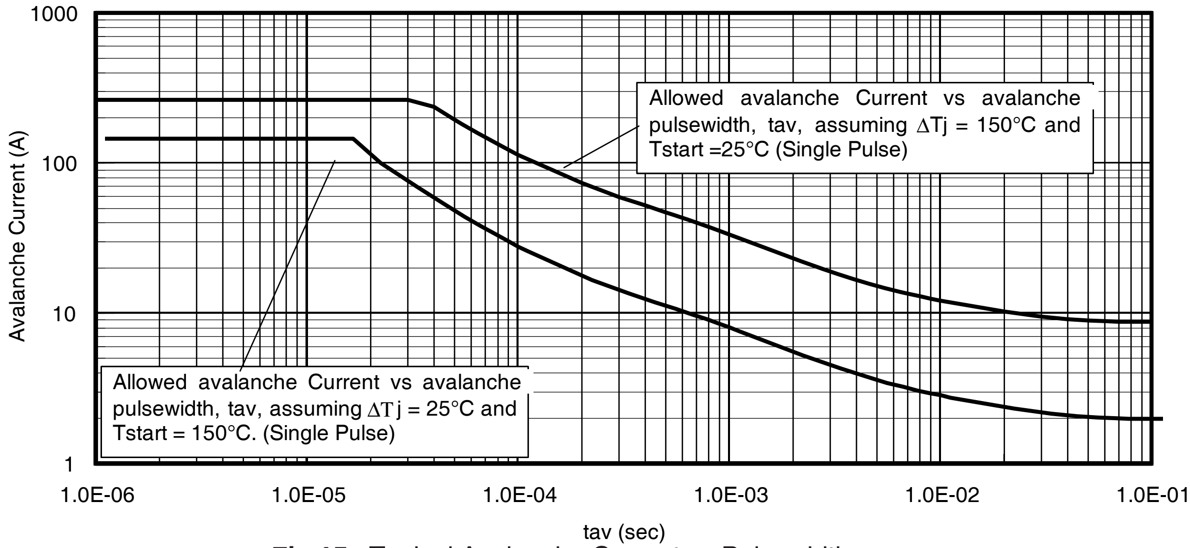



**Fig 15.** Typical Avalanche Current vs.Pulsewidth

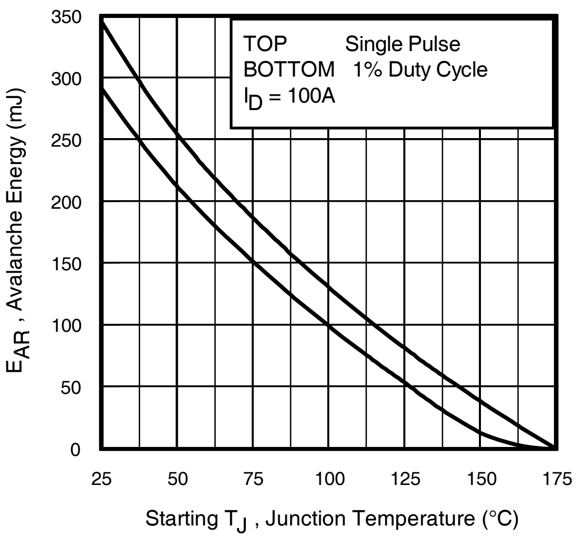



**Fig 16.** Maximum Avalanche Energy vs. Temperature

**Notes on Repetitive Avalanche Curves , Figures 14, 15:**

1. Avalanche failures assumption:
   Purely a thermal phenomenon and failure occurs at a temperature far in excess of $T_{jmax}$. This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as $T_{jmax}$ is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 22a, 22b.
4. $P_{D\ (ave)}$ = Average power dissipation per single avalanche pulse.
5. BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
6. $I_{av}$ = Allowable avalanche current.
7. ΔT = Allowable rise in junction temperature, not to exceed $T_{jmax}$ (assumed as 25°C in Figure 14, 15).
   $t_{av}$ = Average time in avalanche.
   D = Duty cycle in avalanche = $t_{av} \cdot f$
   $Z_{thJC}(D, t_{av})$ = Transient thermal resistance

$$P_{D\ (ave)} = 1/2\ (\ 1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$
$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$
$$E_{AS\ (AR)} = P_{D\ (ave)} \cdot t_{av}$$

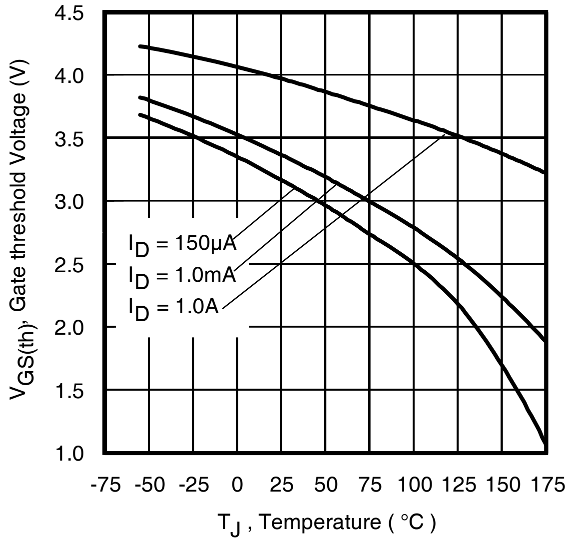



**Fig 17.** Threshold Voltage vs. Temperature

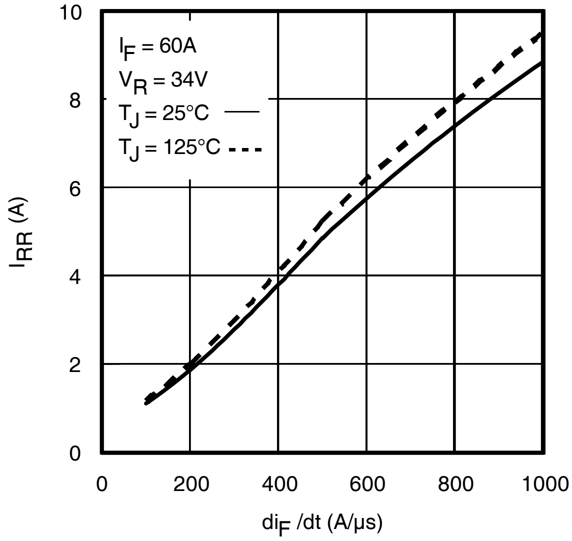



**Fig 18. -** Typical Recovery Current vs. $di_f/dt$

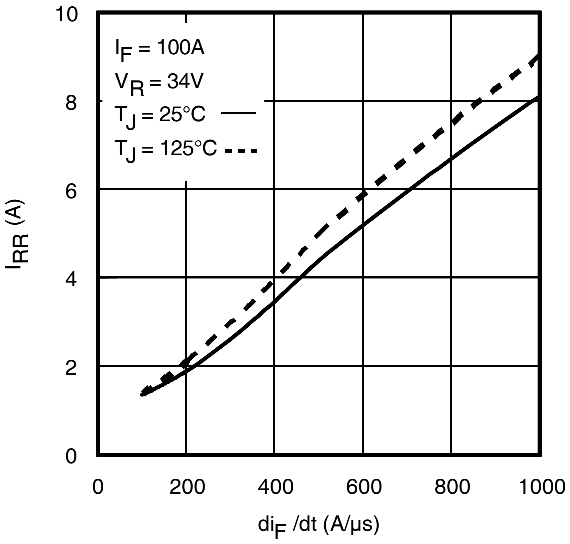



**Fig 19. -** Typical Recovery Current vs. $di_f/dt$

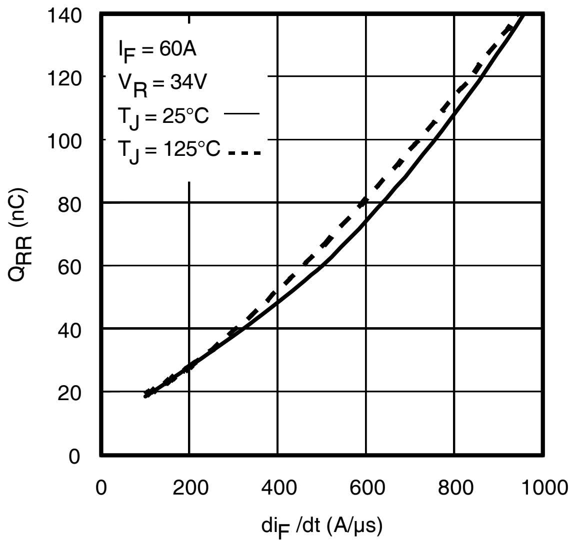



**Fig 20. -** Typical Stored Charge vs. $di_f/dt$

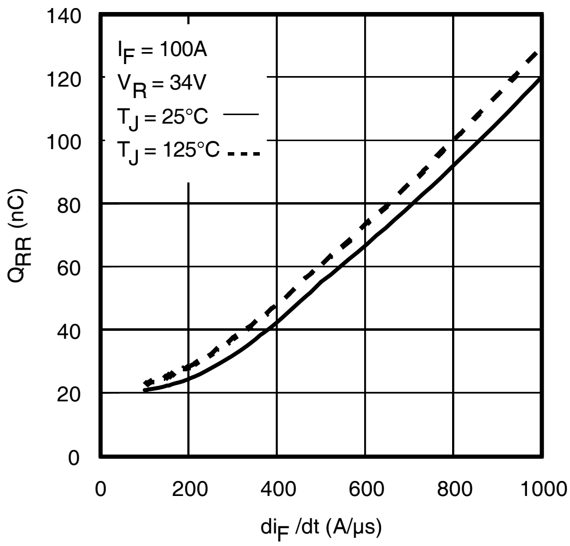
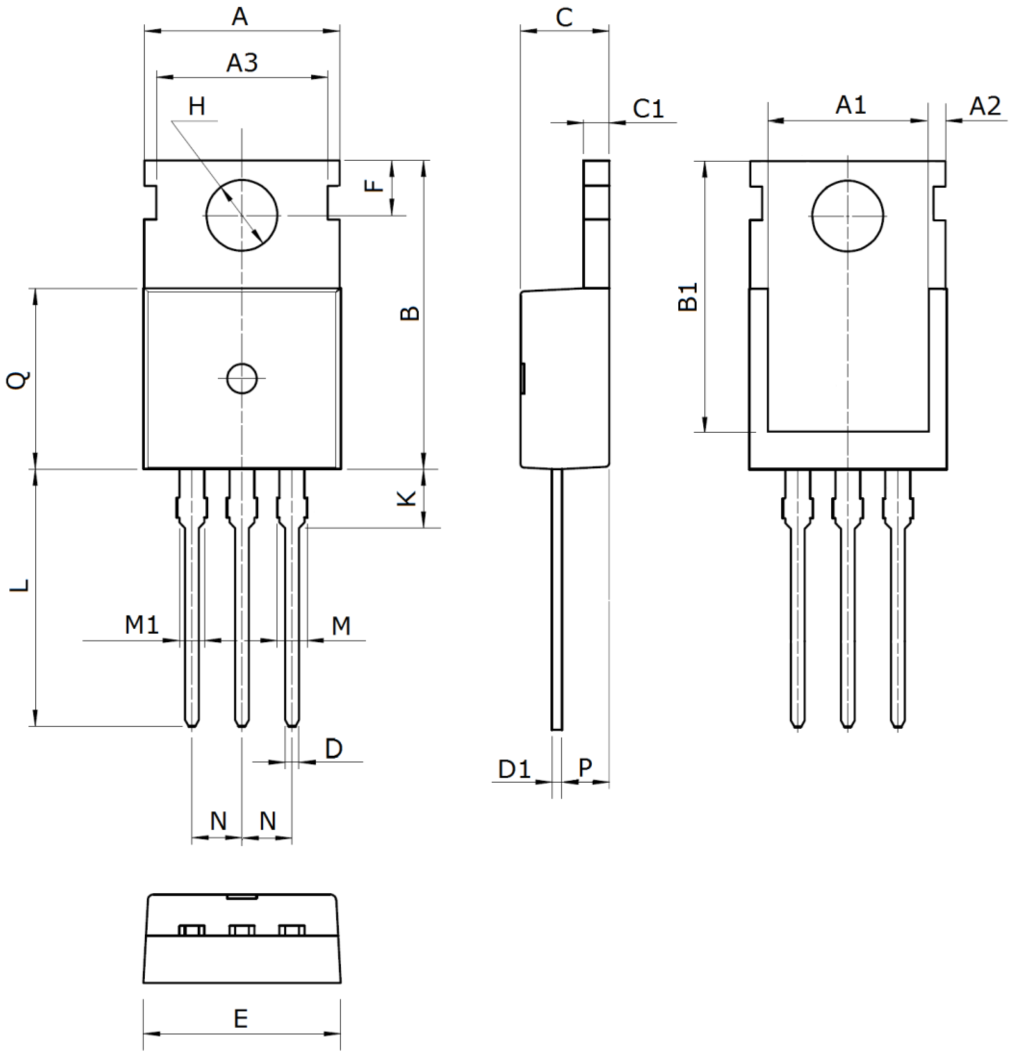



**Fig 21. -** Typical Stored Charge vs. $di_f/dt$

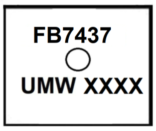
## Package Demensions

TO 220




| Symbol | Dimensions （mm） | Symbol | Dimensions (mm) | Symbol | Dimensions (mm) |
|---|---|---|---|---|---|
| A | 10.0±0.3 | C1 | 1.3±0.2 | L | 13.2±0.4 |
| A1 | 8.0±0.2 | D | 0.8±0.2 | M | 1.38±0.1 |
| A2 | 0.94±0.1 | D1 | 0.5±0.1 | M1 | 1.28±0.1 |
| A3 | 8.7±0.1 | E | 10.0±0.3 | N | 2.54(typ) |
| B | 15.6±0.4 | F | **2.8±0.1** | P | 2.4±0.3 |
| B1 | **13.2±0.2** | H | 3.6±0.1 | Q | **9.15±0.25** |
| C | **4.5±0.2** | K | 3.1±0.2 | | |

## Marking




## Ordering information

| Order code | Package | Baseqty | Deliverymode |
|---|---|---|---|
| UMW IRFB7437PBF | TO-220 | 1000 | Tube and box |