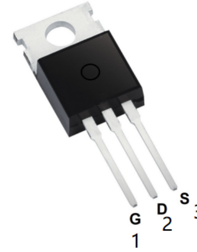
UMW®

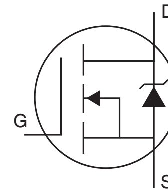
IRF2804

40 V N-Channel MOSFET

Features

- V_{DS}(V) =40V
- I_D =75A (V_{GS}= 10V)
- $R_{DS(ON)}$ <2.0mΩ (V_{GS} =10V)
- $R_{DS(ON)}$ <2.3mΩ (V_{GS} =4.5V)





Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	270	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V (See Fig. 9)	190	
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V (Package Limited)	75	
IDM	Pulsed Drain Current ①	1080	
P_D @T_C = 25°C	Maximum Power Dissipation	300	W
	Linear Derating Factor	2.0	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy (Thermally Limited) ②	540	mJ
E_{AS} (tested)	Single Pulse Avalanche Energy Tested Value ⑦	1160	
I_{AR}	Avalanche Current ①	See Fig.12a,12b,15,16	A
E_{AR}	Repetitive Avalanche Energy ⑥		mJ
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting torque, 6-32 or M3 screw	10 lbf•in (1.1N•m)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case		0.50⑩	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50		
$R_{\theta JA}$	Junction-to-Ambient		62	
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount, steady state)⑧		40	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	40			V	V_{GS} = 0V, I_D = 250μA
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient		0.031		V/°C	Reference to 25°C, I_D = 1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance		1.5	2.0	mΩ	V_{GS} = 10V, I_D = 75A ④
$R_{DS(on)}$	Static Drain-to-Source On-Resistance		1.8	2.3		V_{GS} = 10V, I_D = 75A ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0		4.0	V	V_{DS} = V_{GS}, I_D = 250μA
gfs	Forward Transconductance	130			S	V_{DS} = 10V, I_D = 75A
I_{DSS}	Drain-to-Source Leakage Current			20	μA	V_{DS} = 40V, V_{GS} = 0V
				250		V_{DS} = 40V, V_{GS} = 0V, T_J = 125°C
I_{GSS}	Gate-to-Source Forward Leakage			200	nA	V_{GS} = 20V
	Gate-to-Source Reverse Leakage			-200		V_{GS} = -20V
Q_g	Total Gate Charge		160	240	nC	I_D = 75A
Q_{gs}	Gate-to-Source Charge		41	62		V_{DS} = 32V
Q_{gd}	Gate-to-Drain ("Miller") Charge		66	99		V_{GS} = 10V ④
$t_{d(on)}$	Turn-On Delay Time		13		ns	V_{DD} = 20V
t_r	Rise Time		120			I_D = 75A
$t_{d(off)}$	Turn-Off Delay Time		130			R_G = 2.5Ω
t_f	Fall Time		130			V_{GS} = 10V ④
L_D	Internal Drain Inductance		4.5		nH	Between lead, 6mm (0.25in.)
L_S	Internal Source Inductance		7.5			from package and center of die contact
C_{iss}	Input Capacitance		6450		pF	V_{GS} = 0V
C_{oss}	Output Capacitance		1690			V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance		840			f = 1.0MHz, See Fig. 5
C_{oss}	Output Capacitance		5350			V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz
C_{oss}	Output Capacitance		1520			V_{GS} = 0V, V_{DS} = 32V, f = 1.0MHz
C_{oss} eff.	Effective Output Capacitance		2210			V_{GS} = 0V, V_{DS} = 0V to 32V
I_S	Continuous Source Current (Body Diode)			270	A	MOSFET symbol showing the
I_{SM}	Pulsed Source Current (Body Diode) ①			1080		integral reverse p-n junction diode.
V_{SD}	Diode Forward Voltage			1.3	V	T_J = 25°C, I_S = 75A, V_{GS} = 0V ④
t_{rr}	Reverse Recovery Time		56	84	ns	T_J = 25°C, I_F = 75A, V_{DD} = 20V
Q_{rr}	Reverse Recovery Charge		67	100	nC	di/dt = 100A/μs ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

Notes:

① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).

② Limited by T_{Jmax}, starting T_J = 25°C, L=0.24mH, R_G = 25Ω, I_{AS} = 75A, V_{GS} =10V. Part not recommended for use above this value.

③ $I_{SD} \leq$ 75A, di/dt $\leq$ 220A/μs, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq$ 175°C.

④ Pulse width ≤ 1.0ms; duty cycle ≤ 2%.

⑤ C_{oss} eff. is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

⑥ Limited by T_{Jmax} , see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.

⑦ This value determined from sample failure population. 100% tested to this value in production.

⑧ This is applied to D^2Pak, when mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.

⑨ Max $R_{DS(on)}$ for D^2Pak and TO-262 (SMD) devices.

⑩ TO-220 device will have an Rth value of 0.45°C/W.

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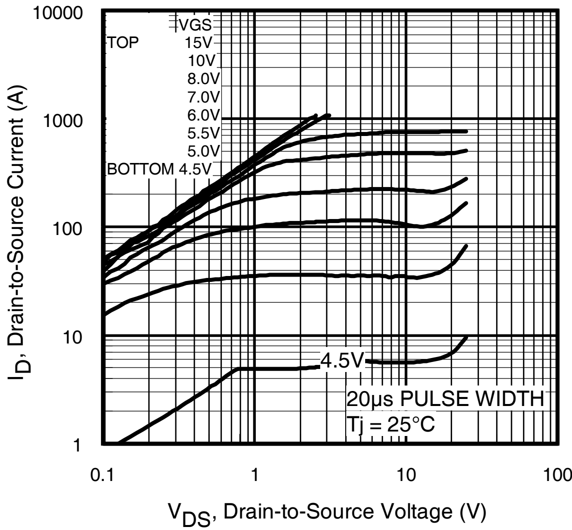

Fig 1. Typical Output Characteristics

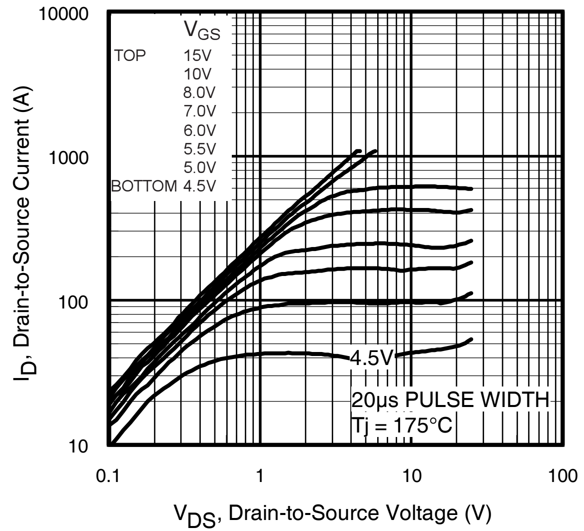

Fig 2. Typical Output Characteristics

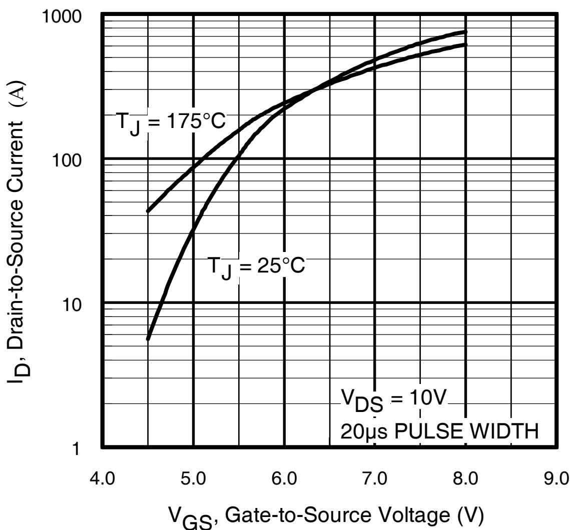

Fig 3. Typical Transfer Characteristics

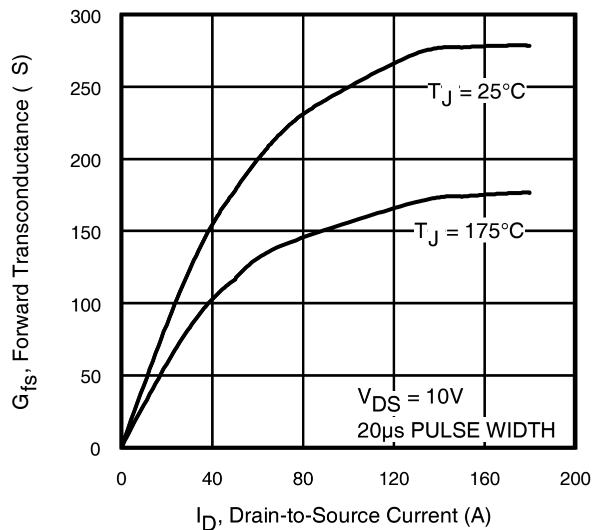

Fig 4. Typical Forward Transconductance vs. Drain Current

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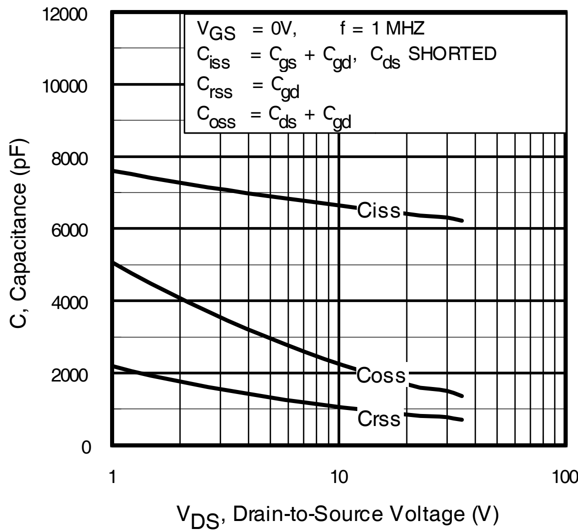

Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

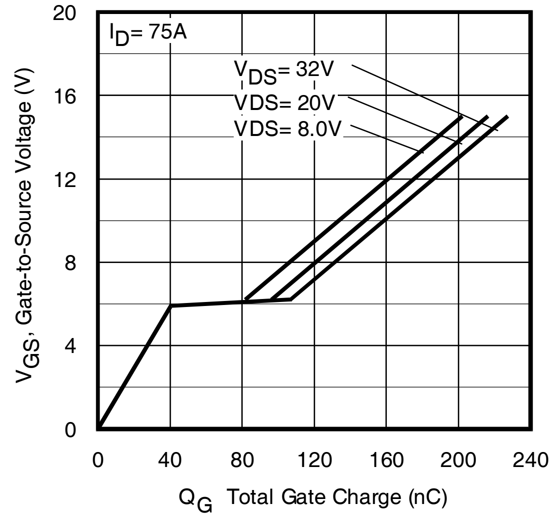

Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

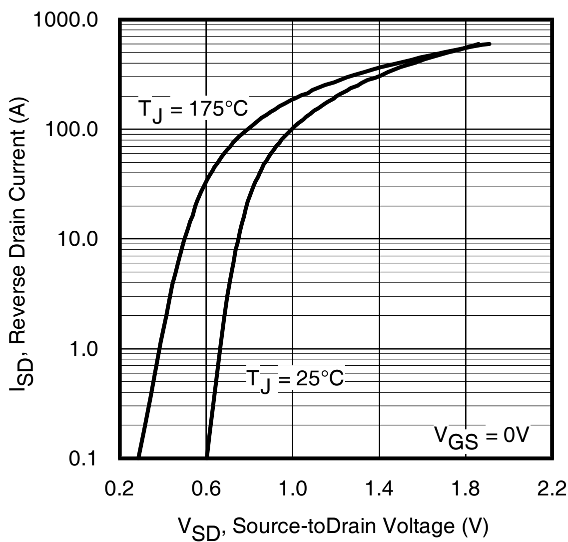

Fig 7. Typical Source-Drain Diode Forward Voltage

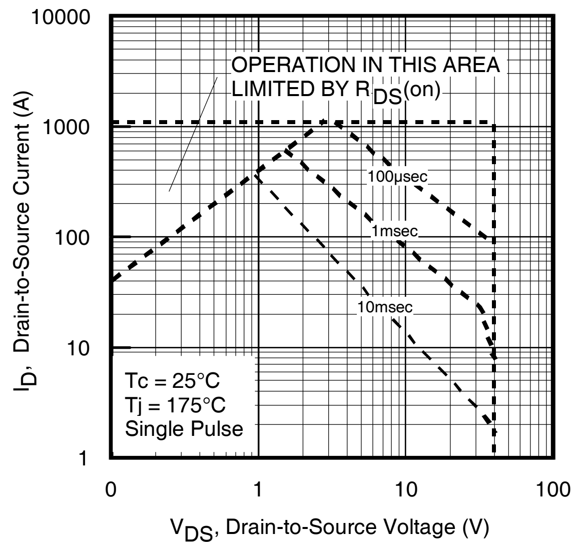

Fig 8. Maximum Safe Operating Area

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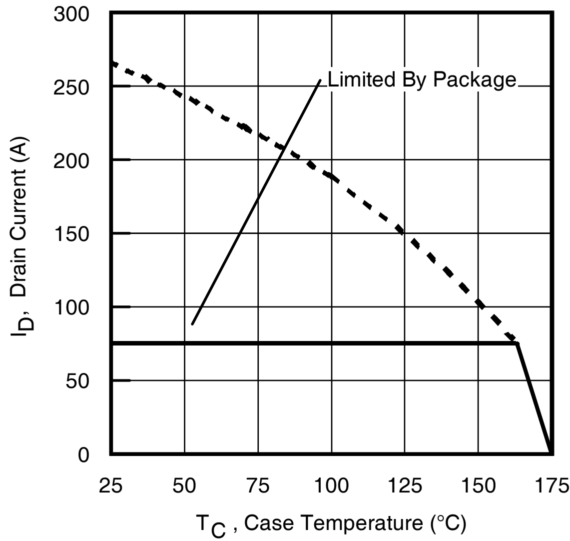

Fig 9. Maximum Drain Current vs. Case Temperature

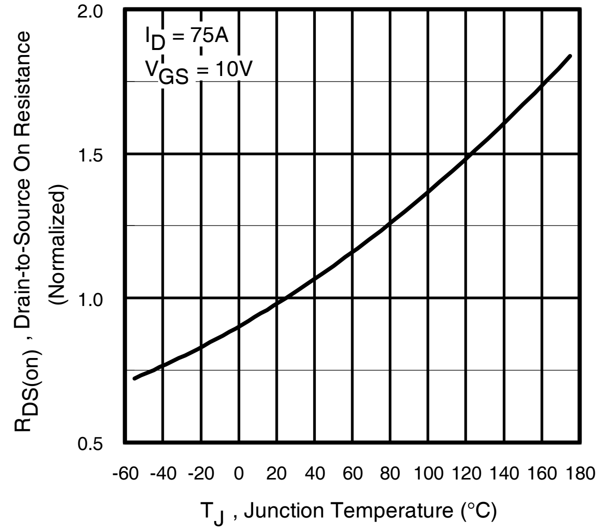

Fig 10. Normalized On-Resistance vs. Temperature

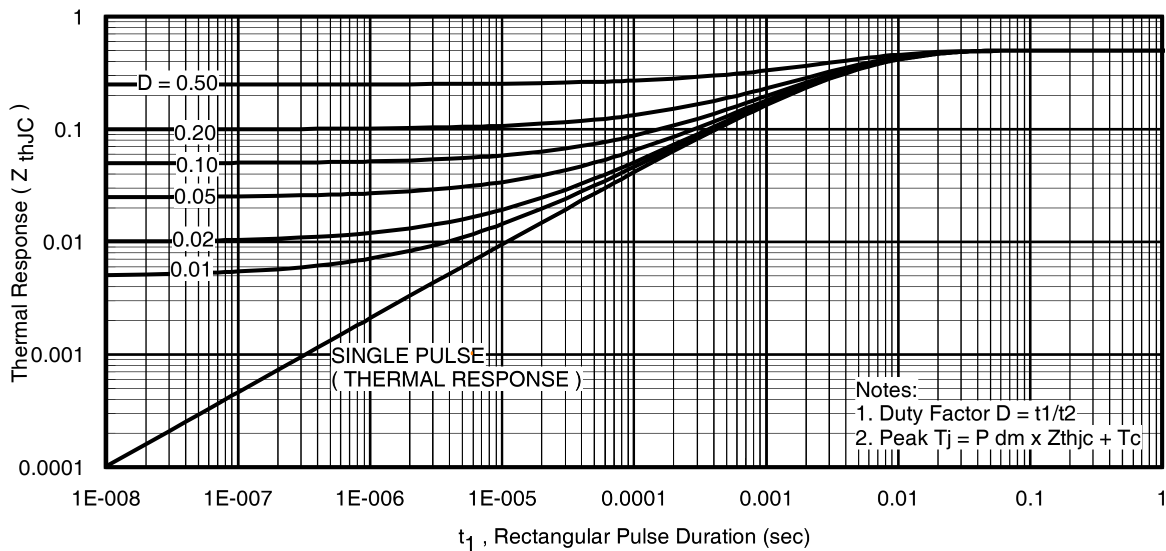

Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

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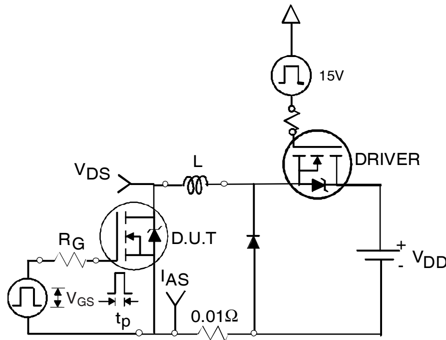

Fig 12a. Unclamped Inductive Test Circuit

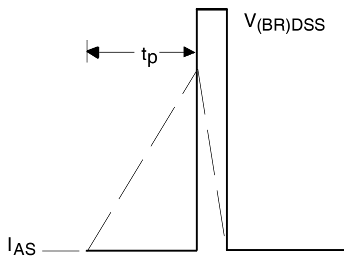

Fig 12b. Unclamped Inductive Waveforms

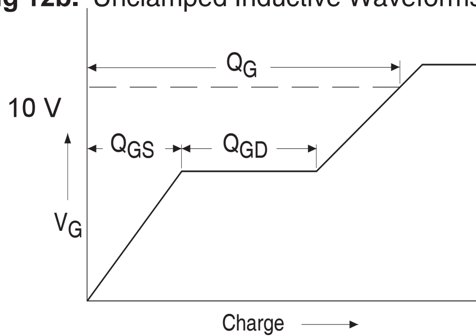

Fig 13a. Basic Gate Charge Waveform

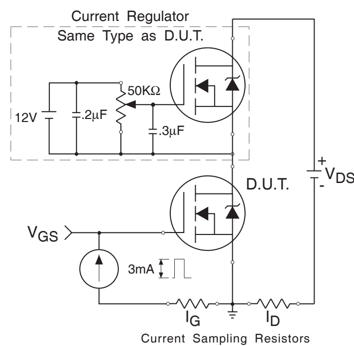

Fig 13b. Gate Charge Test Circuit

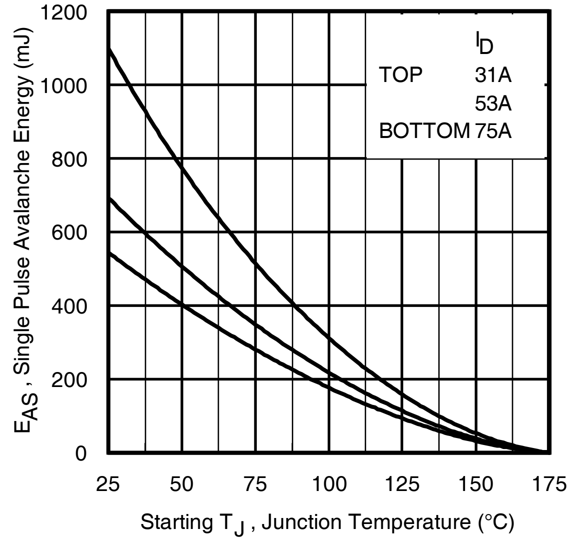

Fig 12c. Maximum Avalanche Energy vs. Drain Current

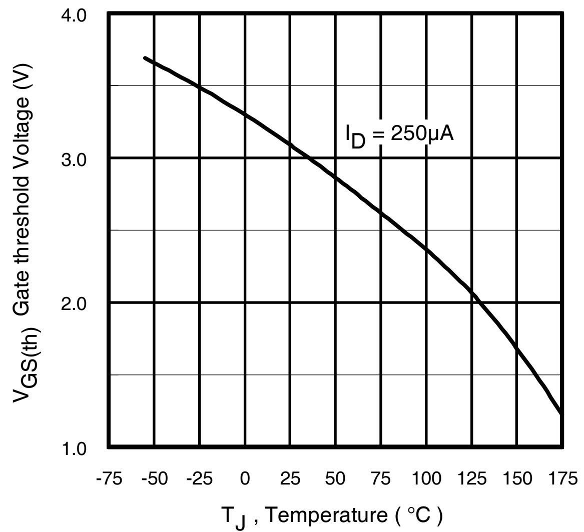

Fig 14. Threshold Voltage vs. Temperature

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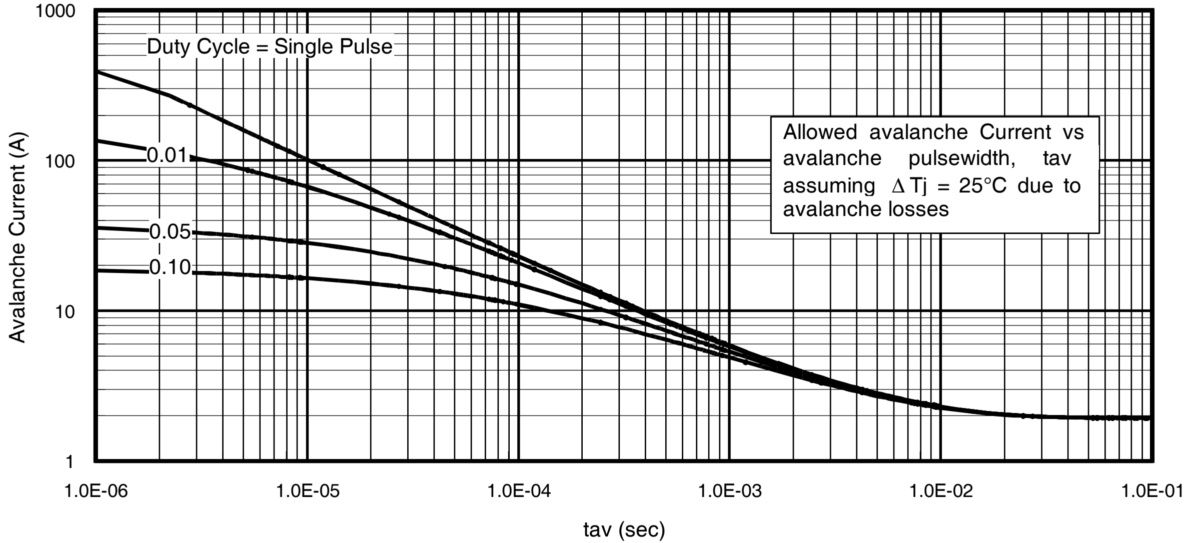

Fig 15. Typical Avalanche Current Vs.Pulsewidth

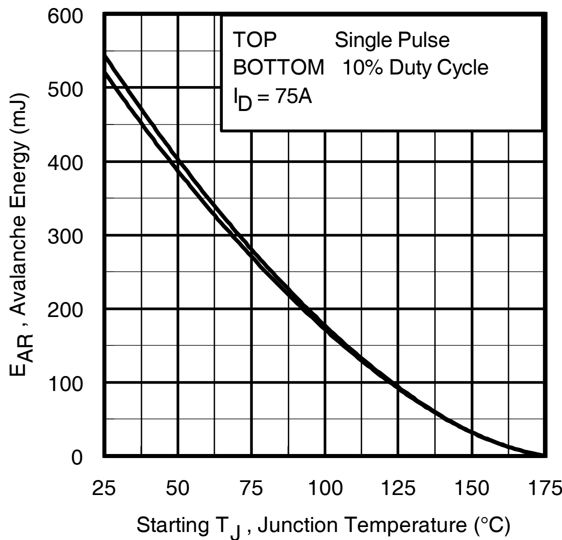

Fig 16. Maximum Avalanche Energy vs. Temperature

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 12a, 12b.
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 15, 16).
   t_{av} = Average time in avalanche.
   D = Duty cycle in avalanche = $t_{av} \cdot f$
   $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see figure 11)

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

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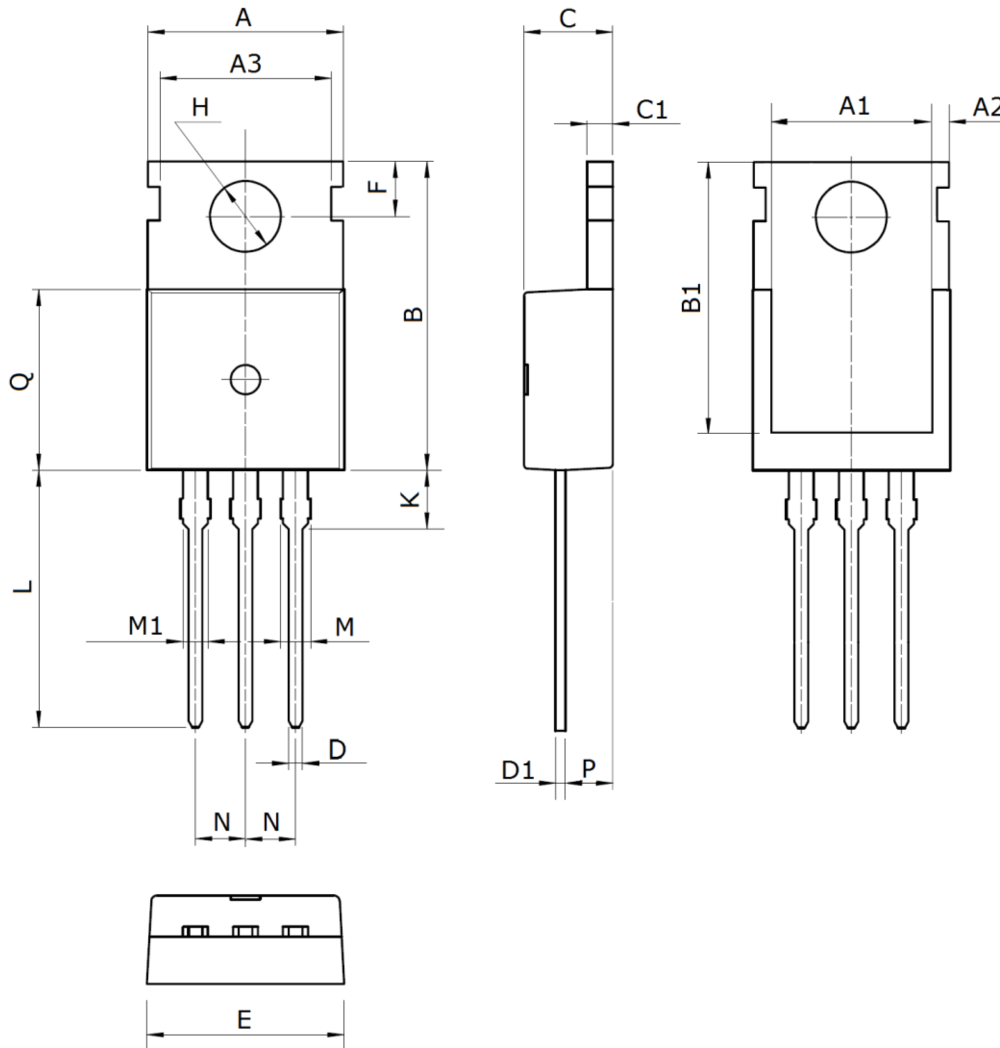
Package Demensions

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		

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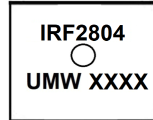
Marking



Ordering information

Order code	Package	Baseqty	Deliverymode
UMW IRF2804PBF	TO-220	1000	Tube and box

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>>UMW(友台半导体)

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