UMW IRF2804PBF

40V N-Channel MOSFET

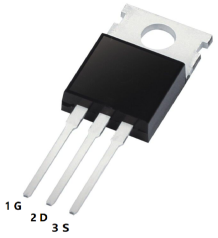
1.Features

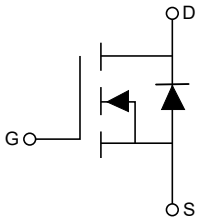
- $V_{DS(V)}$=40V
- I_D=75A
- $R_{DS(ON)}$<2mΩ(V_{GS}=10V)
- $R_{DS(ON)}$<2.3mΩ(V_{GS}=4.5V)

2.Pinning information

Pin	Symbol	Description
1	G	GATE
2	D	DRAIN
3	S	SOURCE

TO-220





3.Absolute Maximum Ratings

Parameter		Symbol	Rating	Units
Continuous Drain Current, V_{GS}=10V(Silicon Limited	T_C=25°C	I_D	270	A
Continuous Drain Current, V_{GS}=10V(See Fig. 9)	T_C=100°C		190	A
Continuous Drain Current, V_{GS}=10V(Package Limited)	T_C=25°C		75	A
Pulsed Drain Current ①		I_{DM}	1080	A
Maximum Power Dissipation	T_C=25°C	P_D	300	W
Linear Derating Factor			2	W/°C
Gate-to-Source Voltage		V_{GS}	±20	V
Single Pulse Avalanche Energy (Thermally Limited) ②		E_{AS}	540	mJ
Single Pulse Avalanche Energy Tested Value ⑦		$E_{AS(tested)}$	1160	mJ
Avalanche Current ①		I_{AR}	See Fig.14a,	A
Repetitive Avalanche Energy ⑥		E_{AR}	14b,16,17	mJ
Storage Temperature Range		T_J, T_{STG}	-55 to 175	°C
Soldering Temperature, for 10 seconds			300(1.6mm from case)	°C
Mounting torque, 6-32 or M3 screw			10 lbf•in (1.1N•m)	

4.Thermal resistance rating

Parameter	Symbol	Typ	Max	Units
Junction-to-Case	$R_{\theta JC}$		0.5⑩	°C/W
Case-to-Sink, Flat Greased Surface	$R_{\theta CS}$	0.5		°C/W
Junction-to-Ambient	$R_{\theta JA}$		62	°C/W
Junction-to-Ambient (PCB Mount, steady state) ⑧	$R_{\theta JA}$		40	°C/W

5.Electrical Characteristics @ T_J= 25°C (unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	I_D=250μA, V_{GS}=0V	40			V
Breakdown Voltage Temp. Coefficient	$\Delta V_{(BR)DSS}/\Delta T_J$	I_D=1mA,Reference to 25°C		0.031		V/°C
Static Drain-to-Source On-Resistance	$R_{DS(ON)}$	V_{GS}=10V, I_D=75A ④		1.5	2	mΩ
Static Drain-to-Source On-Resistance	$R_{DS(ON)}$	V_{GS}=10V, I_D=75A ④		1.8	2.3	mΩ
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS}=V_{GS}, I_D=250μA	2		4	V
Forward Transconductance	g_{FS}	V_{DS}=10V, I_D=75A	130			S
Drain-to-Source Leakage Current	I_{DSS}	V_{DS}=40V, V_{GS}=0V			20	μA
		V_{DS}=40V, V_{GS}=0V, T_J=125°C			250	μA
Gate-to-Source Forward Leakage	I_{GSS}	V_{GS}=20V			200	nA
Gate-to-Source Reverse Leakage		V_{GS}=-20V			-200	nA
Total Gate Charge	Q_g	I_D=75A, V_{DS}=32V, V_{GS}=10V④		160	240	nC
Gate-to-Source Charge	Q_{gs}			41	62	nC
Gate-to-Drain ("Miller") Charge	Q_{gd}			66	99	nC
Tum-On Delay Time	$t_{D(on)}$	V_{DD}=20V, I_D=75A R_G=2.5Ω, V_{GS}=10V④		13		ns
Rise Time	t_r			120		ns
Turn-Off Delay Time	$t_{D(off)}$			130		ns
Fall Time	t_f			130		ns
Internal Drain Inductance	L_D	Between lead, 6mm (0.25in.) from package and center of die contact		4.5		nH
Internal Source Inductance	L_S			7.5		
Input Capacitance	C_{iss}	V_{GS}=0V, V_{DS}=25V, f=1.0MHz See Fig. 5		6450		pF
Output Capacitance	C_{oss}			1690		pF
Reverse Transfer Capacitance	C_{rss}			840		pF
Output Capacitance	C_{oss}	V_{GS}=0V, V_{DS}=1V, f=1MHz		5350		pF
Output Capacitance	C_{oss}	V_{GS}=0V, V_{DS}=32V, f=1MHz		1520		pF
Effective Output Capacitance	C_{oss}eff.(ER)	V_{GS}=0V, V_{DS}=0V to 32V		2210		pF

Diode Characteristics						
Continuous Source Current (Body Diode)	I_S	MOSFET symbol showing the integral reverse p-n junction diode.			270	A
Pulsed Source Current (Body Diode) ①	I_{SM}				1080	A
Diode Forward Voltage	V_{SD}	T_J=25°C,I_S=75A,V_{GS}=0V ④			1.3	V
Reverse Recovery Time	t_{rr}	T_J=25°C,I_S=75A,V_{DD}=20V di/dt=100A/μs ④		56	84	ns
Reverse Recovery Charge	Q_{rr}			67	100	nC
Forward Turn-On Time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L_S+L_D)				

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} ≤75A, di/dt ≤220A/μs, V_{DD} ≤ $V_{(BR)DSS}$, T_J ≤ 175°C.

④ Pulse width ≤ 1ms; 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 D2Pak and TO-262 (SMD) devices.

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

6.1Typical Characterisitics

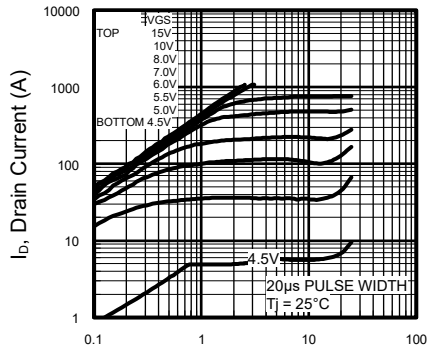


Figure 1: Typical Output Characteristics

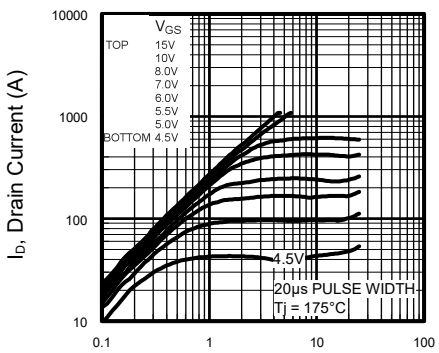


Figure 2: Typical Output Characteristics

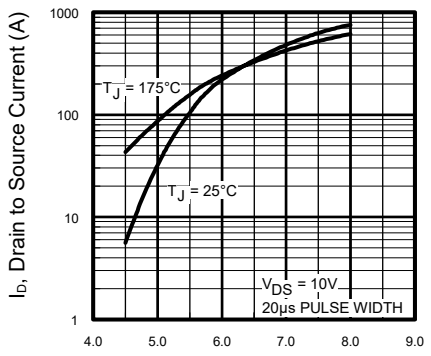


Figure 3: Typical Transfer Characteristics

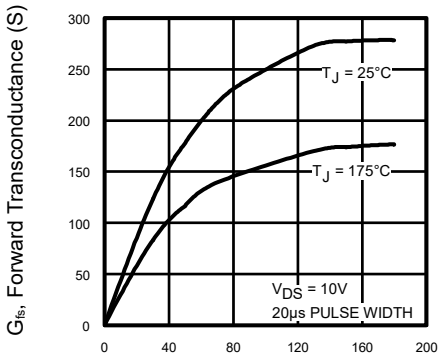


Figure 4: Typical Forward Transconductance vs. Drain Current

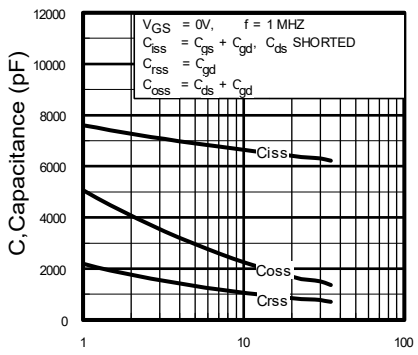


Figure 5: Typical Capacitance vs. Drain-to-Source Voltage

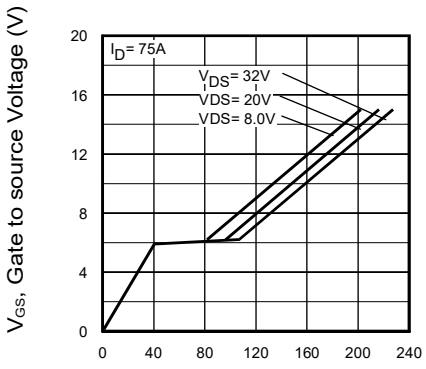


Figure 6: Typical Gate Charge vs. Gate-to-Source Voltage

6.2Typical Characterisitics

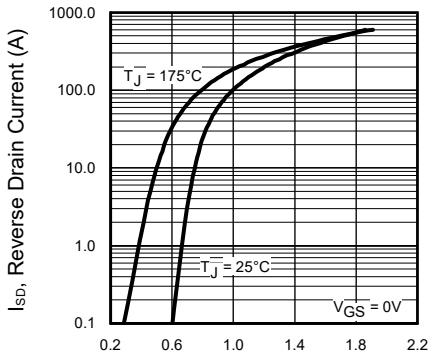


Figure 7: Typical Source-Drain Diode Forward Voltage

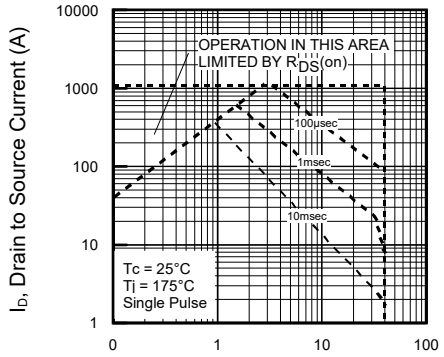


Figure 8: Maximum Safe Operating Area

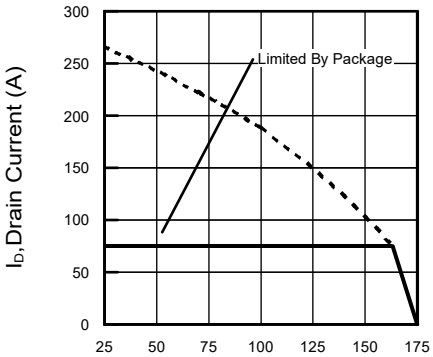


Figure 9: Maximum Drain Current vs. Case Temperature

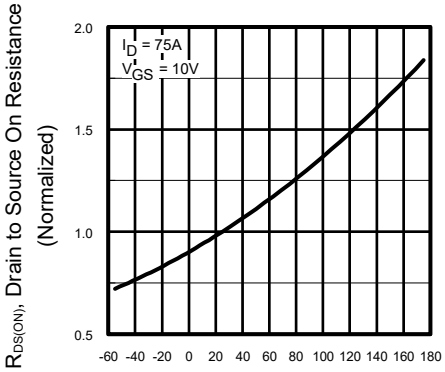


Figure 10: Drain-to-Source Breakdown Voltage

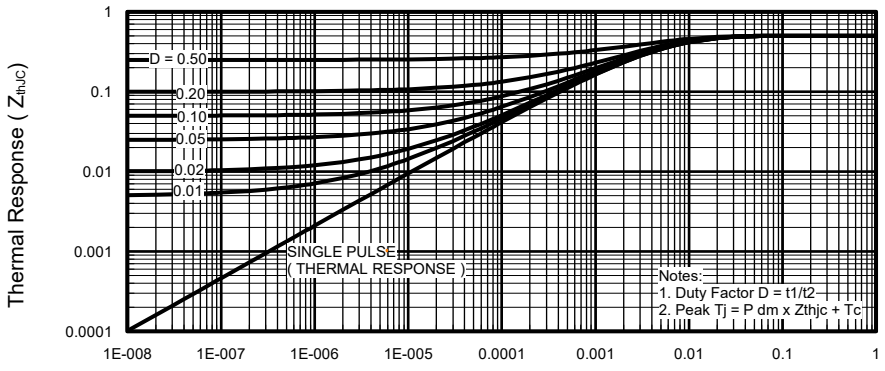


Figure 11: Maximum Effective Transient Thermal Impedance, Junction-to-Case

6.3Typical Characterisitics

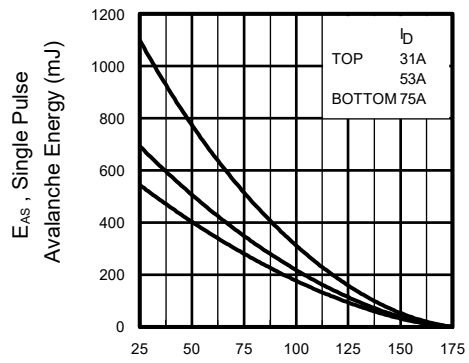


Figure 12: Maximum Avalanche Energy vs. Drain Current

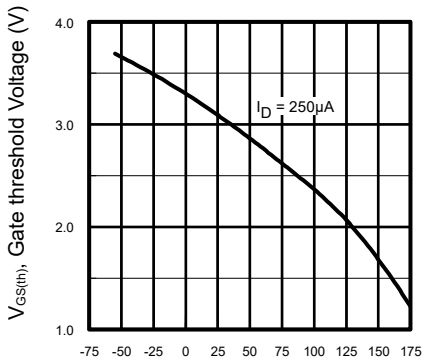


Figure 13:Threshold Voltage vs. Temperature

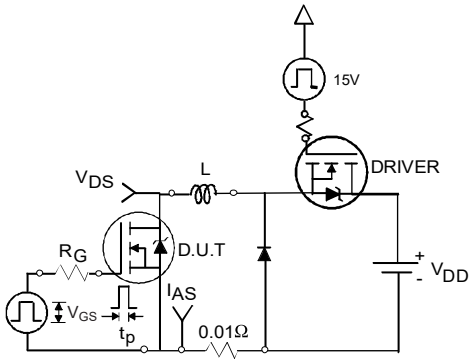


Figure 14a: Unclamped Inductive Test Circuit

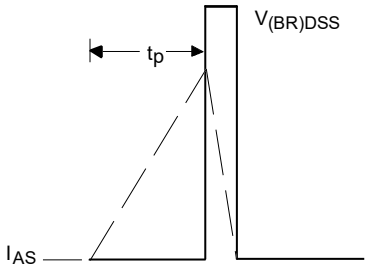


Figure 14b: Unclamped Inductive Waveforms

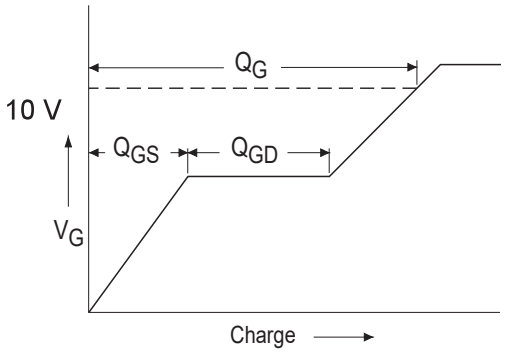


Figure 15a: Basic Gate Charge Waveform

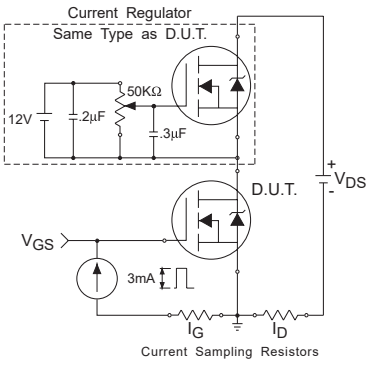


Figure 15b: Gate Charge Test Circuit

6.4Typical Characterisitics

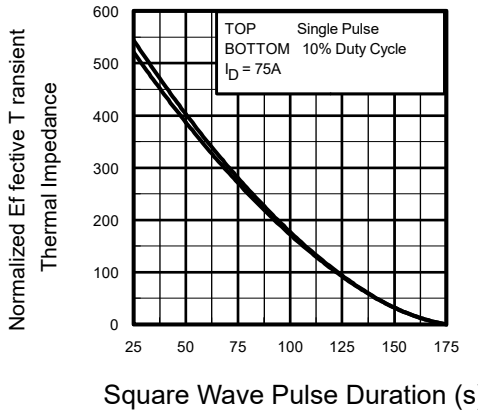


Figure 16: Normalized Thermal Transient Impedance, Junction-to-Ambient

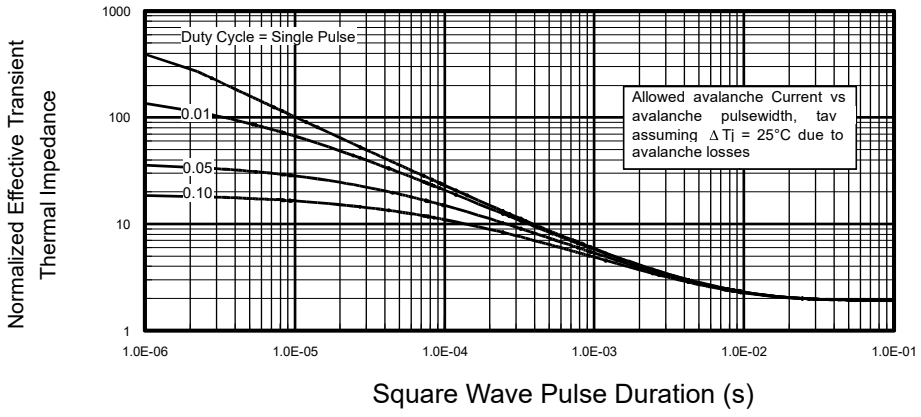


Figure 17: Normalized Thermal Transient Impedance, Junction-to-Case

Notes:

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 asT_{jmax} is not exceeded.

3. Equation below based on circuit and waveforms shown in Figures 14a, 14b.

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 16,17).

t_{av} = Average time in avalanche.

D = Duty cycle in avalanche = tav ·f

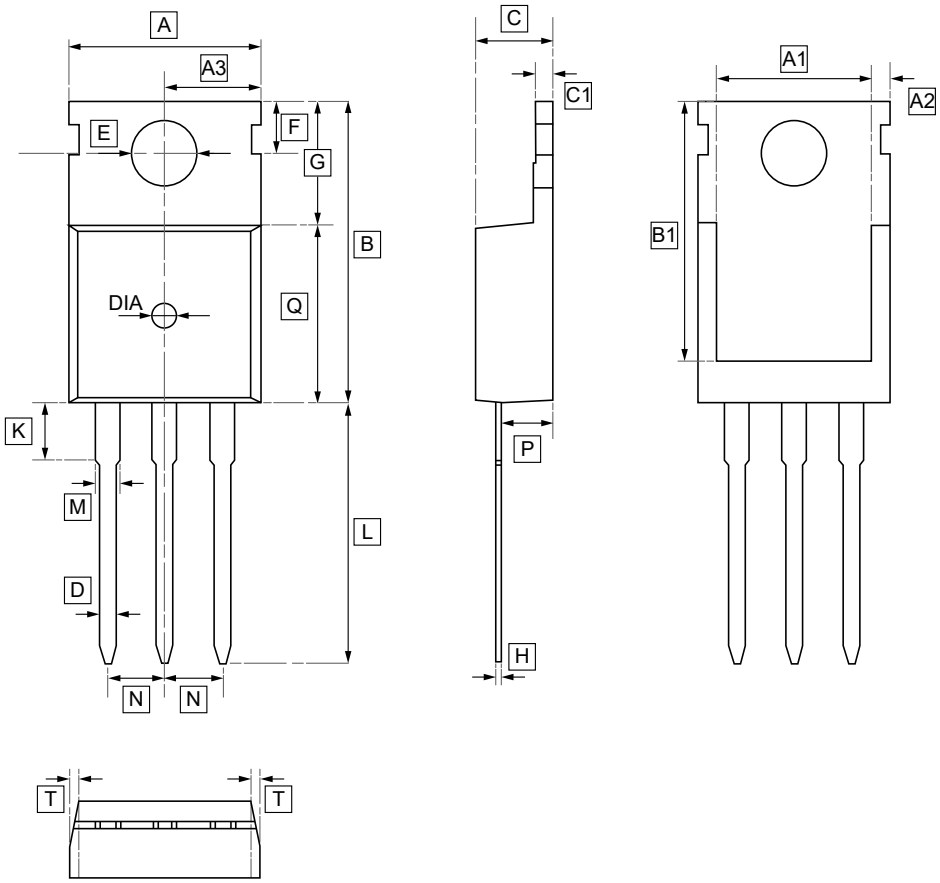
$Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see figure 11).

$P_{D\ (ave)} = 1/2\ (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$

$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$

$E_{AS\ (AR)} = P_{D\ (ave)} \cdot t_{av}$

7.TO-220 Package Outline Dimensions

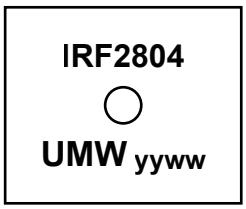


DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	A3	B	B1	C	C1	D	E	F	G
Min	9.7	8.44	1.05	4.8	15.4	12.9	4.28	1.1	0.6	3.4	2.65	5.2
Max	10.3	8.84	1.25	5.2	16.2	13.5	4.68	1.5	1.0	3.8	3.25	5.8

Symbol	H	K	L	L1	M	N	P	Q	T	DIA
Min	0.4	2.9	12.8	2.7	1.15	2.49	2.1	8.7	W:0.35	⊙1.5 (deep 0.2)
Max	0.6	3.3	13.6	3.3	1.35	2.59	2.7	9.3		

8.Ordering information



yy: Year Code
ww: Week Code

Order Code	Package	Base QTY	Delivery Mode
UMW IRF2804PBF	TO-220	1000	Tube and box

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