

1. Description

This Power MOSFET is designed to withstand high energy in the avalanche and commutation modes. Designed for low-voltage, high speed switching applications in power supplies, converters, and power motor controls, these devices are particularly well suited for bridge circuits where diode speed and commutating safe operating areas are critical and offer an additional safety margin against unexpected voltage transients.

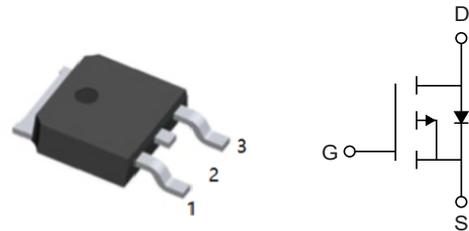
2. Features

- $V_{DS(V)} = -60V$
- $I_D = -12A (V_{GS} = -10V)$
- $R_{DS(ON)} = 150m\Omega (V_{GS} = -10V)$
- Avalanche Energy Specified
- I_{DSS} and $V_{DS(ON)}$ Specified at Elevated Temperature
- Designed for Low-Voltage, High-Speed Switching Applications and to Withstand High Energy in the Avalanche and Commutation Modes

3. Pinning information

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

TO-252(DPAK)
top view





4. Absolute Maximum Ratings

Parameter		Symbol	Rating	Units
Drain-Source Voltage		V_{DS}	-60	V
Gate-Source Voltage		V_{GS}	± 20	V
Continuous Drain Current, $V_{GS} @ -10V$ ¹	$T_C=25^\circ C$	I_D	-20	A
Continuous Drain Current, $V_{GS} @ -10V$ ¹	$T_C=100^\circ C$		-12	A
Continuous Drain Current, $V_{GS} @ -10V$ ¹	$T_A=25^\circ C$		-4.3	A
Continuous Drain Current, $V_{GS} @ -10V$ ¹	$T_A=70^\circ C$		-3.5	A
Pulsed Drain Current ²		I_{DM}	-36	A
Single Pulse Avalanche Energy ³		E_{AS}	35.4	mJ
Avalanche Current		I_{AS}	-26.6	A
Total Power Dissipation ⁴	$T_C=25^\circ C$	P_D	34.7	W
Total Power Dissipation ⁴	$T_A=25^\circ C$		2	W
Storage Temperature Range		T_J	-55 to 150	$^\circ C$
Operating Junction Temperature Range		T_{STG}	-55 to 150	$^\circ C$
Thermal Resistance Junction-Ambient ¹		$R_{\theta JA}$	62	$^\circ C/W$
Thermal Resistance Junction-Case ¹		$R_{\theta JC}$	3.6	$^\circ C/W$



5. Electrical Characteristics @ $T_A = 25^\circ\text{C}$ (unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=250\mu A$	-60			V
BV_{DSS} Temperature Coefficient	$\Delta BV_{DSS}/\Delta T_J$	Referenced to $25^\circ\text{C}, I_D=-1\text{mA}$		-0.03		$V/^\circ\text{C}$
Static Drain-Source On-Resistance	$R_{DS(on)}$	$V_{DS}=-10V, I_D=-12A$		53	75	$\text{m}\Omega$
		$V_{GS}=-4.5V, I_D=-8A$		64	105	$\text{m}\Omega$
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS}=V_{DS}, I_D=-250\mu A$	-1.2	-1.5	-2.5	V
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}$			4.56		$\text{mV}/^\circ\text{C}$
Drain-Source Leakage Current	I_{DSS}	$V_{DS}=-48V, V_{GS}=0V, T_J=25^\circ\text{C}$			-1	μA
		$V_{DS}=-48V, V_{GS}=0V, T_J=55^\circ\text{C}$			-5	μA
Gate-Source Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$			± 100	nA
Forward Transconductance	g_{FS}	$V_{DS}=-5V, I_D=-12A$		15.4		S
Gate Resistance	R_g	$V_{DS}=0V, V_{GS}=0V, f=1\text{MHz}$		13.5		Ω
Total Gate Charge (-4.5V)	Q_g	$V_{DS}=-48V, I_D=-10A$ $V_{GS}=-4.5V$		9.86		nC
Gate-Source Charge	Q_{gs}			3.08		nC
Gate-Drain Charge	Q_{gd}			2.95		nC
Turn-On Delay Time	$t_{D(on)}$	$V_{DD}=-15V, I_D=-1A$ $V_{GS}=-10V, R_G=3.3\Omega$		28.8		ns
Rise Time	t_r			19.8		ns
Turn-Off Delay Time	$t_{D(off)}$			60.8		ns
Fall Time	t_f			7.2		ns
Input Capacitance	C_{iss}	$V_{DS}=-15V, V_{GS}=0V, f=1\text{MHz}$		1447		pF
Output Capacitance	C_{oss}			97.3		pF
Reverse Transfer Capacitance	C_{rss}			70		pF
Continuous Source Current ^{1,5}	I_S	$V_G=V_D=0V, \text{Force Current}$			-18	A
Pulsed Source Current ^{2,5}	I_{SM}				-36	A
Diode Forward Voltage ²	V_{SD}	$V_{GS}=0V, I_S=-1A, T_J=25^\circ\text{C}$			-1.2	V



6.1 Typical Characteristics

<p style="text-align: center;">-I_b, Drain Current (A)</p> <p style="text-align: center;">-V_{DS}, Drain-to-Source Voltage (V)</p>	<p style="text-align: center;">$R_{DS(ON)}$ (mΩ)</p> <p style="text-align: center;">-V_{GS} (V)</p>
<p style="text-align: center;">Figure 1: Typical Output Characteristics</p>	<p style="text-align: center;">Figure 2: On-Resistance v.s Gate-Source</p>
<p style="text-align: center;">-I_s, Source Current (A)</p> <p style="text-align: center;">-V_{SD}, Source-to-Drain Voltage (V)</p>	<p style="text-align: center;">-V_{GS}, Gate to Source Voltage (V)</p> <p style="text-align: center;">Q_G, Total Gate Charge (nC)</p>
<p style="text-align: center;">Figure 3: Forward Characteristics of Reverse</p>	<p style="text-align: center;">Figure 4: Gate-Charge Characteristics</p>
<p style="text-align: center;">Normalized $V_{GS(th)}$ (V)</p> <p style="text-align: center;">T_J, Junction Temperature ($^{\circ}$C)</p>	<p style="text-align: center;">Normalized On-Resistance</p> <p style="text-align: center;">T_J, Junction Temperature ($^{\circ}$C)</p>
<p style="text-align: center;">Figure 5: Normalized $V_{GS(th)}$ v.s T_J</p>	<p style="text-align: center;">Figure 6: Normalized $R_{DS(ON)}$ v.s T_J</p>



6.2 Typical Characteristics

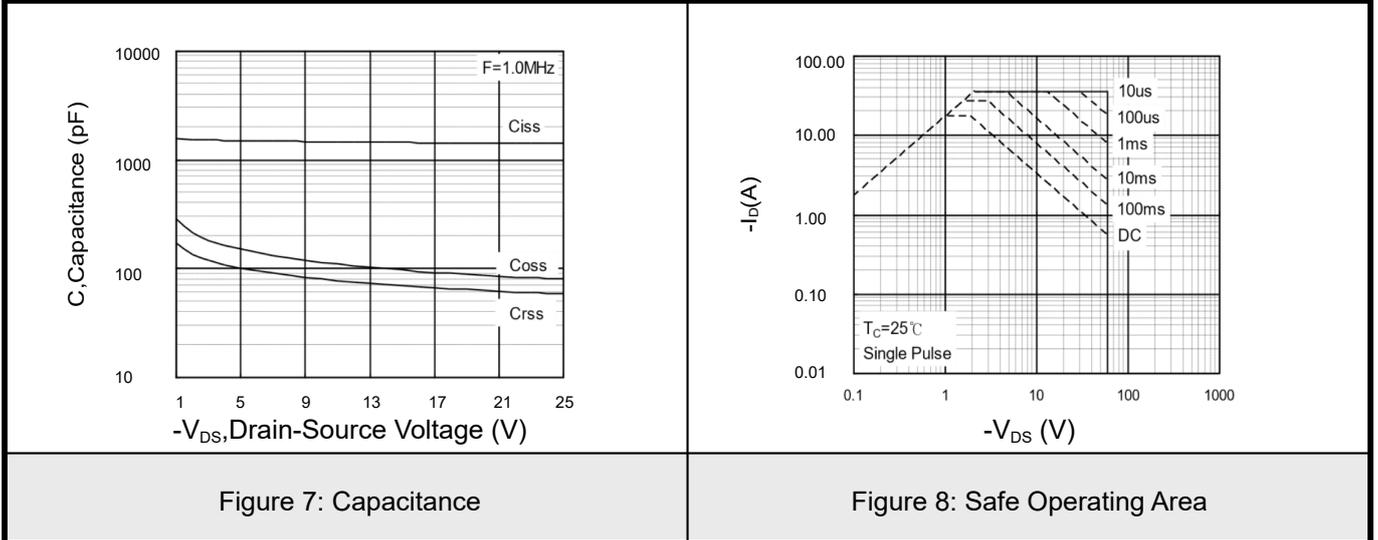


Figure 7: Capacitance

Figure 8: Safe Operating Area

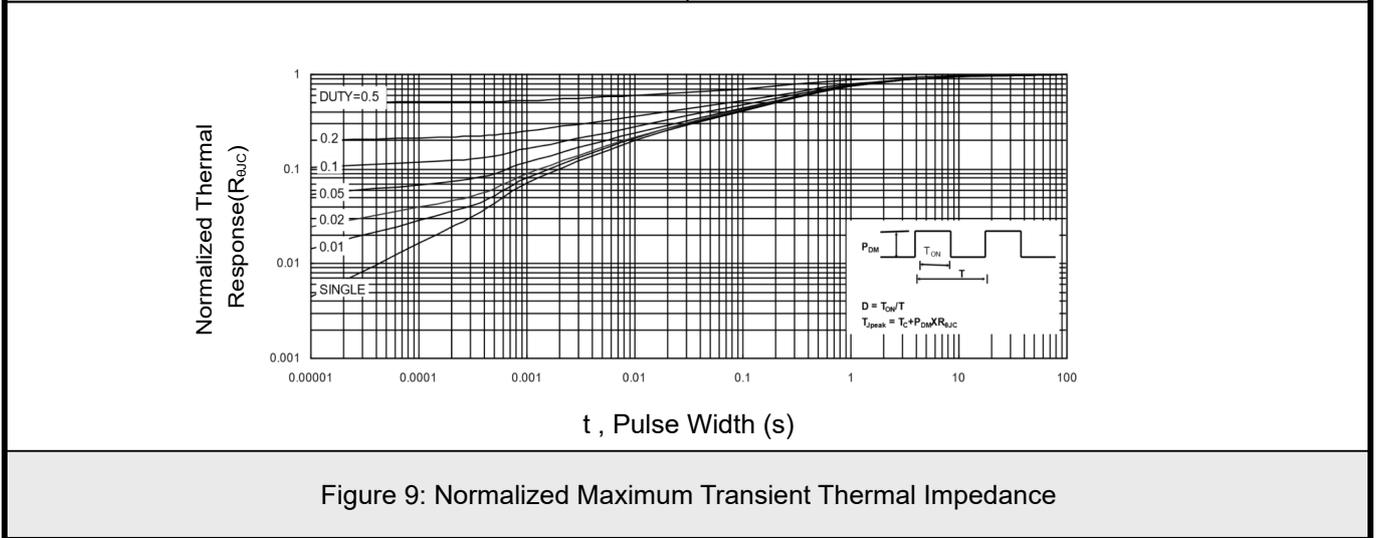


Figure 9: Normalized Maximum Transient Thermal Impedance

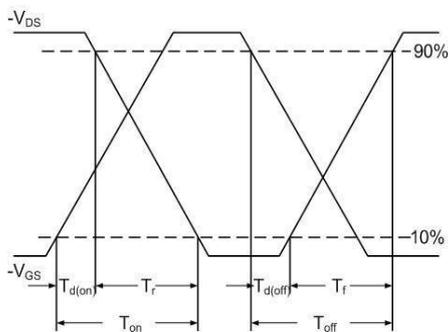


Figure 10: Switching Time Waveform

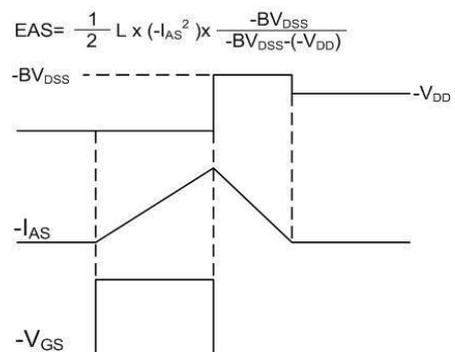
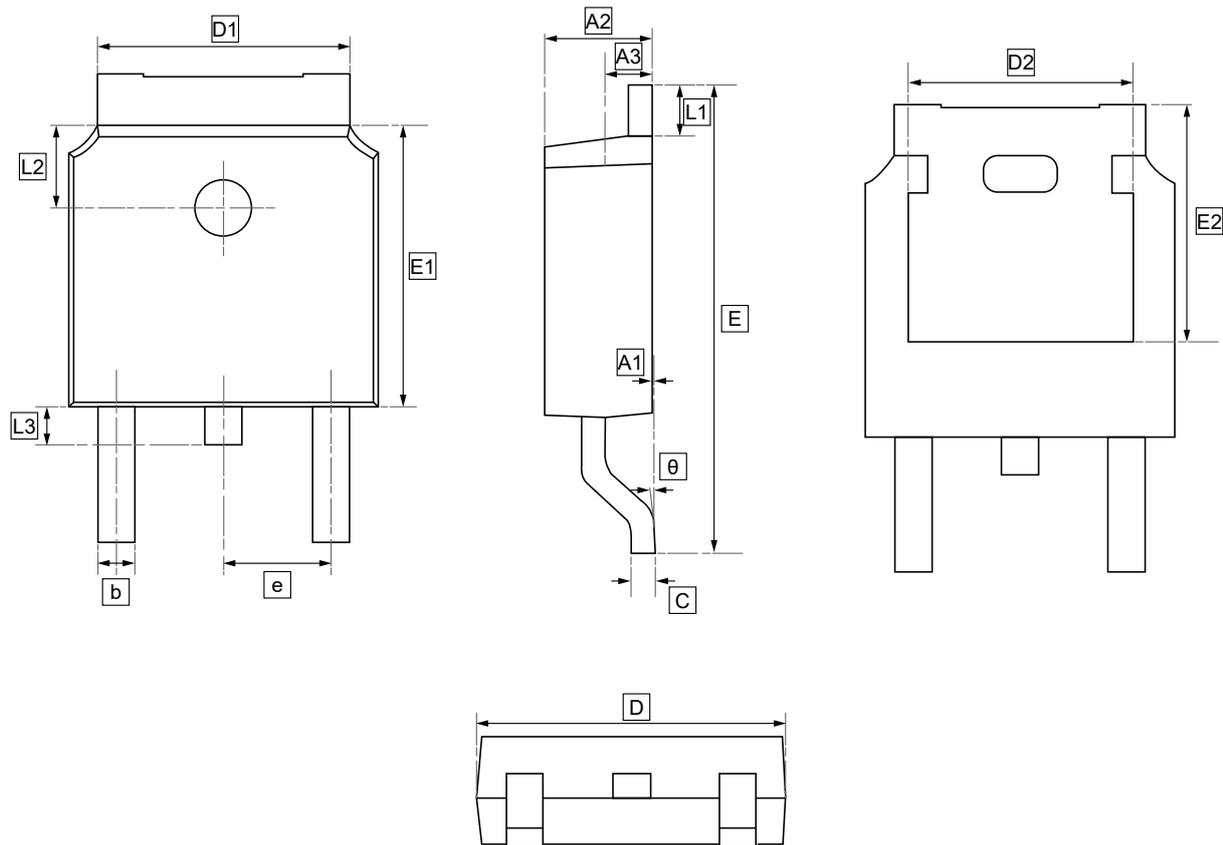


Figure 11: Unclamped Inductive Waveform



7.TO-252 Package Outline Dimensions

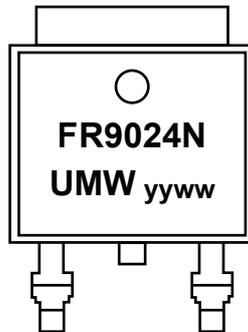


DIMENSIONS (mm are the original dimensions)

Symbol	A1	A2	A3	b	c	D	D1	D2	E	E1	E2	e	L1	L2	L3	θ
Min	0.00	2.18	0.90	0.65	0.46	6.35	4.95	4.32	9.40	5.97	5.21	2.286	0.89	1.70	0.60	0.00
Max	0.13	2.39	1.10	0.85	0.61	6.73	5.46	4.90	10.41	6.22	5.38	BSC	1.27	1.90	1.00	8.00



8. Ordering information



yy: Year Code
ww: Week Code

Order Code	Package	Base QTY	Delivery Mode
UMW IRFR9024NTR	TO-252	2500	Tape and reel



9.Disclaimer

UMW reserves the right to make changes to all products, specifications. Customers should obtain the latest version of product documentation and verify the completeness and currency of the information before placing an order.

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