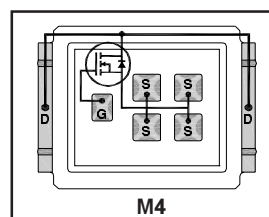


- Advanced Process Technology
- Optimized for Automotive Motor Drive, DC-DC and other Heavy Load Applications
- Exceptionally Small Footprint and Low Profile
- High Power Density
- Low Parasitic Parameters
- Dual Sided Cooling
- 175°C Operating Temperature
- Repetitive Avalanche Capability for Robustness and Reliability
- Lead Free, RoHS Compliant and Halogen Free
- Automotive Qualified \*

$V_{(BR)DSS}$	<b>40V</b>
$R_{DS(on)}$ typ.	<b>2.5mΩ</b>
	<b>3.0mΩ</b>
$I_D$ (Silicon Limited)	<b>108A</b>
$Q_g$	<b>72nC</b>



Applicable DirectFET® Outline and Substrate Outline ①

<b>SB</b>	<b>SC</b>		<b>M2</b>	<b>M4</b>		<b>L4</b>	<b>L6</b>	<b>L8</b>	
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**Description**

The AU1RF7736M2 combines the latest Automotive HEXFET® Power MOSFET Silicon technology with the advanced DirectFET® packaging technology to achieve exceptional performance in a package that has the footprint of an SO-8 or 5X6mm PQFN and only 0.7mm profile. The DirectFET® package is compatible with existing layout geometries used in power applications, PCB assembly equipment and vapor phase, infrared or convection soldering techniques, when application note AN-1035 is followed regarding the manufacturing methods and processes. The DirectFET® package allows dual sided cooling to maximize thermal transfer in automotive power systems.

This HEXFET® Power MOSFET is designed for applications where efficiency and power density are of value. The advanced DirectFET® packaging platform coupled with the latest silicon technology allows the AU1RF7736M2 to offer substantial system level savings and performance improvement specifically in motor drive, high frequency DC-DC and other heavy load applications on ICE, HEV and EV platforms. This MOSFET utilizes the latest processing techniques to achieve low on-resistance and low  $Q_g$  per silicon area. Additional features of this MOSFET are 175°C operating junction temperature and high repetitive peak current capability. These features combine to make this MOSFET a highly efficient, robust and reliable device for high current automotive applications.

**Absolute Maximum Ratings**

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only; and functional operation of the device at these or any other condition beyond those indicated in the specifications is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions. Ambient temperature ( $T_A$ ) is 25°C, unless otherwise specified.

	<b>Parameter</b>	<b>Max.</b>	<b>Units</b>
$V_{DS}$	Drain-to-Source Voltage	40	V
$V_{GS}$	Gate-to-Source Voltage	± 20	
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)④	108	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)④	77	
$I_D @ T_A = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)③	22	
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Package Limited)	179	
$I_{DM}$	Pulsed Drain Current ⑤	432	
$P_D @ T_C = 25^\circ\text{C}$	Power Dissipation ④	63	W
$P_D @ T_A = 25^\circ\text{C}$	Power Dissipation ③	2.5	
$E_{AS}$	Single Pulse Avalanche Energy (Thermally Limited) ⑥	54	mJ
$E_{AS}$ (tested)	Single Pulse Avalanche Energy Tested Value ⑥	286	
$I_{AR}$	Avalanche Current ⑦	See Fig. 18a, 18b, 16, 17	A
$E_{AR}$	Repetitive Avalanche Energy ⑧		mJ
$T_P$	Peak Soldering Temperature	270	°C
$T_J$	Operating Junction and	-55 to + 175	
$T_{STG}$	Storage Temperature Range		

**Thermal Resistance**

	<b>Parameter</b>	<b>Typ.</b>	<b>Max.</b>	<b>Units</b>
$R_{\theta JA}$	Junction-to-Ambient ③	—	60	°C/W
$R_{\theta JA}$	Junction-to-Ambient ③	12.5	—	
$R_{\theta JA}$	Junction-to-Ambient ③	20	—	
$R_{\theta JCan}$	Junction-to-Can ④⑩	—	2.4	
$R_{\theta J-PCB}$	Junction-to-PCB Mounted	1.0	—	
	Linear Derating Factor ④	0.42		W/°C

HEXFET® is a registered trademark of International Rectifier.


## Static Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise stated)

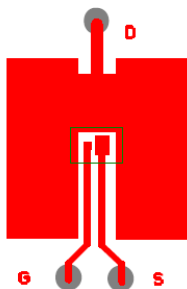
	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	40	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.03	—	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}, I_D = 1\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	2.5	3.0	m $\Omega$	$V_{GS} = 10V, I_D = 65A$ ②
$V_{GS(th)}$	Gate Threshold Voltage	2.0	3.0	4.0	V	$V_{DS} = V_{GS}, I_D = 150\mu A$
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage Coefficient	—	-9.0	—	mV/ $^\circ\text{C}$	
$g_{fs}$	Forward Transconductance	115	—	—	S	$V_{DS} = 10V, I_D = 65A$
$R_G$	Gate Resistance	—	1.0	—	$\Omega$	
$I_{DSS}$	Drain-to-Source Leakage Current	—	—	5	$\mu A$	$V_{DS} = 40V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 40V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -20V$

## Dynamic Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise stated)

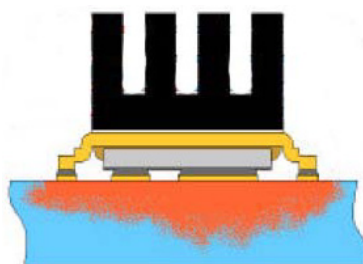
	Parameter	Min.	Typ.	Max.	Units	Conditions
$Q_g$	Total Gate Charge	—	72	108	nC	$V_{DS} = 20V$ $V_{GS} = 10V$ $I_D = 65A$ See Fig.11
$Q_{gs1}$	Pre-V <sub>th</sub> Gate-to-Source Charge	—	15	—		
$Q_{gs2}$	Post-V <sub>th</sub> Gate-to-Source Charge	—	6.3	—		
$Q_{gd}$	Gate-to-Drain ("Miller") Charge	—	26	—		
$Q_{godr}$	Gate Charge Overdrive	—	24.7	—		
$Q_{sw}$	Switch Charge ( $Q_{gs2} + Q_{gd}$ )	—	32.3	—	nC	$V_{DS} = 16V, V_{GS} = 0V$
$Q_{oss}$	Output Charge	—	31	—	ns	$V_{DD} = 20V, V_{GS} = 10V$ ② $I_D = 65A$ $R_G = 6.8\Omega$
$t_{d(on)}$	Turn-On Delay Time	—	21	—		
$t_r$	Rise Time	—	43	—		
$t_{d(off)}$	Turn-Off Delay Time	—	39	—		
$t_f$	Fall Time	—	27	—		
$C_{iss}$	Input Capacitance	—	4267	—	pF	$V_{GS} = 0V$ $V_{DS} = 25V$ $f = 1.0\text{MHz}$
$C_{oss}$	Output Capacitance	—	943	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$
$C_{rss}$	Reverse Transfer Capacitance	—	422	—		
$C_{oss}$	Output Capacitance	—	3489	—		$V_{GS} = 0V, V_{DS} = 32V, f = 1.0\text{MHz}$
$C_{oss}$	Output Capacitance	—	843	—		$V_{GS} = 0V, V_{DS} = 0V \text{ to } 32V$
$C_{oss \text{ eff.}}$	Effective Output Capacitance	—	1222	—		

## Diode Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise stated)

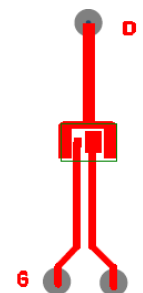
	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	—	—	108	A	MOSFET symbol showing the integral reverse p-n junction diode. 
$I_{SM}$	Pulsed Source Current (Body Diode) ⑤	—	—	432		
$V_{SD}$	Diode Forward Voltage	—	—	1.3	V	$I_S = 65A, V_{GS} = 0V$ ②
$t_{rr}$	Reverse Recovery Time	—	35	53	ns	$I_F = 65A, V_{DD} = 25V$
$Q_{rr}$	Reverse Recovery Charge	—	38	57	nC	$di/dt = 100A/\mu s$ ②



③ Surface mounted on 1 in. square Cu (still air).



④ Mounted to a PCB with small clip heatsink (still air)



⑤ Mounted on minimum footprint full size board with metalized back and with small clip heatsink (still air)

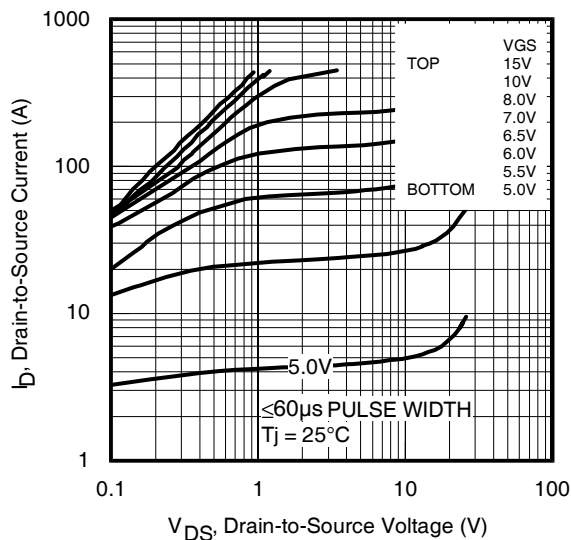
Notes ① through ⑩ are on page 11

## Qualification Information†

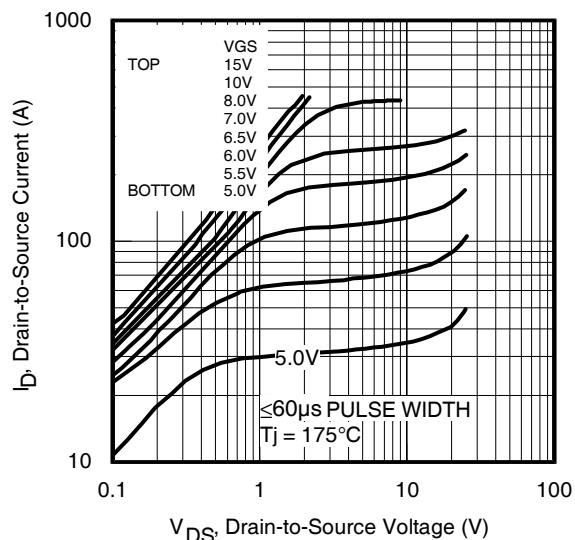
<b>Qualification Level</b>		Automotive (per AEC-Q101) ††	
		Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
<b>Moisture Sensitivity Level</b>		MEDIUM-CAN	MSL1, 260°C
<b>ESD</b>	Machine Model	Class M4 ( +/- 400V) AEC-Q101-002	
	Human Body Model	Class H3B ( +/- 8000V) AEC-Q101-001	
	Charged Device Model	N/A AEC-Q101-005	
<b>RoHS Compliant</b>		Yes	

† Qualification standards can be found at International Rectifier's web site: <http://www.irf.com>

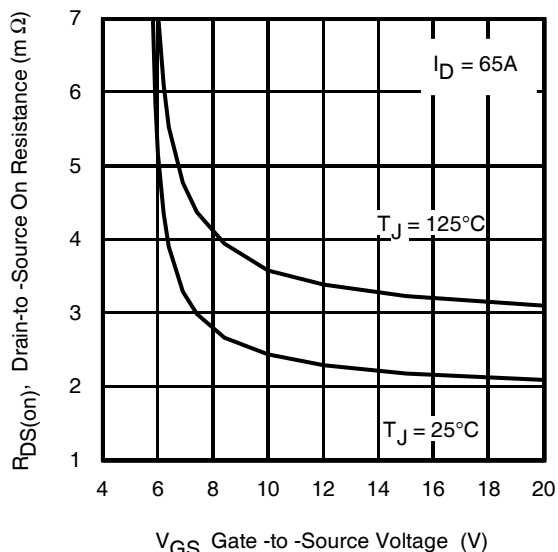
†† Exceptions to AEC-Q101 requirements are noted in the qualification report.



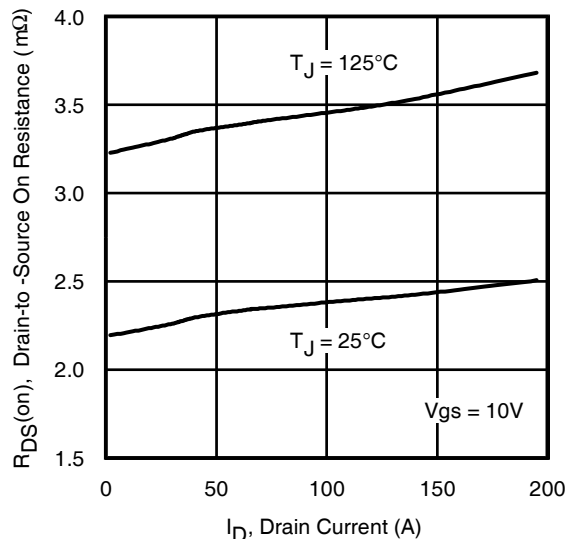
**Fig 1.** Typical Output Characteristics



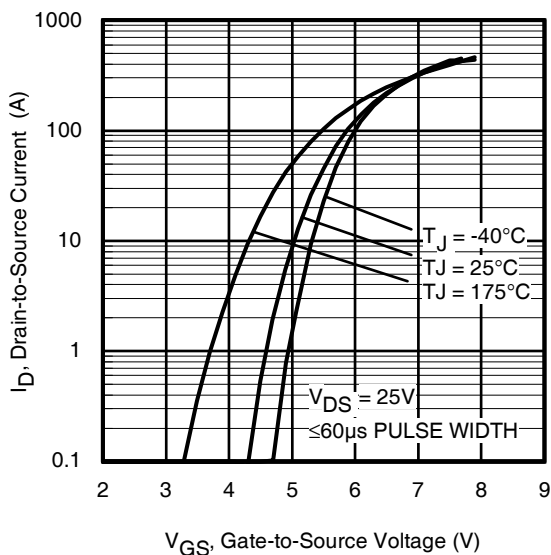
**Fig 2.** Typical Output Characteristics



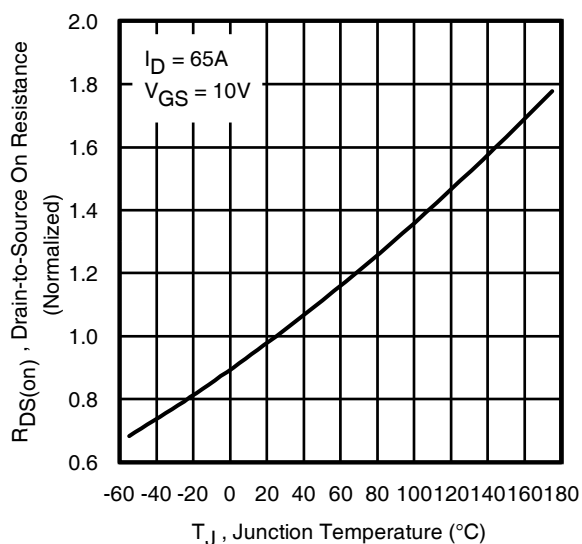
**Fig 3.** Typical On-Resistance vs. Gate Voltage



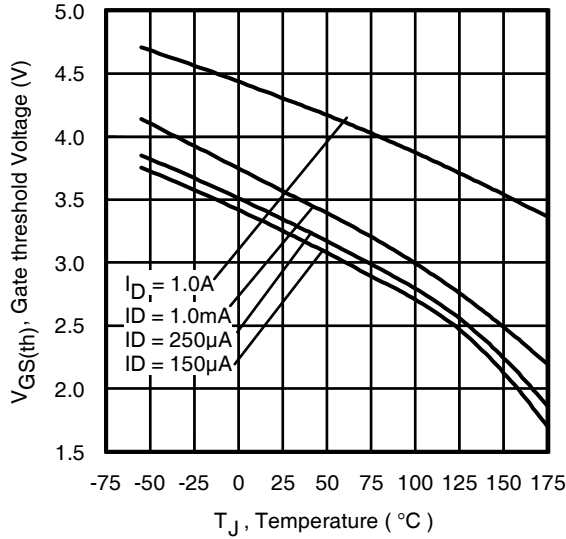
**Fig 4.** Typical On-Resistance vs. Drain Current



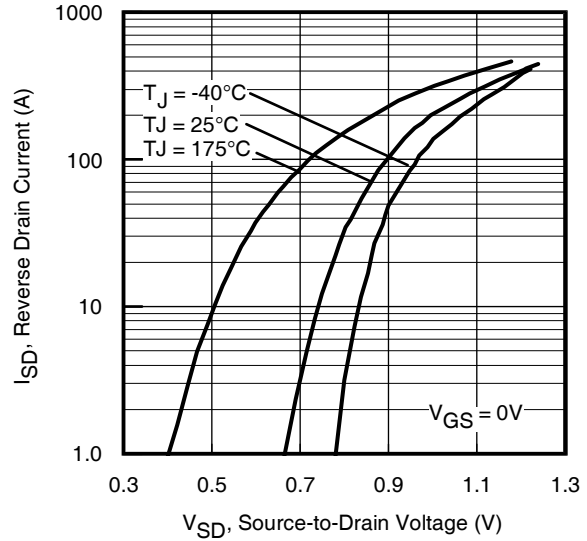
**Fig 5.** Typical Transfer Characteristics



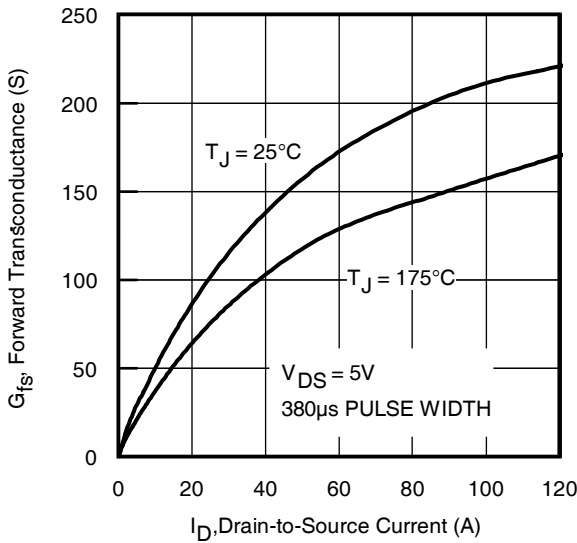
**Fig 6.** Normalized On-Resistance vs. Temperature



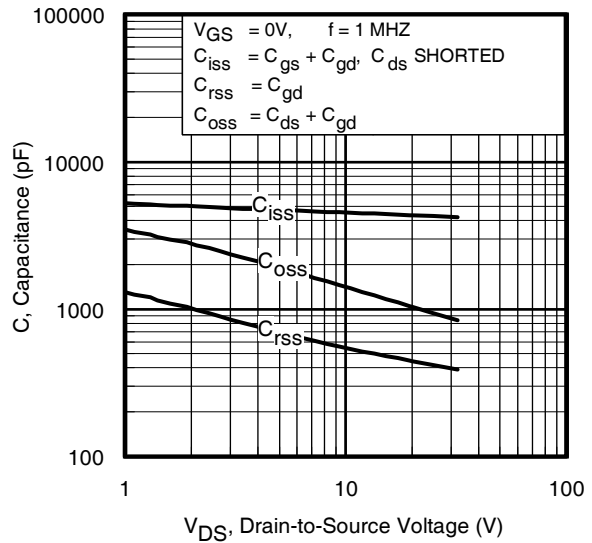
**Fig 7.** Typical Threshold Voltage vs. Junction Temperature



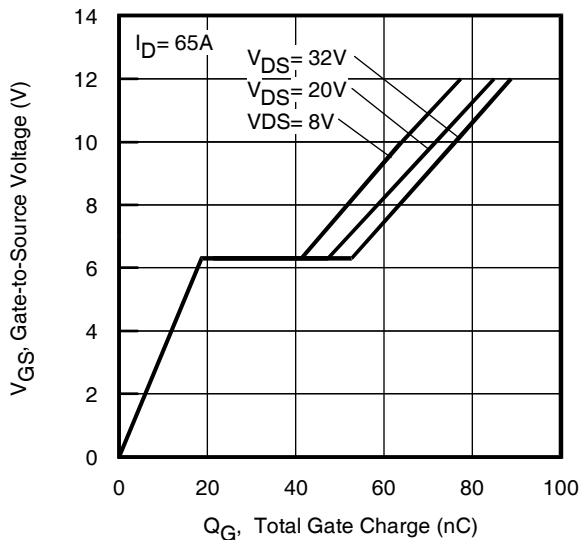
**Fig 8.** Typical Source-Drain Diode Forward Voltage



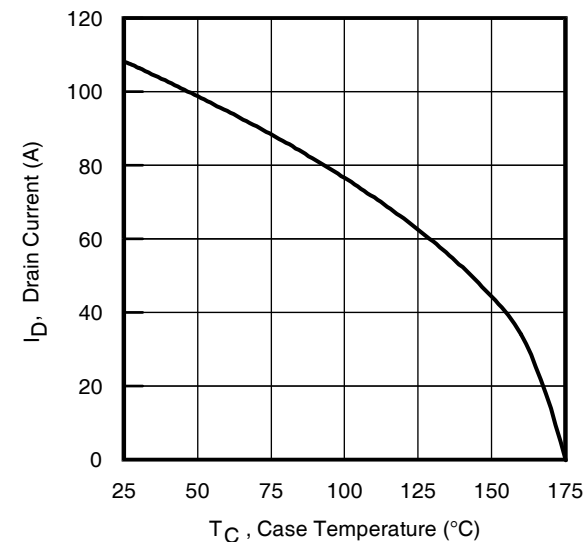
**Fig 9.** Typical Forward Transconductance Vs. Drain Current



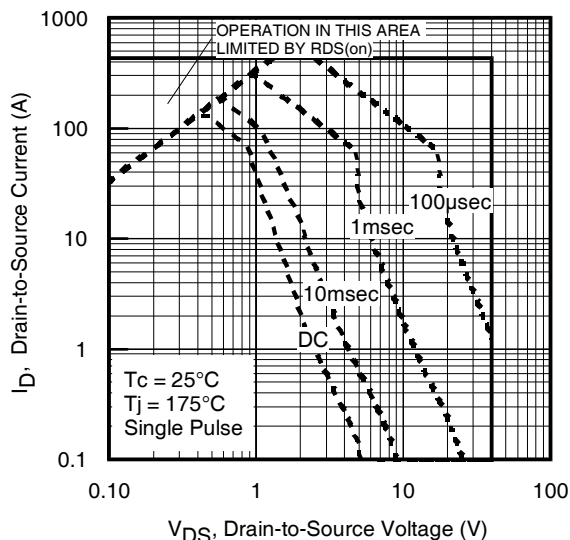
**Fig 10.** Typical Capacitance vs. Drain-to-Source Voltage



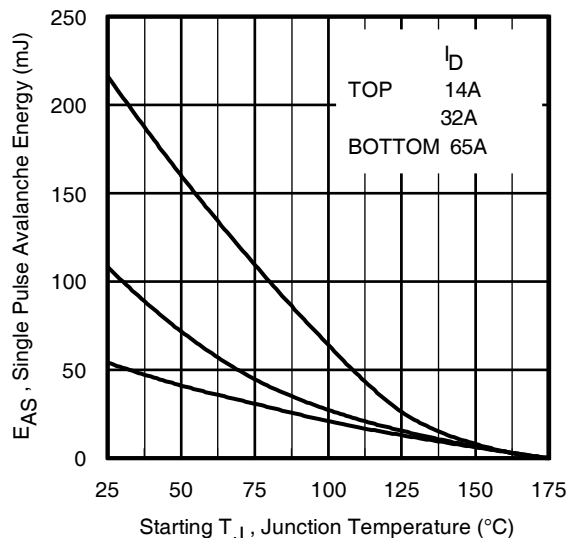
**Fig.11** Typical Gate Charge vs. Gate-to-Source Voltage  
www.irf.com



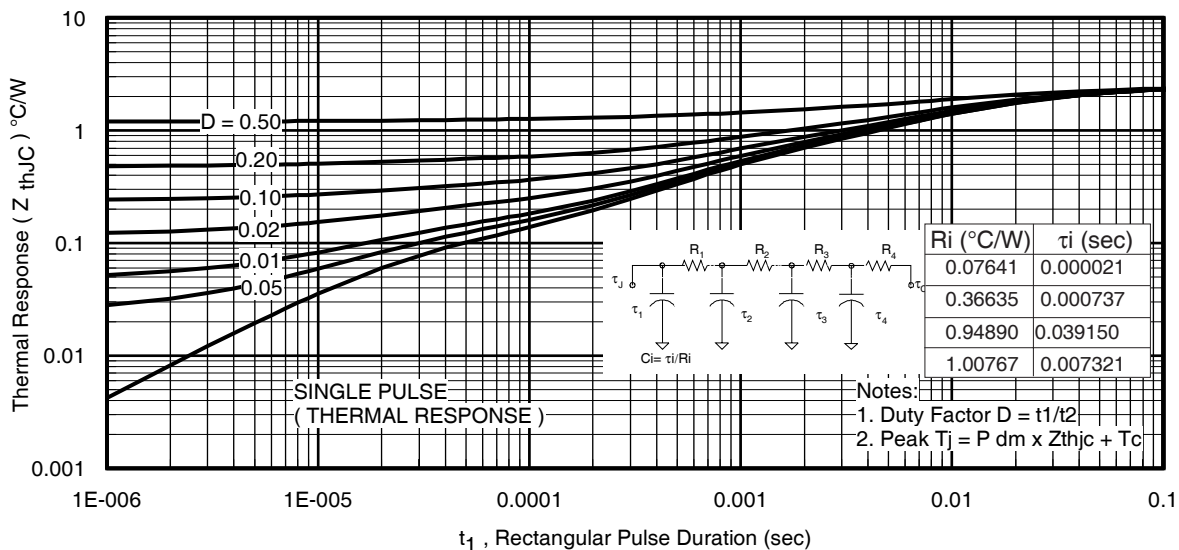
**Fig 12.** Maximum Drain Current vs. Case Temperature



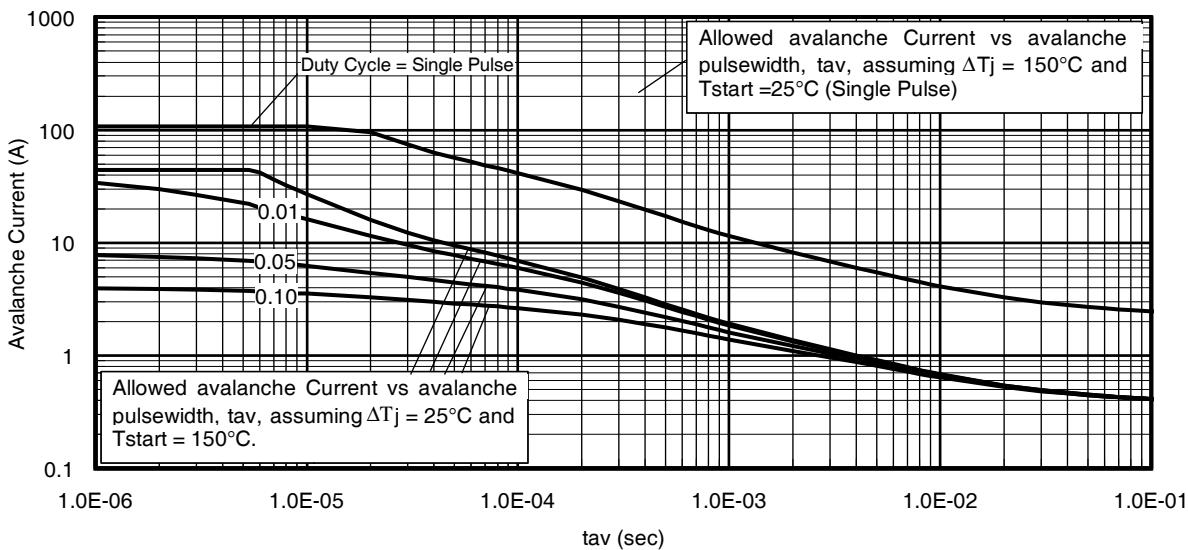
**Fig 13.** Maximum Safe Operating Area



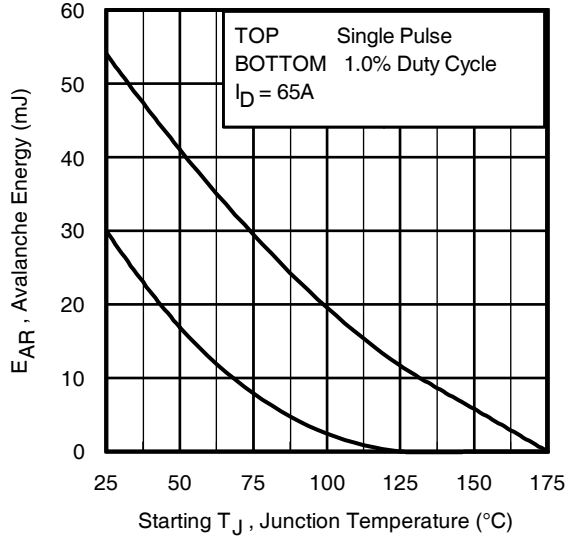
**Fig 14.** Maximum Avalanche Energy vs. Temperature



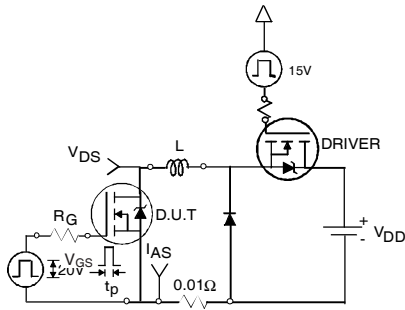
**Fig 15.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



**Fig 16.** Typical Avalanche Current Vs. Pulsewidth



**Fig 17.** Maximum Avalanche Energy Vs. Temperature

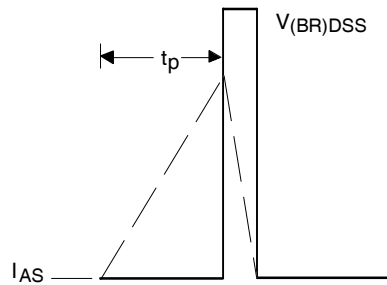


**Fig 18a.** Unclamped Inductive Test Circuit

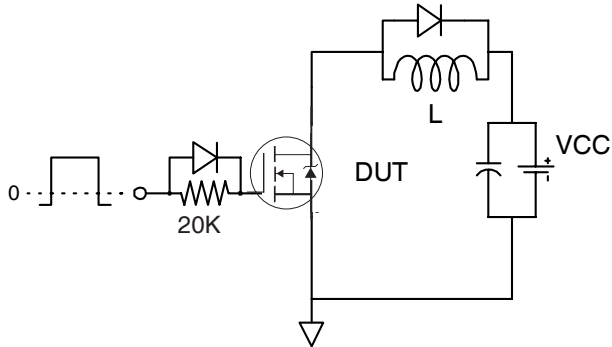
$$P_{D(ave)} = 1/2 (1.3 \cdot BV \cdot I_{av}) \cdot \Delta T / Z_{thJC}$$

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

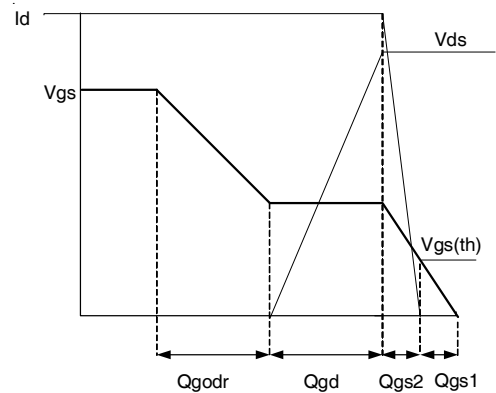
$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$



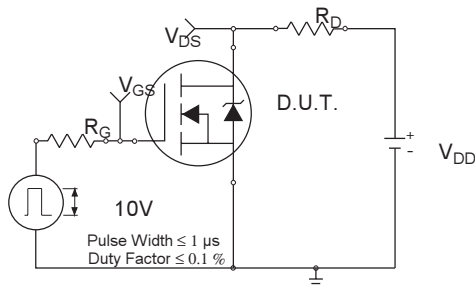
**Fig 18b.** Unclamped Inductive Waveforms



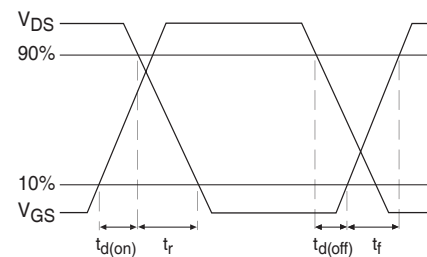
**Fig 19a.** Gate Charge Test Circuit



**Fig 19b.** Gate Charge Waveform



**Fig 20a.** Switching Time Test Circuit



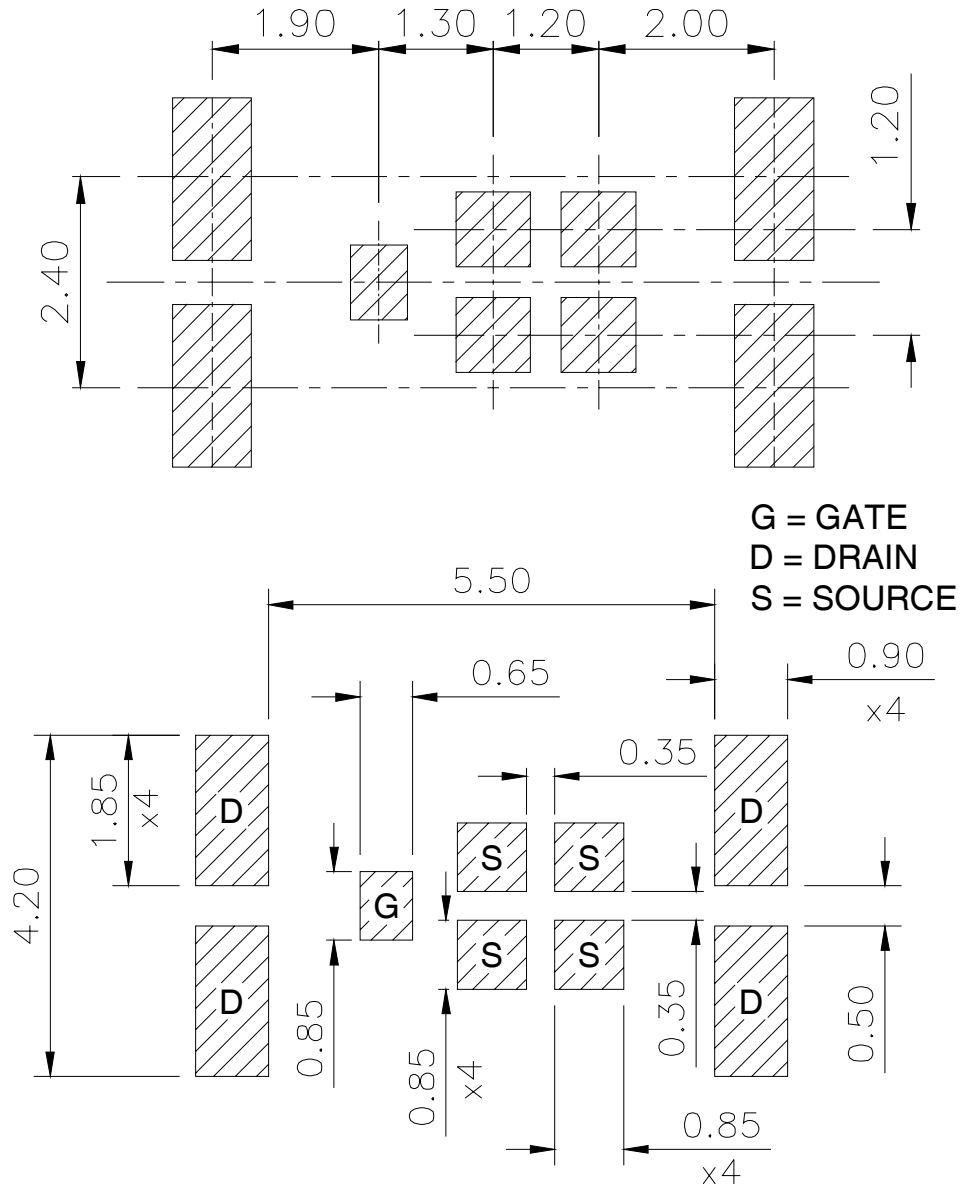
**Fig 20b.** Switching Time Waveforms

**Notes on Repetitive Avalanche Curves , Figures 16, 17:**  
(For further info, see AN-1005 at [www.irf.com](http://www.irf.com))

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 18a, 18b.
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.  $\Delta T$  = 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 =  $t_{av} \cdot f$   
 $Z_{thJC}(D, t_{av})$  = Transient thermal resistance, see figure 15)

## DirectFET® Board Footprint, M4 (Medium Size Can).

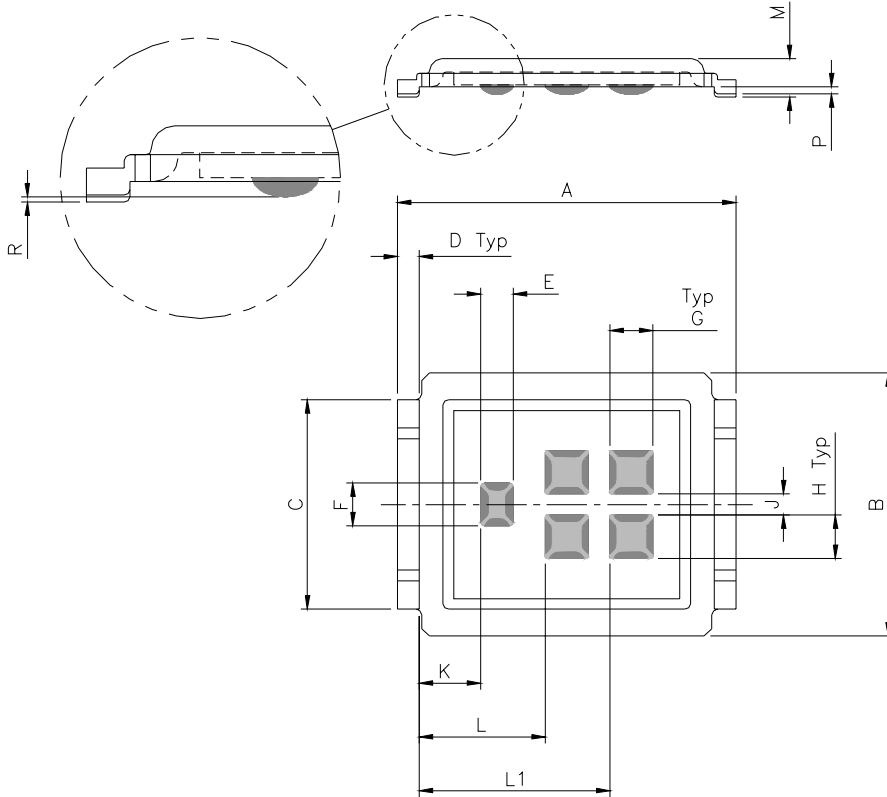
Please see AN-1035 for DirectFET® assembly details and stencil and substrate design recommendations





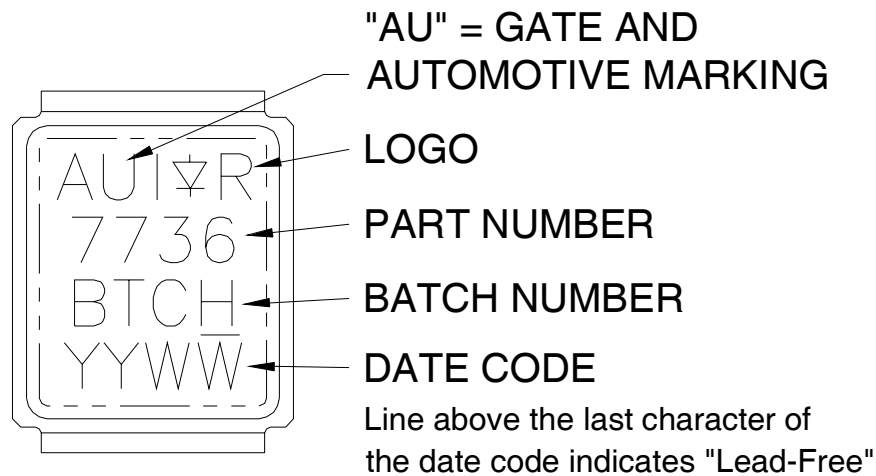
## DirectFET® Outline Dimension, M4 Outline (Medium Size Can).

Please see AN-1035 for DirectFET® assembly details and stencil and substrate design recommendations



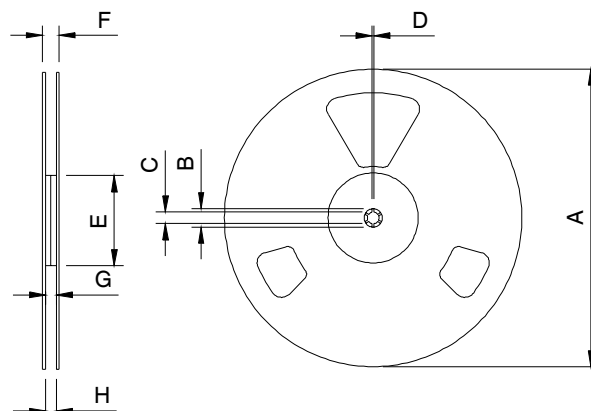
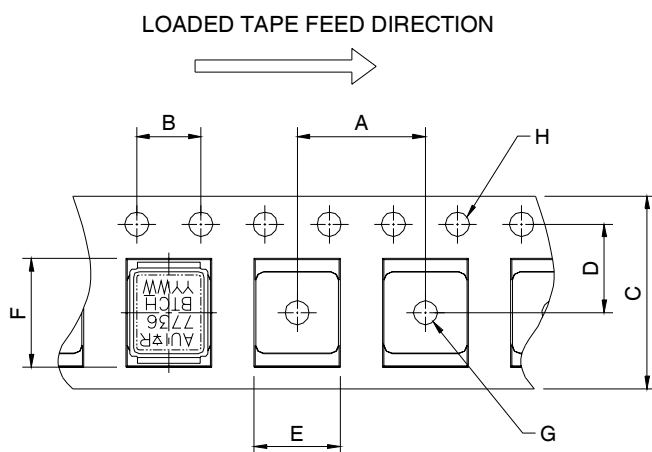
CODE	DIMENSIONS			
	METRIC		IMPERIAL	
	MIN	MAX	MIN	MAX
A	6.25	6.35	0.246	0.250
B	4.80	5.05	0.189	0.201
C	3.85	3.95	0.152	0.156
D	0.35	0.45	0.014	0.018
E	0.58	0.62	0.023	0.024
F	0.78	0.82	0.031	0.032
G	0.78	0.82	0.031	0.032
H	0.78	0.82	0.031	0.032
J	0.38	0.42	0.015	0.017
K	1.10	1.20	0.043	0.047
L	2.30	2.40	0.090	0.094
L1	3.50	3.60	0.138	0.142
M	0.68	0.74	0.027	0.029
P	0.09	0.17	0.003	0.007
R	0.02	0.08	0.001	0.003

## DirectFET® Part Marking



Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

## DirectFET® Tape & Reel Dimension (Showing component orientation).



NOTE: Controlling dimensions in mm  
Std reel quantity is 4800 parts. (ordered as AUIRF7736M2TR). For 1000 parts on 7" reel, order AUIRF7736M2TR1

NOTE: CONTROLLING DIMENSIONS IN MM

CODE	METRIC		IMPERIAL	
	MIN	MAX	MIN	MAX
A	7.90	8.10	0.311	0.319
B	3.90	4.10	0.154	0.161
C	11.90	12.30	0.469	0.484
D	5.45	5.55	0.215	0.219
E	5.10	5.30	0.201	0.209
F	6.50	6.70	0.256	0.264
G	1.50	N.C	0.059	N.C
H	1.50	1.60	0.059	0.063

CODE	REEL DIMENSIONS							
	STANDARD OPTION (QTY 4800)				TR1 OPTION (QTY 1000)			
	METRIC		IMPERIAL		METRIC		IMPERIAL	
MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
A	390.0	N.C	12.992	N.C	177.77	N.C	6.9	N.C
B	20.2	N.C	0.795	N.C	19.06	N.C	0.75	N.C
C	12.8	13.2	0.504	0.520	13.5	12.8	0.53	0.50
D	1.5	N.C	0.059	N.C	1.5	N.C	0.059	N.C
E	100.0	N.C	3.937	N.C	58.72	N.C	2.31	N.C
F	N.C	18.4	N.C	0.724	N.C	13.50	N.C	0.53
G	12.4	14.4	0.488	0.567	11.9	12.01	0.47	N.C
H	11.9	15.4	0.469	0.606	11.9	12.01	0.47	N.C

### Notes:

- ① Click on this section to link to the appropriate technical paper.
- ② Click on this section to link to the DirectFET® Website.
- ③ Surface mounted on 1 in. square Cu board, steady state.
- ④  $T_C$  measured with thermocouple mounted to top (Drain) of part.
- ⑤ Repetitive rating; pulse width limited by max. junction temperature.

- ⑥ Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.026\text{mH}$ ,  $R_G = 50\Omega$ ,  $I_{AS} = 65\text{A}$ ,  $V_{GS} = 20\text{V}$ .
- ⑦ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ⑧ Used double sided cooling, mounting pad with large heatsink.
- ⑨ Mounted on minimum footprint full size board with metalized back and with small clip heatsink.
- ⑩  $R_\theta$  is measured at  $T_J$  of approximately  $90^\circ\text{C}$ .

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For technical support, please contact IR's Technical Assistance Center

<http://www.irf.com/technical-info/>

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