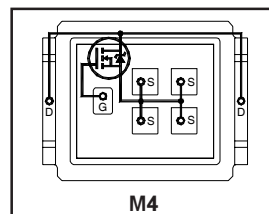


- Advanced Process Technology
- Optimized for Automotive Motor Drive, DC-DC and other Heavy Load Applications
- Exceptionally Small Footprint and Low Profile
- High Power Density
- Low Parasitic Parameters
- Dual Sided Cooling
- 175°C Operating Temperature
- Repetitive Avalanche Capability for Robustness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

$V_{(BR)DSS}$	60V
$R_{DS(on)}$ typ.	5.5mΩ
	7.0mΩ
I_D (Silicon Limited)	68A
Q_g	35nC



Applicable DirectFET Outline and Substrate Outline ①

SB	SC			M2	M4		L4	L6	L8	
----	----	--	--	----	----	--	----	----	----	--

Description

The AUIRF7648M2 combines the latest Automotive HEXFET® Power MOSFET Silicon technology with the advanced DirectFET packaging to achieve low gate charge as well as the lowest on-state resistance in a package that has the footprint of a SO-8 and only 0.7 mm profile. The DirectFET package is compatible with existing layout geometries used in power applications, PCB assembly equipment and vapor phase, infra-red 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 AUIRF7648M2 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

	Parameter	Max.	Units
V _{DS}	Drain-to-Source Voltage	60	V
V _{GS}	Gate-to-Source Voltage	± 20	
I _D @ T _C = 25°C	Continuous Drain Current, V _{GS} @ 10V (Silicon Limited)④	68	A
I _D @ T _C = 100°C	Continuous Drain Current, V _{GS} @ 10V (Silicon Limited)④	48	
I _D @ T _A = 25°C	Continuous Drain Current, V _{GS} @ 10V (Silicon Limited)③	14	
I _D @ T _C = 25°C	Continuous Drain Current, V _{GS} @ 10V (Package Limited)	179	
I _{DM}	Pulsed Drain Current ⑤	272	
P _D @T _C = 25°C	Power Dissipation ④	63	W
P _D @T _A = 25°C	Power Dissipation ③	2.5	
E _{AS}	Single Pulse Avalanche Energy (Thermally Limited) ⑥	70	mJ
E _{AS} (tested)	Single Pulse Avalanche Energy Tested Value ⑥	291	
I _{AR}	Avalanche Current ⑤	See Fig. 18a,18b,16,17	A
E _{AR}	Repetitive Avalanche Energy ⑤		mJ
T _P	Peak Soldering Temperature	270	°C
T _J	Operating Junction and	-55 to + 175	
T _{STG}	Storage Temperature Range		

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JA}$	Junction-to-Ambient ③	—	60	$^\circ\text{C/W}$
$R_{\theta JA}$	Junction-to-Ambient ③	12.5	—	
$R_{\theta JA}$	Junction-to-Ambient ⑨	20	—	
$R_{\theta J-Can}$	Junction-to-Can ④⑩	—	2.4	
$R_{\theta J-PCB}$	Junction-to-PCB Mounted	1.0	—	
	Linear Derating Factor ④	0.42		W/ $^\circ\text{C}$

HEXFET® is a registered trademark of International Rectifier.

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

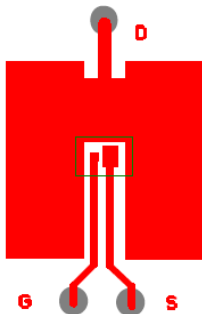
	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	60	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.07	—	V/ $^\circ\text{C}$	Reference to 25°C , $I_D = 1\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	5.5	7.0	m Ω	$V_{GS} = 10V, I_D = 41A$ ⑦
$V_{GS(th)}$	Gate Threshold Voltage	3.0	4.0	4.9	V	$V_{DS} = V_{GS}, I_D = 150\mu A$
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage Coefficient	—	-12	—	mV/ $^\circ\text{C}$	
g_{fs}	Forward Transconductance	44	—	—	S	$V_{DS} = 25V, I_D = 41A$
R_G	Gate Resistance	—	1.4	—	Ω	
I_{DSS}	Drain-to-Source Leakage Current	—	—	5	μA	$V_{DS} = 60V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 60V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
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)

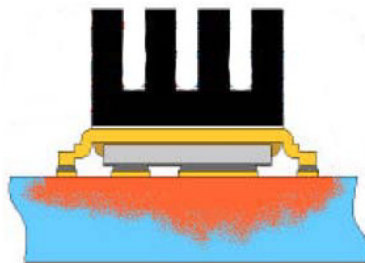
	Parameter	Min.	Typ.	Max.	Units	Conditions
Q_g	Total Gate Charge	—	35	53	nC	$V_{DS} = 30V, V_{GS} = 10V$ $I_D = 41A$ See Fig. 11
Q_{gs1}	Pre-V _{th} Gate-to-Source Charge	—	7.7	—		
Q_{gs2}	Post-V _{th} Gate-to-Source Charge	—	3.4	—		
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	14	—		
Q_{godr}	Gate Charge Overdrive	—	9.9	—		
Q_{sw}	Switch Charge ($Q_{gs2} + Q_{gd}$)	—	17.4	—	nC	$V_{DS} = 16V, V_{GS} = 0V$
Q_{oss}	Output Charge	—	23	—		
$t_{d(on)}$	Turn-On Delay Time	—	12	—	ns	$V_{DD} = 30V, V_{GS} = 10V$ ⑦ $I_D = 41A$ $R_G = 6.8\Omega$
t_r	Rise Time	—	23	—		
$t_{d(off)}$	Turn-Off Delay Time	—	19	—		
t_f	Fall Time	—	14	—		
C_{iss}	Input Capacitance	—	2170	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	633	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	162	—		$f = 1.0\text{MHz}$
C_{oss}	Output Capacitance	—	2661	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$
C_{oss}	Output Capacitance	—	465	—		$V_{GS} = 0V, V_{DS} = 48V, f = 1.0\text{MHz}$
$C_{oss \text{ eff.}}$	Effective Output Capacitance	—	726	—		$V_{GS} = 0V, V_{DS} = 0V \text{ to } 48V$

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

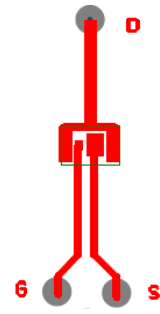
	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	68	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ⑤	—	—	272		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$I_S = 41A, V_{GS} = 0V$ ⑦
t_{rr}	Reverse Recovery Time	—	36	54	ns	$I_F = 41A, V_{DD} = 25V$
Q_{rr}	Reverse Recovery Charge	—	46	69	nC	$di/dt = 100A/\mu s$ ⑦



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



⑥ Mounted to a PCB with small clip heatsink (still air)



⑨ Mounted on minimum footprint full size board with metalized back and with small clip heatsink (still air)

Notes ① through ⑩ are on page 10

Qualification Information[†]

Qualification Level		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.	
Moisture Sensitivity Level		MEDIUM-CAN	MSL1, 260°C
ESD	Machine Model	Class M4 (> 400V) AEC-Q101-002	
	Human Body Model	Class H2(≤ 4000V) AEC-Q101-001	
	Charged Device Model	Class C4(≤ 1000V) AEC-Q101-005	
RoHS Compliant		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.

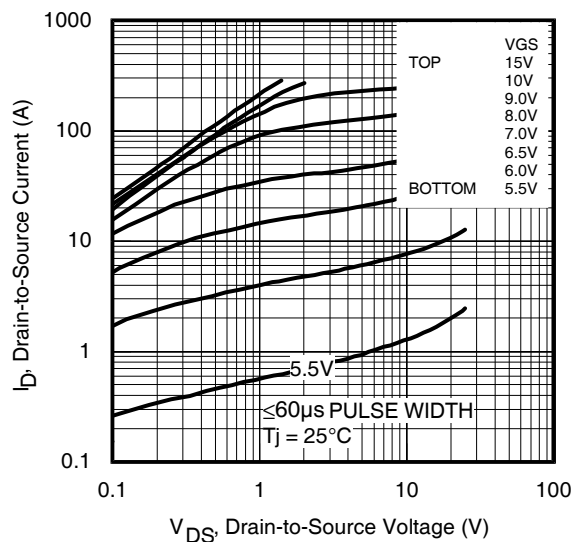


Fig 1. Typical Output Characteristics

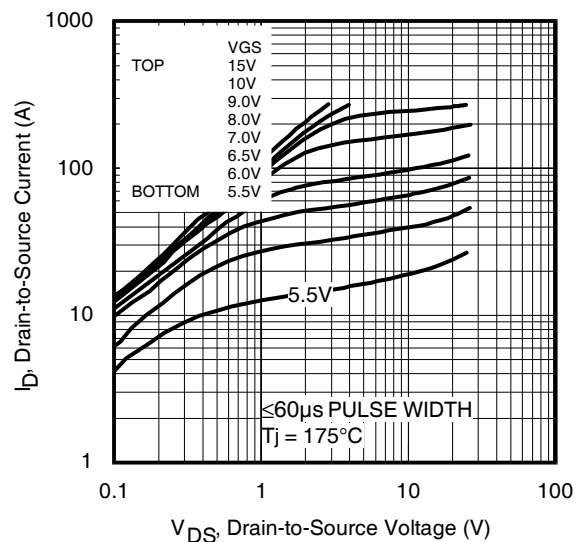


Fig 2. Typical Output Characteristics

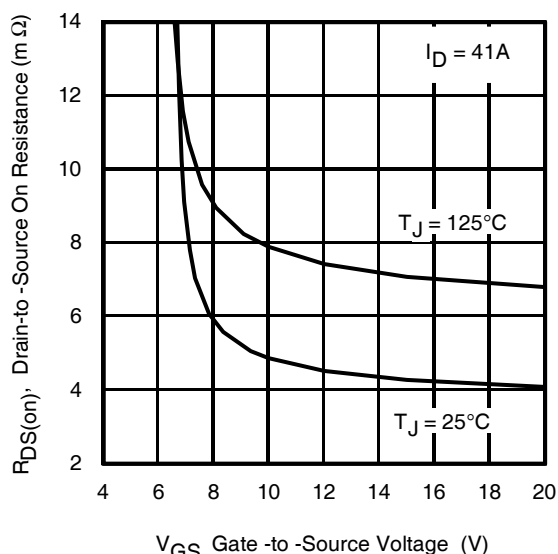


Fig 3. Typical On-Resistance vs. Gate Voltage

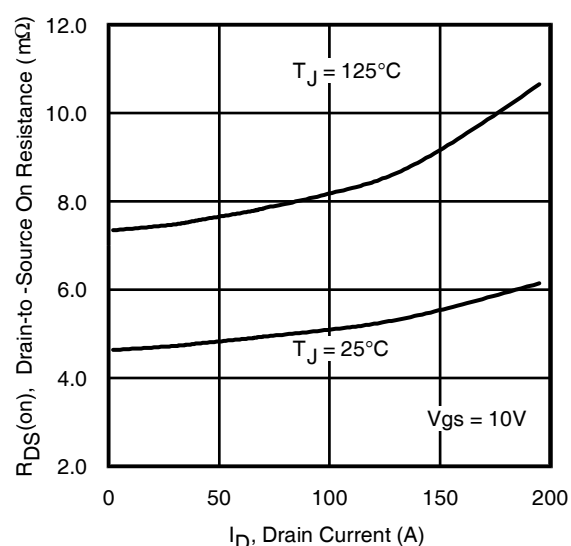


Fig 4. Typical On-Resistance vs. Drain Current

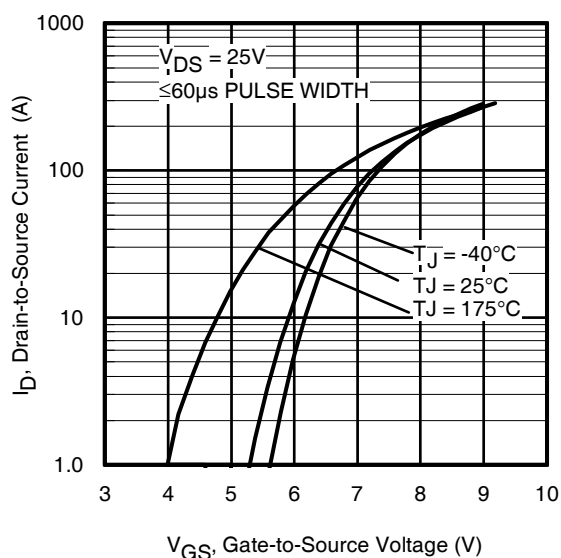


Fig 5. Typical Transfer Characteristics

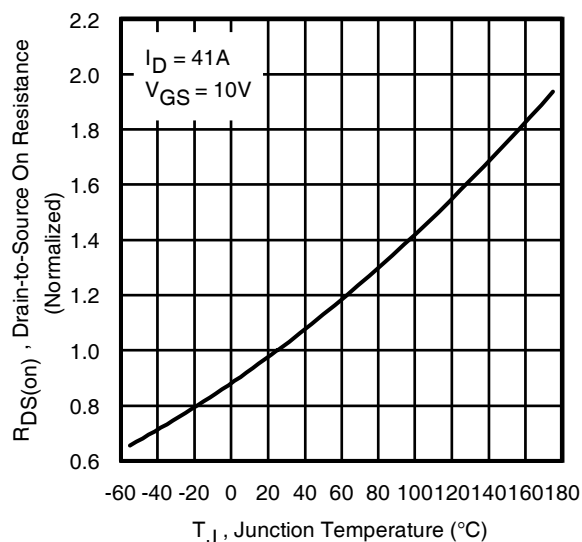


Fig 6. Normalized On-Resistance vs. Temperature

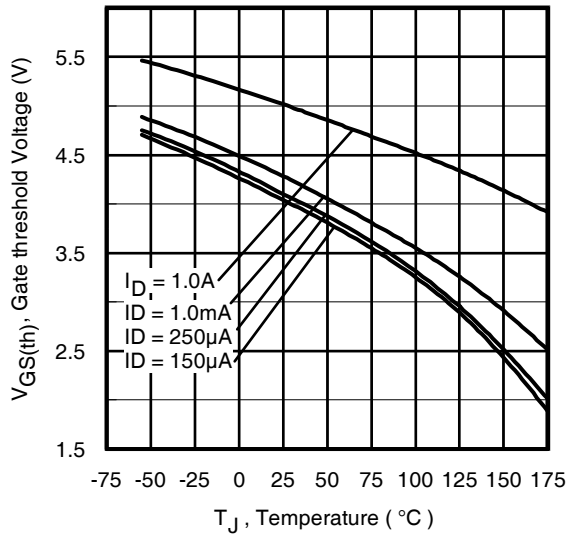


Fig 7. Typical Threshold Voltage vs. Junction Temperature

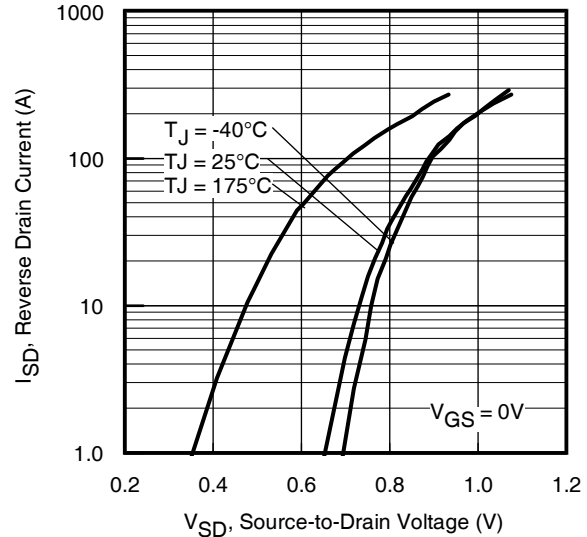


Fig 8. Typical Source-Drain Diode Forward Voltage

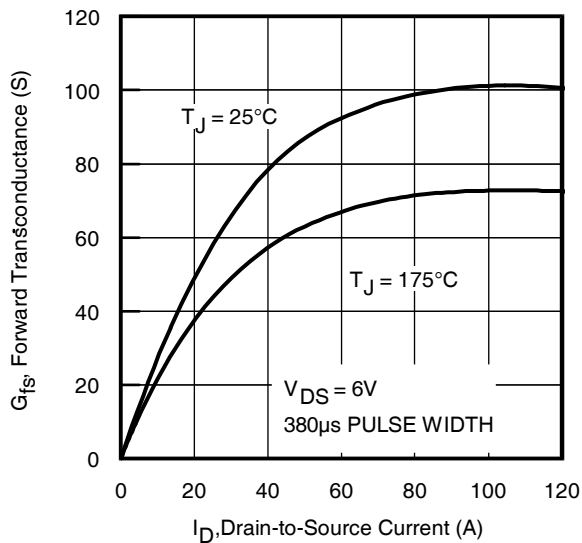


Fig 9. Typical Forward Transconductance Vs. Drain Current

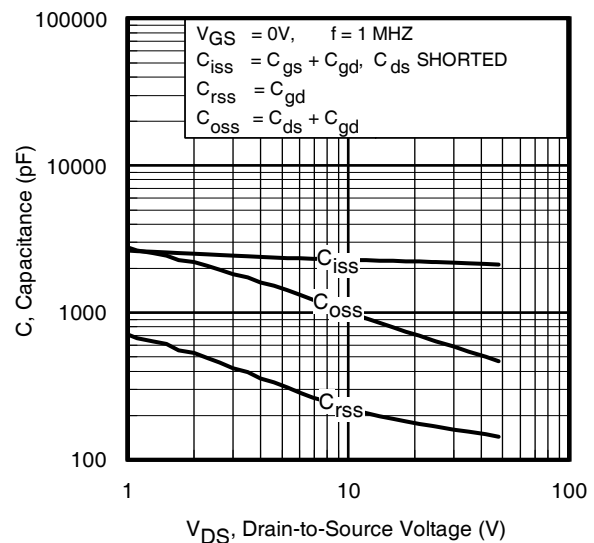


Fig 10. Typical Capacitance vs. Drain-to-Source Voltage

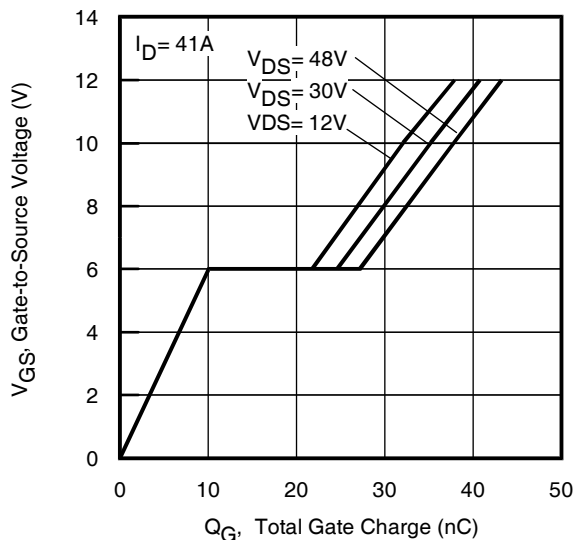


Fig.11 Typical Gate Charge vs. Gate-to-Source Voltage
www.irf.com

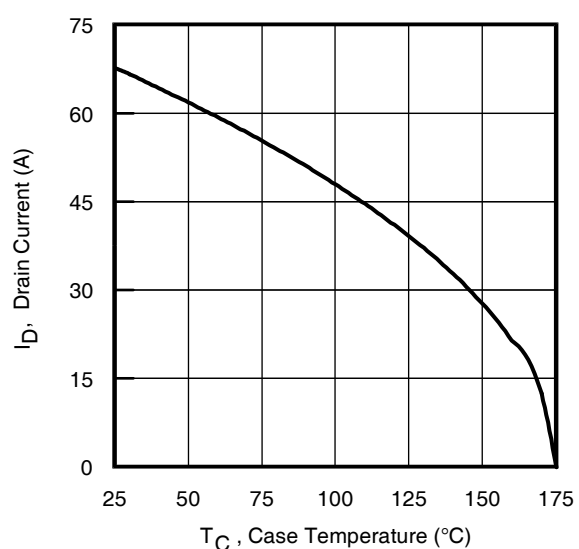


Fig 12. Maximum Drain Current vs. Case Temperature

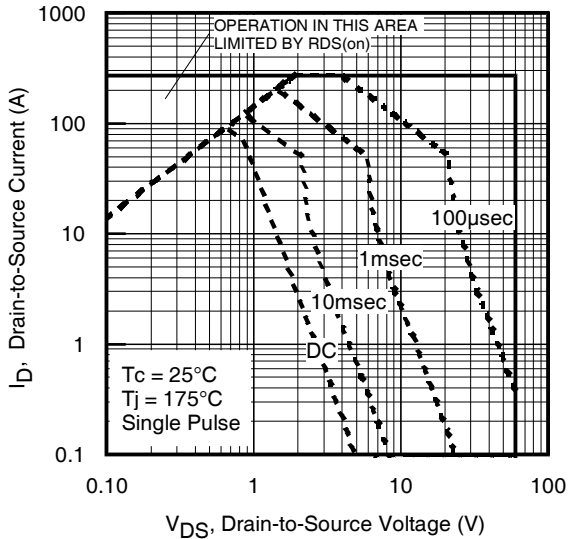


Fig 13. Maximum Safe Operating Area

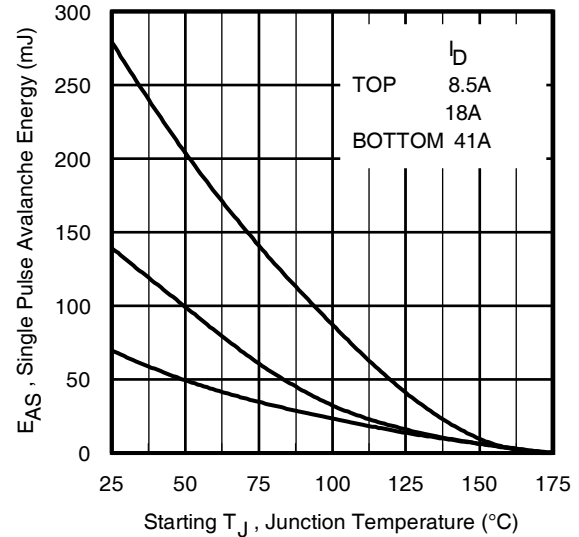


Fig 14. Maximum Avalanche Energy vs. Temperature

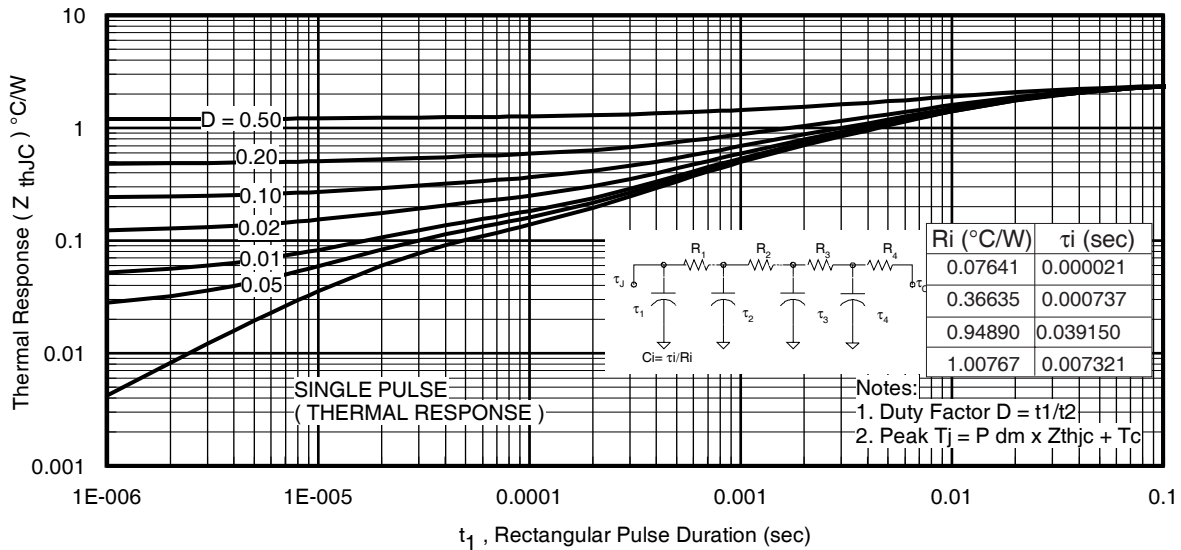


Fig 15. Maximum Effective Transient Thermal Impedance, Junction-to-Case

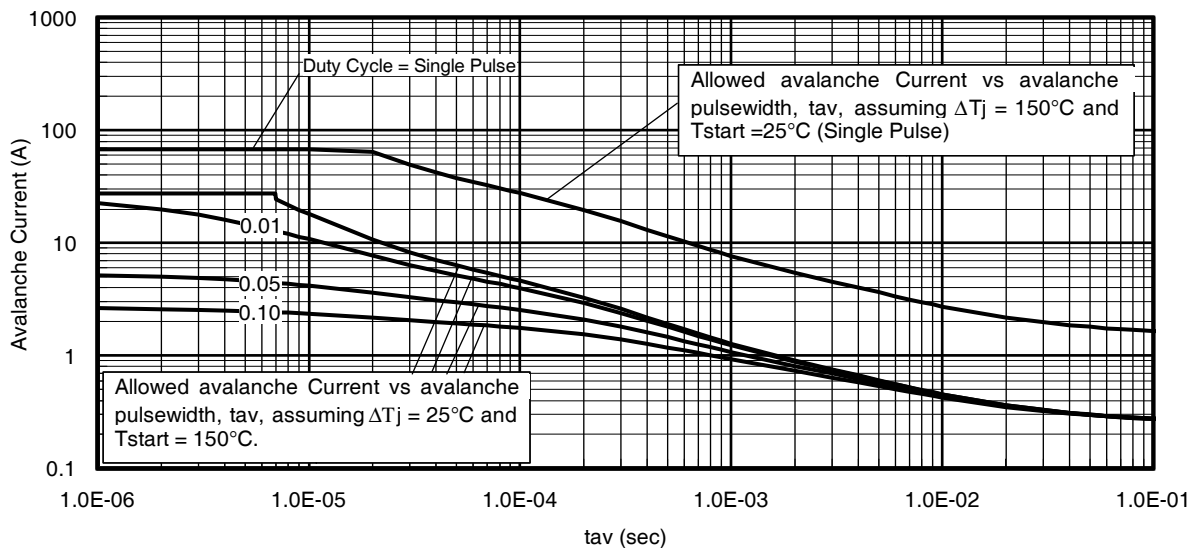


Fig 16. Typical Avalanche Current Vs. Pulsewidth

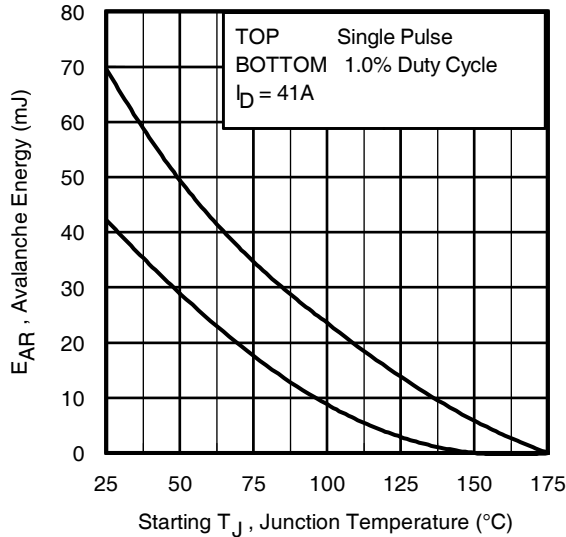


Fig 17. Maximum Avalanche Energy Vs. Temperature

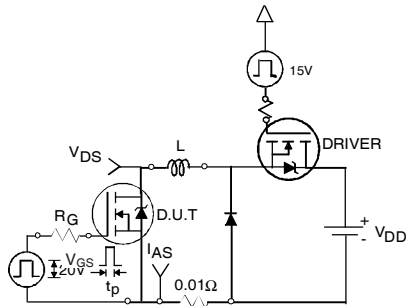


Fig 18a. Unclamped Inductive Test Circuit

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

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

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

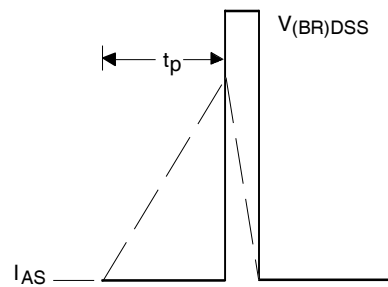


Fig 18b. Unclamped Inductive Waveforms

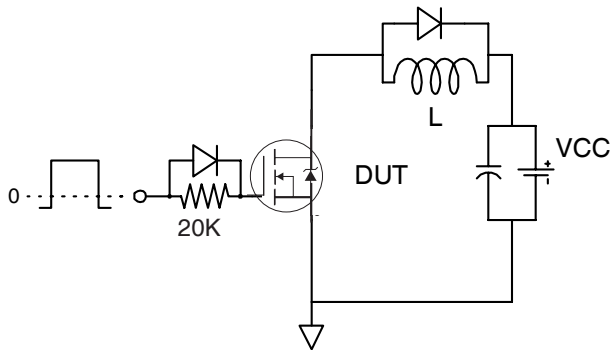


Fig 19a. Gate Charge Test Circuit

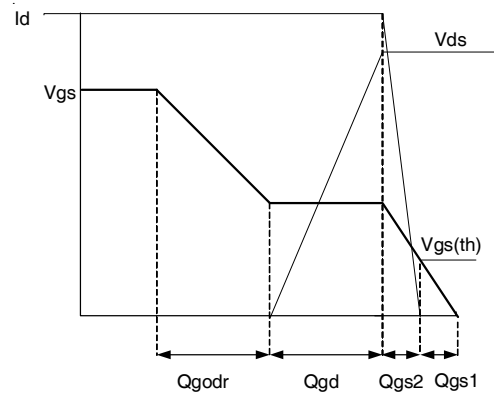


Fig 19b. Gate Charge Waveform

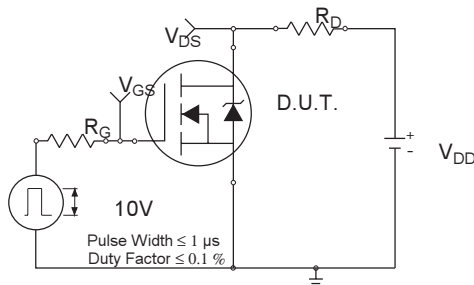


Fig 20a. Switching Time Test Circuit

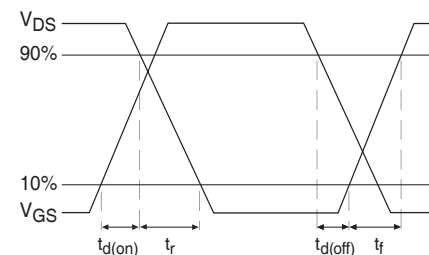
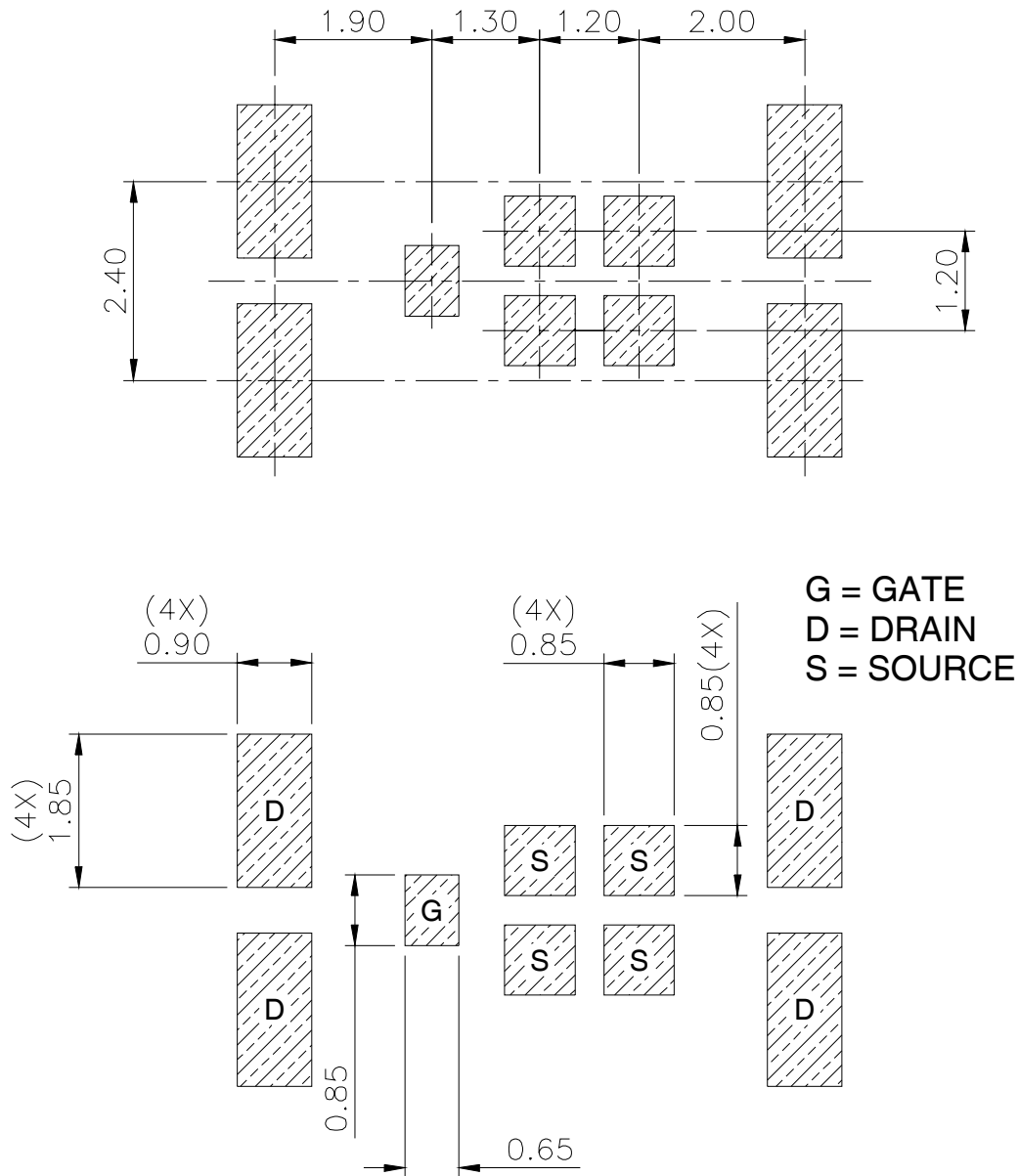


Fig 20b. Switching Time Waveforms

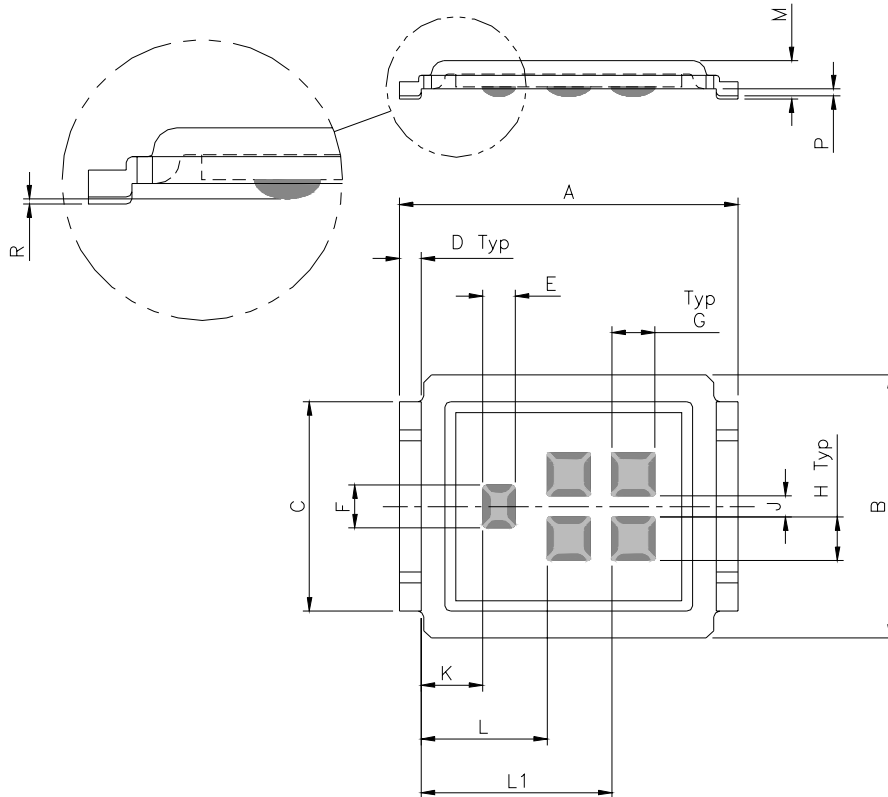
DirectFET™ Board Footprint, M4 (Medium Size Can).

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



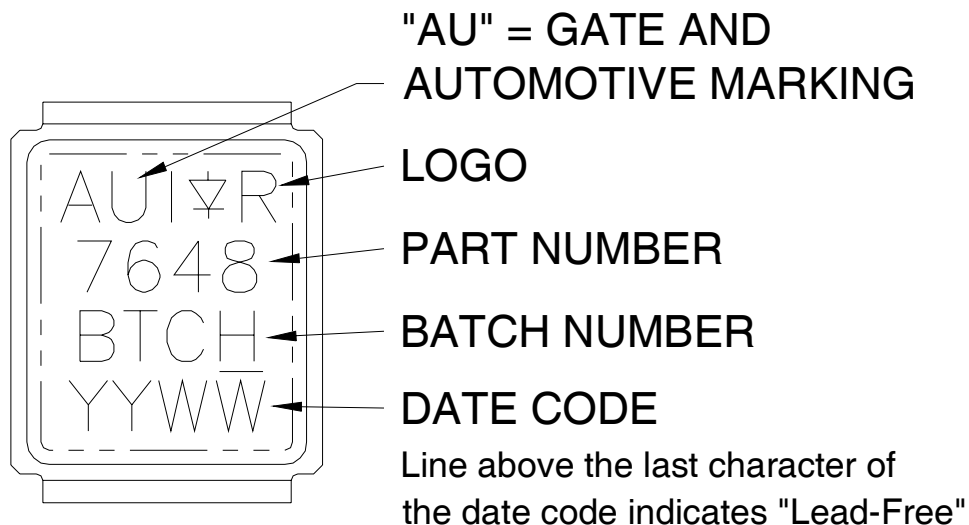
DirectFET™ Outline Dimension, M4 Outline (Medium Size Can).

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



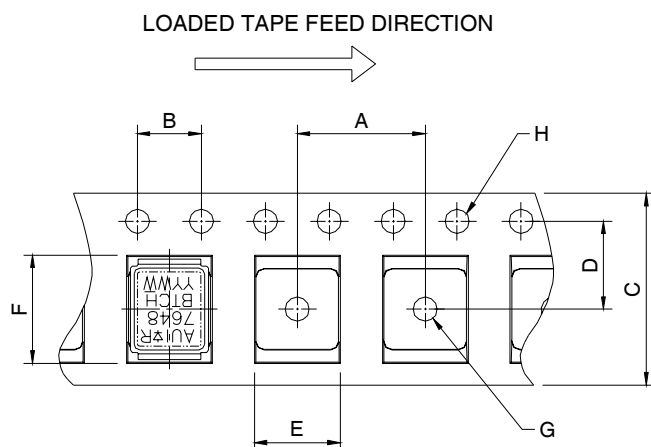
CODE	DIMENSIONS			
	METRIC		IMPERIAL	
	MIN	MAX	MIN	MAX
A	6.25	6.35	0.246	0.250
B	4.80	5.05	0.189	0.201
C	3.85	3.95	0.152	0.156
D	0.35	0.45	0.014	0.018
E	0.58	0.62	0.023	0.024
F	0.78	0.82	0.031	0.032
G	0.78	0.82	0.031	0.032
H	0.78	0.82	0.031	0.032
J	0.38	0.42	0.015	0.017
K	1.10	1.20	0.043	0.047
L	2.30	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



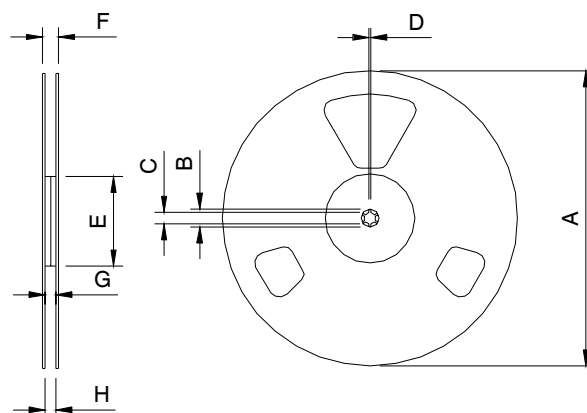
Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

DirectFET™ Tape & Reel Dimension (Showing component orientation).



NOTE: CONTROLLING
DIMENSIONS IN MM

DIMENSIONS				
	METRIC		IMPERIAL	
CODE	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



NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts. (ordered as AUIRF7648M2TR). For 1000 parts on 7" reel, order AUIRF7648M2TR1

REEL DIMENSIONS								
STANDARD OPTION (QTY 4800)					TR1 OPTION (QTY 1000)			
	METRIC		IMPERIAL		METRIC		IMPERIAL	
CODE	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	330.0	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 $T_J = 25^\circ\text{C}$, $L = 0.084\text{mH}$, $R_G = 50\Omega$, $I_{AS} = 41\text{A}$, $V_{GS} = 20\text{V}$.
- 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_θ is measured at T_J of approximately 90°C .

IMPORTANT NOTICE

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IR warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with IR's standard warranty. Testing and other quality control techniques are used to the extent IR deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

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IR products are neither designed nor intended for use in automotive applications or environments unless the specific IR products are designated by IR as compliant with ISO/TS 16949 requirements and bear a part number including the designation "AU". Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, IR will not be responsible for any failure to meet such requirements

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

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

WORLD HEADQUARTERS:

233 Kansas St., El Segundo, California 90245
Tel: (310) 252-7105