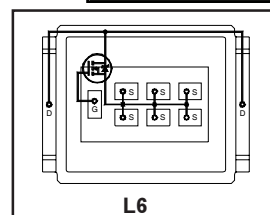


- Advanced Process Technology
- Optimized for Automotive Motor Drive, DC-DC and other Heavy Load Applications
- Exceptionally Small Footprint and Low Profile
- High Power Density
- Low Parasitic Parameters
- Dual Sided Cooling
- 175°C Operating Temperature
- Repetitive Avalanche Capability for Robustness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

$V_{(BR)DSS}$	40V
$R_{DS(on)}$ typ.	1.2mΩ
	1.6mΩ
I_D (Silicon Limited)	184A
Q_g	129nC



L6



DirectFET® ISOMETRIC

Applicable DirectFET® Outline and Substrate Outline ①

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

Description

The AUIRF7738L2 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 a DPak (TO-252AA) 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 AUIRF7738L2 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.

	Parameter	Max.	Units
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)③	184	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)③	130	
$I_D @ T_A = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)③	35	
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Package Limited)	315	
I_{DM}	Pulsed Drain Current ⑤	736	
$P_D @ T_C = 25^\circ\text{C}$	Power Dissipation ④	94	W
$P_D @ T_A = 25^\circ\text{C}$	Power Dissipation ③	3.3	
E_{AS}	Single Pulse Avalanche Energy (Thermally Limited) ⑥	134	mJ
E_{AS} (tested)	Single Pulse Avalanche Energy Tested Value ⑥	538	
I_{AR}	Avalanche Current ⑦	See Fig.18a, 18b, 16, 17	A
E_{AR}	Repetitive Avalanche Energy ⑦		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	—	45	°C/W
$R_{\theta JA}$	Junction-to-Ambient ⑧	12.5	—	
$R_{\theta JA}$	Junction-to-Ambient ⑨	20	—	
$R_{\theta JCan}$	Junction-to-Can ④⑩	—	1.6	
$R_{\theta J-PCB}$	Junction-to-PCB Mounted	—	0.5	
	Linear Derating Factor ④	0.63		W/°C

HEXFET® is a registered trademark of International Rectifier.


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

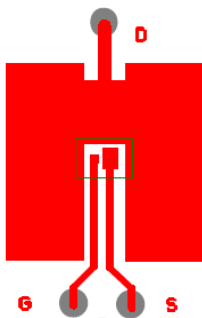
	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	40	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.02	—	V/°C	Reference to $25^\circ\text{C}, I_D = 1mA$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	1.2	1.6	mΩ	$V_{GS} = 10V, I_D = 109A$ ②
$V_{GS(th)}$	Gate Threshold Voltage	2.0	3.0	4.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage Coefficient	—	-8.4	—	mV/°C	
g_{fs}	Forward Transconductance	113	—	—	S	$V_{DS} = 10V, I_D = 109A$
R_G	Gate Resistance	—	1.0	—	Ω	
I_{DSS}	Drain-to-Source Leakage Current	—	—	5	μA	$V_{DS} = 40V, V_{GS} = 0V$
		—	—	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)

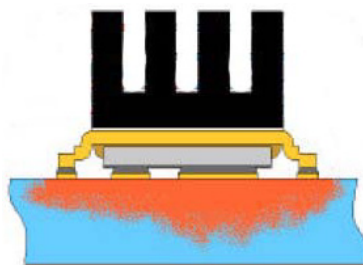
	Parameter	Min.	Typ.	Max.	Units	Conditions
Q_g	Total Gate Charge	—	129	194	nC	$V_{DS} = 20V, V_{GS} = 10V$ $I_D = 109A$ See Fig.11
Q_{gs1}	Pre-Vth Gate-to-Source Charge	—	27	—		
Q_{gs2}	Post-Vth Gate-to-Source Charge	—	10	—		
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	45	—		
Q_{godr}	Gate Charge Overdrive	—	47	—		
Q_{sw}	Switch Charge ($Q_{gs2} + Q_{gd}$)	—	55	—	nC	$V_{DS} = 16V, V_{GS} = 0V$
Q_{oss}	Output Charge	—	54	—		
$t_{d(on)}$	Turn-On Delay Time	—	21	—	ns	$V_{DD} = 20V, V_{GS} = 10V$ ② $I_D = 109A$ $R_G = 1.8\Omega$
t_r	Rise Time	—	77	—		
$t_{d(off)}$	Turn-Off Delay Time	—	39	—		
t_f	Fall Time	—	38	—		
C_{iss}	Input Capacitance	—	7471	—	pF	$V_{GS} = 0V$ $V_{DS} = 25V$ $f = 1.0MHz$
C_{oss}	Output Capacitance	—	1640	—		
C_{riss}	Reverse Transfer Capacitance	—	737	—		
C_{oss}	Output Capacitance	—	5936	—		
C_{oss}	Output Capacitance	—	1465	—		
$C_{oss\ eff.}$	Effective Output Capacitance	—	2261	—		

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

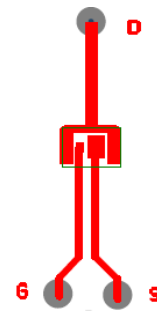
	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	184	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ③	—	—	736		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$I_S = 109A, V_{GS} = 0V$ ②
t_{rr}	Reverse Recovery Time	—	50	75	ns	$I_F = 109A, V_{DD} = 20V$
Q_{rr}	Reverse Recovery Charge	—	68	102	nC	$di/dt = 100A/\mu s$ ②



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



② Mounted to a PCB with small clip heatsink (still air)



② Mounted on minimum footprint full size board with metalized back and with small clip heatsink (still air)

Notes ① through ⑩ are on page 9

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		LARGE-CAN	MSL1
ESD	Machine Model	Class M4 (+/- 800V) (per AEC-Q101-002)	
	Human Body Model	Class H2 (+/- 4000V) (per AEC-Q101-001)	
	Charged Device Model	N/A (per 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.

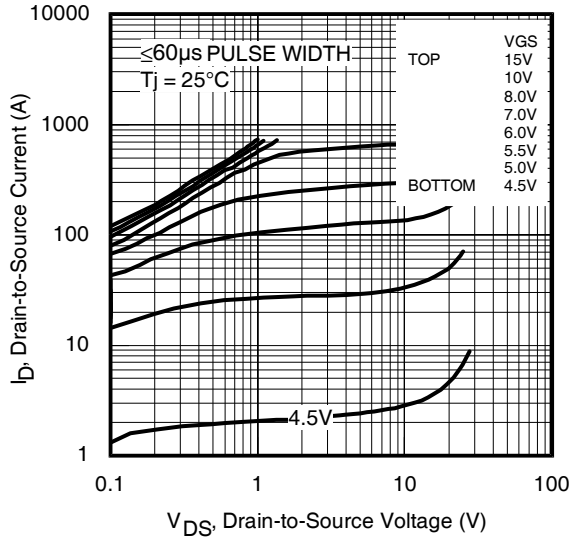


Fig 1. Typical Output Characteristics

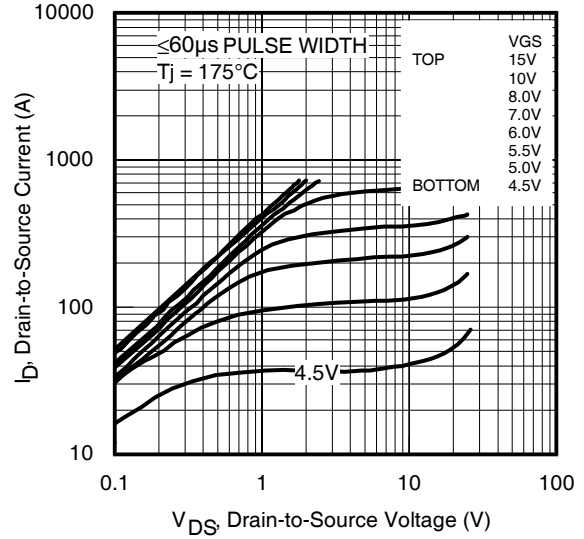


Fig 2. Typical Output Characteristics

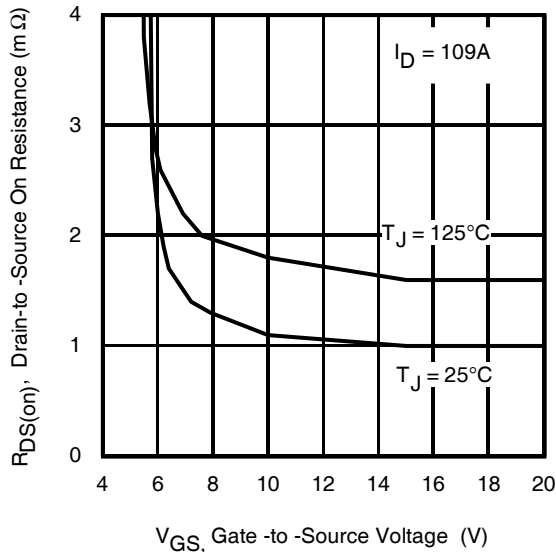


Fig 3. Typical On-Resistance vs. Gate Voltage

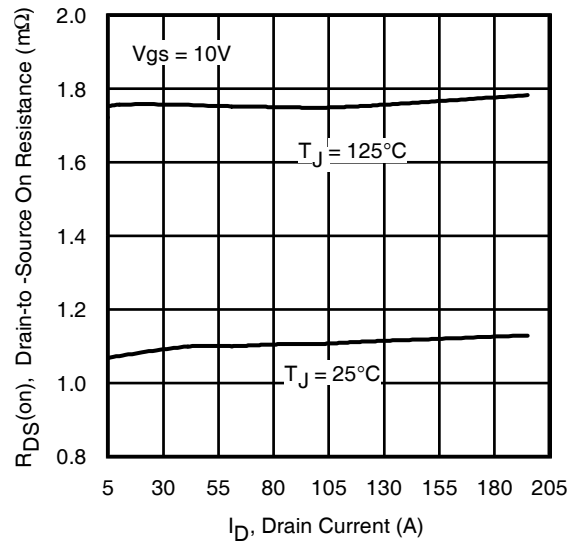


Fig 4. Typical On-Resistance vs. Drain Current

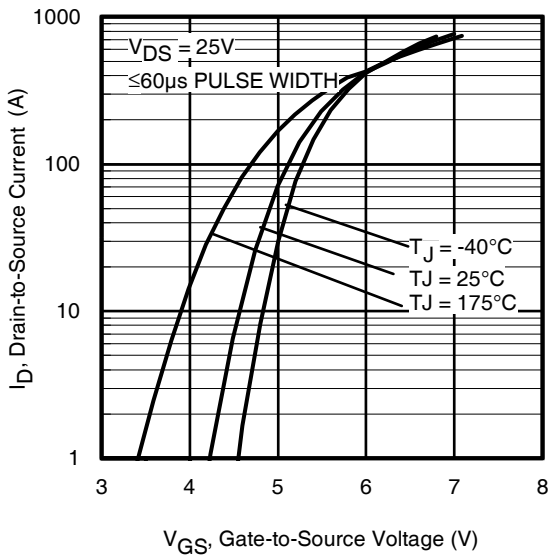


Fig 5. Typical Transfer Characteristics

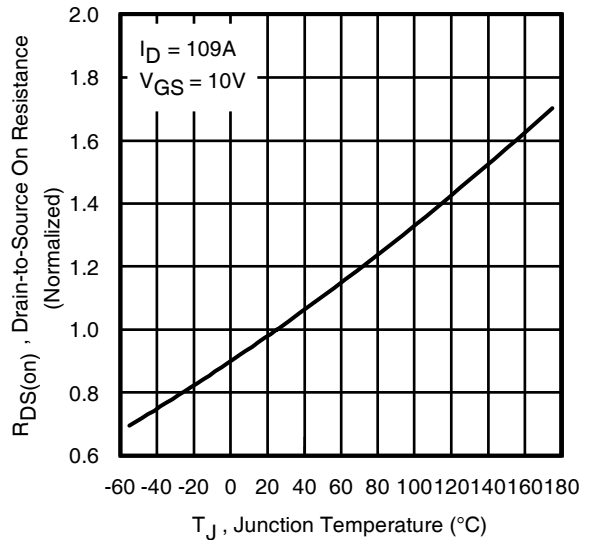


Fig 6. Normalized On-Resistance vs. Temperature

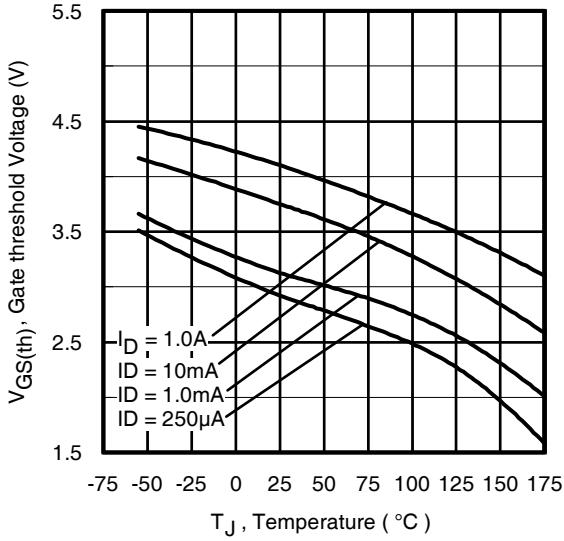


Fig 7. Typical Threshold Voltage vs. Junction Temperature

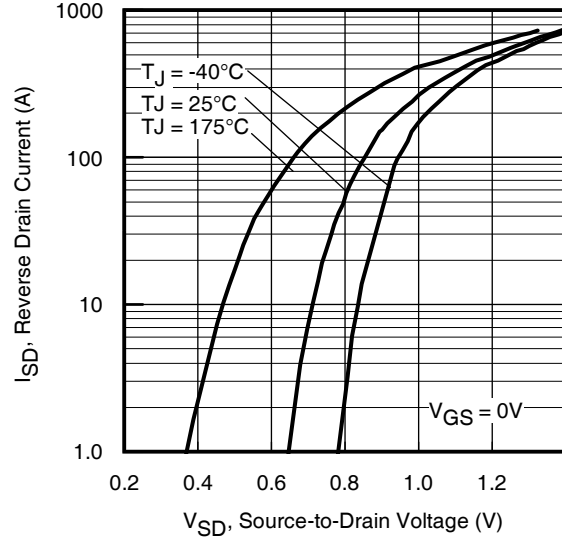


Fig 8. Typical Source-Drain Diode Forward Voltage

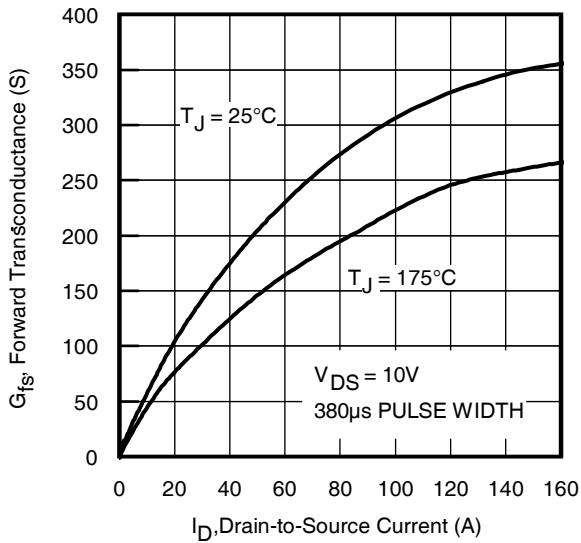


Fig 9. Typical Forward Transconductance Vs. Drain Current

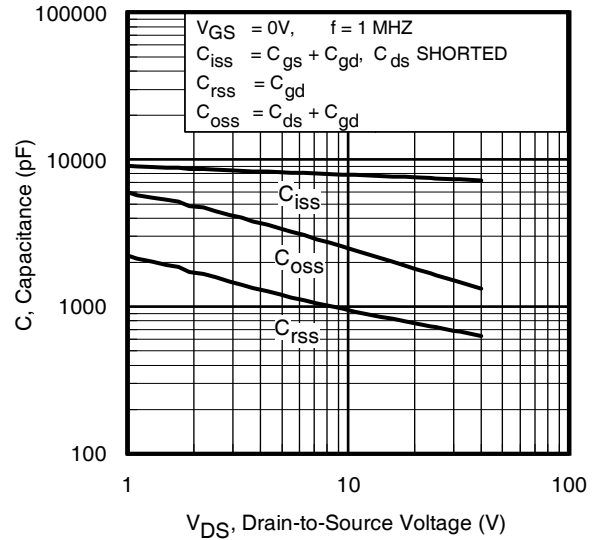


Fig 10. Typical Capacitance vs. Drain-to-Source Voltage

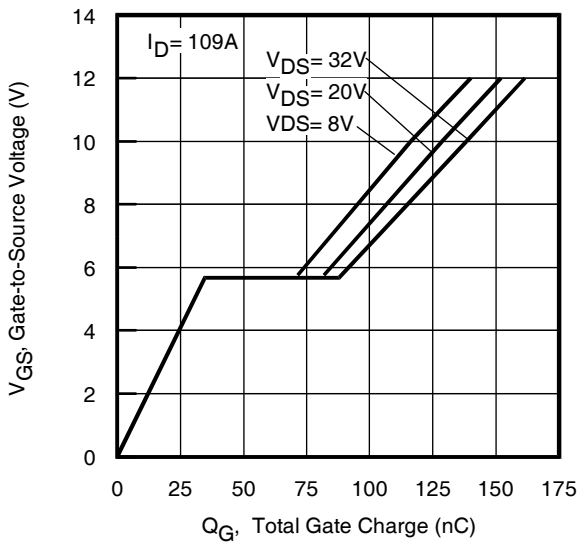


Fig.11 Typical Gate Charge vs. Gate-to-Source Voltage
www.irf.com

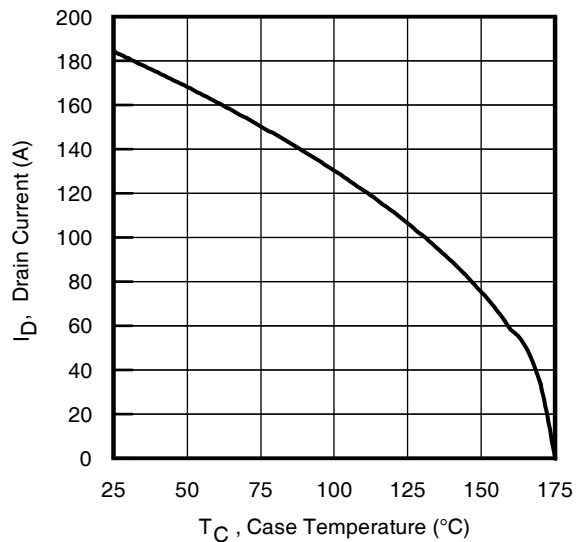


Fig 12. Maximum Drain Current vs. Case Temperature

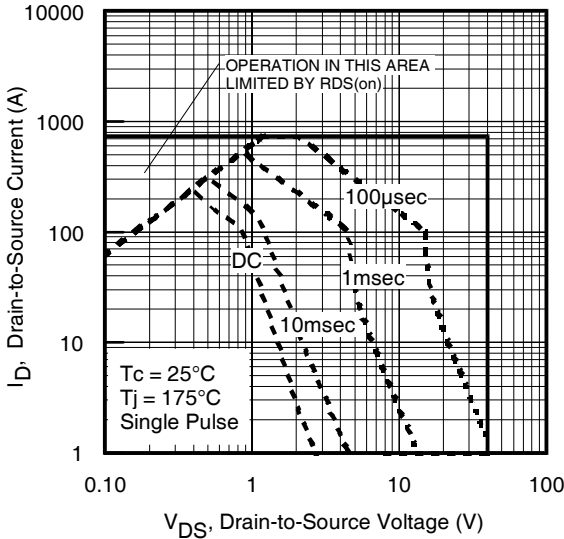


Fig 13. Maximum Safe Operating Area

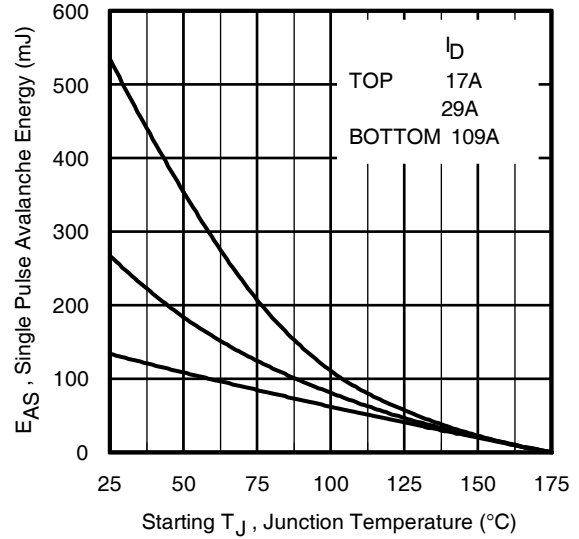


Fig 14. Maximum Avalanche Energy vs. Temperature

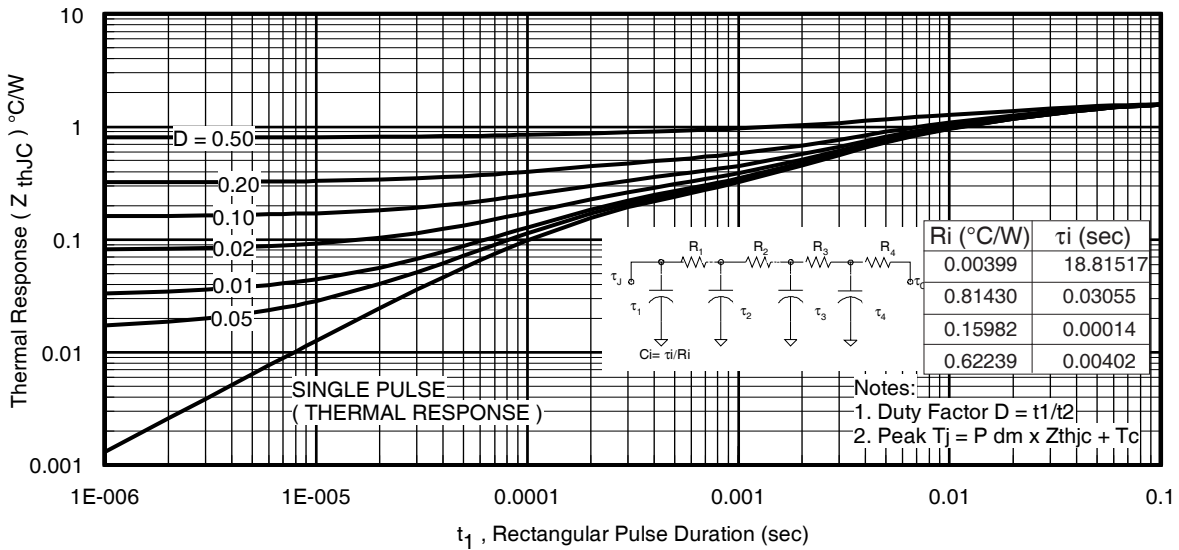


Fig 15. Maximum Effective Transient Thermal Impedance, Junction-to-Case

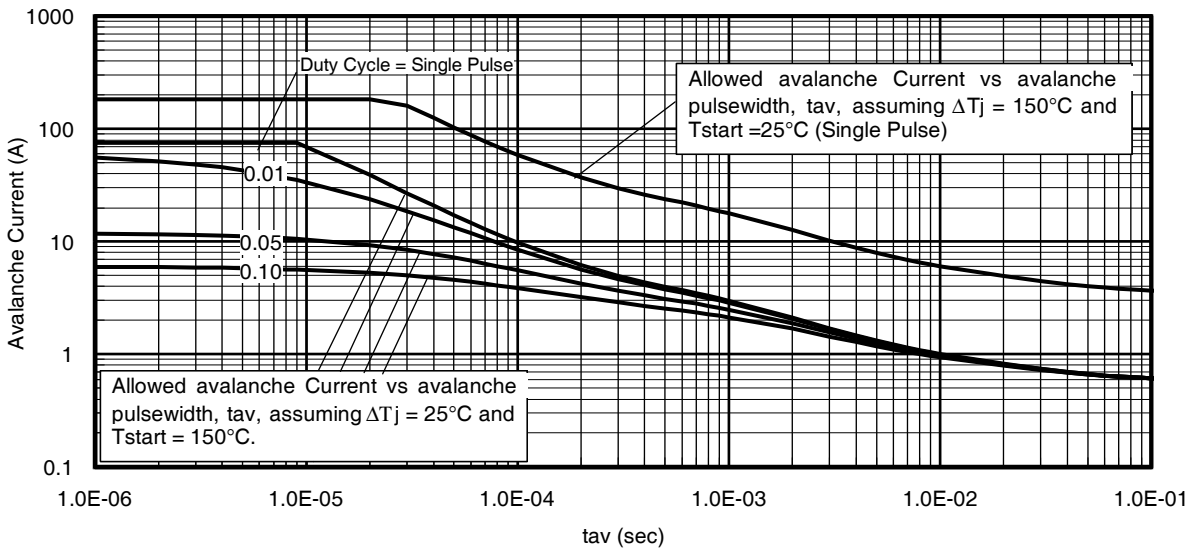


Fig 16. Typical Avalanche Current Vs. Pulsewidth

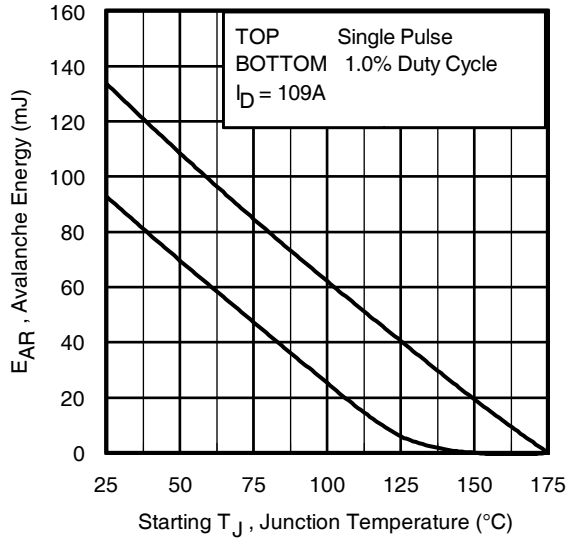


Fig 17. Maximum Avalanche Energy Vs. Temperature

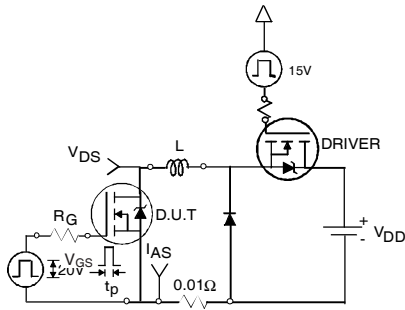


Fig 18a. Unclamped Inductive Test Circuit

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

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

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

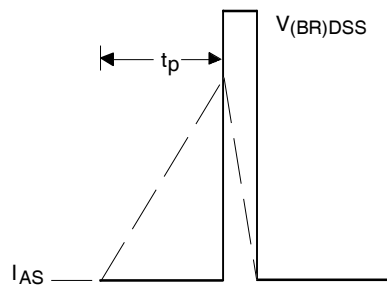


Fig 18b. Unclamped Inductive Waveforms

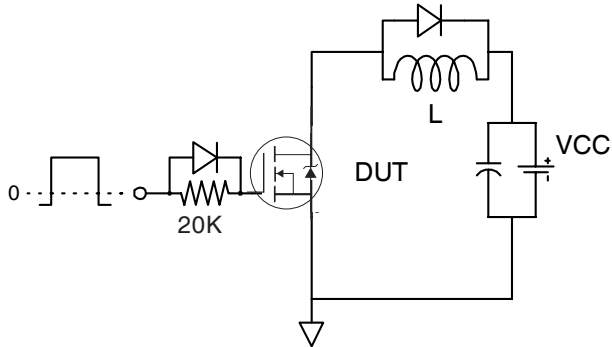


Fig 19a. Gate Charge Test Circuit

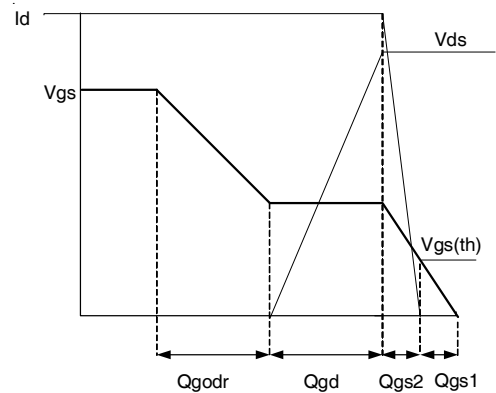


Fig 19b. Gate Charge Waveform

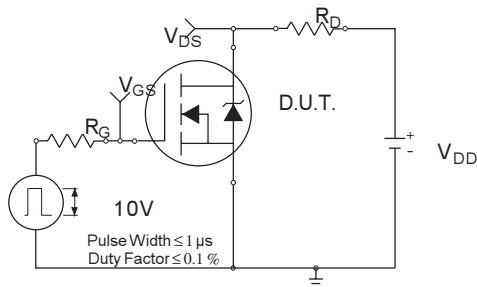


Fig 20a. Switching Time Test Circuit

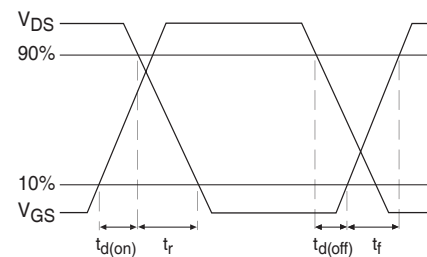


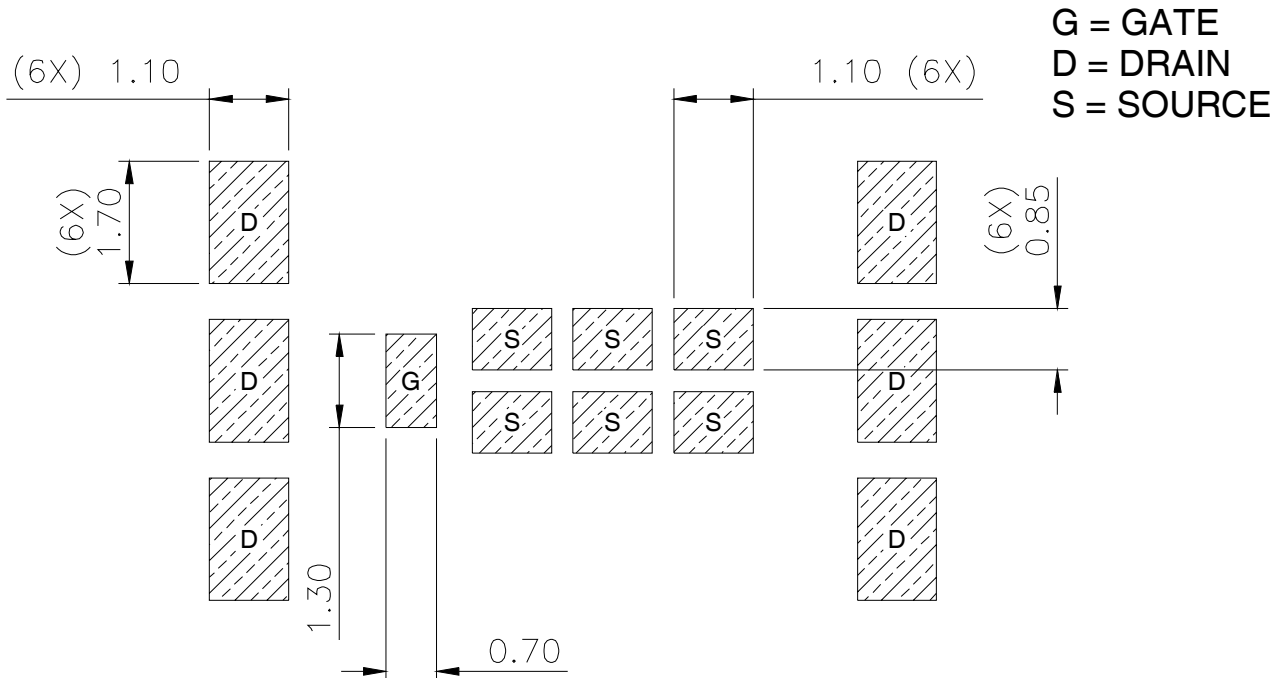
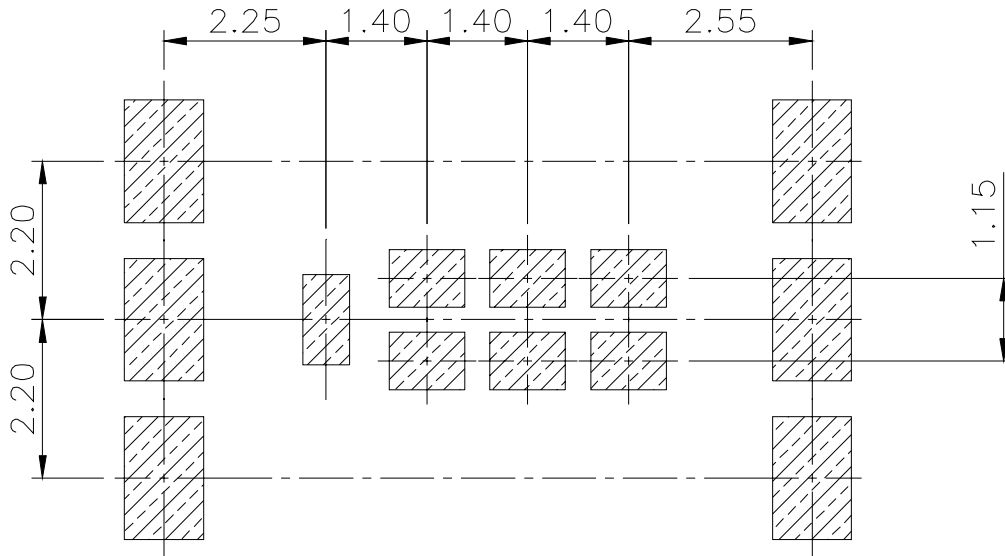
Fig 20b. Switching Time Waveforms

Notes on Repetitive Avalanche Curves , Figures 16, 17:
(For further info, see AN-1005 at 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. 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 = $t_{av} \cdot f$
 $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see figure 15)

Automotive DirectFET® Board Footprint, L6 (Large Size Can).

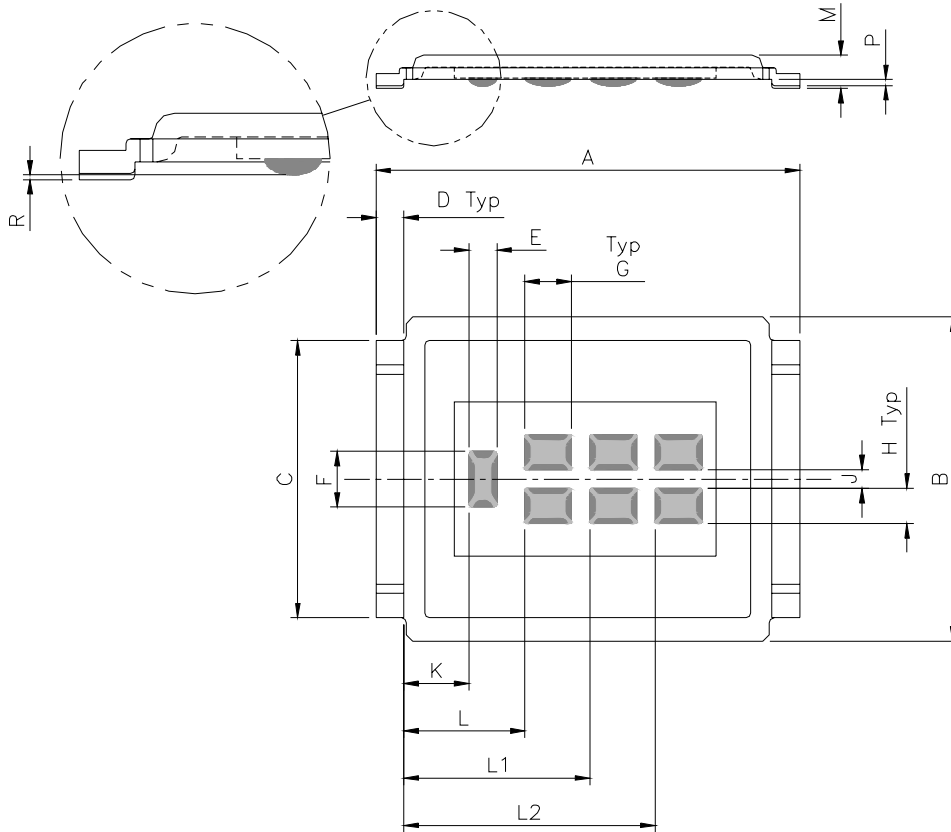
Please see AN-1035 for DirectFET® assembly details and stencil and substrate design recommendations



G = GATE
D = DRAIN
S = SOURCE

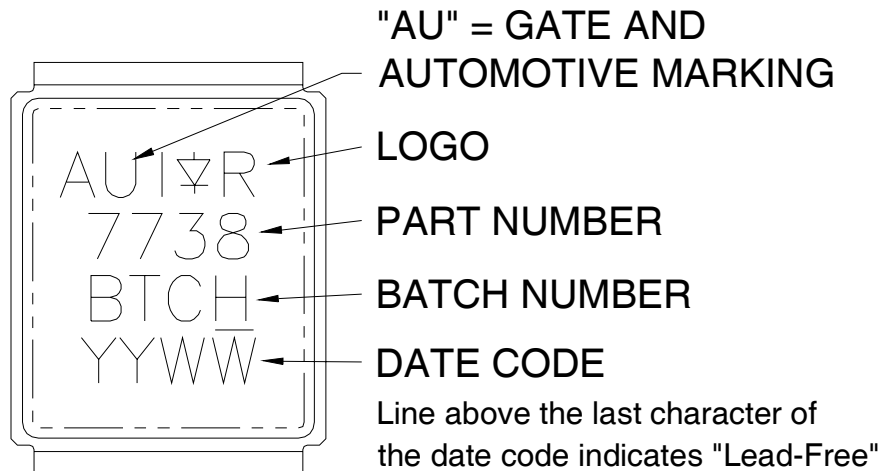
Automotive DirectFET® Outline Dimension, L6 Outline (LargeSize Can).

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



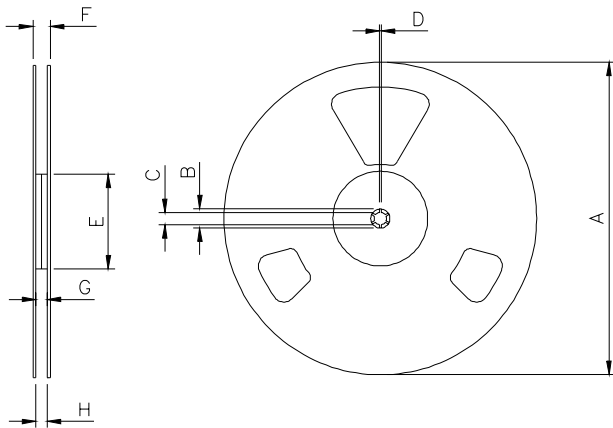
CODE	METRIC		IMPERIAL	
	MIN	MAX	MIN	MAX
A	9.05	9.15	0.356	0.360
B	6.85	7.10	0.270	0.280
C	5.90	6.00	0.232	0.236
D	0.55	0.65	0.022	0.026
E	0.58	0.62	0.023	0.024
F	1.18	1.22	0.046	0.048
G	0.98	1.02	0.039	0.040
H	0.73	0.77	0.029	0.030
J	0.38	0.42	0.015	0.017
K	1.35	1.45	0.053	0.057
L	2.55	2.65	0.100	0.104
L1	3.95	4.05	0.155	0.159
L2	5.35	5.45	0.210	0.214
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

Automotive DirectFET® Part Marking



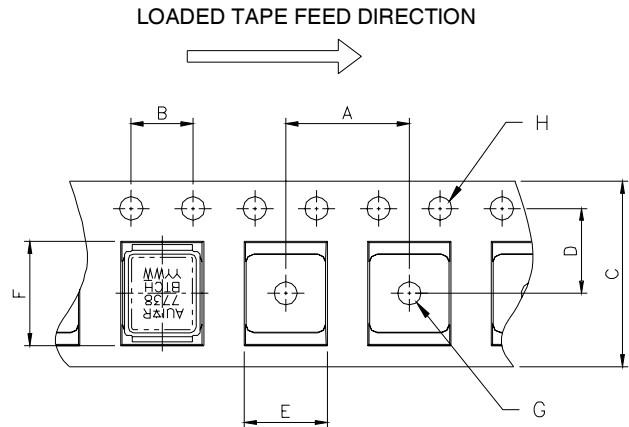
Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

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



NOTE: Controlling dimensions in mm
Std reel quantity is 4000 parts. (ordered as AUIRF7738L2TR). For 1000 parts on 7" reel, order AUIRF7738L2TR1

REEL DIMENSIONS								
STANDARD OPTION (QTY 4000)				TR1 OPTION (QTY 1000)				
CODE	METRIC		IMPERIAL		METRIC		IMPERIAL	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	330.00	N.C	12.992	N.C	177.80	N.C	7.000	N.C
B	20.20	N.C	0.795	N.C	20.20	N.C	0.795	N.C
C	12.80	13.20	0.504	0.520	12.98	13.50	0.331	0.50
D	1.50	N.C	0.059	N.C	1.50	2.50	0.059	N.C
E	99.00	100.00	3.900	3.940	62.48	N.C	2.460	N.C
F	N.C	22.40	N.C	0.880	N.C	N.C	N.C	0.53
G	16.40	18.40	0.650	0.720	N.C	N.C	N.C	N.C
H	15.90	19.40	0.630	0.760	16.00	N.C	0.630	N.C



NOTE: CONTROLLING DIMENSIONS IN MM

CODE	DIMENSIONS			
	METRIC		IMPERIAL	
	MIN	MAX	MIN	MAX
A	11.90	12.10	4.69	0.476
B	3.90	4.10	0.154	0.161
C	15.90	16.30	0.623	0.642
D	7.40	7.60	0.291	0.299
E	7.20	7.40	0.283	0.291
F	9.90	10.10	0.390	0.398
G	1.50	N.C	0.059	N.C
H	1.50	1.60	0.059	0.063

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 $T_J = 25^\circ\text{C}$, $L = 0.022\text{mH}$, $R_G = 50\Omega$, $I_{AS} = 109\text{A}$.
- 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.

IR assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using IR components. To minimize the risks with customer products and applications, customers should provide adequate design and operating safeguards.

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