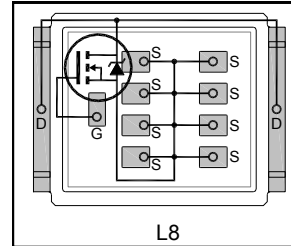


Automotive DirectFET® Power MOSFET ②

- 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 Allowed up to Tjmax
- Lead Free, RoHS Compliant and Halogen Free
- Automotive Qualified \*

$V_{(BR)DSS}$	<b>40V</b>
$R_{DS(on)}$ <b>typ.</b>	<b>0.35mΩ</b>
	<b>max.</b>
$I_D$ (Silicon Limited)	<b>545A</b>
$Q_g$	<b>375nC</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 AUIRF8739L2 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, 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 AUIRF8739L2 to offer substantial system level savings and performance improvement specifically in motor drive, DC-DC and other heavy load applications on ICE, HEV and EV platforms. This MOSFET utilizes the latest processing techniques to achieve ultra low on-resistance 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.

Base Part Number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
AUIRF8739L2	DirectFET®	Tape and Reel	4000	AUIRF8739L2TR

**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 (TA) is 25°C, unless otherwise specified.

	Parameter	Max.	Units
$V_{GS}$	Gate-to-Source Voltage	40	V
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ ④	545	A
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ ④	385	
$I_D @ T_A = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ ③	57	
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ (Package limit)④	375	
$I_{DM}$	Pulsed Drain Current ⑤	1150	
$P_D @ T_C = 25^\circ C$	Power Dissipation ④	340	W
$P_D @ T_A = 25^\circ C$	Power Dissipation ③	3.8	
$E_{AS}$	Single Pulse Avalanche Energy (Thermally Limited) ⑥	312	mJ
$E_{AS} (Tested)$	Single Pulse Avalanche Energy	1500**	
$I_{AR}$	Avalanche Current ⑤	See Fig. 14, 15, 22a, 22b	A
$E_{AR}$	Repetitive Avalanche Energy ⑤		
$T_P$	Peak Soldering Temperature	270	mJ
$T_J$	Operating Junction and	-55 to + 175	°C
$T_{STG}$	Storage Temperature Range		

\*Qualification standards can be found at <http://www.irf.com/>

**Thermal Resistance**

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JA}$	Junction-to-Ambient <sup>③</sup>	—	40	°CW
$R_{\theta JA}$	Junction-to-Ambient <sup>⑧</sup>	12.5	—	
$R_{\theta JA}$	Junction-to-Ambient <sup>⑨</sup>	20	—	
$R_{\theta J-Can}$	Junction-to-Can <sup>④⑩</sup>	—	0.44	
$R_{\theta J-PCB}$	Junction-to-PCB Mounted	—	0.5	
	Linear Derating Factor <sup>④</sup>	2.3		W/°C

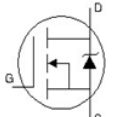
**Static Electrical Characteristics @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)**

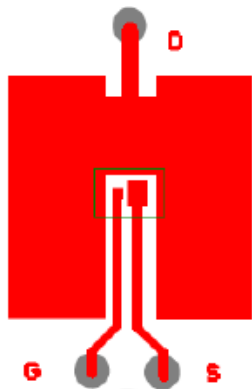
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	40	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.03	—	V/°C	Reference to $25^\circ\text{C}, I_D = 5.0\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	0.35	0.60	mΩ	$V_{GS} = 10V, I_D = 195A$ <sup>⑦</sup>
$V_{GS(th)}$	Gate Threshold Voltage	2.2	—	3.9	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage Coefficient	—	-12	—	mV/°C	
gfs	Forward Transconductance	250	—	—	S	$V_{DS} = 10V, I_D = 195A$
$R_G$	Internal Gate Resistance	—	0.81	—	Ω	
$I_{DSS}$	Drain-to-Source Leakage Current	—	—	1.0	μA	$V_{DS} = 40V, V_{GS} = 0V$
		—	—	150		$V_{DS} = 40V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -20V$

**Dynamic Electrical Characteristics @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)**

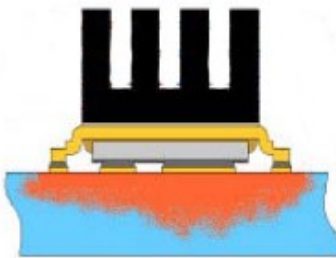
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$Q_g$	Total Gate Charge	—	375	562	nC	$V_{DS} = 20V$
$Q_{gs1}$	Gate-to-Source Charge	—	60	—		$V_{GS} = 10V$
$Q_{gs2}$	Gate-to-Source Charge	—	40	—		$I_D = 195A$
$Q_{gd}$	Gate-to-Drain ("Miller") Charge	—	120	—		
$Q_{godr}$	Gate Charge Overdrive	—	155	—		
$Q_{sw}$	Switch Charge ( $Q_{gs2} + Q_{gd}$ )	—	160	—		
$Q_{oss}$	Output Charge	—	151	—	nC	$V_{DS} = 32V, V_{GS} = 0V$
$t_{d(on)}$	Turn-On Delay Time	—	34	—	ns	$V_{DD} = 20V, V_{GS} = 10V$ <sup>⑦</sup>
$t_r$	Rise Time	—	117	—		$I_D = 195A$
$t_{d(off)}$	Turn-Off Delay Time	—	120	—		$R_G = 1.8\Omega$
$t_f$	Fall Time	—	95	—		
$C_{iss}$	Input Capacitance	—	17890	—	pF	$V_{GS} = 0V$
$C_{oss}$	Output Capacitance	—	2640	—		$V_{DS} = 25V$
$C_{riss}$	Reverse Transfer Capacitance	—	1830	—		$f = 500\text{kHz}$
$C_{oss\ eff.}$	Effective Output Capacitance	—	3785	—		$V_{GS} = 0V, V_{DS} = 0V\ to\ 32V$

**Diode Characteristics**

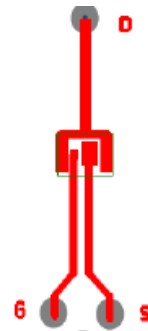
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	—	—	545	A	MOSFET symbol showing the integral reverse p-n junction diode. 
$I_{SM}$	Pulsed Source Current (Body Diode) ③	—	—	1150	A	
$V_{SD}$	Diode Forward Voltage	—	—	1.2	V	$T_J = 25^\circ\text{C}$ , $I_S = 195\text{A}$ , $V_{GS} = 0\text{V}$ ⑦
$t_{rr}$	Reverse Recovery Time	—	47	—	ns	$I_F = 195\text{A}$ , $V_{DD} = 20\text{V}$
$Q_{rr}$	Reverse Recovery Charge	—	66	—	nC	$dv/dt = 100\text{A}/\mu\text{s}$ ⑦



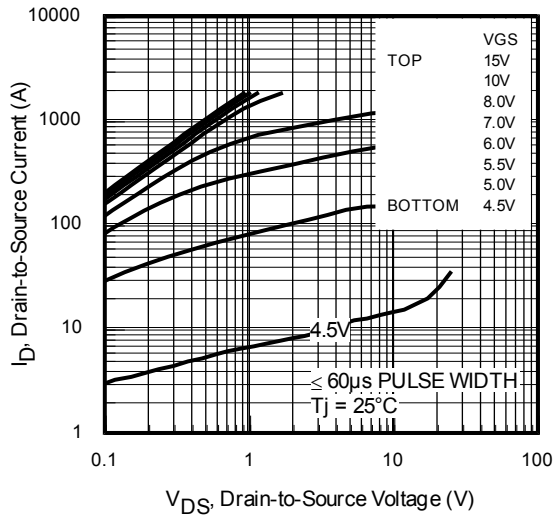
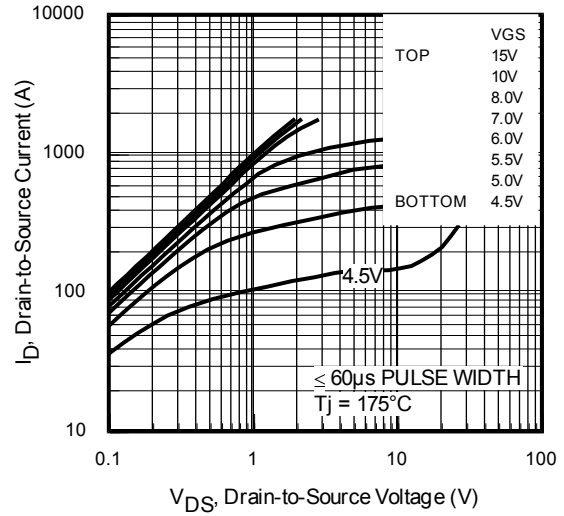
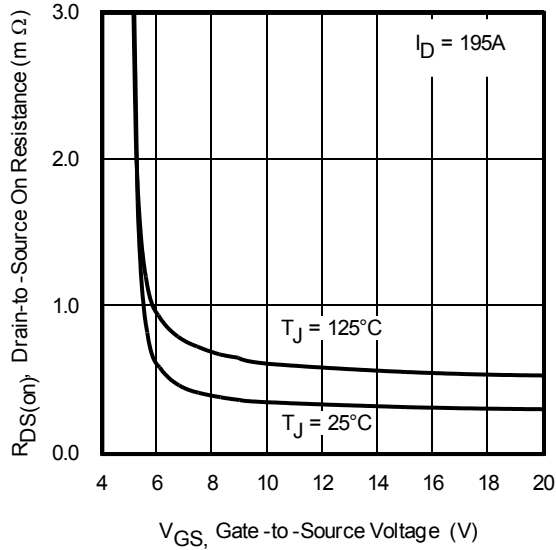
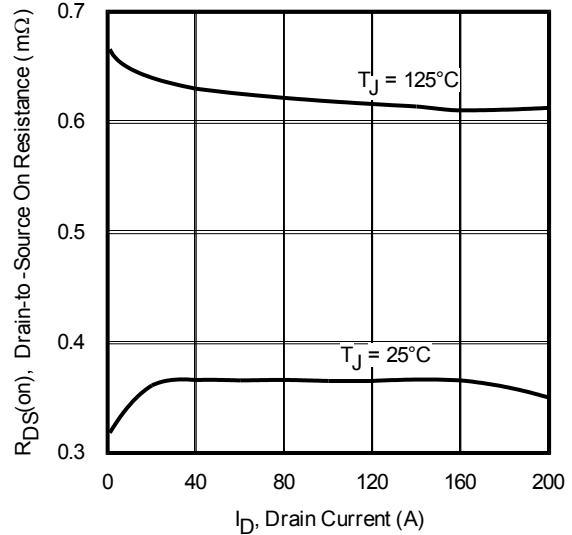
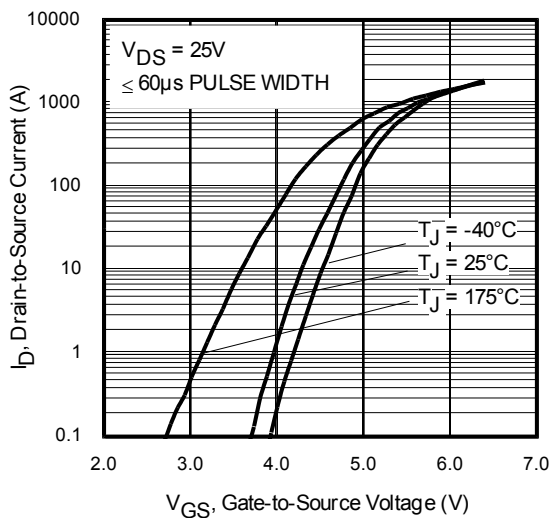
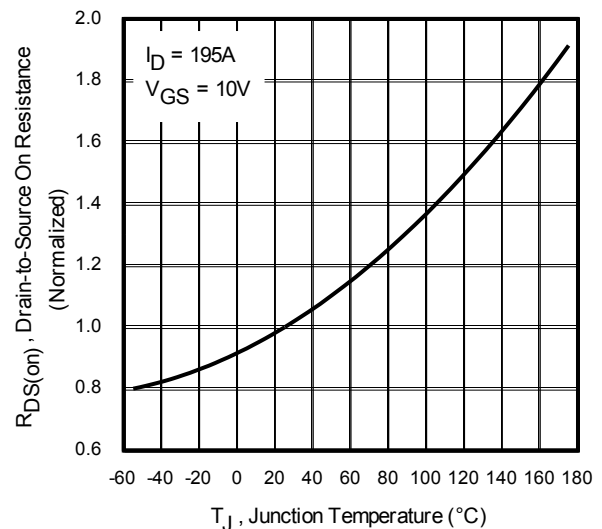
③ Surface mounted on 1 in. square Cu board (still air).

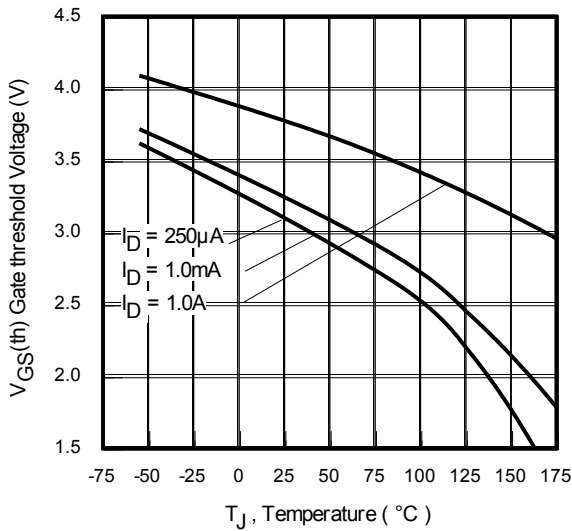
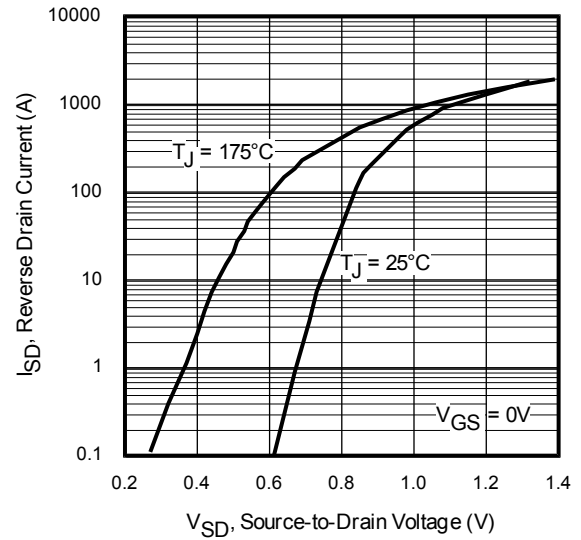
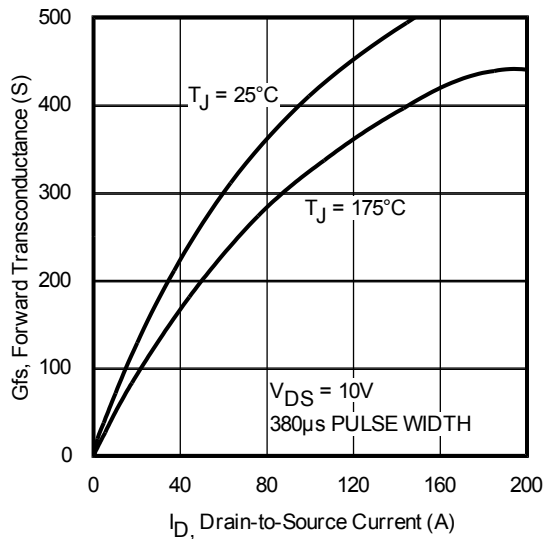
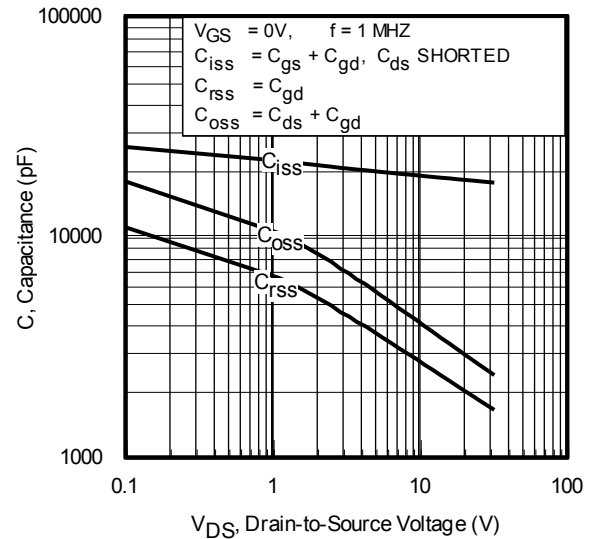
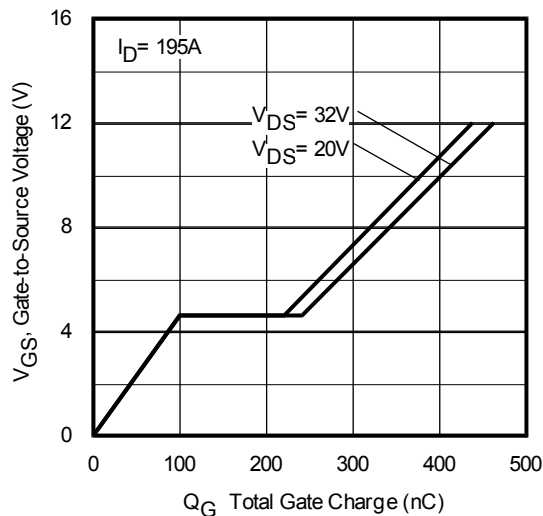
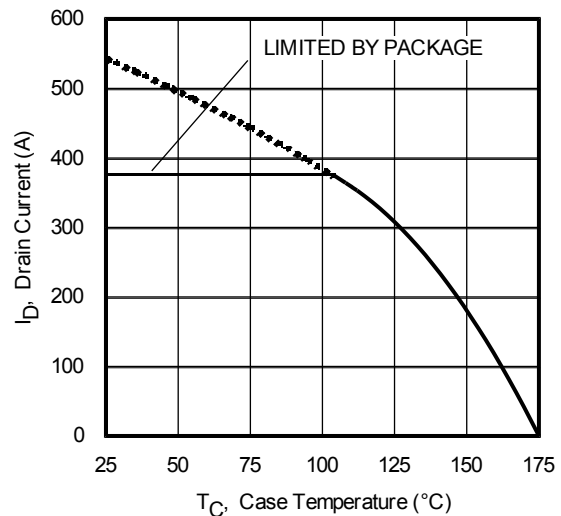


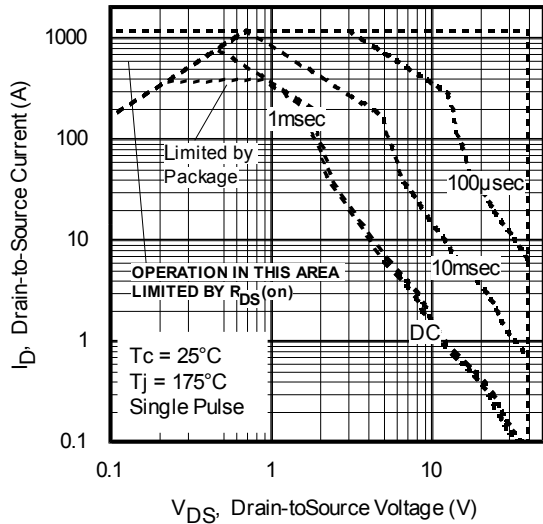
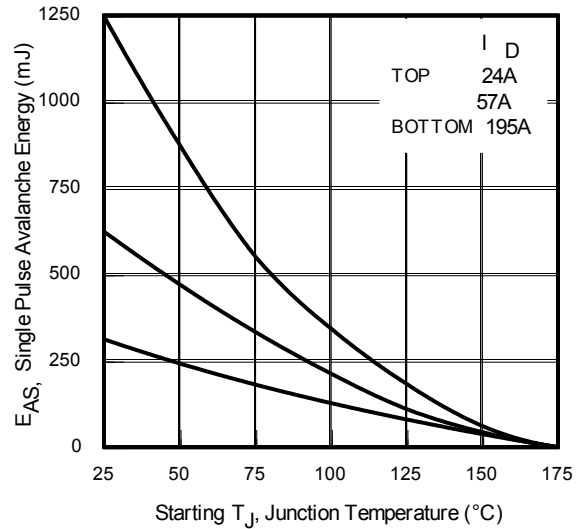
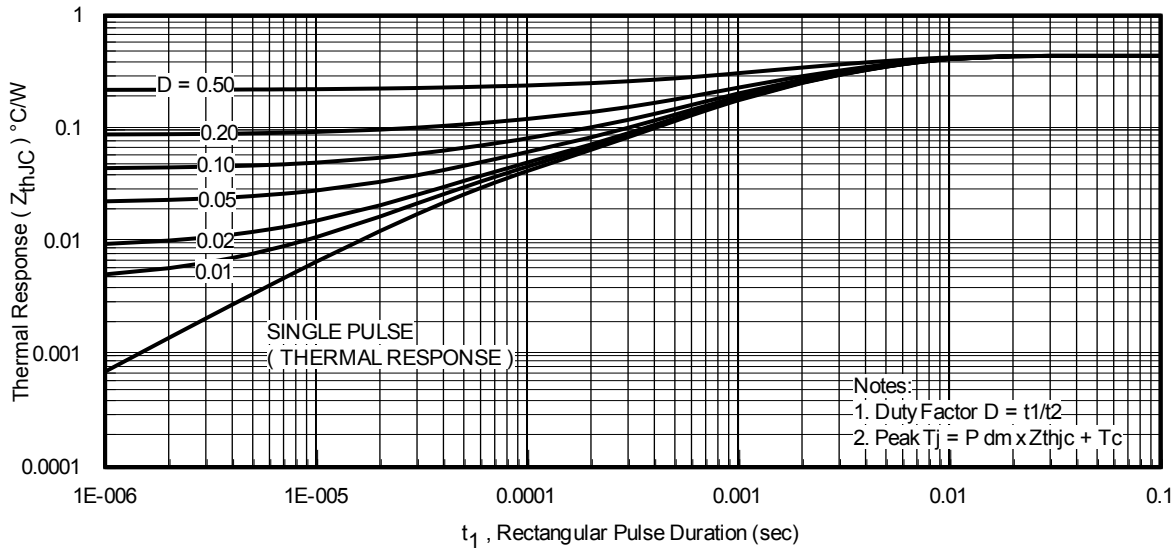
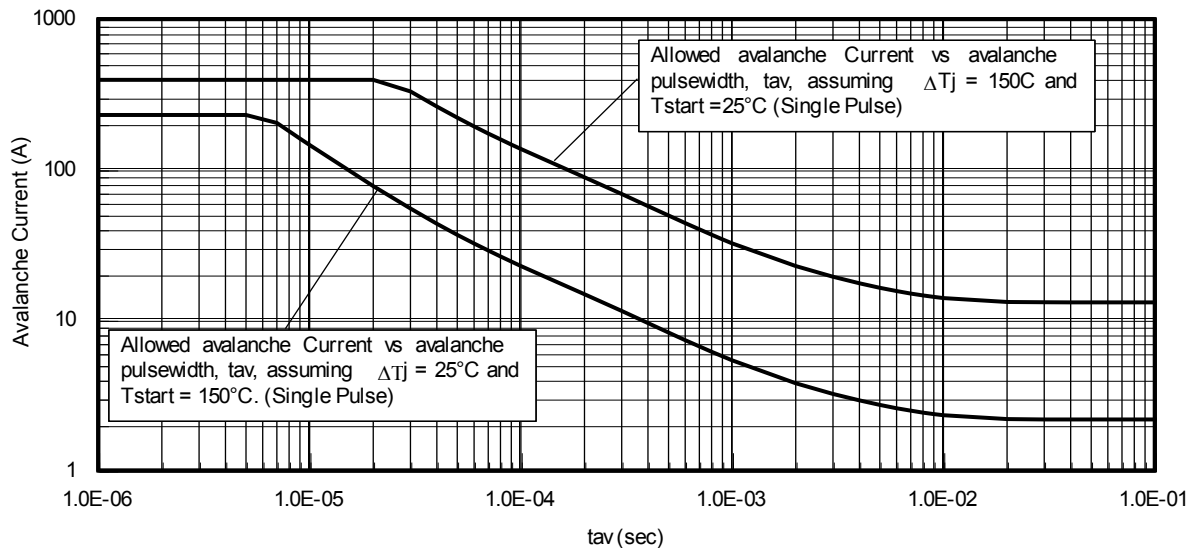
⑦ Mounted to a PCB with small clip heatsink (still air)

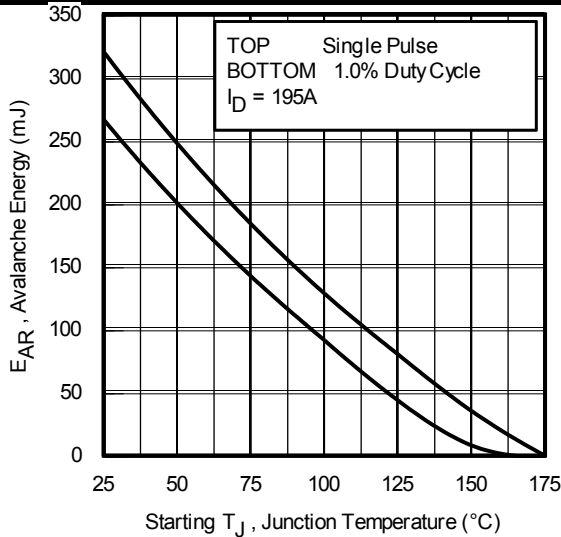


⑧ Mounted on minimum footprint full size board with metalized back and with small clip heatsink (still air).


**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.** 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.

**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. Pulse Width**

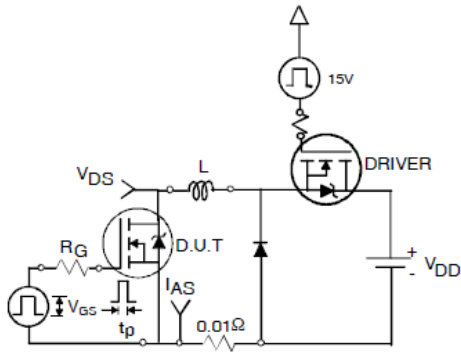
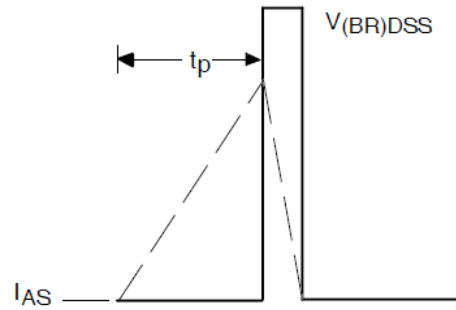
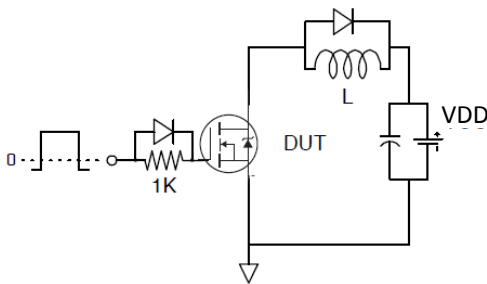
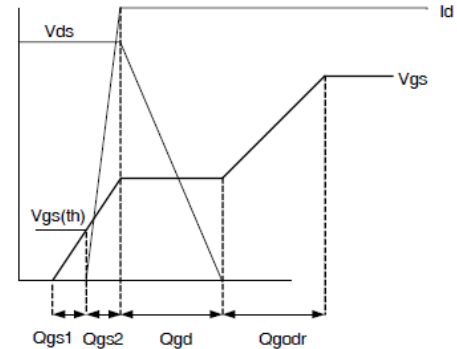
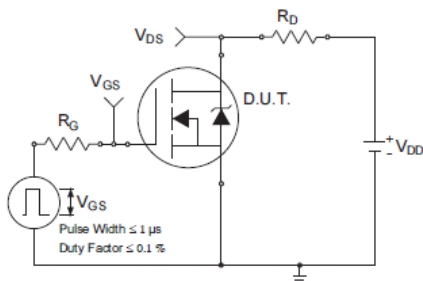
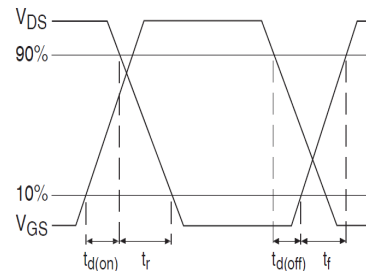

**Fig 17. Maximum Avalanche Energy vs. Temperature**
**Notes on Repetitive Avalanche Curves , Figures 16, 17:**
**(For further info, see AN-1005 at www.irf.com)**

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.  $\Delta T$  = 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 Figures 15)

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

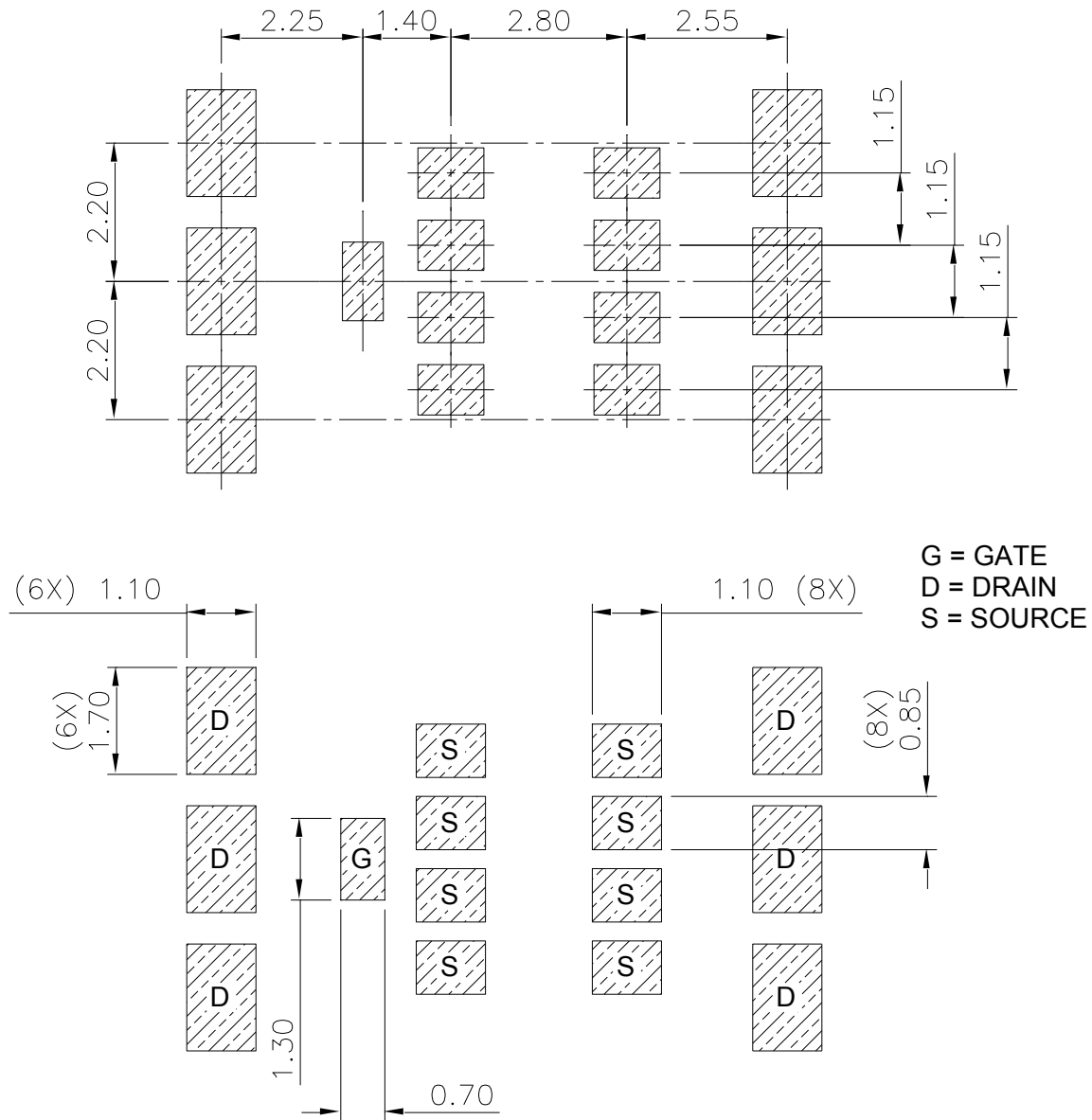
$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$

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


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

**Fig**

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

**Fig 19b. Gate Charge Waveform**

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

**Fig 20b. Switching Time Waveforms**

**DirectFET<sup>®</sup> Board Footprint, L8 Outline  
(Large Size Can, 8-Source Pads)**

Please see DirectFET application note AN-1035 for all details regarding the assembly of DirectFET. This includes all recommendations for stencil and substrate designs.

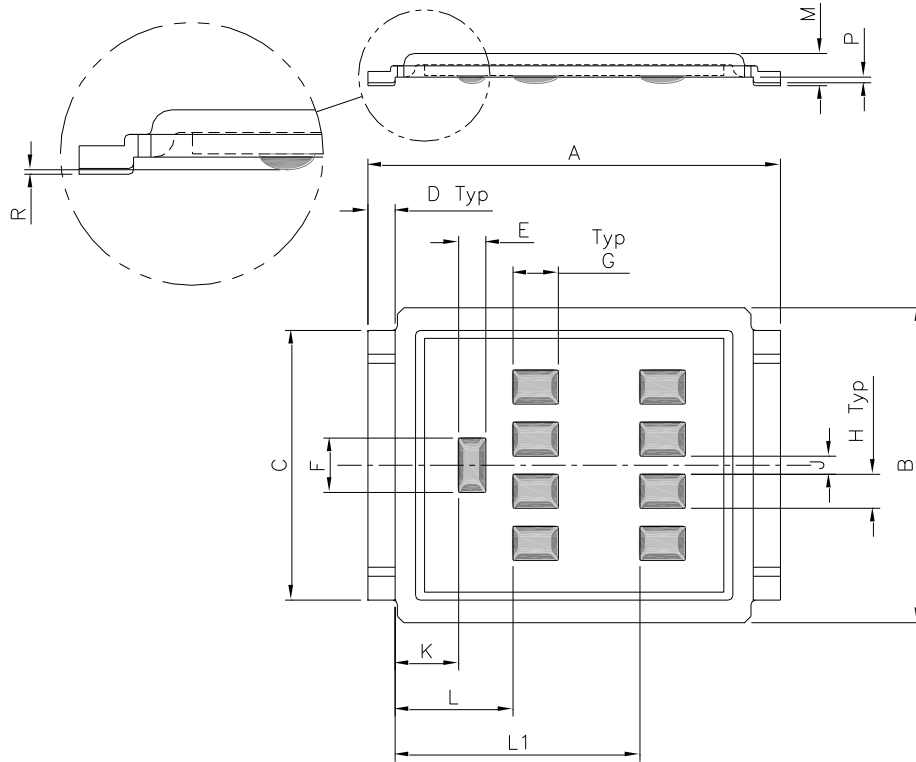


Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>



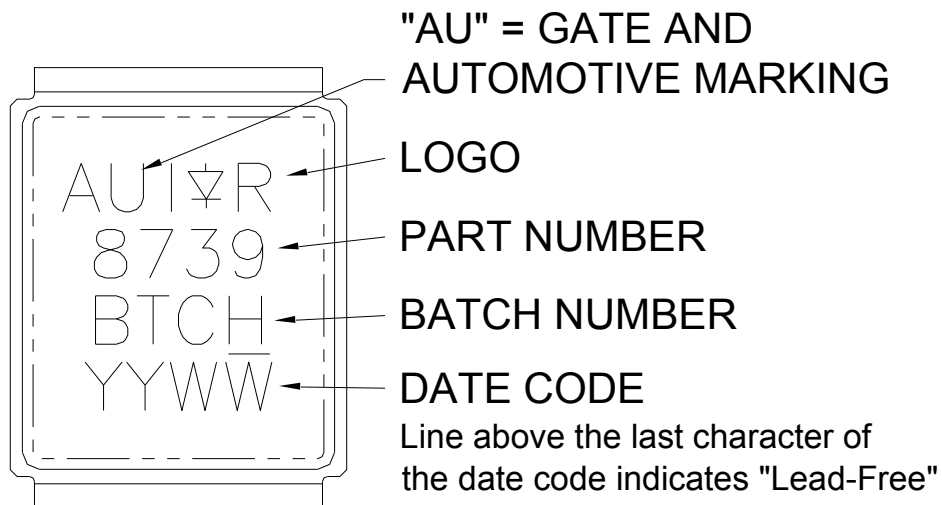
**DirectFET® Outline Dimension, L8 Outline  
(Large Size Can, 8-Source Pads)**

Please see DirectFET application note AN-1035 for all details regarding the assembly of DirectFET. This includes all recommendations for stencil and substrate designs.

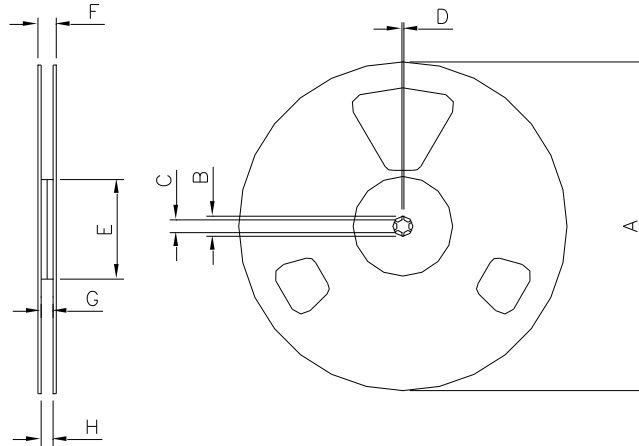


CODE	METRIC		IMPERIAL	
	MIN	MAX	MIN	MAX
A	9.05	9.15	0.356	0.360
B	6.85	7.10	0.270	0.280
C	5.90	6.00	0.232	0.236
D	0.55	0.65	0.022	0.026
E	0.58	0.62	0.023	0.024
F	1.18	1.22	0.046	0.048
G	0.98	1.02	0.039	0.040
H	0.73	0.77	0.029	0.030
J	0.38	0.42	0.015	0.017
K	1.35	1.45	0.053	0.057
L	2.55	2.65	0.100	0.104
L1	5.35	5.45	0.211	0.215
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

Dimensions are shown in millimeters (inches)

**DirectFET® Part Marking**


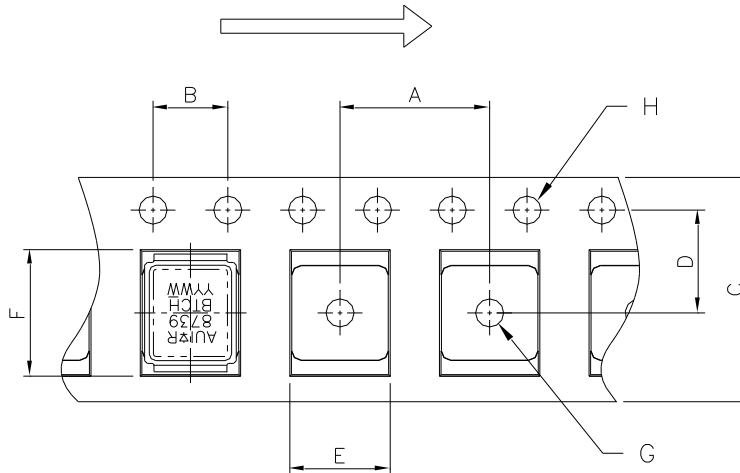
Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

**DirectFET® Tape & Reel Dimension (Showing component orientation)**


NOTE: Controlling dimensions in mm  
Std reel quantity is 4000 parts, ordered as AUIRF8739L2TR.

REEL DIMENSIONS				
STANDARD OPTION (QTY 4000)				
CODE	METRIC		IMPERIAL	
	MIN	MAX	MIN	MAX
A	330.00	N.C	12.992	N.C
B	20.20	N.C	0.795	N.C
C	12.80	13.20	0.504	0.520
D	1.50	N.C	0.059	N.C
E	99.00	100.00	3.900	3.940
F	N.C	22.40	N.C	0.880
G	16.40	18.40	0.650	0.720
H	15.90	19.40	0.630	0.760

LOADED TAPE FEED DIRECTION



NOTE: CONTROLLING DIMENSIONS IN MM

DIMENSIONS				
CODE	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

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

**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>		DirectFET2 L-CAN	MSL1
<b>ESD</b>	Machine Model	Class M4 (+/- 800V) <sup>††</sup>	
		AEC-Q101-002	
	Human Body Model	Class H2 (+/- 4000V) <sup>††</sup>	
		AEC-Q101-001	
<b>RoHS Compliant</b>		Yes	

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

†† Highest passing voltage.

- 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<sub>C</sub> measured with thermocouple mounted to top (Drain) of part.
- ⑤ Repetitive rating; pulse width limited by max. junction temperature.

- ⑥ Starting T<sub>J</sub> = 25°C, L = 0.016mH, R<sub>G</sub> = 50Ω, I<sub>AS</sub> = 195A, V<sub>gs</sub> = 20V.
- ⑦ Pulse width ≤ 400μs; duty cycle ≤ 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<sub>θ</sub> is measured at T<sub>J</sub> of approximately 90°C.
- \*\* Starting T<sub>J</sub> = 25°C, L = 0.1mH, R<sub>G</sub> = 50Ω, I<sub>AS</sub> = 288A, V<sub>gs</sub> = 20V

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