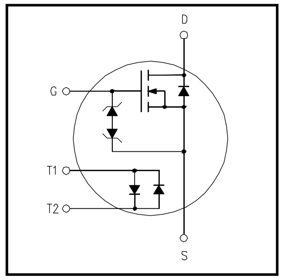
International
IOR Rectifier

PD -93910B

IRLBD59N04E

HEXFET® Power MOSFET

- Integrated Temperature Sensing Diode
- Ultra Low On-Resistance
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fully Avalanche Rated
- Zener Gate Protected



V_{DSS} = 40V

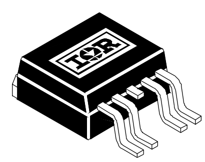
$R_{DS(on)}$ = 0.018Ω

I_D = 59A⑤

Description

The IRLBD59N04E is a 40V, N-channel HEXFET® power MOSFET with gate protection provided by integrated back to back zener diodes. Temperature sensing is given by the change in forward voltage drop of two antiparallel electrically isolated poly-silicon diodes.

The IRLBD59N04E provides cost effective temperature sensing for system protection along with the quality and ruggedness you expect from a HEXFET power MOSFET.



5 Lead-D²Pak

Absolute Maximum Ratings

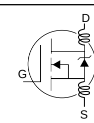
	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V	59⑥	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V	41	
I_{DM}	Pulsed Drain Current ①	230	
P_D @T_C = 25°C	Power Dissipation	130	W
	Linear Derating Factor	0.89	W/°C
V_{GS}	Gate-to-Source Voltage	± 10	V
E_{AS}	Single Pulse Avalanche Energy②	340	mJ
I_{AR}	Avalanche Current①	35	A
E_{AR}	Repetitive Avalanche Energy①	13	mJ
dv/dt	Peak Diode Recovery dv/dt ③	3.6	V/ns
I_G	V_{GS} Clamp Current	± 50	mA
V_{ESD}	Electrostatic Votage Rating⑥	± 2.0	kV
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C °C
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting torque, 6-32 or M3 srew	10 lbf•in (1.1N•m)	

Thermal Resistance

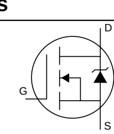
	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	——	1.12	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB Mounted,steady-state)**	——	40	

11/13/01

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	40	——	——	V	V_{GS} = 0V, I_D = 250µA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	——	0.044	——	V/°C	Reference to 25°C, I_D = 1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	——	——	0.018	Ω	V_{GS} = 10V, I_D = 35A ④
		——	——	0.021		V_{GS} = 5.0V, I_D = 30A ④
$V_{GS(th)}$	Gate Threshold Voltage	1.0	——	2.0	V	V_{DS} = V_{GS}, I_D = 250µA
V_{GS}	Clamp Voltage	10	——	20	V	I_{GSS} = 20µA
g_{fs}	Forward Transconductance	29	——	——	S	V_{DS} = 25V, I_D = 35A
I_{DSS}	Drain-to-Source Leakage Current	——	——	25	µA	V_{DS} = 40V, V_{GS} = 0V
		——	——	250		V_{DS} = 32V, V_{GS} = 0V, T_J = 150°C
I_{GSS}	Gate-to-Source Forward Leakage	——	——	1.0	µA	V_{GS} = 5.0V
	Gate-to-Source Reverse Leakage	——	——	-1.0		V_{GS} = -5.0V
Q_g	Total Gate Charge	——	——	50	nC	I_D = 35A
Q_{gs}	Gate-to-Source Charge	——	——	13		V_{DS} = 32V
Q_{gd}	Gate-to-Drain ("Miller") Charge	——	——	18		V_{GS} = 5.0V, See Fig. 6 and 13 ④
$t_{d(on)}$	Turn-On Delay Time	——	7.8	——	ns	V_{DD} = 20V
t_r	Rise Time	——	84	——		I_D = 35A
$t_{d(off)}$	Turn-Off Delay Time	——	33	——		R_G = 5.1Ω,
t_f	Fall Time	——	67	——		V_{GS} = 5.0V, See Fig.10 ④
L_D	Internal Drain Inductance	——	2.0	——	nH	Between lead, 6mm (0.25in.) from package and center of die contact 
L_S	Internal Source Inductance	——	5.0	——		
C_{iss}	Input Capacitance	——	2190	——	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	——	670	——		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	——	130	——		f = 1.0MHz, See Fig. 5

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	——	——	59⑥	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	——	——	230		
V_{SD}	Diode Forward Voltage	——	——	1.3	V	T_J = 25°C, I_S = 35A, V_{GS} = 0V ④
t_{rr}	Reverse Recovery Time	——	57	86	ns	T_J = 25°C, I_F = 35A
Q_{rr}	Reverse Recovery Charge	——	84	130	nC	di/dt = 100A/µs ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L_S+L_D)				

Sense Diode Rating

	Parameter	Min.	Typ.	Max.	Units	Conditions
V_{FM}	Sense Diode Maximum Voltage Drop	675	——	725	mV	I_F = 250µA, T_J = 25°C
$\Delta V_F/\Delta T_J$	Sense Diode Temperature Coefficient	-1.30	-1.40	-1.58	mV/°C	I_F = 250µA, (T_J = 25°C and 160°C)

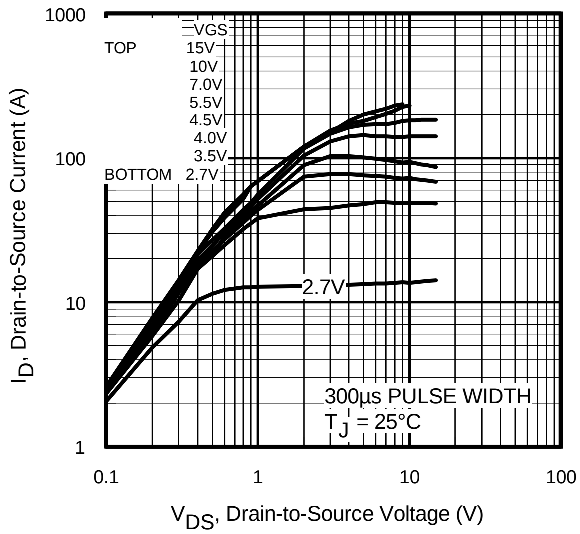


Fig 1. Typical Output Characteristics

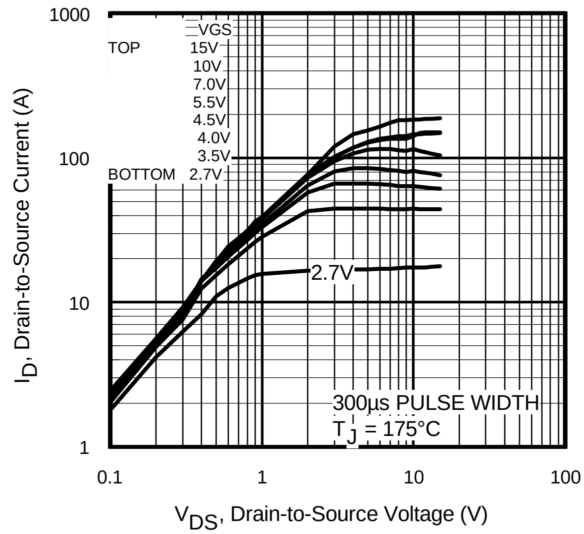


Fig 2. Typical Output Characteristics

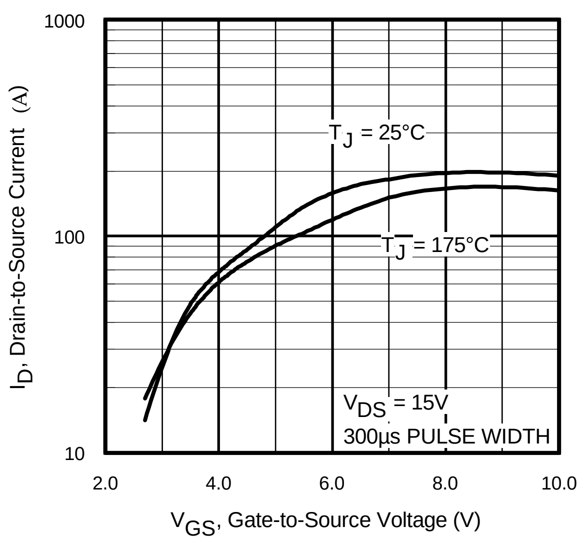


Fig 3. Typical Transfer Characteristics

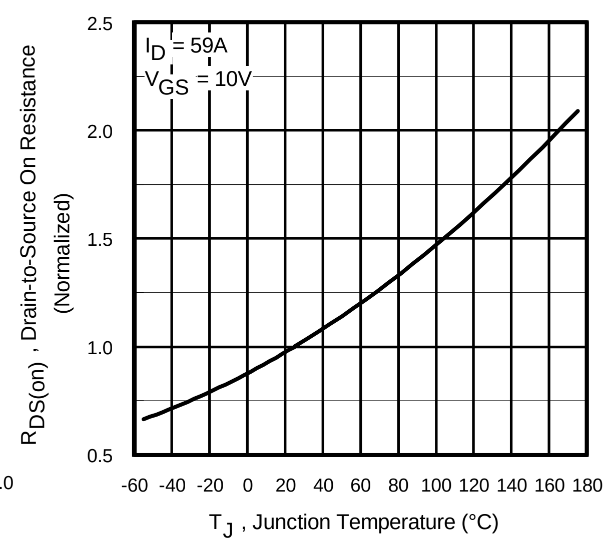


Fig 4. Normalized On-Resistance Vs. Temperature

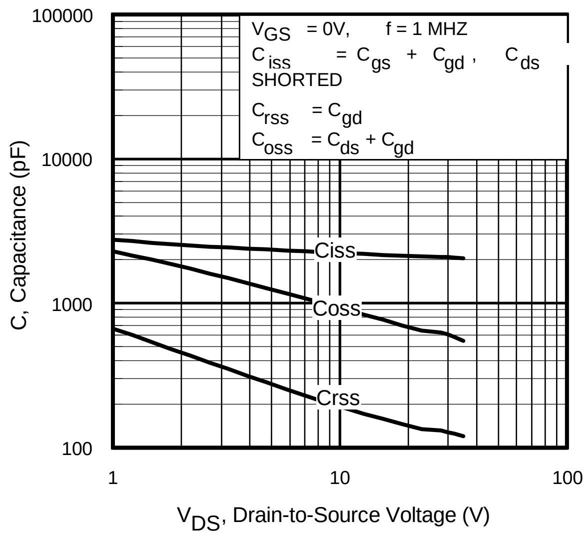


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

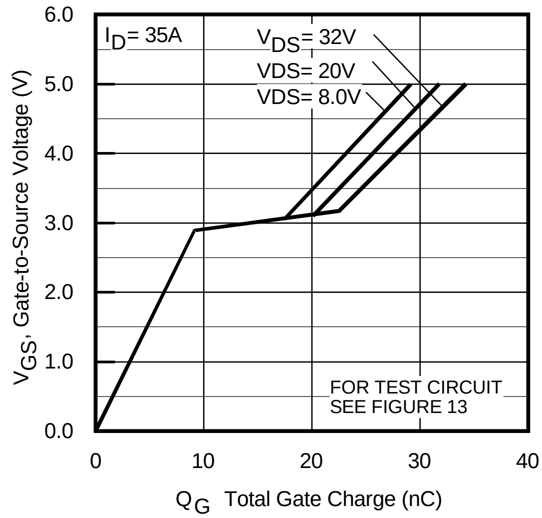


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

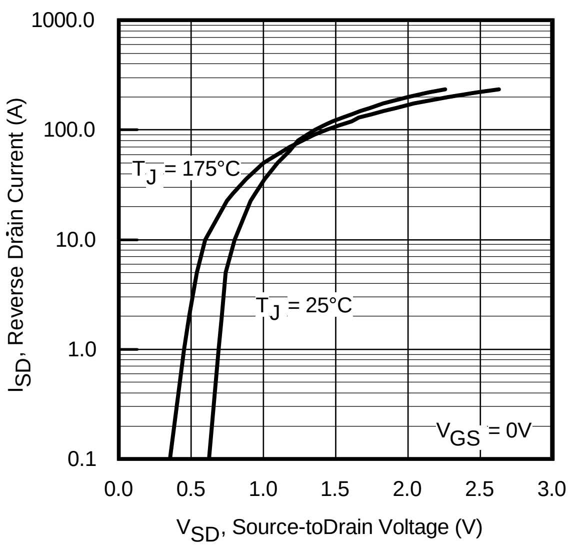


Fig 7. Typical Source-Drain Diode Forward Voltage

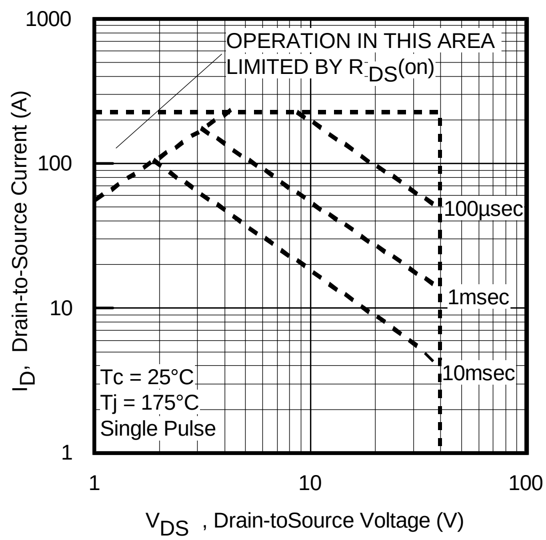


Fig 8. Maximum Safe Operating Area

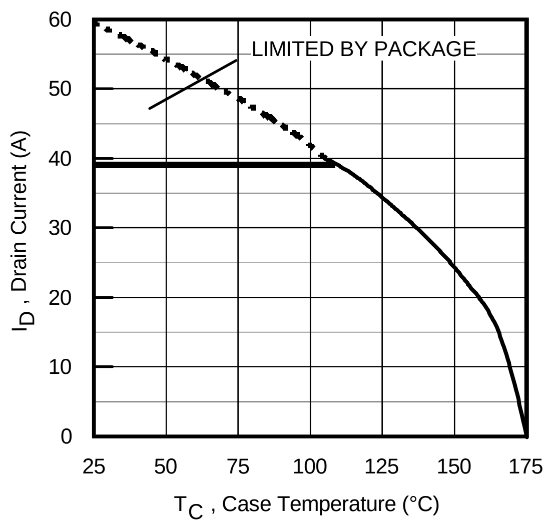
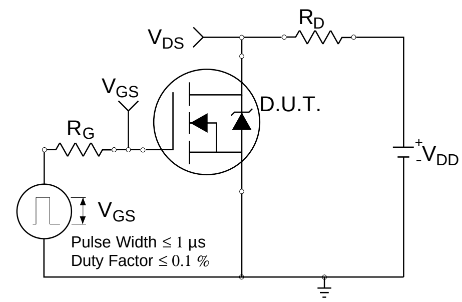
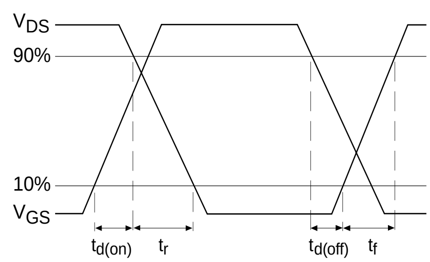


Fig 9. Maximum Drain Current Vs. Case Temperature





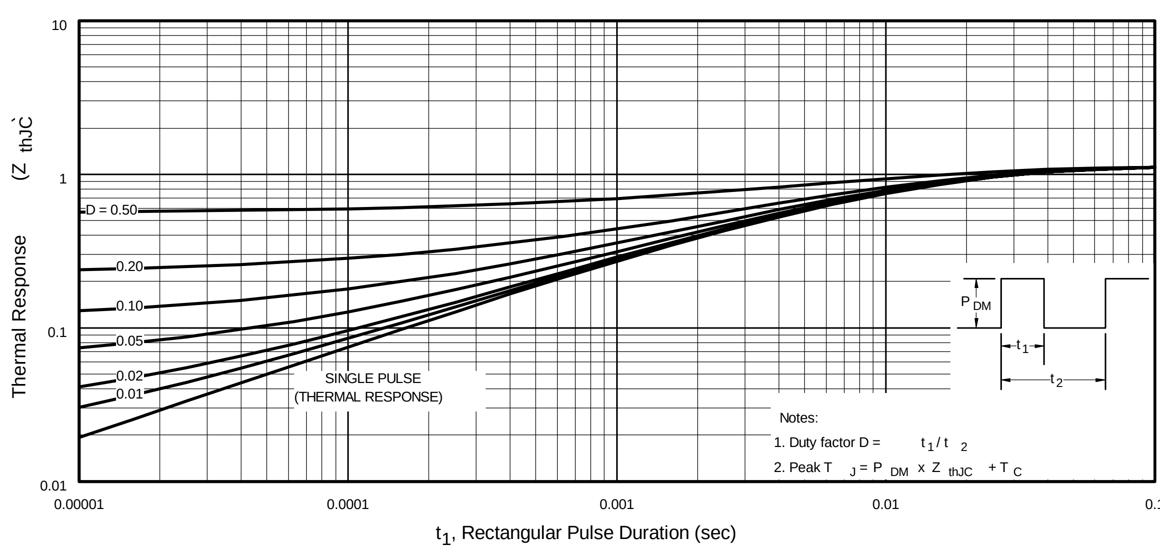


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

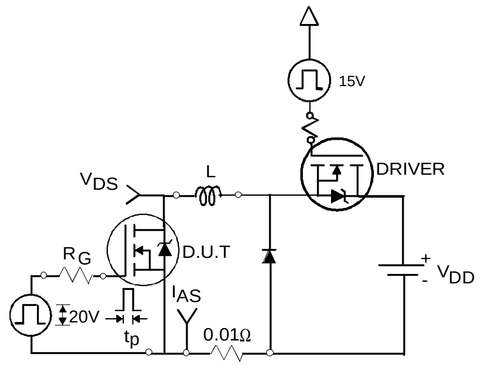


Fig 12a. Unclamped Inductive Test Circuit

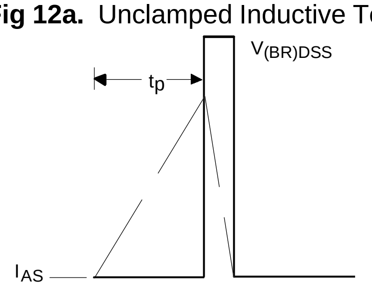


Fig 12b. Unclamped Inductive Waveforms

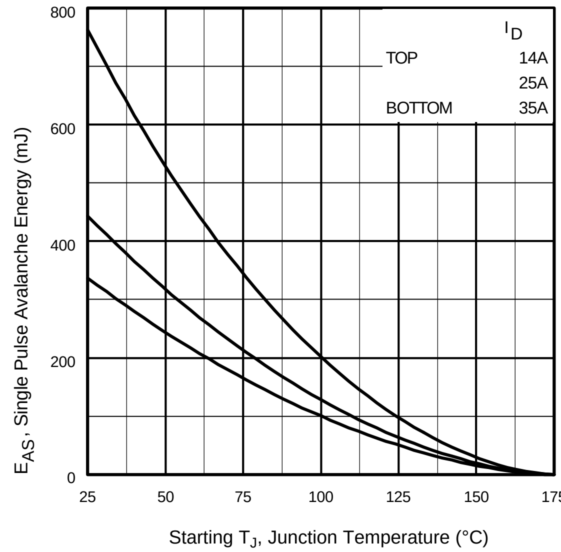


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

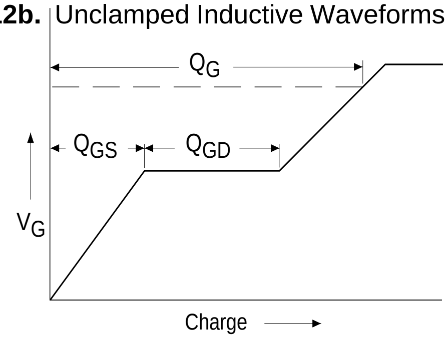


Fig 13a. Basic Gate Charge Waveform

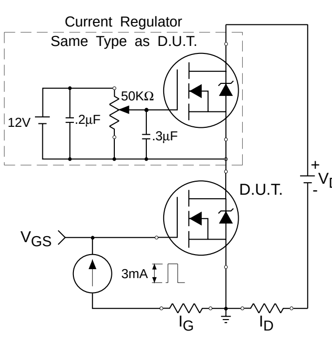


Fig 13b. Gate Charge Test Circuit

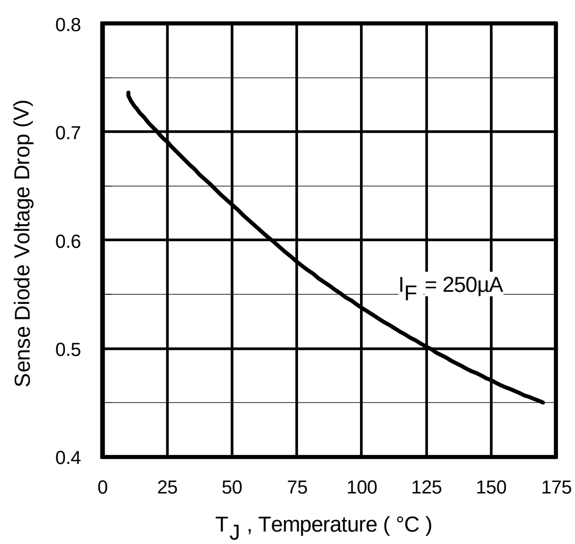
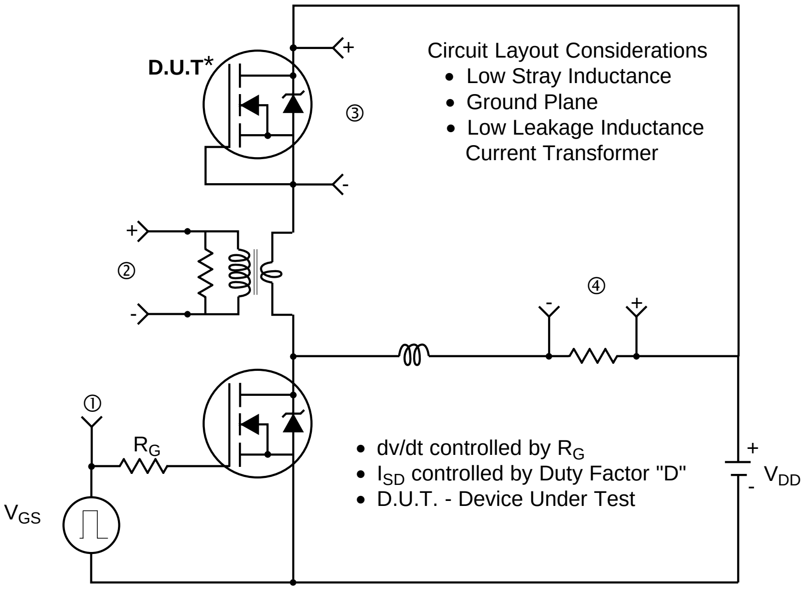
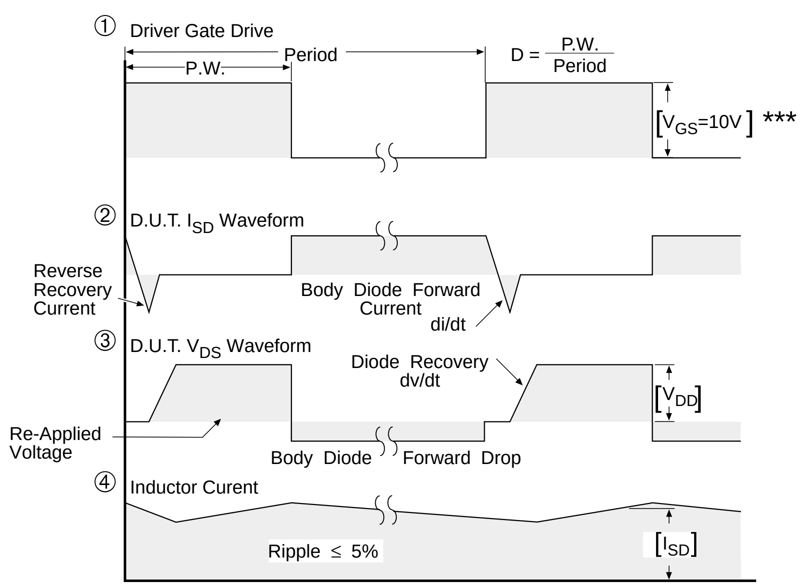


Fig 14. Sense Diode Voltage Drop Vs.Temperature

Peak Diode Recovery dv/dt Test Circuit



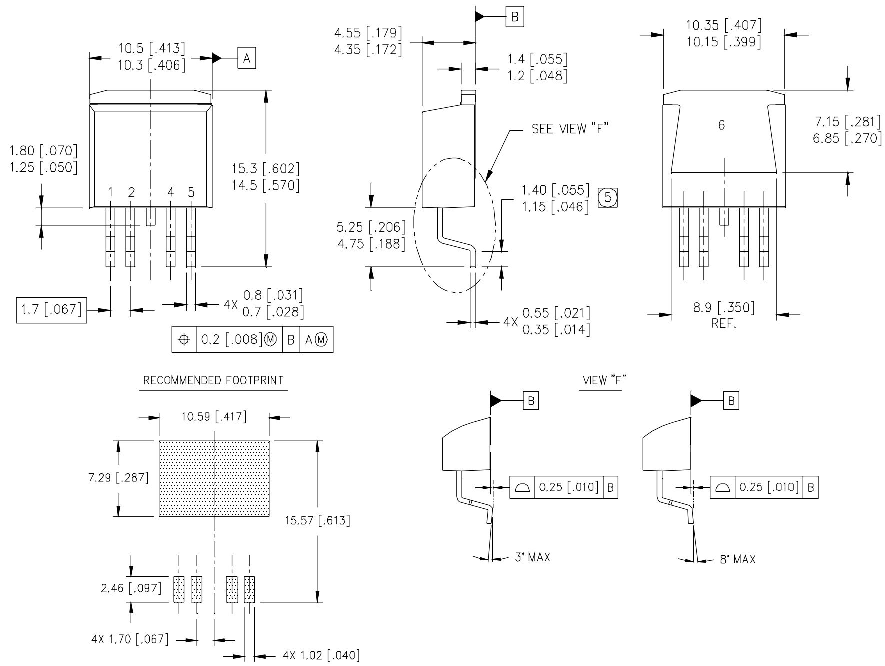
* Reverse Polarity of D.U.T for P-Channel



*** V_{GS} = 5.0V for Logic Level and 3V Drive Devices

Fig 15. For N-channel HEXFET® power MOSFETs

Case Outline 5 Lead-D^{2}Pak (SMD-220)



NOTES:

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. OUTLINE SIMILAR TO JEDEC OUTLINE SERIES TO-263.

5. DIMENSION IS THE LENGTH OF LEAD FOR SOLDERING TO A SUBSTRATE.

PIN ASSIGNMENTS

1 - G - GATE
2 - T1 - ANODE
3 - D - DRAIN
4 - T2 - CATHODE
5 - S - SOURCE

Notes:

① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)

② Starting T_J = 25°C, L = 0.55mH R_G = 25Ω, I_{AS} = 35A. (See Figure 12)

③ $I_{SD} \le$ 35A, di/dt $\le$ 150A/µs, $V_{DD} \le V_{(BR)DSS}$, $T_J \le$ 175°C

④ Pulse width ≤ 400µs; duty cycle ≤ 2%.

⑤ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 39A

⑥ C = 100pF, R = 1.5kΩ

** When mounted on 1" square PCB (FR-4 or G-10 Material).
For recommended soldering techniques refer to application note #AN-994.

Data and specifications subject to change without notice.
This product has been designed and qualified for the Automotive [Q101] market.
Qualification Standards can be found on IR's Web site.

International
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Note: For the most current drawings please refer to the IR website at:
http://www.irf.com/package/