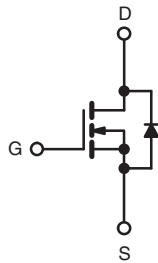
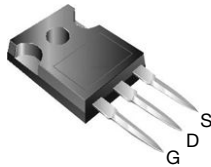


## Power MOSFET

PRODUCT SUMMARY	
$V_{DS}$ (V)	500
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10\text{ V}$   0.15
$Q_g$ (Max.) (nC)	210
$Q_{gs}$ (nC)	58
$Q_{gd}$ (nC)	100
Configuration	Single

TO-247AC



N-Channel MOSFET

### FEATURES

- Super Fast Body Diode Eliminates the Need for External Diodes in ZVS Applications
- Lower Gate Charge Results in Simpler Drive Requirements
- Enhanced  $dV/dt$  Capabilities Offer Improved Ruggedness
- Higher Gate Voltage Threshold Offers Improved Noise Immunity
- Compliant to RoHS Directive 2002/95/EC



Available  
**RoHS\***  
COMPLIANT

### APPLICATIONS

- Zero Voltage Switching SMPS
- Telecom and Server Power Supplies
- Uninterruptible Power Supplies
- Motor Control Applications

ORDERING INFORMATION	
Package	TO-247AC
Lead (Pb)-free	IRFP31N50LPbF
	SiHFP31N50L-E3
SnPb	IRFP31N50L
	SiHFP31N50L


ABSOLUTE MAXIMUM RATINGS ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted)				
PARAMETER	SYMBOL	LIMIT	UNIT	
Drain-Source Voltage	$V_{DS}$	500	V	
Gate-Source Voltage	$V_{GS}$	$\pm 30$		
Continuous Drain Current	$V_{GS}$ at 10 V	$T_C = 25\text{ }^\circ\text{C}$	31	A
		$T_C = 100\text{ }^\circ\text{C}$	20	
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	124		
Linear Derating Factor		3.7	W/ $^\circ\text{C}$	
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$	460	mJ	
Repetitive Avalanche Current <sup>a</sup>	$I_{AR}$	31	A	
Repetitive Avalanche Energy <sup>a</sup>	$E_{AR}$	46	mJ	
Maximum Power Dissipation	$T_C = 25\text{ }^\circ\text{C}$	$P_D$	460	W
Peak Diode Recovery $dV/dt$ <sup>c</sup>	$dV/dt$	19	V/ns	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to + 150	$^\circ\text{C}$	
Soldering Recommendations (Peak Temperature)	for 10 s	300 <sup>d</sup>		
Mounting Torque	6-32 or M3 screw		10	lbf · in
			1.1	N · m

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 1\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 31\text{ A}$  (see fig. 12).
- $I_{SD} \leq 31\text{ A}$ ,  $dI/dt \leq 422\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^\circ\text{C}$ .
- 1.6 mm from case.

\* Pb containing terminations are not RoHS compliant, exemptions may apply

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	40	°C/W
Case-to-Sink, Flat, Greased Surface	$R_{thCS}$	0.24	-	
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	0.26	

SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT	
<b>Static</b>							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$	500	-	-	V	
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$	-	0.28	-	V/°C	
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	3.0	-	5.0	V	
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 30\text{ V}$	-	-	$\pm 100$	nA	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 500\text{ V}$ , $V_{GS} = 0\text{ V}$	-	-	50	$\mu\text{A}$	
		$V_{DS} = 400\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$	-	-	2.0	mA	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$ , $I_D = 19\text{ A}^b$	-	0.15	0.18	$\Omega$	
Forward Transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}$ , $I_D = 19\text{ A}^b$	15	-	-	S	
<b>Dynamic</b>							
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1.0\text{ MHz}$ , see fig. 5	-	5000	-	pF	
Output Capacitance	$C_{oss}$		-	553	-		
Reverse Transfer Capacitance	$C_{rss}$		-	59	-		
Output Capacitance	$C_{oss}$	$V_{GS} = 0\text{ V}$	$V_{DS} = 1.0\text{ V}$ , $f = 1.0\text{ MHz}$	-	6630	-	
Effective Output Capacitance	$C_{oss\text{ eff.}}$		$V_{DS} = 400\text{ V}$ , $f = 1.0\text{ MHz}$	-	155	-	
Effective Output Capacitance	$C_{oss\text{ eff. (ER)}}$		$V_{DS} = 0\text{ V to }400\text{ V}^c$	-	276	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 31\text{ A}$ , $V_{DS} = 400\text{ V}$ , see fig. 7 and 13 <sup>b</sup>	-	-	210	nC
Gate-Source Charge	$Q_{gs}$			-	-	58	
Gate-Drain Charge	$Q_{gd}$			-	-	100	
Internal Gate Resistance	$R_g$	$f = 1\text{ MHz}$ , open drain		-	1.1	-	$\Omega$
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 250\text{ V}$ , $I_D = 31\text{ A}$ , $R_g = 4.3\text{ }\Omega$ , see fig. 10 <sup>b</sup>		-	28	-	ns
Rise Time	$t_r$			-	115	-	
Turn-Off Delay Time	$t_{d(off)}$			-	54	-	
Fall Time	$t_f$			-	53	-	
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p-n junction diode 	-	-	31	A	
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$		-	-	124		
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_S = 31\text{ A}$ , $V_{GS} = 0\text{ V}^b$	-	-	1.5	V	
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_F = 31\text{ A}$	-	170	250	ns	
		$T_J = 125\text{ }^\circ\text{C}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$	-	220	330		
Body Diode Reverse Recovery Charge	$Q_{rr}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_S = 31\text{ A}$ , $V_{GS} = 0\text{ V}^b$	-	570	860	nC	
		$T_J = 125\text{ }^\circ\text{C}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$	-	1.2	1.8	$\mu\text{C}$	
Reverse Recovery Current	$I_{RRM}$	$T_J = 25\text{ }^\circ\text{C}$	-	7.9	12	A	
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )					

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- $C_{oss\text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0% to 80%  $V_{DS}$ .  
 $C_{oss\text{ eff. (ER)}}$  is a fixed capacitance that stores the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0% to 80%  $V_{DS}$ .

## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

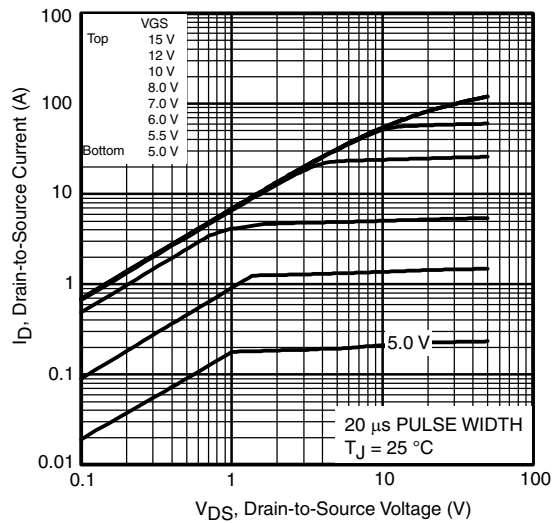


Fig. 1 - Typical Output Characteristics

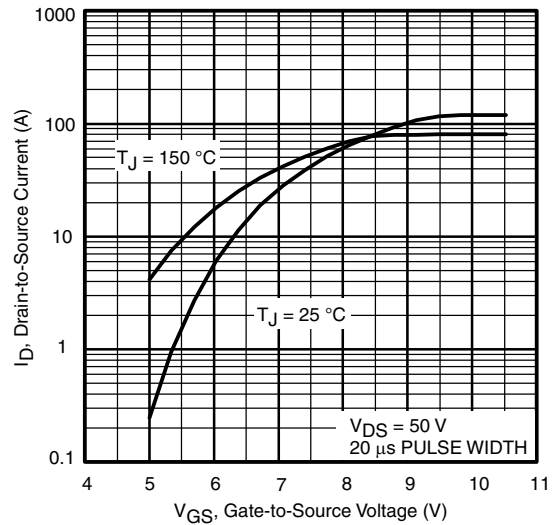


Fig. 3 - Typical Transfer Characteristics

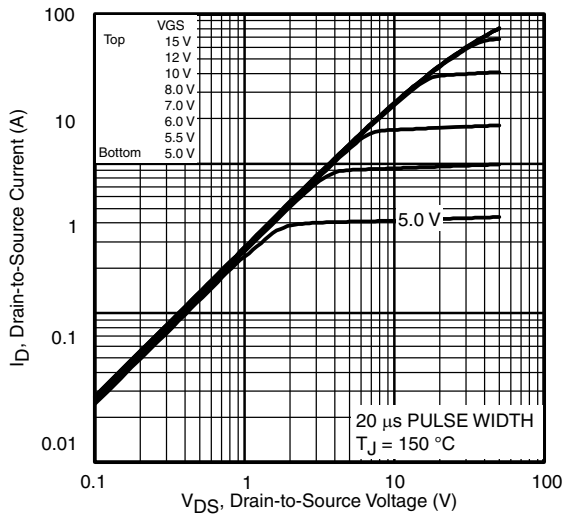


Fig. 2 - Typical Output Characteristics

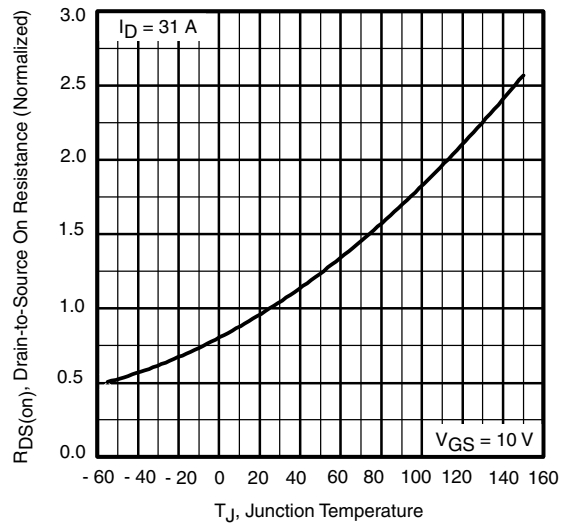


Fig. 4 - Normalized On-Resistance vs. Temperature

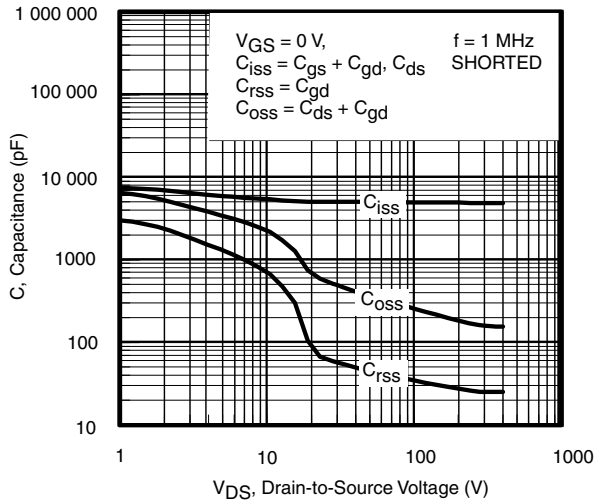


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

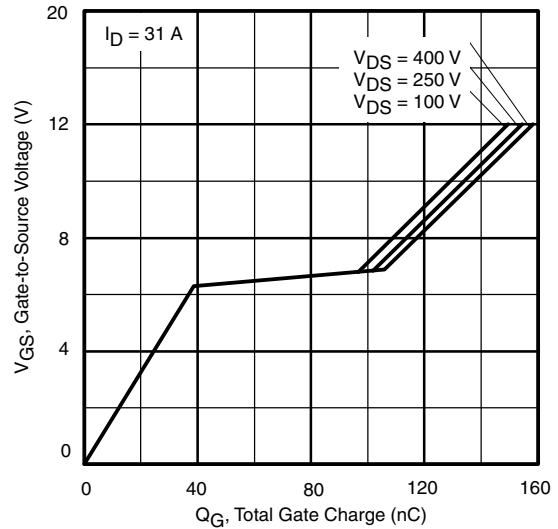


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

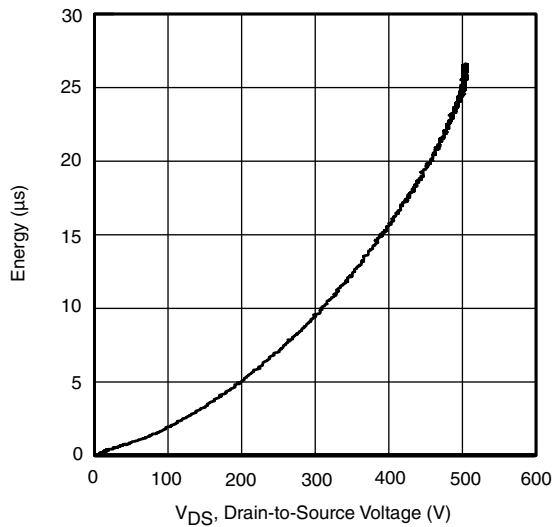


Fig. 6 - Output Capacitance Stored Energy vs.  $V_{DS}$

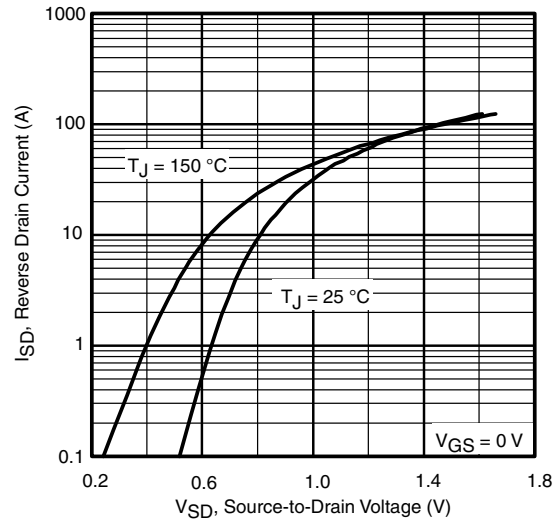
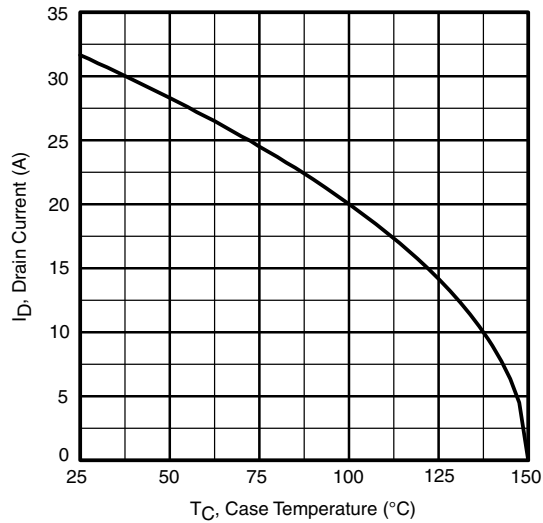
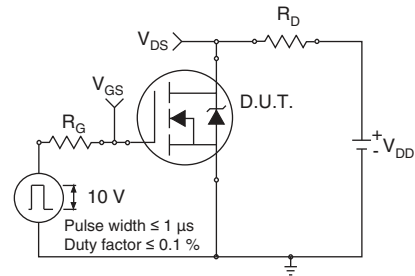


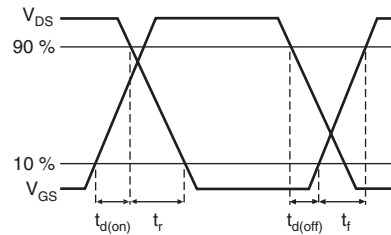
Fig. 8 - Typical Source Drain Diode Forward Voltage



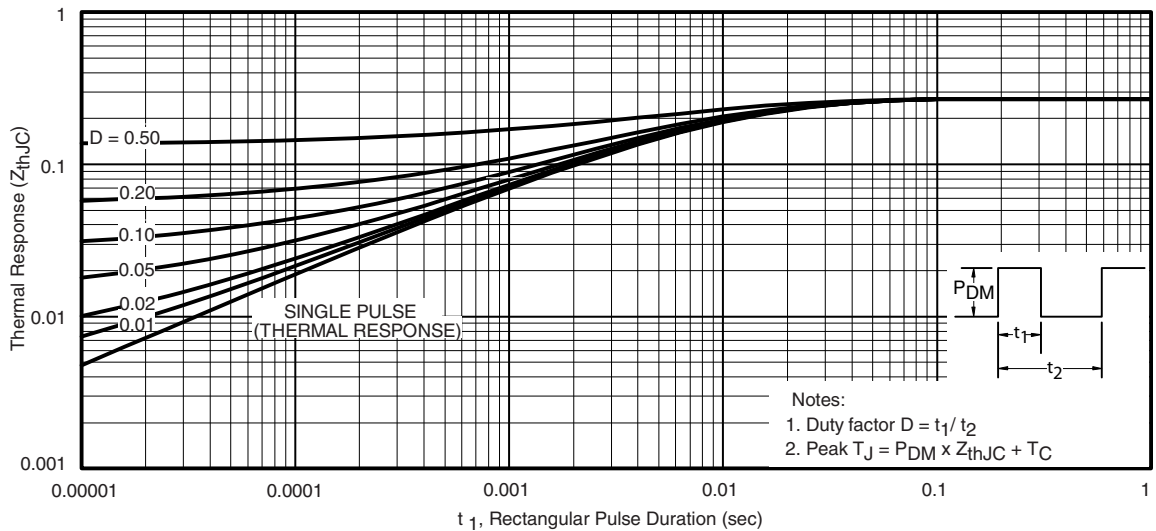
**Fig. 9 - Maximum Drain Current vs. Case Temperature**



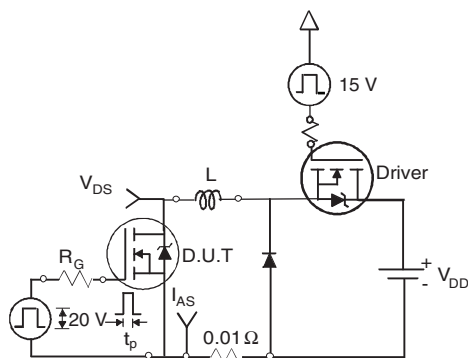
**Fig. 10a - Switching Time Test Circuit**



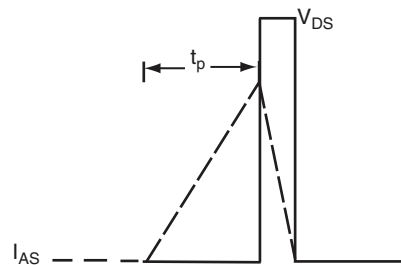
**Fig. 10b - Switching Time Waveforms**



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



**Fig. 12a - Unclamped Inductive Test Circuit**



**Fig. 12b - Unclamped Inductive Waveforms**

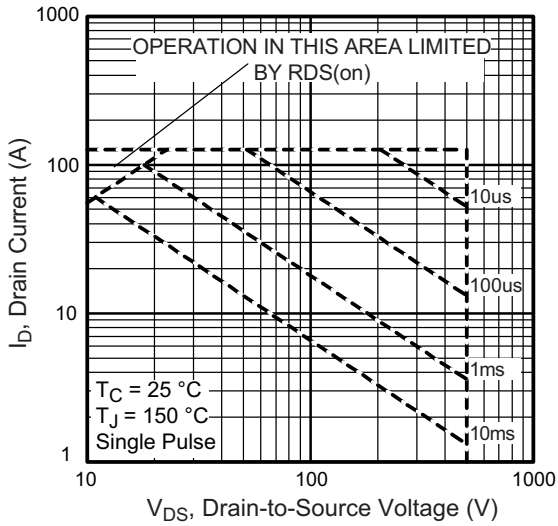


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

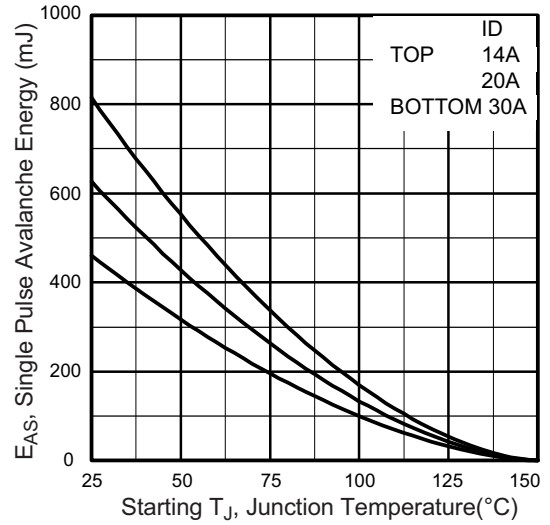


Fig. 12d - Gate Charge Test Circuit

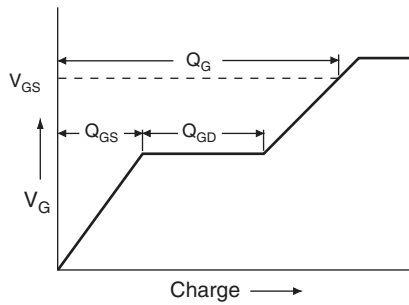


Fig. 13a - Maximum Safe Operating Area

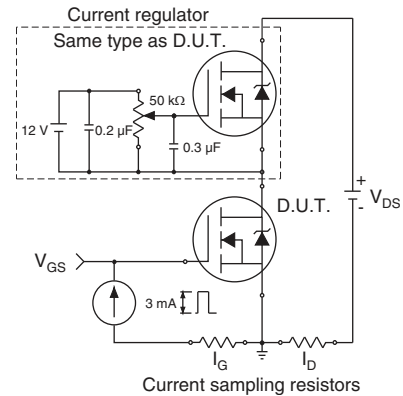
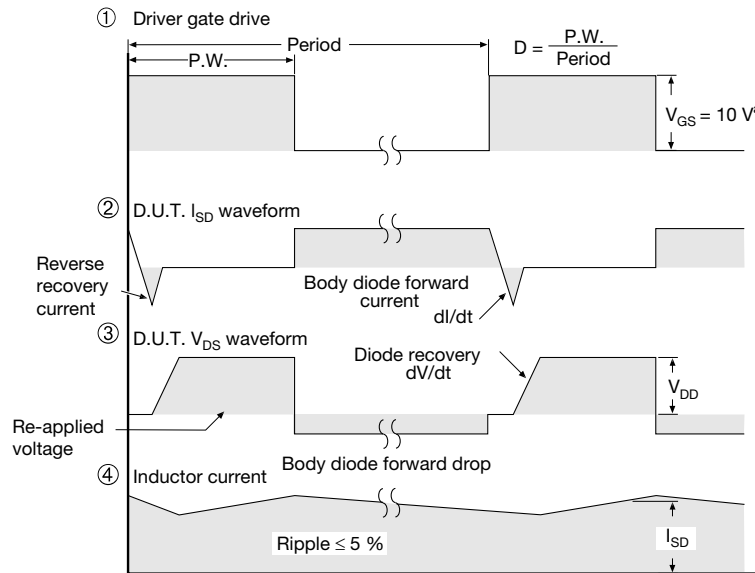
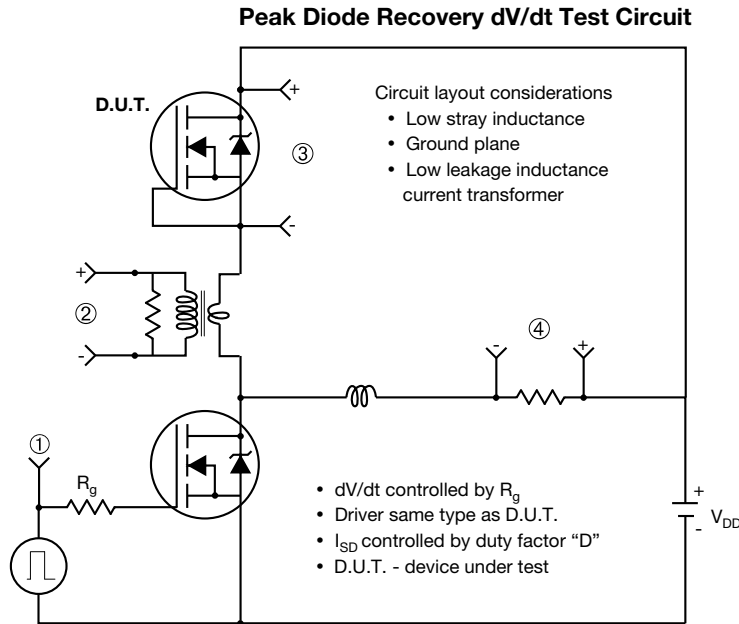


Fig. 13b - Basic Gate Charge Waveform



**Note**

a.  $V_{GS} = 5\text{ V}$  for logic level devices

**Fig. 14 - For N-Channel**

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