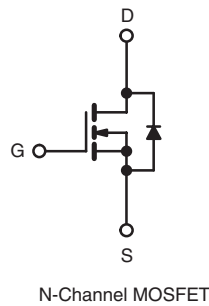


## Power MOSFET

PRODUCT SUMMARY		
$V_{DS}$ (V)	500	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10\text{ V}$	0.087
$Q_g$ (Max.) (nC)	380	
$Q_{gs}$ (nC)	80	
$Q_{gd}$ (nC)	190	
Configuration	Single	



### FEATURES

- Superfast 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
- Lead (Pb)-free Available



**RoHS\***  
COMPLIANT

### APPLICATIONS

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

ORDERING INFORMATION	
Package	SUPER-247™
Lead (Pb)-free	IRFPS40N50LPbF
	SiHFPS40N50L-E3
SnPb	IRFPS40N50L
	SiHFPS40N50L

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	$T_C = 25\text{ }^\circ\text{C}$	46	A	
		$T_C = 100\text{ }^\circ\text{C}$	29		
Pulsed Drain Current <sup>a</sup>	$I_{DM}$		180		
Linear Derating Factor			4.3	$W/^\circ\text{C}$	
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$		920	mJ	
Repetitive Avalanche Current <sup>a</sup>	$I_{AR}$		46	A	
Repetitive Avalanche Energy <sup>a</sup>	$E_{AR}$		54	mJ	
Maximum Power Dissipation	$T_C = 25\text{ }^\circ\text{C}$		$P_D$	540	W
Peak Diode Recovery $dV/dt^c$			$dV/dt$	34	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>		

#### Notes


- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 0.86\text{ mH}$ ,  $R_G = 25\text{ }^\circ\Omega$ ,  $I_{AS} = 46\text{ A}$  (see fig. 12).
- $I_{SD} \leq 46\text{ A}$ ,  $dI/dt \leq 550\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^\circ\text{C}$ .
- 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 <sup>a</sup>	$R_{thJA}$	-	40	°C/W
Case-to-Sink, Flat, Greased Surface	$R_{thCS}$	0.24	-	
Maximum Junction-to-Case (Drain) <sup>a</sup>	$R_{thJC}$	-	0.23	

### Note

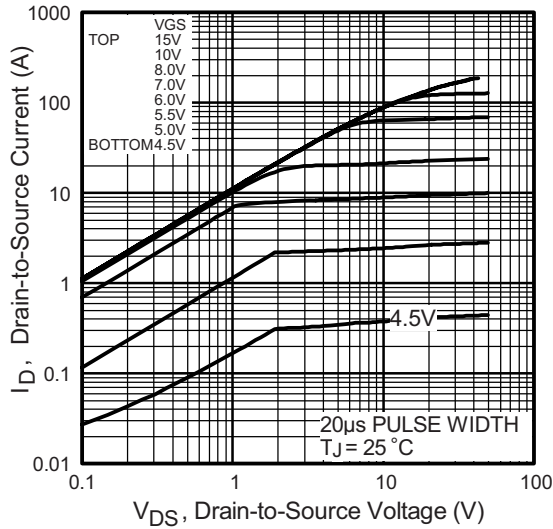
a.  $R_{th}$  is measured at  $T_J$  approximately 90 °C.

SPECIFICATIONS $T_J = 25\text{ °C}$ , 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 °C, $I_D = 1\text{ mA}$	-	0.60	-	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	$\mu\text{A}$	
		$V_{DS} = 400\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ °C}$	-	-	2.0	mA	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$ , $I_D = 28\text{ A}^b$	-	0.087	0.100	$\Omega$	
Forward Transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}$ , $I_D = 46\text{ A}$	21	-	-	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	-	8110	-	pF	
Output Capacitance	$C_{oss}$		-	960	-		
Reverse Transfer Capacitance	$C_{rss}$		-	130	-		
Output Capacitance	$C_{oss}$	$V_{GS} = 0\text{ V}$	$V_{DS} = 1.0\text{ V}$ , $f = 1.0\text{ MHz}$	-	11200	-	
Effective Output Capacitance	$C_{oss\text{ eff.}}$		$V_{DS} = 400\text{ V}$ , $f = 1.0\text{ MHz}$	-	240	-	
Effective Output Capacitance (Energy Related)	$C_{oss\text{ eff. (ER)}}$	$V_{DS} = 0\text{ V to }400\text{ V}^c$	-	310	-		
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 46\text{ A}$ , $V_{DS} = 400\text{ V}$ , see fig. 7 and 15 <sup>b</sup>	-	-	380	nC
Gate-Source Charge	$Q_{gs}$			-	-	80	
Gate-Drain Charge	$Q_{gd}$			-	-	190	
Internal Gate Resistance	$R_G$	$f = 1\text{ MHz}$ , open drain		-	0.90	-	$\Omega$
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 250\text{ V}$ , $I_D = 46\text{ A}$ , $R_G = 0.85\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ , see fig. 14a and 14b <sup>b</sup>		-	27	-	ns
Rise Time	$t_r$			-	170	-	
Turn-Off Delay Time	$t_{d(off)}$			-	50	-	
Fall Time	$t_f$			-	69	-	
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	46	A	
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$		-	-	180		
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ °C}$ , $I_S = 46\text{ A}$ , $V_{GS} = 0\text{ V}^b$	-	-	1.5	V	
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ °C}$ , $I_F = 46\text{ A}$	-	170	250	ns	
		$T_J = 125\text{ °C}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$	-	220	330		
Body Diode Reverse Recovery Charge	$Q_{rr}$	$T_J = 25\text{ °C}$ , $I_S = 46\text{ A}$ , $V_{GS} = 0\text{ V}^b$	-	705	1060	nC	
		$T_J = 125\text{ °C}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$	-	1.3	2.0		
Reverse Recovery Current	$I_{RRM}$	$T_J = 25\text{ °C}$	-	9.0	-	A	
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )					

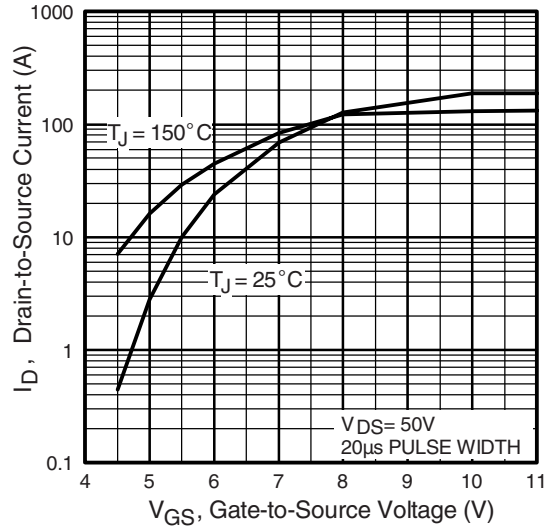
### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Pulse width  $\leq 400\text{ }\mu\text{s}$ ; 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 %  $V_{DS}$ .

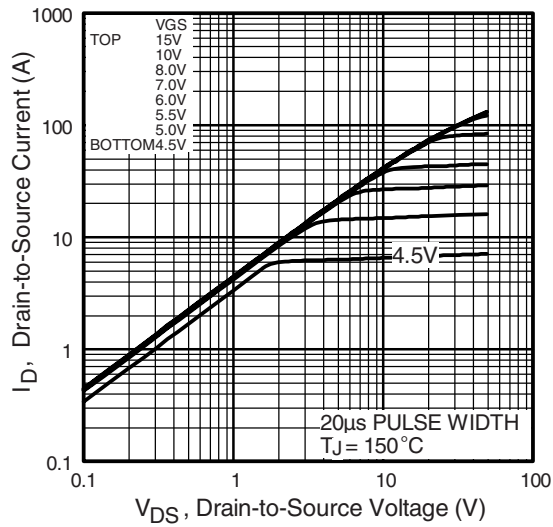
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



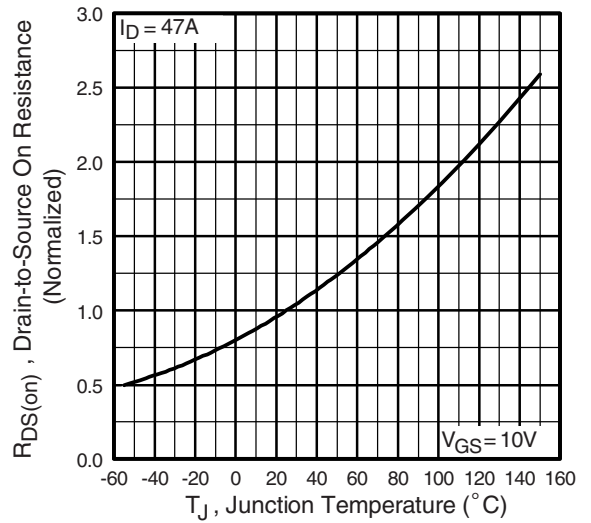
**Fig. 1 - Typical Output Characteristics**



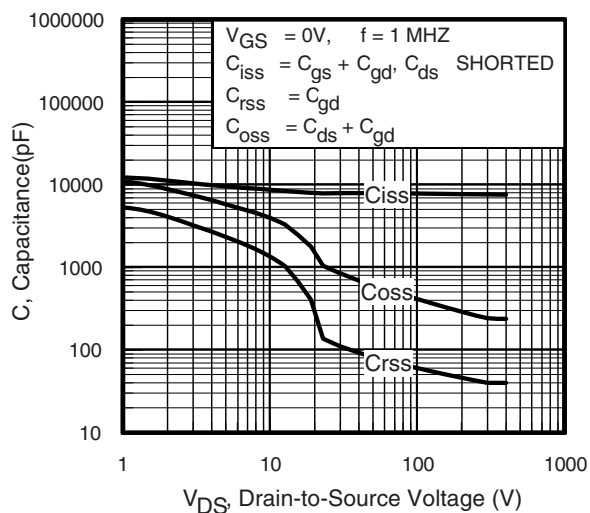
**Fig. 3 - Typical Transfer Characteristics**



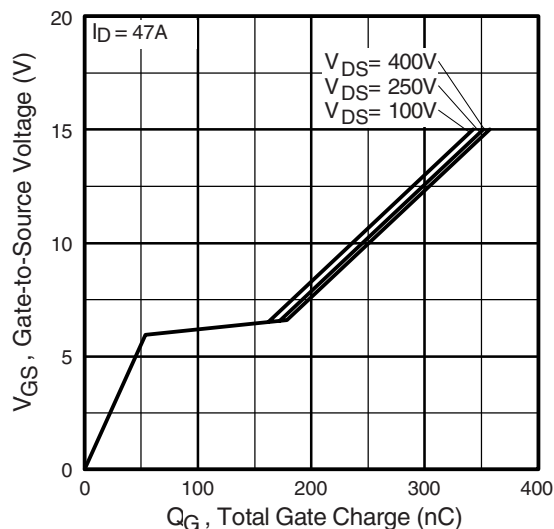
**Fig. 2 - Typical Output Characteristics**



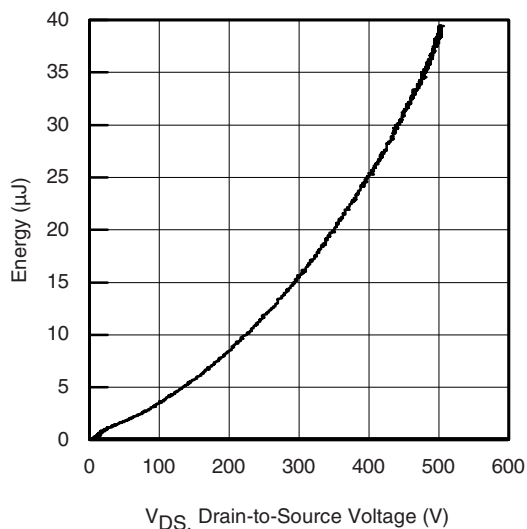
**Fig. 4 - Normalized On-Resistance vs. Temperature**



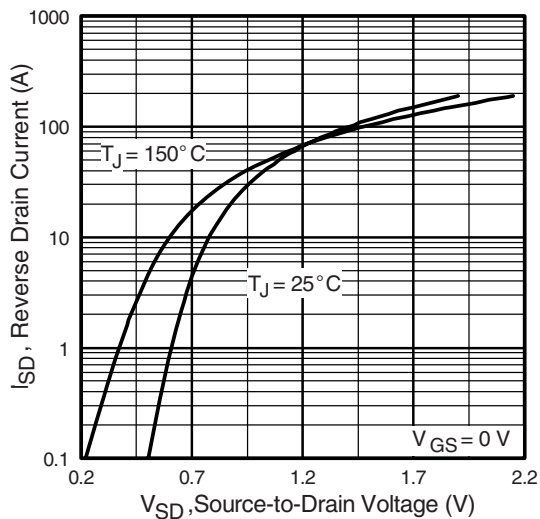
**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**



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



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



**Fig. 8 - Typical Source Drain Diode Forward Voltage**

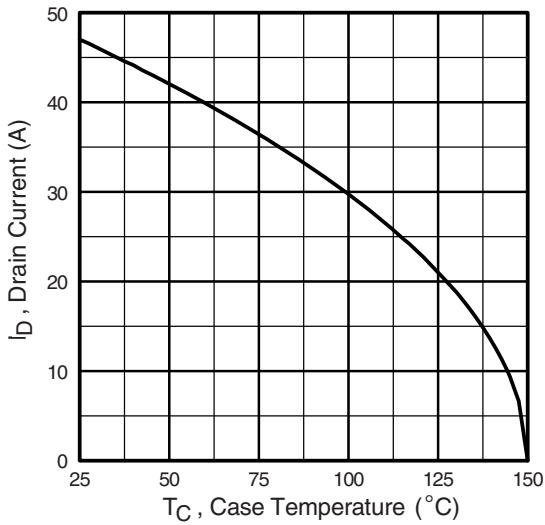


Fig. 9 - Maximum Drain Current vs. Case Temperature

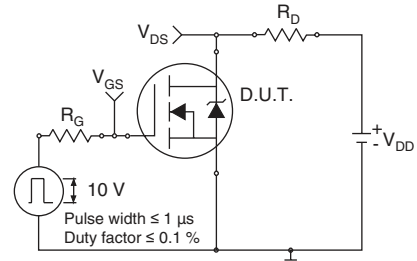


Fig. 10a - Switching Time Test Circuit

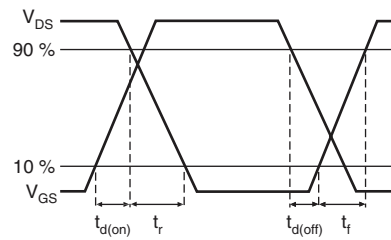


Fig. 10b - Switching Time Waveforms

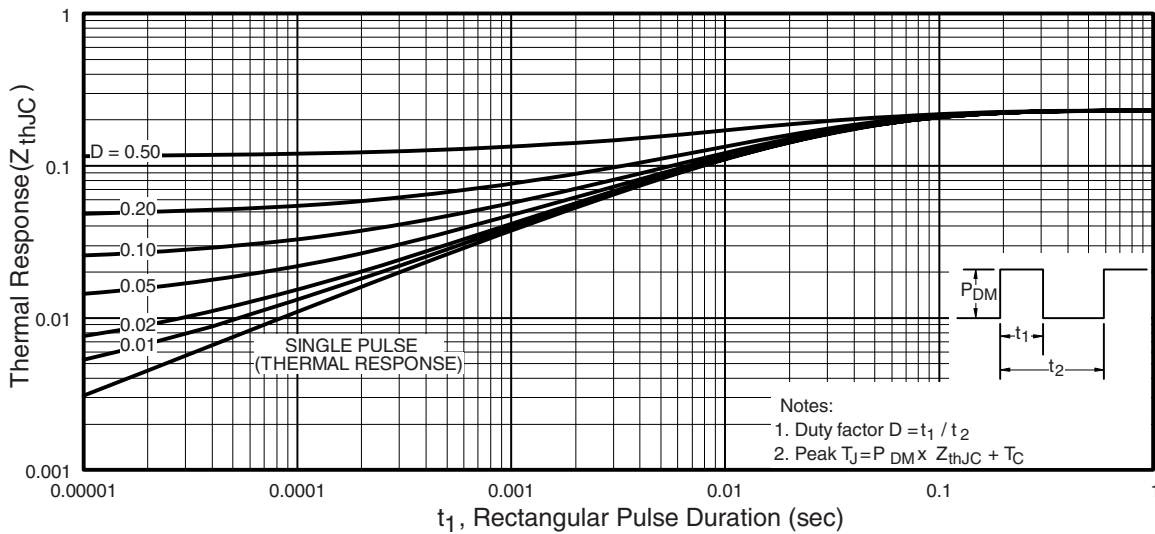


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

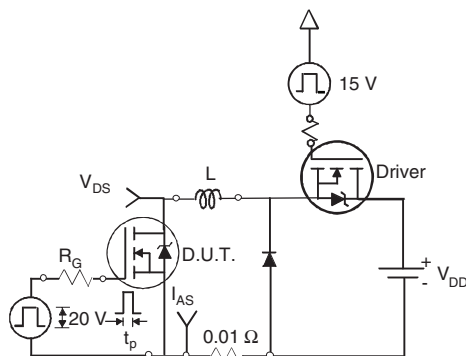


Fig. 12a - Unclamped Inductive Test Circuit

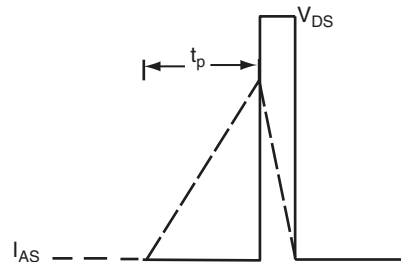


Fig. 12b - Unclamped Inductive Waveforms

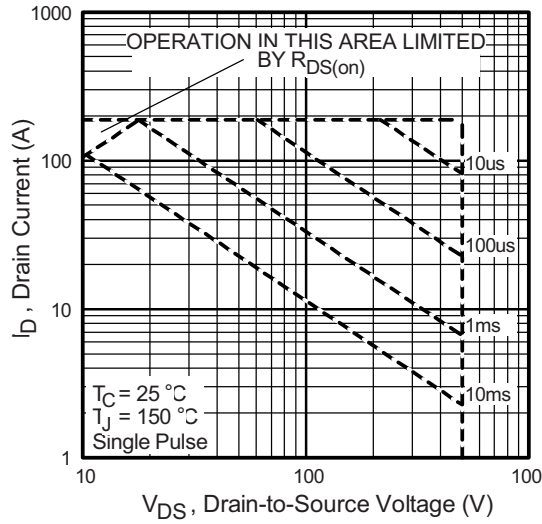


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

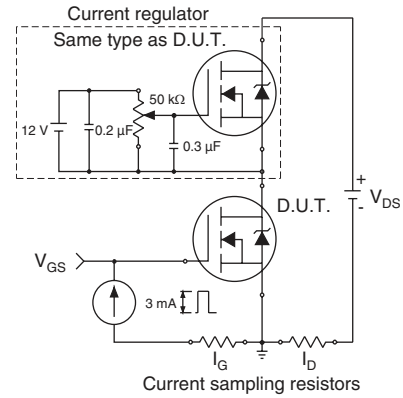


Fig. 13a - Gate Charge Test Circuit

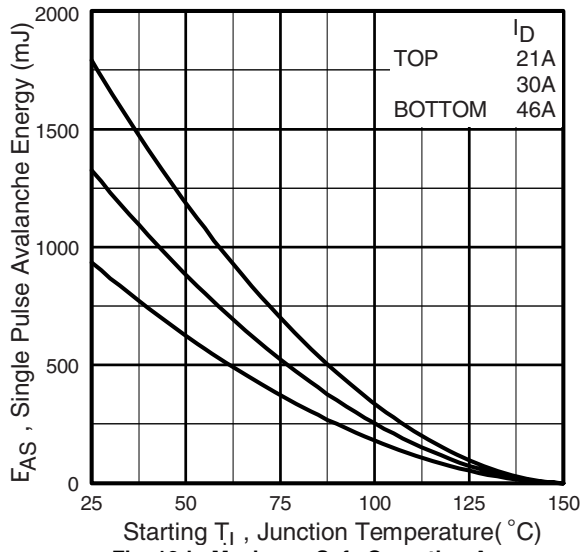


Fig. 12d - Maximum Safe Operating Area

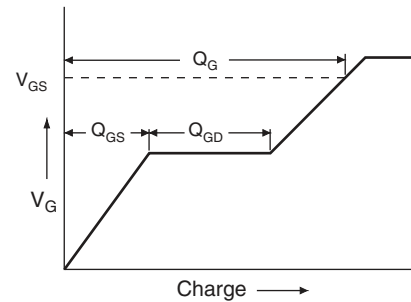
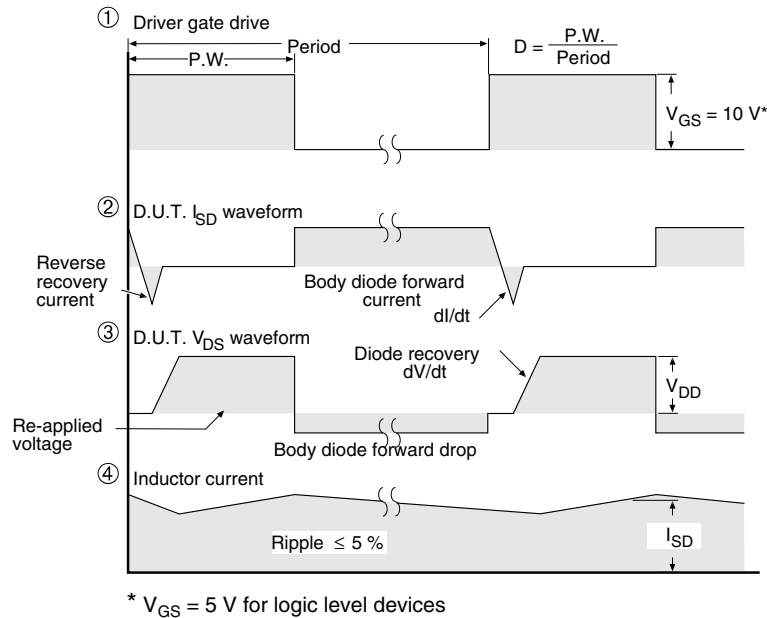
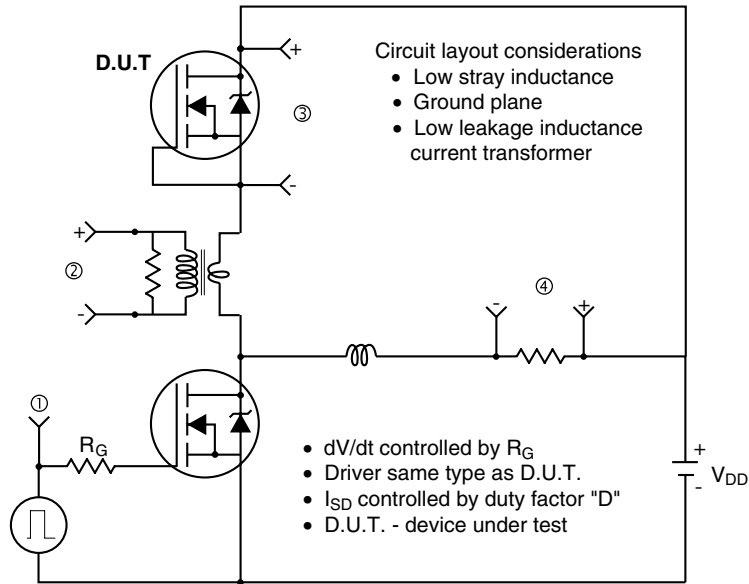


Fig. 13b - Basic Gate Charge Waveform

## Peak Diode Recovery $dV/dt$ Test Circuit



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

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