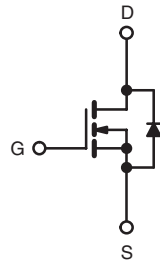
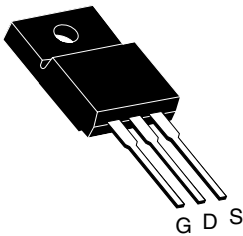


## Power MOSFET

PRODUCT SUMMARY		
$V_{DS}$ (V) at $T_J$ max.	650	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10$ V	0.75
$Q_g$ (Max.) (nC)	49	
$Q_{gs}$ (nC)	13	
$Q_{gd}$ (nC)	20	
Configuration	Single	

**TO-220 FULLPAK**


N-Channel MOSFET

### FEATURES

- Low Gate Charge  $Q_g$  Results in Simple Drive Requirement
- Improved Gate, Avalanche and Dynamic  $dV/dt$  Ruggedness
- Fully Characterized Capacitance and Avalanche Voltage and Current
- Lead (Pb)-free


**RoHS**  
COMPLIANT

### APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply
- High Speed Power Switching
- High Voltage Isolation = 2.5 kV<sub>RMS</sub> ( $t = 60$  s,  $f = 60$  Hz)

### TYPICAL SMPS TOPOLOGIES

- Single Transistor Forward
- Active Clamped Forward

### ORDERING INFORMATION

Package	TO-220 FULLPAK
Lead (Pb)-free	SiHFIB9N60A-E3


### ABSOLUTE MAXIMUM RATINGS $T_C = 25$ °C, unless otherwise noted

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	$V_{DS}$	600	V
Gate-Source Voltage	$V_{GS}$	$\pm 30$	
Continuous Drain Current <sup>e</sup>	$I_D$	$T_C = 25$ °C	A
Continuous Drain Current		$T_C = 100$ °C	
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	37	
Linear Derating Factor		0.48	W/°C
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$	290	mJ
Repetitive Avalanche Current <sup>a</sup>	$I_{AR}$	9.2	A
Repetitive Avalanche Energy <sup>a</sup>	$E_{AR}$	6.0	mJ
Maximum Power Dissipation	$P_D$	60	W
Peak Diode Recovery $dV/dt^c$	$dV/dt$	5.0	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to + 150	°C
Soldering Recommendations (Peak Temperature) <sup>d</sup>	for 10 s	300	
Mounting Torque	6-32 or M3 screw	10	
		1.1	N · m

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Starting  $T_J = 25$  °C,  $L = 6.8$  mH,  $R_G = 25$   $\Omega$ ,  $I_{AS} = 9.2$  A (see fig. 12).
- $I_{SD} \leq 9.2$  A,  $dI/dt \leq 50$  A/ $\mu$ s,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150$  °C.
- 1.6 mm from case.
- Drain current limited by maximum junction.

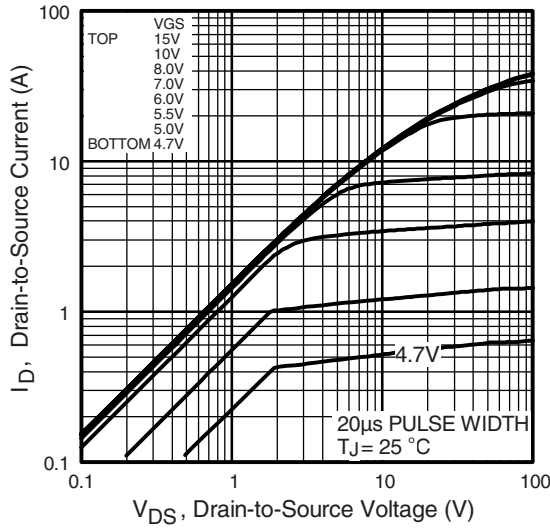
THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	65	°C/W
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	2.1	

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	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$	600	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}^d$	-	660	-	mV/°C
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	2.0	-	4.0	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 30\text{ V}$	-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 600\text{ V}$ , $V_{GS} = 0\text{ V}$	-	-	25	$\mu\text{A}$
		$V_{DS} = 480\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$	-	-	250	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$ , $I_D = 3.3\text{ A}^b$	-	-	0.75	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 25\text{ V}$ , $I_D = 5.5\text{ A}$	5.5	-	-	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	-	1400	-	$\mu\text{F}$
Output Capacitance	$C_{oss}$		-	180	-	
Reverse Transfer Capacitance	$C_{rss}$		-	7.1	-	
Output Capacitance	$C_{oss}$	$V_{GS} = 0\text{ V}$	$V_{DS} = 1.0\text{ V}$ , $f = 1.0\text{ MHz}$	-	1957	-
			$V_{DS} = 480\text{ V}$ , $f = 1.0\text{ MHz}$	-	49	-
Effective Output Capacitance	$C_{oss\text{ eff.}}$	$V_{DS} = 0\text{ V to }480\text{ V}^c$	-	96	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$ , $I_D = 9.2\text{ A}$ , $V_{DS} = 400\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	49	nC
Gate-Source Charge	$Q_{gs}$		-	-	13	
Gate-Drain Charge	$Q_{gd}$		-	-	20	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 300\text{ V}$ , $I_D = 9.2\text{ A}$ , $R_G = 9.1\text{ }\Omega$ , $R_D = 35.5\text{ }\Omega$ , see fig. 10 <sup>b</sup>	-	13	-	ns
Rise Time	$t_r$		-	25	-	
Turn-Off Delay Time	$t_{d(off)}$		-	30	-	
Fall Time	$t_f$		-	22	-	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	9.2	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$		-	-	37	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_S = 9.2\text{ A}$ , $V_{GS} = 0\text{ V}^b$	-	-	1.5	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_F = 9.2\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$	-	530	800	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$		-	3.0	4.4	$\mu\text{C}$
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )				

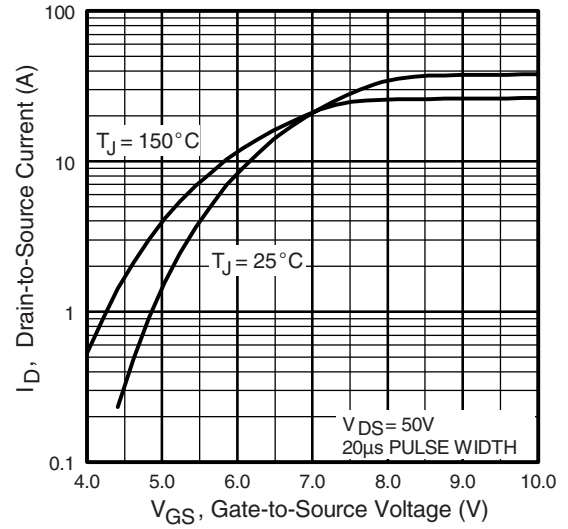
**Notes**

- 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 %  $V_{DS}$ .
- $t = 60\text{ s}$ ,  $f = 60\text{ Hz}$ .

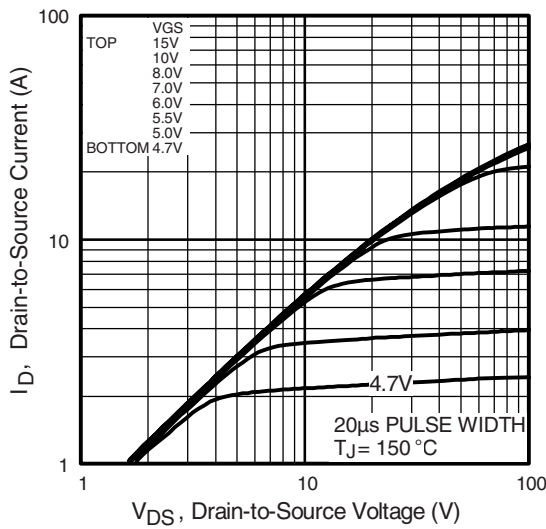
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



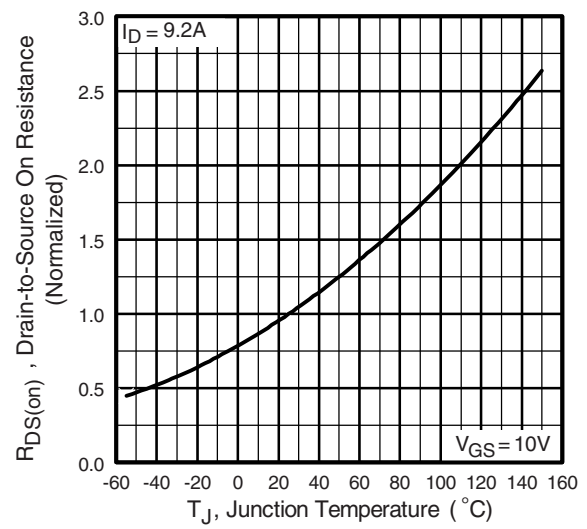
**Fig. 1 - Typical Output Characteristics**



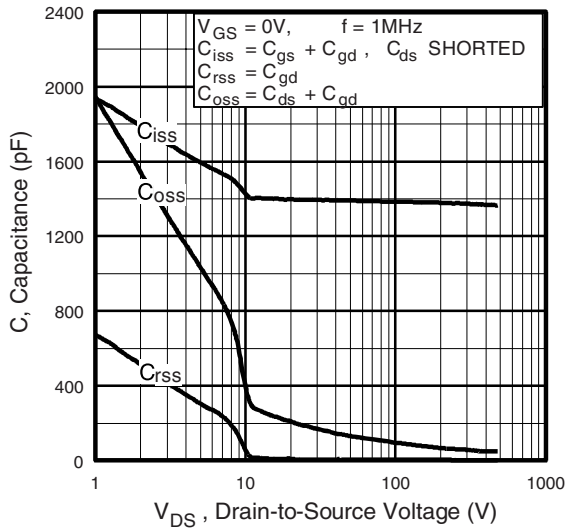
**Fig. 3 - Typical Transfer Characteristics**



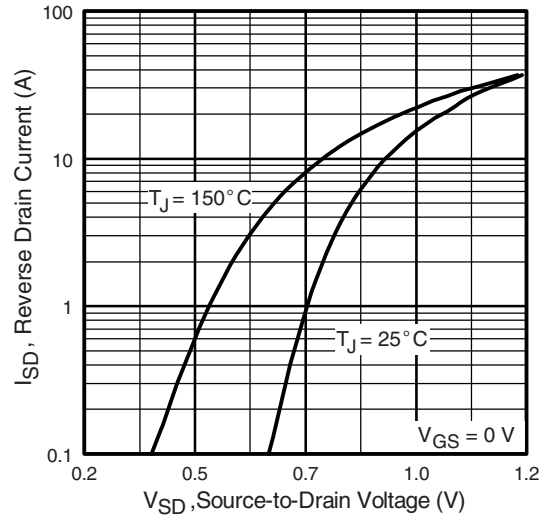
**Fig. 2 - Typical Output Characteristics**



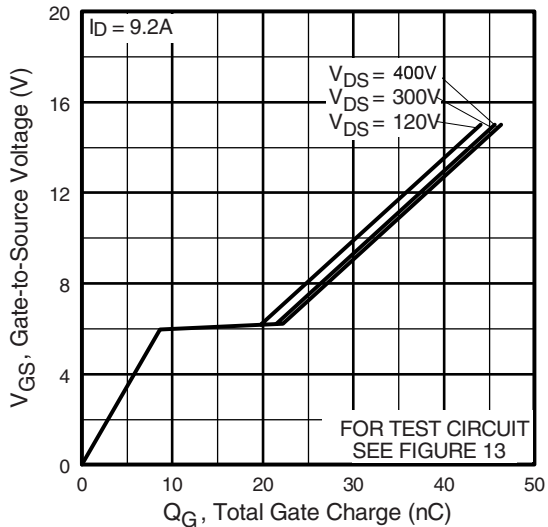
**Fig. 4 - Normalized On-Resistance vs. Temperature**



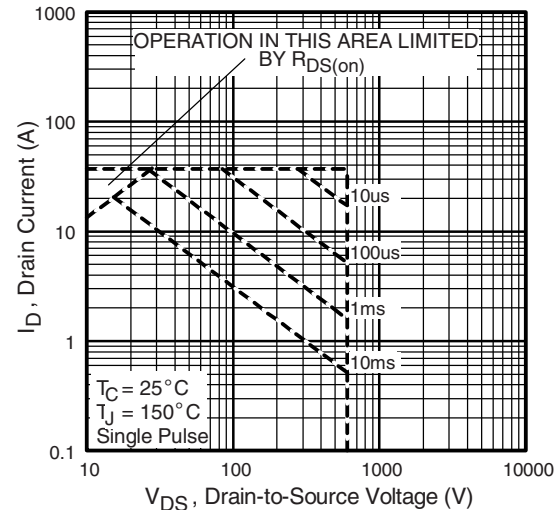
**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**



**Fig. 7 - Typical Source-Drain Diode Forward Voltage**



**Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage**



**Fig. 8 - Maximum Safe Operating Area**

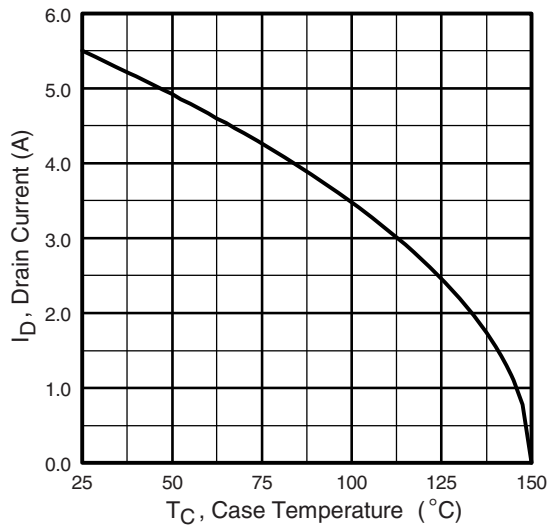


Fig. 9 - Maximum Drain Current vs. Case Temperature

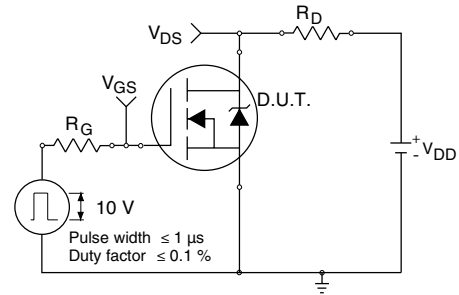


Fig. 10a - Switching Time Test Circuit

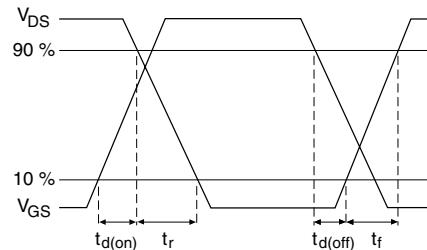


Fig. 10b - Switching Time Waveforms

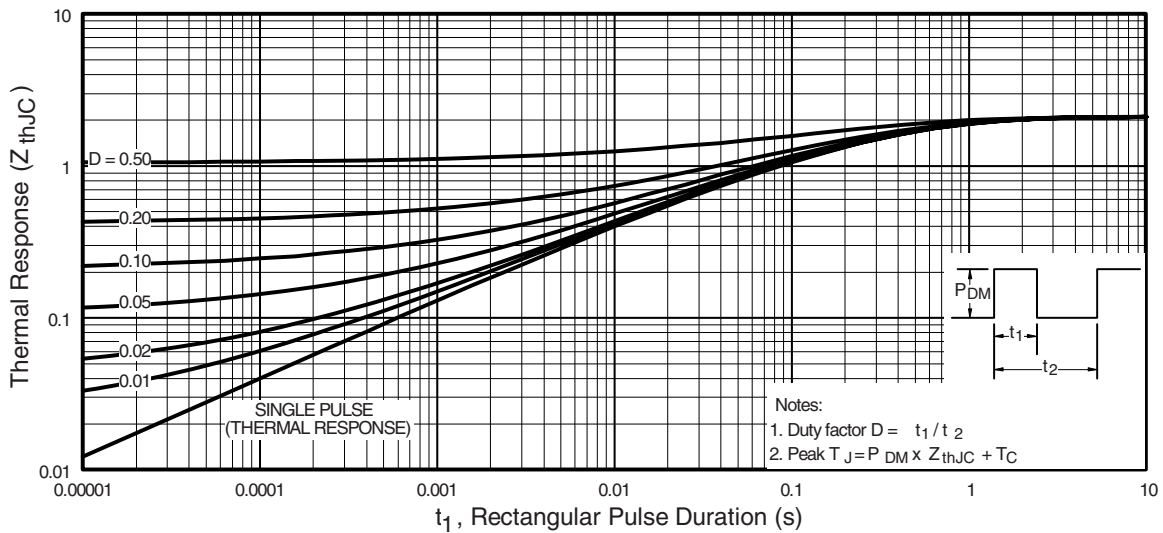


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

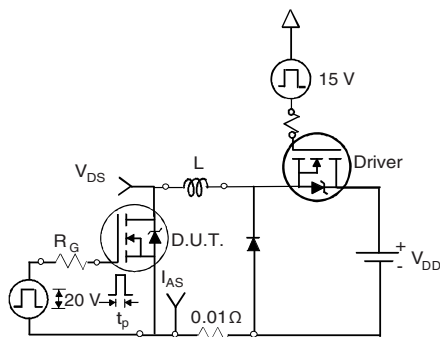


Fig. 12a - Unclamped Inductive Test Circuit

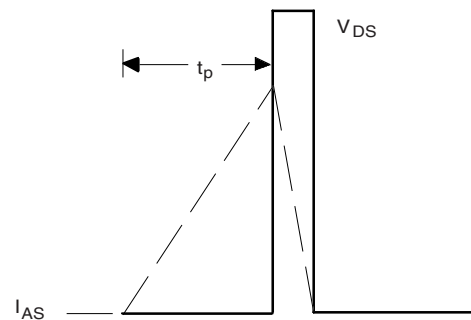


Fig. 12b - Unclamped Inductive Waveforms

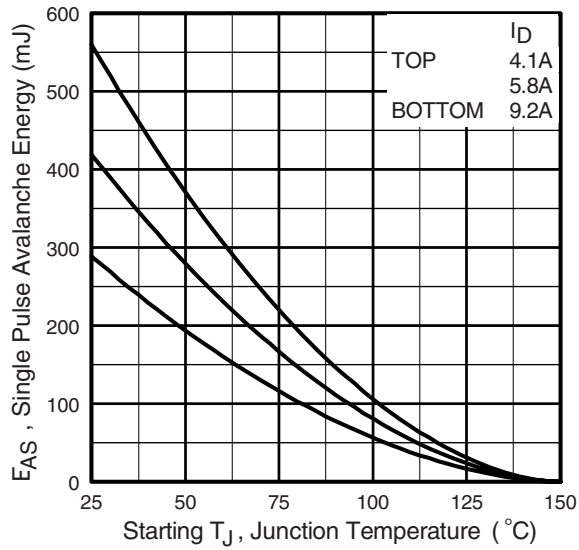


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

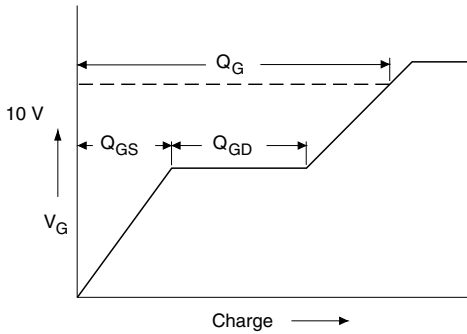


Fig. 13a - Basic Gate Charge Waveform

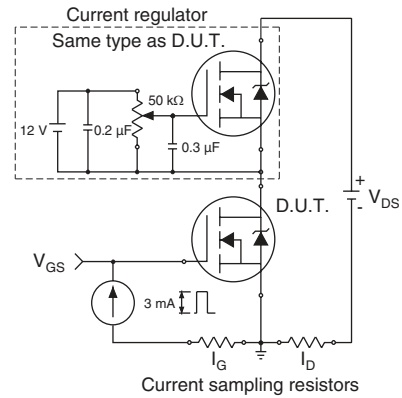
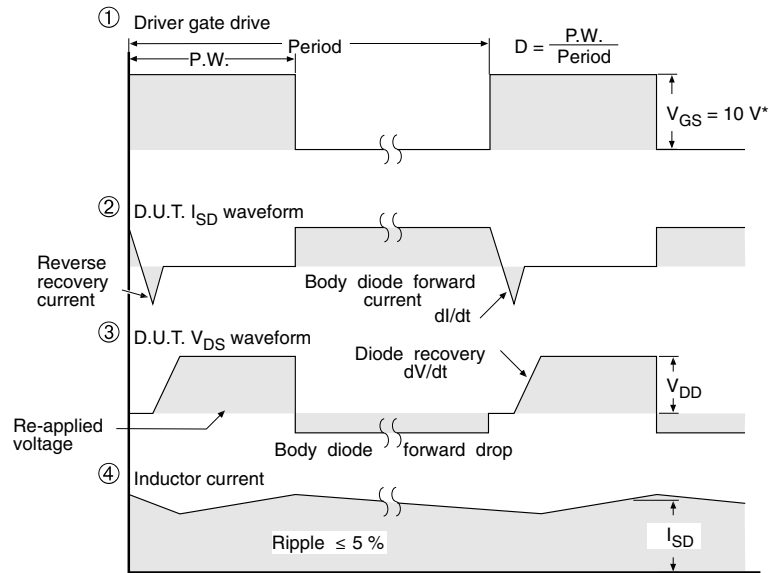
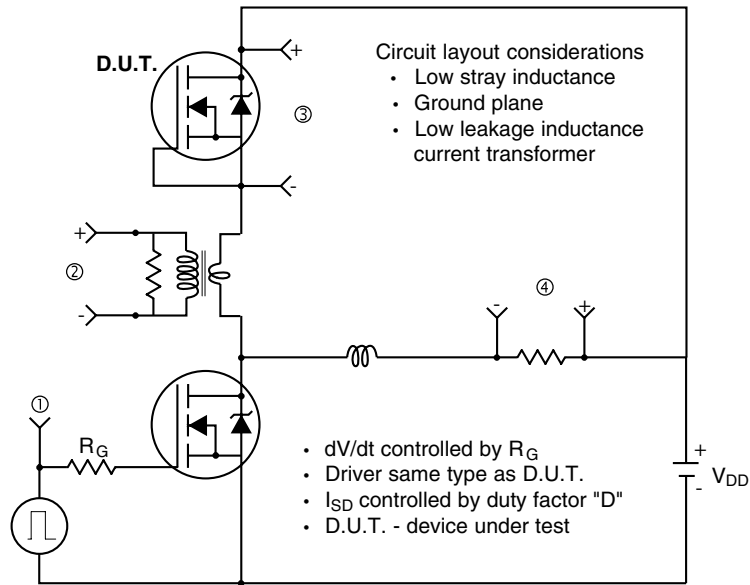


Fig. 13b - Gate Charge Test Circuit

## Peak Diode Recovery dV/dt Test Circuit



\*  $V_{GS} = 5 V$  for logic level devices

Fig. 14 - For N-Channel

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