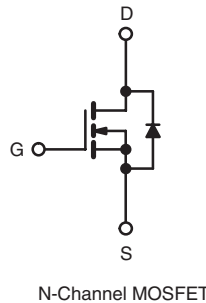
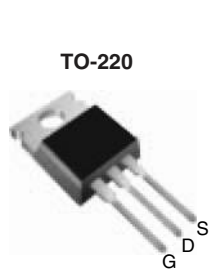


## Power MOSFET

PRODUCT SUMMARY		
$V_{DS}$ (V)	650	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10$ V	0.93
$Q_g$ (Max.) (nC)	48	
$Q_{gs}$ (nC)	12	
$Q_{gd}$ (nC)	19	
Configuration	Single	



### 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 Available



RoHS\*  
COMPLIANT

### APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply
- High Speed Power Switching

### TYPICAL SMPS TOPOLOGIES

- Single Transistor Flyback
- Single Transistor Forward

ORDERING INFORMATION	
Package	TO-220
Lead (Pb)-free	IRFB9N65APbF
	SiHFB9N65A-E3
SnPb	IRFB9N65A
	SiHFB9N65A


ABSOLUTE MAXIMUM RATINGS $T_C = 25$ °C, unless otherwise noted				
PARAMETER	SYMBOL	LIMIT	UNIT	
Drain-Source Voltage	$V_{DS}$	650	V	
Gate-Source Voltage	$V_{GS}$	$\pm 30$		
Continuous Drain Current	$V_{GS}$ at 10 V	$T_C = 25$ °C	8.5	A
		$T_C = 100$ °C	5.4	
Pulsed Drain Current <sup>a</sup>		$I_{DM}$	21	
Linear Derating Factor			1.3	W/°C
Single Pulse Avalanche Energy <sup>b</sup>		$E_{AS}$	325	mJ
Repetitive Avalanche Current <sup>a</sup>		$I_{AR}$	5.2	A
Repetitive Avalanche Energy <sup>a</sup>		$E_{AR}$	16	mJ
Maximum Power Dissipation	$T_C = 25$ °C	$P_D$	167	W
Peak Diode Recovery $dV/dt^c$		$dV/dt$	2.8	V/ns
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	- 55 to + 150	°C
Soldering Recommendations (Peak Temperature)	for 10 s		300 <sup>d</sup>	
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,  $L = 24$  mH,  $R_G = 25$   $\Omega$ ,  $I_{AS} = 5.2$  A (see fig. 12).
- $I_{SD} \leq 5.2$  A,  $dI/dt \leq 90$  A/ $\mu$ s,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150$  °C.
- 1.6 mm from case.

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

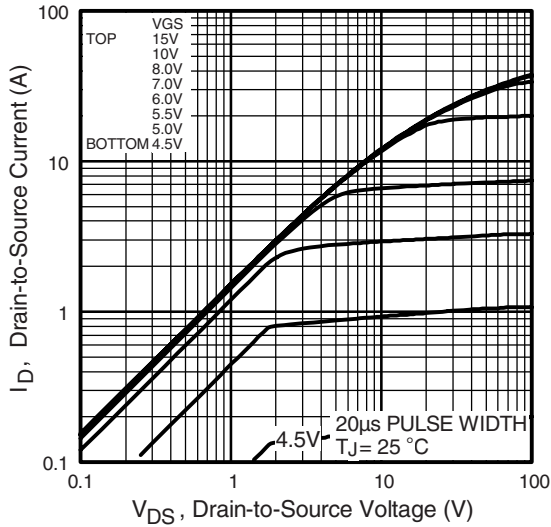
THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	62	°C/W
Case-to-Sink, Flat, Greased Surface	$R_{thCS}$	0.50	-	
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	0.75	

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	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	650	-	-	V	
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}^d$	-	670	-	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	$I_{DSS}$	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$	-	-	25	$\mu\text{A}$	
		$V_{DS} = 520\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	-	250		
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$   $I_D = 5.1\text{ A}^b$	-	-	0.93	$\Omega$	
Forward Transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}, I_D = 3.1\text{ A}$	3.9	-	-	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	-	1417	-	pF	
Output Capacitance	$C_{oss}$		-	177	-		
Reverse Transfer Capacitance	$C_{rss}$		-	7.0	-		
Output Capacitance	$C_{oss}$	$V_{GS} = 0\text{ V}$	$V_{DS} = 1.0\text{ V}, f = 1.0\text{ MHz}$	-	1912	-	
			$V_{DS} = 520\text{ V}, f = 1.0\text{ MHz}$	-	48	-	
Effective Output Capacitance	$C_{oss\text{ eff.}}$		$V_{DS} = 0\text{ V to } 520\text{ V}^c$	-	84	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 5.2\text{ A}, V_{DS} = 400\text{ V}$ see fig. 6 and 13 <sup>b</sup>	-	-	48	nC
Gate-Source Charge	$Q_{gs}$			-	-	12	
Gate-Drain Charge	$Q_{gd}$			-	-	19	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 325\text{ V}, I_D = 5.2\text{ A}$ $R_G = 9.1\text{ }\Omega, R_D = 62\text{ }\Omega$ , see fig. 10 <sup>b</sup>	-	14	-	ns	
Rise Time	$t_r$		-	20	-		
Turn-Off Delay Time	$t_{d(off)}$		-	34	-		
Fall Time	$t_f$		-	18	-		
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	5.2	A	
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$		-	-	21		
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 5.2\text{ A}, V_{GS} = 0\text{ V}^b$	-	-	1.5	V	
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = 5.2\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$	-	493	739	ns	
Body Diode Reverse Recovery Charge	$Q_{rr}$		-	2.1	3.2	$\mu\text{C}$	
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )					

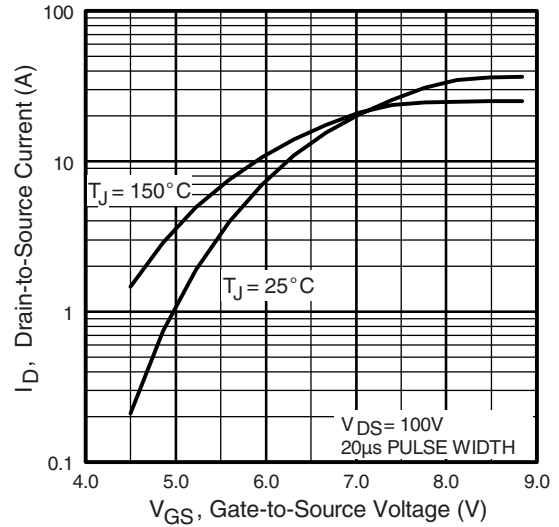
**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- c.  $C_{oss\text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80 %  $V_{DS}$ .
- d. Uses SiHFIB5N65A data and test conditions.

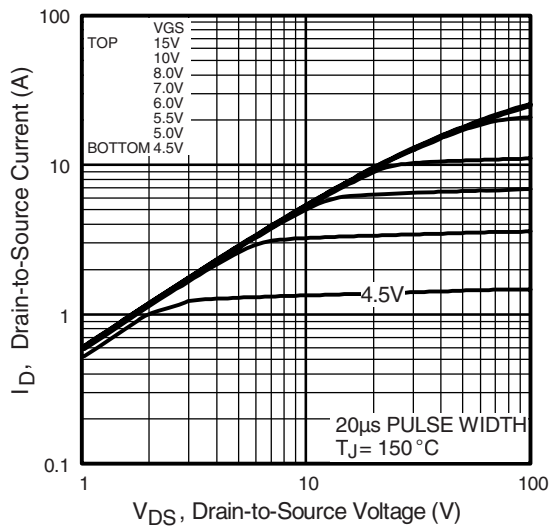
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



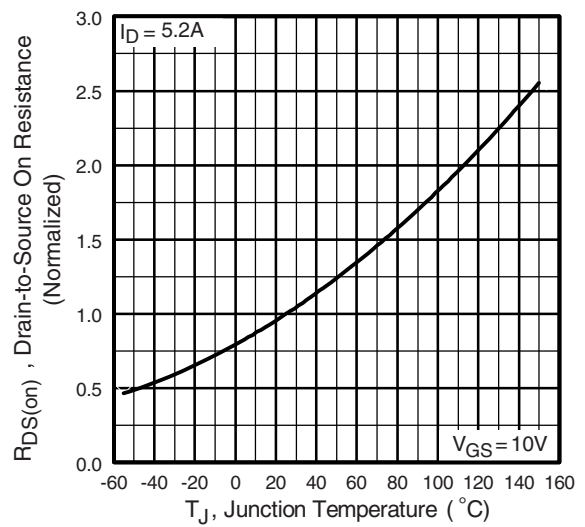
**Fig. 1 - Typical Output Characteristics**



**Fig. 3 - Typical Transfer Characteristics**



**Fig. 2 - Typical Output Characteristics**



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

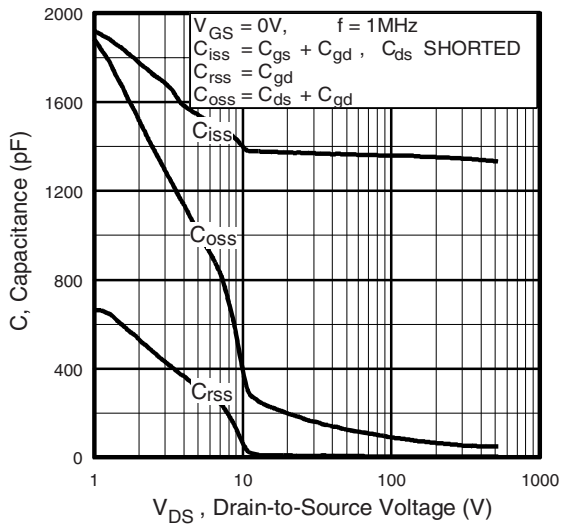


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

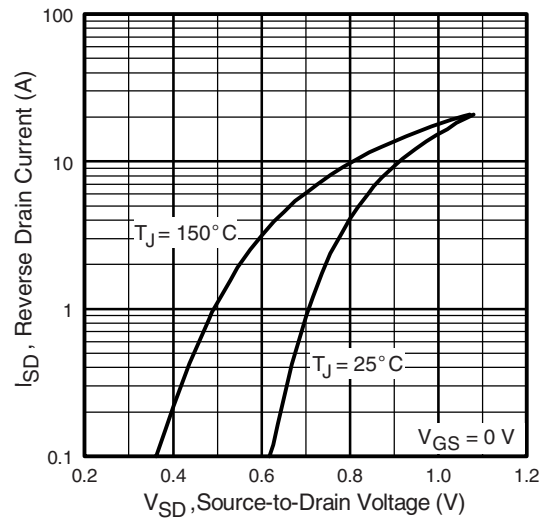


Fig. 7 - Typical Source-Drain Diode Forward Voltage

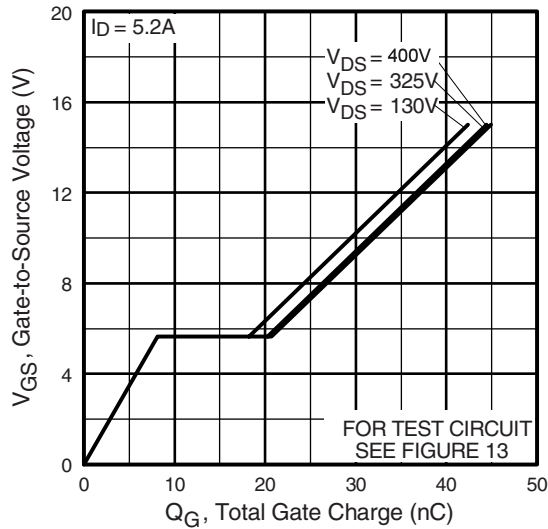


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

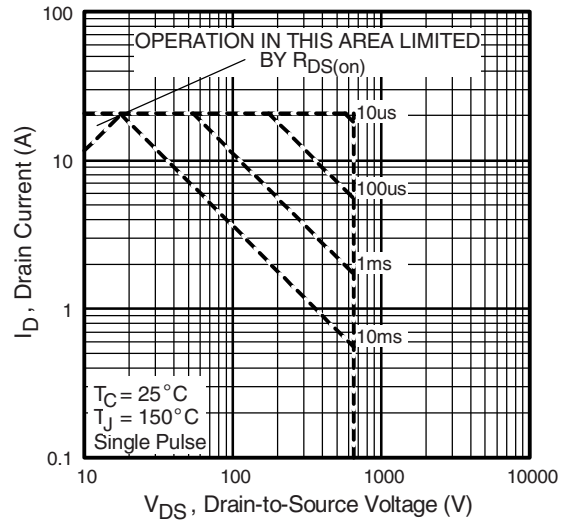
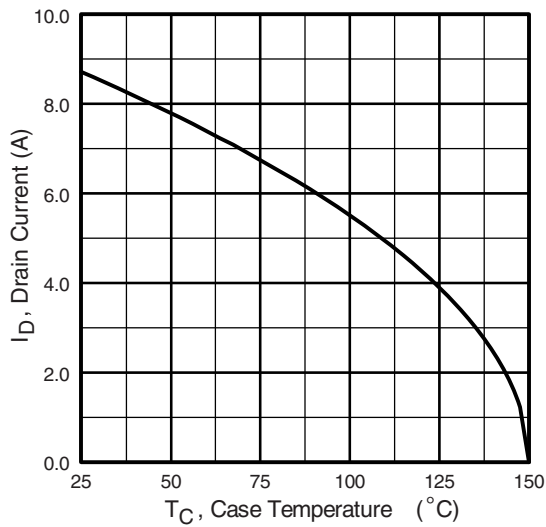
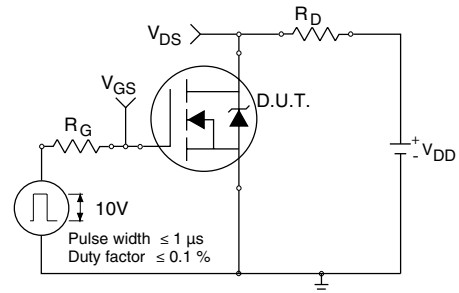


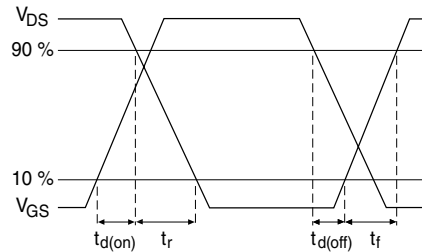
Fig. 8 - Maximum Safe Operating Area



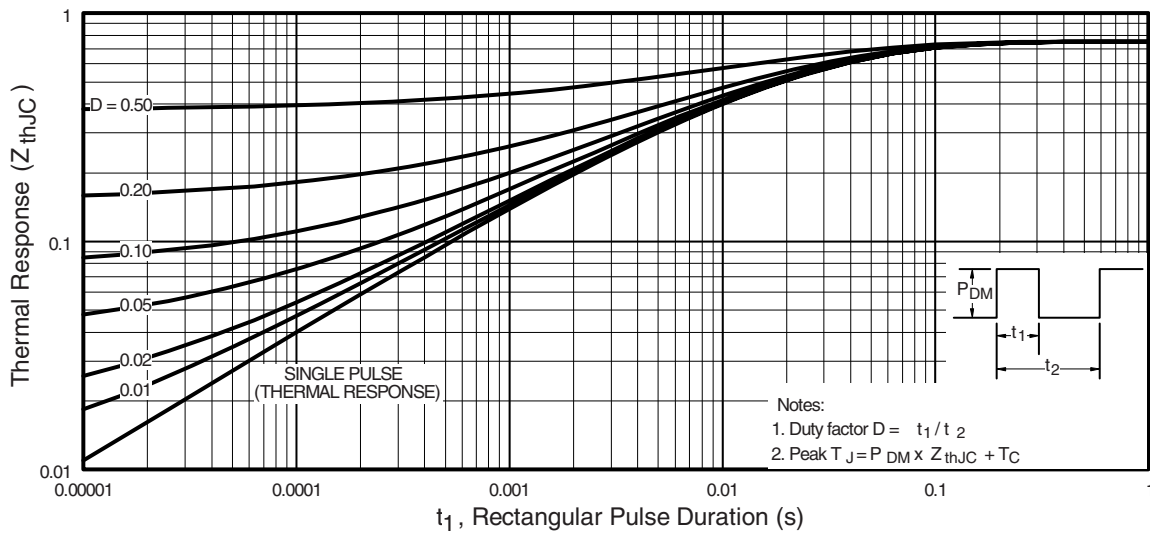
**Fig. 9 - Maximum Drain Current vs. Case Temperature**



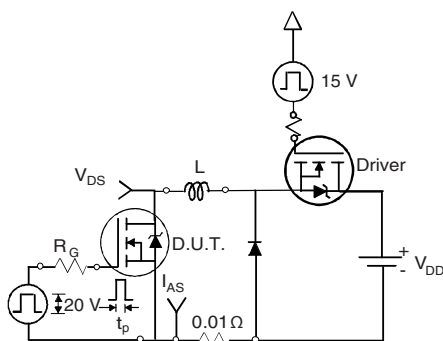
**Fig. 10a - Switching Time Test Circuit**



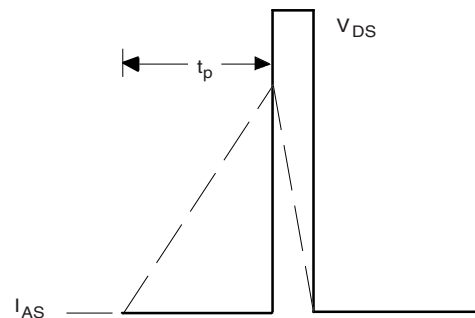
**Fig. 10b - Switching Time Waveforms**



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



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



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

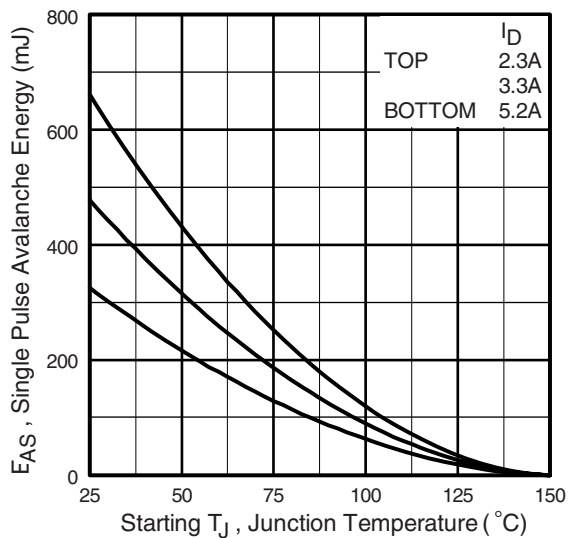


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

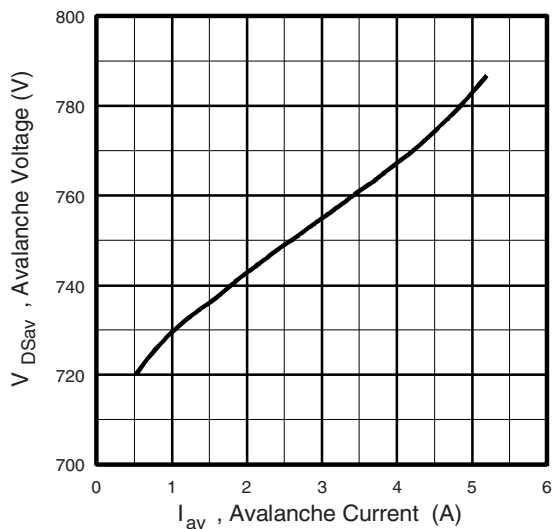


Fig. 12d - Typical Drain-to-Source Voltage vs. Avalanche Current

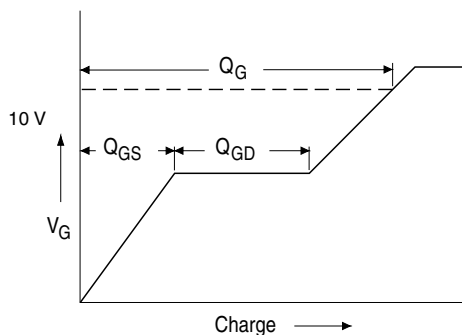


Fig. 13a - Basic Gate Charge Waveform

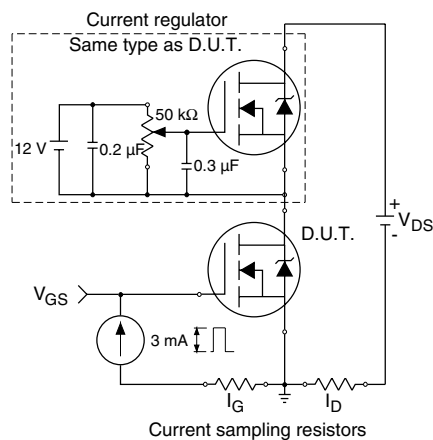
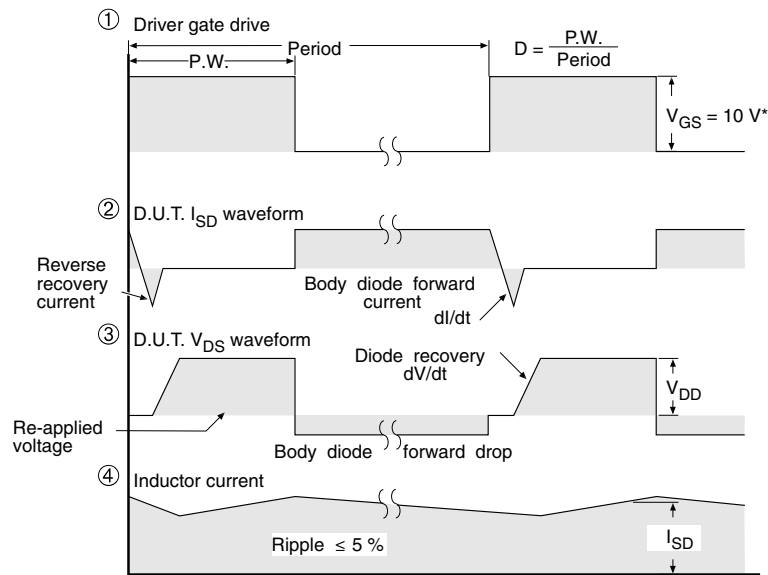
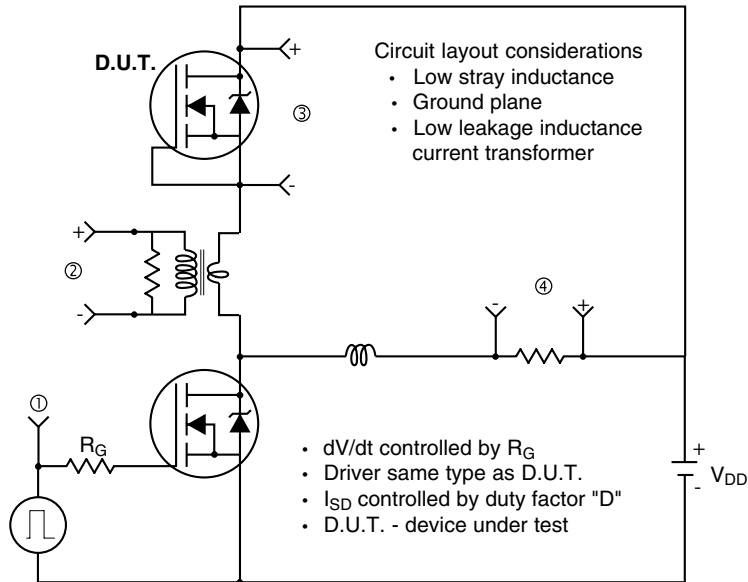


Fig. 13b - Gate Charge Test Circuit

## Peak Diode Recovery dV/dt Test Circuit



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

Fig. 14 - For N-Channel

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