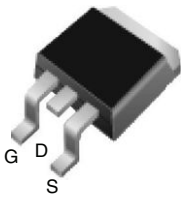
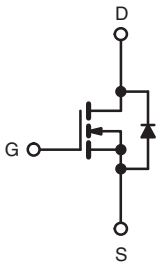
Power MOSFET

PRODUCT SUMMARY		
V_{DS} (V)	600	
$R_{DS(on)}$ (Ω)	V_{GS} = 10 V	0.75
Q_g (Max.) (nC)	49	
Q_{gs} (nC)	13	
Q_{gd} (nC)	20	
Configuration	Single	

D²PAK (TO-263)





N-Channel MOSFET

FEATURES

- **Halogen-free According to IEC 61249-2-21 Definition**
- 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
- Compliant to RoHS Directive 2002/95/EC

Pb Available
RoHS* COMPLIANT
HALOGEN FREE Available

APPLICATIONS

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

APPLICABLE OFF LINE SMPS TOPOLOGIES

- Active Clamped Forward
- Main Switch

ORDERING INFORMATION			
Package	D²PAK (TO-263)	D²PAK (TO-263)	D²PAK (TO-263)
Lead (Pb)-free and Halogen-free	SiHFS9N60A-GE3	SiHFS9N60ATRR-GE3[a]	SiHFS9N60ATRL-GE3[a]
Lead (Pb)-free	IRFS9N60APbF	IRFS9N60ATRRPbF[a]	IRFS9N60ATRLPbF[a]
	SiHFS9N60A-E3	SiHFS9N60ATR-E3[a]	SiHFS9N60ATL-E3[a]
SnPb	IRFS9N60A	IRFS9N60ATRR[a]	IRFS9N60ATRL[a]
	SiHFS9N60A	SiHFS9N60ATR[a]	SiHFS9N60ATL[a]

Note

a. See device orientation.

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}	± 30	
Continuous Drain Current	V_{GS} at 10 V	T_C = 25 °C	I_D	9.2	A
		T_C = 100 °C		5.8	
Pulsed Drain Current[a]			I_{DM}	37	
Linear Derating Factor				1.3	W/°C
Single Pulse Avalanche Energy[b]			E_{AS}	290	mJ
Repetitive Avalanche Current[a]			I_{AR}	9.2	A
Repetitive Avalanche Energy[a]			E_{AR}	17	mJ
Maximum Power Dissipation	T_C = 25 °C		P_D	170	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)	for 10 s			300[d]	

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
b. Starting T_J = 25 °C, L = 6.8 mH, R_g = 25 Ω, I_{AS} = 9.2 A (see fig. 12).
c. I_{SD} ≤ 9.2 A, dI/dt ≤ 50 A/µs, V_{DD} ≤ V_{DS}, T_J ≤ 150 °C.
d. 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
Maximum Junction-to-Case (Drain)	R_{thJC}	-	0.75	

SPECIFICATIONS (T_J = 25 °C, unless otherwise noted)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS**		**MIN.**	**TYP.**	**MAX.**	**UNIT**
Static							
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0 V, I_D = 250 µA		600	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, I_D = 1 mA		-	0.66	-	V/°C
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 µA		2.0	-	4.0	V
Gate-Source Leakage	I_{GSS}	V_{GS} = ± 30 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 600 V, V_{GS} = 0 V		-	-	25	µA
		V_{DS} = 480 V, V_{GS} = 0 V, T_J = 125 °C		-	-	250	
Drain-Source On-State Resistance	$R_{DS(on)}$	V_{GS} = 10 V	I_D = 5.5 A[b]	-	-	0.75	Ω
Forward Transconductance	g_{fs}	V_{DS} = 25 V, I_D = 3.1 A		5.5	-	-	S
Dynamic							
Input Capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 25 V, f = 1.0 MHz, see fig. 5		-	1400	-	pF
Output Capacitance	C_{oss}			-	180	-	
Reverse Transfer Capacitance	C_{rss}			-	7.1	-	
Output Capacitance	C_{oss}	V_{GS} = 0 V	V_{DS} = 1.0 V, f = 1.0 MHz	-	1957	-	
			V_{DS} = 480 V, f = 1.0 MHz	-	49	-	
Effective Output Capacitance	C_{oss} eff.		V_{DS} = 0 V to 480 V[c]	-	96	-	
Total Gate Charge	Q_g	V_{GS} = 10 V	I_D = 9.2 A, V_{DS} = 400 V see fig. 6 and 13[b]	-	-	49	nC
Gate-Source Charge	Q_{gs}			-	-	13	
Gate-Drain Charge	Q_{gd}			-	-	20	
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 300 V, I_D = 9.2 A R_g = 9.1 Ω, R_D = 35.5 Ω, see fig. 10[b]		-	13	-	ns
Rise Time	t_r			-	25	-	
Turn-Off Delay Time	$t_{d(off)}$			-	30	-	
Fall Time	t_f			-	22	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	9.2	A
Pulsed Diode Forward Current[a]	I_{SM}			-	-	37	
Body Diode Voltage	V_{SD}	T_J = 25 °C, I_S = 9.2 A, V_{GS} = 0 V[b]		-	-	1.5	V
Body Diode Reverse Recovery Time	t_{rr}	T_J = 25 °C, I_F = 9.2 A, dI/dt = 100 A/µs[b]		-	530	800	ns
Body Diode Reverse Recovery Charge	Q_{rr}			-	3.0	4.4	µC
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 ≤ 300 µs; duty cycle ≤ 2 %.

c. C_{oss} 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}.

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

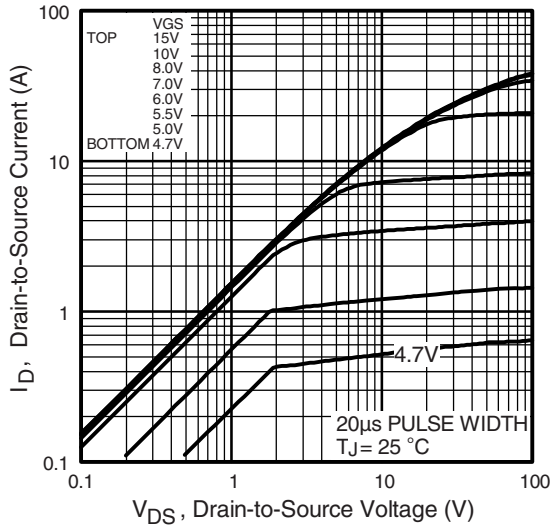


Fig. 1 - Typical Output Characteristics

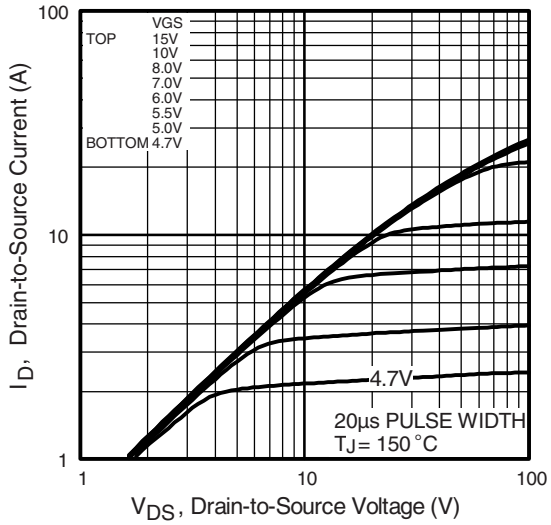


Fig. 2 - Typical Output Characteristics

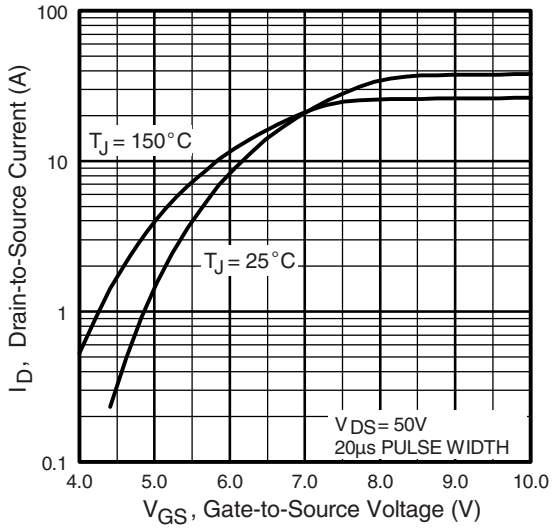


Fig. 3 - Typical Transfer Characteristics

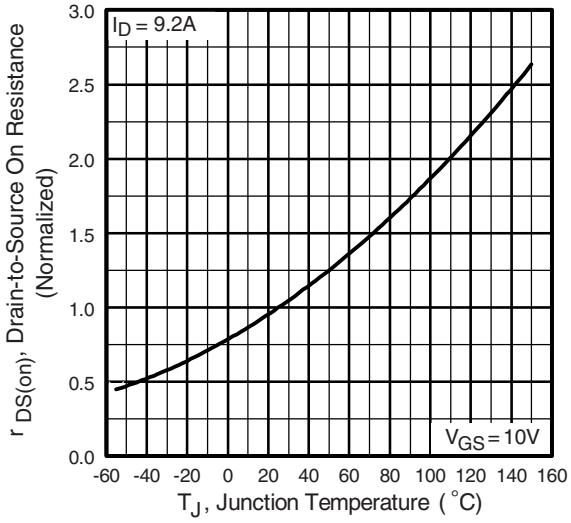


Fig. 4 - Normalized On-Resistance vs. Temperature

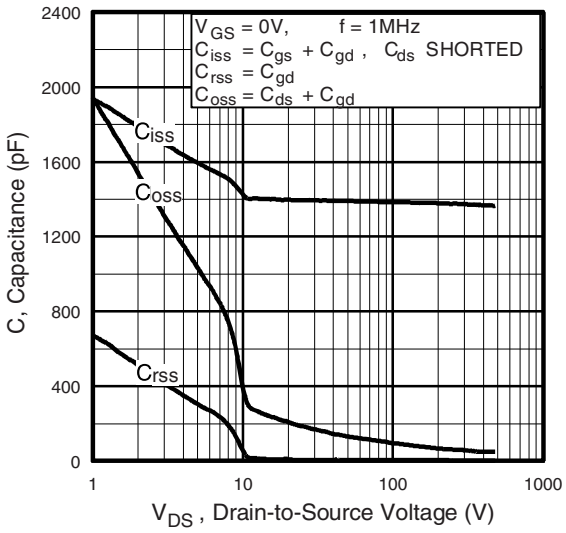


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

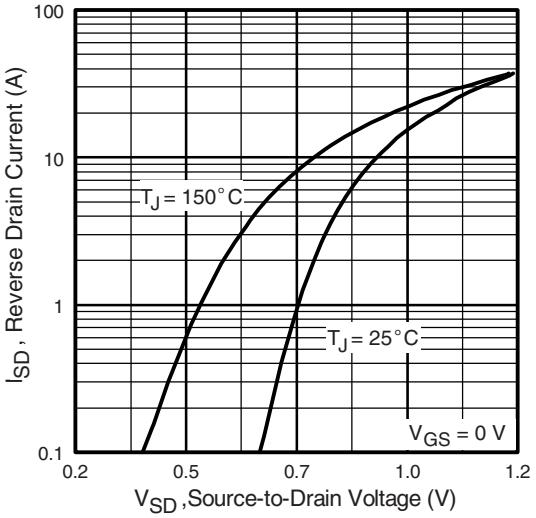


Fig. 7 - Typical Source-Drain Diode Forward Voltage

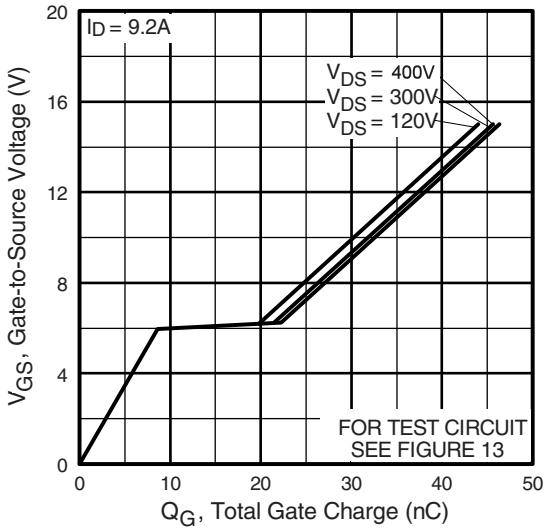


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

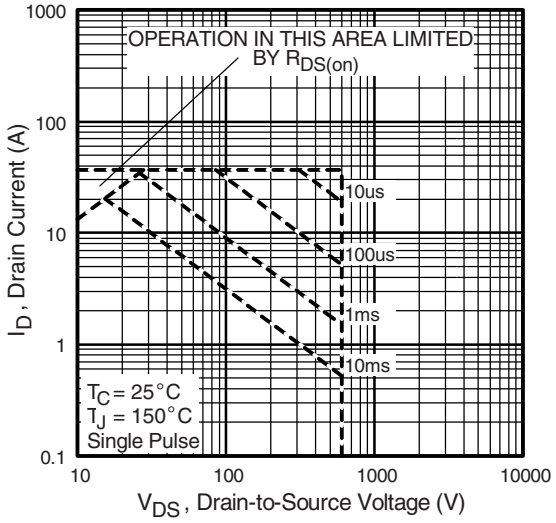


Fig. 8 - Maximum Safe Operating Area

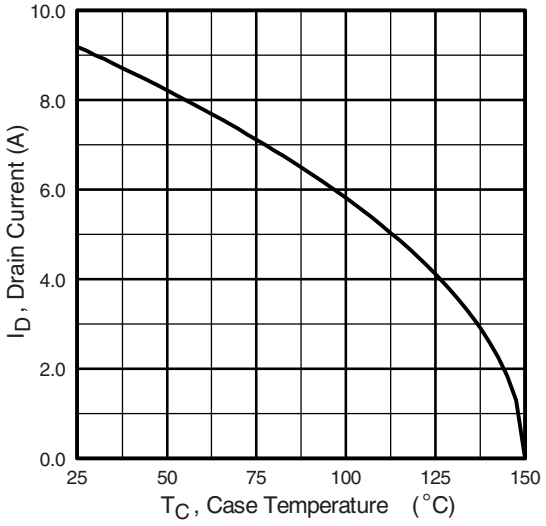


Fig. 9 - Maximum Drain Current vs. Case Temperature

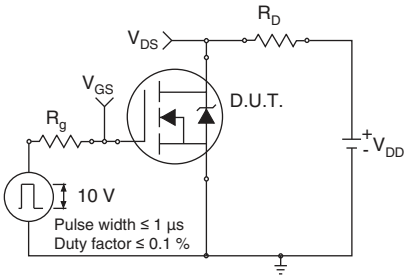


Fig. 10a - Switching Time Test Circuit

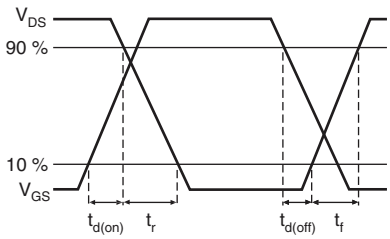


Fig. 10b - Switching Time Waveforms

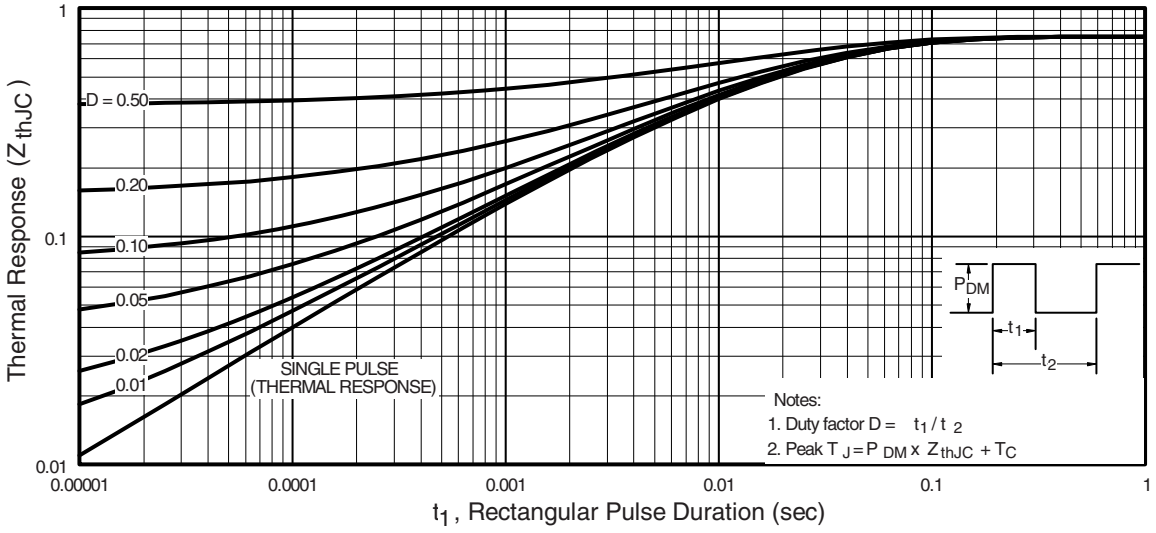


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

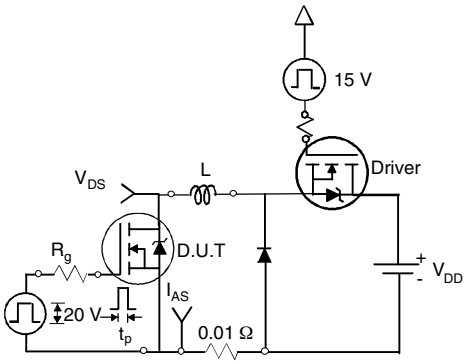


Fig. 12a - Unclamped Inductive Test Circuit

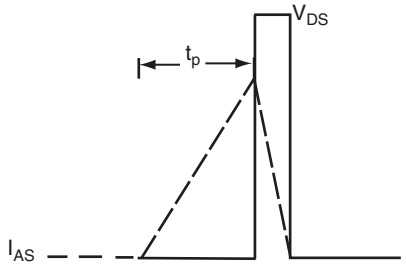


Fig. 12b - Unclamped Inductive Waveforms

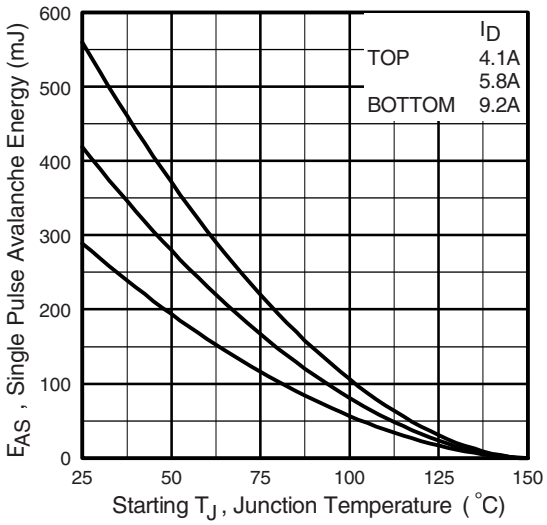


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

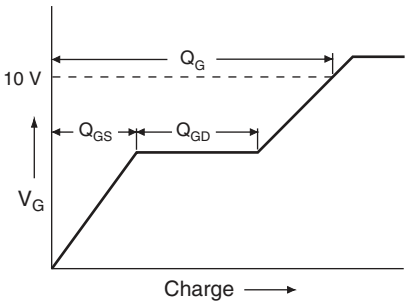


Fig. 13a - Basic Gate Charge Waveform

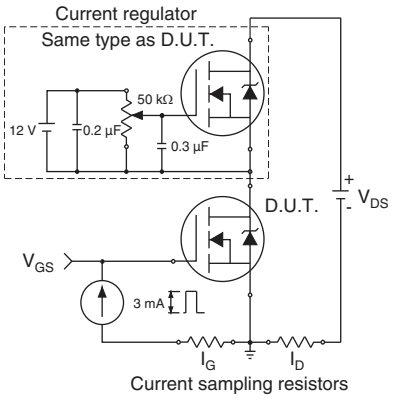
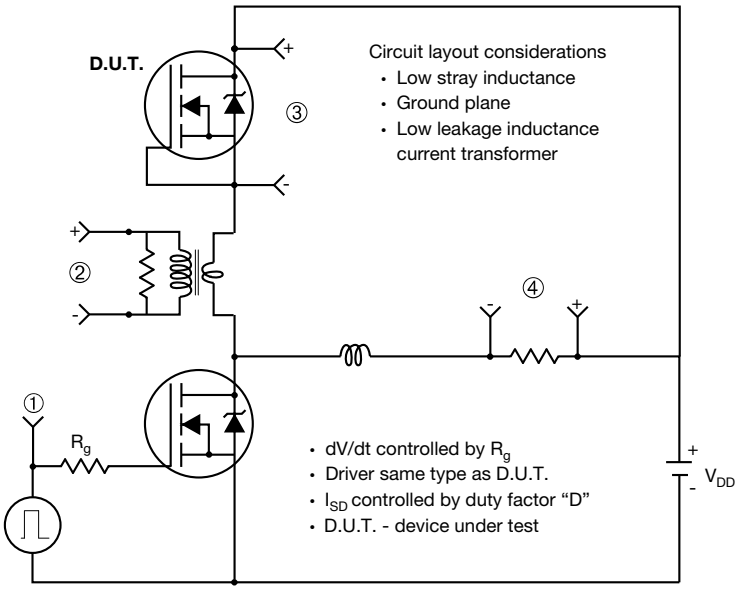
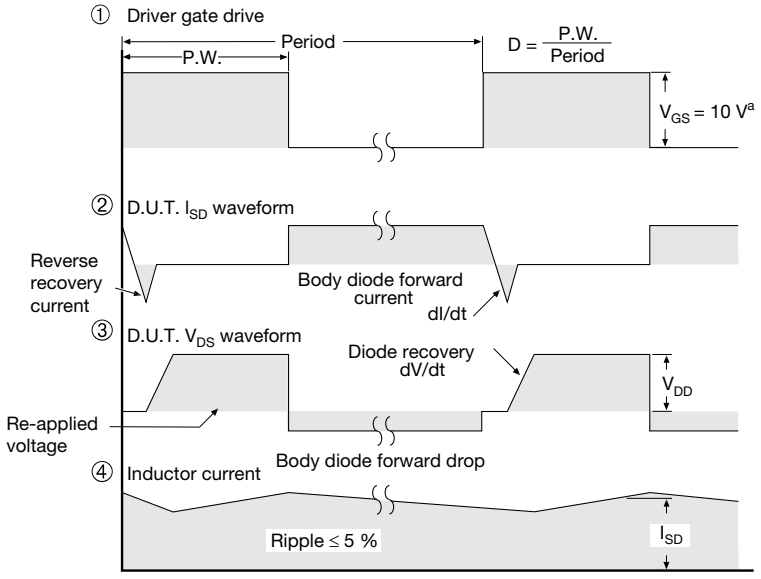


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit





Note

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

Fig. 14 - For N-Channel

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