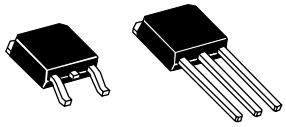
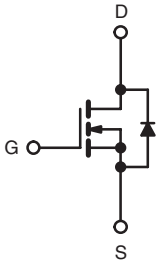
Power MOSFET

PRODUCT SUMMARY		
V_{DS} (V)	600	
$R_{DS(on)}$ (Max.) (Ω)	V_{GS} = 10 V	7.0
Q_g (Max.) (nC)	14	
Q_{gs} (nC)	2.7	
Q_{gd} (nC)	8.1	
Configuration	Single	

DPAK (TO-252) **IPAK (TO-251)**





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 Available

Pb Available

RoHS* COMPLIANT

APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply
- Power Factor Correction

TYPICAL SMPS TOPOLOGIES

- Low Power Single Transistor Flyback

ORDERING INFORMATION					
Package	DPAK (TO-252)	DPAK (TO-252)	DPAK (TO-252)	DPAK (TO-252)	IPAK (TO-251)
Lead (Pb)-free	IRFR1N60APbF	IRFR1N60ATRLPbF[a]	IRFR1N60ATRPbF[a]	IRFR1N60ATRRPbF[a]	IRFU1N60APbF
	SiHFR1N60A-E3	SiHFR1N60ATL-E3[a]	SiHFR1N60AT-E3[a]	SiHFR1N60ATR-E3[a]	SiHFU1N60A-E3
SnPb	IRFR1N60A	-	IRFR1N60ATR[a]	-	IRFU1N60A
	SiHFR1N60A	-	SiHFR1N60AT[a]	-	SiHFU1N60A

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	1.4	A
		T_C = 100 °C		0.89	
Pulsed Drain Current[a]			I_{DM}	5.6	
Linear Derating Factor				0.28	W/°C
Single Pulse Avalanche Energy[b]			E_{AS}	93	mJ
Repetitive Avalanche Current[a]			I_{AR}	1.4	A
Repetitive Avalanche Energy[a]			E_{AR}	3.6	mJ
Maximum Power Dissipation	T_C = 25 °C		P_D	36	W
Peak Diode Recovery dV/dt[c]			dV/dt	3.8	V/ns
Operating Junction and Storage Temperature Range			T_J, T_{stg}	- 55 to + 150	°C
Soldering Recommendations (Peak Temperature)	for 10 s			300[d]	

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
b. Starting T_J = 25 °C, L = 95 mH, R_G = 25 Ω, I_{AS} = 1.4 A (see fig. 12).
c. $I_{SD} \leq$ 1.4 A, dI/dt ≤ 180 A/µs, $V_{DD} \leq V_{DS}$, $T_J \leq$ 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}	-	110	°C/W
Maximum Junction-to-Ambient (PCB Mount)[a]	R_{thJA}	-	50	
Maximum Junction-to-Case (Drain)	R_{thJC}	-	3.5	

Note

a. When mounted on 1" square PCB (FR-4 or G-10 material).

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
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 µA		2.0	-	4.0	
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 = 150 °C		-	-	250	
Drain-Source On-State Resistance	$R_{DS(on)}$	V_{GS} = 10 V	I_D = 0.84 A[b]	-	-	7.0	Ω
Forward Transconductance	g_{fs}	V_{DS} = 50 V, I_D = 0.84 A		0.88	-	-	S
Dynamic							
Input Capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 25 V, f = 1.0 MHz, see fig. 5		-	229	-	pF
Output Capacitance	C_{oss}			-	32.6	-	
Reverse Transfer Capacitance	C_{rss}			-	2.4	-	
Output Capacitance	C_{oss}	V_{GS} = 0 V	V_{DS} = 1.0 V, f = 1.0 MHz	-	320	-	
			V_{DS} = 480 V, f = 1.0 MHz	-	11.5	-	
Effective Output Capacitance	C_{oss} eff.		V_{DS} = 0 V to 480 V[c]	-	130	-	
Total Gate Charge	Q_g	V_{GS} = 10 V	I_D = 1.4 A, V_{DS} = 400 V, see fig. 6 and 13[b]	-	-	14	nC
Gate-Source Charge	Q_{gs}			-	-	2.7	
Gate-Drain Charge	Q_{gd}			-	-	8.1	
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 250 V, I_D = 1.4 A, R_G = 2.15 Ω, R_D = 178 Ω, see fig. 10[b]		-	9.8	-	ns
Rise Time	t_r			-	14	-	
Turn-Off Delay Time	$t_{d(off)}$			-	18	-	
Fall Time	t_f			-	20	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	1.4	A
Pulsed Diode Forward Current[a]	I_{SM}			-	-	5.6	
Body Diode Voltage	V_{SD}	T_J = 25 °C, I_S = 1.4 A, V_{GS} = 0 V[b]		-	-	1.6	V
Body Diode Reverse Recovery Time	t_{rr}	T_J = 25 °C, I_F = 1.4 A, dI/dt = 100 A/µs[b]		-	290	440	ns
Body Diode Reverse Recovery Charge	Q_{rr}			-	510	760	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

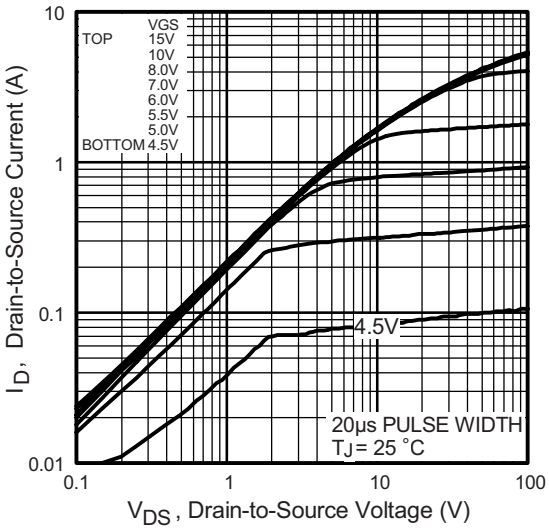


Fig. 1 - Typical Output Characteristics

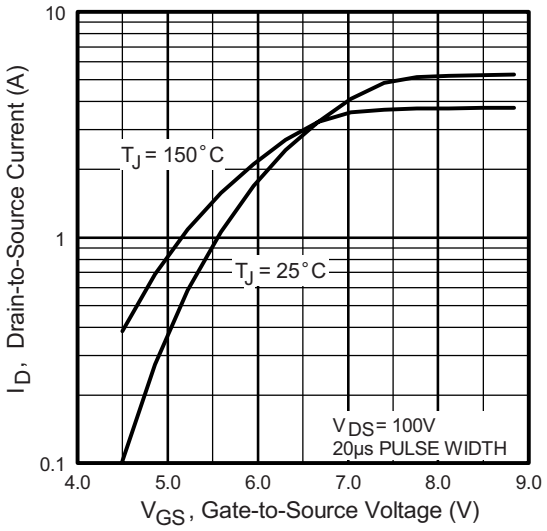


Fig. 3 - Typical Transfer Characteristics

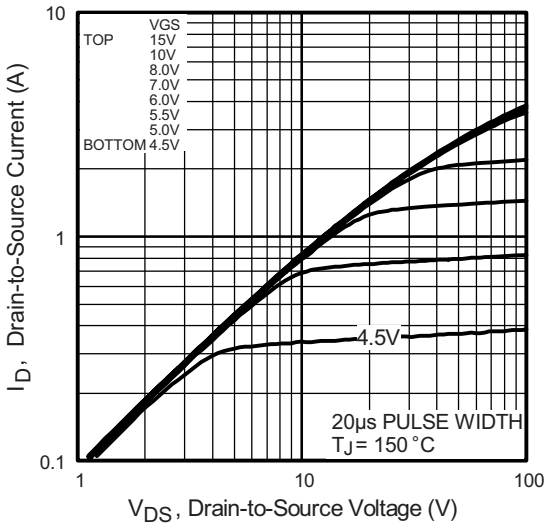


Fig. 2 - Typical Output Characteristics

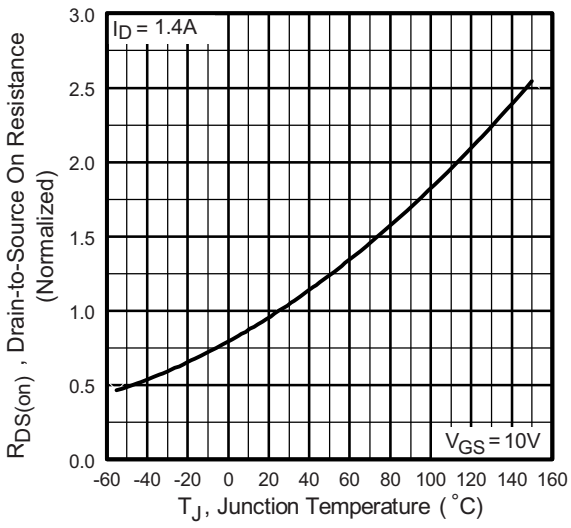


Fig. 4 - Normalized On-Resistance vs. Temperature

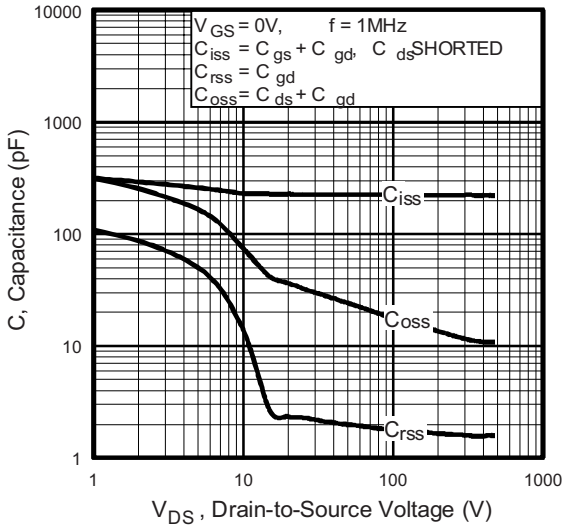


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

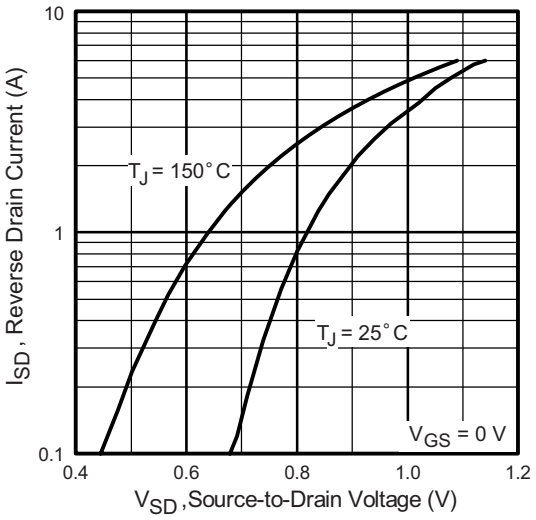


Fig. 7 - Typical Source-Drain Diode Forward Voltage

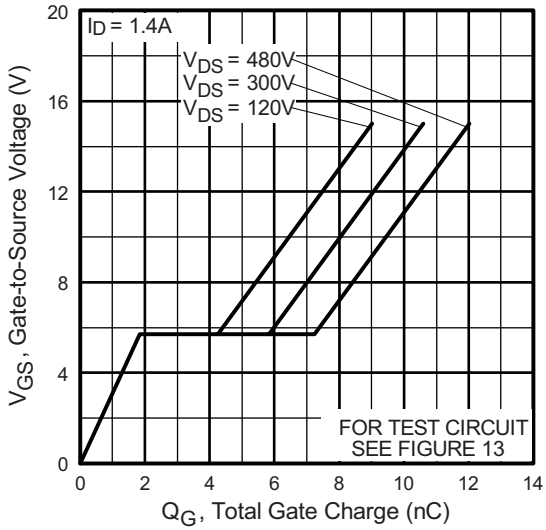


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

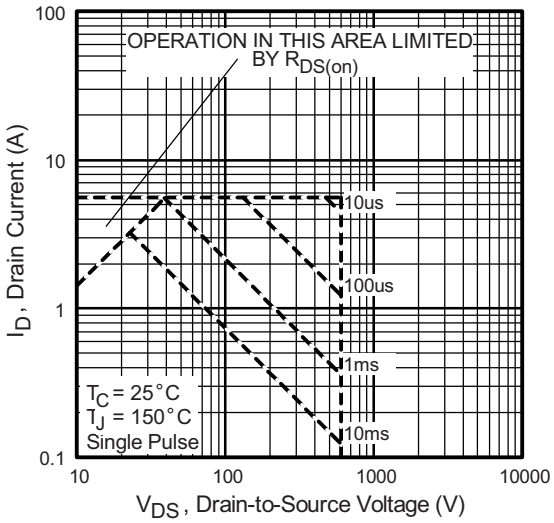


Fig. 8 - Maximum Safe Operating Area

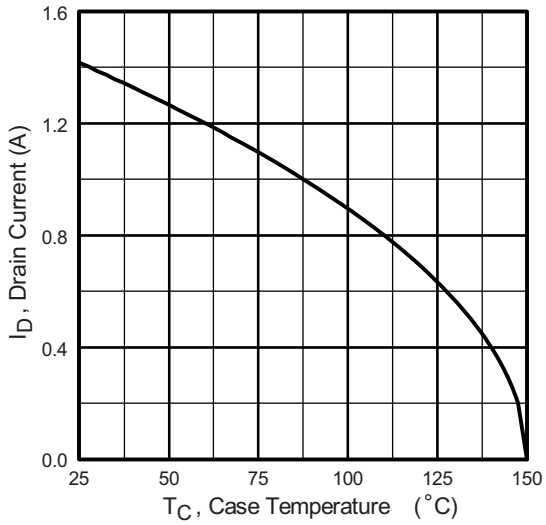


Fig. 9 - Maximum Drain Current vs. Case Temperature

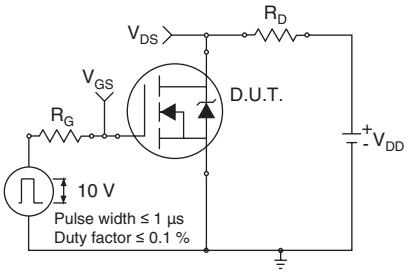


Fig. 10a - Switching Time Test Circuit

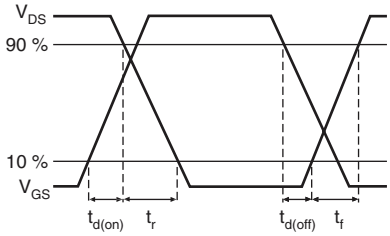


Fig. 10b - Switching Time Waveforms

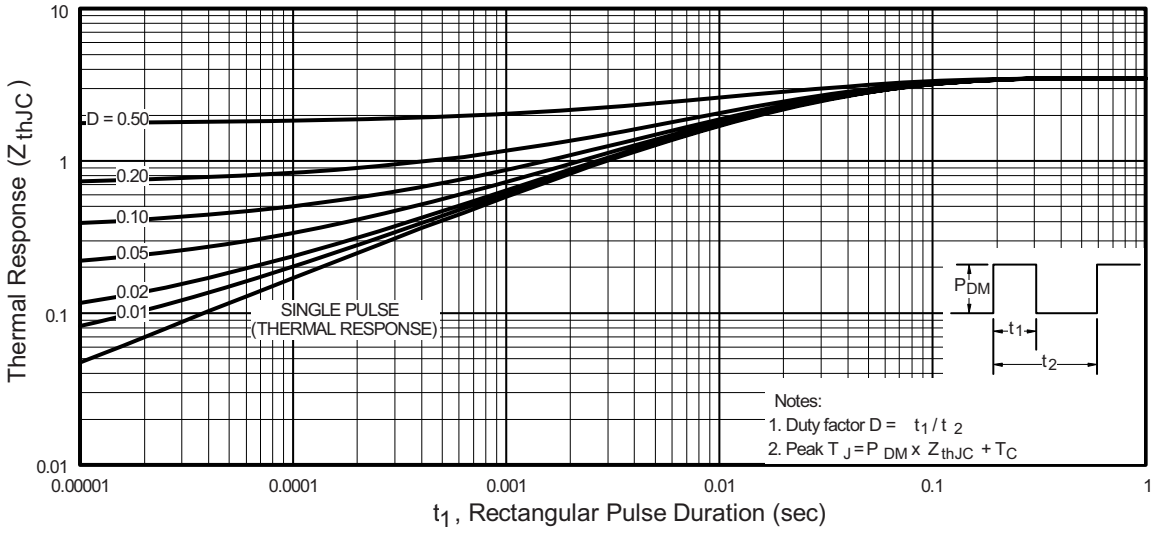


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

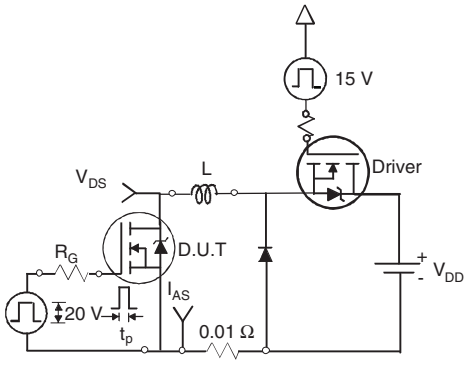


Fig. 12a - Unclamped Inductive Test Circuit

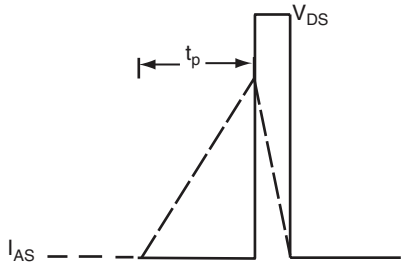


Fig. 12b - Unclamped Inductive Waveforms

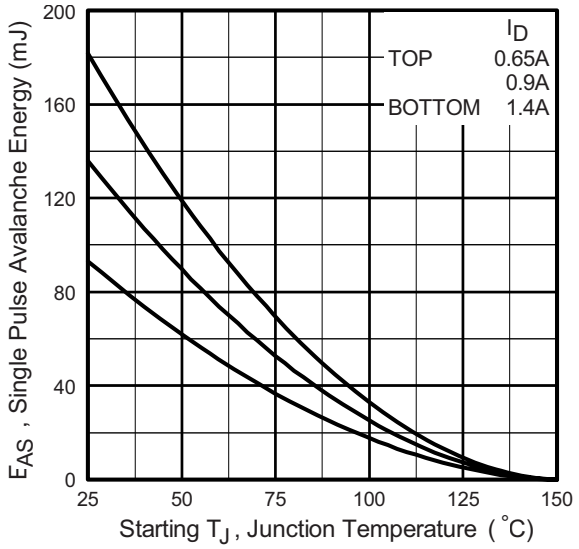


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

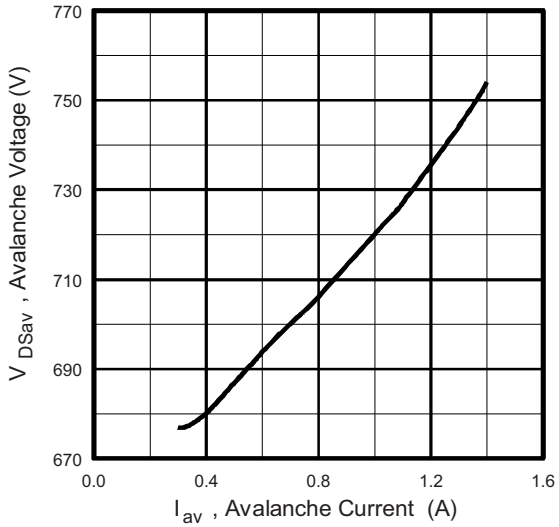


Fig. 12d - Basic Gate Charge Waveform

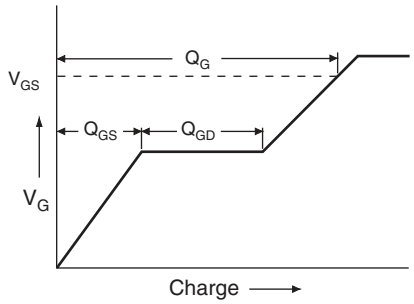


Fig. 13a - Maximum Avalanche Energy vs. Drain Current

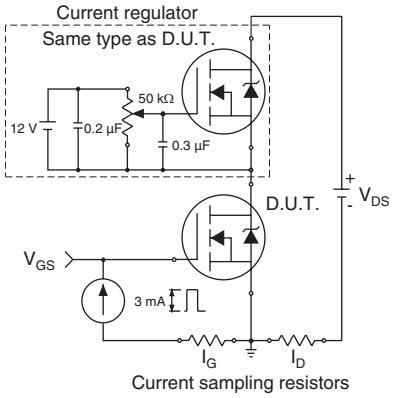
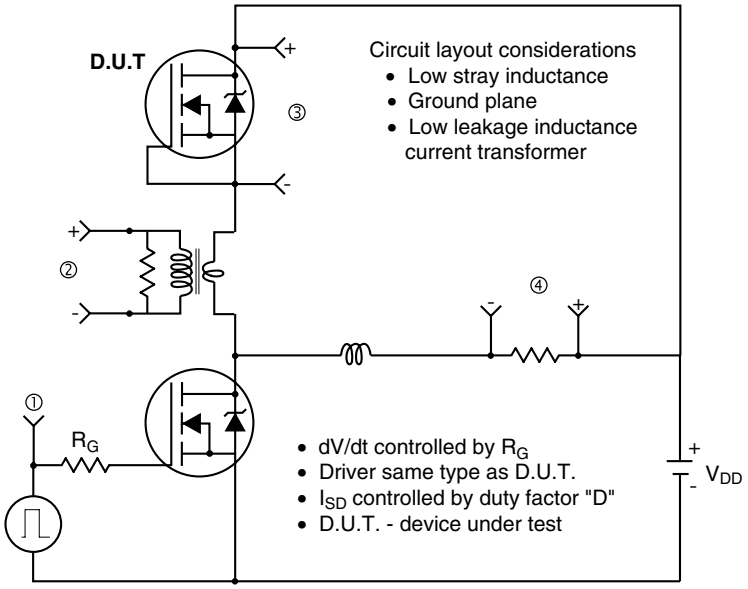
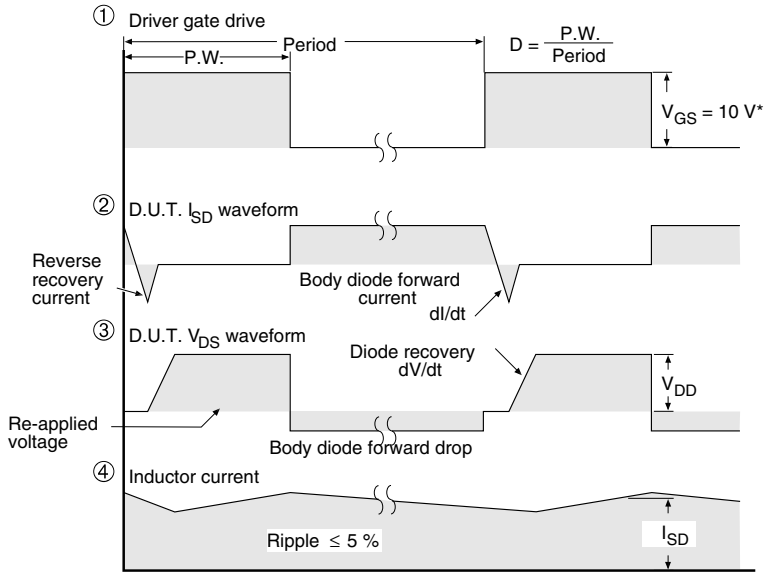


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit





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

Fig. 14 - For N-Channel

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