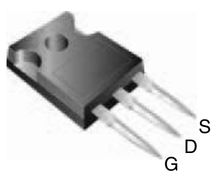
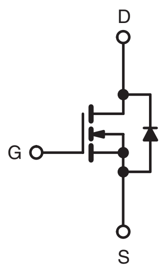
Power MOSFET

PRODUCT SUMMARY		
V_{DS} (V)	500	
$R_{DS(on)}$ (Ω)	V_{GS} = 10 V	0.15
Q_g (Max.) (nC)	210	
Q_{gs} (nC)	58	
Q_{gd} (nC)	100	
Configuration	Single	

TO-247





N-Channel MOSFET

FEATURES

- Super Fast 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

Pb Available
RoHS*
COMPLIANT

APPLICATIONS

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

ORDERING INFORMATION	
Package	TO-247
Lead (Pb)-free	IRFP31N50LPbF
	SiHFP31N50L-E3
SnPb	IRFP31N50L
	SiHFP31N50L

ABSOLUTE MAXIMUM RATINGS T_C = 25 °C, unless otherwise noted					
PARAMETER			SYMBOL	LIMIT	UNIT
Drain-Source Voltage			V_{DS}	500	V
Gate-Source Voltage			V_{GS}	± 30	
Continuous Drain Current	V_{GS} at 10 V	T_C = 25 °C	I_D	31	A
		T_C = 100 °C		20	
Pulsed Drain Current[a]			I_{DM}	124	
Linear Derating Factor				3.7	W/°C
Single Pulse Avalanche Energy[b]			E_{AS}	460	mJ
Repetitive Avalanche Current[a]			I_{AR}	31	A
Repetitive Avalanche Energy[a]			E_{AR}	46	mJ
Maximum Power Dissipation	T_C = 25 °C		P_D	460	W
Peak Diode Recovery dV/dt[c]			dV/dt	19	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]	
Mounting Torque	6-32 or M3 screw			10	lbf · in
				1.1	N · m

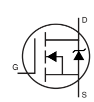
Notes
a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
b. Starting T_J = 25 °C, L = 1 mH, R_G = 25 Ω, I_{AS} = 31 A (see fig. 12).
c. $I_{SD} \leq$ 31 A, dI/dt $\leq$ 422 A/µs, $V_{DD} \leq V_{DS}$, $T_J \leq$ 150 °C.
d. 1.6 mm from case.

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

THERMAL RESISTANCE RATINGS

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	40	°C/W
Case-to-Sink, Flat, Greased Surface	R_{thCS}	0.24	-	
Maximum Junction-to-Case (Drain)	R_{thJC}	-	0.26	

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		500	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, I_D = 1 mA		-	0.28	-	V/°C
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 µA		3.0	-	5.0	V
Gate-Source Leakage	I_{GSS}	V_{GS} = ± 30 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 500 V, V_{GS} = 0 V		-	-	50	µA
		V_{DS} = 400 V, V_{GS} = 0 V, T_J = 125 °C		-	-	2.0	mA
Drain-Source On-State Resistance	$R_{DS(on)}$	V_{GS} = 10 V	I_D = 19 A[b]	-	0.15	0.18	Ω
Forward Transconductance	g_{fs}	V_{DS} = 50 V, I_D = 19 A[b]		15	-	-	S
Dynamic							
Input Capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 25 V, f = 1.0 MHz, see fig. 5		-	5000	-	pF
Output Capacitance	C_{oss}			-	553	-	
Reverse Transfer Capacitance	C_{rss}			-	59	-	
Output Capacitance	C_{oss}	V_{GS} = 0 V	V_{DS} = 1.0 V , f = 1.0 MHz	-	6630	-	
			V_{DS} = 400 V , f = 1.0 MHz	-	155	-	
Effective Output Capacitance	C_{oss} eff.		V_{DS} = 0 V to 400 V[c]	-	276	-	
Effective Output Capacitance	$C_{oss\ eff.\ (ER)}$			-	200	-	
Total Gate Charge	Q_g	V_{GS} = 10 V	I_D = 31 A, V_{DS} = 400 V, see fig. 7 and 13[b]	-	-	210	nC
Gate-Source Charge	Q_{gs}			-	-	58	
Gate-Drain Charge	Q_{gd}			-	-	100	
Internal Gate Resistance	r_G	f = 1 MHz, open drain		-	1.1	-	Ω
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 250 V, I_D = 31 A, R_G = 4.3 Ω, see fig. 10[b]		-	28	-	ns
Rise Time	t_r			-	115	-	
Turn-Off Delay Time	$t_{d(off)}$			-	54	-	
Fall Time	t_f			-	53	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode		-	-	31	A
Pulsed Diode Forward Current[a]	I_{SM}			-	-	124	
Body Diode Voltage	V_{SD}	T_J = 25 °C, I_S = 31 A, V_{GS} = 0 V[b]		-	-	1.5	V
Body Diode Reverse Recovery Time	t_{rr}	T_J = 25 °C, I_F = 31 A		-	170	250	ns
		T_J = 125 °C, dI/dt = 100 A/µs[b]		-	220	330	
Body Diode Reverse Recovery Charge	Q_{rr}	T_J = 25 °C, I_S = 31 A, V_{GS} = 0 V[b]		-	570	860	nC
		T_J = 125 °C, dI/dt = 100 A/µs[b]		-	1.2	1.8	µC
Reverse Recovery Current	I_{RRM}	T_J = 25 °C		-	7.9	12	A
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}.
C_{oss} 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}.

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TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

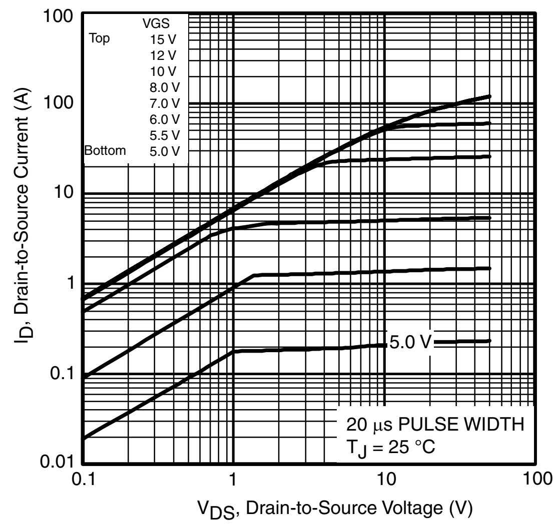


Fig. 1 - Typical Output Characteristics

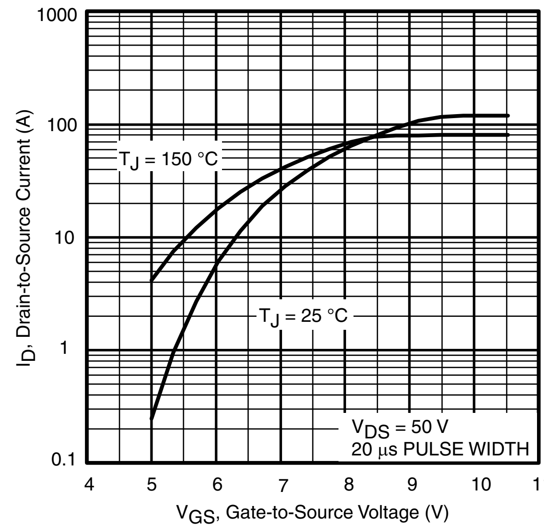


Fig. 3 - Typical Transfer Characteristics

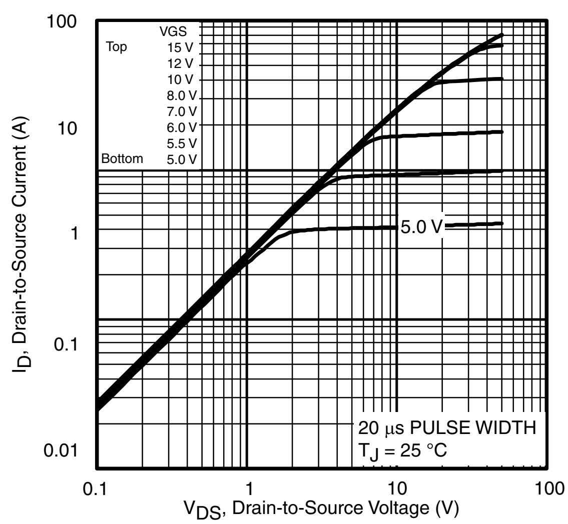


Fig. 2 - Typical Output Characteristics

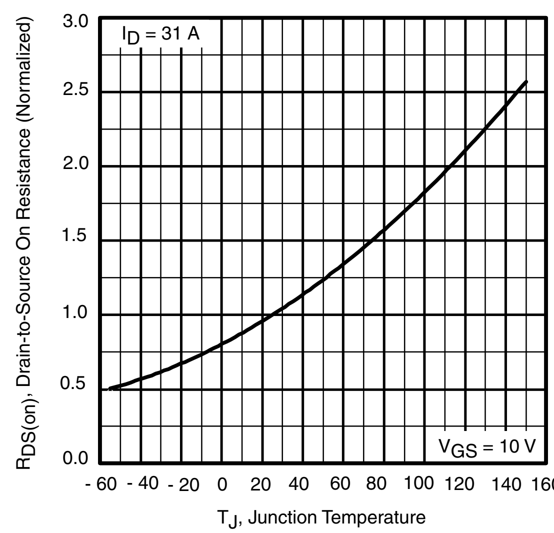


Fig. 4 - Normalized On-Resistance vs. Temperature

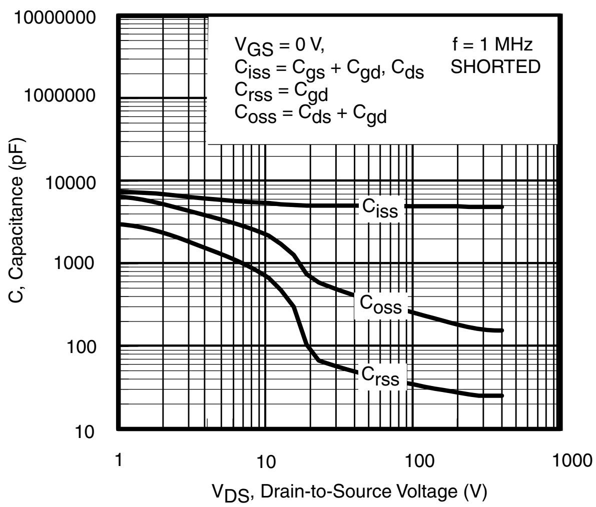


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

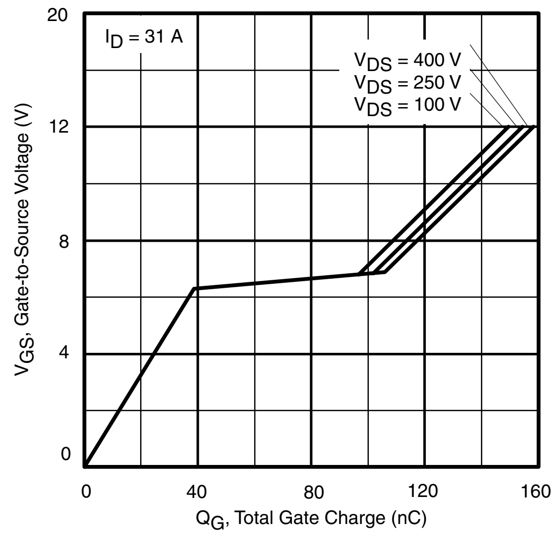


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

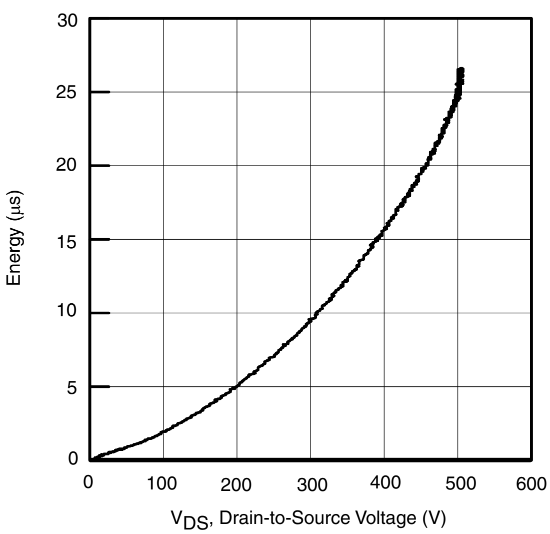


Fig. 6 - Output Capacitance Stored Energy vs. V_{DS}

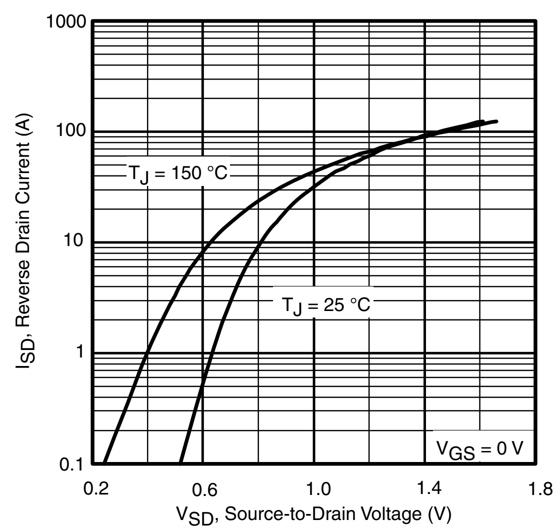


Fig. 8 - Typical Source Drain Diode Forward Voltage

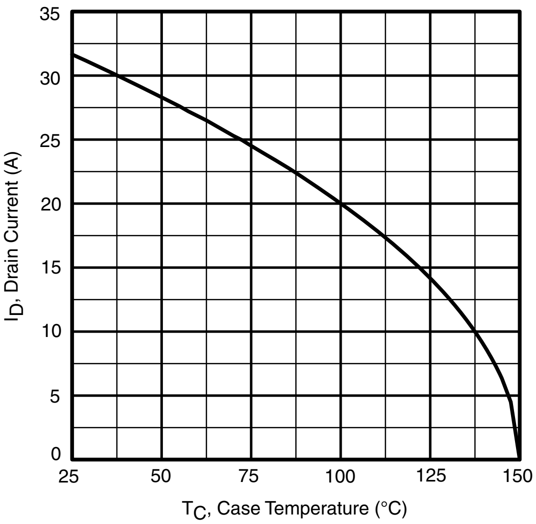


Fig. 9 - Maximum Drain Current vs. Case Temperature

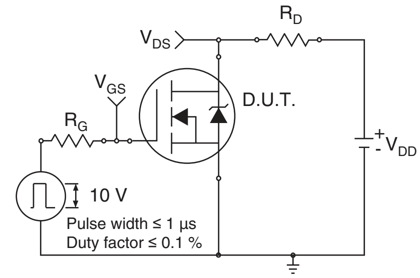


Fig. 10a - Switching Time Test Circuit

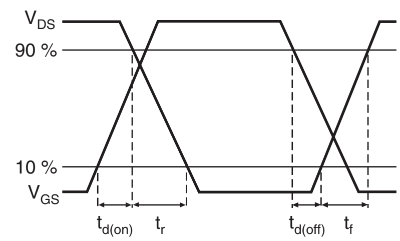


Fig. 10b - Switching Time Waveforms

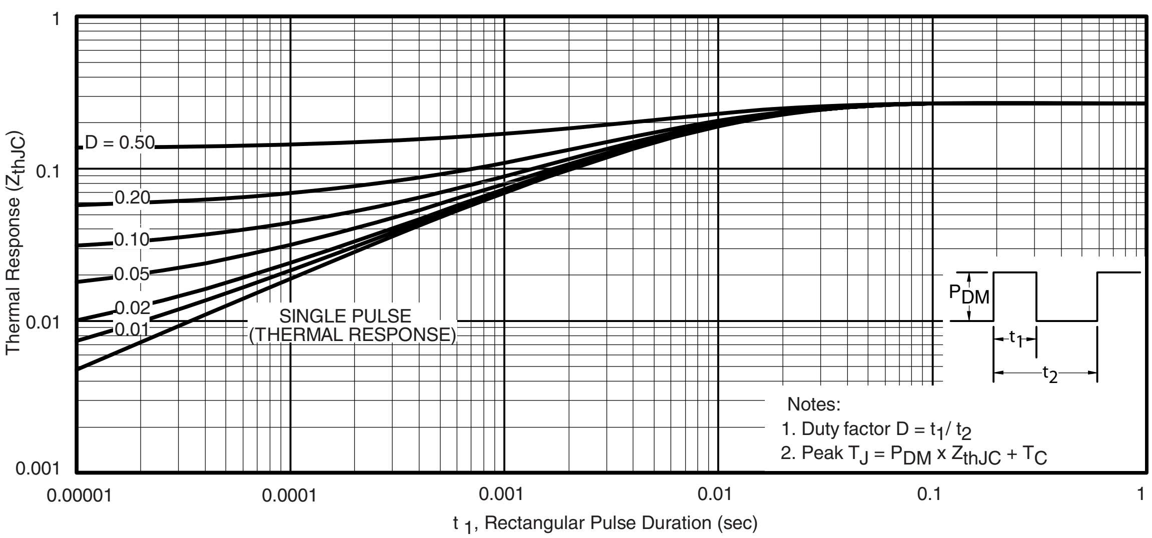


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

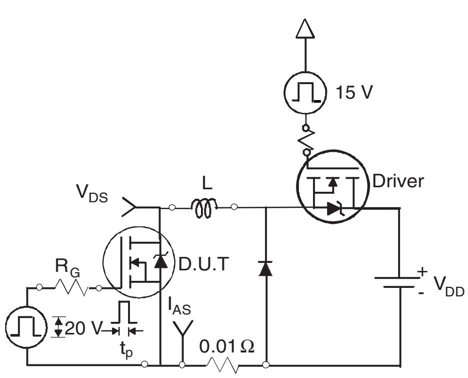


Fig. 12a - Unclamped Inductive Test Circuit

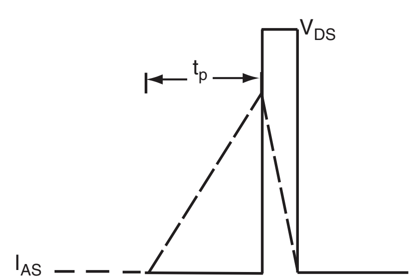


Fig. 12b - Unclamped Inductive Waveforms

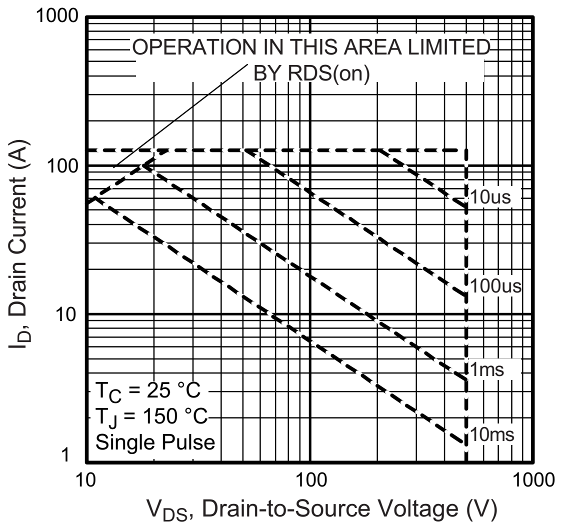


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

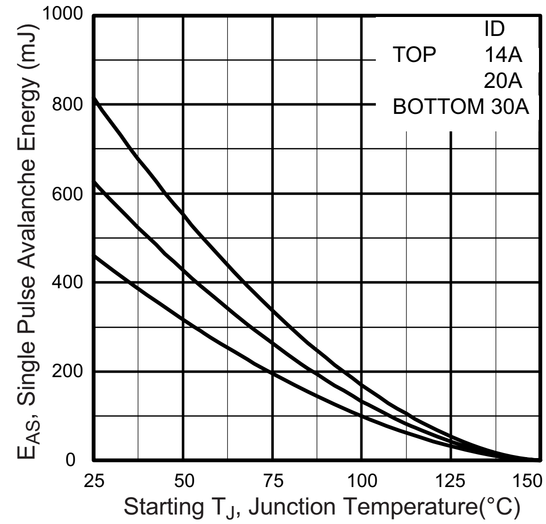


Fig. 12d - Gate Charge Test Circuit

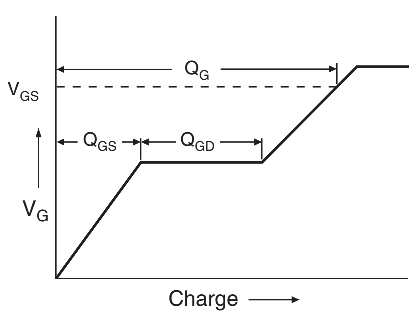


Fig. 13a - Maximum Safe Operating Area

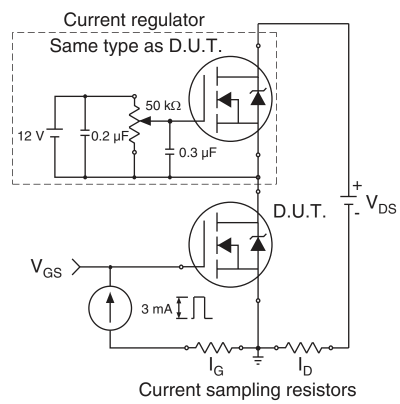
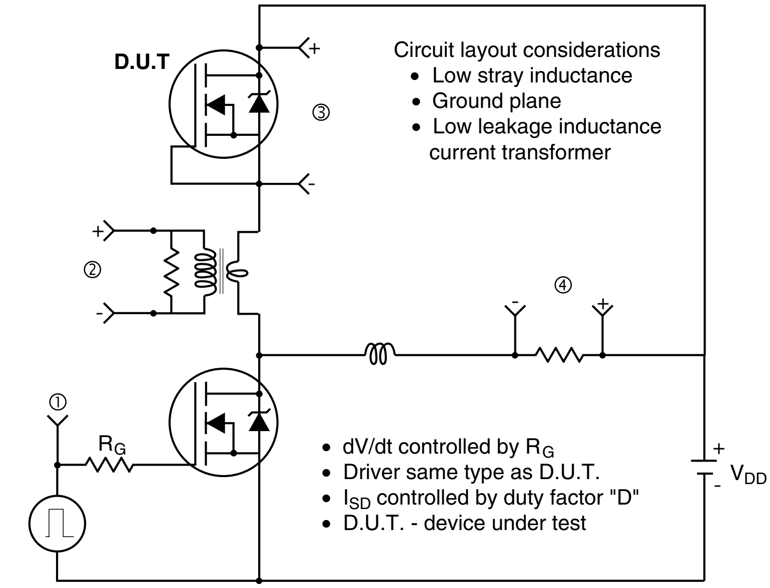
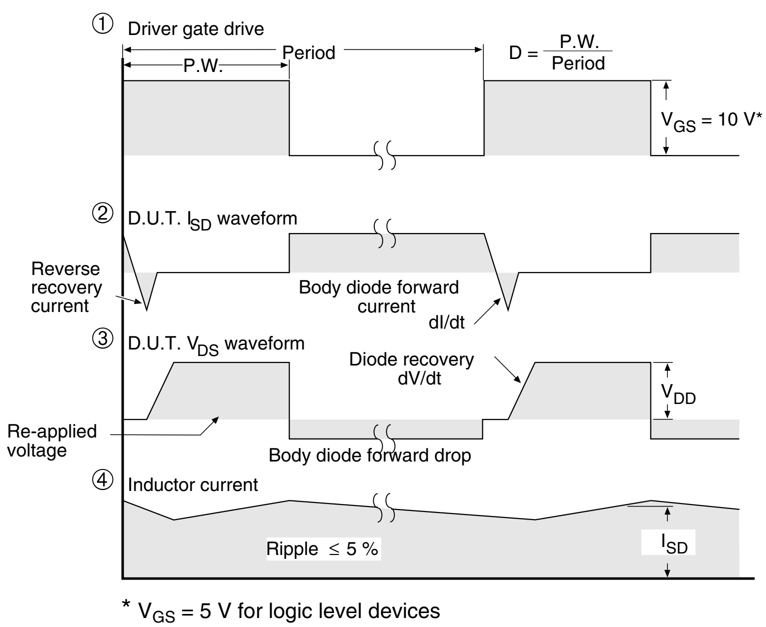


Fig. 13b - Basic Gate Charge Waveform

Peak Diode Recovery dV/dt Test Circuit





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

Fig. 14 - For N-Channel

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