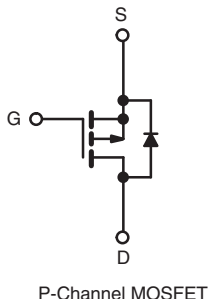
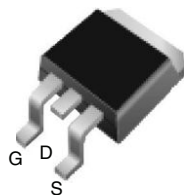


## Power MOSFET

### PRODUCT SUMMARY

$V_{DS}$ (V)	- 100	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = - 10$ V	0.20
$Q_g$ (Max.) (nC)	61	
$Q_{gs}$ (nC)	14	
$Q_{gd}$ (nC)	29	
Configuration	Single	

D<sup>2</sup>PAK (TO-263)



### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- Surface Mount
- Available in Tape and Reel
- Dynamic  $dV/dt$  Rating
- Repetitive Avalanche Rated
- P-Channel
- 175 °C Operating Temperature
- Fast Switching
- Compliant to RoHS Directive 2002/95/EC



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**  
Available

### DESCRIPTION

Third generation Power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The D<sup>2</sup>PAK (TO-263) is a surface mount power package capable of accommodating die sizes up to HEX-4. It provides the highest power capability and the lowest possible on-resistance in any existing surface mount package. The D<sup>2</sup>PAK (TO-263) is suitable for high current applications because of its low internal connection resistance and can dissipate up to 2.0 W in a typical surface mount application.

### ORDERING INFORMATION

Package	D <sup>2</sup> PAK (TO-263)	D <sup>2</sup> PAK (TO-263)
Lead (Pb)-free and Halogen-free	SiHF9540S-GE3	SiHF9540STRL-GE3 <sup>a</sup>
Lead (Pb)-free	IRF9540SPbF	IRF9540STRLPbF <sup>a</sup>
	SiHF9540S-E3	SiHF9540STL-E3 <sup>a</sup>

#### Note

a. See device orientation.

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

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	$V_{DS}$	- 100	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	
Continuous Drain Current	$V_{GS}$ at - 10 V	$T_C = 25$ °C	A
		$T_C = 100$ °C	
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	- 72	W/°C
Linear Derating Factor		1.0	
Linear Derating Factor (PCB Mount) <sup>e</sup>		0.025	
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$	640	mJ
Repetitive Avalanche Current <sup>a</sup>	$I_{AR}$	- 19	A
Repetitive Avalanche Energy <sup>a</sup>	$E_{AR}$	15	mJ
Maximum Power Dissipation	$T_C = 25$ °C	150	W
Maximum Power Dissipation (PCB Mount) <sup>e</sup>		3.7	
Peak Diode Recovery $dV/dt$ <sup>c</sup>	$dV/dt$	- 5.5	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to + 175	°C
Soldering Recommendations (Peak Temperature)	for 10 s	300 <sup>d</sup>	

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = - 25$  V, starting  $T_J = 25$  °C,  $L = 2.7$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = - 19$  A (see fig. 12).
- $I_{SD} \leq - 19$  A,  $dI/dt \leq 200$  A/ $\mu$ s,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 175$  °C.
- 1.6 mm from case.
- When mounted on 1" square PCB (FR-4 or G-10 material)

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

**THERMAL RESISTANCE RATINGS**

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient (PCB Mount) <sup>a</sup>	$R_{thJA}$	-	-	40	°C/W
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	-	1.0	

**Note**

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

**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0, I <sub>D</sub> = - 250 μA		- 100	-	-	V
V <sub>DS</sub> Temperature Coefficient	ΔV <sub>DS</sub> /T <sub>J</sub>	Reference to 25 °C, I <sub>D</sub> = - 1 mA		-	- 0.087	-	V/°C
Gate-Source Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = - 250 μA		- 2.0	-	- 4.0	V
Gate-Source Leakage	I <sub>GSS</sub>	V <sub>GS</sub> = ± 20 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = - 100 V, V <sub>GS</sub> = 0 V		-	-	- 100	μA
		V <sub>DS</sub> = - 80 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150 °C		-	-	- 500	
Drain-Source On-State Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = - 10 V	I <sub>D</sub> = - 11 A <sup>b</sup>	-	-	0.20	Ω
Forward Transconductance	g <sub>fs</sub>	V <sub>DS</sub> = - 50 V, I <sub>D</sub> = - 11 A		6.2	-	-	S
Dynamic							
Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = - 25 V, f = 1.0 MHz, see fig. 5		-	1400	-	pF
Output Capacitance	C <sub>oss</sub>			-	590	-	
Reverse Transfer Capacitance	C <sub>rss</sub>			-	140	-	
Total Gate Charge	Q <sub>g</sub>	V <sub>GS</sub> = - 10 V	I <sub>D</sub> = - 19 A, V <sub>DS</sub> = - 80 V, see fig. 6 and 13 <sup>b</sup>	-	-	61	nC
Gate-Source Charge	Q <sub>gs</sub>			-	-	14	
Gate-Drain Charge	Q <sub>gd</sub>			-	-	29	
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = - 50 V, I <sub>D</sub> = - 19 A, R <sub>G</sub> = 9.1 Ω, R <sub>D</sub> = 2.4 Ω, see fig. 10 <sup>b</sup>		-	16	-	ns
Rise Time	t <sub>r</sub>			-	73	-	
Turn-Off Delay Time	t <sub>d(off)</sub>			-	34	-	
Fall Time	t <sub>f</sub>			-	57	-	
Internal Drain Inductance	L <sub>D</sub>	Between lead, 6 mm (0.25") from package and center of die contact		-	4.5	-	nH
Internal Source Inductance	L <sub>S</sub>			-	7.5	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I <sub>S</sub>	MOSFET symbol showing the integral reverse p - n junction diode		-	-	- 19	A
Pulsed Diode Forward Current <sup>a</sup>	I <sub>SM</sub>			-	-	- 72	
Body Diode Voltage	V <sub>SD</sub>	T <sub>J</sub> = 25 °C, I <sub>S</sub> = - 19 A, V <sub>GS</sub> = 0 V <sup>b</sup>		-	-	- 5.0	V
Body Diode Reverse Recovery Time	t <sub>rr</sub>	T <sub>J</sub> = 25 °C, I <sub>F</sub> = - 19 A, dI/dt = 100 A/μs <sup>b</sup>		-	130	260	ns
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>			-	0.35	0.70	nC
Forward Turn-On Time	t <sub>on</sub>	Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> and L <sub>D</sub> )					

**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  $\leq 2\%$ .

## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

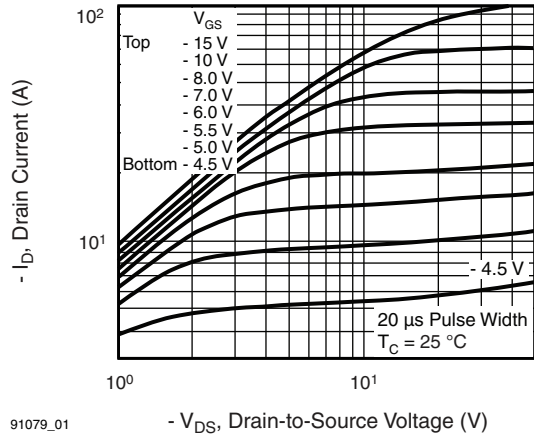


Fig. 1 - Typical Output Characteristics,  $T_C = 25^\circ\text{C}$

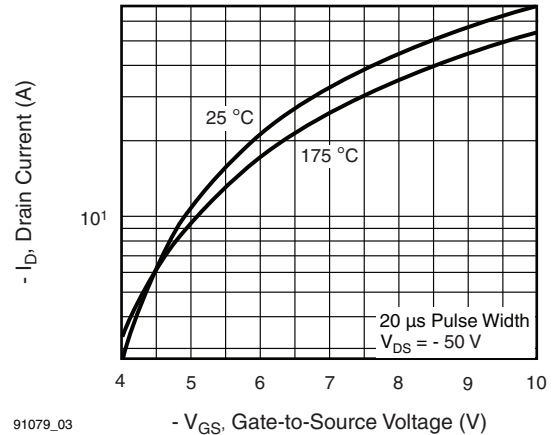


Fig. 3 - Typical Transfer Characteristics

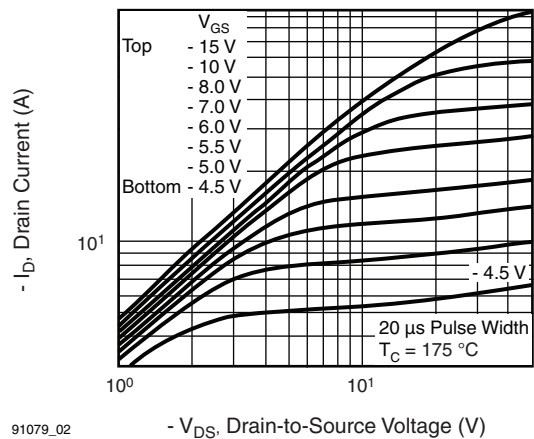


Fig. 2 - Typical Output Characteristics,  $T_C = 175^\circ\text{C}$

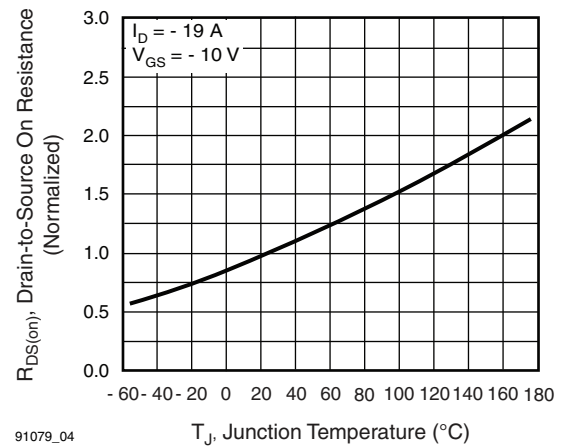
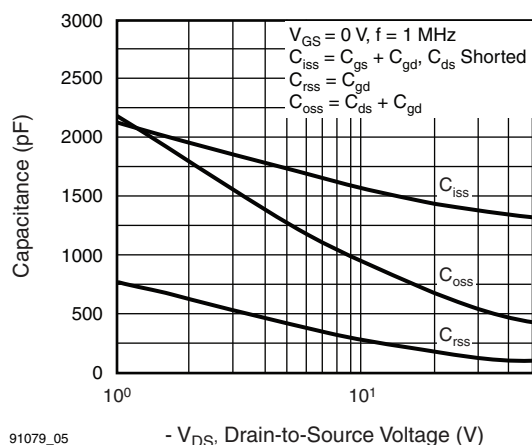
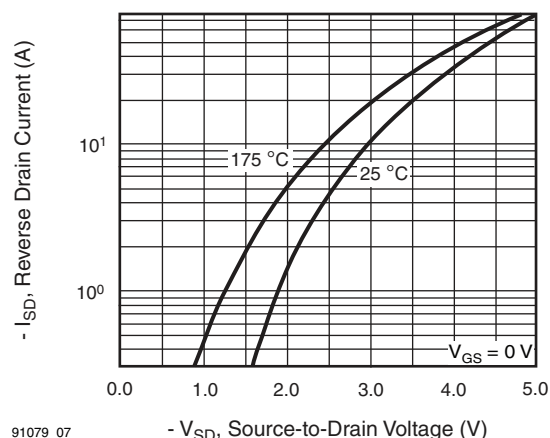


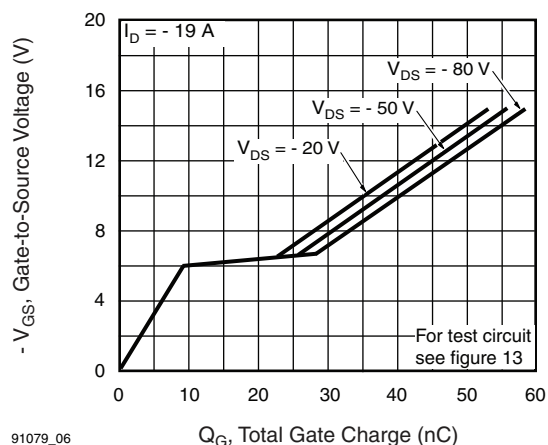
Fig. 4 - Normalized On-Resistance vs. Temperature



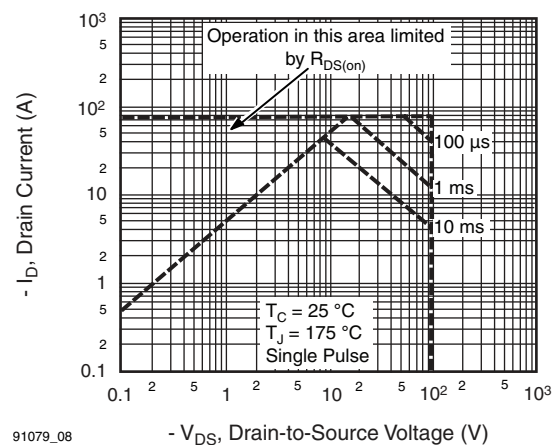
**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**



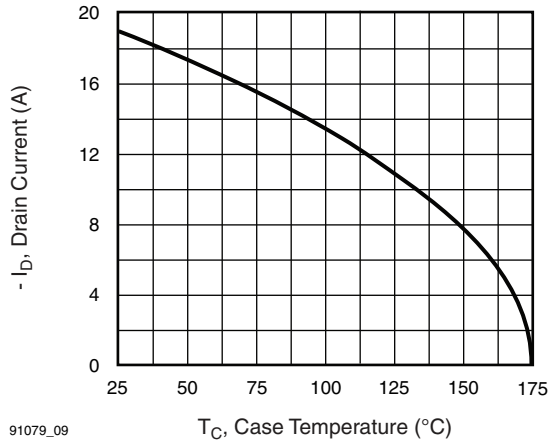
**Fig. 7 - Typical Source-Drain Diode Forward Voltage**



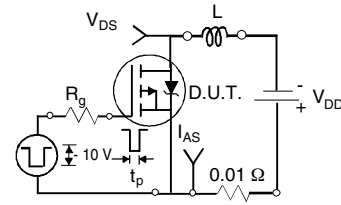
**Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage**



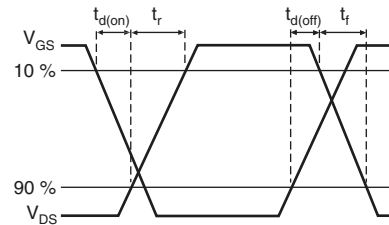
**Fig. 8 - Maximum Safe Operating Area**



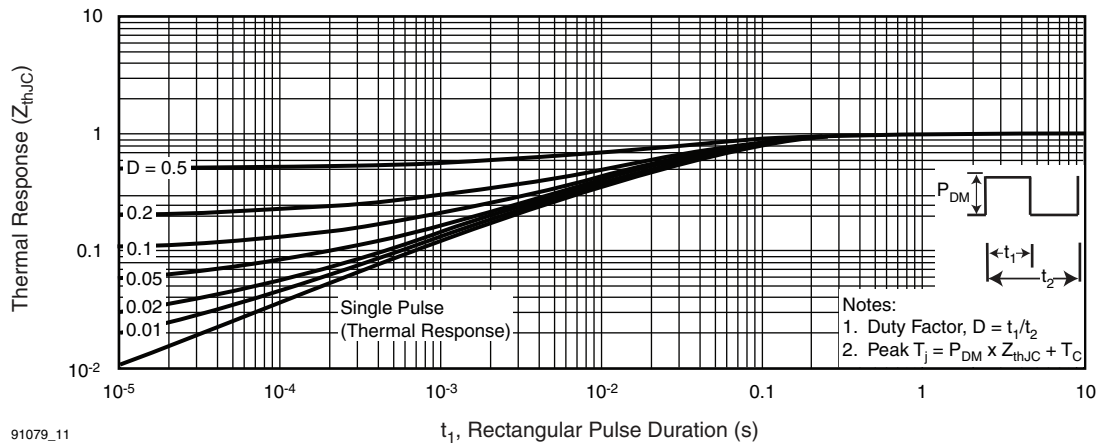
**Fig. 9 - Maximum Drain Current vs. Case Temperature**



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



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



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

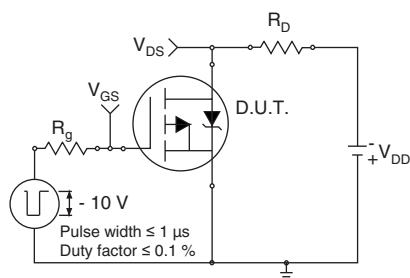


Fig. 12a - Unclamped Inductive Test Circuit

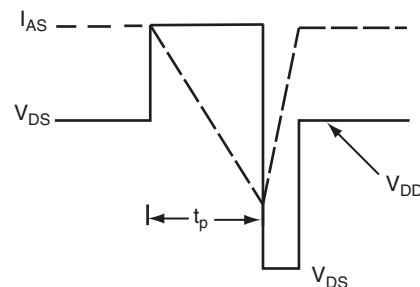


Fig. 12b - Unclamped Inductive Waveforms

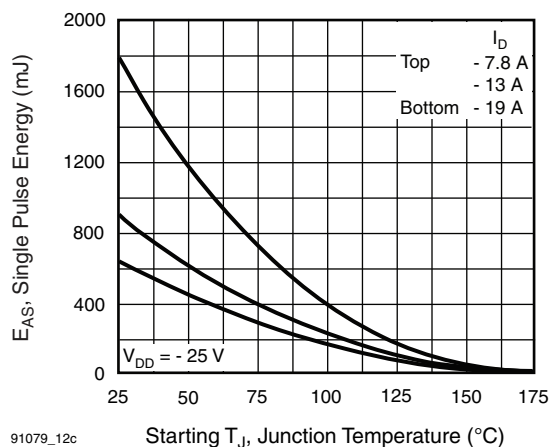


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

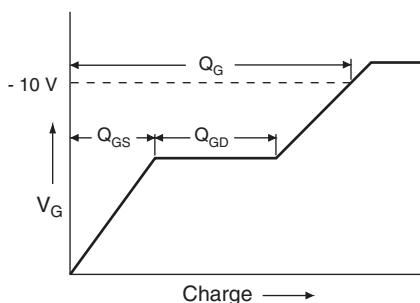


Fig. 13a - Basic Gate Charge Waveform

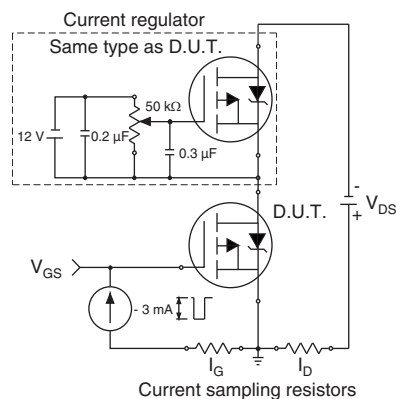
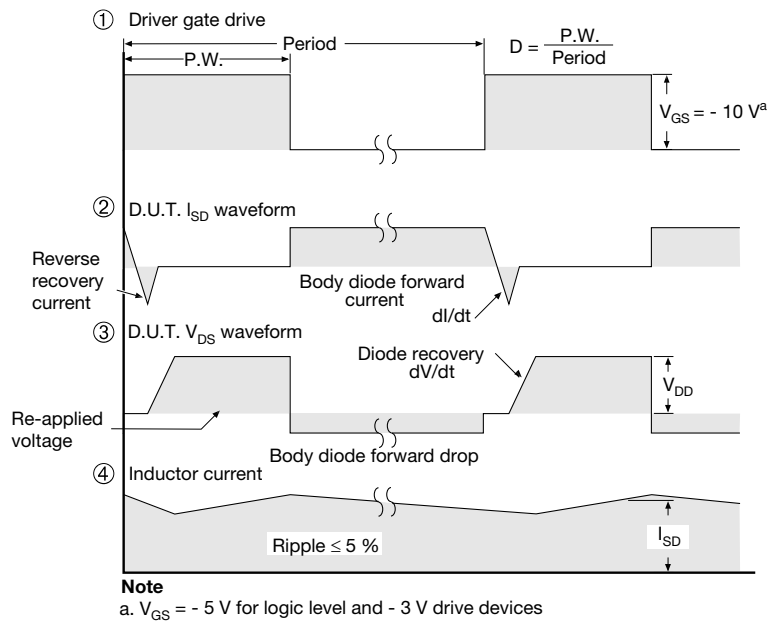
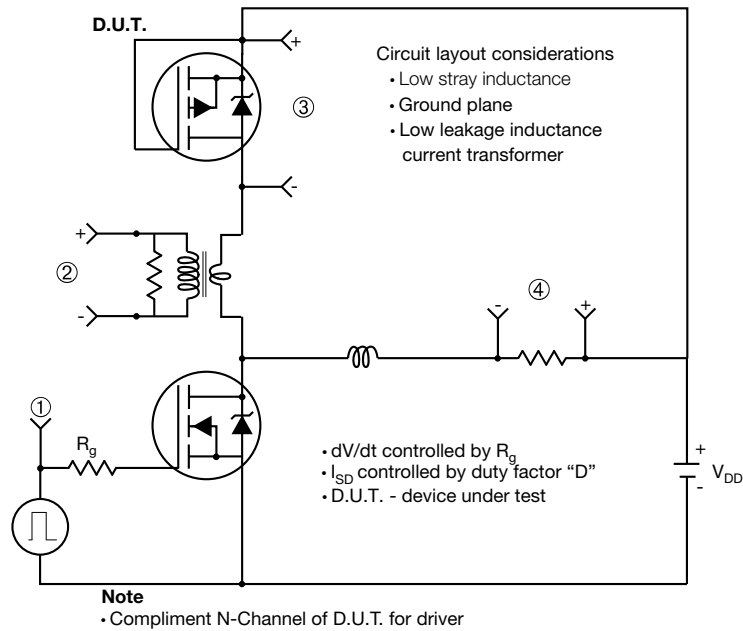


Fig. 13b - Gate Charge Test Circuit

## Peak Diode Recovery dV/dt Test Circuit



**Fig. 14 - For P-Channel**

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	MILLIMETERS		INCHES	
DIM.	MIN.	MAX.	MIN.	MAX.
D1	6.86	-	0.270	-
E	9.65	10.67	0.380	0.420
E1	6.22	-	0.245	-
e	2.54 BSC		0.100 BSC	
H	14.61	15.88	0.575	0.625
L	1.78	2.79	0.070	0.110
L1	-	1.65	-	0.066
L2	-	1.78	-	0.070
L3	0.25 BSC		0.010 BSC	
L4	4.78	5.28	0.188	0.208





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