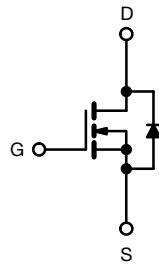
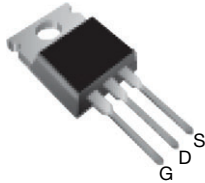




**THE DATASHEET OF  
SIHP35N60EF-GE3**



## EF Series Power MOSFET With Fast Body Diode

**TO-220AB**


N-Channel MOSFET

### FEATURES

- A specific on resistance ( $m\Omega\text{-cm}^2$ ) reduction of 25 %
- Low figure-of-merit (FOM)  $R_{\text{on}} \times Q_g$
- Low input capacitance ( $C_{\text{iss}}$ )
- Reduced switching and conduction losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
 COMPLIANT  
 HALOGEN  
**FREE**

### PRODUCT SUMMARY

$V_{\text{DS}}$ (V) at $T_J$ max.	650	
$R_{\text{DS(on)}}$ typ. ( $\Omega$ ) at 25 °C	$V_{\text{GS}} = 10$ V	0.084
$Q_g$ max. (nC)	134	
$Q_{\text{gs}}$ (nC)	16	
$Q_{\text{gd}}$ (nC)	48	
Configuration	Single	

### APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Industrial
  - Welding
  - Induction heating
  - Motor drives
  - Battery chargers
  - Renewable energy
  - Solar (PV inverters)

### ORDERING INFORMATION

Package	TO-220AB
Lead (Pb)-free and halogen-free	SiHP35N60EF-GE3

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


PARAMETER	SYMBOL	LIMIT	UNIT
Drain-source voltage	$V_{\text{DS}}$	600	V
Gate-source voltage	$V_{\text{GS}}$	$\pm 30$	
Continuous drain current ( $T_J = 150$ °C)	$V_{\text{GS}}$ at 10 V	$T_C = 25$ °C	A
		$T_C = 100$ °C	
Pulsed drain current <sup>a</sup>	$I_{\text{DM}}$	80	
Linear derating factor		2.0	W/°C
Single pulse avalanche energy <sup>b</sup>	$E_{\text{AS}}$	298	mJ
Maximum power dissipation	$P_D$	250	W
Operating junction and storage temperature range	$T_J, T_{\text{stg}}$	-55 to +150	°C
Drain-source voltage slope	$dv/dt$	$T_J = 125$ °C	V/ns
Reverse diode $dv/dt$ <sup>d</sup>			
Soldering recommendations (peak temperature) <sup>c</sup>	For 10 s	260	°C

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{\text{DD}} = 140$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{\text{AS}} = 4.6$  A
- 1.6 mm from case
- $I_{\text{SD}} = 17$  A,  $di/dt = 300$  A/ $\mu$ s, starting  $T_J = 25$  °C



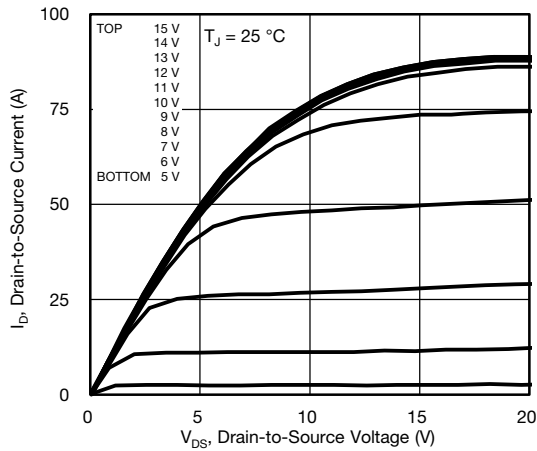
THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	R <sub>thJA</sub>	-	62	°C/W
Maximum junction-to-case (drain)	R <sub>thJC</sub>	-	0.5	

SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Drain-source breakdown voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA		600	-	-	V
V <sub>DS</sub> temperature coefficient	ΔV <sub>DS</sub> /T <sub>J</sub>	Reference to 25 °C, I <sub>D</sub> = 10 mA		-	0.66	-	V/°C
Gate-source threshold voltage (N)	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
		V <sub>GS</sub> = ± 30 V		-	-	± 1	μA
Zero gate voltage drain current	I <sub>DSS</sub>	V <sub>DS</sub> = 480 V, V <sub>GS</sub> = 0 V		-	-	1	μA
		V <sub>DS</sub> = 480 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C		-	-	500	
Drain-source on-state resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V	I <sub>D</sub> = 17 A	-	0.084	0.097	Ω
Forward transconductance <sup>a</sup>	g <sub>fs</sub>	V <sub>DS</sub> = 30 V, I <sub>D</sub> = 17 A		-	8	-	S
<b>Dynamic</b>							
Input capacitance	C <sub>iSS</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 100 V, f = 1 MHz		-	2568	-	pF
Output capacitance	C <sub>oss</sub>			-	113	-	
Reverse transfer capacitance	C <sub>rSS</sub>			-	7	-	
Effective output capacitance, energy related <sup>a</sup>	C <sub>o(er)</sub>			-	81	-	
Effective output capacitance, time related <sup>b</sup>	C <sub>o(tr)</sub>	V <sub>DS</sub> = 0 V to 480 V, V <sub>GS</sub> = 0 V		-	421	-	
Total gate charge	Q <sub>g</sub>	V <sub>GS</sub> = 10 V	I <sub>D</sub> = 17 A, V <sub>DS</sub> = 480 V	-	89	134	nC
Gate-source charge	Q <sub>gs</sub>			-	16	-	
Gate-drain charge	Q <sub>gd</sub>			-	48	-	
Turn-on delay time	t <sub>d(on)</sub>	V <sub>DD</sub> = 480 V, I <sub>D</sub> = 17 A, V <sub>GS</sub> = 10 V, R <sub>g</sub> = 9.1 Ω		-	28	56	ns
Rise time	t <sub>r</sub>			-	85	170	
Turn-off delay time	t <sub>d(off)</sub>			-	96	192	
Fall time	t <sub>f</sub>			-	61	122	
Gate input resistance	R <sub>g</sub>			f = 1 MHz, open drain		0.2	
<b>Drain-Source Body Diode Characteristics</b>							
Continuous source-drain diode current	I <sub>S</sub>	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	32	A
Pulsed diode forward current	I <sub>SM</sub>			-	-	80	
Diode forward voltage	V <sub>SD</sub>	T <sub>J</sub> = 25 °C, I <sub>S</sub> = 17 A, V <sub>GS</sub> = 0 V		-	-	1.2	V
Reverse recovery time	t <sub>rr</sub>	T <sub>J</sub> = 25 °C, I <sub>F</sub> = I <sub>S</sub> = 17 A, di/dt = 100 A/μs, V <sub>R</sub> = 400 V		-	150	300	ns
Reverse recovery charge	Q <sub>rr</sub>			-	1.1	2.2	μC
Reverse recovery current	I <sub>RRM</sub>			-	14	-	A

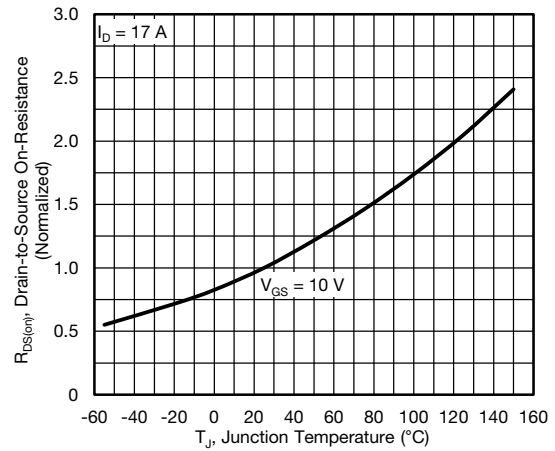
**Notes**

- a. C<sub>oss(er)</sub> is a fixed capacitance that gives the same energy as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 % to 80 % V<sub>DSS</sub>
- b. C<sub>oss(tr)</sub> is a fixed capacitance that gives the same charging time as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 % to 80 % V<sub>DSS</sub>

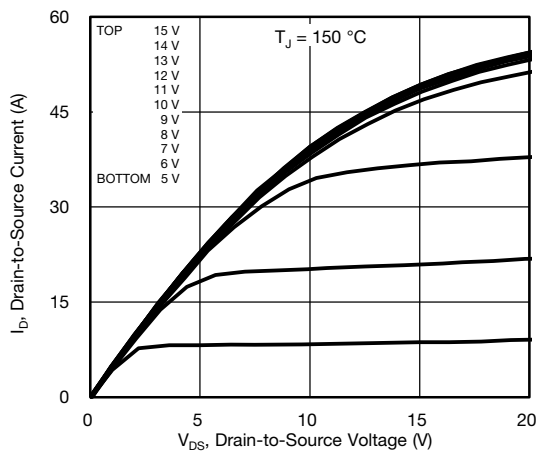
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



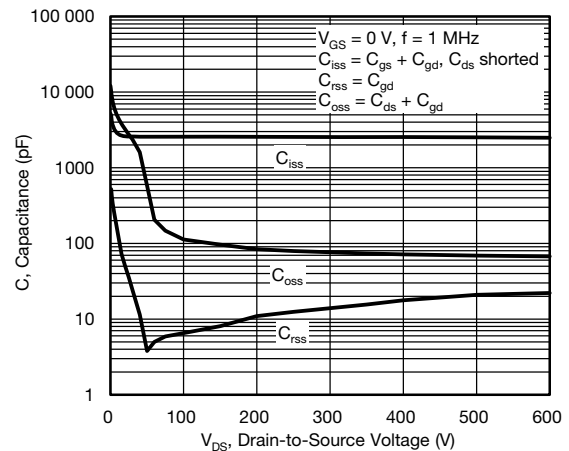
**Fig. 1 - Typical Output Characteristics**



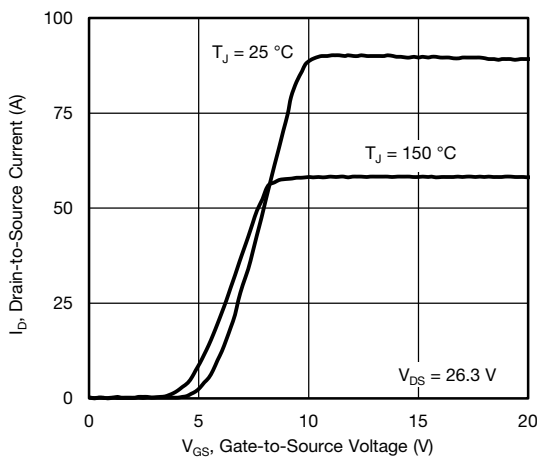
**Fig. 4 - Normalized On-Resistance vs. Temperature**



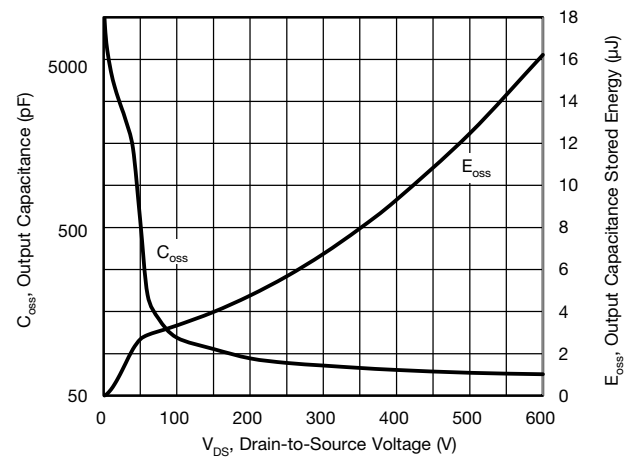
**Fig. 2 - Typical Output Characteristics**



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



**Fig. 3 - Typical Transfer Characteristics**



**Fig. 6 - C<sub>oss</sub> and E<sub>oss</sub> vs. V<sub>DS</sub>**

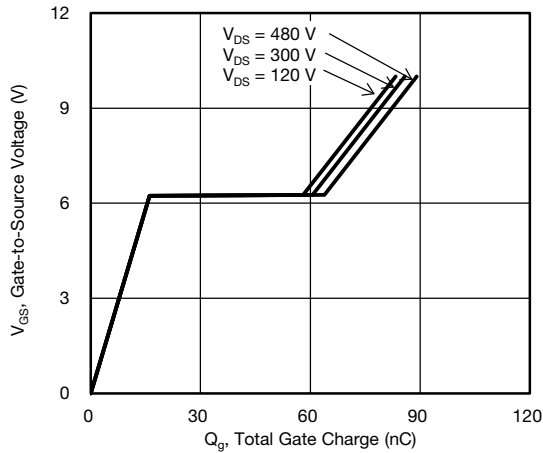


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

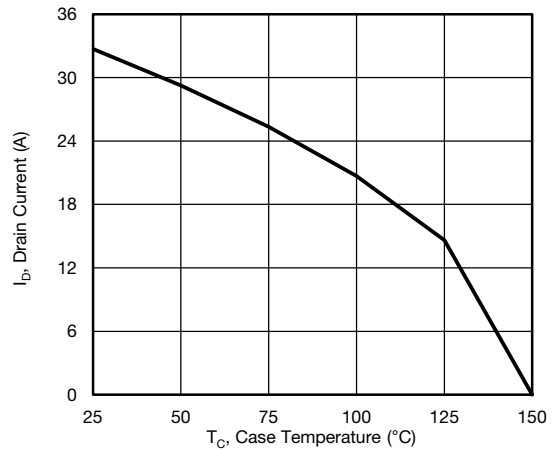


Fig. 10 - Maximum Drain Current vs. Case Temperature

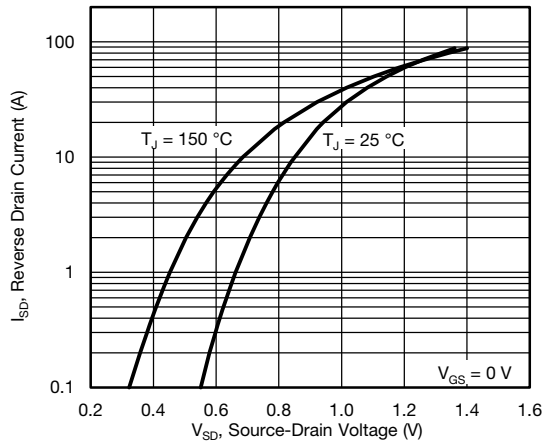


Fig. 8 - Typical Source-Drain Diode Forward Voltage

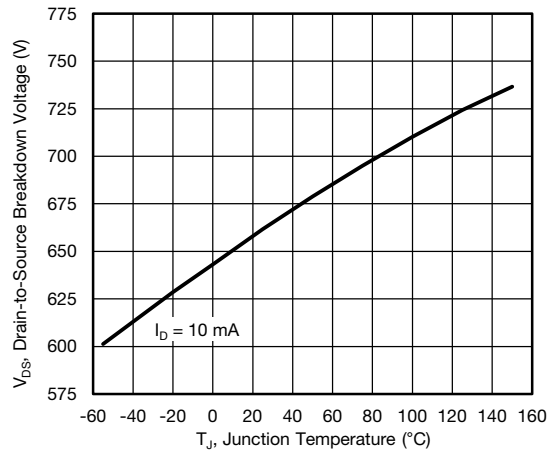


Fig. 11 - Temperature vs. Drain-to-Source Voltage

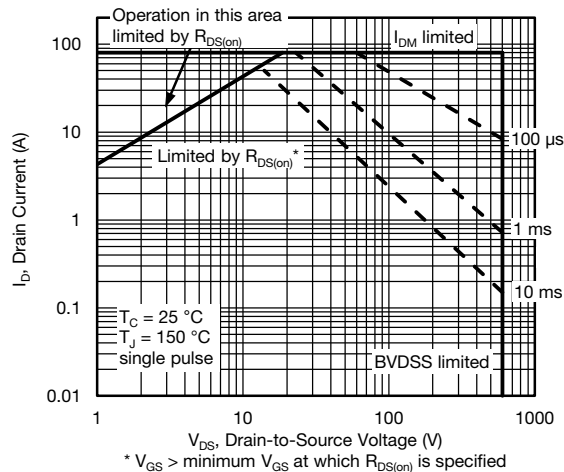


Fig. 9 - Maximum Safe Operating Area

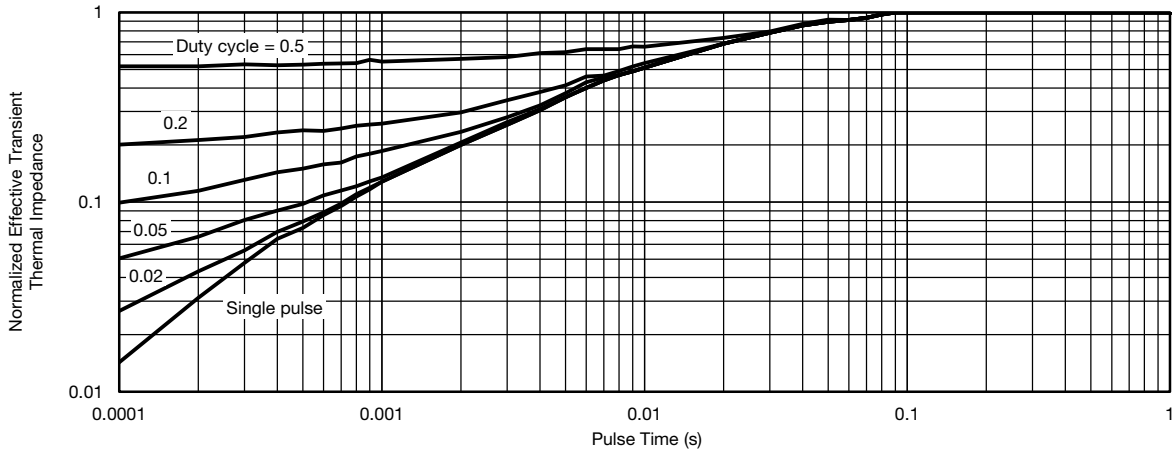


Fig. 12 - Normalized Transient Thermal Impedance, Junction-to-Case

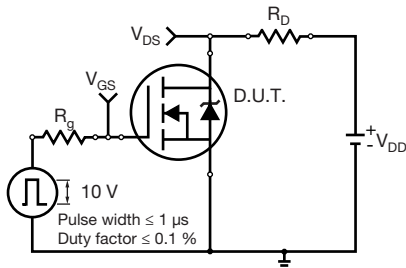


Fig. 13 - Switching Time Test Circuit

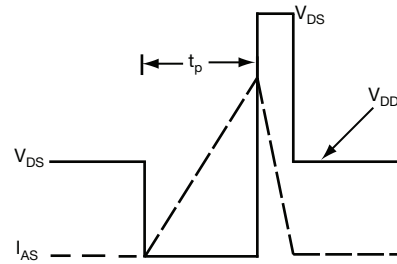


Fig. 16 - Unclamped Inductive Waveforms

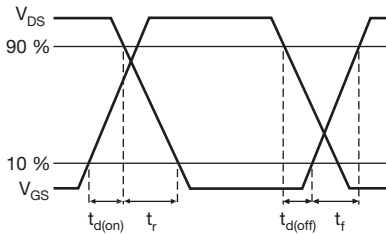


Fig. 14 - Switching Time Waveforms

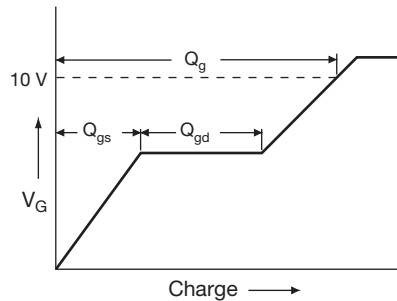


Fig. 17 - Basic Gate Charge Waveform

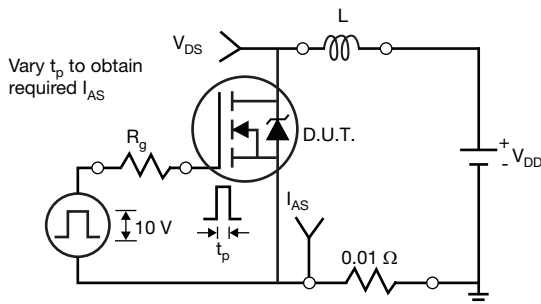


Fig. 15 - Unclamped Inductive Test Circuit

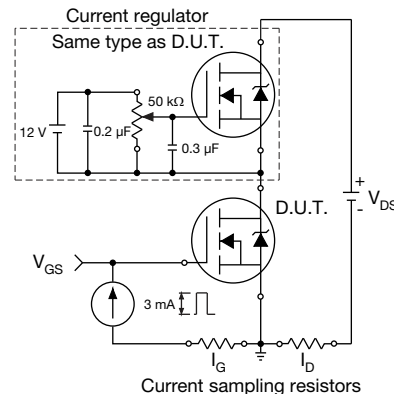
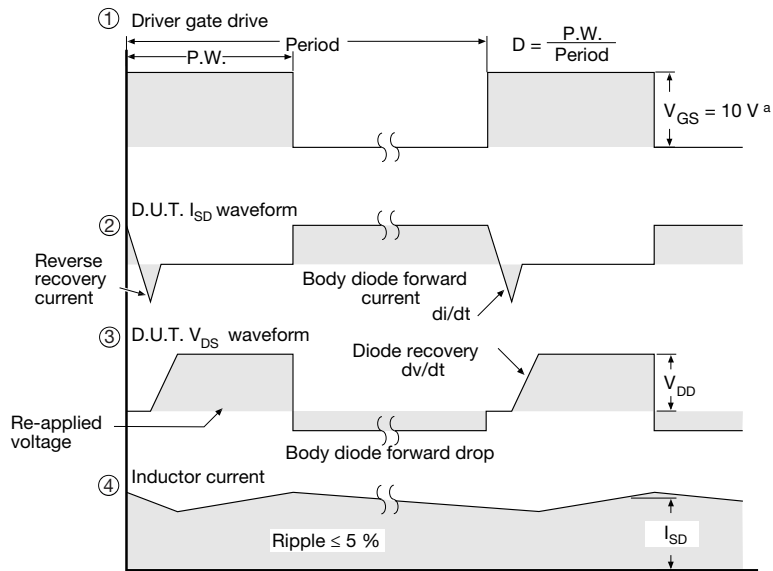
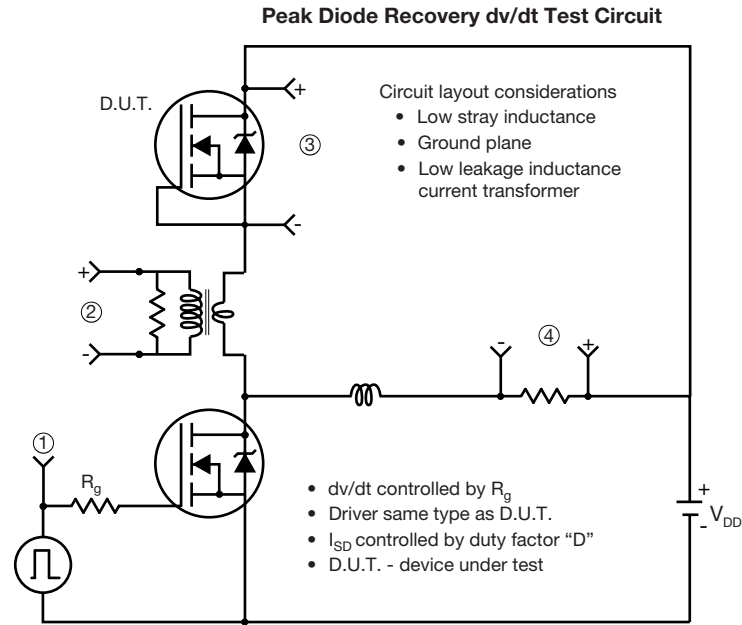


Fig. 18 - Gate Charge Test Circuit



**Note**  
a.  $V_{GS} = 5\text{ V}$  for logic level devices

**Fig. 19 - For N-Channel**

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*Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see [www.vishay.com/ppg?92107](http://www.vishay.com/ppg?92107).*



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