

# Power MOSFET

**TO-220AB**


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
- Effective  $C_{oss}$  specified
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS\***  
Available

## Note

\* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

## APPLICATIONS

- Switch mode power supply (SMPS)
- Uninterruptable power supply
- High speed power switching

## TYPICAL SMPS TOPOLOGIES

- Two transistor forward
- Half bridge
- Full bridge

## PRODUCT SUMMARY

$V_{DS}$ (V)	500	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10\text{ V}$	0.85
$Q_g$ max. (nC)	38	
$Q_{gs}$ (nC)	9.0	
$Q_{gd}$ (nC)	18	
Configuration	Single	

## ORDERING INFORMATION

Package	TO-220AB
Lead (Pb)-free	IRF840APbF
Lead (Pb)-free and halogen-free	IRF840APbF-BE3

## ABSOLUTE MAXIMUM RATINGS ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted)

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-source voltage	$V_{DS}$	500	V
Gate-source voltage	$V_{GS}$	$\pm 30$	
Continuous drain current	$V_{GS}$ at 10 V	$T_C = 25\text{ }^\circ\text{C}$	A
		$T_C = 100\text{ }^\circ\text{C}$	
Pulsed drain current <sup>a</sup>	$I_{DM}$	32	
Linear derating factor		1.0	W/ $^\circ\text{C}$
Single pulse avalanche energy <sup>b</sup>	$E_{AS}$	510	mJ
Repetitive avalanche current <sup>a</sup>	$I_{AR}$	8.0	A
Repetitive avalanche energy <sup>a</sup>	$E_{AR}$	13	mJ
Maximum power dissipation	$P_D$	125	W
Peak diode recovery $dV/dt$ <sup>c</sup>	$dV/dt$	5.0	V/ns
Operating junction and storage temperature range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$
Soldering recommendations (peak temperature) <sup>d</sup>	For 10 s	300	
Mounting torque	6-32 or M3 screw	10	
		1.1	N · m


## Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- $V_{DD} = 50\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 16\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 8.0\text{ A}$  (see fig. 12)
- $I_{SD} \leq 8.0\text{ A}$ ,  $dI/dt \leq 100\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^\circ\text{C}$
- 1.6 mm from case

**THERMAL RESISTANCE RATINGS**

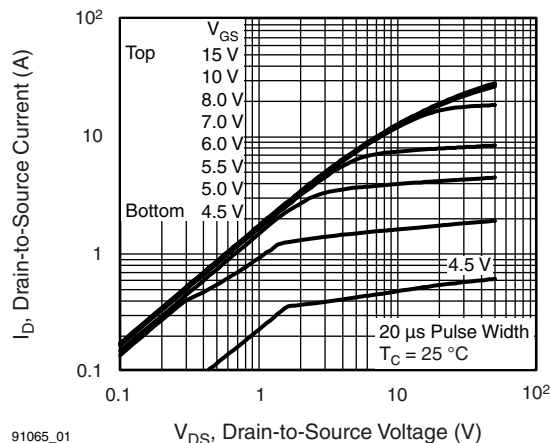
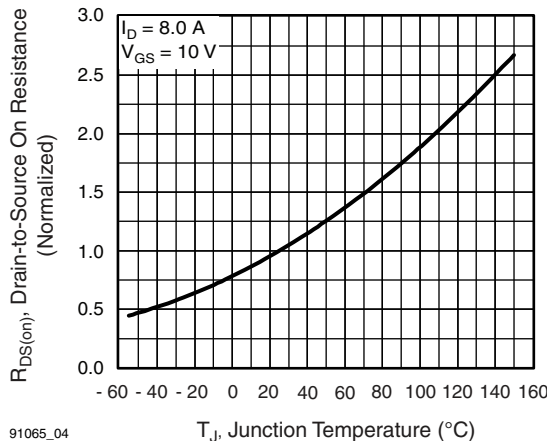
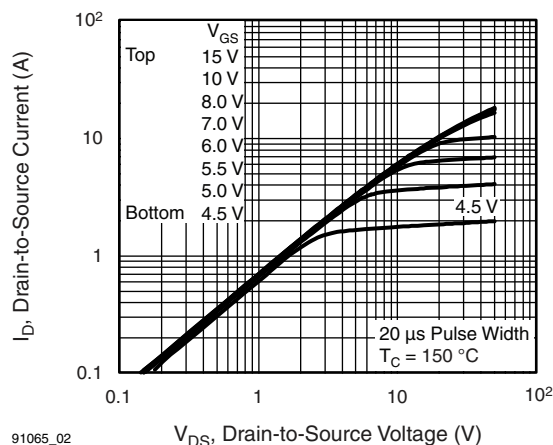
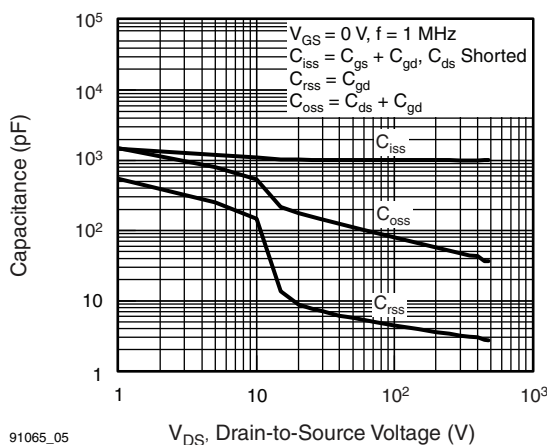
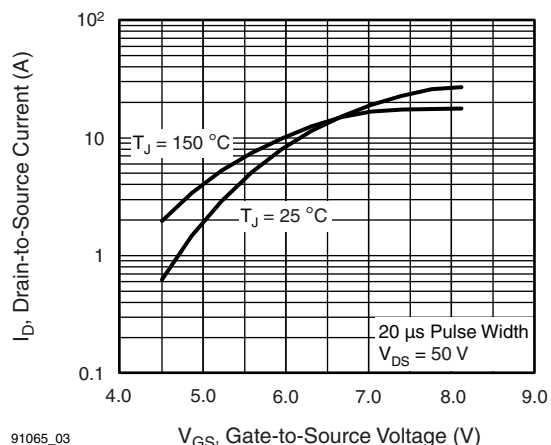
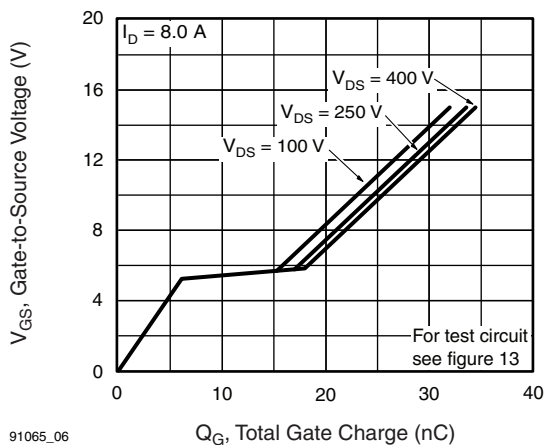
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	$R_{thJA}$	-	62	°C/W
Case-to-sink, flat, greased surface	$R_{thCS}$	0.50	-	
Maximum junction-to-case (drain)	$R_{thJC}$	-	1.0	

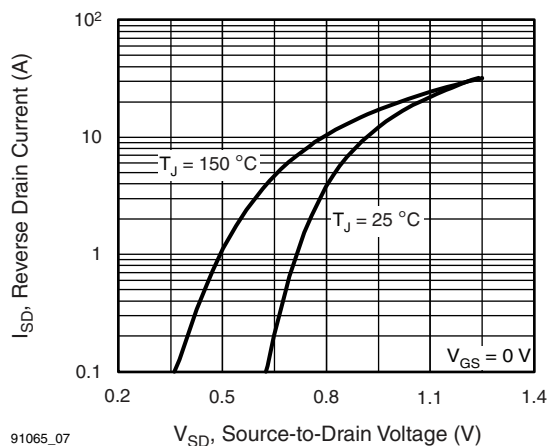
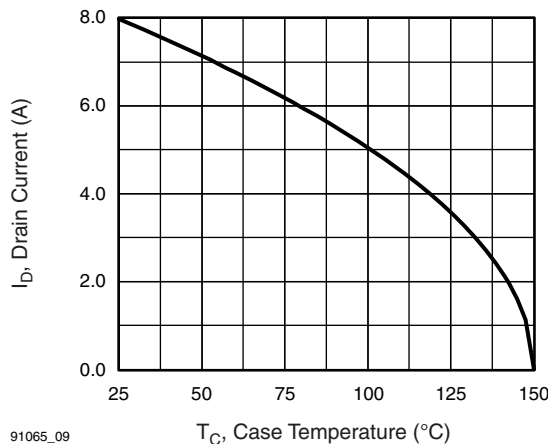
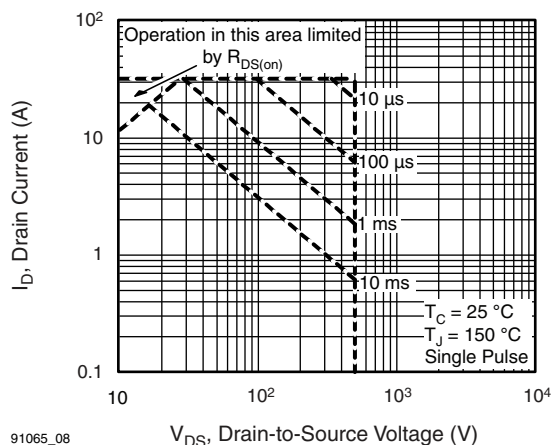
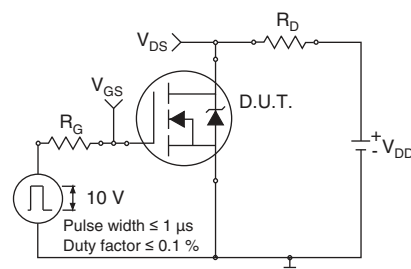
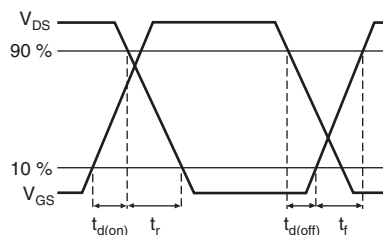
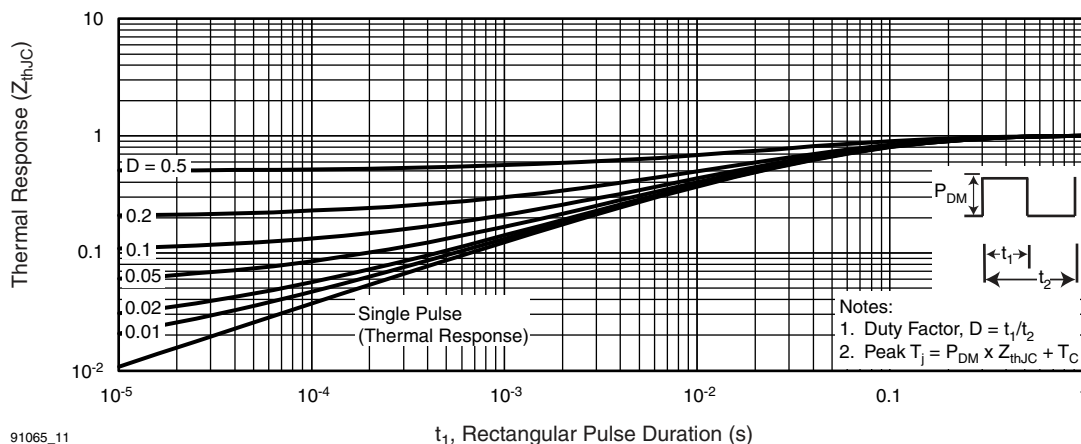
**SPECIFICATIONS** ( $T_J = 25\text{ °C}$ , unless otherwise noted)

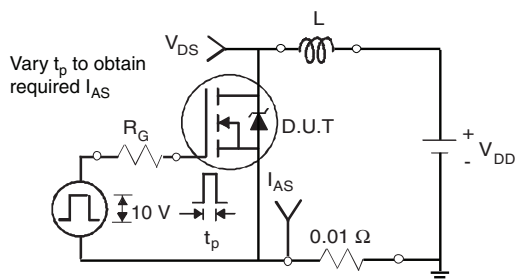
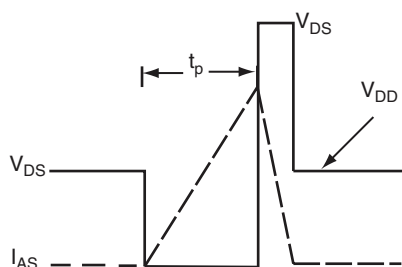
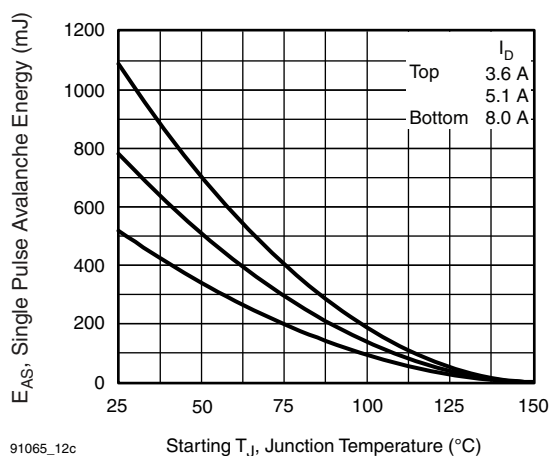
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-source breakdown voltage	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$	500	-	-	V
$V_{DS}$ temperature coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ °C}$ , $I_D = 1\text{ mA}$	-	0.58	-	V/°C
Gate-source threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	2.0	-	4.0	V
Gate-source leakage	$I_{GSS}$	$V_{GS} = \pm 30\text{ V}$	-	-	$\pm 100$	nA
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = 500\text{ V}$ , $V_{GS} = 0\text{ V}$	-	-	25	$\mu\text{A}$
		$V_{DS} = 400\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ °C}$	-	-	250	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$ , $I_D = 4.8\text{ A}^b$	-	-	0.85	$\Omega$
Forward transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}$ , $I_D = 4.8\text{ A}^b$	3.7	-	-	S
<b>Dynamic</b>						
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1.0\text{ MHz}$ , see fig. 5	-	1018	-	pF
Output capacitance	$C_{oss}$		-	155	-	
Reverse transfer capacitance	$C_{rss}$		-	8.0	-	
Output capacitance	$C_{oss}$	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 1.0\text{ V}$ , $f = 1.0\text{ MHz}$	-	1490	-	
Output capacitance	$C_{oss}$	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 400\text{ V}$ , $f = 1.0\text{ MHz}$	-	42	-	
Effective output capacitance	$C_{oss\text{ eff.}}$	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 0\text{ V}$ to $400\text{ V}^c$	-	56	-	
Total gate charge	$Q_g$	$V_{GS} = 10\text{ V}$ , $I_D = 8\text{ A}$ , $V_{DS} = 400\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	38	nC
Gate-source charge	$Q_{gs}$		-	-	9.0	
Gate-drain charge	$Q_{gd}$		-	-	18	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 250\text{ V}$ , $I_D = 8\text{ A}$ $R_g = 9.1\text{ }\Omega$ , $R_D = 31\text{ }\Omega$ , see fig. 10 <sup>b</sup>	-	11	-	ns
Rise time	$t_r$		-	23	-	
Turn-off delay time	$t_{d(off)}$		-	26	-	
Fall time	$t_f$		-	19	-	
Gate input resistance	$R_g$	$f = 1\text{ MHz}$ , open drain	0.7	-	3.7	$\Omega$
<b>Drain-Source Body Diode Characteristics</b>						
Continuous source-drain diode current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	8.0	A
Pulsed diode forward current <sup>a</sup>	$I_{SM}$		-	-	32	
Body diode voltage	$V_{SD}$	$T_J = 25\text{ °C}$ , $I_S = 8\text{ A}$ , $V_{GS} = 0\text{ V}^b$	-	-	2.0	V
Body diode reverse recovery time	$t_{rr}$	$T_J = 25\text{ °C}$ , $I_F = 8\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$	-	422	633	ns
Body diode reverse recovery charge	$Q_{rr}$		-	2.16	3.24	$\mu\text{C}$
Forward turn-on time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )				

**Notes**

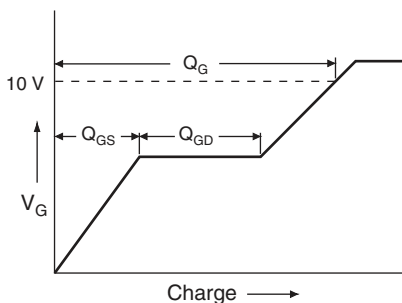
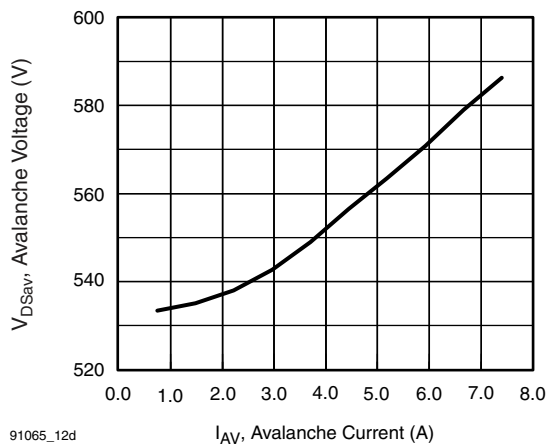
- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)  
b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$   
c.  $C_{oss\text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DS}$

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

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

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

**Fig. 2 - Typical Output Characteristics,  $T_C = 150^\circ\text{C}$** 

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

**Fig. 3 - Typical Transfer Characteristics**

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

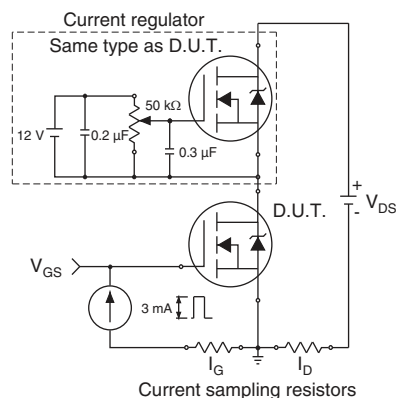

**Fig. 7 - Typical Source-Drain Diode Forward Voltage**

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

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

**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**


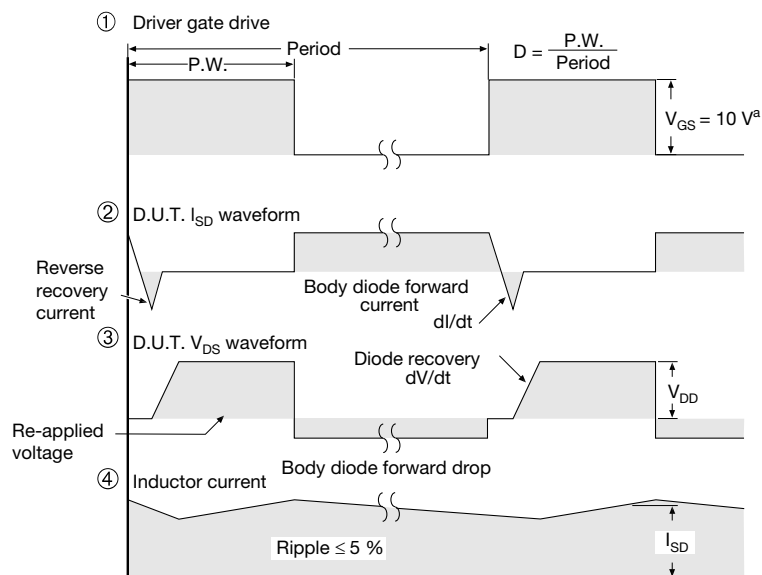
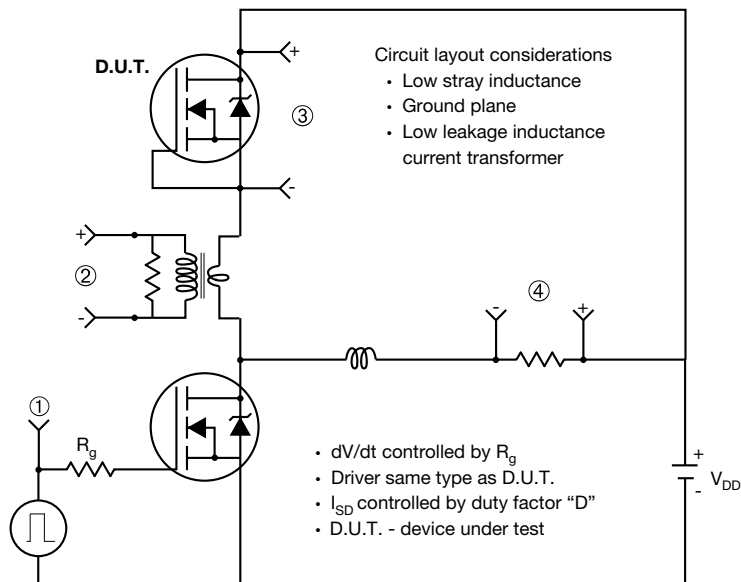
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**Fig. 12c - Maximum Avalanche Energy vs. Drain Current**

**Fig. 12d - Basic Gate Charge Waveform**


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**Fig. 13a - Typical Drain-to-Source Voltage vs. Avalanche Current**

**Fig. 13b - Gate Charge Test Circuit**

## Peak Diode Recovery dV/dt Test Circuit



### Note

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

**Fig. 14 - For N-Channel**



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