

## N-Channel 60 V (D-S) MOSFET

PRODUCT SUMMARY			
V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A) <sup>a, e</sup>	Q <sub>g</sub> (Max)
60	0.032 at V <sub>GS</sub> = 10 V	50	66 nC
	0.035 at V <sub>GS</sub> = 4.5 V	40	

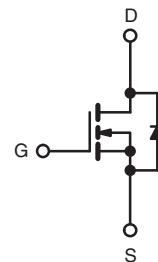
### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- Surface Mount
- Available in Tape and Reel
- Dynamic dV/dt Rating
- Logic-Level Gate Drive
- Fast Switching
- Compliant to RoHS Directive 2002/95/EC



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

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



N-Channel MOSFET

### ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25 °C, unless otherwise noted)

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	V <sub>DS</sub>	60	
Gate-Source Voltage	V <sub>GS</sub>	± 10	
Continuous Drain Current <sup>f</sup>	I <sub>D</sub>	50	A
Continuous Drain Current		36	
Pulsed Drain Current <sup>a</sup>	I <sub>DM</sub>	200	
Linear Derating Factor		1.0	W/°C
Linear Derating Factor (PCB Mount) <sup>e</sup>		0.025	
Single Pulse Avalanche Energy <sup>b</sup>	E <sub>AS</sub>	400	mJ
Maximum Power Dissipation	P <sub>D</sub>	150	W
Maximum Power Dissipation (PCB Mount) <sup>e</sup>		3.7	
Peak Diode Recovery dV/dt <sup>c</sup>	dV/dt	4.5	V/ns
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 55 to + 175	°C
Soldering Recommendations (Peak Temperature) <sup>d</sup>	for 10 s	300 <sup>d</sup>	

**Notes**

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).

b. V<sub>DD</sub> = 25 V, starting T<sub>J</sub> = 25 °C, L = 179 µH, R<sub>g</sub> = 25 Ω, I<sub>AS</sub> = 51 A (see fig. 12).

c. I<sub>SD</sub> ≤ 51 A, dI/dt ≤ 250 A/µs, V<sub>DD</sub> ≤ V<sub>DS</sub>, T<sub>J</sub> ≤ 175 °C.

d. 1.6 mm from case.

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

f. Current limited by the package, (die current = 51 A).

**THERMAL RESISTANCE RATINGS**

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	62	$^{\circ}\text{C}/\text{W}$
Maximum Junction-to-Ambient (PCB Mount) <sup>a</sup>	$R_{thJA}$	-	40	
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	1.0	

**Note**

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

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

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT	
<b>Static</b>								
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0$ , $I_D = 250 \mu\text{A}$		60	-	-	V	
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25^{\circ}\text{C}$ , $I_D = 1 \text{ mA}$		-	0.070	-	$^{\circ}\text{C}/\text{V}$	
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = 250 \mu\text{A}$		1.0	-	3.0	V	
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 10 \text{ V}$		-	-	$\pm 100$	nA	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 60 \text{ V}$ , $V_{GS} = 0 \text{ V}$		-	-	25	$\mu\text{A}$	
		$V_{DS} = 48 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $T_J = 150^{\circ}\text{C}$		-	-	250		
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10 \text{ V}$	$I_D = 21 \text{ A}^b$	-	0.032	-	$\Omega$	
		$V_{GS} = 4.5 \text{ V}$	$I_D = 15 \text{ A}^b$	-	0.035	-		
Forward Transconductance	$g_{fs}$	$V_{DS} = 25 \text{ V}$ , $I_D = 21 \text{ A}^b$		23	-	-	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		-	3000	-	pF	
Output Capacitance	$C_{oss}$			-	1000	-		
Reverse Transfer Capacitance	$C_{rss}$			-	200	-		
Total Gate Charge	$Q_g$	$V_{GS} = 5.0 \text{ V}$	$I_D = 51 \text{ A}$ , $V_{DS} = 48 \text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	60	-	nC	
Gate-Source Charge	$Q_{gs}$			-	10	-		
Gate-Drain Charge	$Q_{gd}$			-	40	-		
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 30 \text{ V}$ , $I_D = 51 \text{ A}$ , $R_g = 4.6 \Omega$ , $R_D = 0.56 \Omega$ , see fig. 10 <sup>b</sup>		-	17	-	ns	
Rise Time	$t_r$			-	230	-		
Turn-Off Delay Time	$t_{d(off)}$			-	42	-		
Fall Time	$t_f$			-	110	-		
Internal Drain Inductance	$L_D$	Between lead, 6 mm (0.25") from package and center of die contact		-	4.5	-	nH	
Internal Source Inductance	$L_S$			-	7.5	-		
<b>Drain-Source Body Diode Characteristics</b>								
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode		-	-	50 <sup>c</sup>	A	
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$			-	-	200		
Body Diode Voltage	$V_{SD}$	$T_J = 25^{\circ}\text{C}$ , $I_S = 51 \text{ A}$ , $V_{GS} = 0 \text{ V}^b$		-	-	2.5	V	
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25^{\circ}\text{C}$ , $I_F = 51 \text{ A}$ , $dI/dt = 100 \text{ A}/\mu\text{s}^b$		-	130	180	ns	
Body Diode Reverse Recovery Charge	$Q_{rr}$			-	0.84	1.3	$\mu\text{C}$	
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  $\leq 300 \mu\text{s}$ ; duty cycle  $\leq 2\%$ .  
 c. Current limited by the package, (Die Current = 51 A).

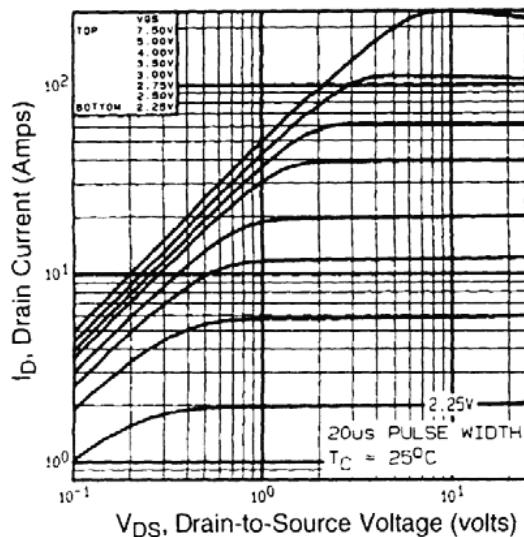
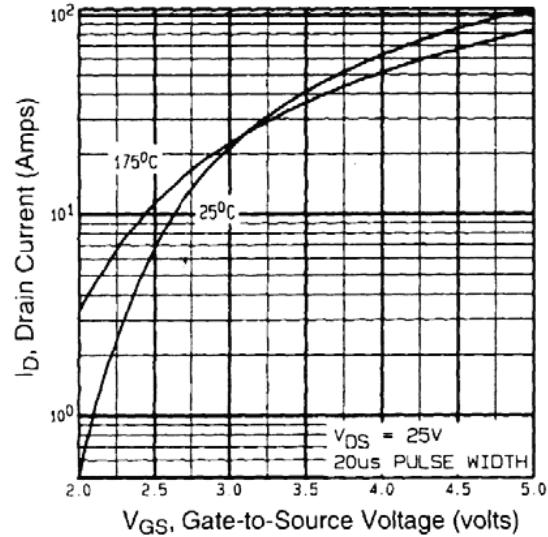
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)
Fig. 1 - Typical Output Characteristics,  $T_C = 25\text{ }^{\circ}\text{C}$ 

Fig. 3 - Typical Transfer Characteristics

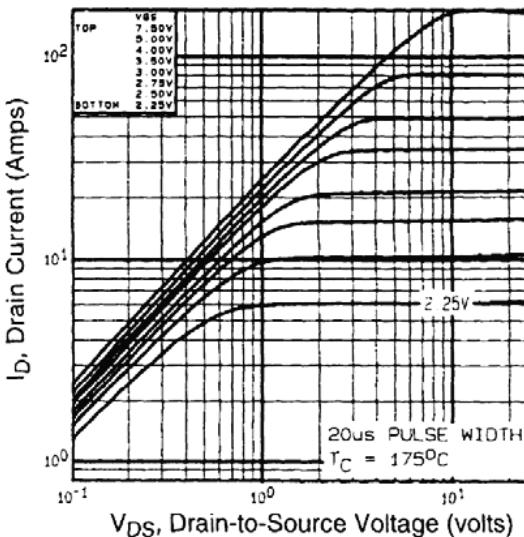
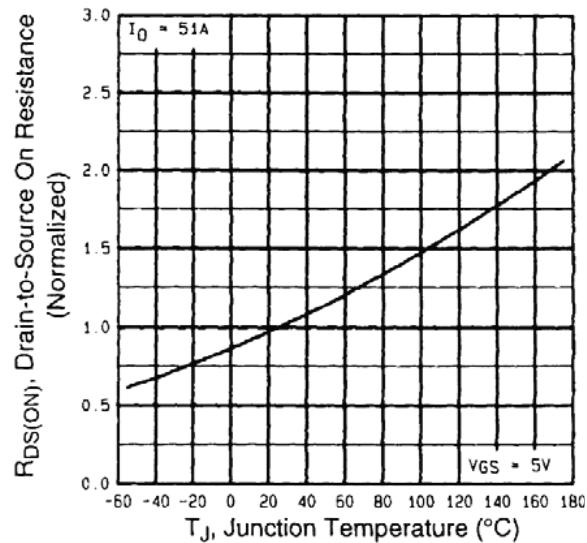
Fig. 2 - Typical Output Characteristics,  $T_C = 150\text{ }^{\circ}\text{C}$ 

Fig. 4 - Normalized On-Resistance vs. Temperature

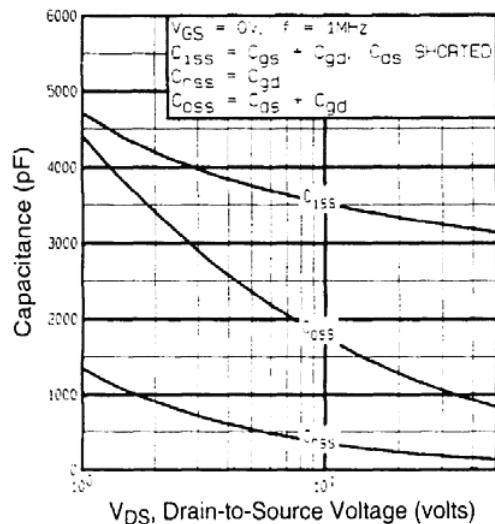


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

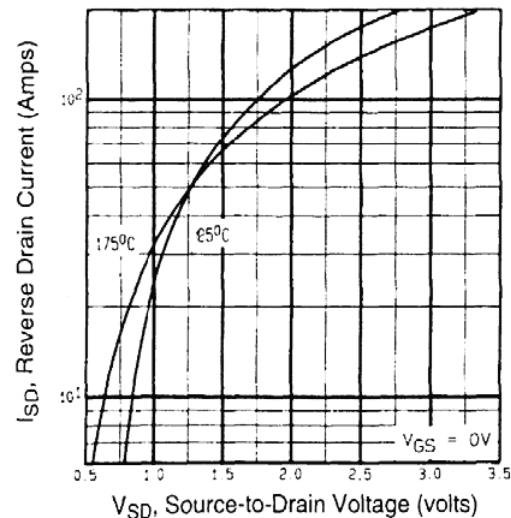


Fig. 7 - Typical Source-Drain Diode Forward Voltage

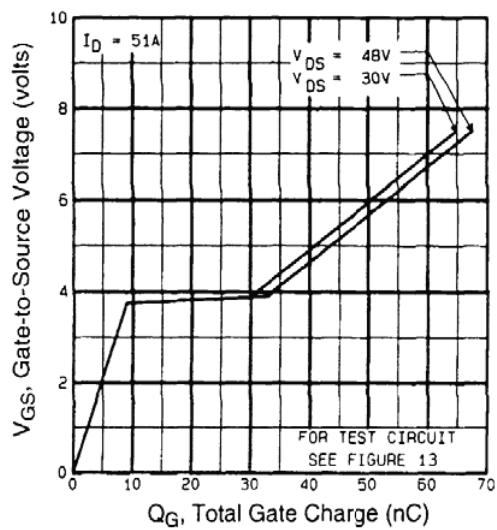


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

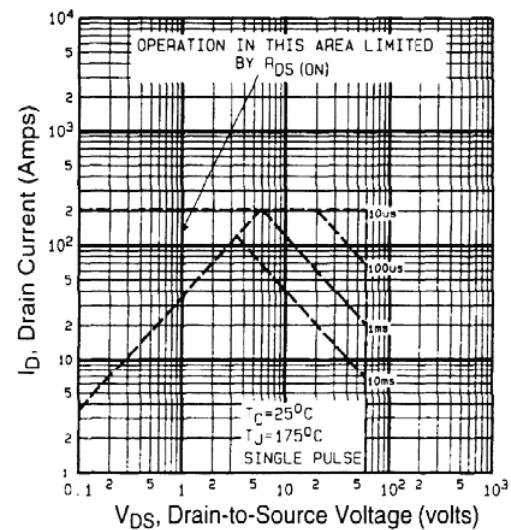


Fig. 8 - Maximum Safe Operating Area

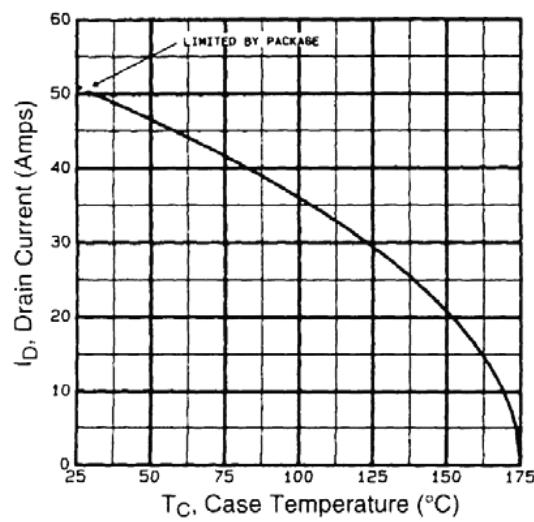


Fig. 9 - Maximum Drain Current vs. Case Temperature

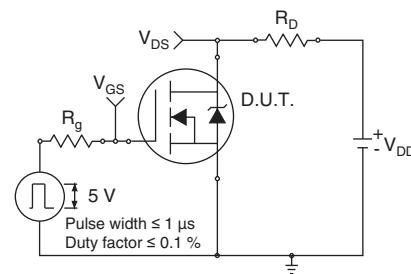


Fig. 10a - Switching Time Test Circuit

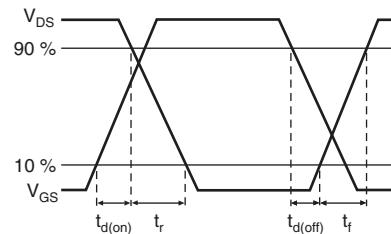


Fig. 10b - Switching Time Waveforms

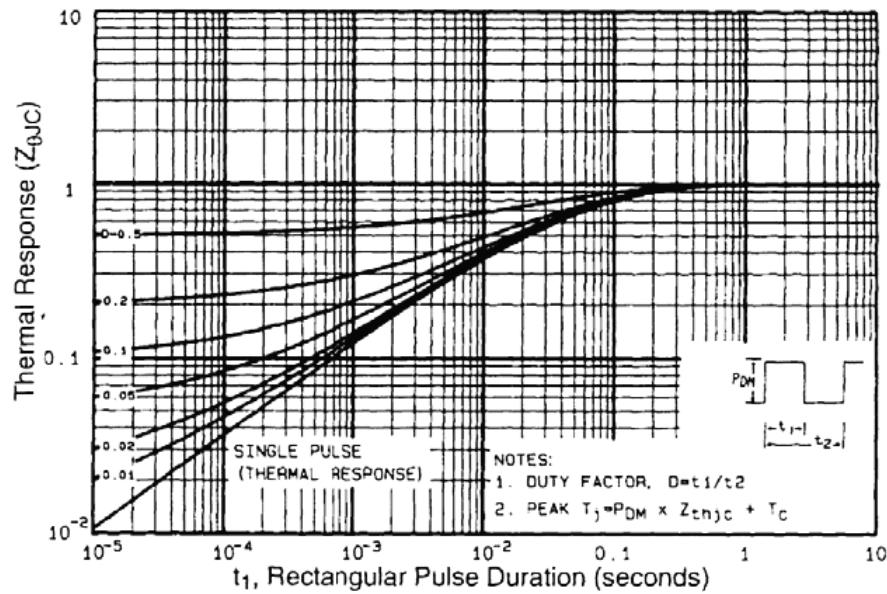


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

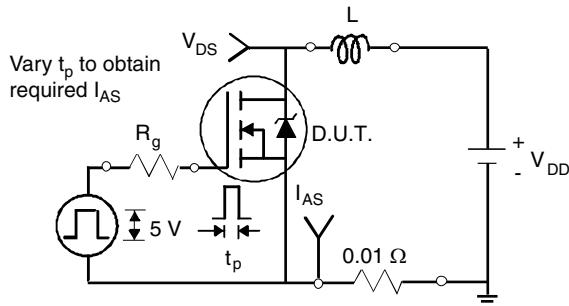


Fig. 12a - Unclamped Inductive Test Circuit

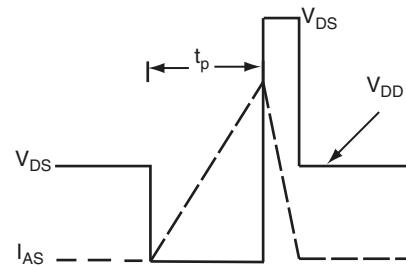


Fig. 12b - Unclamped Inductive Waveforms

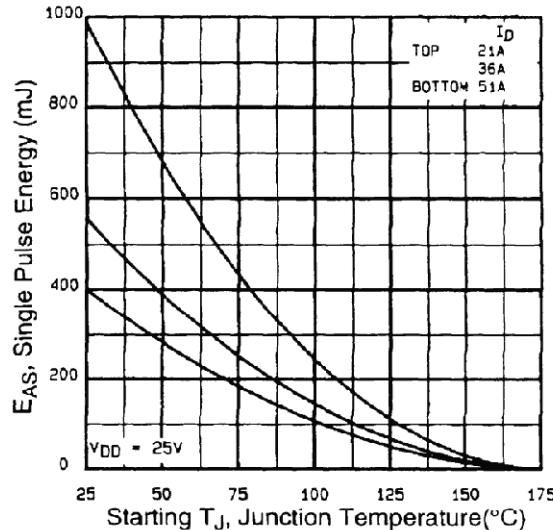


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

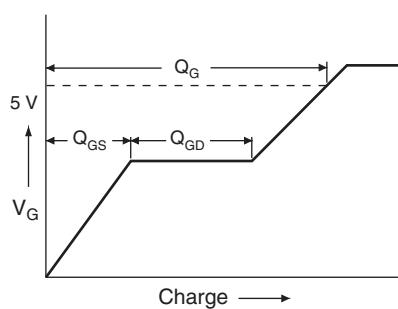


Fig. 13a - Basic Gate Charge Waveform

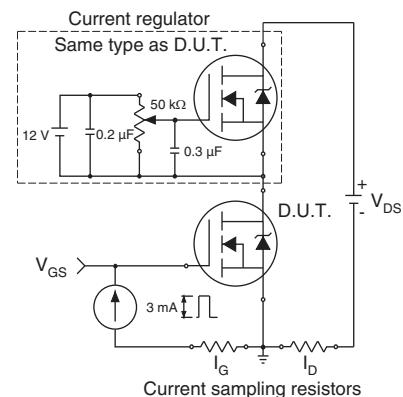


Fig. 13b - Gate Charge Test Circuit

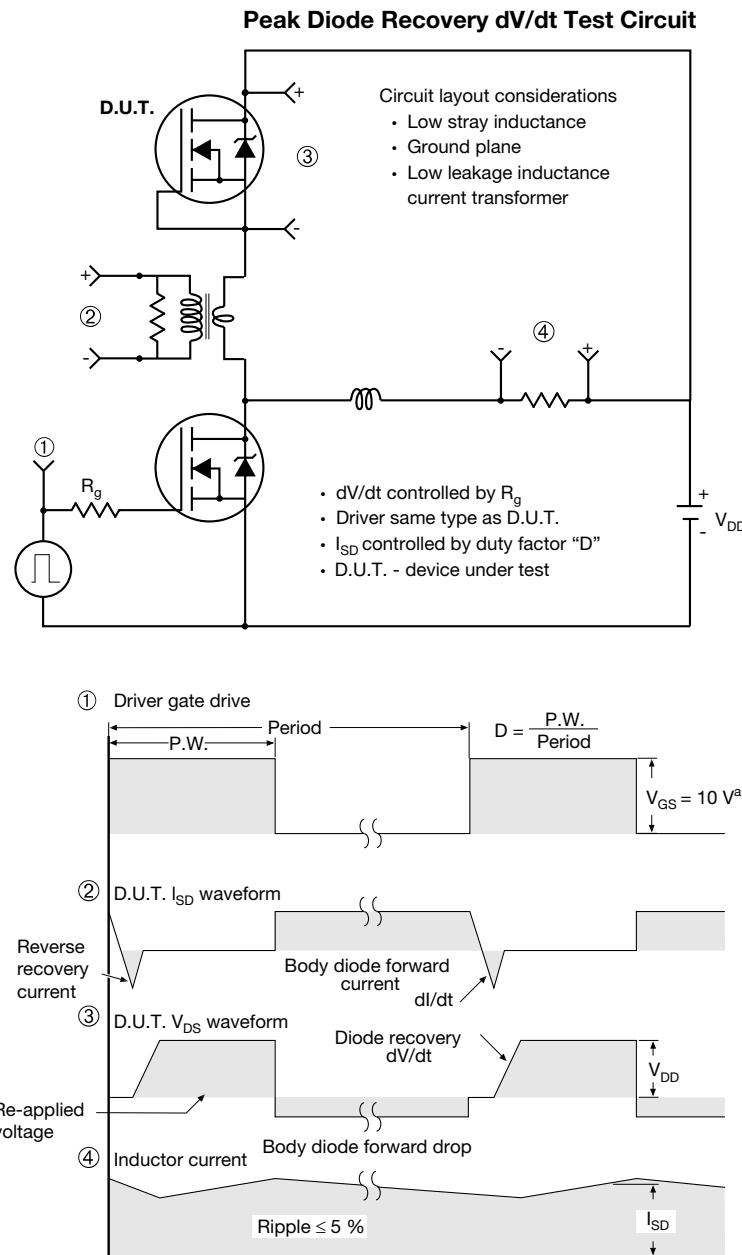
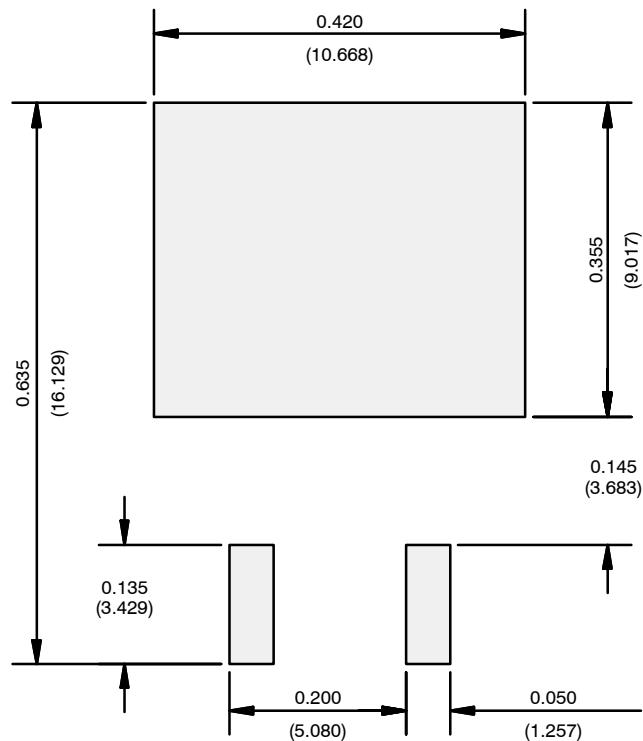


Fig. 14 - For N-Channel

**RECOMMENDED MINIMUM PADS FOR D<sup>2</sup>PAK: 3-Lead**

Recommended Minimum Pads  
Dimensions in Inches/(mm)

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