

## 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	0.023 at V <sub>GS</sub> = 10 V	50	66 nC
	0.027 at V <sub>GS</sub> = 4.5 V	40	

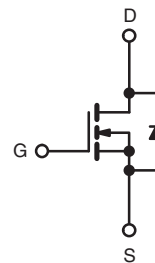
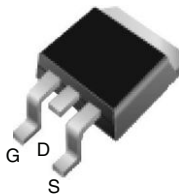
### FEATURES

- 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	V
Gate-Source Voltage			V <sub>GS</sub>	± 10	
Continuous Drain Current <sup>f</sup>	V <sub>GS</sub> at 10 V	T <sub>C</sub> = 25 °C	I <sub>D</sub>	50	A
Continuous Drain Current		T <sub>C</sub> = 100 °C		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	T <sub>C</sub> = 25 °C		P <sub>D</sub>	150	W
Maximum Power Dissipation (PCB Mount) <sup>e</sup>	T <sub>A</sub> = 25 °C			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

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- 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).
- 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.
- 1.6 mm from case.
- When mounted on 1" square PCB (FR-4 or G-10 material).
- Current limited by the package, (die current = 51 A).

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	62	°C/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 <sub>J</sub> = 25 °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		60	-	-	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		-	0.070	-	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		1.0	-	3.0	V
Gate-Source Leakage	I <sub>GSS</sub>	V <sub>GS</sub> = ± 10 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V		-	-	25	μA
		V <sub>DS</sub> = 48 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150 °C		-	-	250	
Drain-Source On-State Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V	I <sub>D</sub> = 21 A <sup>b</sup>	-	23	-	Ω
		V <sub>GS</sub> = 4.5 V	I <sub>D</sub> = 15 A <sup>b</sup>	-	27	-	
Forward Transconductance	g <sub>fs</sub>	V <sub>DS</sub> = 25 V, I <sub>D</sub> = 21A <sup>b</sup>		23	-	-	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		-	3000	-	pF
Output Capacitance	C <sub>oss</sub>			-	1000	-	
Reverse Transfer Capacitance	C <sub>rss</sub>			-	200	-	
Total Gate Charge	Q <sub>g</sub>	V <sub>GS</sub> = 5.0 V	I <sub>D</sub> = 51 A, V <sub>DS</sub> = 48 V, see fig. 6 and 13 <sup>b</sup>	-	60	-	nC
Gate-Source Charge	Q <sub>gs</sub>			-	10	-	
Gate-Drain Charge	Q <sub>gd</sub>			-	40	-	
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 30 V, I <sub>D</sub> = 51 A, R <sub>g</sub> = 4.6 Ω, R <sub>D</sub> = 0.56 Ω, see fig. 10 <sup>b</sup>		-	17	-	ns
Rise Time	t <sub>r</sub>			-	230	-	
Turn-Off Delay Time	t <sub>d(off)</sub>			-	42	-	
Fall Time	t <sub>f</sub>			-	110	-	
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		-	-	50 <sup>c</sup>	A
Pulsed Diode Forward Current <sup>a</sup>	I <sub>SM</sub>			-	-	200	
Body Diode Voltage	V <sub>SD</sub>	T <sub>J</sub> = 25 °C, I <sub>S</sub> = 51 A, V <sub>GS</sub> = 0 V <sup>b</sup>		-	-	2.5	V
Body Diode Reverse Recovery Time	t <sub>rr</sub>	T <sub>J</sub> = 25 °C, I <sub>F</sub> = 51 A, dI/dt = 100 A/μs <sup>b</sup>		-	130	180	ns
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>			-	0.84	1.3	μC
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  $\leq 2\%$ .  
c. Current limited by the package, (Die Current = 51 A).

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

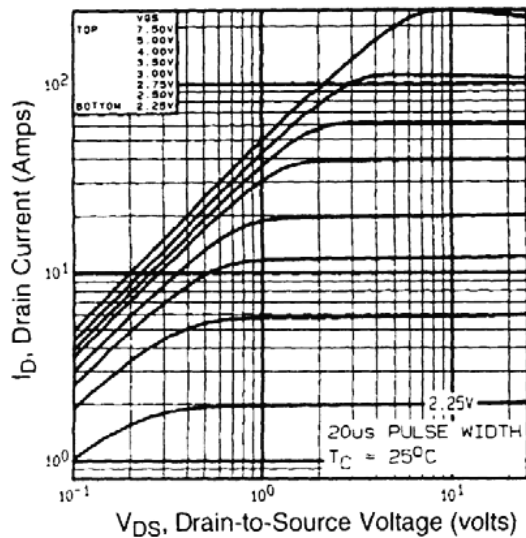


Fig. 1 - Typical Output Characteristics,  $T_C = 25^\circ\text{C}$

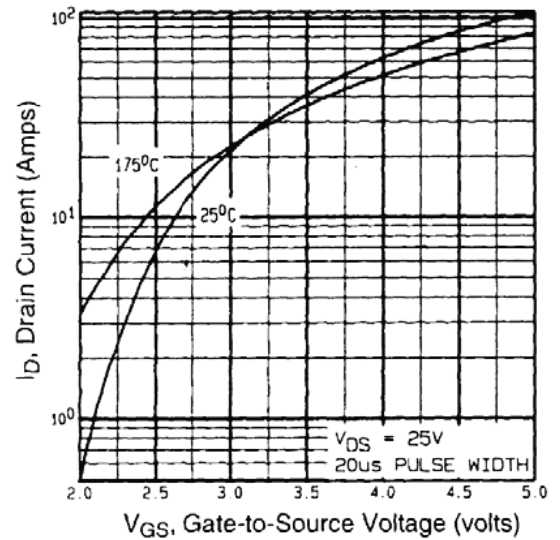


Fig. 3 - Typical Transfer Characteristics

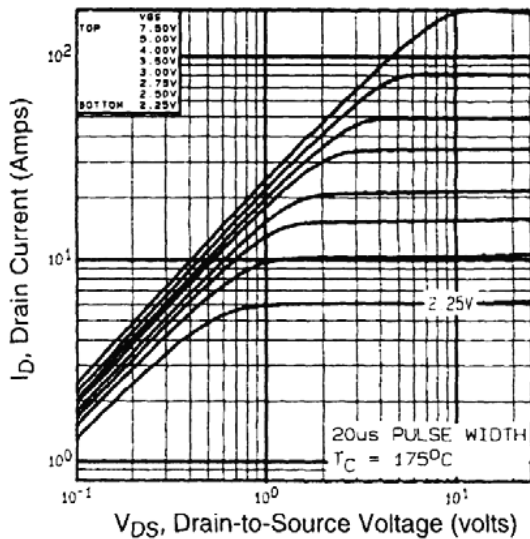


Fig. 2 - Typical Output Characteristics,  $T_C = 150^\circ\text{C}$

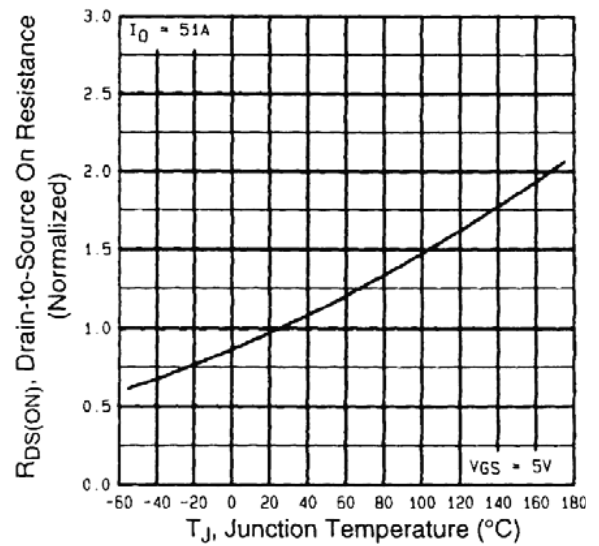


Fig. 4 - Normalized On-Resistance vs. Temperature

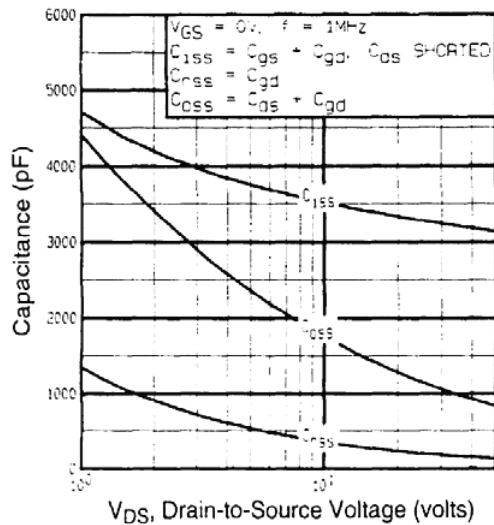


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

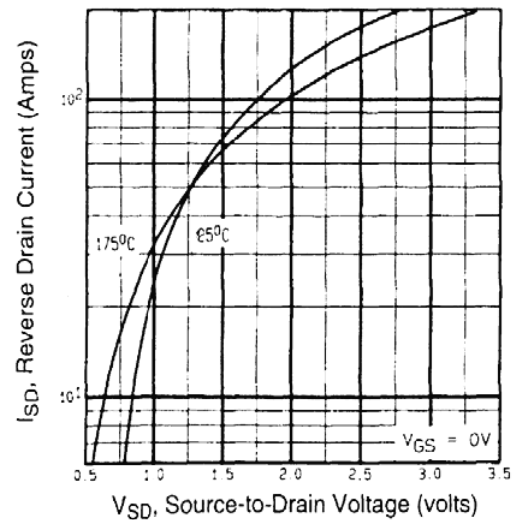


Fig. 7 - Typical Source-Drain Diode Forward Voltage



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

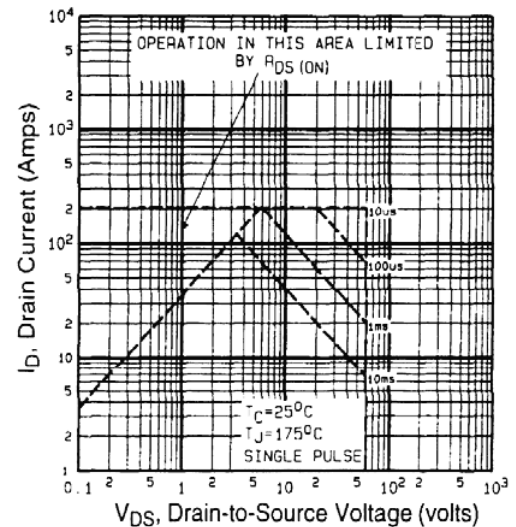


Fig. 8 - Maximum Safe Operating Area

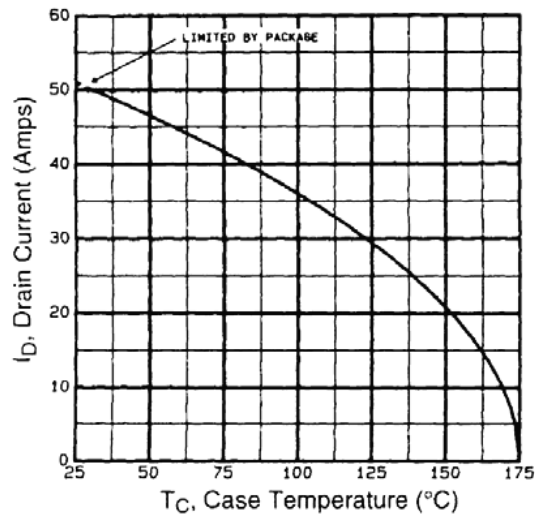


Fig. 9 - Maximum Drain Current vs. Case Temperature

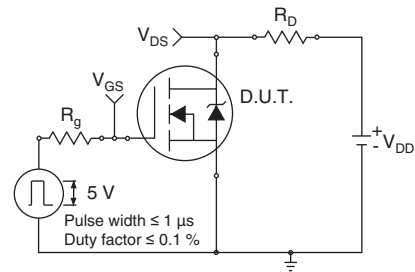


Fig. 10a - Switching Time Test Circuit

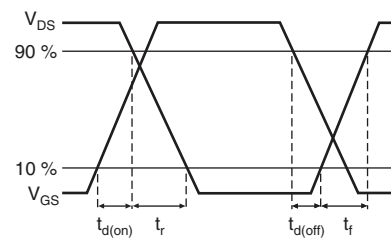


Fig. 10b - Switching Time Waveforms

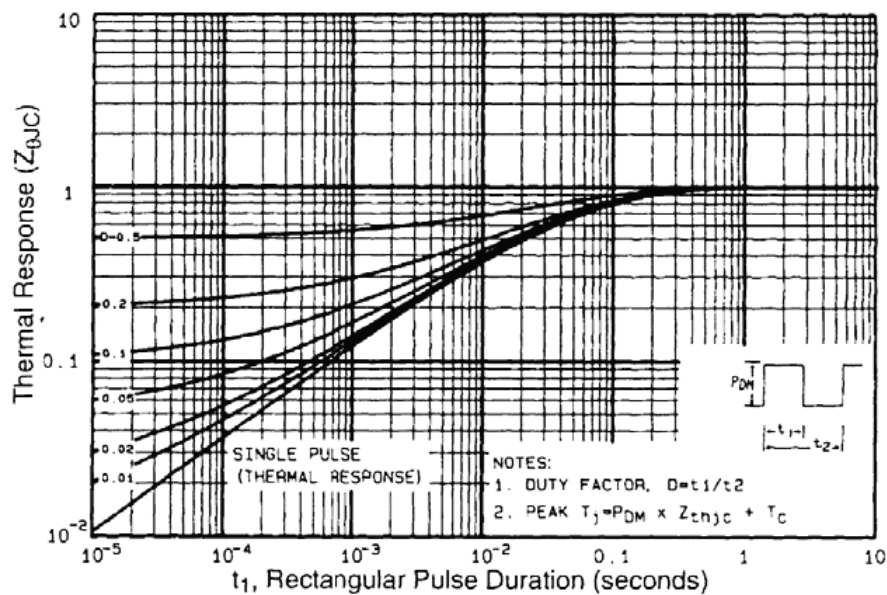


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

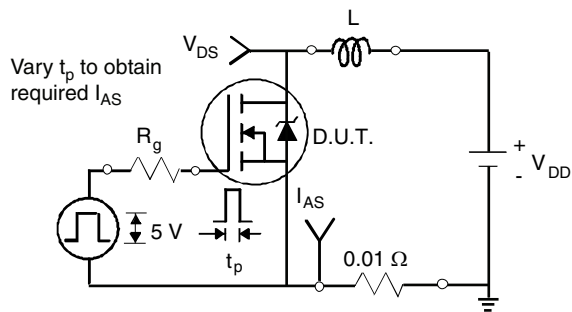


Fig. 12a - Unclamped Inductive Test Circuit

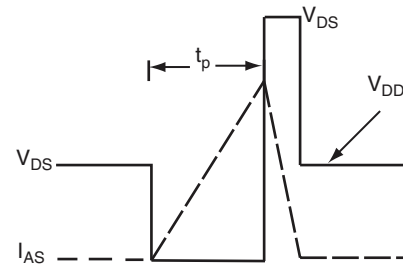


Fig. 12b - Unclamped Inductive Waveforms

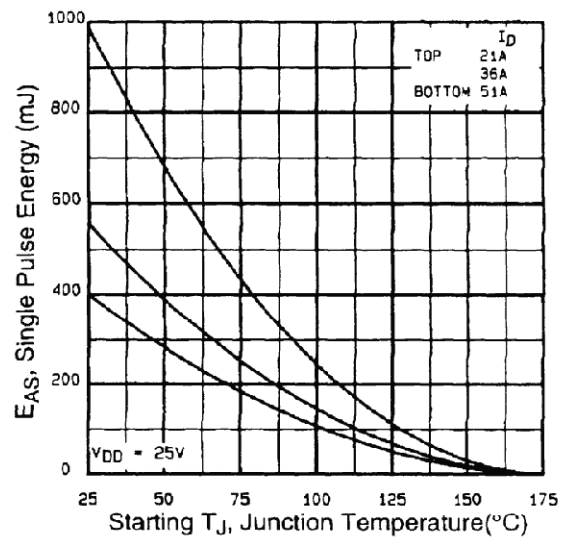


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

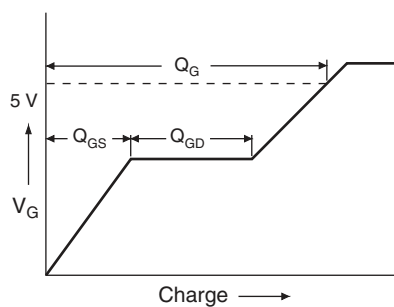


Fig. 13a - Basic Gate Charge Waveform

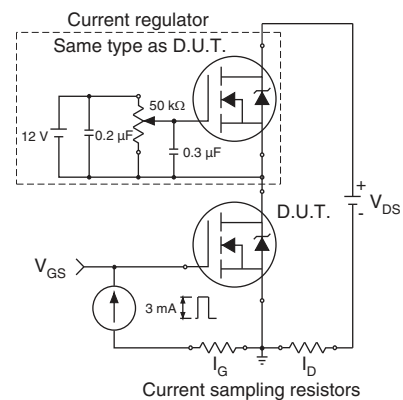
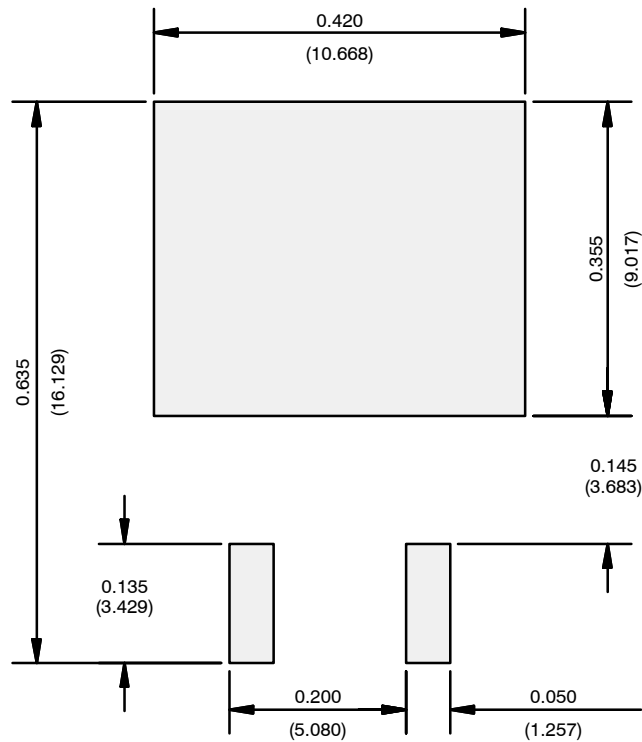


Fig. 13b - Gate Charge Test Circuit



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



Recommended Minimum Pads  
Dimensions in Inches/(mm)



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