

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

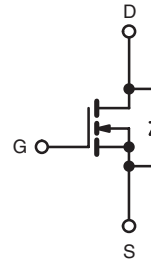
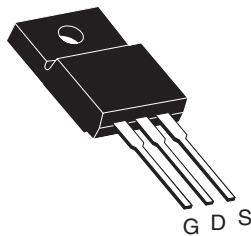
PRODUCT SUMMARY		
$V_{DS}$ (V)	60	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10\text{ V}$	0.027
$Q_g$ (Max.) (nC)	95	
$Q_{gs}$ (nC)	27	
$Q_{gd}$ (nC)	46	
Configuration	Single	

### FEATURES

- Isolated Package
- High Voltage Isolation = 2.5 kV<sub>RMS</sub> (t = 60 s; f = 60 Hz)
- Sink to Lead Creepage Distance = 4.8 mm
- 175 °C Operating Temperature
- Dynamic dV/dt Rating
- Low Thermal Resistance
- Lead (Pb)-free Available



TO-220 FULLPAK



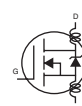
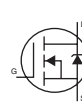
N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted				
PARAMETER		SYMBOL	LIMIT	UNIT
Drain-Source Voltage		$V_{DS}$	60	V
Gate-Source Voltage		$V_{GS}$	$\pm 20$	
Continuous Drain Current	$V_{GS}$ at 10 V	$I_D$	$T_C = 25\text{ }^\circ\text{C}$	45
			$T_C = 100\text{ }^\circ\text{C}$	30
Pulsed Drain Current <sup>a</sup>		$I_{DM}$	220	A
Linear Derating Factor			0.32	W/ $^\circ\text{C}$
Single Pulse Avalanche Energy <sup>b</sup>		$E_{AS}$	100	mJ
Maximum Power Dissipation		$P_D$	52	W
$T_C = 25\text{ }^\circ\text{C}$				
Peak Diode Recovery dV/dt <sup>c</sup>		dV/dt	4.5	V/ns
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	- 55 to + 175	$^\circ\text{C}$
Soldering Recommendations (Peak Temperature)		for 10 s		
Mounting Torque		6-32 or M3 screw		
			10	lbf · in
			1.1	N · m

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 25\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 129\text{ }\mu\text{H}$ ,  $R_G = 25\text{ }\Omega$ ,  $I_{AS} = 30\text{ A}$  (see fig. 12).
- $I_{SD} \leq 52\text{ A}$ ,  $dI/dt \leq 250\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 175\text{ }^\circ\text{C}$ .
- 1.6 mm from case.

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	65	°C/W
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	3.1	

SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		60	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$		-	0.060	-	V/°C
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$		1.0	-	3.0	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$		-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$		-	-	25	$\mu\text{A}$
		$V_{DS} = 48\text{ V}, V_{GS} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$		-	-	250	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 18\text{ A}^b$	-	0.027	-	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 25\text{ V}, I_D = 18\text{ A}^b$		15	-	-	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		-	1500	-	pF
Output Capacitance	$C_{oss}$			-	720	-	
Reverse Transfer Capacitance	$C_{riss}$			-	100	-	
Drain to Sink Capacitance	$C$	$f = 1.0\text{ MHz}$		-	12	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 52\text{ A}, V_{DS} = 48\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	95	nC
Gate-Source Charge	$Q_{GS}$			-	-	27	
Gate-Drain Charge	$Q_{GD}$			-	-	46	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 30\text{ V}, I_D = 52\text{ A}, R_G = 9.1\text{ }\Omega, R_D = 0.54\text{ }\Omega$ , see fig. 10 <sup>b</sup>		-	19	-	ns
Rise Time	$t_r$			-	120	-	
Turn-Off Delay Time	$t_{d(off)}$			-	55	-	
Fall Time	$t_f$			-	86	-	
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 		-	-	45	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$			-	-	120	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 30\text{ A}, V_{GS} = 0\text{ V}^b$		-	-	2.5	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = 52\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$		-	140	300	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			-	1.2	2.8	$\mu\text{C}$
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  $\leq 2\%$ .

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

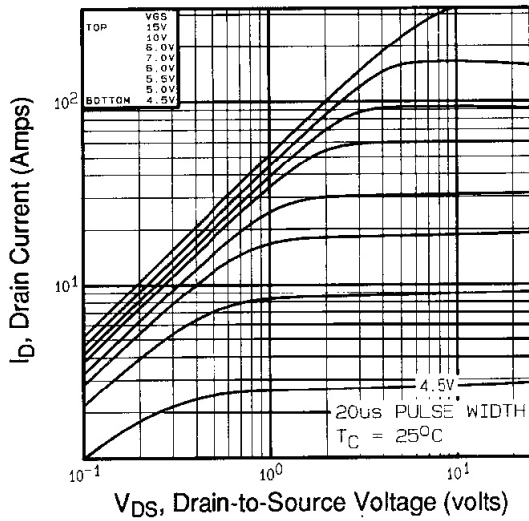


Fig. 1 - Typical Output Characteristics,  $T_C = 25\text{ }^\circ\text{C}$

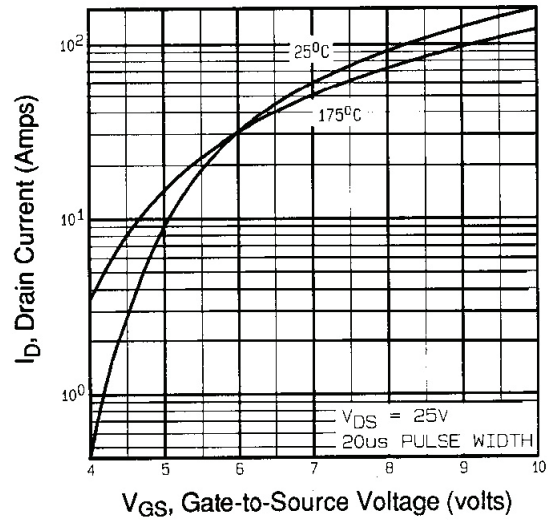


Fig. 3 - Typical Transfer Characteristics

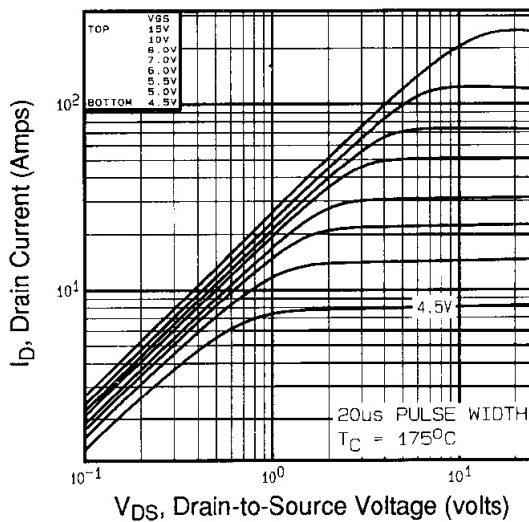


Fig. 2 - Typical Output Characteristics,  $T_C = 175\text{ }^\circ\text{C}$

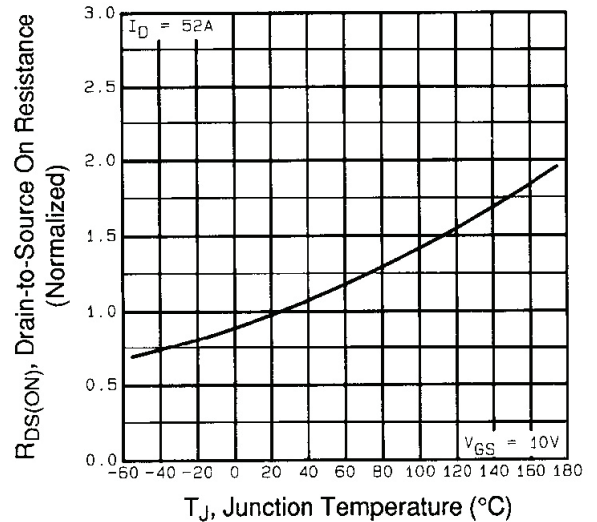


Fig. 4 - Normalized On-Resistance vs. Temperature



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

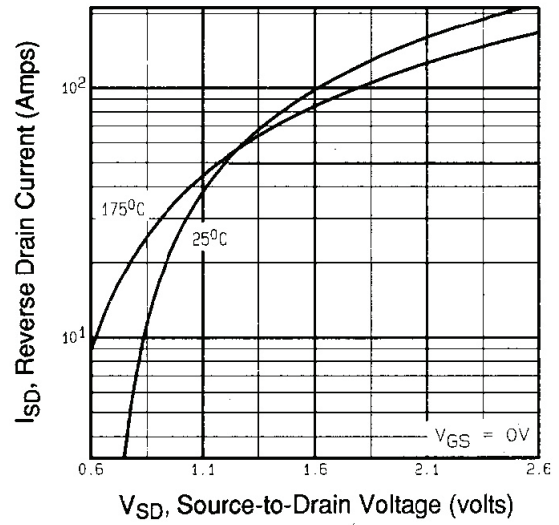


Fig. 7 - Typical Source-Drain Diode Forward Voltage

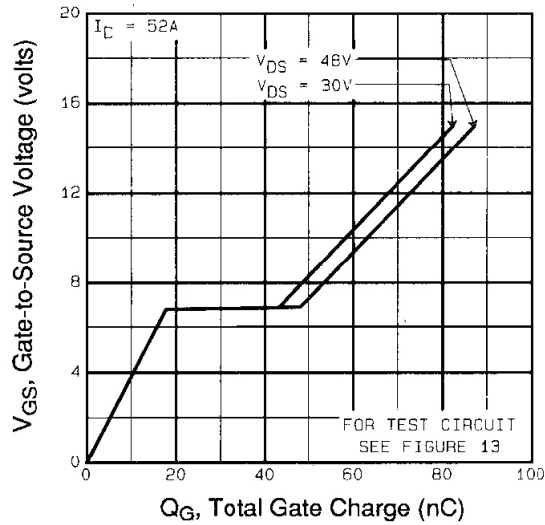


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

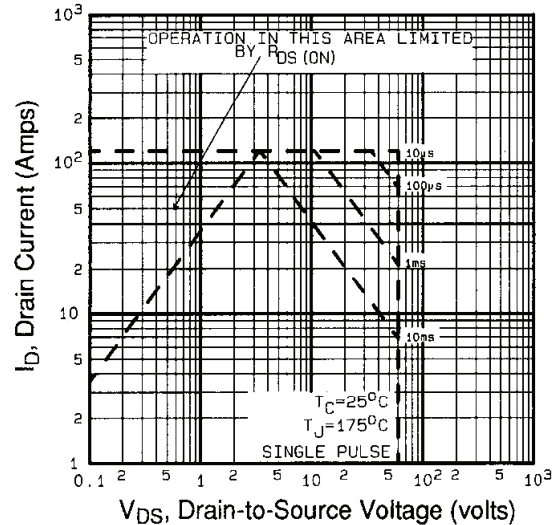


Fig. 8 - Maximum Safe Operating Area

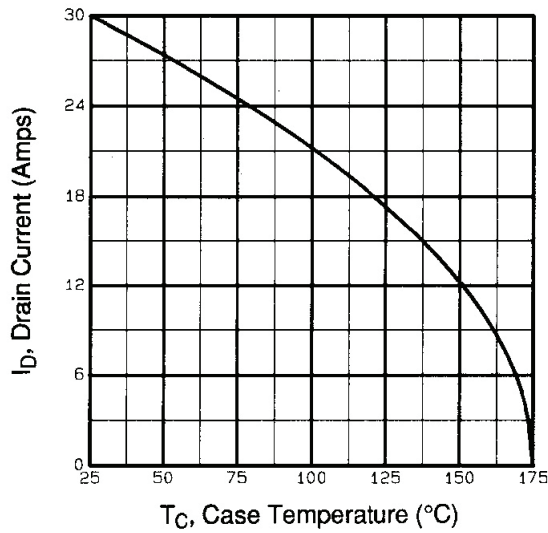


Fig. 9 - Maximum Drain Current vs. Case Temperature

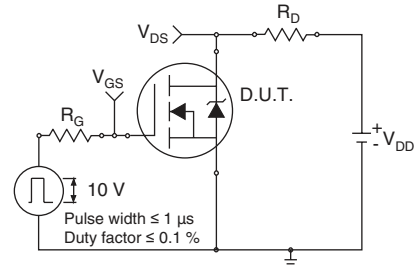


Fig. 10a - Switching Time Test Circuit

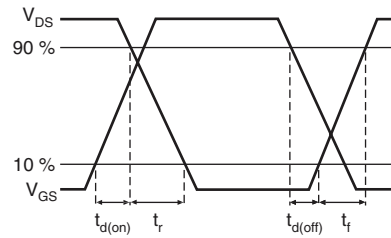


Fig. 10b - Switching Time Waveforms

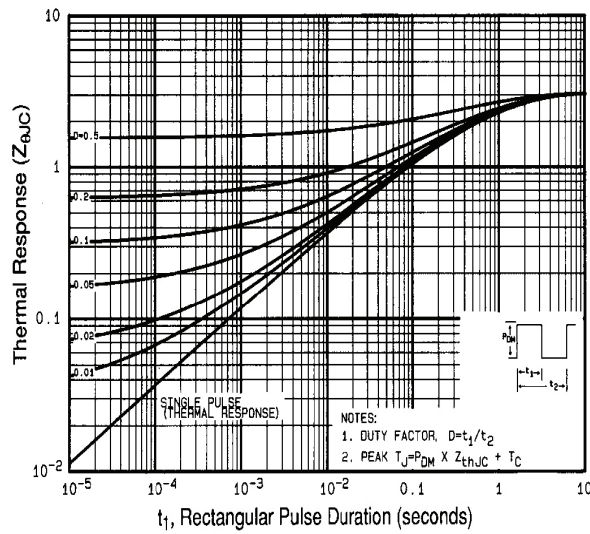


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

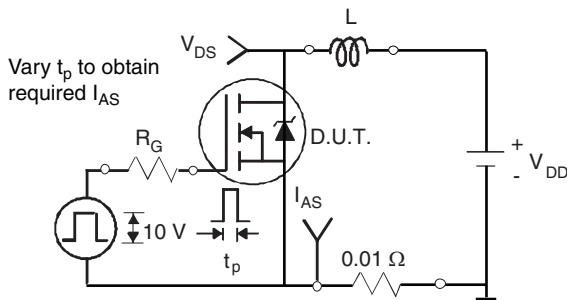


Fig. 12a - Unclamped Inductive Test Circuit

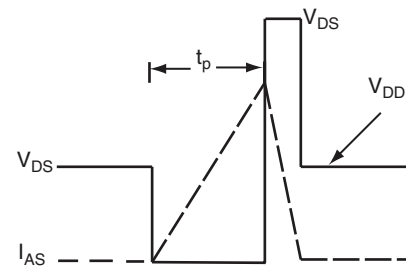


Fig. 12b - Unclamped Inductive Waveforms

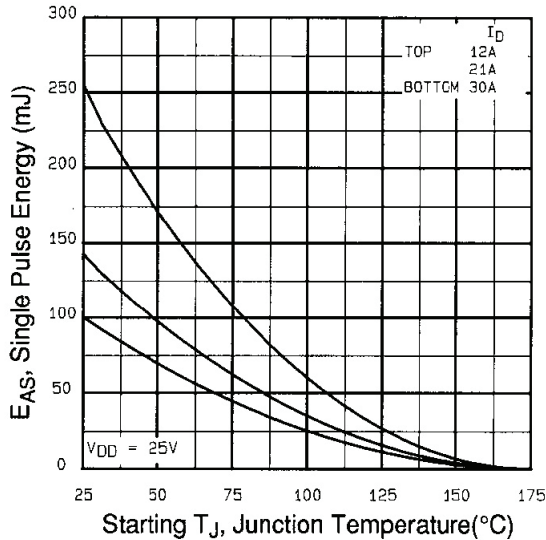


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

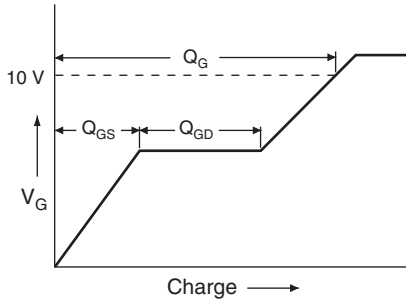


Fig. 13a - Basic Gate Charge Waveform

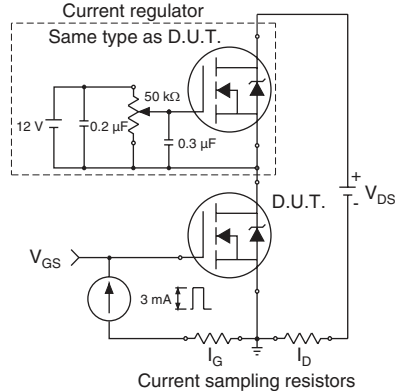
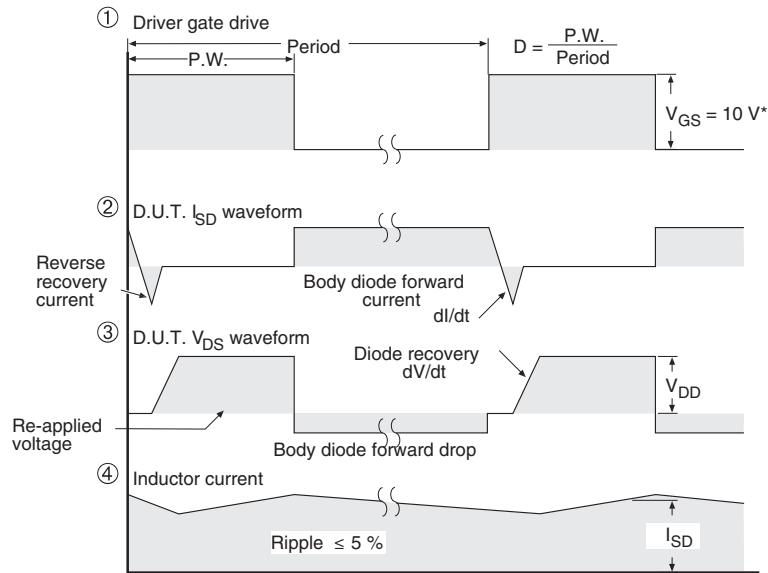
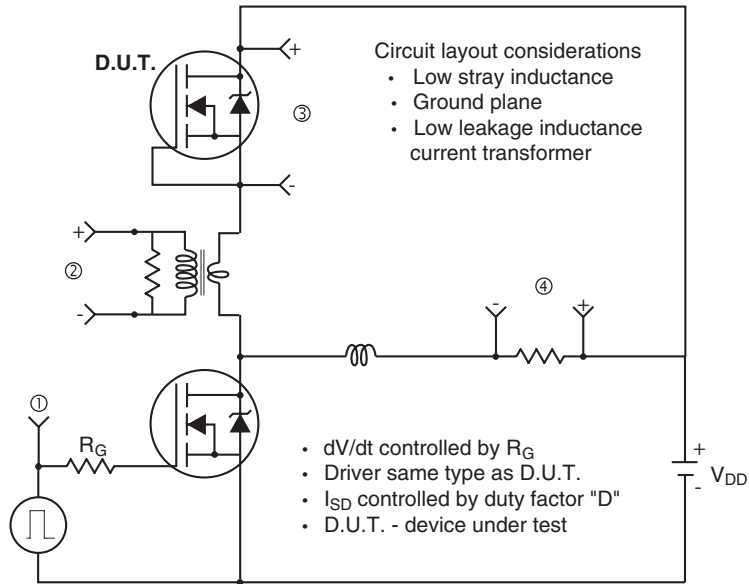


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



\*  $V_{GS} = 5 V$  for logic level devices

Fig. 14 - For N-Channel

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