

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

### PRODUCT SUMMARY

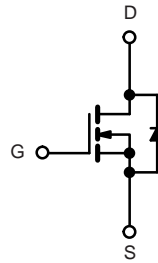
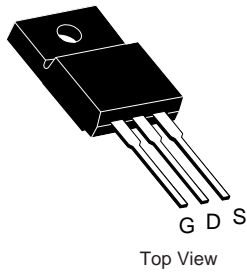
$V_{DS}$ (V)	$R_{DS(on)}$ ( $\Omega$ )	$I_D$ (A) <sup>a</sup>
60	0.010 at $V_{GS} = 10$ V	60
	0.012 at $V_{GS} = 4.5$ V	50

### FEATURES

- 175 °C Junction Temperature
- TrenchFET® Power MOSFET
- Material categorization:


**RoHS**  
 COMPLIANT

TO-220 FULLPAK



N-Channel MOSFET

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

Parameter		Symbol	Limit	Unit
Gate-Source Voltage		$V_{GS}$	$\pm 20$	V
Continuous Drain Current ( $T_J = 175$ °C) <sup>b</sup>	$T_C = 25$ °C	$I_D$	60	A
	$T_C = 100$ °C		50 <sup>a</sup>	
Pulsed Drain Current		$I_{DM}$	200	
Continuous Source Current (Diode Conduction)		$I_S$	50 <sup>a</sup>	
Avalanche Current		$I_{AS}$	50	
Single Avalanche Energy (Duty Cycle $\leq 1$ %)	$L = 0.1$ mH	$E_{AS}$	125	mJ
Maximum Power Dissipation	$T_C = 25$ °C	$P_D$	136	W
	$T_A = 25$ °C		3 <sup>b</sup> , 8.3 <sup>b, c</sup>	
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	- 55 to 175	°C

### THERMAL RESISTANCE RATINGS

Parameter		Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient <sup>a</sup>	$t \leq 10$ sec	$R_{thJA}$	15	18	°C/W
	Steady State		40	50	
Maximum Junction-to-Case		$R_{thJC}$	0.85	1.1	

Notes:

a. Package limited.

b. Surface mounted on 1" x 1" FR4 board.

c.  $t \leq 10$  s.

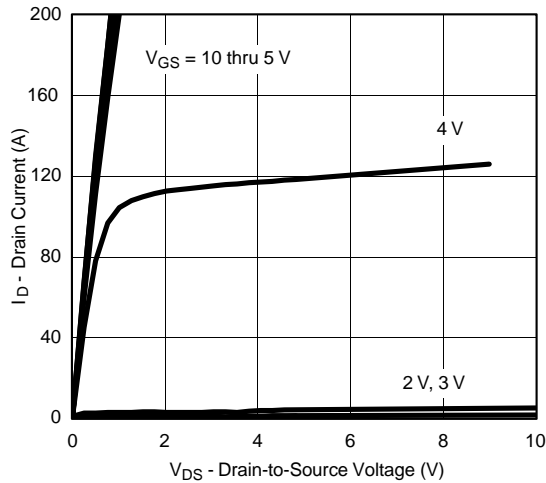
SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)						
Parameter	Symbol	Test Conditions	Min.	Typ. <sup>a</sup>	Max.	Unit
Static						
Drain-Source Breakdown Voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	60			V
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	1	2	3	
Gate-Body Leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V			± 100	nA
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V			1	μA
		V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C			50	
		V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 175 °C			250	
On-State Drain Current <sup>b</sup>	I <sub>D(on)</sub>	V <sub>DS</sub> = 5 V, V <sub>GS</sub> = 10 V	60			A
Drain-Source On-State Resistance <sup>b</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 20 A		0.010	0.012	Ω
		V <sub>GS</sub> = 10 V, I <sub>D</sub> = 20 A, T <sub>J</sub> = 125 °C			0.016	
		V <sub>GS</sub> = 10 V, I <sub>D</sub> = 20 A, T <sub>J</sub> = 175 °C			0.020	
		V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 15 A			0.013	
Forward Transconductance <sup>b</sup>	g <sub>fs</sub>	V <sub>DS</sub> = 15 V, I <sub>D</sub> = 20 A		60		S
Dynamic						
Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 25 V, f = 1 MHz		2650		pF
Output Capacitance	C <sub>oss</sub>			470		
Reverse Transfer Capacitance	C <sub>rss</sub>			225		
Total Gate Charge <sup>c</sup>	Q <sub>g</sub>	V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 50 A		47	70	nC
Gate-Source Charge <sup>c</sup>	Q <sub>gs</sub>			10		
Gate-Drain Charge <sup>c</sup>	Q <sub>gd</sub>			12		
Turn-On Delay Time <sup>c</sup>	t <sub>d(on)</sub>	V <sub>DD</sub> = 30 V, R <sub>L</sub> = 0.6 Ω I <sub>D</sub> ≅ 50 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 2.5 Ω		10	20	ns
Rise Time <sup>c</sup>	t <sub>r</sub>			15	25	
Turn-Off Delay Time <sup>c</sup>	t <sub>d(off)</sub>			35	50	
Fall Time <sup>c</sup>	t <sub>f</sub>			20	30	
Source-Drain Diode Ratings and Characteristics (T <sub>C</sub> = 25 °C)						
Pulsed Current	I <sub>SM</sub>				60	A
Diode Forward Voltage	V <sub>SD</sub>	I <sub>F</sub> = 20 A, V <sub>GS</sub> = 0 V		1	1.5	V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = 20 A, di/dt = 100 A/μs		45	100	ns

Notes:

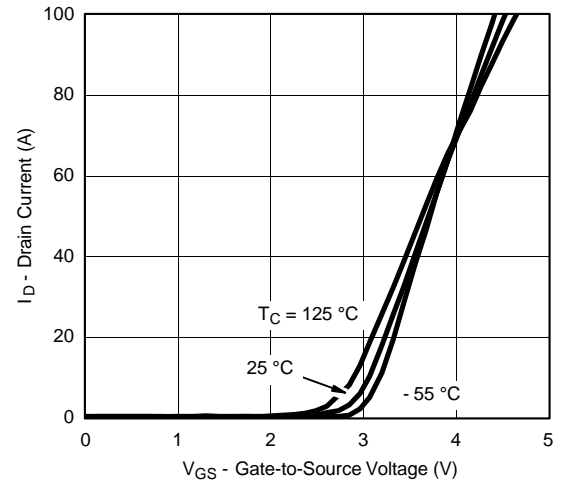
- a. For design aid only; not subject to production testing.  
 b. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
 c. Independent of operating temperature.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

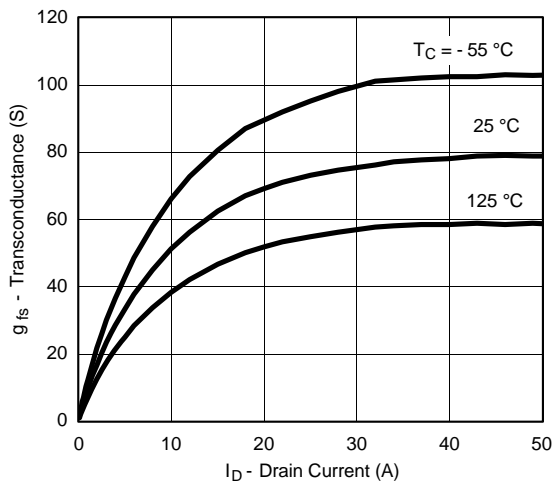
## TYPICAL CHARACTERISTICS (25 °C unless noted)



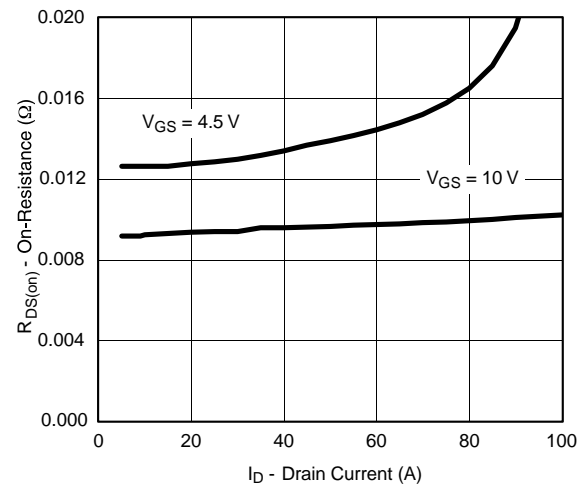
Output Characteristics



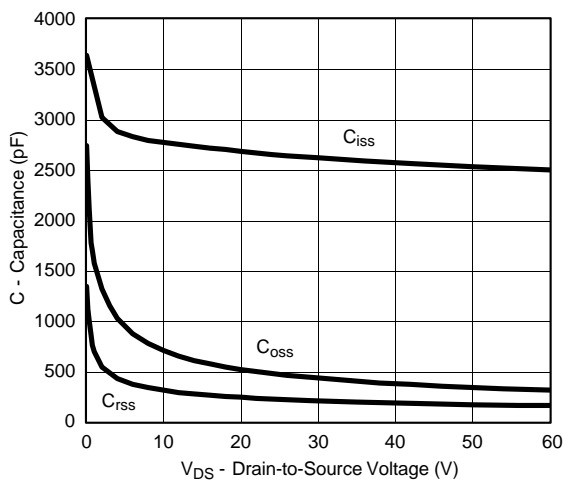
Transfer Characteristics



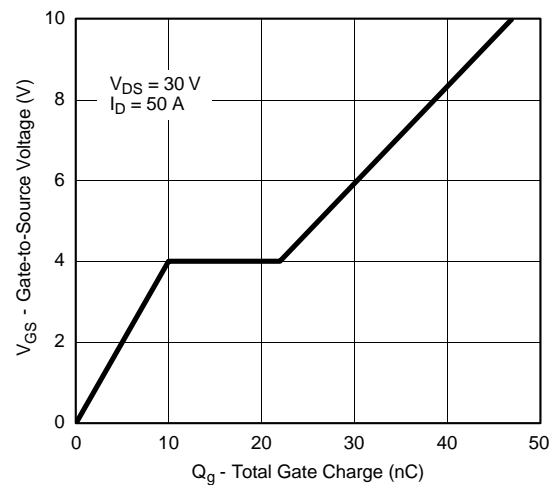
Transconductance



On-Resistance vs. Drain Current



Capacitance

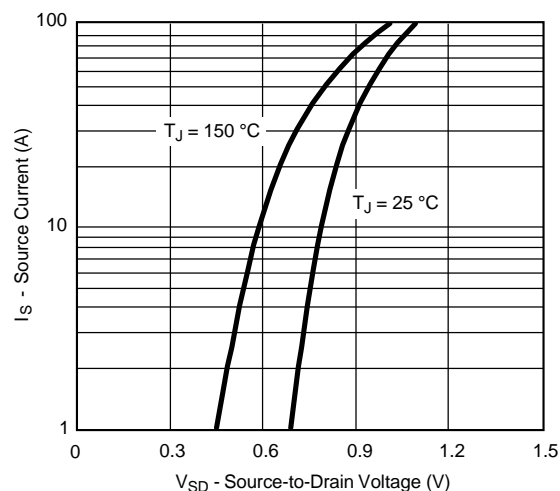


Gate Charge

## TYPICAL CHARACTERISTICS (25 °C unless noted)

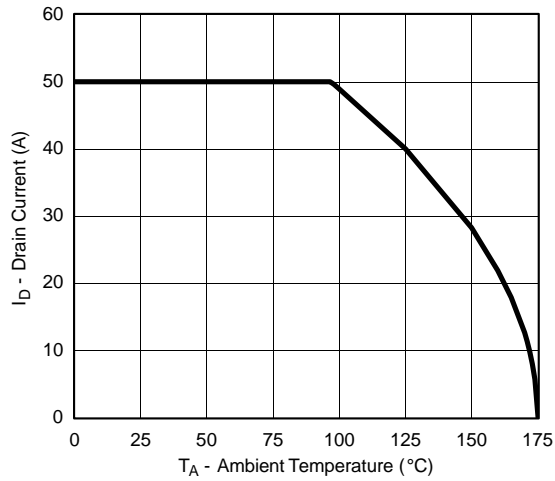


On-Resistance vs. Junction Temperature

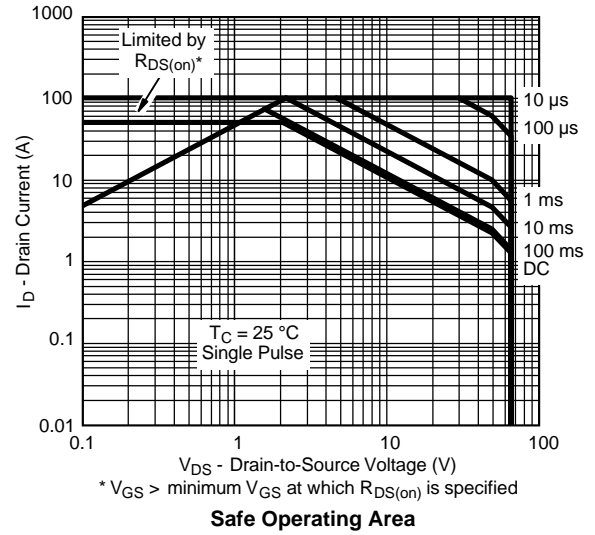


Source-Drain Diode Forward Voltage

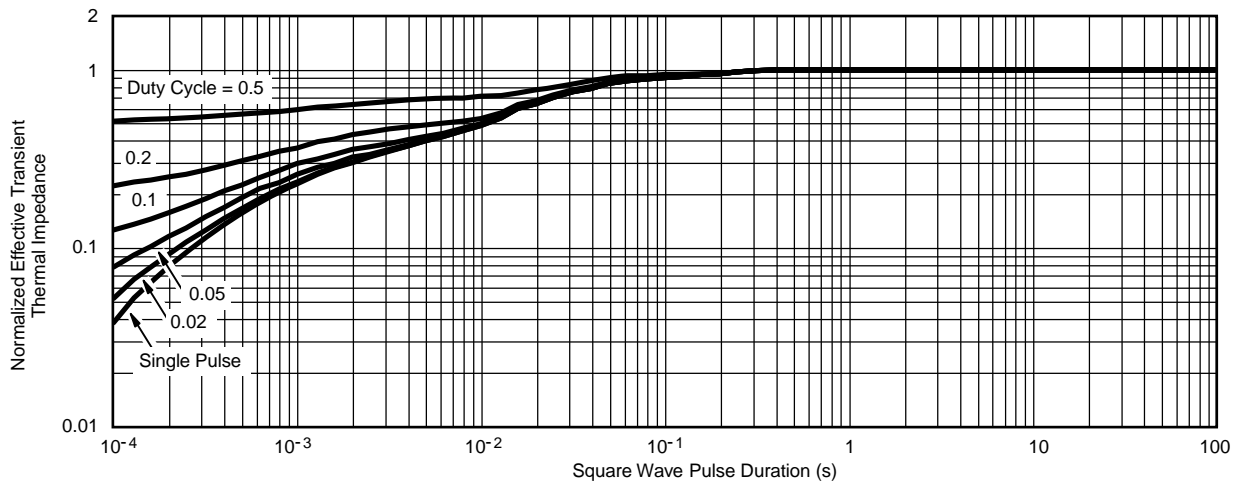
## THERMAL RATINGS



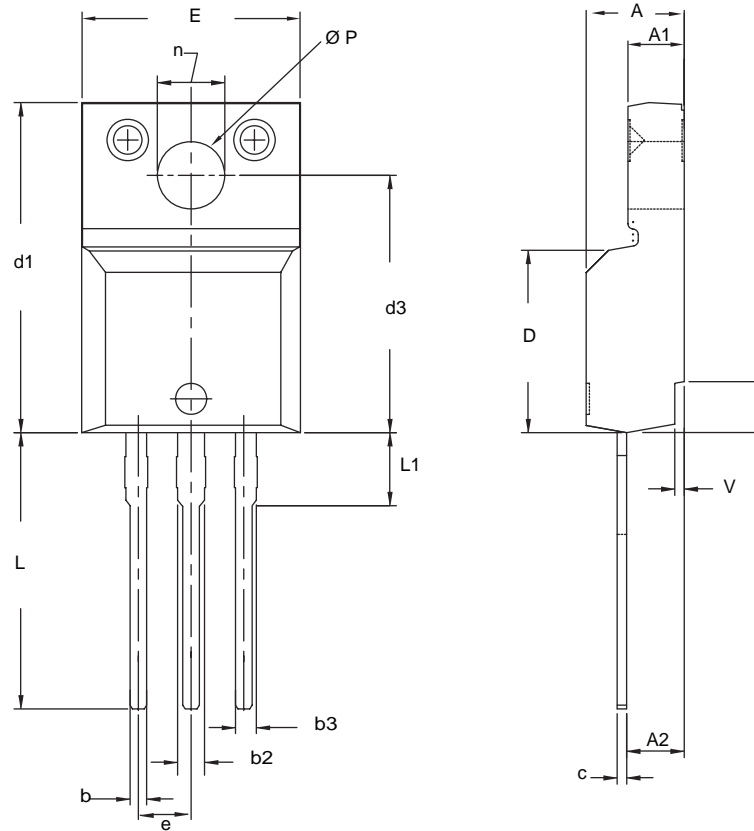
Maximum Drain Current vs. Ambient Temperature



Safe Operating Area



Normalized Thermal Transient Impedance, Junction-to-Case

**TO-220 FULLPAK (HIGH VOLTAGE)**

DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.570	4.830	0.180	0.190
A1	2.570	2.830	0.101	0.111
A2	2.510	2.850	0.099	0.112
b	0.622	0.890	0.024	0.035
b2	1.229	1.400	0.048	0.055
b3	1.229	1.400	0.048	0.055
c	0.440	0.629	0.017	0.025
D	8.650	9.800	0.341	0.386
d1	15.88	16.120	0.622	0.635
d3	12.300	12.920	0.484	0.509
E	10.360	10.630	0.408	0.419
e	2.54 BSC		0.100 BSC	
L	13.200	13.730	0.520	0.541
L1	3.100	3.500	0.122	0.138
n	6.050	6.150	0.238	0.242
Ø P	3.050	3.450	0.120	0.136
u	2.400	2.500	0.094	0.098
v	0.400	0.500	0.016	0.020

ECN: X09-0126-Rev. B, 26-Oct-09  
DWG: 5972

**Notes**

1. To be used only for process drawing.
2. These dimensions apply to all TO-220, FULLPAK leadframe versions 3 leads.
3. All critical dimensions should C meet  $C_{pk} > 1.33$ .
4. All dimensions include burrs and plating thickness.
5. No chipping or package damage.

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