

## P-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</sup>	Q <sub>g</sub> (Typ.)
- 60	0.022 at V <sub>GS</sub> = - 10 V	- 55	147 nC
	0.032 at V <sub>GS</sub> = - 4.5 V	- 40	

### FEATURES

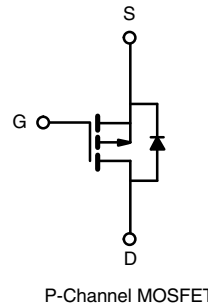
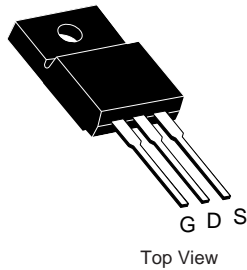
- DT-Trench Power MOSFET
- 100 % R<sub>g</sub> and UIS Tested



### APPLICATIONS

- Load Switch

TO-220 FULLPAK



ABSOLUTE MAXIMUM RATINGS (T <sub>A</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>	± 20	
Continuous Drain Current (T <sub>J</sub> = 150 °C)	I <sub>D</sub>	T <sub>C</sub> = 25 °C	- 55 <sup>a</sup>
		T <sub>C</sub> = 70 °C	- 35
		T <sub>A</sub> = 25 °C	10 <sup>b</sup>
		T <sub>A</sub> = 70 °C	- 6.2 <sup>b</sup>
Pulsed Drain Current	I <sub>DM</sub>	- 220	A
Avalanche Current Pulse	I <sub>AS</sub>	- 55	
Single Pulse Avalanche Energy	E <sub>AS</sub>	255	mJ
Continuous Source-Drain Diode Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	55 <sup>a</sup>
		T <sub>A</sub> = 25 °C	3.1 <sup>b</sup>
Maximum Power Dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	134 <sup>a</sup>
		T <sub>C</sub> = 70 °C	81 <sup>a</sup>
		T <sub>A</sub> = 25 °C	4.2 <sup>b</sup>
		T <sub>A</sub> = 70 °C	1.9 <sup>b</sup>
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 55 to 150	°C

THERMAL RESISTANCE RATINGS					
Parameter	Symbol	Typical	Maximum	Unit	
Maximum Junction-to-Ambient <sup>b</sup>	R <sub>thJA</sub>	40	65	°C/W	
Maximum Junction-to-Case	R <sub>thJC</sub>	0.38	0.62		

Notes:

a. Based on T<sub>C</sub> = 25 °C.

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

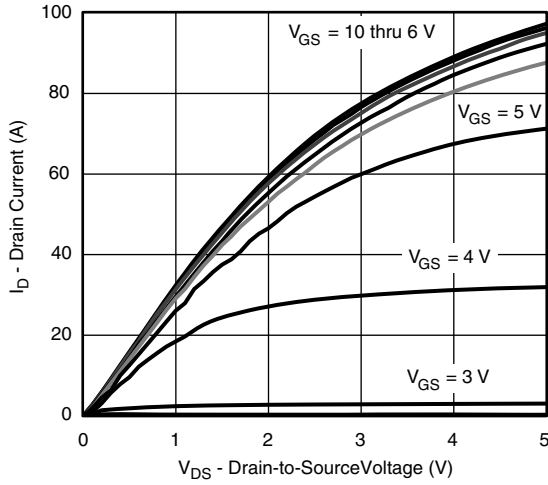
<b>SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	-60			V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = -250\text{ }\mu\text{A}$		38		mV/ $^\circ\text{C}$
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$			-5.2		
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	-1		-3	V
Gate-Source Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -48\text{ V}, V_{GS} = 0\text{ V}$			-1	$\mu\text{A}$
		$V_{DS} = -48\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$			-10	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} = -5\text{ V}, V_{GS} = -10\text{ V}$	-55			A
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = -10\text{ V}, I_D = -30\text{ A}$		0.022	0.03	$\Omega$
		$V_{GS} = -4.5\text{ V}, I_D = -20\text{ A}$		0.032	0.042	
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = -15\text{ V}, I_D = -50\text{ A}$		17		S
<b>Dynamic<sup>b</sup></b>						
Input Capacitance	$C_{iss}$	$V_{DS} = -48\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		7750		pF
Output Capacitance	$C_{oss}$			480		
Reverse Transfer Capacitance	$C_{rss}$			281		
Total Gate Charge	$Q_g$	$V_{DS} = -48\text{ V}, V_{GS} = -10\text{ V}, I_D = -30\text{ A}$		147		nC
				37		
Gate-Source Charge	$Q_{gs}$	$V_{DS} = -48\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -20\text{ A}$		15		
Gate-Drain Charge	$Q_{gd}$			21		
Gate Resistance	$R_g$		$f = 1\text{ MHz}$		4.4	$\Omega$
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -48\text{ V}, R_L = 2\text{ }\Omega$ $I_D \cong -10\text{ A}, V_{GEN} = -10\text{ V}, R_g = 1\text{ }\Omega$		73		ns
Rise Time	$t_r$			158		
Turn-Off Delay Time	$t_{d(off)}$			212		
Fall Time	$t_f$			165		
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25\text{ }^\circ\text{C}$			-55	A
Pulse Diode Forward Current <sup>a</sup>	$I_{SM}$				-220	
Body Diode Voltage	$V_{SD}$	$I_S = -30\text{ A}$		-0.7	-1.5	V
Body Diode Reverse Recovery Time	$t_{rr}$	$I_F = -50\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$		47		ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			57		nC
Reverse Recovery Fall Time	$t_a$			27		ns
Reverse Recovery Rise Time	$t_b$			15		

Notes:

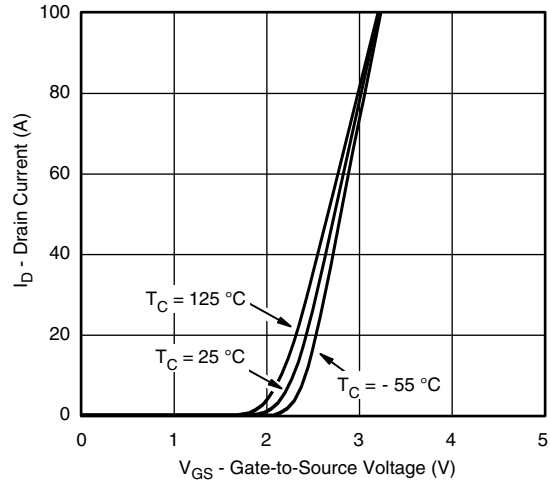
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
 b. Guaranteed by design, not subject to production testing.

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.

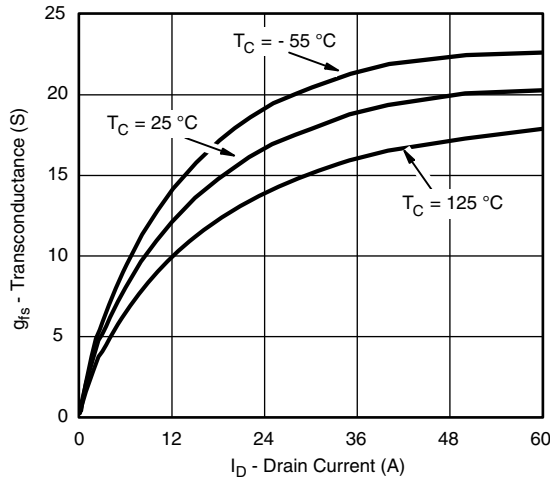
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



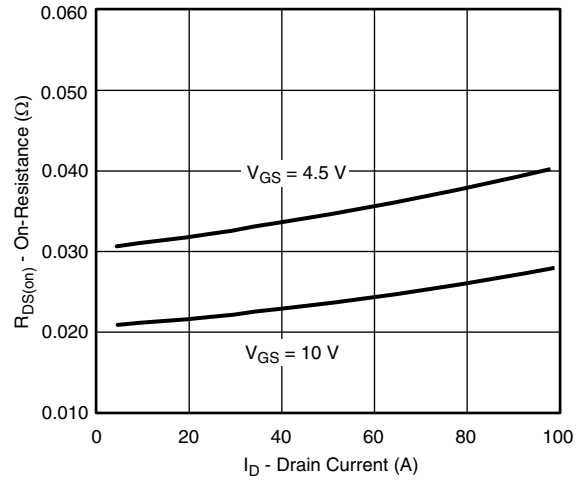
**Output Characteristics**



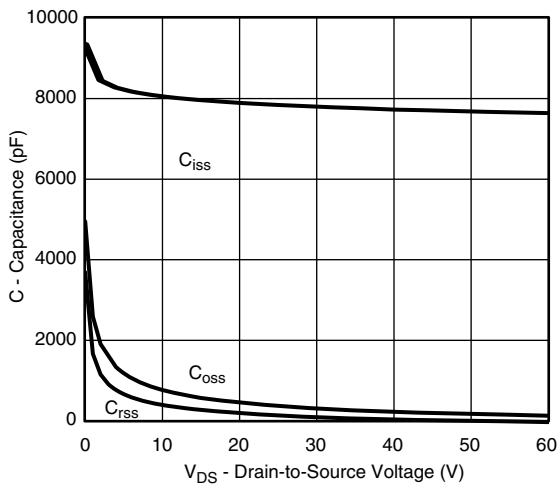
**Transfer Characteristics**



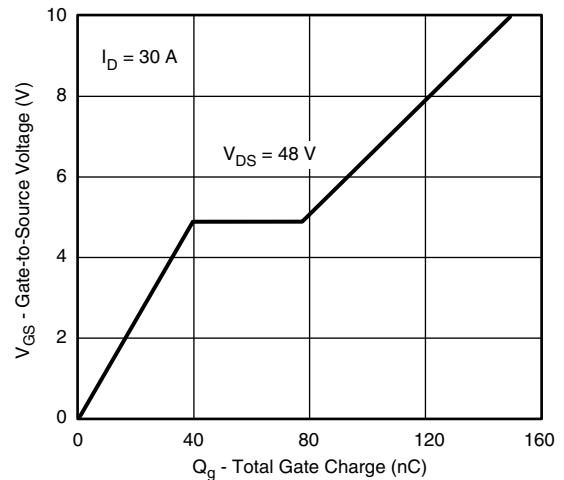
**Transconductance**



**On-Resistance vs. Drain Current**

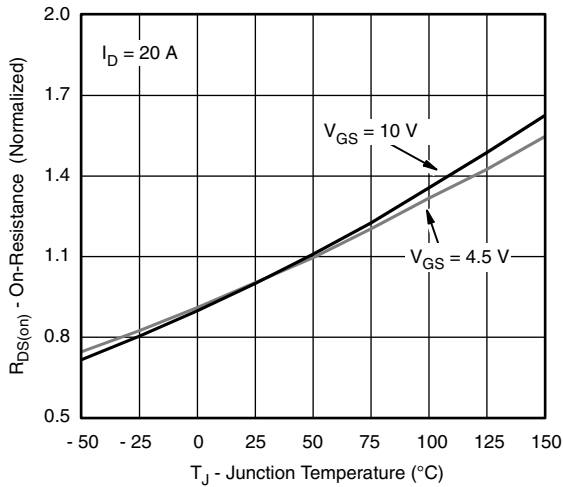


**Capacitance**

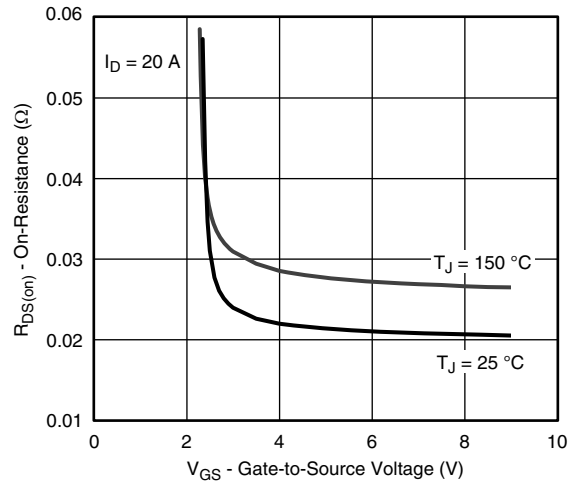


**Gate Charge**

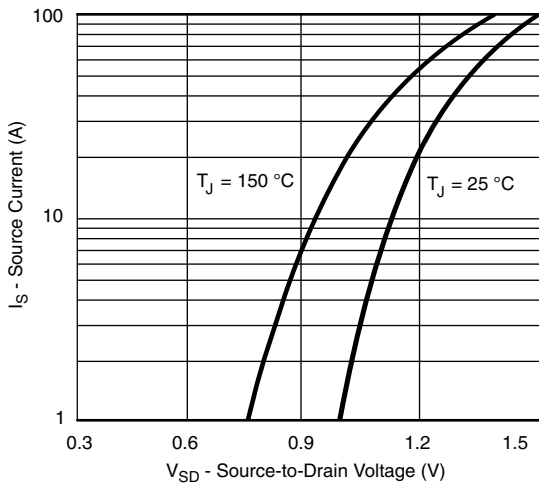
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



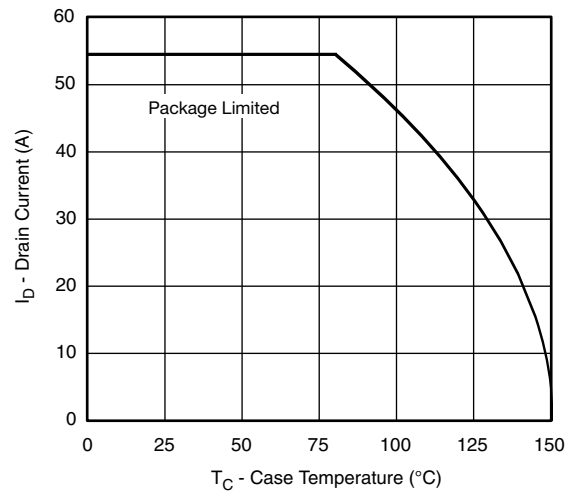
**On-Resistance vs. Gate-to-Source Voltage**



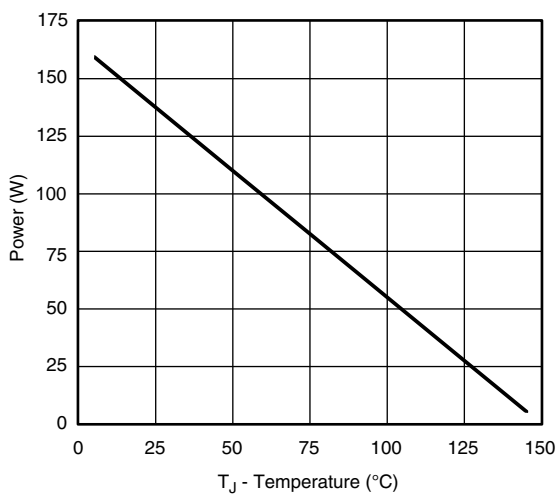
**On-Resistance vs. Gate-to-Source Voltage**



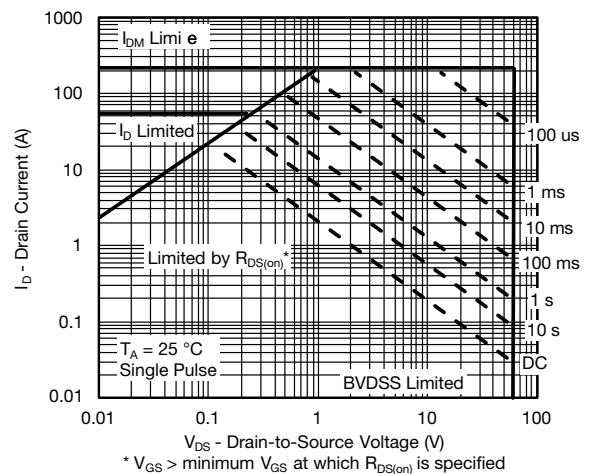
**Source-Drain Diode Forward Voltage**



**Max. Drain Current vs. Case Temperature**



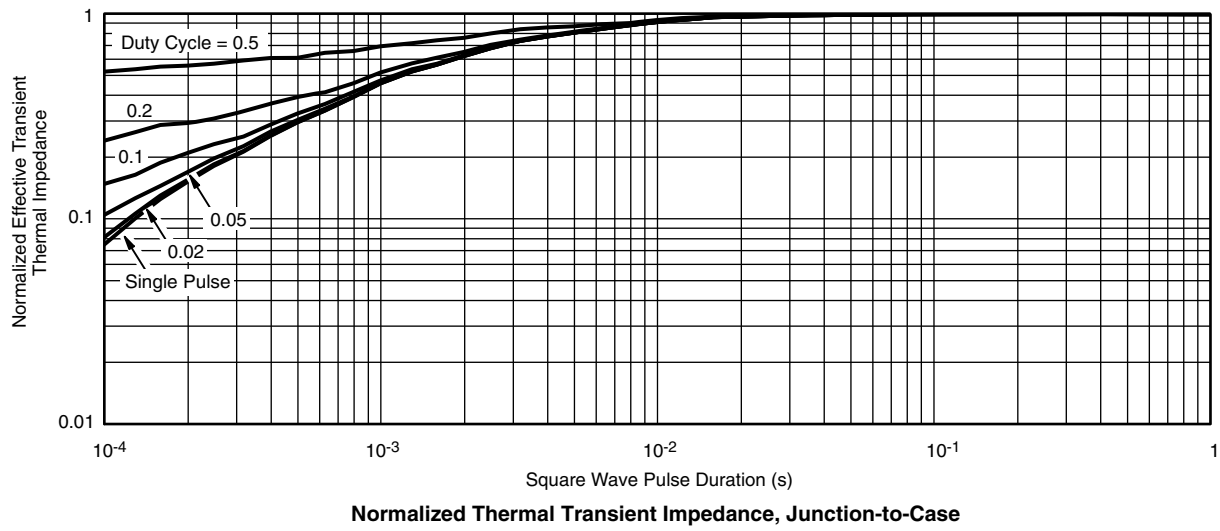
**Power Derating, Junction-to-Case**



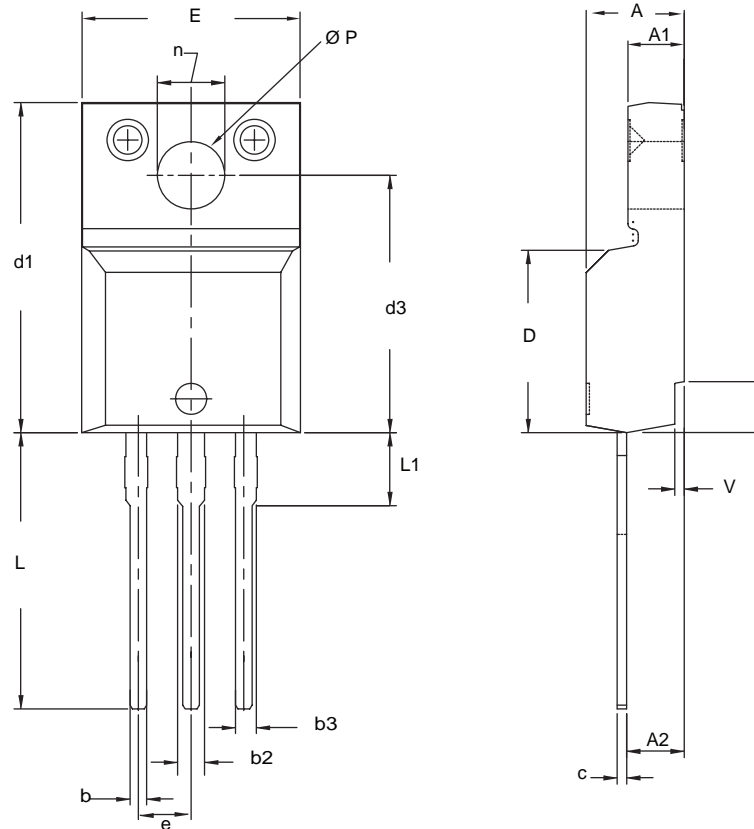
\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

**Safe Operating Area, Junction-to-Ambient**

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



**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
$\varnothing P$	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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