

## P-Channel 60 V (D-S) 175 °C MOSFET

PRODUCT SUMMARY		
V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A) <sup>c</sup>
- 60	0.0093 at V <sub>GS</sub> = - 10 V	- 90
	0.0118 at V <sub>GS</sub> = - 4.5 V	- 90

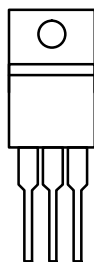
**FEATURES**

- TrenchFET<sup>®</sup> Power MOSFET
- Compliant to RoHS Directive 2002/95/EC


**RoHS**  
COMPLIANT

**APPLICATIONS**

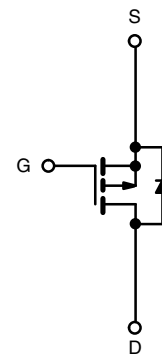
- DC/DC Primary Switch

**TO-220AB**


G D S

Top View

Drain connected to Tab

**Ordering Information:** SUP90P06-09L-E3 (Lead (Pb)-free)


P-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>	± 20		
Continuous Drain Current (T <sub>J</sub> = 175 °C) <sup>c</sup>	T <sub>C</sub> = 25 °C	I <sub>D</sub>	- 90	A
	T <sub>C</sub> = 125 °C		- 67	
Pulsed Drain Current	I <sub>DM</sub>	- 200		
Avalanche Current	L = 0.1 mH	I <sub>AS</sub>	- 65	mJ
Single Pulse Avalanche Energy <sup>a</sup>		E <sub>AS</sub>	211	
Power Dissipation	T <sub>C</sub> = 25 °C	P <sub>D</sub>	250 <sup>b</sup>	W
	T <sub>A</sub> = 25 °C		2.4	
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 55 to 175	°C	

THERMAL RESISTANCE RATINGS			
Parameter	Symbol	Limit	Unit
Junction-to-Ambient Free Air	R <sub>thJA</sub>	62	°C/W
Junction-to-Case	R <sub>thJC</sub>	0.6	

Notes:

a. Duty cycle ≤ 1 %.

b. See SOA curve for voltage derating.

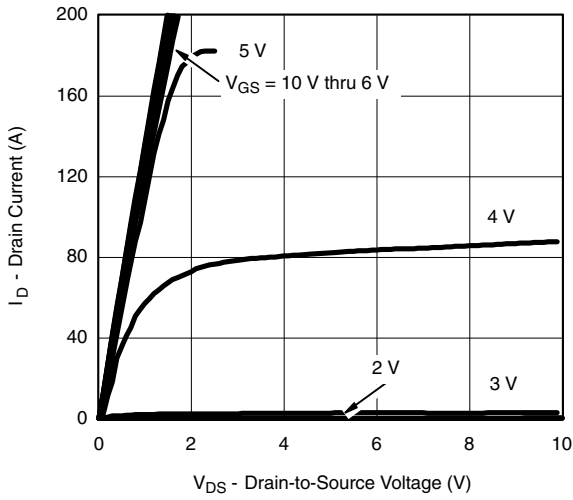
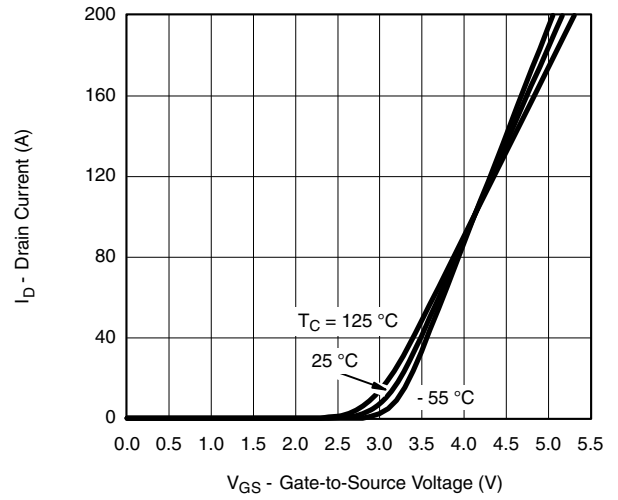
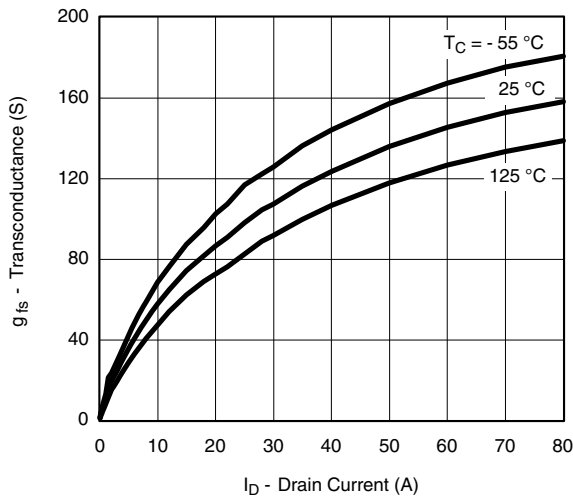
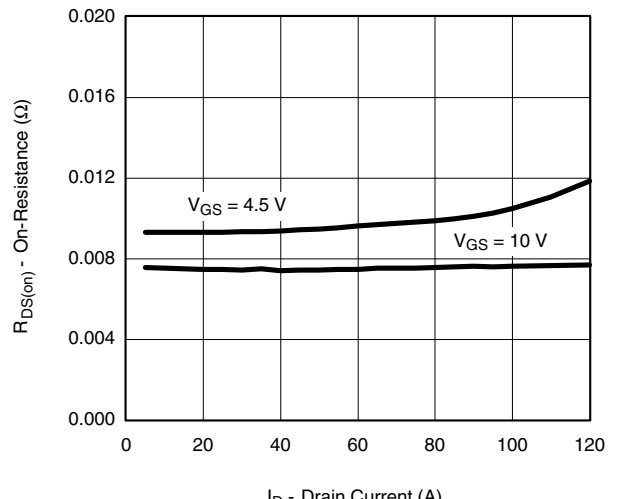
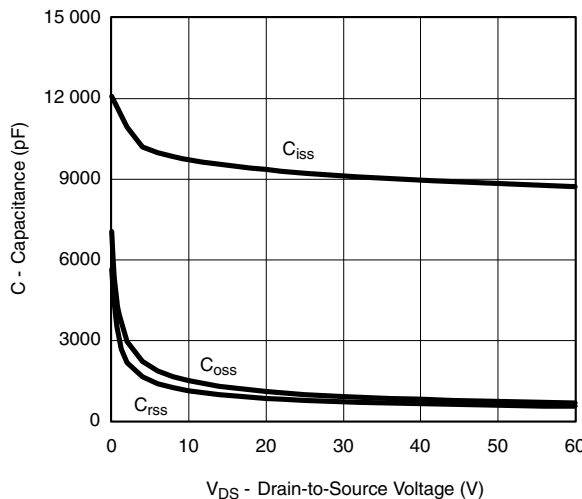
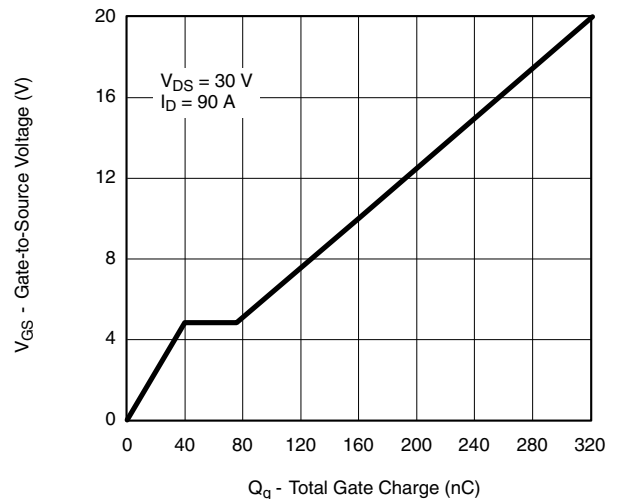
c. Limited by package.

<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
Gate-Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	- 1		- 3	
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -60\text{ V}, V_{GS} = 0\text{ V}$			- 1	$\mu\text{A}$
		$V_{DS} = -60\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$			- 50	
		$V_{DS} = -60\text{ V}, V_{GS} = 0\text{ V}, T_J = 175\text{ }^\circ\text{C}$			- 250	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} = -5\text{ V}, V_{GS} = -10\text{ V}$	- 120			A
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = -10\text{ V}, I_D = -30\text{ A}$		0.0074	0.0093	$\Omega$
		$V_{GS} = -10\text{ V}, I_D = -30\text{ A}, T_J = 125\text{ }^\circ\text{C}$			0.0150	
		$V_{GS} = -10\text{ V}, I_D = -30\text{ A}, T_J = 175\text{ }^\circ\text{C}$			0.0190	
		$V_{GS} = -4.5\text{ V}, I_D = -20\text{ A}$		0.0094	0.0118	
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = -15\text{ V}, I_D = -30\text{ A}$	20			S
<b>Dynamic<sup>b</sup></b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, V_{DS} = -25\text{ V}, f = 1\text{ MHz}$		9200		pF
Output Capacitance	$C_{oss}$			975		
Reverse Transfer Capacitance	$C_{rss}$			760		
Total Gate Charge <sup>c</sup>	$Q_g$	$V_{DS} = -30\text{ V}, V_{GS} = -10\text{ V}, I_D = -90\text{ A}$		160	240	nC
Gate-Source Charge <sup>c</sup>	$Q_{gs}$			40		
Gate-Drain Charge <sup>c</sup>	$Q_{gd}$			36		
Gate Resistance	$R_g$	$f = 1.0\text{ MHz}$		3		$\Omega$
Turn-On Delay Time <sup>c</sup>	$t_{d(on)}$	$V_{DD} = -30\text{ V}, R_L = 0.33\text{ }\Omega$ $I_D \cong -90\text{ A}, V_{GEN} = -10\text{ V}, R_g = 2.5\text{ }\Omega$		20	30	ns
Rise Time <sup>c</sup>	$t_r$			190	285	
Turn-Off Delay Time <sup>c</sup>	$t_{d(off)}$			140	210	
Fall Time <sup>c</sup>	$t_f$			300	450	
<b>Source-Drain Diode Ratings and Characteristics</b> ( $T_C = 25\text{ }^\circ\text{C}$ ) <sup>b</sup>						
Continuous Current	$I_S$				- 90	A
Pulsed Current	$I_{SM}$				- 200	
Forward Voltage <sup>a</sup>	$V_{SD}$	$I_F = -50\text{ A}, V_{GS} = 0\text{ V}$		- 1.0	- 1.5	V
Reverse Recovery Time	$t_{rr}$	$I_F = -50\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$		60	90	ns
Peak Reverse Recovery Current	$I_{RM(REC)}$			- 3	- 4.5	A
Reverse Recovery Charge	$Q_{rr}$				0.09	0.2

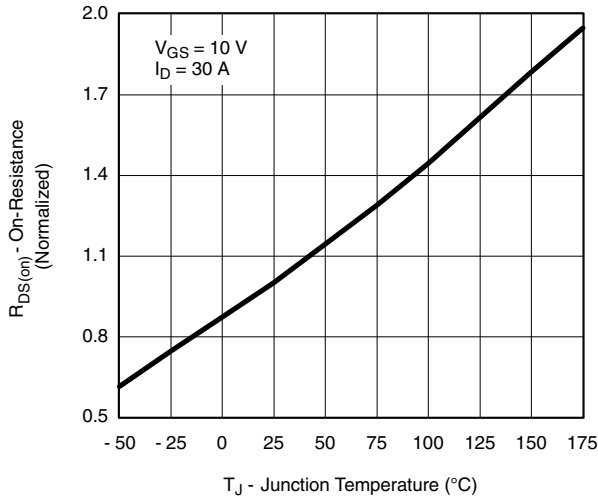
Notes:

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

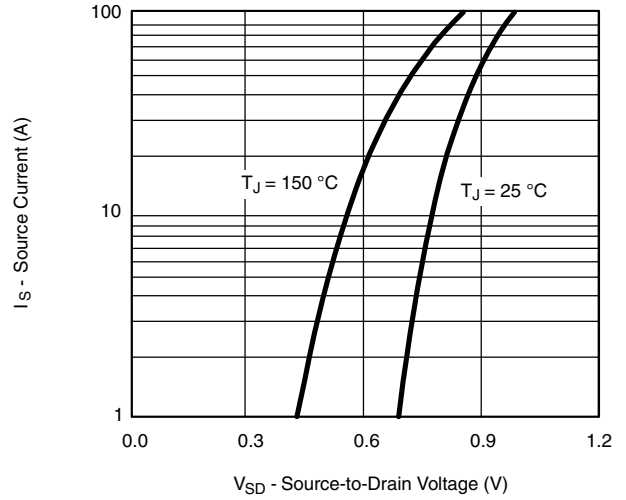
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

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

**Output Characteristics**

**Transfer Characteristics**

**Transconductance**

**On-Resistance vs. Drain Current**

**Capacitance**

**Gate Charge**

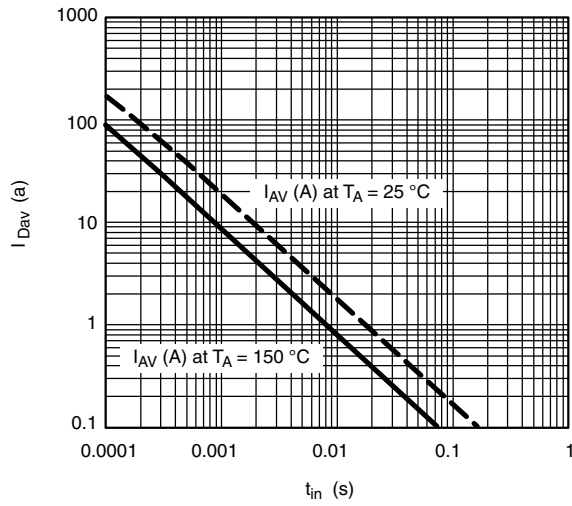
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



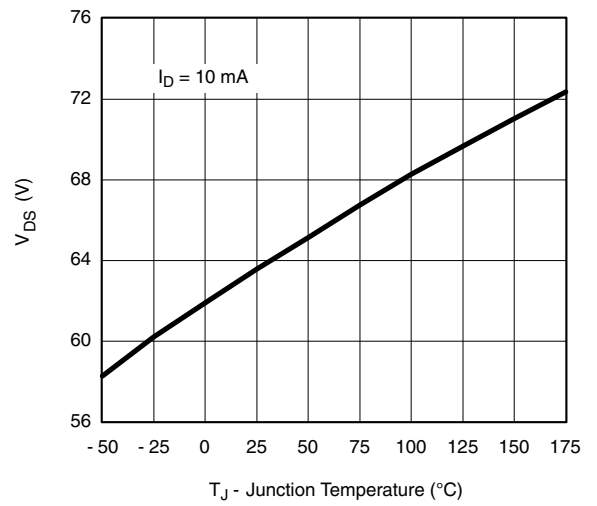
**On-Resistance vs. Junction Temperature**



**Source-Drain Diode Forward Voltage**

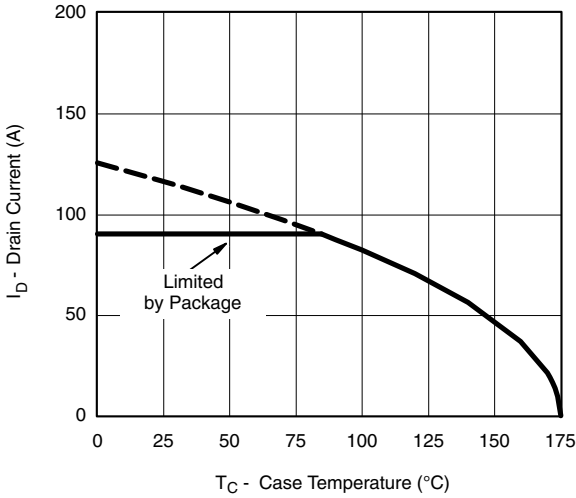


**Avalanche Current vs. Time**

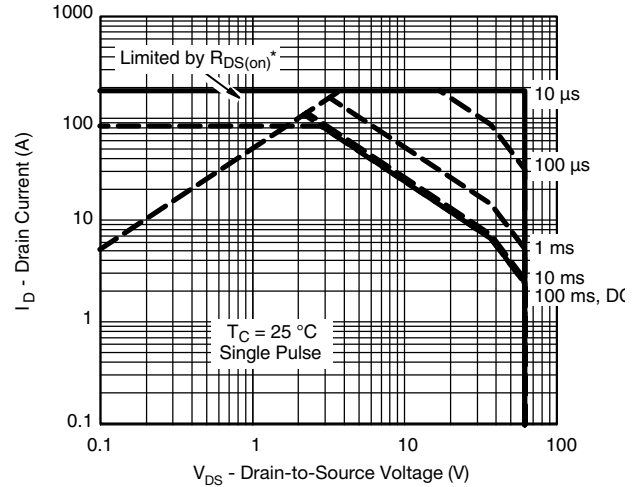


**Drain Source Breakdown vs. Junction Temperature**

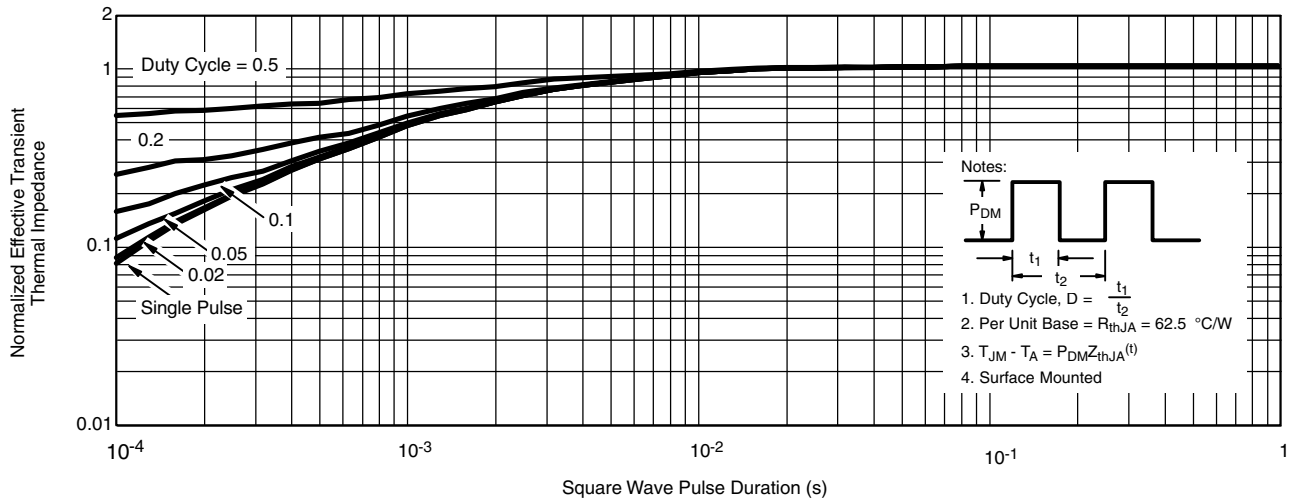
**THERMAL RATINGS**



**Maximum Avalanche and Drain Current vs. Case Temperature**



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



**Normalized Thermal Transient Impedance, Junction-to-Case**

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### TO-220AB

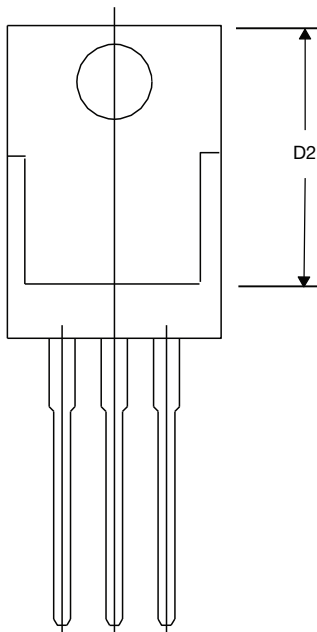


DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.25	4.65	0.167	0.183
b	0.69	1.01	0.027	0.040
b(1)	1.20	1.73	0.047	0.068
c	0.36	0.61	0.014	0.024
D	14.85	15.49	0.585	0.610
D2	12.19	12.70	0.480	0.500
E	10.04	10.51	0.395	0.414
e	2.41	2.67	0.095	0.105
e(1)	4.88	5.28	0.192	0.208
F	1.14	1.40	0.045	0.055
H(1)	6.09	6.48	0.240	0.255
J(1)	2.41	2.92	0.095	0.115
L	13.35	14.02	0.526	0.552
L(1)	3.32	3.82	0.131	0.150
$\varnothing P$	3.54	3.94	0.139	0.155
Q	2.60	3.00	0.102	0.118

ECN: T14-0413-Rev. P, 16-Jun-14  
DWG: 5471

**Note**

\* M = 1.32 mm to 1.62 mm (dimension including protrusion)  
Heatsink hole for HVM





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