

## F9204-VB Datasheet

### P-Channel 40 V (D-S) MOSFET

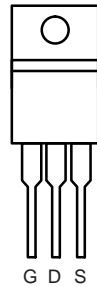
PRODUCT SUMMARY		
V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A) <sup>a</sup>
- 40	0.012 at V <sub>GS</sub> = - 10 V	± 65
	0.014 at V <sub>GS</sub> = - 4.5 V	± 60

**FEATURES**

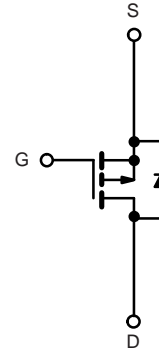
- Compliant to RoHS Directive 2002/95/EC



TO-220AB



Top View



P-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted)			
Parameter	Symbol	Limit	Unit
Gate-Source Voltage	V <sub>GS</sub>	± 40	V
Continuous Drain Current (T <sub>J</sub> = 175 °C)	I <sub>D</sub>	T <sub>C</sub> = 25 °C	- 65 <sup>a</sup>
		T <sub>C</sub> = 125 °C	- 62
Pulsed Drain Current	I <sub>DM</sub>	- 60	A
Avalanche Current	I <sub>AR</sub>	- 60	
Repetitive Avalanche Energy <sup>b</sup>	E <sub>AR</sub>	180	mJ
Power Dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C (TO-220AB and TO-263)	187 <sup>d</sup>
		T <sub>A</sub> = 25 °C (TO-263) <sup>c</sup>	3.75
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	R <sub>thJA</sub>	PCB Mount (TO-263) <sup>c</sup>	40
		Free Air (TO-220AB)	62.5
Junction-to-Case	R <sub>thJC</sub>	0.8	°C/W

Notes:

- a. Package limited.
- b. Duty cycle ≤ 1 %.
- c. When mounted on 1" square PCB (FR-4 material).
- d. See SOA curve for voltage derating.

\* Pb containing terminations are not RoHS compliant, exemptions may apply.

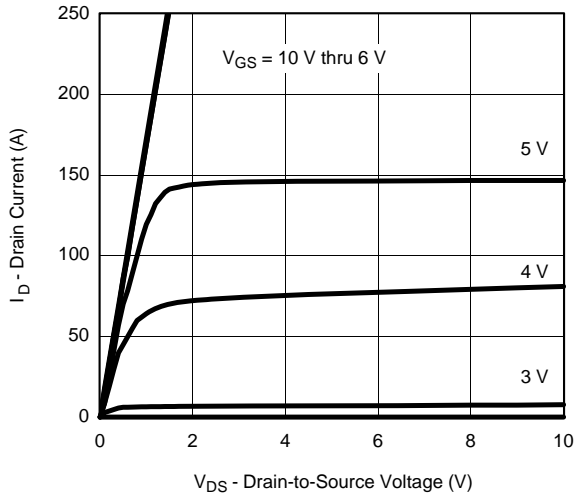
<b>SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	-40			V
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	-1.5		-1.7	
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -30\text{ V}, V_{GS} = 0\text{ V}$			-1	$\mu\text{A}$
		$V_{DS} = -30\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$			-50	
		$V_{DS} = -30\text{ V}, V_{GS} = 0\text{ V}, T_J = 175\text{ }^\circ\text{C}$			-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>	$R_{DS(on)}$	$V_{GS} = -10\text{ V}, I_D = -30\text{ A}$		0.012		$\Omega$
		$V_{GS} = -10\text{ V}, I_D = -30\text{ A}, T_J = 125\text{ }^\circ\text{C}$		0.010		
		$V_{GS} = -10\text{ V}, I_D = -30\text{ A}, T_J = 175\text{ }^\circ\text{C}$		0.013		
		$V_{GS} = -4.5\text{ V}, I_D = -20\text{ A}$		0.014		
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = -15\text{ V}, I_D = -75\text{ A}$	20			S
<b>Dynamic<sup>b</sup></b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, V_{DS} = -25\text{ V}, f = 1\text{ MHz}$		9000		$\mu\text{F}$
Output Capacitance	$C_{oss}$			1565		
Reverse Transfer Capacitance	$C_{rss}$			715		
Total Gate Charge <sup>c</sup>	$Q_g$	$V_{DS} = -15\text{ V}, V_{GS} = -10\text{ V}, I_D = -75\text{ A}$		160	240	nC
Gate-Source Charge <sup>c</sup>	$Q_{gs}$			32		
Gate-Drain Charge <sup>c</sup>	$Q_{gd}$			30		
Turn-On Delay Time <sup>c</sup>	$t_{d(on)}$	$V_{DD} = -15\text{ V}, R_L = 0.2\text{ }\Omega$ $I_D \equiv -75\text{ A}, V_{GEN} = -10\text{ V}, R_g = 2.5\text{ }\Omega$		25	40	ns
Rise Time <sup>c</sup>	$t_r$			225	360	
Turn-Off Delay Time <sup>c</sup>	$t_{d(off)}$			150	240	
Fall Time <sup>c</sup>	$t_f$			210	340	
<b>Source-Drain Diode Ratings and Characteristics<sup>b</sup></b> ( $T_C = 25\text{ }^\circ\text{C}$ )						
Continuous Current	$I_S$				-80	A
Pulsed Current	$I_{SM}$				-240	
Forward Voltage <sup>a</sup>	$V_{SD}$	$I_F = -75\text{ A}, V_{GS} = 0\text{ V}$		-1.2	-1.5	V
Reverse Recovery Time	$t_{rr}$	$I_F = -75\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$		55	100	ns
Peak Reverse Recovery Current	$I_{RM(REC)}$			2.5	5	A
Reverse Recovery Charge	$Q_{rr}$			0.07	0.25	$\mu\text{C}$

Notes:

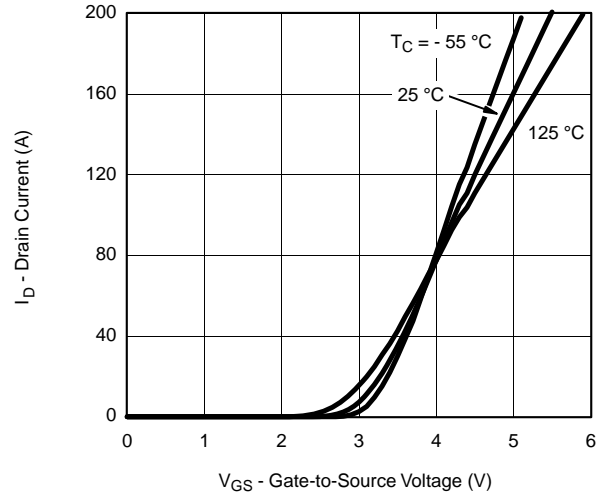
- Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .
- Guaranteed by design, not subject to production testing.
- Independent of operating temperature.

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)



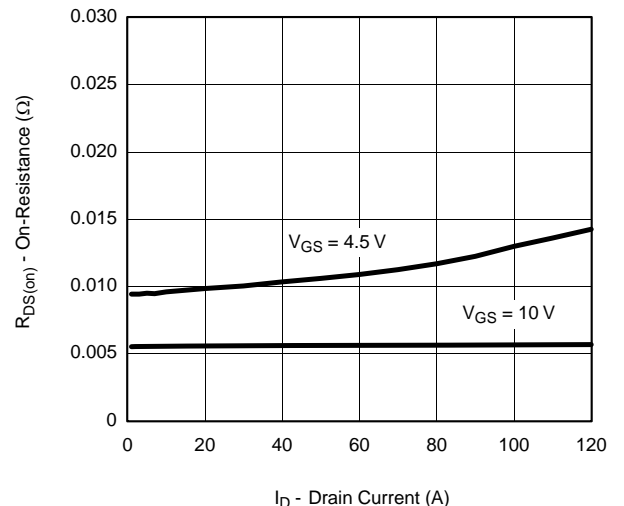
**Output Characteristics**



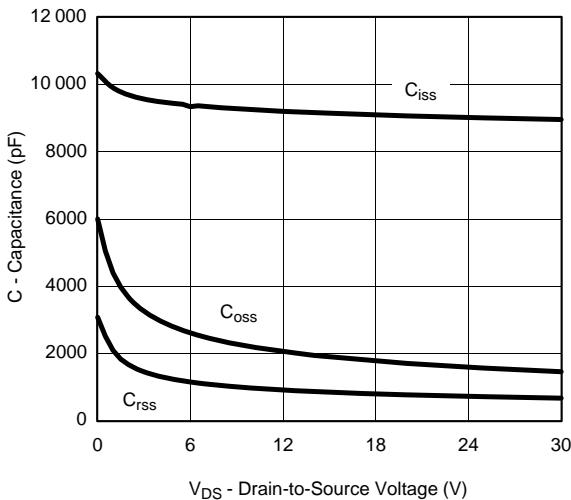
**Transfer Characteristics**



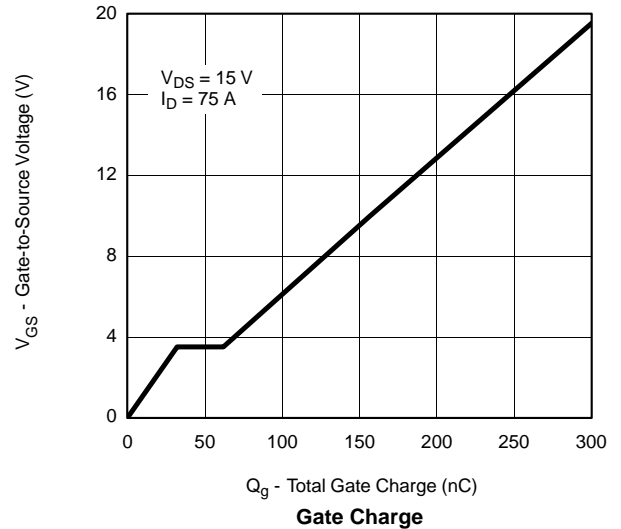
**Transconductance**



**On-Resistance vs. Drain Current**

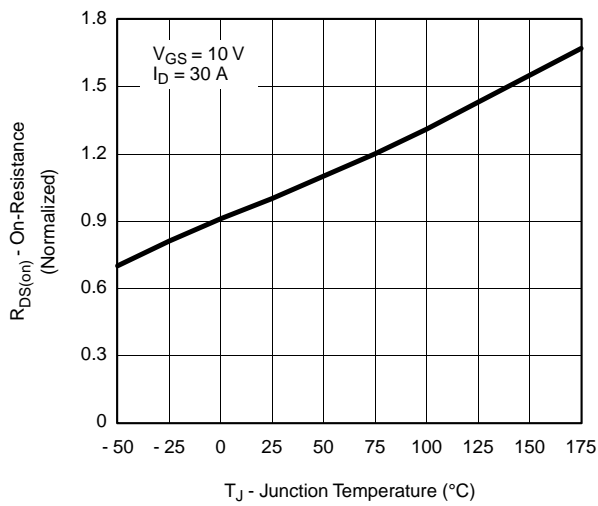


**Capacitance**

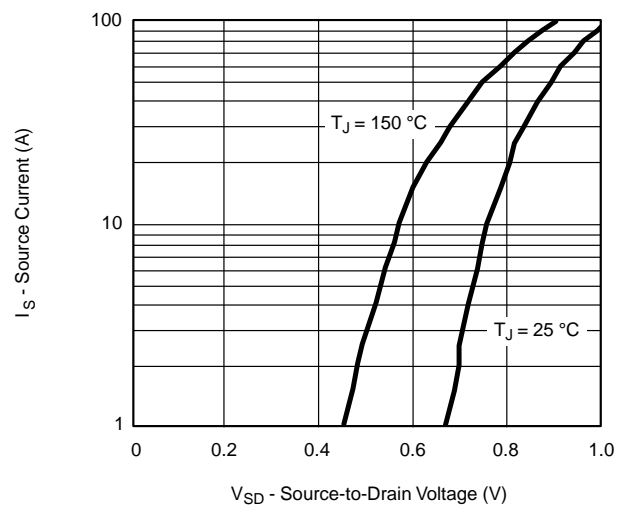


**Gate Charge**

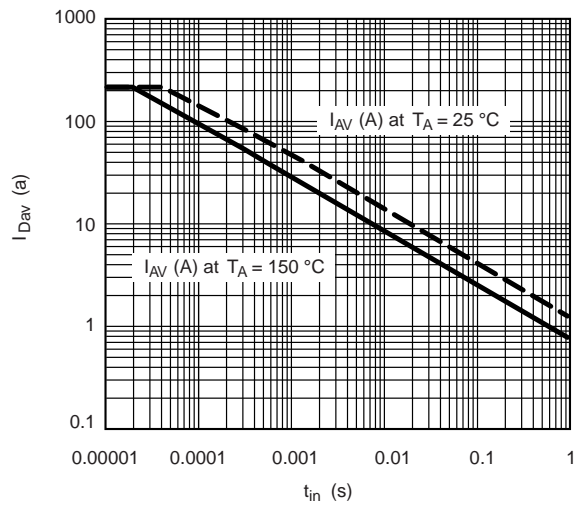
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



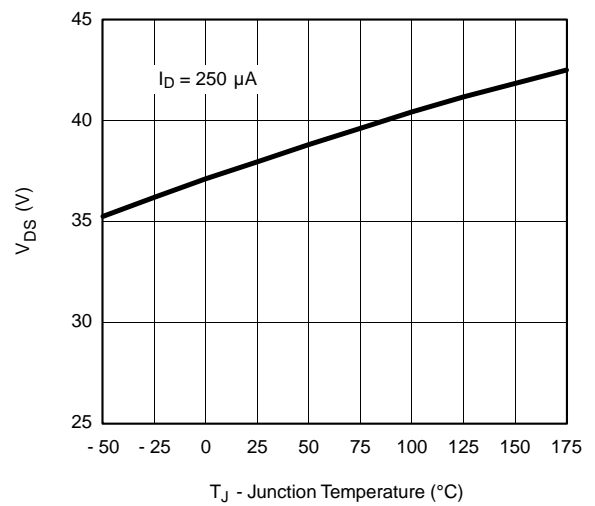
**On-Resistance vs. Junction Temperature**



**Source-Drain Diode Forward Voltage**

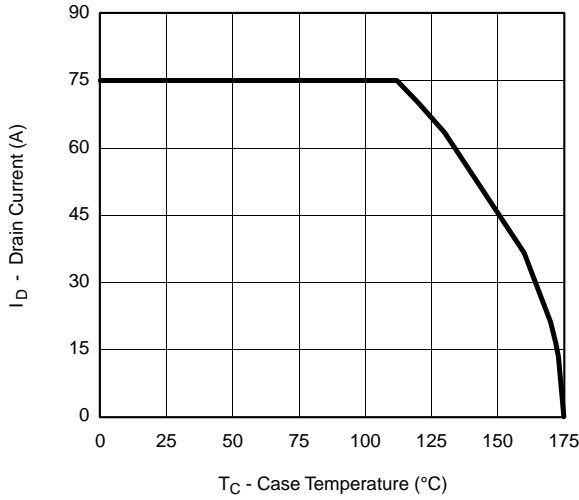


**Avalanche Current vs. Time**

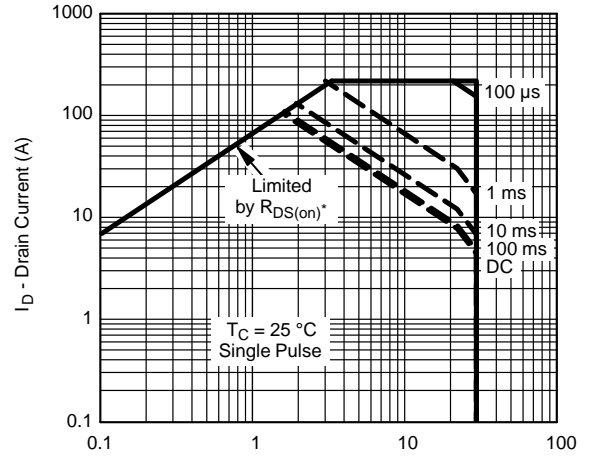


**Drain Source Breakdown vs. Junction Temperature**

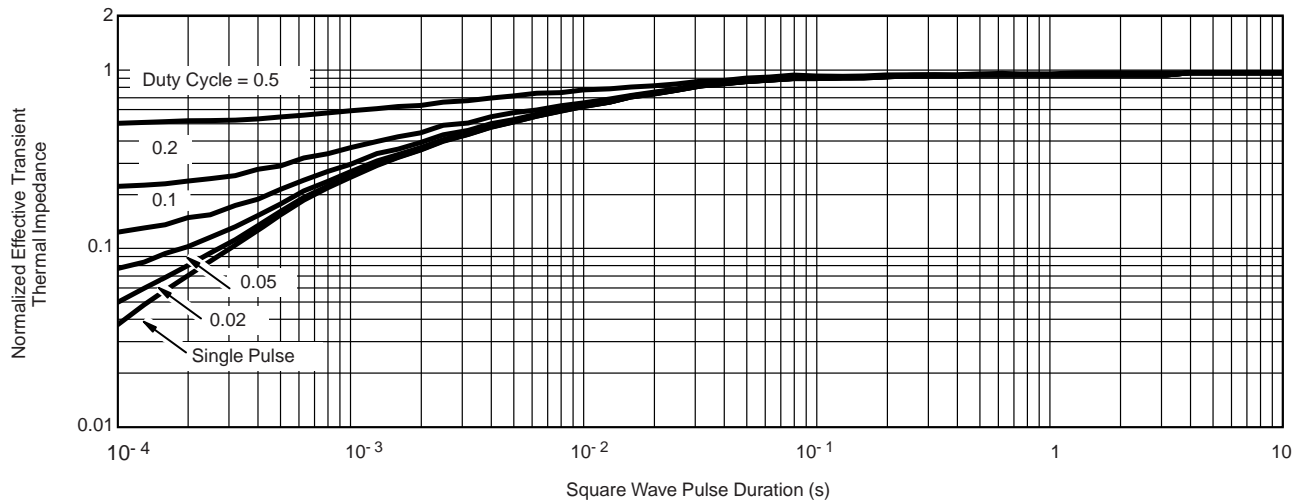
**THERMAL RATINGS**



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

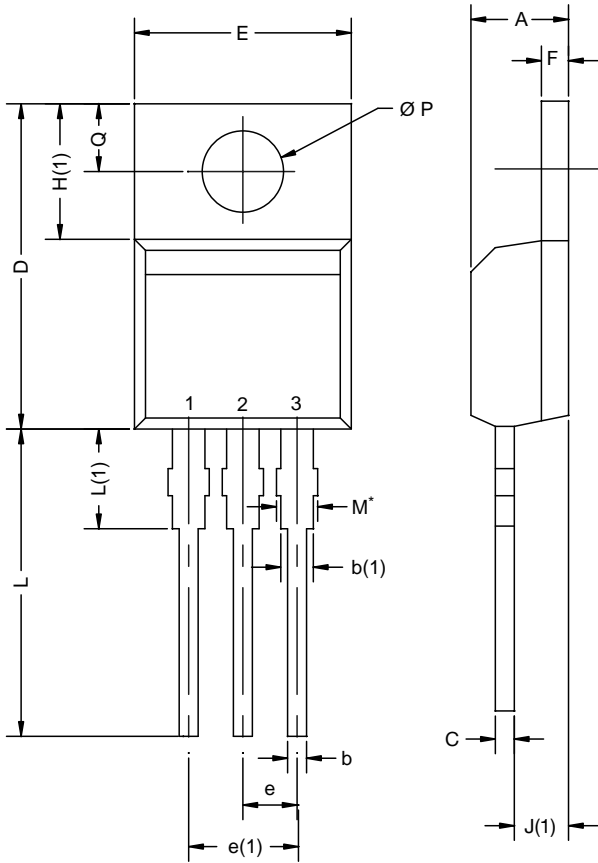


**Safe Operating Area**  
\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified



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

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
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
Ø P	3.54	3.94	0.139	0.155
Q	2.60	3.00	0.102	0.118

ECN: X12-0208-Rev. N, 08-Oct-12  
DWG: 5471

Notes

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

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