

## 2SK209-VB Datasheet

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

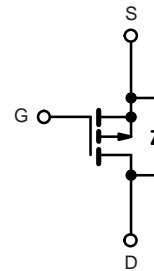
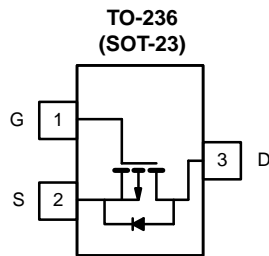
PRODUCT SUMMARY			
$V_{DS}$ (V)	$R_{DS(on)}$ ( $\Omega$ )	$V_{GS(th)}$ (V)	$I_D$ (mA)
- 60	3 at $V_{GS} = - 10$ V	- 1 to - 3	-500

#### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET<sup>®</sup> Power MOSFET
- High-Side Switching
- Low On-Resistance: 3  $\Omega$
- Low Threshold: - 2 V (typ.)
- Fast Switching Speed: 20 ns (typ.)
- Low Input Capacitance: 20 pF (typ.)
- Compliant to RoHS Directive 2002/95/EC



**RoHS**  
COMPLIANT



P-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS $T_A = 25$ °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 <sup>a</sup>	$I_D$	$T_A = 25$ °C	- 500
		$T_A = 100$ °C	- 350
Pulsed Drain Current <sup>b</sup>	$I_{DM}$	-1500	mA
Power Dissipation <sup>a</sup>	$P_D$	$T_A = 25$ °C	
		$T_A = 100$ °C	240
Maximum Junction-to-Ambient <sup>a</sup>	$R_{thJA}$	350	°C/W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to 150	°C

Notes:

a. Surface mounted on FR4 board.

b. Pulse width limited by maximum junction temperature.

<b>SPECIFICATIONS</b> $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Limits			Unit
			Min.	Typ. <sup>a</sup>	Max.	
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = -10\text{ }\mu\text{A}$	- 60			V
Gate-Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	- 1		- 3	
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
		$V_{DS} = 0\text{ V}, V_{GS} = \pm 10\text{ V}$			$\pm 200$	
		$V_{DS} = 0\text{ V}, V_{GS} = \pm 10\text{ V}, T_J = 85\text{ }^\circ\text{C}$			$\pm 500$	nA
		$V_{DS} = 0\text{ V}, V_{GS} = \pm 5\text{ V}$			$\pm 100$	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -60\text{ V}, V_{GS} = 0\text{ V}$			- 25	
		$V_{DS} = -60\text{ V}, V_{GS} = 0\text{ V}, T_J = 85\text{ }^\circ\text{C}$			- 250	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{GS} = -10\text{ V}, V_{DS} = -4.5\text{ V}$	- 50			mA
		$V_{GS} = -10\text{ V}, V_{DS} = -10\text{ V}$	- 600			
Drain-Source On-Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = -4.5\text{ V}, I_D = -25\text{ mA}$		4		$\Omega$
		$V_{GS} = -10\text{ V}, I_D = -100\text{ mA}$		3		
		$V_{GS} = -10\text{ V}, I_D = -100\text{ mA}, T_J = 125\text{ }^\circ\text{C}$		9		
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = -10\text{ V}, I_D = -100\text{ mA}$	80			mS
Diode Forward Voltage	$V_{SD}$	$I_S = -100\text{ mA}, V_{GS} = 0\text{ V}$			- 1.4	V
<b>Dynamic</b>						
Total Gate Charge	$Q_g$	$V_{DS} = -30\text{ V}, V_{GS} = -15\text{ V}$ $I_D \cong -100\text{ mA}$		2.0		nC
Gate-Source Charge	$Q_{gs}$			1.2		
Gate-Drain Charge	$Q_{gd}$			0.8		
Input Capacitance	$C_{iss}$	$V_{DS} = -25\text{ V}, V_{GS} = 0\text{ V}$ $f = 1\text{ MHz}$		23		pF
Output Capacitance	$C_{oss}$			10		
Reverse Transfer Capacitance	$C_{rss}$			5		
<b>Switching<sup>b</sup></b>						
Turn-On Time	$t_{d(on)}$	$V_{DD} = -25\text{ V}, R_L = 150\text{ }\Omega$ $I_D \cong -200\text{ mA}, V_{GEN} = -10\text{ V}, R_g = 10\text{ }\Omega$		20		ns
Turn-Off Time	$t_{d(off)}$			35		

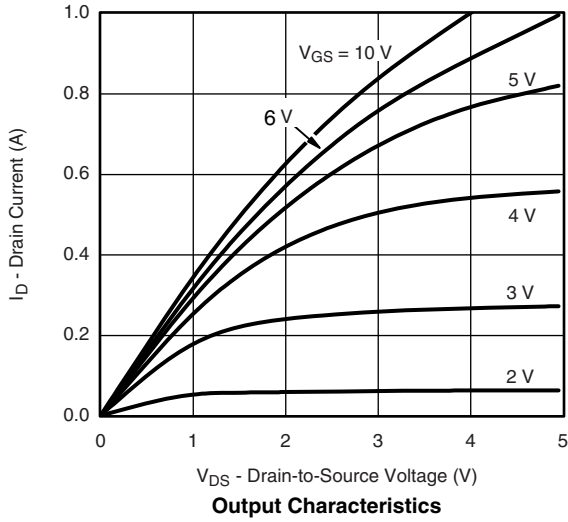
Notes:

a. Pulse test:  $PW \leq 300\text{ }\mu\text{s}$  duty cycle  $\leq 2\%$ .

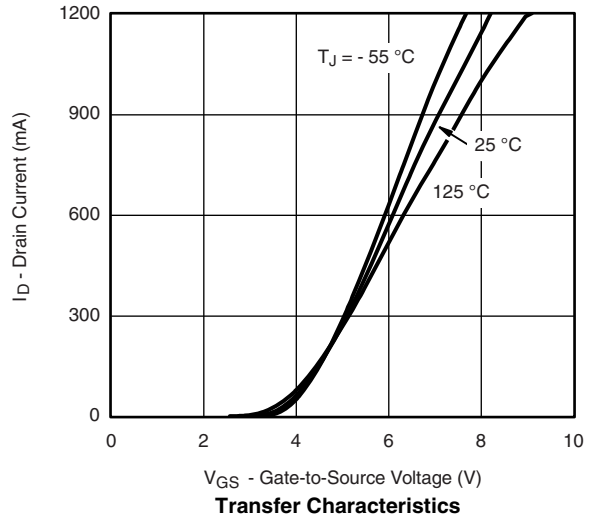
b. Switching time is essentially independent of operating temperature.

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



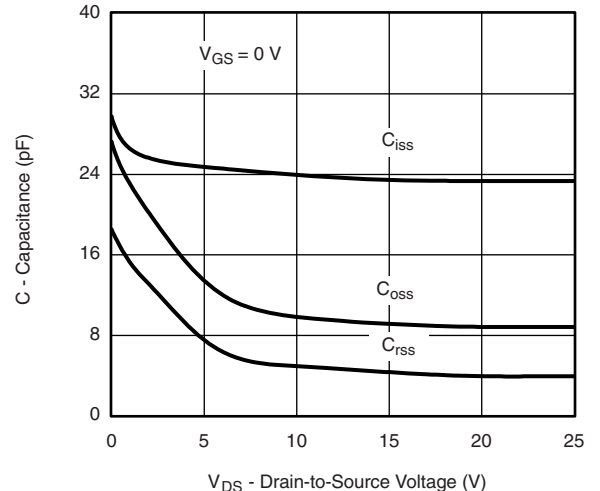
**Output Characteristics**



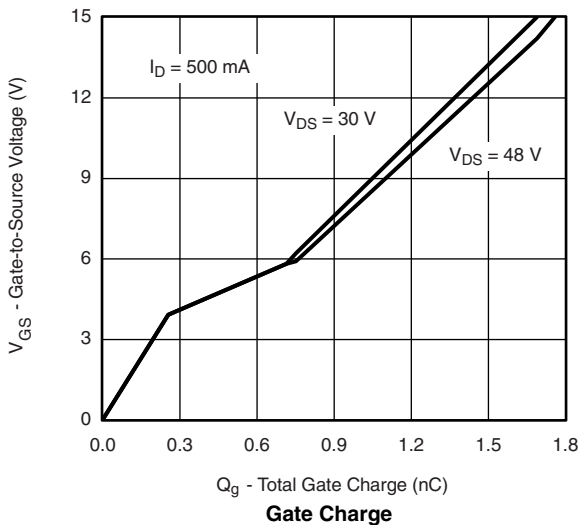
**Transfer Characteristics**



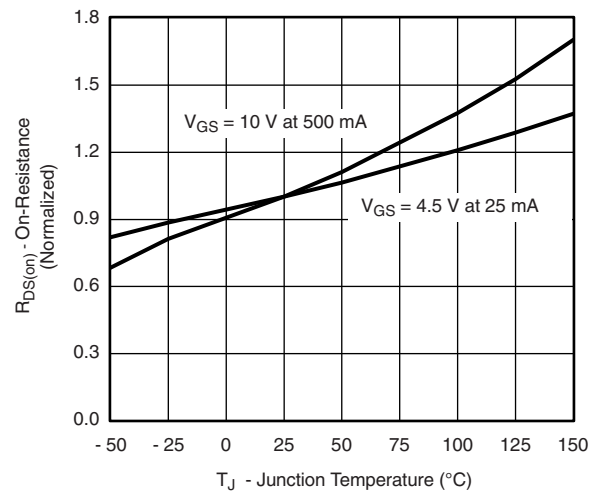
**On-Resistance vs. Drain Current**



**Capacitance**

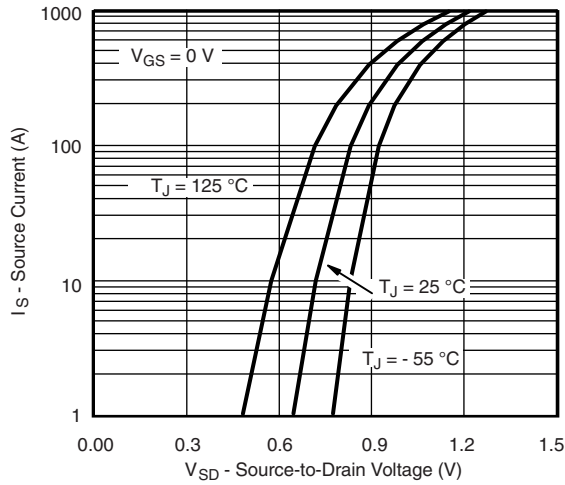


**Gate Charge**

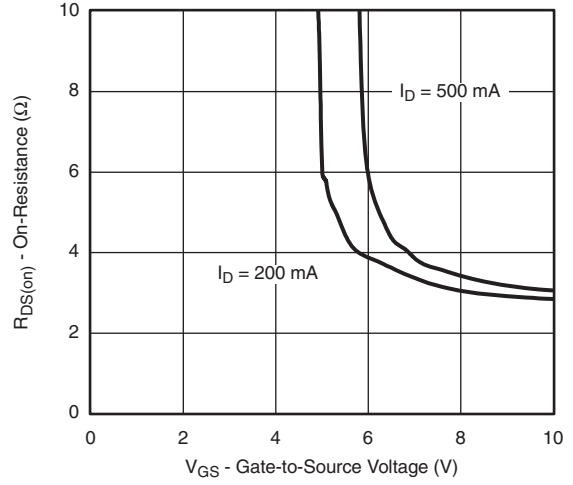


**On-Resistance vs. Junction Temperature**

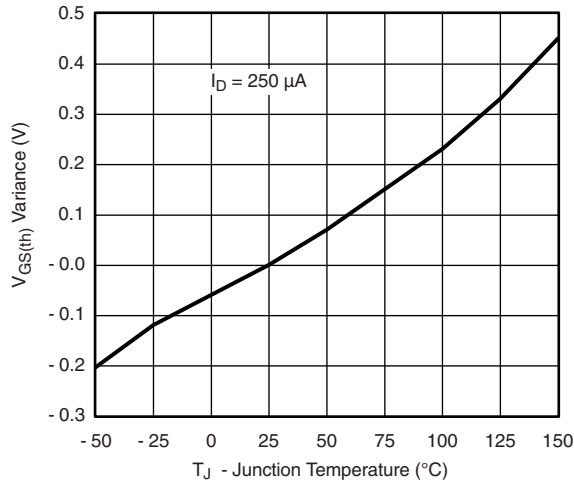
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



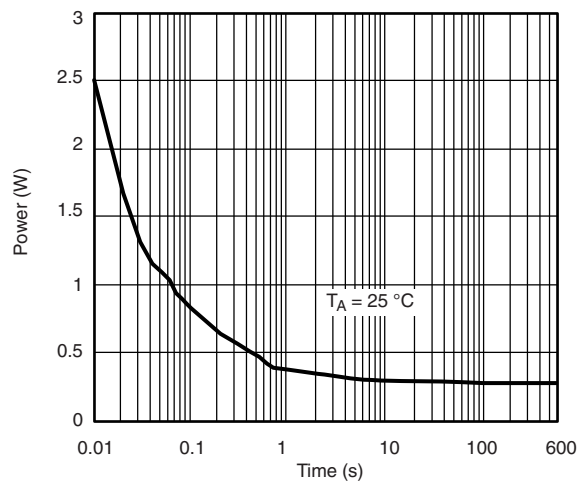
Source-Drain Diode Forward Voltage



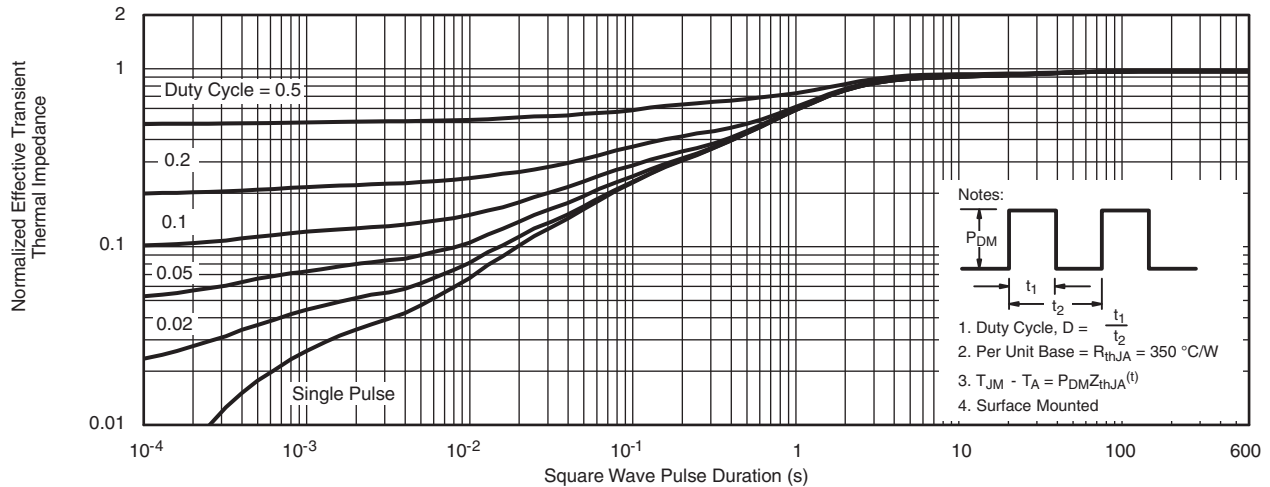
On-Resistance vs. Gate-Source Voltage



Threshold Voltage Variance Over Temperature



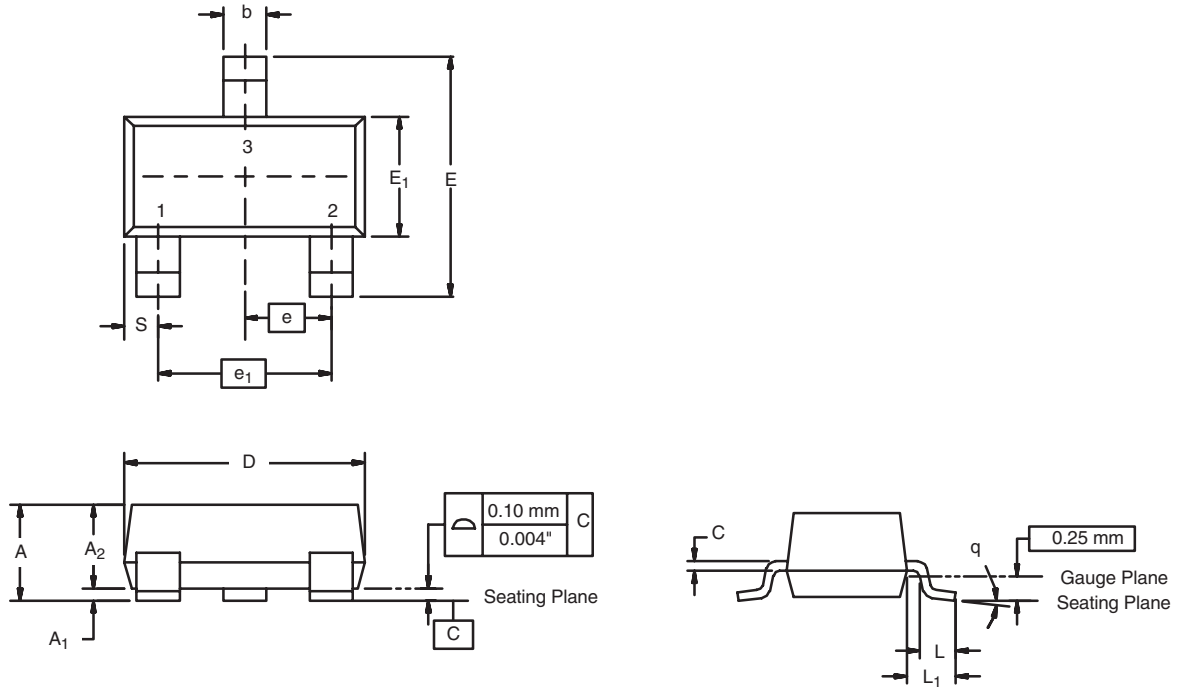
Single Pulse Power, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Ambient

- Notes:
- Duty Cycle,  $D = \frac{t_1}{t_2}$
  - Per Unit Base =  $R_{thJA} = 350\text{ }^{\circ}\text{C/W}$
  - $T_{JM} - T_A = P_{DM} Z_{thJA}^{(t)}$
  - Surface Mounted

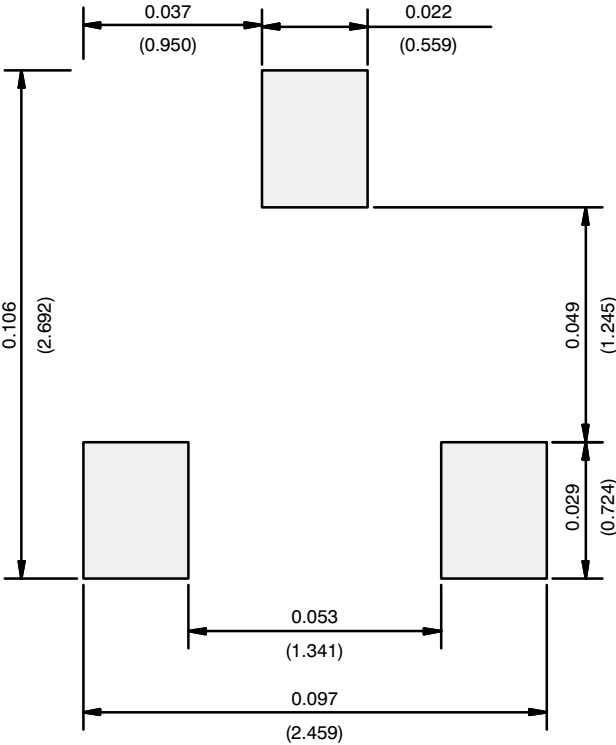
**SOT-23 (TO-236): 3-LEAD**



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	0.89	1.12	0.035	0.044
A <sub>1</sub>	0.01	0.10	0.0004	0.004
A <sub>2</sub>	0.88	1.02	0.0346	0.040
b	0.35	0.50	0.014	0.020
c	0.085	0.18	0.003	0.007
D	2.80	3.04	0.110	0.120
E	2.10	2.64	0.083	0.104
E <sub>1</sub>	1.20	1.40	0.047	0.055
e	0.95 BSC		0.0374 Ref	
e <sub>1</sub>	1.90 BSC		0.0748 Ref	
L	0.40	0.60	0.016	0.024
L <sub>1</sub>	0.64 Ref		0.025 Ref	
S	0.50 Ref		0.020 Ref	
q	3°	8°	3°	8°

ECN: S-03946-Rev. K, 09-Jul-01  
DWG: 5479

RECOMMENDED MINIMUM PADS FOR SOT-23



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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