

# FDB9509L-F085

## Power MOSFET, Single P-Channel

-40 V, -83 A, 8.0 mΩ

### Features

- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low QG and Capacitance to Minimize Driver Losses
- AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DS}$	-40	V
Gate-to-Source Voltage	$V_{GS}$	$\pm 16$	V
Continuous Drain Current $R_{\theta JC}$ (Notes 1, 3)	$I_D$	$T_C = 25^\circ\text{C}$	-83
		$T_C = 100^\circ\text{C}$	-59
Power Dissipation $R_{\theta JC}$ (Note 1)	$P_D$	$T_C = 25^\circ\text{C}$	93.8
		$T_C = 100^\circ\text{C}$	46.9
Continuous Drain Current $R_{\theta JA}$ (Notes 1, 2, 3)	$I_D$	$T_C = 25^\circ\text{C}$	-16.1
		$T_C = 100^\circ\text{C}$	-11.4
Power Dissipation $R_{\theta JA}$ (Notes 1 & 2)	$P_D$	$T_C = 25^\circ\text{C}$	3.5
		$T_C = 100^\circ\text{C}$	1.7
Pulsed Drain Current	$I_{DM}$	-669	A
Operating Junction and Storage Temperature	$T_J, T_{stg}$	-55 to +175	$^\circ\text{C}$
Source Current (Body Diode)	$I_S$	-80	A
Single Pulse Drain-to-Source Avalanche Energy ( $I_L(pk) = -64$ )	$E_{AS}$	82	mJ
Lead Temperature for Soldering Purposes (1/83 from case for 10 s)	$T_L$	260	$^\circ\text{C}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Case - Steady State	$R_{\theta JC}$	1.6	$^\circ\text{C}/\text{W}$
Junction-to-Ambient - Steady State (Note 2)	$R_{\theta JA}$	43	$^\circ\text{C}/\text{W}$

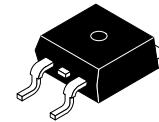
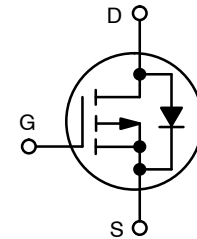
1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
2. Surface-mounted on FR4 board using a 650 mm<sup>2</sup>, 2 oz. Cu pad.
3. Maximum current for pulses as long as 1 second is higher but is dependent on pulse duration and duty cycle.



ON Semiconductor®

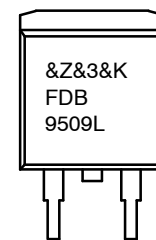
[www.onsemi.com](http://www.onsemi.com)

$V_{(BR)DSS}$	$R_{DS(ON)} \text{ MAX}$	$I_D \text{ MAX}$
-40 V	8.0 mΩ @ -10 V	-83 A
	12.5 mΩ @ -4.5 V	



D<sup>2</sup>PAK-3 (TO-163AB)  
CASE 418AJ

### MARKING DIAGRAM



&Z = Assembly Plant Code  
 &3 = Numeric Date Code  
 &K = Lot Code  
 FDB9509L = Specific Device Code

### ORDERING INFORMATION

See detailed ordering, marking and shipping information on page 6 of this data sheet.

# FDB9509L-F085

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
-----------	--------	----------------	-----	-----	-----	------

### Off Characteristics

Drain to Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = -250\ \mu\text{A}$	-40			V	
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			20		$\text{mV}/^\circ\text{C}$	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = -40\text{ V}$	$T_J = 25^\circ\text{C}$			-1	$\mu\text{A}$
			$T_J = 175^\circ\text{C}$			-1	$\text{mA}$
Zero Gate Voltage Drain Current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 16\text{ V}$				$\pm 100$	$\text{nA}$

### On Characteristics (Note 4)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = -250\ \mu\text{A}$	-1	-1.7	-3	V
Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			-5		$\text{mV}/^\circ\text{C}$
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = -10\text{ V}$	$I_D = -80\text{ A}$	6.4	8.0	$\text{m}\Omega$
		$V_{GS} = -4.5\text{ V}$	$I_D = -40\text{ A}$	9.6	12.5	

### Charges, Capacitances & Gate Resistance

Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = -20\text{ V}$		3400		$\mu\text{F}$
Output Capacitance	$C_{oss}$			1250		$\mu\text{F}$
Reverse Transfer Capacitance	$C_{rss}$			39		$\mu\text{F}$
Gate Resistance	$R_g$	$V_{GS} = 0.5\text{ V}, f = 100\text{ kHz}$		21		$\Omega$
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -10\text{ V}, V_{DS} = -32\text{ V}; I_D = -80\text{ A}$		48		$\text{nC}$
		$V_{GS} = -4.5\text{ V}, V_{DS} = -32\text{ V}; I_D = -80\text{ A}$		22		
Threshold Gate Charge	$Q_{g(th)}$	$V_{GS} = 0\text{ to }-1\text{ V}$		6		
Gate to Source Gate Charge	$Q_{gs}$	$V_{DD} = -32\text{ V}, I_D = -80\text{ A}$		12		
Gate to Drain "Miller" Charge	$Q_{gd}$			5		
Plateau Voltage	$V_{GP}$			-3.5		V

### Switching Characteristics

Turn-On Delay Time	$t_{d(ON)}$	$V_{DD} = -20\text{ V}, I_D = -80\text{ A}, V_{GS} = -10\text{ V}, R_{GEN} = 6\ \Omega$		9		$\text{ns}$
Turn-On Rise Time	$t_r$			4		$\text{ns}$
Turn-Off Delay Time	$t_{d(OFF)}$			200		$\text{ns}$
Turn-Off Fall Time	$t_f$			57		$\text{ns}$

### Drain-Source Diode Characteristics

Source to Drain Diode Voltage	$V_{SD}$	$I_{SD} = -80\text{ A}, V_{GS} = 0\text{ V}$		-0.98	-1.25	V
		$I_{SD} = -40\text{ A}, V_{GS} = 0\text{ V}$		-0.9	-1.2	V
Reverse Recovery Time	$T_{RR}$	$V_{GS} = 0\text{ V}, dI_{SD}/dt = 100\text{ A}/\mu\text{s}, I_S = -80\text{ A}$		78		$\text{ns}$
Charge Time	$t_a$			33		
Discharge Time	$t_b$			46		
Reverse Recovery Charge	$Q_{RR}$			95		

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. Pulse Test: pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$

5. Switching characteristics are independent of operating junction temperatures.

TYPICAL CHARACTERISTICS

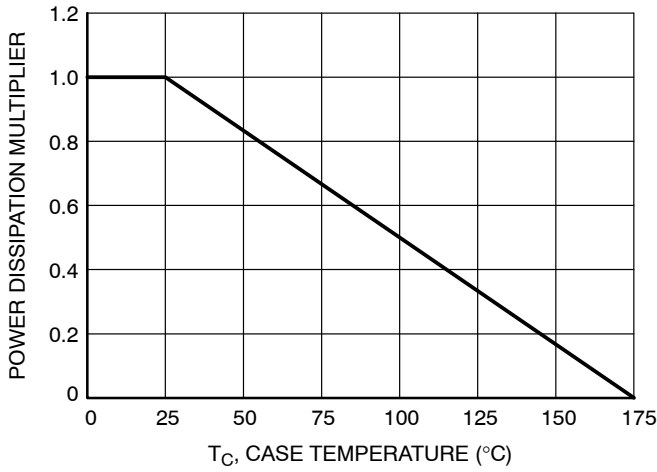


Figure 1. Normalized Power Dissipation vs. Case Temperature

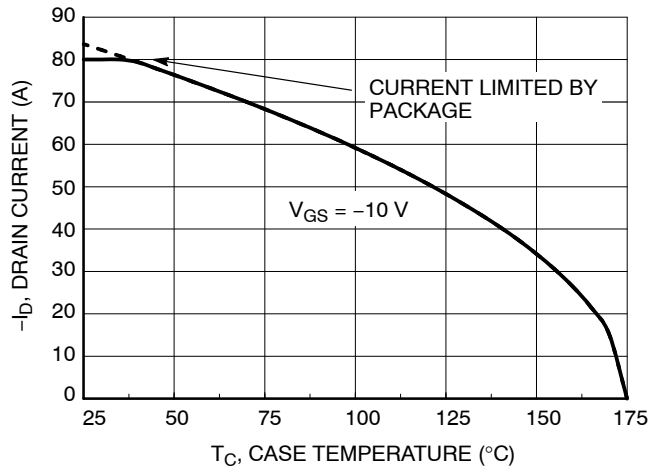


Figure 2. Maximum Continuous Drain Current vs. Case Temperature

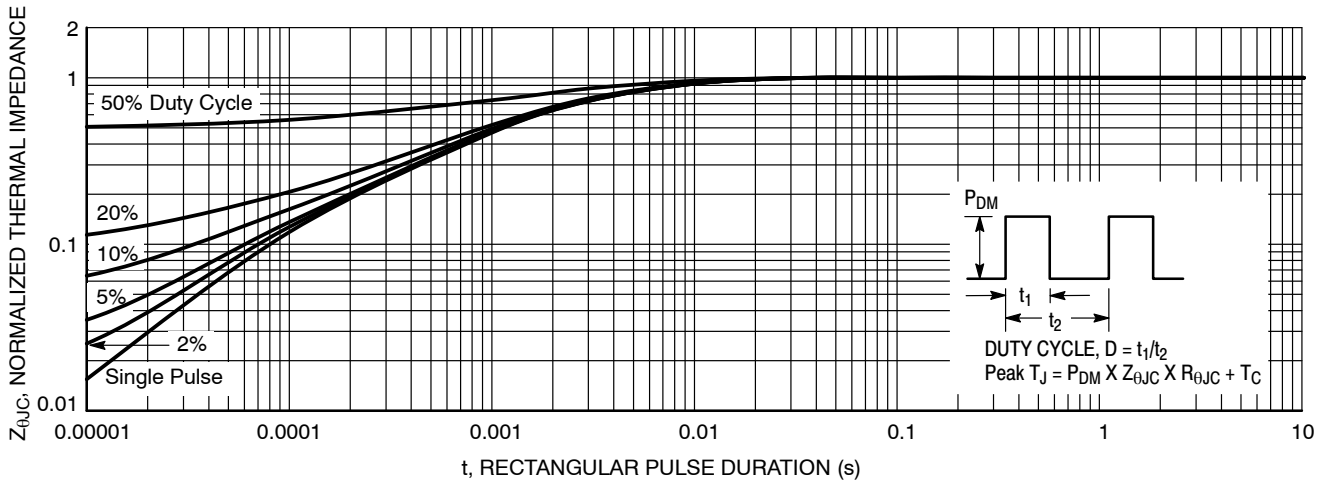


Figure 3. Normalized Maximum Transient Thermal Impedance

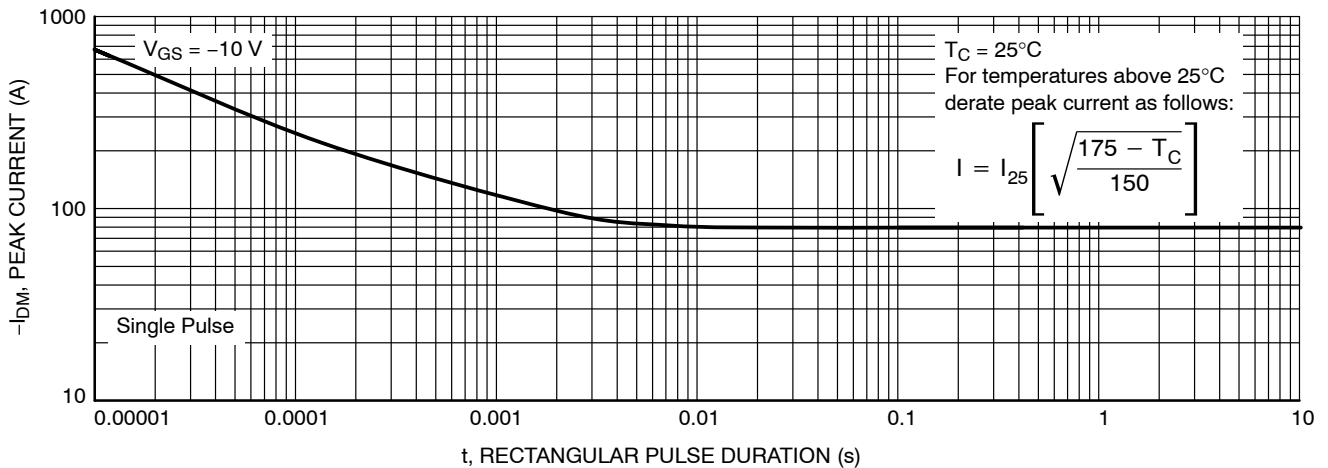


Figure 4. Peak Current Capability

TYPICAL CHARACTERISTICS

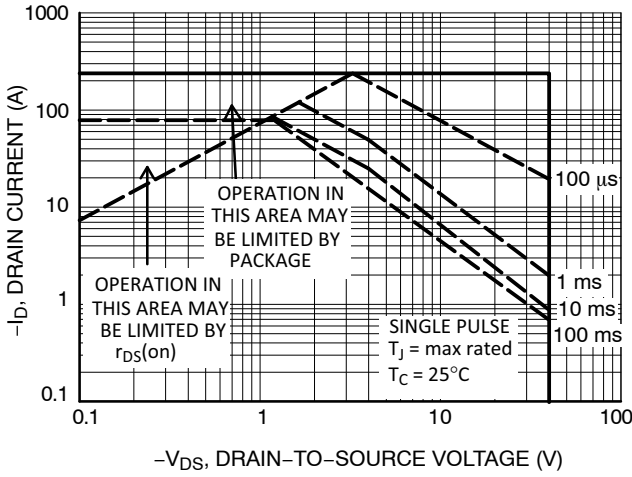
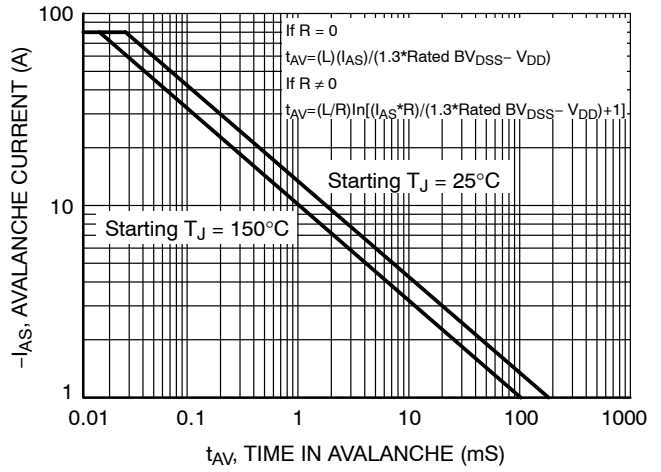


Figure 5. Forward Bias Safe Operating Area



Note: Refer to ON Semiconductor Application Notes AN7514 and AN7515

Figure 6. Unclamped Inductive Switching Capability

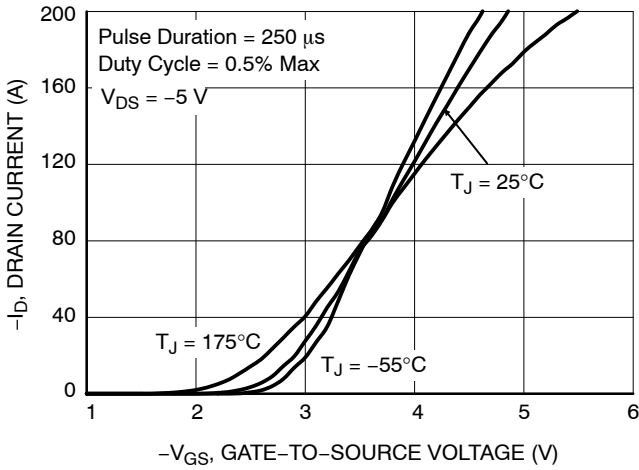


Figure 7. Transfer Characteristics

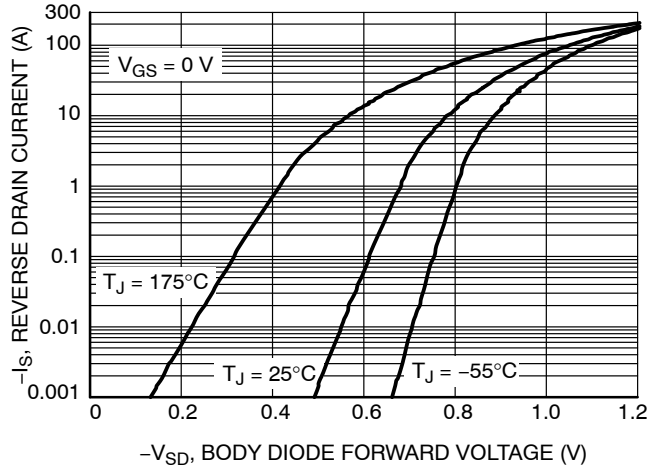


Figure 8. Forward Diode Characteristics

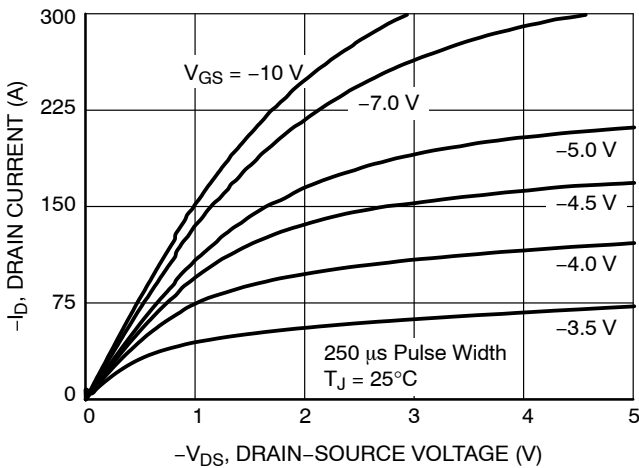


Figure 9. Saturation Characteristics

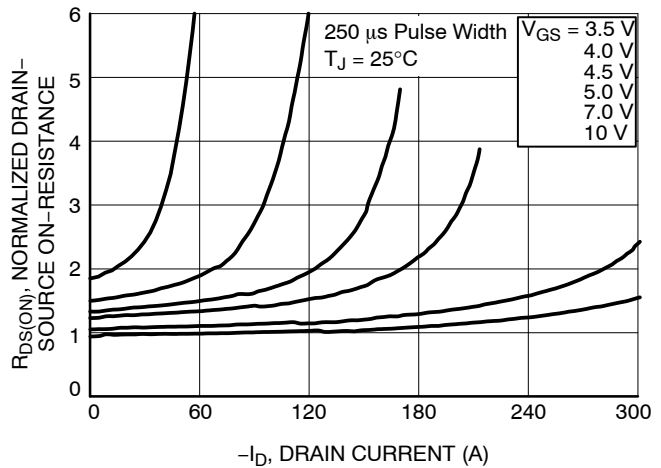


Figure 10. Normalized  $R_{DS(ON)}$  vs. Drain Current

TYPICAL CHARACTERISTICS

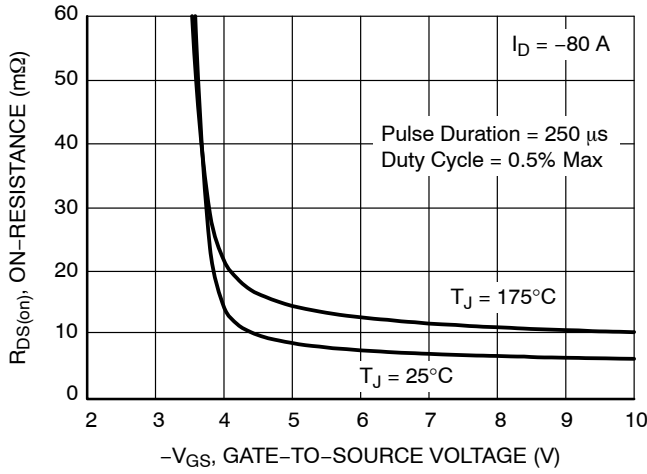


Figure 11.  $R_{DS(on)}$  vs. Gate Voltage

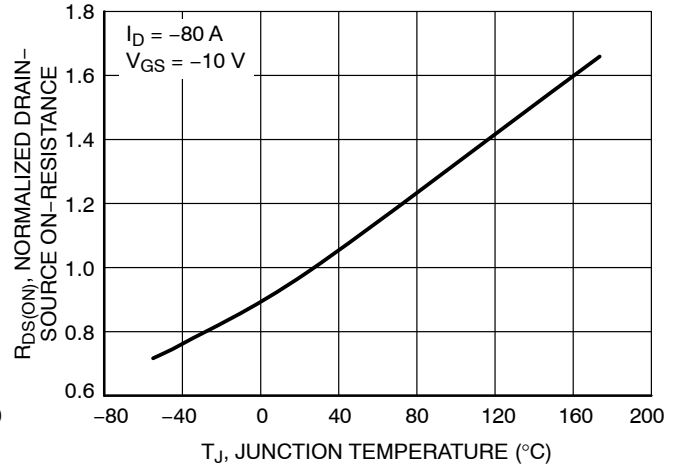


Figure 12. Normalized  $R_{DS(on)}$  vs. Junction Temperature

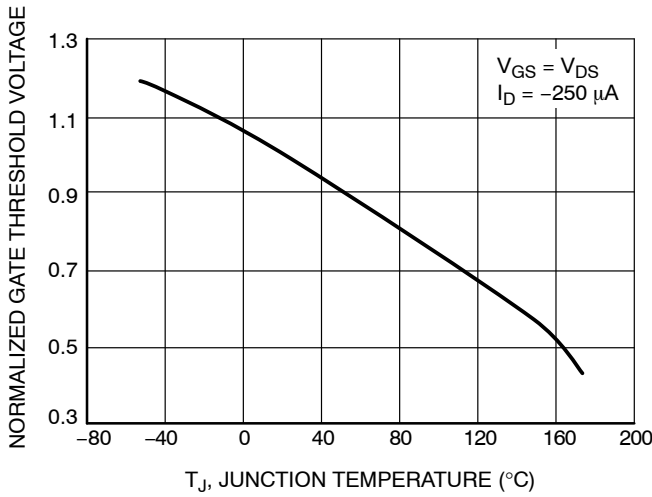


Figure 13. Normalized Gate Threshold Voltage vs. Temperature

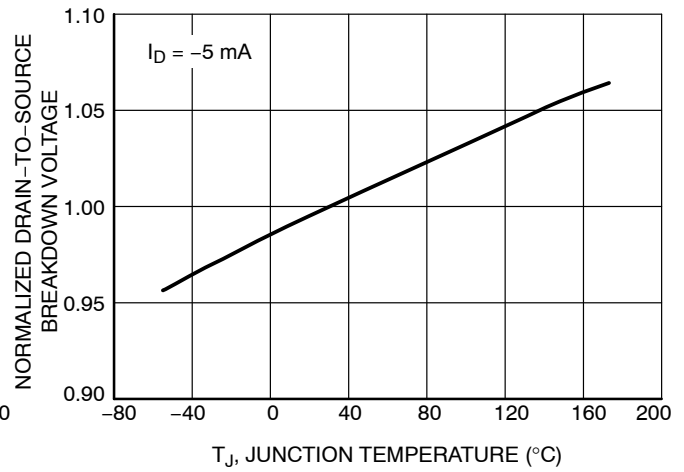


Figure 14. Normalized Drain-to-Source Breakdown Voltage vs. Junction Temperature

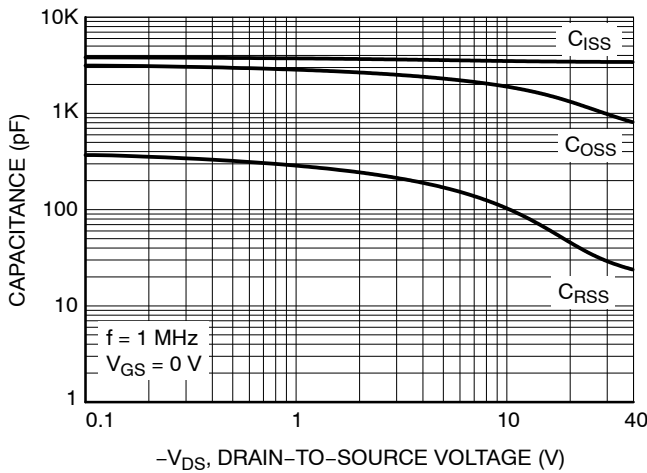


Figure 15. Capacitance vs. Drain-to-Source Voltage

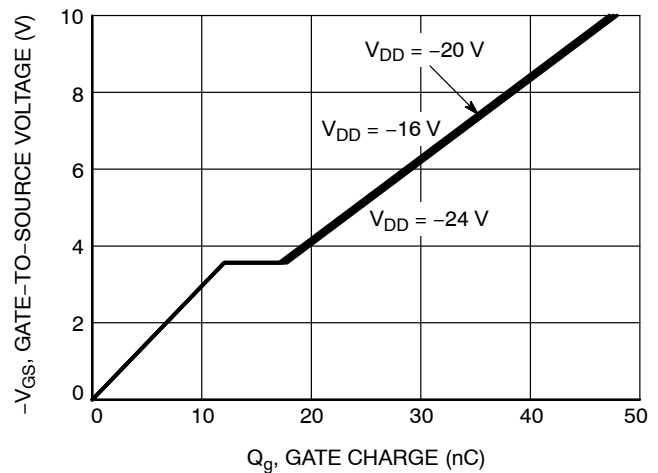


Figure 16. Gate Charge vs. Gate-to-Source Voltage

# FDB9509L-F085

## ORDERING INFORMATION

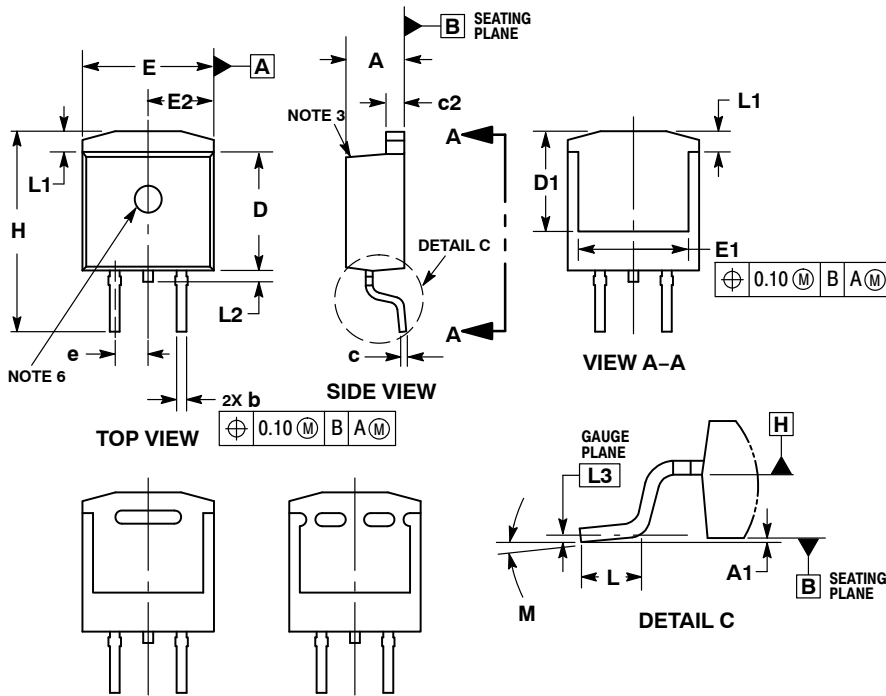
Device	Device Marking	Package	Shipping†
FDB9509L-F085	FDB9509L	D <sup>2</sup> PAK-3 (Pb-Free, Halogen Free)	3,000 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D

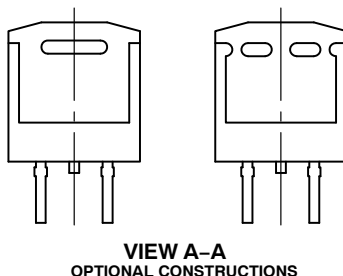
# FDB9509L-F085

## PACKAGE DIMENSIONS

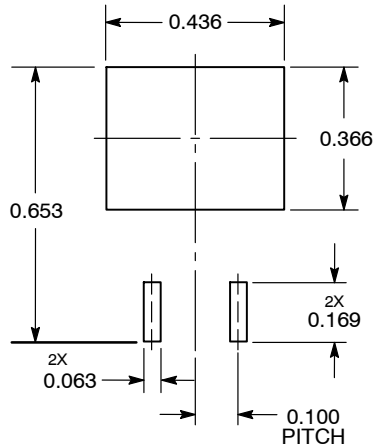
**D<sup>2</sup>PAK-3 (TO-263, 3-LEAD)**  
**CASE 418AJ**  
**ISSUE B**



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: INCHES.
  3. CHAMFER OPTIONAL
  4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005 PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
  5. THERMAL PAD CONTOUR IS OPTIONAL WITHIN DIMENSIONS E, L1, D1 AND E1.
  6. OPTIONAL MOLD FEATURE




### RECOMMENDED SOLDERING FOOTPRINT\*



DIMENSIONS: INCHES

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

**PUBLICATION ORDERING INFORMATION**

**LITERATURE FULFILLMENT:**

Literature Distribution Center for ON Semiconductor  
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**N. American Technical Support:** 800-282-9855 Toll Free  
USA/Canada  
**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)  
**Order Literature:** <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative