

www.vishay.com

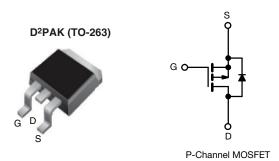
Vishay Siliconix

HALOGEN

FREE

# **Power MOSFET**

PRODUCT SUMMARY					
V <sub>DS</sub> (V)	-60				
$R_{DS(on)}(\Omega)$	V <sub>GS</sub> = -10 V 0.14				
Q <sub>g</sub> max. (nC)	34				
Q <sub>gs</sub> (nC)	9.9				
Q <sub>gd</sub> (nC)	16				
Configuration	Single				



#### **FEATURES**

- Advanced process technology
- Surface mount (IRF9Z34S, SiHF9Z34S)
- 175 °C operating temperature
- Fast switching
- P-channel
- Fully avalanche rated
- · Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

## Note

This datasheet provides information about parts that are RoHS-compliant and / or parts that are non-RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details.

#### DESCRIPTION

Third generation power MOSFETs from Vishay utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications.

The D<sup>2</sup>PAK is a surface mount power package capable of accommodating die sizes up to HEX-4. It provides the highest power capability and the lowest possible on-resistance in any existing surface mount package. The D<sup>2</sup>PAK is suitable for high current applications because of its low internal connection resistance and can dissipate up to 2.0 W in a typical surface mount application.

ORDERING INFORMATION					
Package	D <sup>2</sup> PAK (TO-263)	D <sup>2</sup> PAK (TO-263)	D <sup>2</sup> PAK (TO-263)		
Lead (Pb)-free and Halogen-free	SiHF9Z34S-GE3	SiHF9Z34STRL-GE3 a	SiHF9Z34STRR-GE3 <sup>a</sup>		
Lead (Pb)-free	IRF9Z34SPbF	IRF9Z34STRLPbF a	IRF9Z34STRRPbF a		

#### Note

a. See device orientation.

ABSOLUTE MAXIMUM RATINGS (TC:	= 25 °C, unless otherwis	se noted)			
PARAMETER	SYMBOL	LIMIT	UNIT		
Drain-Source Voltage		V <sub>DS</sub>	-60	.,	
Gate-Source Voltage		V <sub>GS</sub>	± 20	V	
Continuous Drain Current	$V_{GS}$ at -10 V $T_C = 25 ^{\circ}C$ $T_C = 100 ^{\circ}C$	1	-18		
Continuous Drain Current	$V_{GS}$ at -10 V $T_C = 100 ^{\circ}C$	I <sub>D</sub>	-13	Α	
Pulsed Drain Current a, e		I <sub>DM</sub>	-72		
Linear Derating Factor		0.59	W/°C		
Single Pulse Avalanche Energy b, e	E <sub>AS</sub>	370	mJ		
Avalanche Current <sup>a</sup>	I <sub>AR</sub>	-18	А		
Repetitive Avalanche Energy <sup>a</sup>		E <sub>AR</sub>	8.8	mJ	
Maximum Power Dissipation $ T_{C} = 25  ^{\circ}C $ $ T_{A} = 25  ^{\circ}C $		Б	88	W	
		P <sub>D</sub>	3.7		
Peak Diode Recovery dV/dt c, e	dV/dt	-4.5	V/ns		
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	-55 to +175	00		
Soldering Recommendations (Peak temperature) d	_	300	°C		

## **Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- b.  $V_{DD}$  = 25 V, starting  $T_J$  = 25 °C, L = 1.3 mH,  $R_g$  = 25  $\Omega$ ,  $I_{AS}$  = 18 A (see fig. 12). c.  $I_{SD} \le$  18 A, dl/dt  $\le$  170 A/µs,  $V_{DD} \le V_{DS}$ ,  $T_J \le$  175 °C. d. 1.6 mm from case.

- e. Uses IRF9Z34, SiHF9Z34 data and test conditions.



www.vishay.com

# Vishay Siliconix

THERMAL RESISTANCE RATINGS						
PARAMETER SYMBOL TYP. MAX. UNIT						
Maximum Junction-to-Ambient (PCB mounted, steady-state) <sup>a</sup>	R <sub>thJA</sub>	-	40	°C/W		
Maximum Junction-to-Case (Drain)	R <sub>thJC</sub>	-	1.7			

#### Note

a. When mounted on 1" square PCB (FR-4 or G-10 material).

SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)								
PARAMETER	SYMBOL	TES	TEST CONDITIONS		TYP.	MAX.	UNIT	
Static								
Drain-Source Breakdown Voltage	V <sub>DS</sub>	V <sub>GS</sub> =	= 0 V, I <sub>D</sub> = -250 μA	-60	-	-	V	
V <sub>DS</sub> Temperature Coefficient	$\Delta V_{DS}/T_{J}$	Reference	e to 25 °C, I <sub>D</sub> = -1 mA °	-	-0.06	-	V/°C	
Gate-Source Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =	· V <sub>GS</sub> , I <sub>D</sub> = -250 μA	-2.0	-	-4.0	V	
Gate-Source Leakage	I <sub>GSS</sub>		V <sub>GS</sub> = ± 20 V	-	-	± 100	nA	
Zero Gate Voltage Drain Current		V <sub>DS</sub> :	= -60 V, V <sub>GS</sub> = 0 V	-	-	-100	μA	
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	$V_{DS} = -48 \text{ V}$	/, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150 °C	-	-	-500	μΑ	
Drain-Source On-State Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = -10 V	I <sub>D</sub> = -11 A <sup>b</sup>	-	-	0.14	Ω	
Forward Transconductance	9 <sub>fs</sub>	V <sub>DS</sub> =	-25 V, I <sub>D</sub> = -11 A <sup>c</sup>	5.9	-	-	S	
Dynamic								
Input Capacitance	C <sub>iss</sub>		$V_{GS} = 0 V$	=	1100	-		
Output Capacitance	C <sub>oss</sub>		$V_{DS} = -25 \text{ V},$	-	620	-	рF	
Reverse Transfer Capacitance	C <sub>rss</sub>	f = 1.	f = 1.0 MHz, see fig. 5 <sup>c</sup>		100	-	1	
Total Gate Charge	Qg			-	-	34		
Gate-Source Charge	Q <sub>gs</sub>	V <sub>GS</sub> = -10 V	$V_{GS} = -10 \text{ V}$ $I_{D} = -18 \text{ A}, V_{DS} = -48 \text{ V},$ see fig. 6 and 13 b, c		-	9.9	nC	
Gate-Drain Charge	Q <sub>gd</sub>	1	See fig. 6 dild 16	-	-	16	1	
Turn-On Delay Time	t <sub>d(on)</sub>				18	-		
Rise Time	t <sub>r</sub>	V <sub>DD</sub> =	= -30 V, I <sub>D</sub> = -18 A,	-	120	-	ns ns	
Turn-Off Delay Time	t <sub>d(off)</sub>	$R_g = 12 \Omega$ , F	$R_D = 1.5  \Omega$ , see fig. 10 b, c	-	20	-		
Fall Time	t <sub>f</sub>	1		-	58	-		
Gate Input Resistance	$R_g$	f = 1	MHz, open drain	0.7	-	3.9	Ω	
Drain-Source Body Diode Characteristic	s							
Continuous Source-Drain Diode Current	I <sub>S</sub>	showing the	MOSFET symbol showing the		-	-18	Α	
Pulsed Diode Forward Current <sup>a</sup>	I <sub>SM</sub>	integral reverse p -n junction diode		-	-	-72		
Body Diode Voltage	V <sub>SD</sub>	T <sub>J</sub> = 25 °C	$I_{S} = -18 \text{ A}, V_{GS} = 0 \text{ V}^{\text{ b}}$	-	-	-6.3	V	
Body Diode Reverse Recovery Time	t <sub>rr</sub>	$T_J = 25  ^{\circ}\text{C}$ , $I_F = -18  \text{A}$ , $dI/dt = 100  \text{A/}\mu\text{s}^{ \text{b},  \text{c}}$		-	100	200	ns	
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>			-	280	520	nC	
Forward Turn-On Time	t <sub>on</sub>	Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> and L <sub>D</sub> )				L <sub>D</sub> )		

## Notes

- b. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- c. Pulse width  $\leq 300~\mu s;$  duty cycle  $\leq 2~\%.$
- d. Uses IRF9Z34, SiHF9Z34 data and test conditions.



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

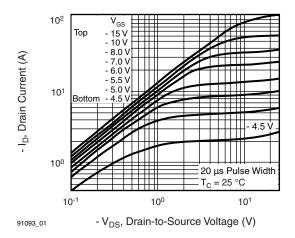


Fig. 1 - Typical Output Characteristics

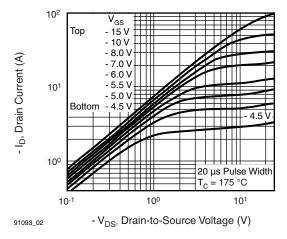


Fig. 2 - Typical Output Characteristics

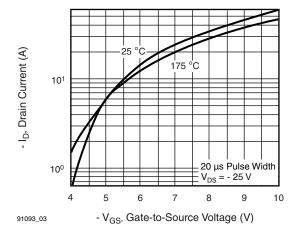


Fig. 3 - Typical Transfer Characteristics

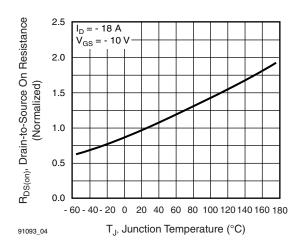


Fig. 4 - Normalized On-Resistance vs. Temperature

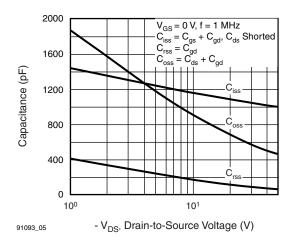


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

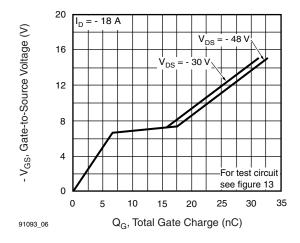


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage



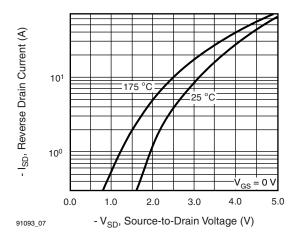


Fig. 7 - Typical Source-Drain Diode Forward Voltage

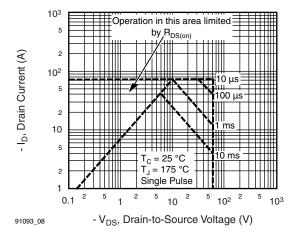


Fig. 8 - Maximum Safe Operating Area

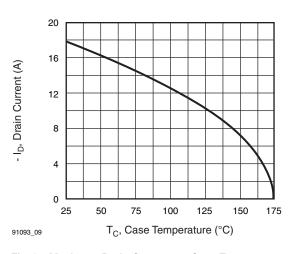


Fig. 9 - Maximum Drain Current vs. Case Temperature

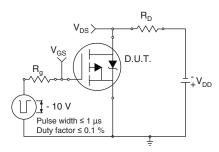


Fig. 10a - Switching Time Test Circuit

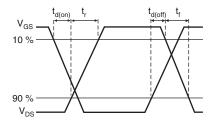


Fig. 10b - Switching Time Waveforms

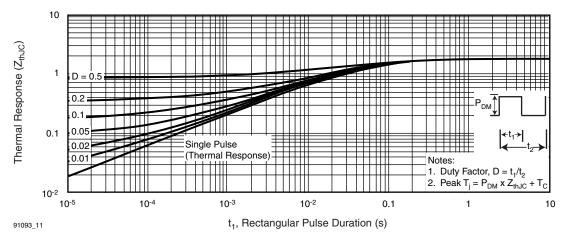


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



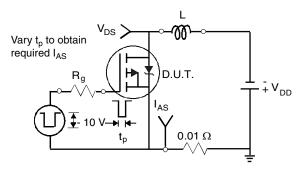


Fig. 12a - Unclamped Inductive Test Circuit

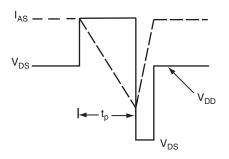


Fig. 12b - Unclamped Inductive Waveforms

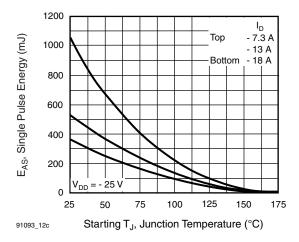


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

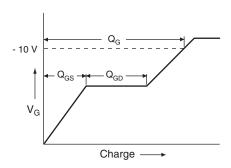


Fig. 13 - Maximum Avalanche Energy vs. Drain Current

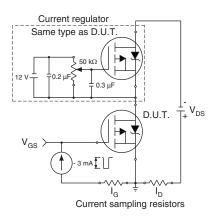
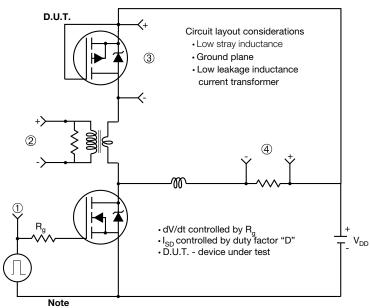


Fig. 13b - Gate Charge Test Circuit



### Peak Diode Recovery dV/dt Test Circuit



· Compliment N-Channel of D.U.T. for driver

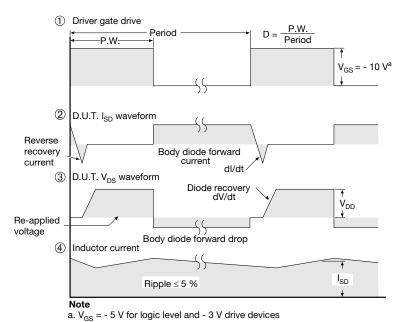


Fig. 14 - For P-Channel

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data see <a href="https://www.vishay.com/ppg?91093">www.vishay.com/ppg?91093</a>.





# **TO-263AB (HIGH VOLTAGE)**







]	+		D1	4
	-E1-	<b>₩</b>	<u> </u>	7

	MILLIN	METERS	INC	HES
DIM.	MIN. MAX.		MIN.	MAX.
Α	4.06	4.83	0.160	0.190
A1	0.00	0.25	0.000	0.010
b	0.51	0.99	0.020	0.039
b1	0.51	0.89	0.020	0.035
b2	1.14	1.78	0.045	0.070
b3	1.14	1.73	0.045	0.068
С	0.38	0.74	0.015	0.029
c1	0.38	0.58	0.015	0.023
c2	1.14	1.65	0.045	0.065
D	8.38	9.65	0.330	0.380

	MILLIN	METERS	INCHES		
DIM.	MIN.	MAX.	MIN.	MAX.	
D1	6.86	-	0.270	-	
E	9.65	10.67	0.380	0.420	
E1	6.22	-	0.245	i	
е	2.54	BSC	0.100 BSC		
Н	14.61	15.88	0.575	0.625	
L	1.78	2.79	0.070	0.110	
L1	-	1.65	ı	0.066	
L2	-	1.78	i	0.070	
L3	0.25 BSC		0.010	BSC	
L4	4.78	5.28	0.188	0.208	

## DWG: 5970 Notes

- 1. Dimensioning and tolerancing per ASME Y14.5M-1994.
- 2. Dimensions are shown in millimeters (inches).

ECN: S-82110-Rev. A, 15-Sep-08

- 3. Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outmost extremes of the plastic body at datum A.
- 4. Thermal PAD contour optional within dimension E, L1, D1 and E1.
- 5. Dimension b1 and c1 apply to base metal only.
- 6. Datum A and B to be determined at datum plane H.
- 7. Outline conforms to JEDEC outline to TO-263AB.

Document Number: 91364 www.vishay.com Revision: 15-Sep-08





# RECOMMENDED MINIMUM PADS FOR D<sup>2</sup>PAK: 3-Lead



Recommended Minimum Pads Dimensions in Inches/(mm)

Return to Index



# **Legal Disclaimer Notice**

Vishay

# **Disclaimer**

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

Revision: 13-Jun-16 1 Document Number: 91000