

Power MOSFET

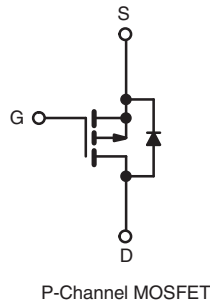
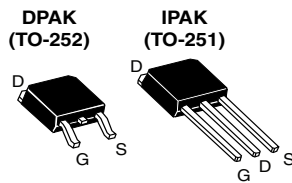
PRODUCT SUMMARY		
V_{DS} (V)	- 400	
$R_{DS(on)}$ (Ω)	$V_{GS} = - 10$ V	7.0
Q_g (Max.) (nC)	13	
Q_{gs} (nC)	3.2	
Q_{gd} (nC)	5.0	
Configuration	Single	

FEATURES

- P-Channel
- Surface Mount (IRFR9310, SiHFR9310)
- Straight Lead (IRFU9310, SiHFU9310)
- Advanced Process Technology
- Fast Switching
- Fully Avalanche Rated
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE
Available



DESCRIPTION

Third generation power MOSFETs from Vishay utilize advanced processing techniques to achieve 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 DPAK is designed for surface mounting using vapor phase, infrared, or wave soldering techniques. The straight lead version (IRFU/SiHFU series) is for through-hole mounting applications. Power dissipation levels up to 1.5 W are possible in typical surface mount applications.

ORDERING INFORMATION					
Package	DPAK (TO-252)	DPAK (TO-252)	DPAK (TO-252)	DPAK (TO-252)	IPAK (TO-251)
Lead (Pb)-free and Halogen-free	SiHFR9310-GE3	SiHFR9310TRL-GE3	SiHFR9310TR-GE3	SiHFR9310TRR-GE3	SiHFU9310-GE3
Lead (Pb)-free	IRFR9310PbF	IRFR9310TRLPbF ^a	IRFR9310TRPbF ^a	IRFR9310TRRPbF ^a	IRFU9310PbF
	SiHFR9310-E3	SiHFR9310TL-E3 ^a	SiHFR9310T-E3 ^a	SiHFR9310TR-E3 ^a	SiHFU9310-E3

Note

- a. See device orientation.

ABSOLUTE MAXIMUM RATINGS ($T_C = 25$ °C, unless otherwise noted)				
PARAMETER	SYMBOL	LIMIT	UNIT	
Drain-Source Voltage	V_{DS}	- 400	V	
Gate-Source Voltage	V_{GS}	± 20		
Continuous Drain Current	V_{GS} at - 10 V	$T_C = 25$ °C	- 1.8	
		$T_C = 100$ °C	- 1.1	
Pulsed Drain Current ^a	I_{DM}	- 7.2	A	
Linear Derating Factor		0.40	W/°C	
Single Pulse Avalanche Energy ^b	E_{AS}	92	mJ	
Repetitive Avalanche Current ^a	I_{AR}	- 1.8	A	
Repetitive Avalanche Energy ^a	E_{AR}	5.0	mJ	
Maximum Power Dissipation	$T_C = 25$ °C	P_D	50	W
Peak Diode Recovery dV/dt^c		dV/dt	- 24	V/ns
Operating Junction and Storage Temperature Range		T_J, T_{stg}	- 55 to + 150	°C
Soldering Recommendations (Peak Temperature) ^d	for 10 s		300	

Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
 b. Starting $T_J = 25$ °C, $L = 57$ mH, $R_g = 25$ Ω , $I_{AS} = - 1.8$ A (see fig. 12).
 c. $I_{SD} \leq - 1.1$ A, $dI/dt \leq 450$ A/ μ s, $V_{DD} \leq V_{DS}$, $T_J \leq 150$ °C.
 d. 1.6 mm from case.



THERMAL RESISTANCE RATINGS					
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	-	110	°C/W
Maximum Junction-to-Ambient (PCB Mount) ^a	R_{thJA}	-	-	50	
Maximum Junction-to-Case (Drain)	R_{thJC}	-	-	2.5	

Note

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

SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$		- 400	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$, $I_D = -1\text{ mA}$		-	- 0.41	-	V/°C
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$		- 2.0	-	- 4.0	V
Gate-Source Leakage	I_{GSS}	$V_{GS} = \pm 20\text{ V}$		-	-	± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = -400\text{ V}, V_{GS} = 0\text{ V}$		-	-	- 100	μA
		$V_{DS} = -320\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	- 500	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = -10\text{ V}$	$I_D = -1.1\text{ A}^b$	-	-	7.0	Ω
Forward Transconductance	g_{fs}	$V_{DS} = -50\text{ V}, I_D = -1.1\text{ A}$		0.91	-	-	S
Dynamic							
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V}, V_{DS} = -25\text{ V}, f = 1.0\text{ MHz}$, see fig. 5		-	270	-	pF
Output Capacitance	C_{oss}			-	50	-	
Reverse Transfer Capacitance	C_{rss}			-	8.0	-	
Total Gate Charge	Q_g	$V_{GS} = -10\text{ V}$	$I_D = -1.1\text{ A}, V_{DS} = -320\text{ V}$, see fig. 6 and 13 ^b	-	-	13	nC
Gate-Source Charge	Q_{gs}			-	-	3.2	
Gate-Drain Charge	Q_{gd}			-	-	5.0	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -200\text{ V}, I_D = -1.1\text{ A}, R_g = 21\text{ }\Omega, R_D = 180\text{ }\Omega$, see fig. 10 ^b		-	11	-	ns
Rise Time	t_r			-	10	-	
Turn-Off Delay Time	$t_{d(off)}$			-	25	-	
Fall Time	t_f			-	24	-	
Internal Drain Inductance	L_D	Between lead, 6 mm (0.25") from package and center of die contact ^c		-	4.5	-	nH
Internal Source Inductance	L_S			-	7.5	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode		-	-	- 1.9	A
Pulsed Diode Forward Current ^a	I_{SM}			-	-	- 7.6	
Body Diode Voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}, I_S = -1.1\text{ A}, V_{GS} = 0\text{ V}^b$		-	-	- 4.0	V
Body Diode Reverse Recovery Time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}, I_F = -1.1\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$		-	170	260	ns
Body Diode Reverse Recovery Charge	Q_{rr}			-	640	960	nC
Forward Turn-On Time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L_S and L_D)					

Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- b. Pulse width $\leq 300\text{ }\mu\text{s}$; duty cycle $\leq 2\%$.
- c. This is applied for IPAK, L_S of DPAK is measured between lead and center of die contact.



TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

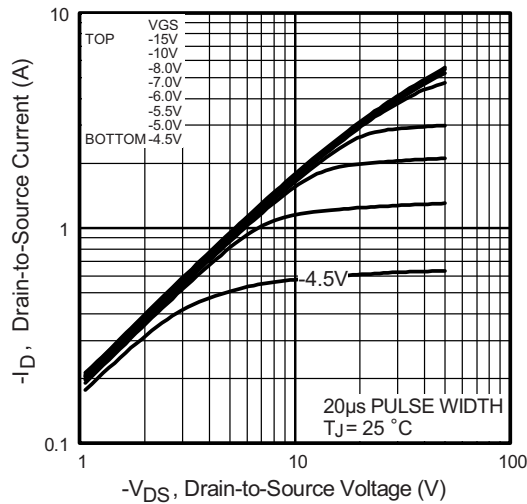


Fig. 1 - Typical Output Characteristics

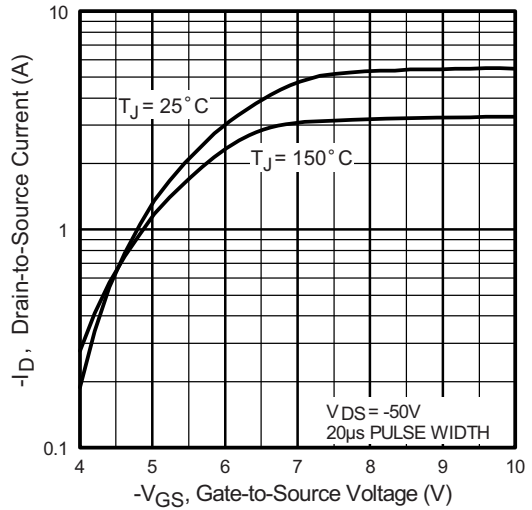


Fig. 3 - Typical Transfer Characteristics

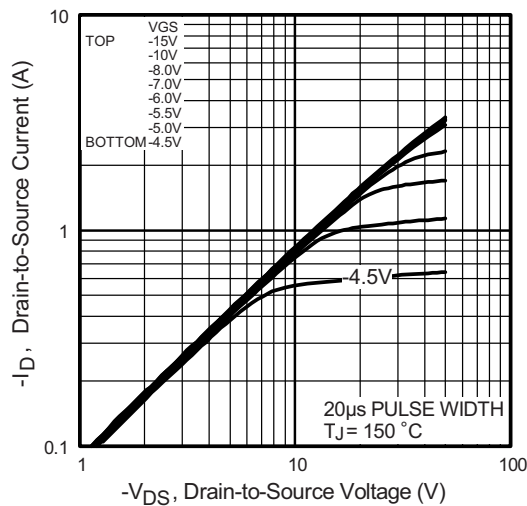


Fig. 2 - Typical Output Characteristics

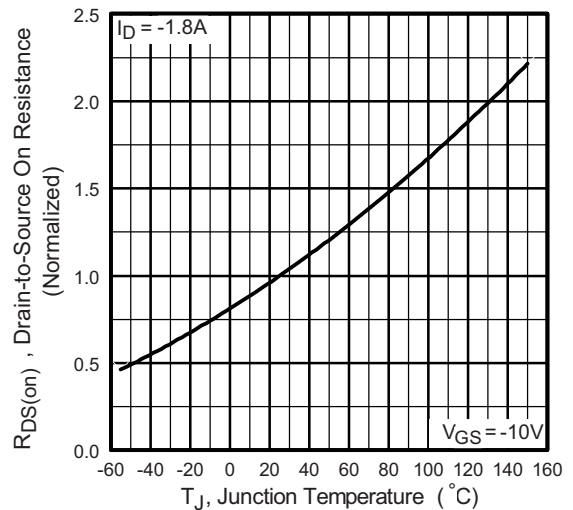


Fig. 4 - Normalized On-Resistance vs. Temperature

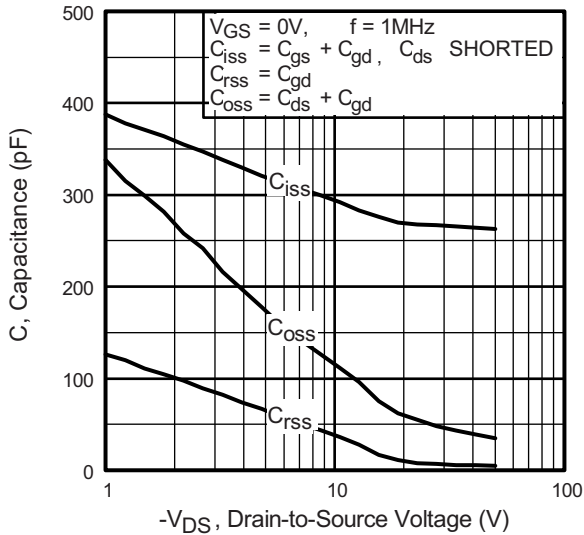


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

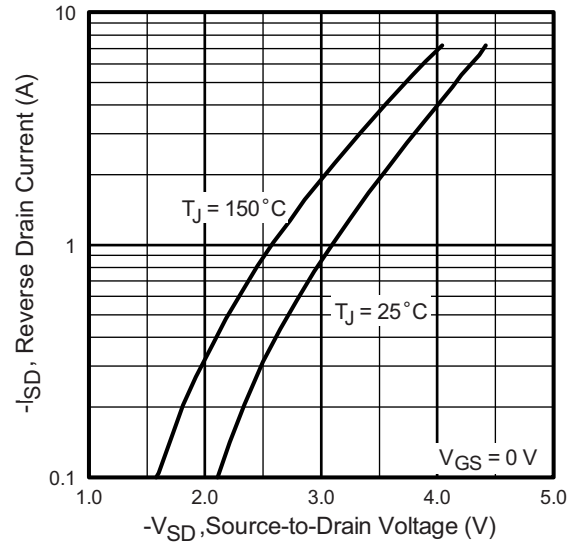


Fig. 7 - Typical Source-Drain Diode Forward Voltage

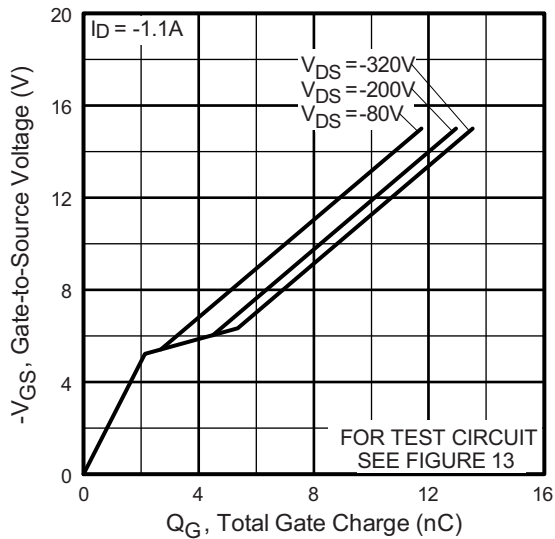


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

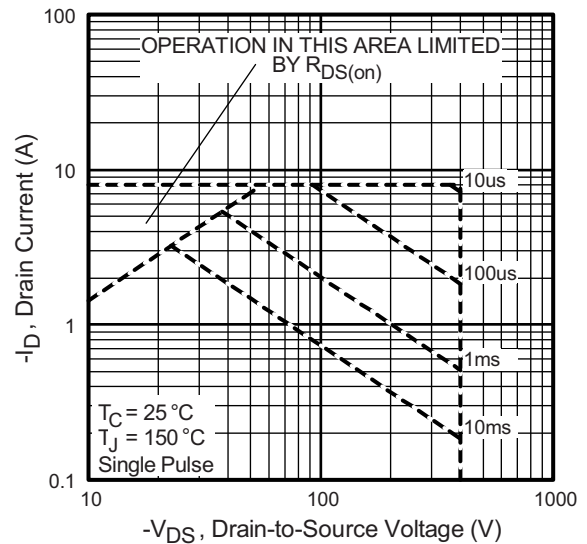


Fig. 8 - Maximum Safe Operating Area

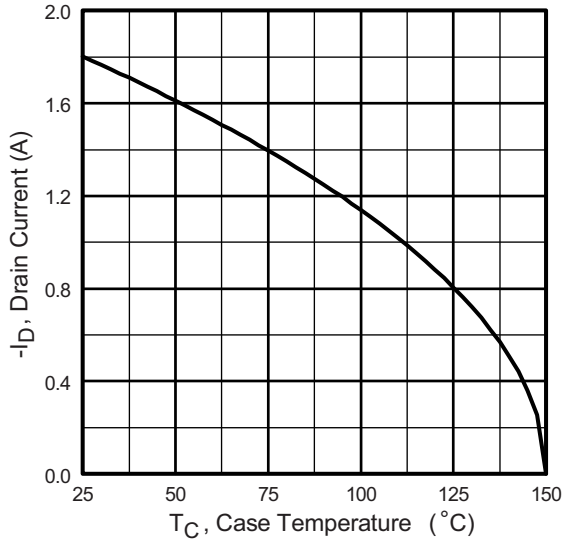


Fig. 9 - Maximum Drain Current vs. Case Temperature

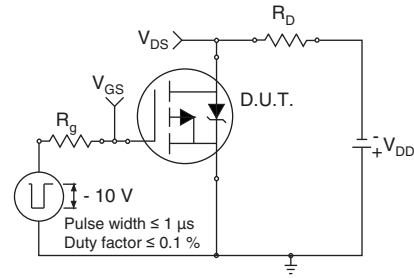


Fig. 10a - Switching Time Test Circuit

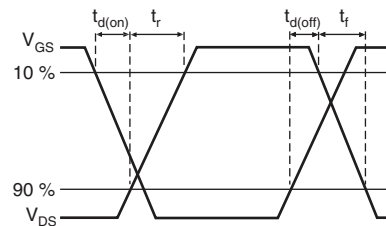


Fig. 10b - Switching Time Waveforms

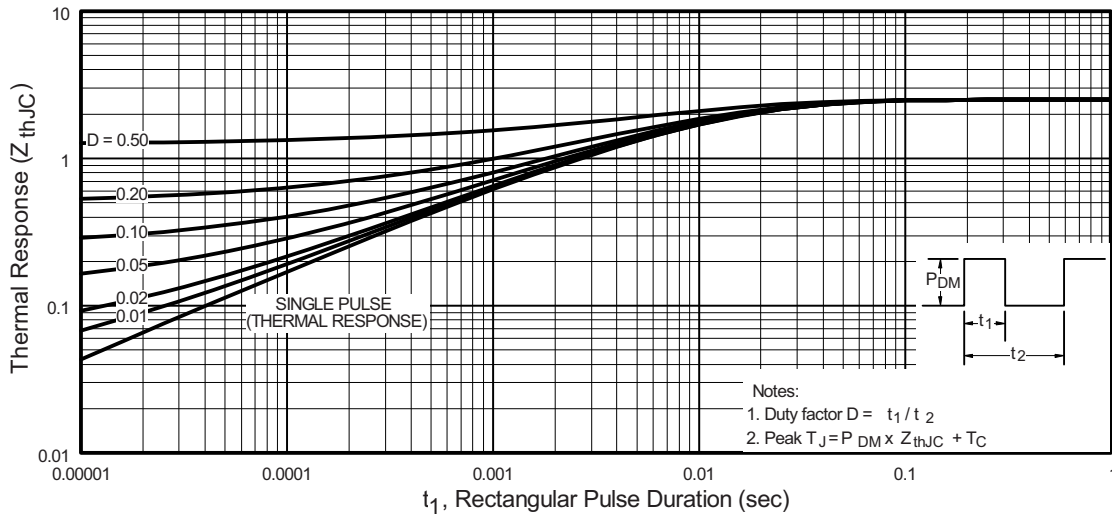
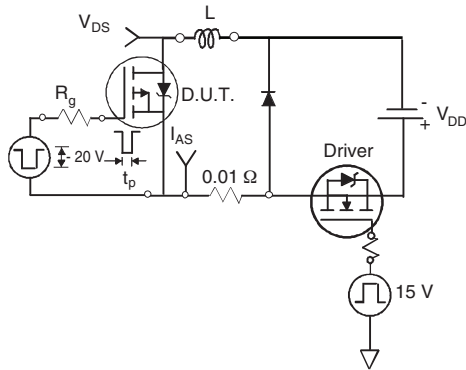
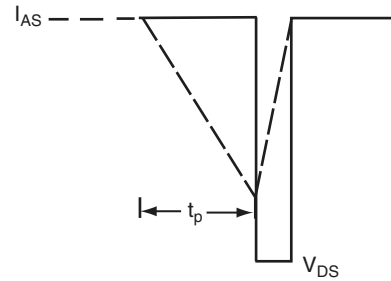
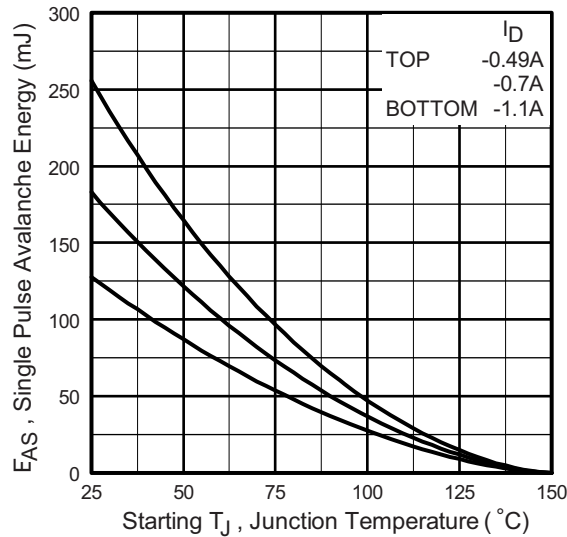
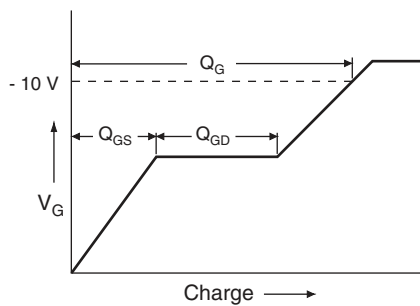
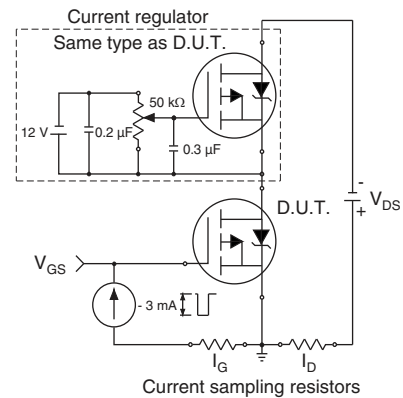


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case


Fig. 12a - Unclamped Inductive Test Circuit

Fig. 12b - Unclamped Inductive Waveforms

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

Fig. 13a - Basic Gate Charge Waveform

Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



Note
• 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 www.vishay.com/ppg?91284.

TO-252AA (HIGH VOLTAGE)



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
E	6.40	6.73	0.252	0.265
L	1.40	1.77	0.055	0.070
L1	2.743 REF		0.108 REF	
L2	0.508 BSC		0.020 BSC	
L3	0.89	1.27	0.035	0.050
L4	0.64	1.01	0.025	0.040
D	6.00	6.22	0.236	0.245
H	9.40	10.40	0.370	0.409
b	0.64	0.88	0.025	0.035
b2	0.77	1.14	0.030	0.045
b3	5.21	5.46	0.205	0.215
e	2.286 BSC		0.090 BSC	
A	2.20	2.38	0.087	0.094
A1	0.00	0.13	0.000	0.005
c	0.45	0.60	0.018	0.024
c2	0.45	0.58	0.018	0.023
D1	5.30	-	0.209	-
E1	4.40	-	0.173	-
θ	0'	10'	0'	10'

ECN: S-81965-Rev. A, 15-Sep-08
DWG: 5973

Notes

1. Package body sizes exclude mold flash, protrusion or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 0.10 mm per side.
2. Package body sizes determined at the outermost extremes of the plastic body exclusive of mold flash, gate burrs and interlead flash, but including any mismatch between the top and bottom of the plastic body.
3. The package top may be smaller than the package bottom.
4. Dimension "b" does not include dambar protrusion. Allowable dambar protrusion shall be 0.10 mm total in excess of "b" dimension at maximum material condition. The dambar cannot be located on the lower radius of the foot.

TO-251AA (HIGH VOLTAGE)



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	2.18	2.39	0.086	0.094
A1	0.89	1.14	0.035	0.045
b	0.64	0.89	0.025	0.035
b1	0.65	0.79	0.026	0.031
b2	0.76	1.14	0.030	0.045
b3	0.76	1.04	0.030	0.041
b4	4.95	5.46	0.195	0.215
c	0.46	0.61	0.018	0.024
c1	0.41	0.56	0.016	0.022
c2	0.46	0.86	0.018	0.034
D	5.97	6.22	0.235	0.245

DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
D1	5.21	-	0.205	-
E	6.35	6.73	0.250	0.265
E1	4.32	-	0.170	-
e	2.29 BSC		2.29 BSC	
L	8.89	9.65	0.350	0.380
L1	1.91	2.29	0.075	0.090
L2	0.89	1.27	0.035	0.050
L3	1.14	1.52	0.045	0.060
theta1	0'	15'	0'	15'
theta2	25'	35'	25'	35'

ECN: S-82111-Rev. A, 15-Sep-08
 DWG: 5968

Notes

1. Dimensioning and tolerancing per ASME Y14.5M-1994.
2. Dimension are shown in inches and millimeters.
3. Dimension D and E do not include mold flash. Mold flash shall not exceed 0.13 mm (0.005") per side. These dimensions are measured at the outermost extremes of the plastic body.
4. Thermal pad contour optional with dimensions b4, L2, E1 and D1.
5. Lead dimension uncontrolled in L3.
6. Dimension b1, b3 and c1 apply to base metal only.
7. Outline conforms to JEDEC outline TO-251AA.

RECOMMENDED MINIMUM PADS FOR DPAK (TO-252)



Recommended Minimum Pads
Dimensions in Inches/(mm)

[Return to Index](#)



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.

Material Category Policy

Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.

Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.

Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)

Факс: 8 (812) 320-02-42

Электронная почта: org@eplast1.ru

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.