Power MOSFET

PRODUCT SUMMARY

V_{DS} (V)		200
$R_{DS(on)}$ (Ω)	V_{GS} = 10 V	0.18
Q_g (Max.) (nC)		70
Q_{gs} (nC)		13
Q_{gd} (nC)		39
Configuration		Single

TO-247AC

N-Channel MOSFET
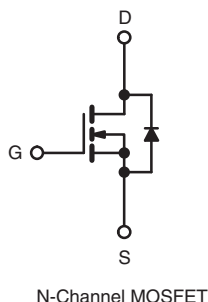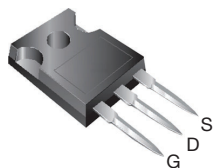
FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- Isolated Central Mounting Hole
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Compliant to RoHS Directive 2002/95/EC

Pb
Available

RoHS*
COMPLIANT

DESCRIPTION

Third generation Power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The TO-247AC package is preferred for commercial-industrial applications where higher power levels preclude the use of TO-220AB devices. The TO-247AC is similar but superior to the earlier TO-218 package because its isolated mounting hole. It also provides greater creepage distances between pins to meet the requirements of most safety specifications.

ORDERING INFORMATION

Package	TO-247AC
Lead (Pb)-free	IRFP240PbF
	SiHFP240-E3
SnPb	IRFP240
	SiHFP240

ABSOLUTE MAXIMUM RATINGS (T_C = 25 °C, unless otherwise noted)

PARAMETER			SYMBOL	LIMIT	UNIT
Drain-Source Voltage			V_{DS}	200	V
Gate-Source Voltage			V_{GS}	± 20	
Continuous Drain Current	V_{GS} at 10 V	T_C = 25 °C	I_D	20	A
		T_C = 100 °C		12	
Pulsed Drain Current[a]			I_{DM}	80	
Linear Derating Factor				1.2	W/°C
Single Pulse Avalanche Energy[b]			E_{AS}	510	mJ
Repetitive Avalanche Current[a]			I_{AR}	20	A
Repetitive Avalanche Energy[a]			E_{AR}	15	mJ
Maximum Power Dissipation	T_C = 25 °C		P_D	150	W
Peak Diode Recovery dV/dt[c]			dV/dt	5.0	V/ns
Operating Junction and Storage Temperature Range			T_J, T_{stg}	- 55 to + 150	°C
Soldering Recommendations (Peak Temperature)	for 10 s			300[d]	
Mounting Torque	6-32 or M3 screw			10	lbf · in
				1.1	N · m

Notes

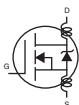a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
b. V_{DD} = 50 V, starting T_J = 25 °C, L = 1.9 mH, R_g = 25 Ω, I_{AS} = 20 A (see fig. 12).
c. $I_{SD} \leq$ 18 A, dI/dt $\leq$ 150 A/µs, $V_{DD} \leq V_{DS}$, $T_J \leq$ 150 °C.
d. 1.6 mm from case.

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

THERMAL RESISTANCE RATINGS

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	40	
Case-to-Sink, Flat, Greased Surface	R_{thCS}	0.24	-	°C/W
Maximum Junction-to-Case (Drain)	R_{thJC}	-	0.83	

SPECIFICATIONS (T_J = 25 °C, unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0 V, I_D = 250 µA		200	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, I_D = 1 mA		-	0.29	-	V/°C
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 µA		2.0	-	4.0	V
Gate-Source Leakage	I_{GSS}	V_{GS} = ± 20 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 200 V, V_{GS} = 0 V		-	-	25	µA
		V_{DS} = 160 V, V_{GS} = 0 V, T_J = 125 °C		-	-	250	
Drain-Source On-State Resistance	$R_{DS(on)}$	V_{GS} = 10 V	I_D = 12 A[b]	-	-	0.18	Ω
Forward Transconductance	g_{fs}	V_{DS} = 50 V, I_D = 12 A[b]		6.9	-	-	S
Dynamic							
Input Capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 25 V, f = 1.0 MHz, see fig. 5		-	1300	-	pF
Output Capacitance	C_{oss}			-	400	-	
Reverse Transfer Capacitance	C_{rss}			-	130	-	
Total Gate Charge	Q_g	V_{GS} = 10 V	I_D = 18 A, V_{DS} = 160 V, see fig. 6 and 13[b]	-	-	70	nC
Gate-Source Charge	Q_{gs}			-	-	13	
Gate-Drain Charge	Q_{gd}			-	-	39	
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 100 V, I_D = 18 A, R_g = 9.1 Ω, R_D = 5.4 Ω, see fig. 10[b]		-	14	-	ns
Rise Time	t_r			-	51	-	
Turn-Off Delay Time	$t_{d(off)}$			-	45	-	
Fall Time	t_f			-	36	-	
Internal Drain Inductance	L_D	Between lead, 6 mm (0.25") from package and center of die contact		-	5.0	-	nH
Internal Source Inductance	L_S			-	13	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode		-	-	20	A
Pulsed Diode Forward Current[a]	I_{SM}			-	-	80	
Body Diode Voltage	V_{SD}	T_J = 25 °C, I_S = 20 A, V_{GS} = 0 V[b]		-	-	2.0	V
Body Diode Reverse Recovery Time	t_{rr}	T_J = 25 °C, I_F = 18 A, dI/dt = 100 A/µs[b]		-	300	610	ns
Body Diode Reverse Recovery Charge	Q_{rr}			-	3.4	7.1	µC
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 ≤ 300 µs; duty cycle ≤ 2 %.

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)
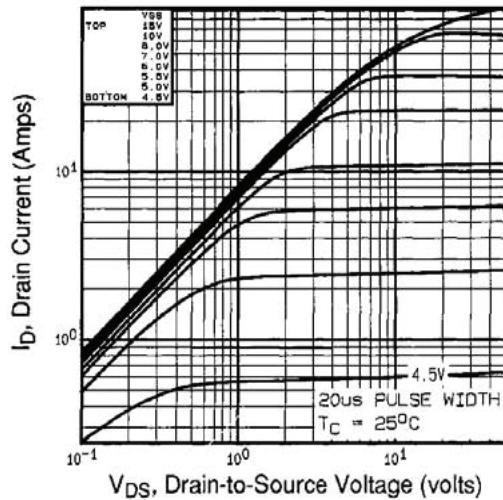
Fig. 1 - Typical Output Characteristics, T_C = 25 °C

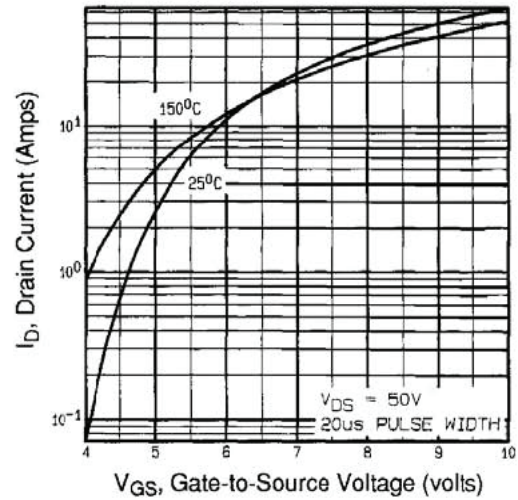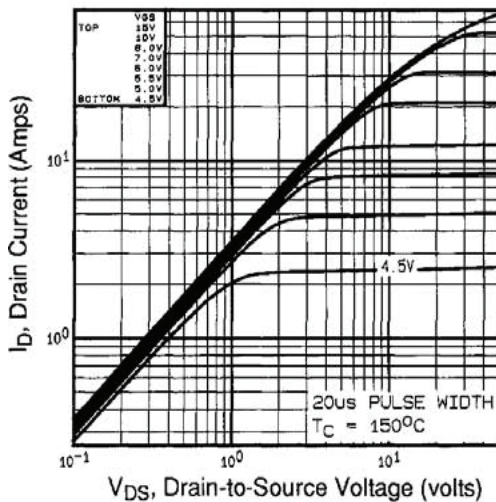Fig. 3 - Typical Transfer Characteristics

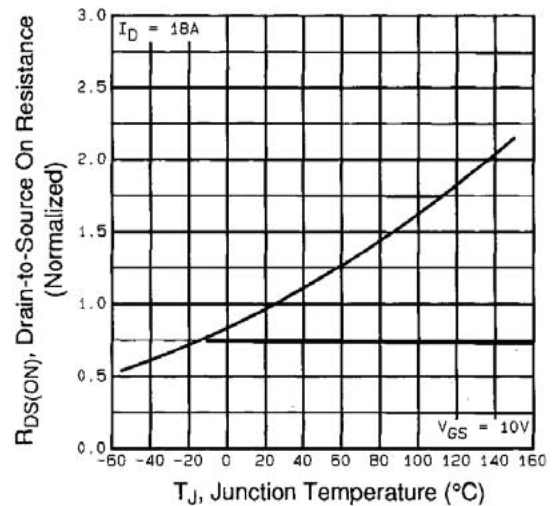Fig. 2 - Typical Output Characteristics, T_C = 150 °C

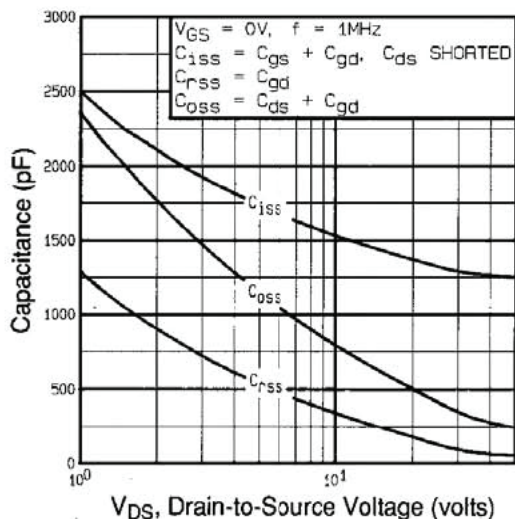Fig. 4 - Normalized On-Resistance vs. Temperature

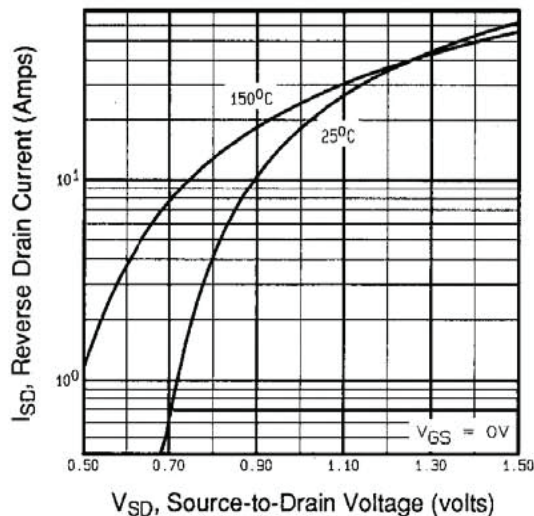**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

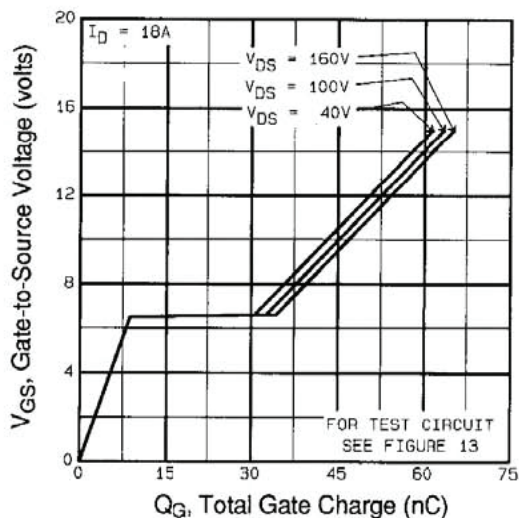**Fig. 7 - Typical Source-Drain Diode Forward Voltage**

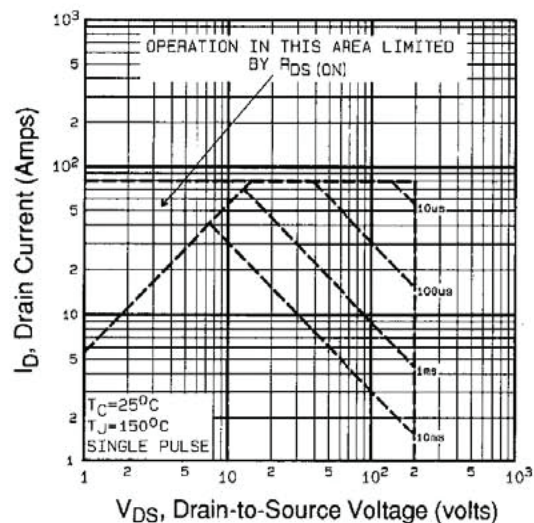**Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage**

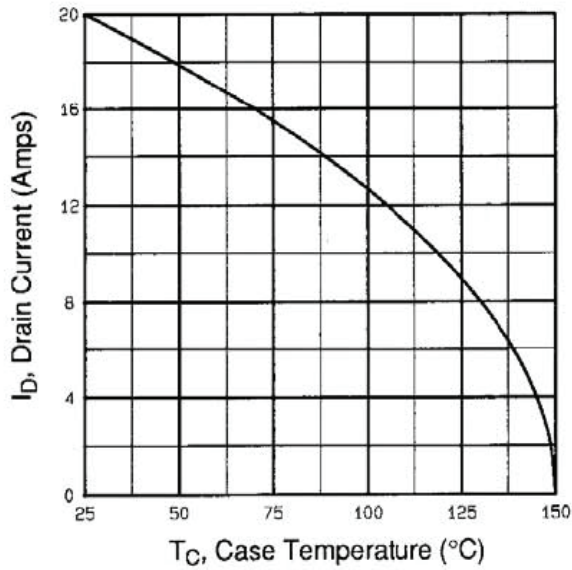**Fig. 8 - Maximum Safe Operating Area**

Fig. 9 - Maximum Drain Current vs. Case Temperature
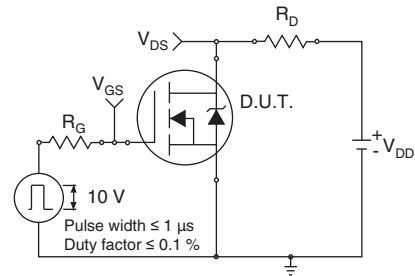

Fig. 10a - Switching Time Test Circuit
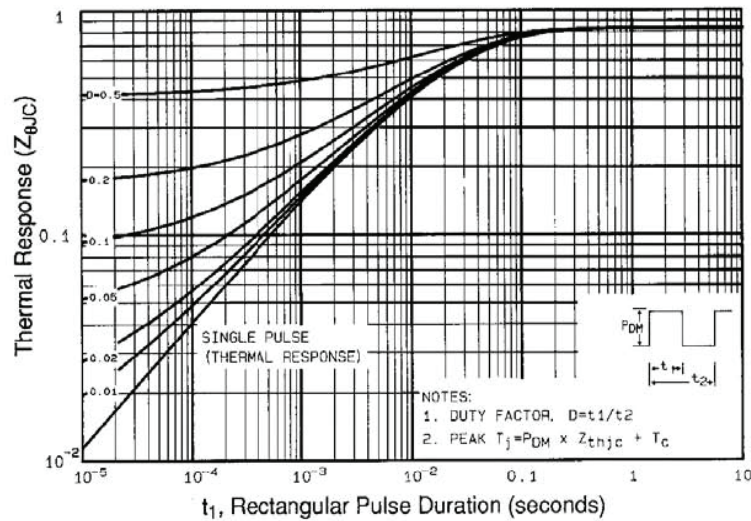

Fig. 10b - Switching Time Waveforms

Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case
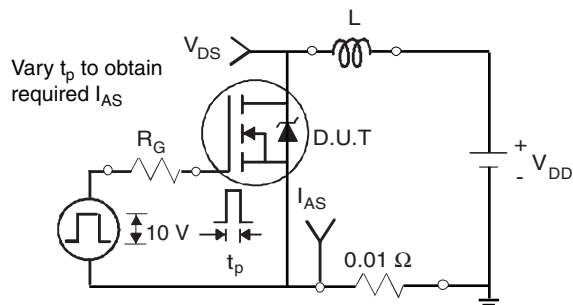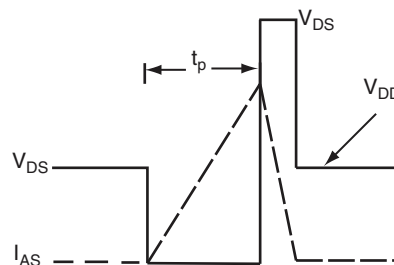
Fig. 12a - Unclamped Inductive Test Circuit

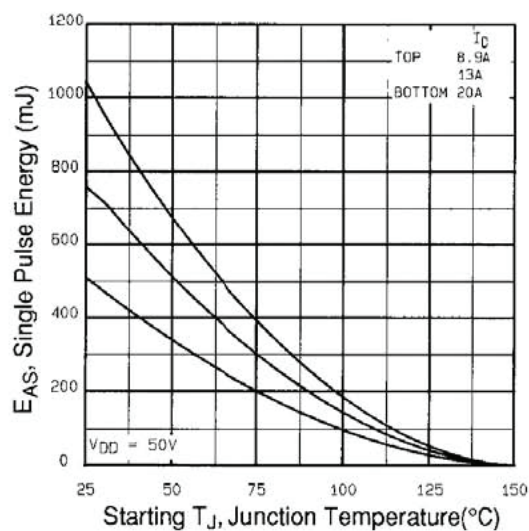**Fig. 12b - Unclamped Inductive Waveforms**

Fig. 12c - Maximum Avalanche Energy vs. Drain Current
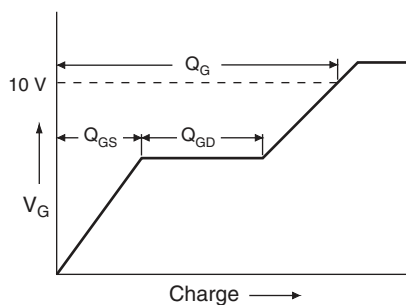
Fig. 13a - Basic Gate Charge Waveform
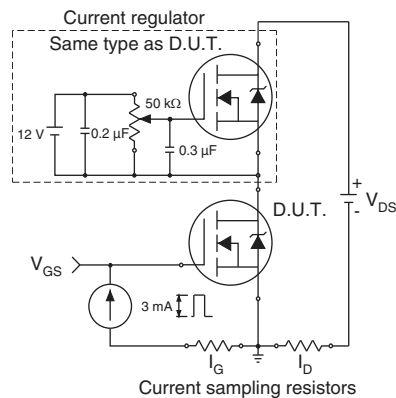
Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit

D.U.T.

Circuit layout considerations
- Low stray inductance
- Ground plane
- Low leakage inductance
  current transformer

① R_g

- dV/dt controlled by R_g
- Driver same type as D.U.T.
- I_{SD} controlled by duty factor "D"
- D.U.T. - device under test

$+$ V_{DD} $-$

① Driver gate drive

$D = \dfrac{P.W.}{Period}$

P.W.

Period

$V_{GS} = 10 \ V^{a}$

② D.U.T. I_{SD} waveform

Reverse
recovery
current

Body diode forward
current

dI/dt

③ D.U.T. V_{DS} waveform

Diode recovery
dV/dt

V_{DD}

Re-applied
voltage

Body diode forward drop

④ Inductor current

Ripple ≤ 5 %

I_{SD}

Note

a. $V_{GS} = 5 \ V$ for logic level devices

Fig. 14 - For N-Channel

TO-247AC (HIGH VOLTAGE)

View A - A

View B

Section C - C, D - D, E - E
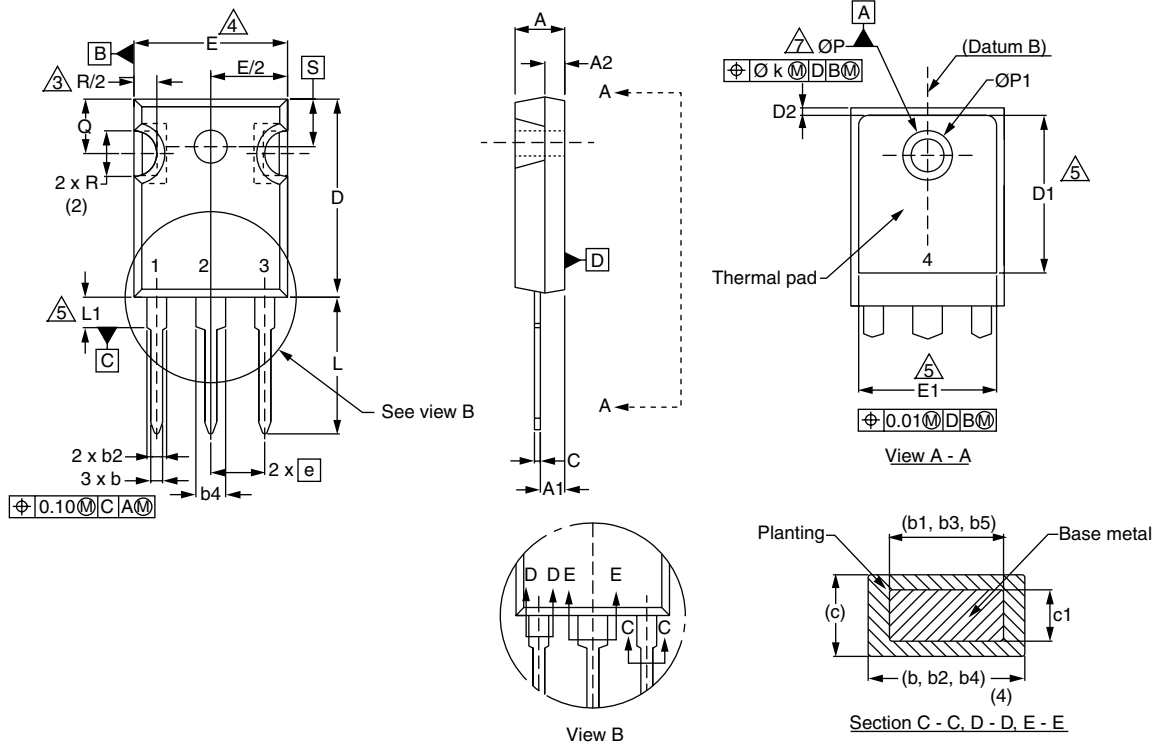
DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.65	5.31	0.183	0.209
A1	2.21	2.59	0.087	0.102
A2	1.50	2.49	0.059	0.098
b	0.99	1.40	0.039	0.055
b1	0.99	1.35	0.039	0.053
b2	1.65	2.39	0.065	0.094
b3	1.65	2.37	0.065	0.093
b4	2.59	3.43	0.102	0.135
b5	2.59	3.38	0.102	0.133
c	0.38	0.86	0.015	0.034
c1	0.38	0.76	0.015	0.030
D	19.71	20.70	0.776	0.815
D1	13.08	-	0.515	-

DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
D2	0.51	1.30	0.020	0.051
E	15.29	15.87	0.602	0.625
E1	13.72	-	0.540	-
e	5.46 BSC		0.215 BSC	
Ø k	0.254		0.010	
L	14.20	16.10	0.559	0.634
L1	3.71	4.29	0.146	0.169
N	7.62 BSC		0.300 BSC	
Ø P	3.56	3.66	0.140	0.144
Ø P1	-	7.39	-	0.291
Q	5.31	5.69	0.209	0.224
R	4.52	5.49	0.178	0.216
S	5.51 BSC		0.217 BSC	

ECN: S-81920-Rev. A, 15-Sep-08
DWG: 5971

Notes

1. Dimensioning and tolerancing per ASME Y14.5M-1994.
2. Contour of slot optional.
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 outermost extremes of the plastic body.
4. Thermal pad contour optional with dimensions D1 and E1.
5. Lead finish uncontrolled in L1.
6. Ø P to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154").
7. Outline conforms to JEDEC outline TO-247 with exception of dimension c.

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 and agree to fully indemnify and hold Vishay and its distributors harmless from and against any and all claims, liabilities, expenses and damages arising or resulting in connection with such use or sale, including attorneys fees, even if such claim alleges that Vishay or its distributor was negligent regarding the design or manufacture of the part. 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.