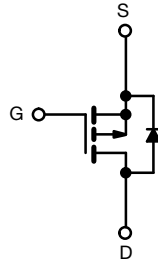
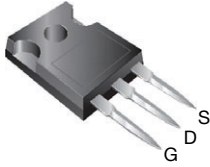


## Power MOSFET

**TO-247AC**


P-Channel MOSFET

### FEATURES

- Dynamic dV/dt rating
- Repetitive avalanche rated
- P-channel
- Isolated central mounting hole
- 175 °C operating temperature
- Fast switching
- Ease of paralleling
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS\***  
Available

### 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 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 of its isolated mounting hole. It also provides greater creepage distance between pins to meet the requirements of most safety specifications.

### PRODUCT SUMMARY

$V_{DS}$ (V)	-100	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = -10$ V	0.20
$Q_g$ (max.) (nC)	61	
$Q_{gs}$ (nC)	14	
$Q_{gd}$ (nC)	29	
Configuration	Single	

### ORDERING INFORMATION

Package	TO-247AC
Lead (Pb)-free	IRFP9140PbF

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

PARAMETER	SYMBOL	LIMIT	UNIT	
Drain-source voltage	$V_{DS}$	-100	V	
Gate-source voltage	$V_{GS}$	$\pm 20$		
Continuous drain current	$V_{GS}$ at -10 V	$T_C = 25$ °C	-21	A
		$T_C = 100$ °C	-15	
Pulsed drain current <sup>a</sup>	$I_{DM}$	-84		
Linear derating factor		1.2	W/°C	
Single pulse avalanche energy <sup>b</sup>	$E_{AS}$	960	mJ	
Repetitive avalanche current <sup>a</sup>	$I_{AR}$	-21	A	
Repetitive avalanche energy <sup>a</sup>	$E_{AR}$	18	mJ	
Maximum power dissipation	$T_C = 25$ °C	$P_D$	180	W
Peak diode recovery dV/dt <sup>c</sup>	$dV/dt$	-5.5	V/ns	
Operating junction and storage temperature range	$T_J, T_{stg}$	-5 to +175	°C	
Soldering recommendations (peak temperature)	for 10 s	300 <sup>d</sup>		
Mounting Torque	6-32 or M3 screw	10		lbf · in
		1.1	N · m	

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- $V_{DD} = -25$  V, starting  $T_J = 25$  °C,  $L = 3.3$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = -21$  A (see fig. 12)
- $I_{SD} \leq -21$  A,  $dI/dt \leq 200$  A/ $\mu$ s,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 175$  °C
- 1.6 mm from case

<b>THERMAL RESISTANCE RATINGS</b>				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	$R_{thJA}$	-	40	°C/W
Case-to-sink, flat, greased surface	$R_{thCS}$	0.24	-	
Maximum junction-to-case (drain)	$R_{thJC}$	-	0.83	

<b>SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-source breakdown voltage	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = -250\text{ }\mu\text{A}$	-100	-	-	V
$V_{DS}$ temperature coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = -1\text{ mA}$	-	-0.087	-	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	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$	-	-	$\pm 100$	nA
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = -100\text{ V}$ , $V_{GS} = 0\text{ V}$	-	-	-100	$\mu\text{A}$
		$V_{DS} = -80\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$	-	-	-500	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = -10\text{ V}$ , $I_D = -13\text{ A}^b$	-	-	0.20	$\Omega$
Forward transconductance	$g_{fs}$	$V_{DS} = -50\text{ V}$ , $I_D = -13\text{ A}^b$	6.2	-	-	S
<b>Dynamic</b>						
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}$ , $V_{DS} = -25\text{ V}$ , $f = 1.0\text{ MHz}$ , see fig. 5	-	1400	-	pF
Output capacitance	$C_{oss}$		-	590	-	
Reverse transfer capacitance	$C_{rss}$		-	140	-	
Total gate charge	$Q_g$	$V_{GS} = -10\text{ V}$ , $I_D = -19\text{ A}$ , $V_{DS} = -80\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	61	nC
Gate-source charge	$Q_{gs}$		-	-	14	
Gate-drain charge	$Q_{gd}$		-	-	29	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = -50\text{ V}$ , $I_D = -19\text{ A}$ , $R_g = 9.1\text{ }\Omega$ , $R_D = 2.4\text{ }\Omega$ , see fig. 10 <sup>b</sup>	-	16	-	ns
Rise time	$t_r$		-	73	-	
Turn-off delay time	$t_{d(off)}$		-	34	-	
Fall time	$t_f$		-	57	-	
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	-	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous source-drain diode current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode	-	-	-21	A
Pulsed diode forward current <sup>a</sup>	$I_{SM}$		-	-	-84	
Body diode voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_S = -21\text{ A}$ , $V_{GS} = 0\text{ V}^b$	-	-	-5.0	V
Body diode reverse recovery time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_F = -19\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$	-	130	260	ns
Body diode reverse recovery charge	$Q_{rr}$		-	0.35	0.70	$\mu\text{C}$
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  $\leq 2\%$ .

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

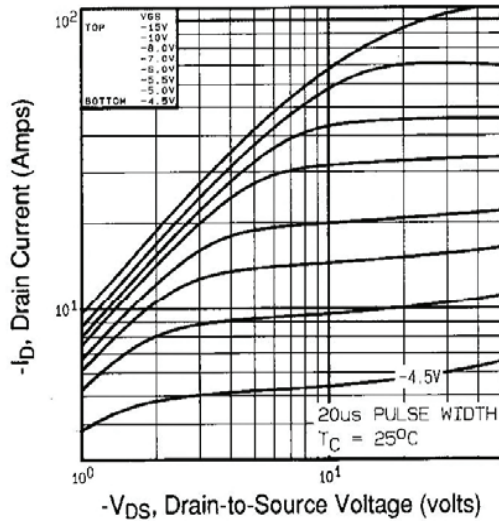


Fig. 1 - Typical Output Characteristics,  $T_C = 25^\circ\text{C}$

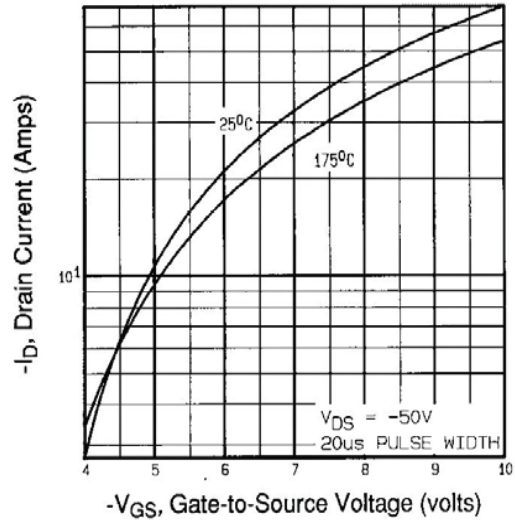


Fig. 3 - Typical Transfer Characteristics

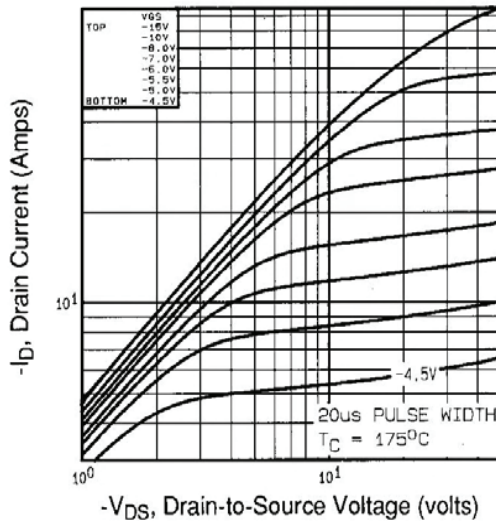


Fig. 2 - Typical Output Characteristics,  $T_C = 175^\circ\text{C}$

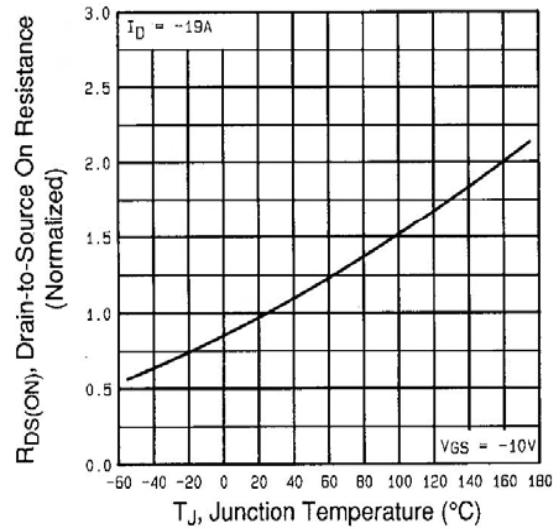


Fig. 4 - Normalized On-Resistance vs. Temperature

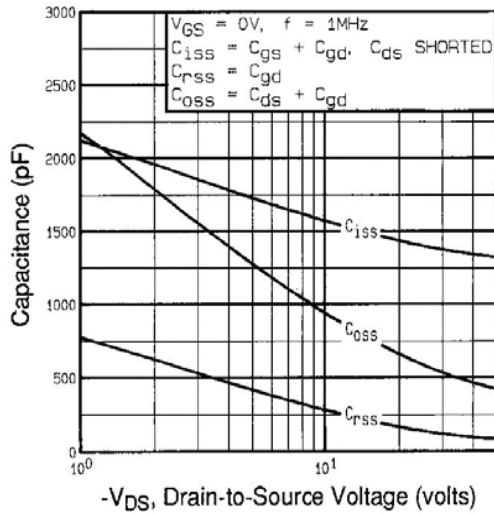


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

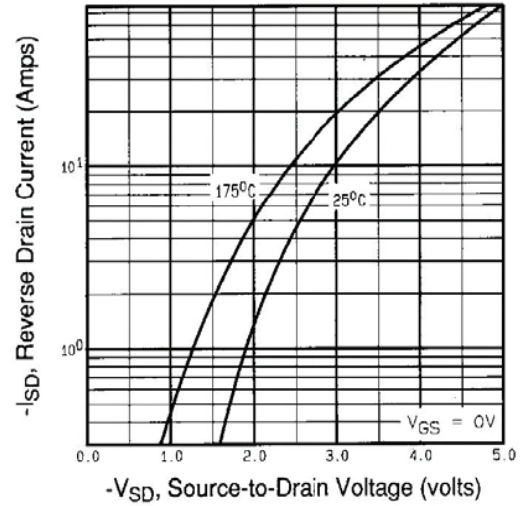


Fig. 7 - Typical Source-Drain Diode Forward Voltage

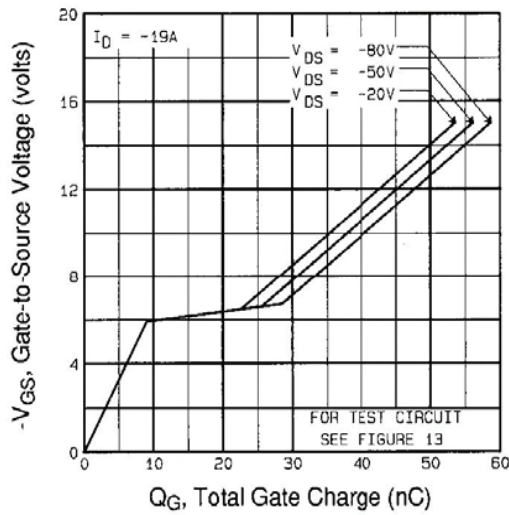


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

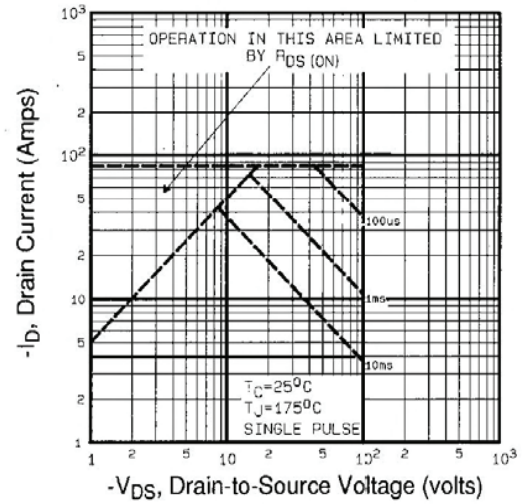


Fig. 8 - Maximum Safe Operating Area

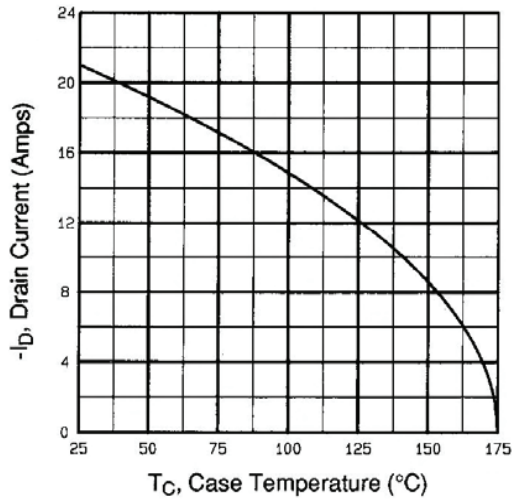


Fig. 9 - Maximum Drain Current vs. Case Temperature

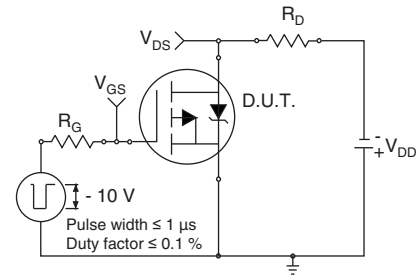


Fig. 10 - Switching Time Test Circuit

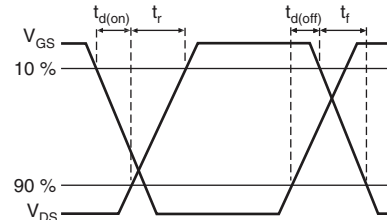


Fig. 11 - Switching Time Waveforms

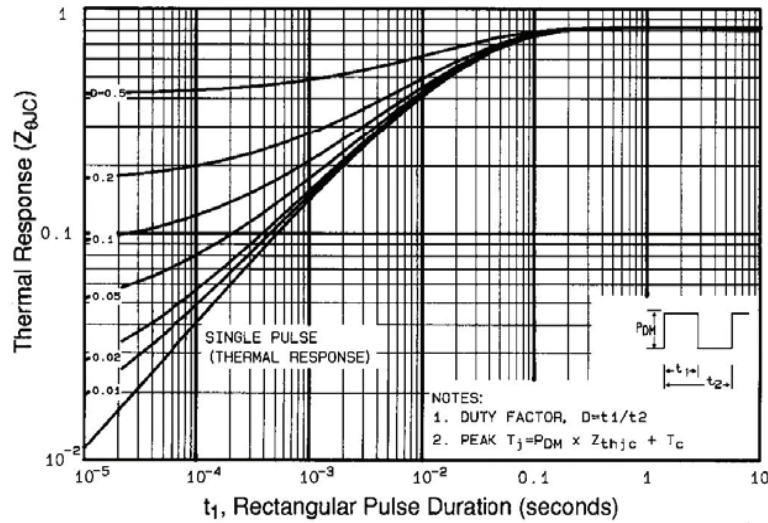


Fig. 12 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

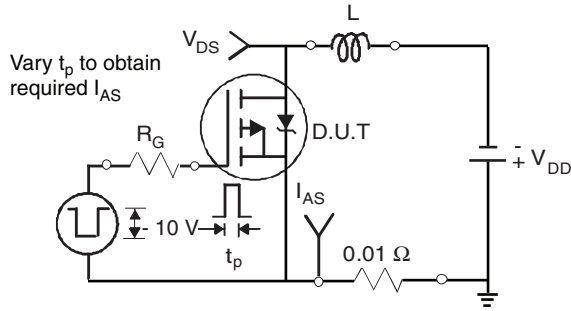


Fig. 13 - Unclamped Inductive Test Circuit

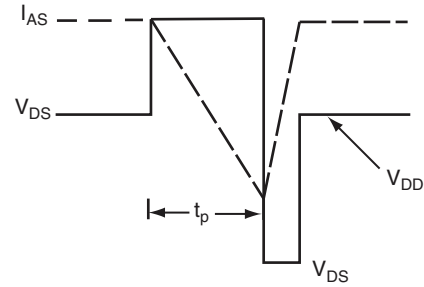


Fig. 14 - Unclamped Inductive Waveforms

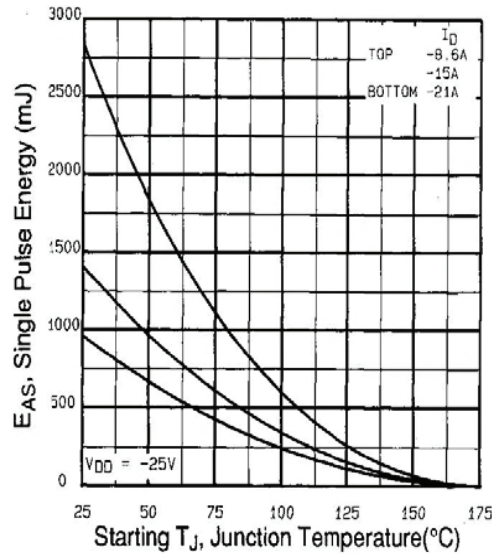


Fig. 15 - Maximum Avalanche Energy vs. Drain Current

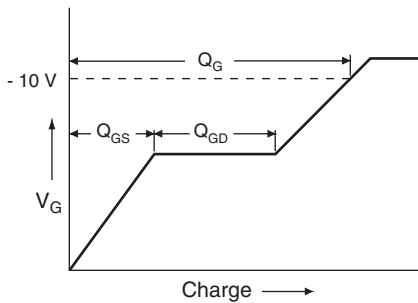


Fig. 16 - Basic Gate Charge Waveform

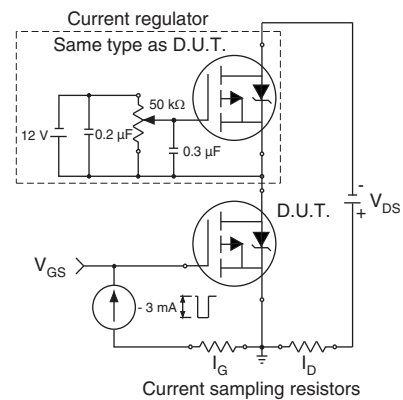
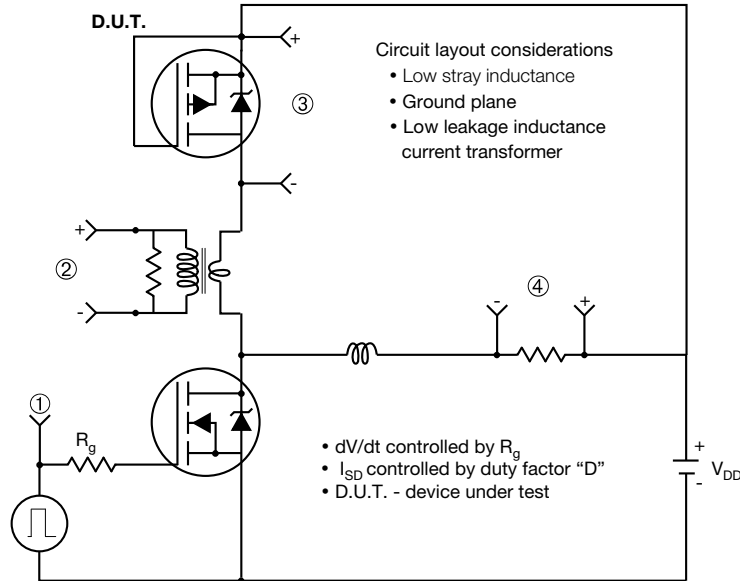


Fig. 17 - Gate Charge Test Circuit

**Peak Diode Recovery dV/dt Test Circuit**



**Note**  
• Compliment N-Channel of D.U.T. for driver



**Fig. 18 - For P-Channel**

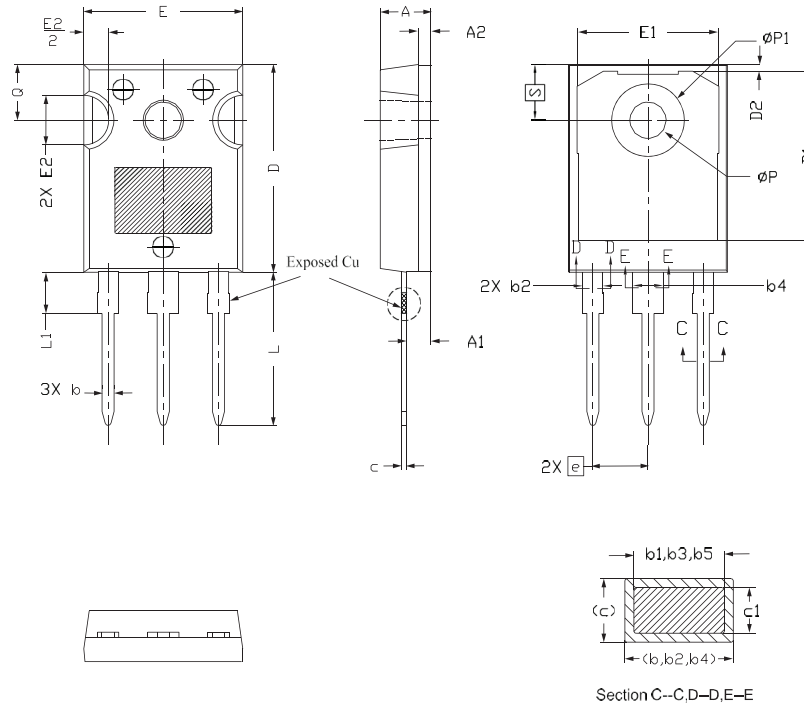
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# TO-247AC (High Voltage)

VERSION 1: FACILITY CODE = 9



DIM.	MILLIMETERS			NOTES
	MIN.	NOM.	MAX.	
A	4.83	5.02	5.21	
A1	2.29	2.41	2.55	
A2	1.17	1.27	1.37	
b	1.12	1.20	1.33	
b1	1.12	1.20	1.28	
b2	1.91	2.00	2.39	6
b3	1.91	2.00	2.34	
b4	2.87	3.00	3.22	6, 8
b5	2.87	3.00	3.18	
c	0.40	0.50	0.60	6
c1	0.40	0.50	0.56	
D	20.40	20.55	20.70	4

DIM.	MILLIMETERS			NOTES
	MIN.	NOM.	MAX.	
D1	16.46	16.76	17.06	5
D2	0.56	0.66	0.76	
E	15.50	15.70	15.87	4
E1	13.46	14.02	14.16	5
E2	4.52	4.91	5.49	3
e	5.46 BSC			
L	14.90	15.15	15.40	
L1	3.96	4.06	4.16	6
Ø P	3.56	3.61	3.65	7
Ø P1	7.19 ref.			
Q	5.31	5.50	5.69	
S	5.51 BSC			

**Notes**

- (1) Package reference: JEDEC® TO247, variation AC
- (2) All dimensions are in mm
- (3) Slot required, notch may be rounded
- (4) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm per side. These dimensions are measured at the outermost extremes of the plastic body
- (5) Thermal pad contour optional with dimensions D1 and E1
- (6) Lead finish uncontrolled in L1
- (7) 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
- (8) Dimension b2 and b4 does not include dambar protrusion. Allowable dambar protrusion shall be 0.1 mm total in excess of b2 and b4 dimension at maximum material condition





**VERSION 2: FACILITY CODE = Y**



DIM.	MILLIMETERS		NOTES
	MIN.	MAX.	
A	4.58	5.31	
A1	2.21	2.59	
A2	1.17	2.49	
b	0.99	1.40	
b1	0.99	1.35	
b2	1.53	2.39	
b3	1.65	2.37	
b4	2.42	3.43	
b5	2.59	3.38	
c	0.38	0.86	
c1	0.38	0.76	
D	19.71	20.82	
D1	13.08	-	

DIM.	MILLIMETERS		NOTES
	MIN.	MAX.	
D2	0.51	1.30	
E	15.29	15.87	
E1	13.72	-	
e	5.46 BSC		
Ø k	0.254		
L	14.20	16.25	
L1	3.71	4.29	
Ø P	3.51	3.66	
Ø P1	-	7.39	
Q	5.31	5.69	
R	4.52	5.49	
S	5.51 BSC		

**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



**VERSION 3: FACILITY CODE = N**



MILLIMETERS		
DIM.	MIN.	MAX.
A	4.65	5.31
A1	2.21	2.59
A2	1.17	1.37
b	0.99	1.40
b1	0.99	1.35
b2	1.65	2.39
b3	1.65	2.34
b4	2.59	3.43
b5	2.59	3.38
c	0.38	0.89
c1	0.38	0.84
D	19.71	20.70
D1	13.08	-

MILLIMETERS		
DIM.	MIN.	MAX.
D2	0.51	1.35
E	15.29	15.87
E1	13.46	-
e	5.46 BSC	
k	0.254	
L	14.20	16.10
L1	3.71	4.29
N	7.62 BSC	
P	3.56	3.66
P1	-	7.39
Q	5.31	5.69
R	4.52	5.49
S	5.51 BSC	

ECN: E22-0452-Rev. G, 31-Oct-2022  
 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")



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