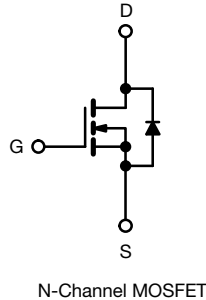
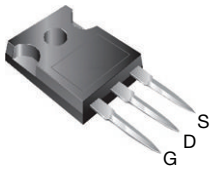


## Power MOSFET

| PRODUCT SUMMARY           |                              |
|---------------------------|------------------------------|
| $V_{DS}$ (V)              | 60                           |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10\text{ V}$ 0.018 |
| $Q_g$ max. (nC)           | 110                          |
| $Q_{gs}$ (nC)             | 29                           |
| $Q_{gd}$ (nC)             | 38                           |
| Configuration             | Single                       |

**TO-247AC**


### FEATURES

- Dynamic  $dV/dt$  rating
- Isolated central mounting hole
- 175 °C operating temperature
- Ease of paralleling
- Simple drive requirements
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**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       | IRFP048RPbF |

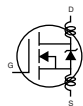
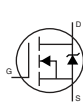
| ABSOLUTE MAXIMUM RATINGS ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted) |                                  |                                   |      |          |
|---|----------------------------------|-----------------------------------|------|----------|
| PARAMETER   | SYMBOL                           | LIMIT                             | UNIT |          |
| Drain-Source Voltage  | $V_{DS}$                         | 60                                | V    |          |
| Gate-Source Voltage   | $V_{GS}$                         | $\pm 20$                          |      |          |
| Continuous Drain Current <sup>e</sup>   | $V_{GS}$ at 10 V                 | $T_C = 25\text{ }^\circ\text{C}$  | A    |          |
| Continuous Drain Current  |                                  | $T_C = 100\text{ }^\circ\text{C}$ |      |          |
| Pulsed Drain Current <sup>a</sup>   | $I_{DM}$                         | 290                               |      |          |
| Linear Derating Factor  |                                  | 1.3                               | W/°C |          |
| Single Pulse Avalanche Energy <sup>b</sup>  | $E_{AS}$                         | 200                               | mJ   |          |
| Maximum Power Dissipation   | $T_C = 25\text{ }^\circ\text{C}$ | $P_D$                             | 190  | W        |
| Peak Diode Recovery $dV/dt$ <sup>c</sup>  |                                  | $dV/dt$                           | 4.5  | V/ns     |
| Operating Junction and Storage Temperature Range                                      | $T_J, T_{stg}$                   | -55 to +175                       | °C   |          |
| Soldering Recommendations (Peak temperature) <sup>d</sup>                             | for 10 s                         |                                   |      | 300      |
| 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).
- $V_{DD} = 25\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 43\text{ }\mu\text{H}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 73\text{ A}$  (see fig. 12).
- $I_{SD} \leq 72\text{ A}$ ,  $dI/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 175\text{ }^\circ\text{C}$ .
- 1.6 mm from case.
- Current limited by the package (die current = 73 A)



| THERMAL RESISTANCE RATINGS          |            |      |      |      |
|-------------------------------------|------------|------|------|------|
| 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)    | $R_{thJC}$ | -    | 0.80 |      |

| SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted) |                     |   |      |       |                 |               |
|---|---------------------|---|------|-------|-----------------|---------------|
| PARAMETER   | SYMBOL              | TEST CONDITIONS   | MIN. | TYP.  | MAX.            | UNIT          |
| <b>Static</b>   |                     |   |      |       |                 |               |
| Drain-Source Breakdown Voltage  | $V_{DS}$            | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$   | 60   | -     | -               | V             |
| $V_{DS}$ Temperature Coefficient  | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}, I_D = 1\text{ mA}$  | -    | 0.060 | -               | 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   | $I_{DSS}$           | $V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$   | -    | -     | 25              | $\mu\text{A}$ |
|   |                     | $V_{DS} = 48\text{ V}, V_{GS} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$  | -    | -     | 250             |               |
| Drain-Source On-State Resistance  | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}, I_D = 44\text{ A}^b$   | -    | -     | 0.018           | $\Omega$      |
| Forward Transconductance  | $g_{fs}$            | $V_{DS} = 25\text{ V}, I_D = 44\text{ A}^b$   | 20   | -     | -               | S             |
| <b>Dynamic</b>  |                     |   |      |       |                 |               |
| Input Capacitance   | $C_{iss}$           | $V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz}, \text{ see fig. 5}$   | -    | 2400  | -               | pF            |
| Output Capacitance  | $C_{oss}$           |   | -    | 1300  | -               |               |
| Reverse Transfer Capacitance  | $C_{rss}$           |   | -    | 190   | -               |               |
| Total Gate Charge   | $Q_g$               | $V_{GS} = 10\text{ V}, I_D = 72\text{ A}, V_{DS} = 48\text{ V}$<br>see fig. 6 and 13 <sup>b</sup>   | -    | -     | 110             | nC            |
| Gate-Source Charge  | $Q_{gs}$            |   | -    | -     | 29              |               |
| Gate-Drain Charge   | $Q_{gd}$            |   | -    | -     | 38              |               |
| Turn-On Delay Time  | $t_{d(on)}$         | $V_{DD} = 30\text{ V}, I_D = 72\text{ A}, R_g = 9.1\text{ }\Omega, R_D = 0.34\text{ }\Omega, \text{ see fig. 10}^b$                                     | -    | 8.1   | -               | ns            |
| Rise Time   | $t_r$               |   | -    | 250   | -               |               |
| Turn-Off Delay Time   | $t_{d(off)}$        |   | -    | 210   | -               |               |
| Fall Time   | $t_f$               |   | -    | 250   | -               |               |
| 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    | -    | -     | 70 <sup>c</sup> | A             |
| Pulsed Diode Forward Current <sup>a</sup>                                   | $I_{SM}$            |   | -    | -     | 290             |               |
| Body Diode Voltage  | $V_{SD}$            | $T_J = 25\text{ }^\circ\text{C}, I_S = 73\text{ A}, V_{GS} = 0\text{ V}^b$  | -    | -     | 2.0             | V             |
| Body Diode Reverse Recovery Time  | $t_{rr}$            | $T_J = 25\text{ }^\circ\text{C}, I_F = 72\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}^b$   | -    | 120   | 180             | ns            |
| Body Diode Reverse Recovery Charge  | $Q_{rr}$            |   | -    | 0.50  | 0.80            | $\mu\text{C}$ |
| 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  $\leq 2\%$ .
- c. Current limited by the package (die current = 73 A).



TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

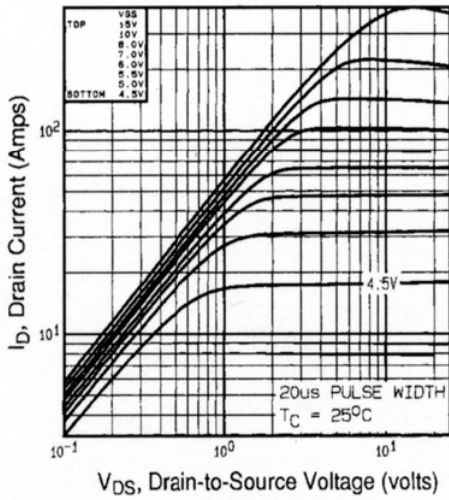


Fig. 1 - Typical Output Characteristics,  $T_C = 25\text{ }^\circ\text{C}$

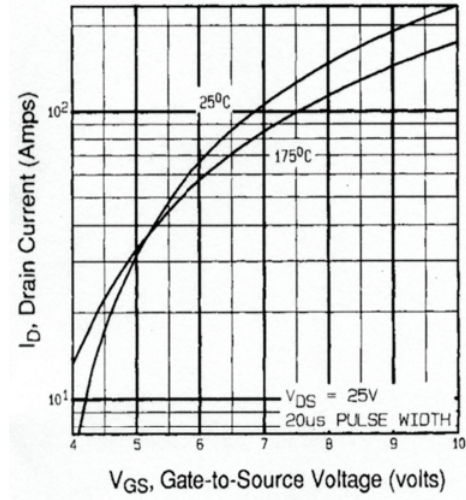


Fig. 3 - Typical Transfer Characteristics

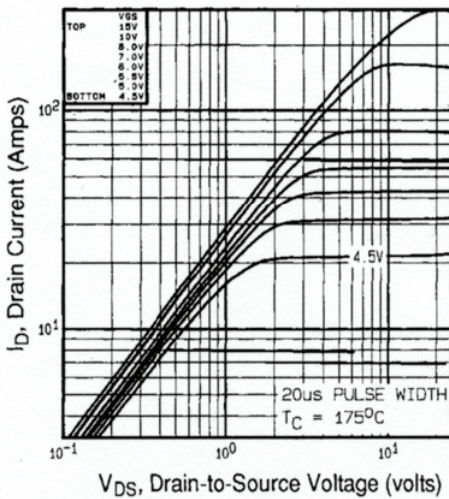


Fig. 2 - Typical Output Characteristics,  $T_C = 175\text{ }^\circ\text{C}$

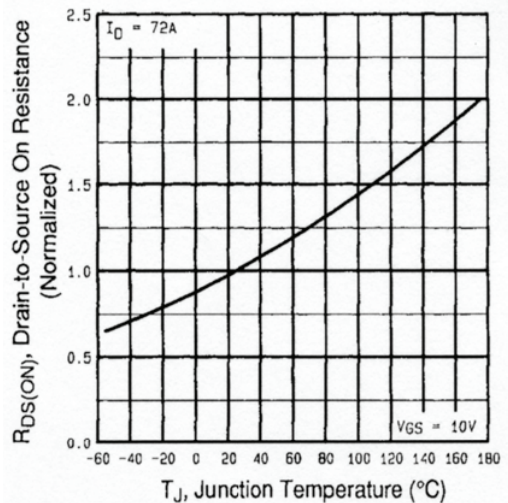


Fig. 4 - Normalized On-Resistance vs. Temperature

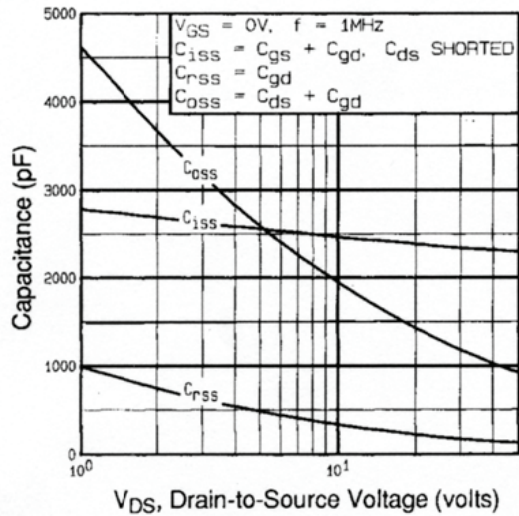


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

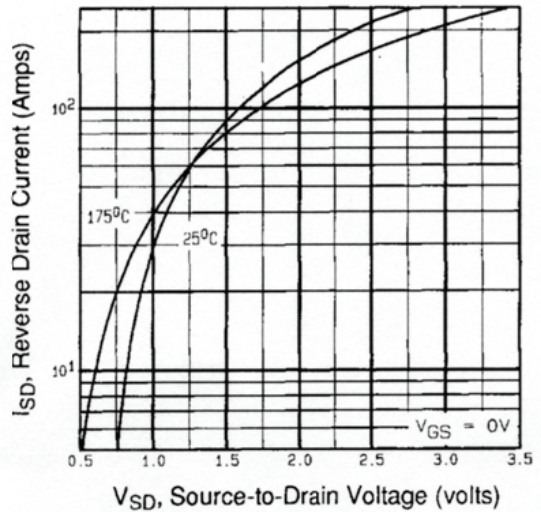


Fig. 7 - Typical Source-Drain Diode Forward Voltage

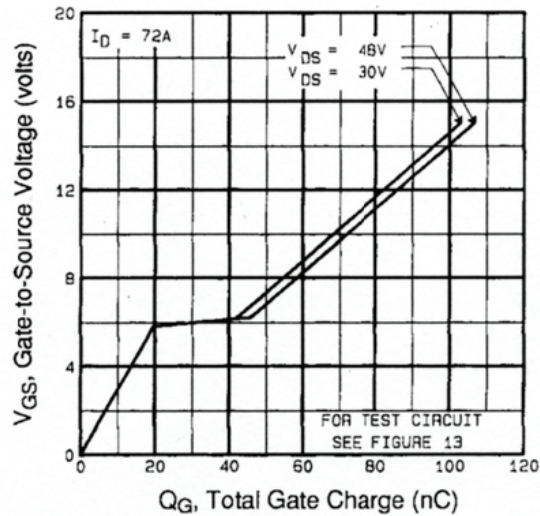


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

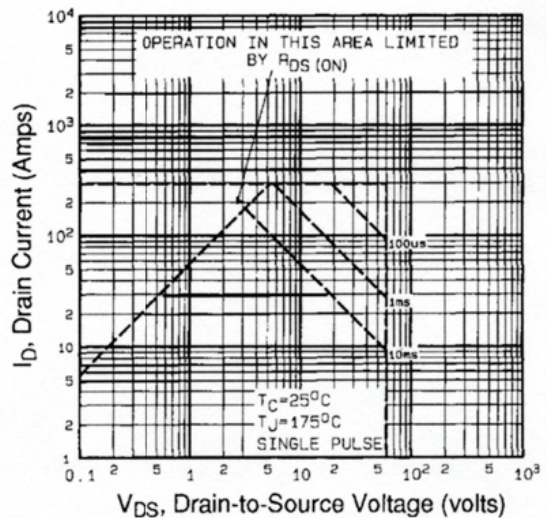


Fig. 8 - Maximum Safe Operating Area

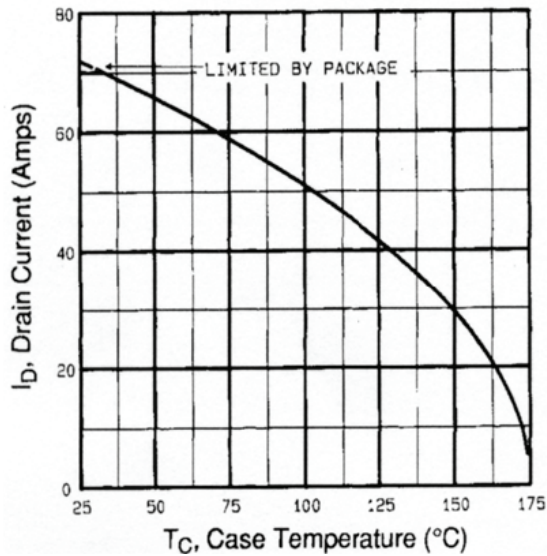


Fig. 9 - Maximum Drain Current vs. Case Temperature

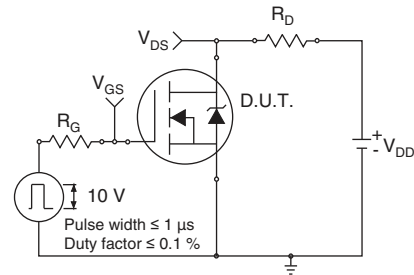


Fig. 10a - Switching Time Test Circuit

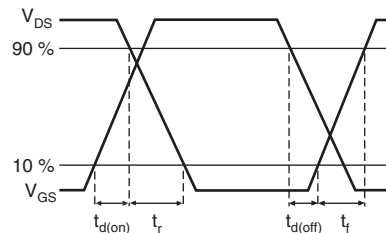


Fig. 10b - Switching Time Waveforms

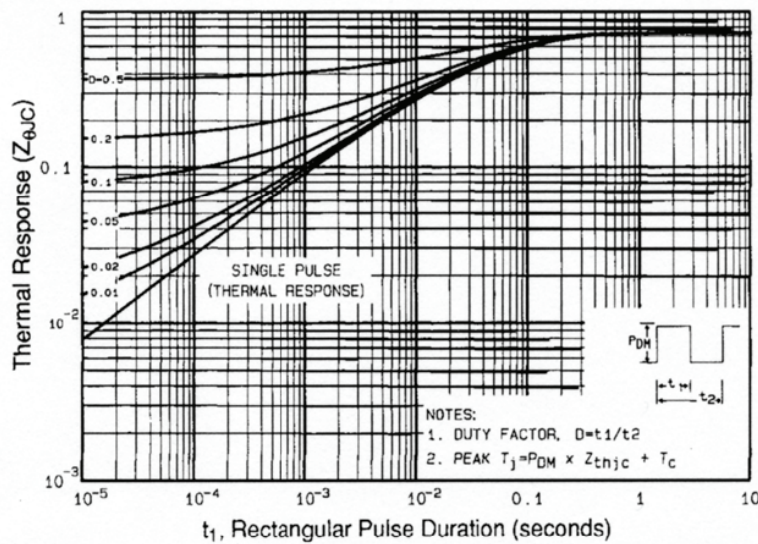


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

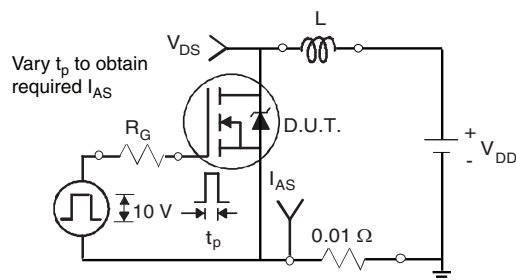


Fig. 12a - Unclamped Inductive Test Circuit

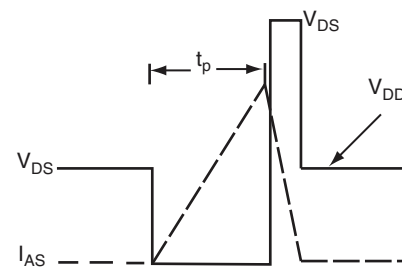


Fig. 12b - Unclamped Inductive Waveforms

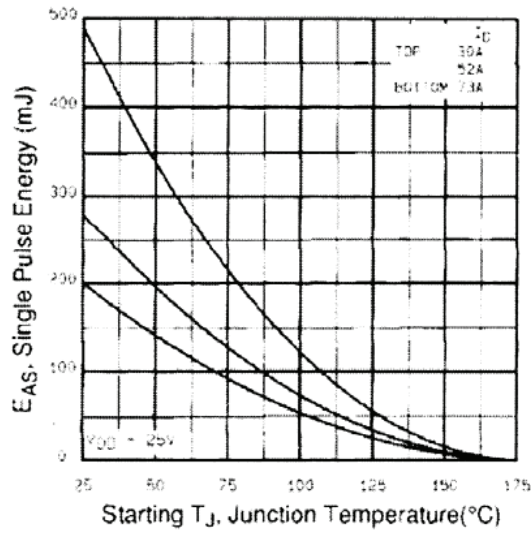


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

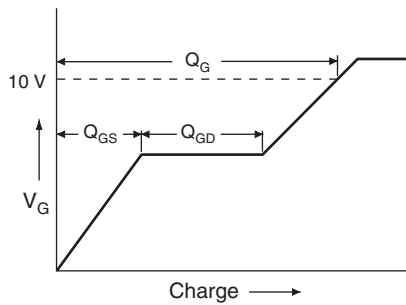


Fig. 13a - Basic Gate Charge Waveform

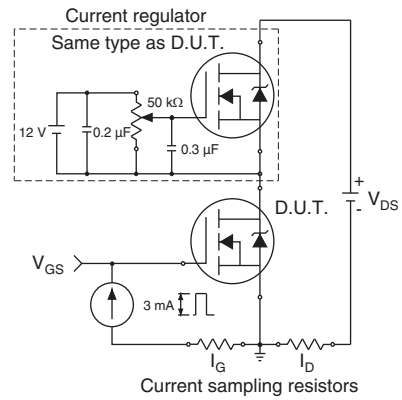
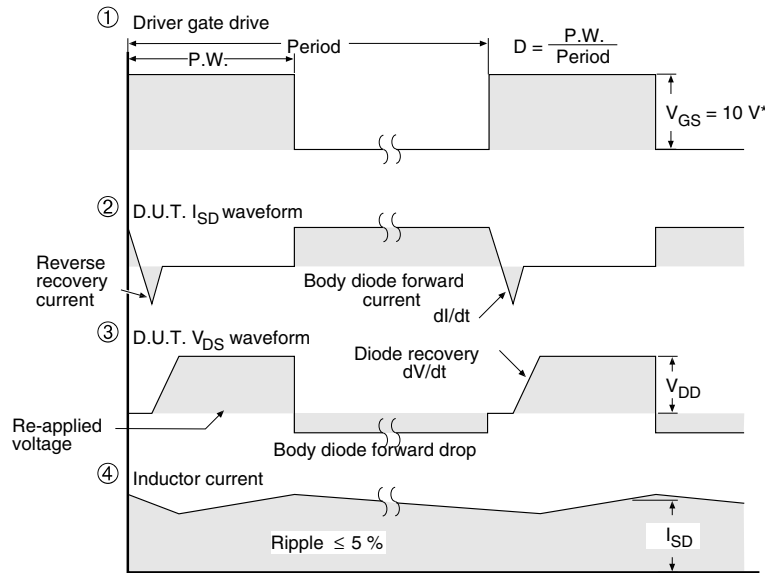
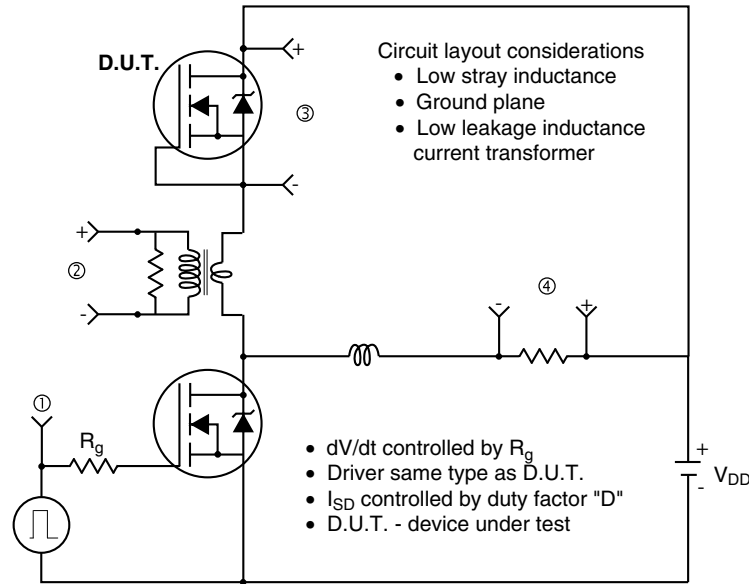


Fig. 13b - Gate Charge Test Circuit

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



\*  $V_{GS} = 5\text{ V}$  for logic level devices

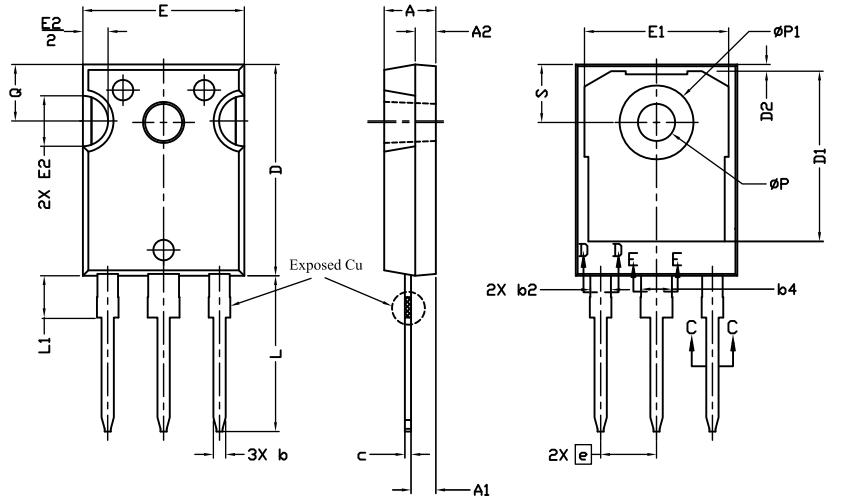
**Fig. 14 - For N-Channel**

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# TO-247AC (High Voltage)

VERSION 1: FACILITY CODE = 9



Section C--C, D--D, E--E

| DIM. | MILLIMETERS |       | NOTES |
|------|-------------|-------|-------|
|      | MIN.        | MAX.  |       |
| A    | 4.83        | 5.21  |       |
| A1   | 2.29        | 2.55  |       |
| A2   | 1.50        | 2.49  |       |
| b    | 1.12        | 1.33  |       |
| b1   | 1.12        | 1.28  |       |
| b2   | 1.91        | 2.39  | 6     |
| b3   | 1.91        | 2.34  |       |
| b4   | 2.87        | 3.22  | 6, 8  |
| b5   | 2.87        | 3.18  |       |
| c    | 0.55        | 0.69  | 6     |
| c1   | 0.55        | 0.65  |       |
| D    | 20.40       | 20.70 | 4     |

| DIM. | MILLIMETERS |       | NOTES |
|------|-------------|-------|-------|
|      | MIN.        | MAX.  |       |
| D1   | 16.25       | 16.85 | 5     |
| D2   | 0.56        | 0.76  |       |
| E    | 15.50       | 15.87 | 4     |
| E1   | 13.46       | 14.16 | 5     |
| E2   | 4.52        | 5.49  | 3     |
| e    | 5.44 BSC    |       |       |
| L    | 14.90       | 15.40 |       |
| L1   | 3.96        | 4.16  | 6     |
| Ø P  | 3.56        | 3.65  | 7     |
| Ø P1 | 7.19 ref.   |       |       |
| Q    | 5.31        | 5.69  |       |
| S    | 5.54        | 5.74  |       |

### 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       | -     |       |

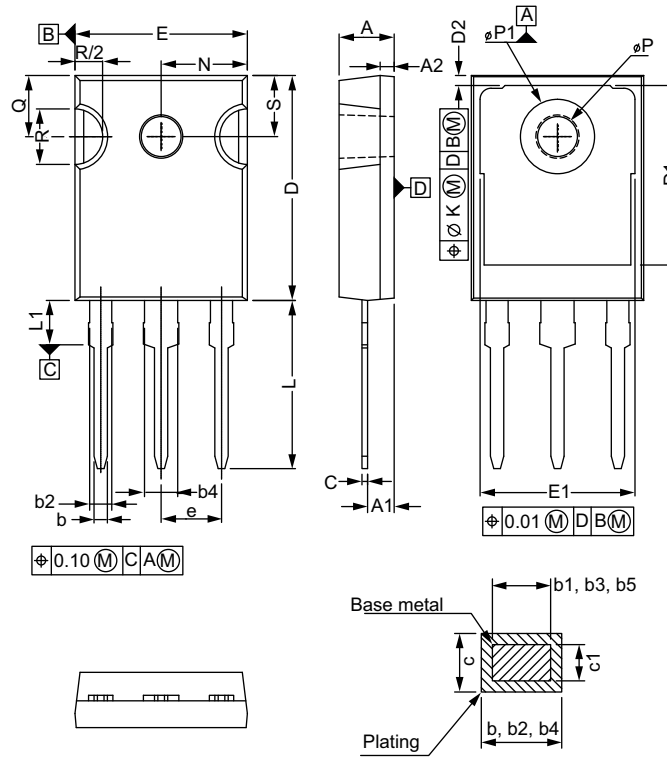
| DIM. | MILLIMETERS |       | NOTES |
|------|-------------|-------|-------|
|      | MIN.        | MAX.  |       |
| D2   | 0.51        | 1.30  |       |
| E    | 15.29       | 15.87 |       |
| E1   | 13.72       | -     |       |
| e    | 5.46 BSC    |       |       |
| Ø k  | 0.254       |       |       |
| 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: E20-0545-Rev. F, 19-Oct-2020  
 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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