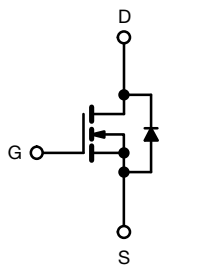
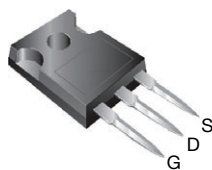


# Power MOSFET

**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
- 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-220AB package is universally 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)              | 200                    |       |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10\text{ V}$ | 0.085 |
| $Q_g$ (max.) (nC)         | 140                    |       |
| $Q_{gs}$ (nC)             | 28                     |       |
| $Q_{gd}$ (nC)             | 74                     |       |
| Configuration             | Single                 |       |

## ORDERING INFORMATION

|                |            |
|----------------|------------|
| Package        | TO-247AC   |
| Lead (Pb)-free | IRFP250PbF |

## ABSOLUTE MAXIMUM RATINGS ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted)

| PARAMETER                                                 | SYMBOL           | LIMIT                             | UNIT                |
|-----------------------------------------------------------|------------------|-----------------------------------|---------------------|
| Drain-source voltage                                      | $V_{DS}$         | 200                               | V                   |
| Gate-source voltage                                       | $V_{GS}$         | $\pm 20$                          |                     |
| Continuous drain current                                  | $I_D$            | $T_C = 25\text{ }^\circ\text{C}$  | A                   |
|                                                           |                  | $T_C = 100\text{ }^\circ\text{C}$ |                     |
| Pulsed drain current <sup>a</sup>                         | $I_{DM}$         | 120                               |                     |
| Linear derating factor                                    |                  | 1.5                               | W/ $^\circ\text{C}$ |
| Single pulse avalanche energy <sup>b</sup>                | $E_{AS}$         | 410                               | mJ                  |
| Repetitive avalanche current <sup>a</sup>                 | $I_{AR}$         | 30                                | A                   |
| Repetitive avalanche energy <sup>a</sup>                  | $E_{AR}$         | 19                                | mJ                  |
| Maximum power dissipation                                 | $P_D$            | 190                               | W                   |
| Peak diode recovery dV/dt <sup>c</sup>                    | dV/dt            | 5.0                               | V/ns                |
| Operating junction and storage temperature range          | $T_J, T_{stg}$   | -55 to +150                       | $^\circ\text{C}$    |
| 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)
- $V_{DD} = 50\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 683\text{ }\mu\text{H}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 30\text{ A}$  (see fig. 12)
- $I_{SD} \leq 30\text{ A}$ ,  $dI/dt \leq 190\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^\circ\text{C}$
- 1.6 mm from case

**THERMAL RESISTANCE RATINGS**

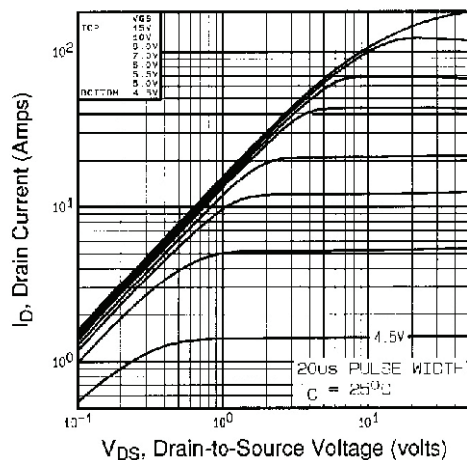
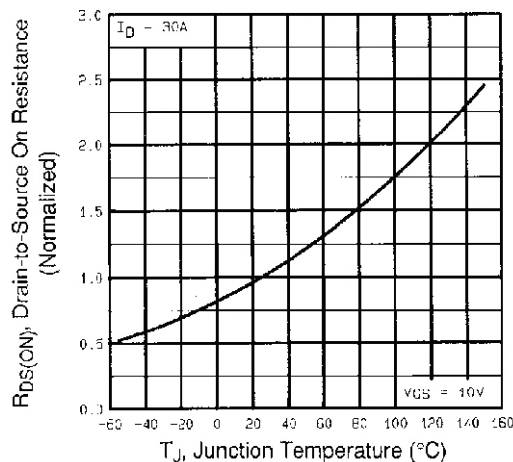
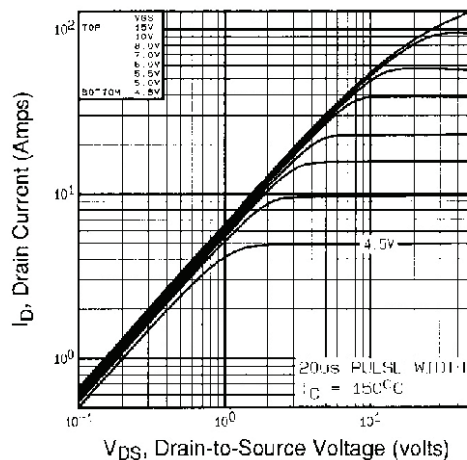
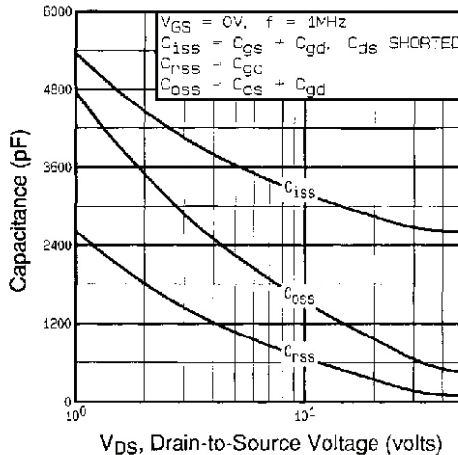
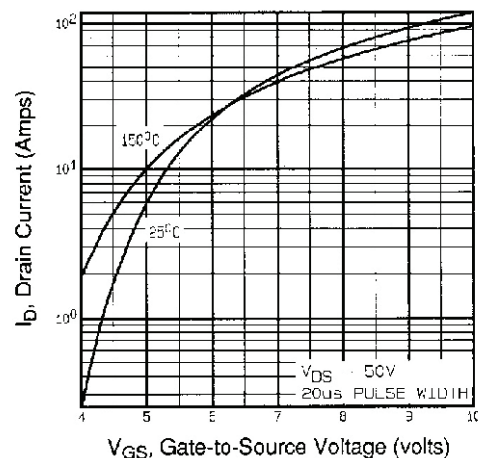
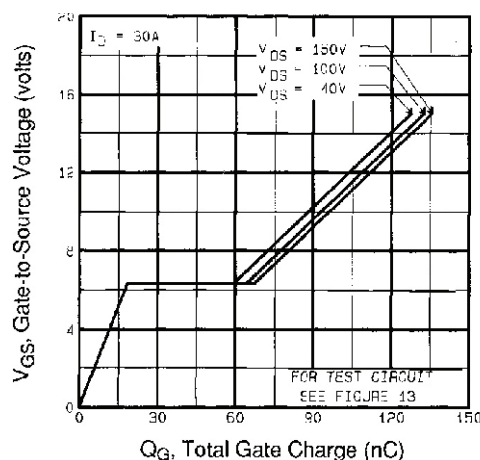
| PARAMETER                           | SYMBOL     | TYP. | MAX. | UNIT |
|-------------------------------------|------------|------|------|------|
| Maximum junction-to-ambient         | $R_{thJA}$ | -    | 40   | °C/W |
| Case-to-sink, flat, greased surface | $R_{thCS}$ | 0.24 | -    |      |
| Maximum junction-to-case (drain)    | $R_{thJC}$ | -    | 0.65 |      |

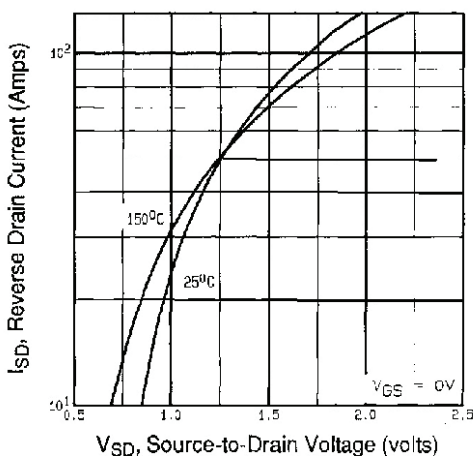
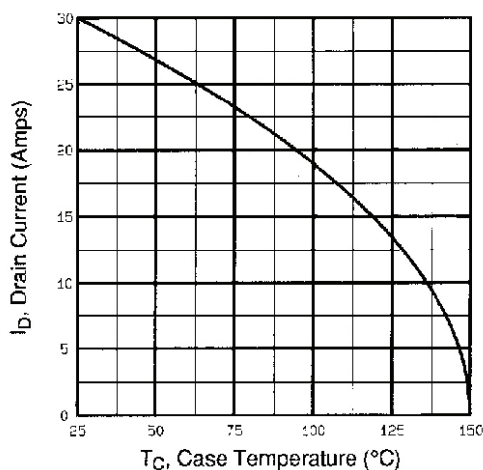
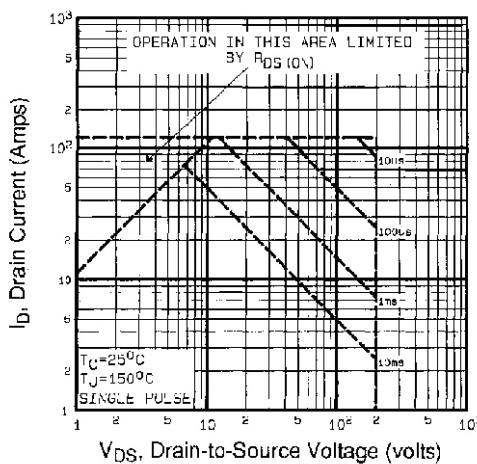
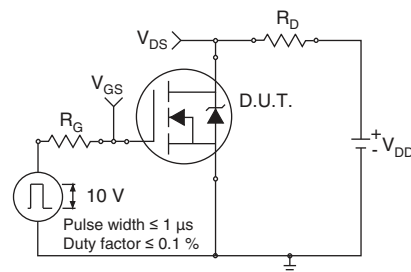
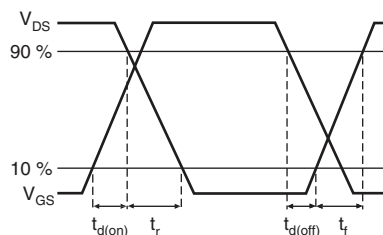
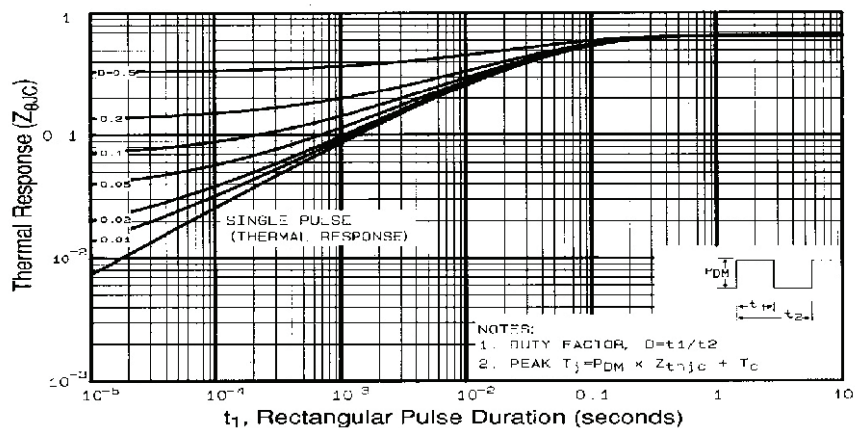
**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

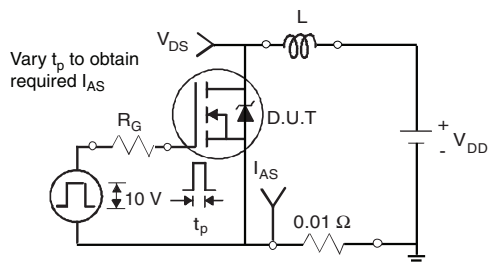
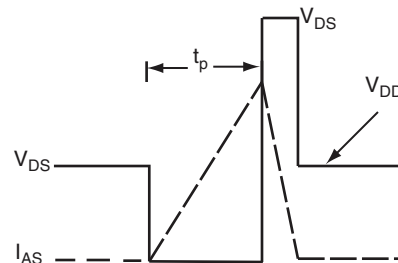
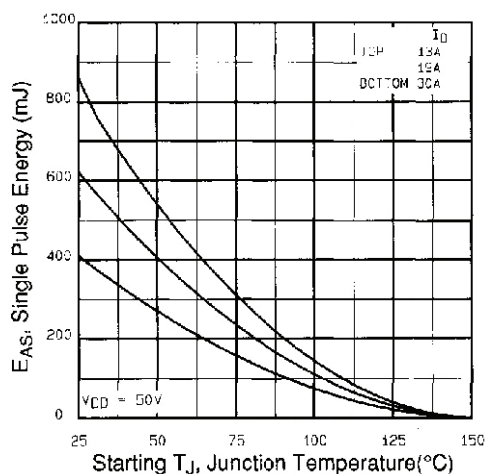
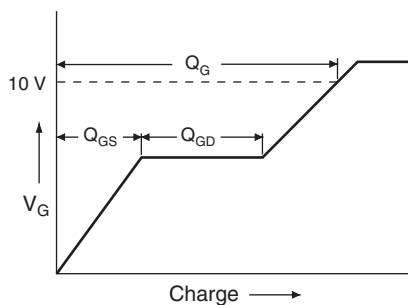
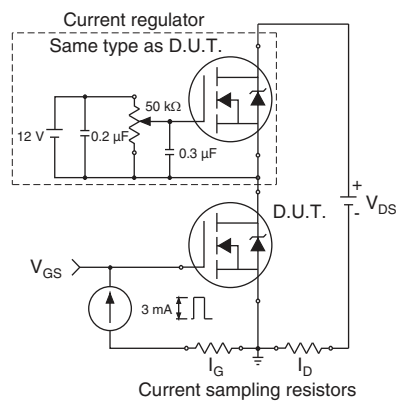
| PARAMETER                                 | SYMBOL              | TEST CONDITIONS                                                                                                                     |                                                                                   | MIN. | TYP. | MAX.      | UNIT                  |
|-------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|------|-----------|-----------------------|
| Static                                    |                     |                                                                                                                                     |                                                                                   |      |      |           |                       |
| Drain-source breakdown voltage            | $V_{DS}$            | $V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$                                                                              |                                                                                   | 200  | -    | -         | V                     |
| $V_{DS}$ temperature coefficient          | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^{\circ}\text{C}$ , $I_D = 1\text{ mA}$                                                                     |                                                                                   | -    | 0.27 | -         | V/ $^{\circ}\text{C}$ |
| 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           | $I_{DSS}$           | $V_{DS} = 200\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                     |                                                                                   | -    | -    | 25        | $\mu\text{A}$         |
|                                           |                     | $V_{DS} = 160\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^{\circ}\text{C}$                                               |                                                                                   | -    | -    | 250       |                       |
| Drain-source on-state resistance          | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$                                                                                                              | $I_D = 18\text{ A}^b$                                                             | -    | -    | 0.085     | $\Omega$              |
| Forward transconductance                  | $g_{fs}$            | $V_{DS} = 50\text{ V}$ , $I_D = 18\text{ A}$                                                                                        |                                                                                   | 12   | -    | -         | S                     |
| Dynamic                                   |                     |                                                                                                                                     |                                                                                   |      |      |           |                       |
| Input capacitance                         | $C_{iss}$           | $V_{GS} = 0\text{ V}$ ,<br>$V_{DS} = 25\text{ V}$ ,<br>$f = 1.0\text{ MHz}$ , see fig. 5                                            |                                                                                   | -    | 2800 | -         | pF                    |
| Output capacitance                        | $C_{oss}$           |                                                                                                                                     |                                                                                   | -    | 780  | -         |                       |
| Reverse transfer capacitance              | $C_{rss}$           |                                                                                                                                     |                                                                                   | -    | 250  | -         |                       |
| Total gate charge                         | $Q_g$               | $V_{GS} = 10\text{ V}$                                                                                                              | $I_D = 30\text{ A}$ , $V_{DS} = 160\text{ V}$ ,<br>see fig. 6 and 13 <sup>b</sup> | -    | -    | 140       | nC                    |
| Gate-source charge                        | $Q_{gs}$            |                                                                                                                                     |                                                                                   | -    | -    | 28        |                       |
| Gate-drain charge                         | $Q_{gd}$            |                                                                                                                                     |                                                                                   | -    | -    | 74        |                       |
| Turn-on delay time                        | $t_{d(on)}$         | $V_{DD} = 100\text{ V}$ , $I_D = 30\text{ A}$ ,<br>$R_g = 6.2\text{ }\Omega$ , $R_D = 3.2\text{ }\Omega$ , see fig. 10 <sup>b</sup> |                                                                                   | -    | 16   | -         | ns                    |
| Rise time                                 | $t_r$               |                                                                                                                                     |                                                                                   | -    | 86   | -         |                       |
| Turn-off delay time                       | $t_{d(off)}$        |                                                                                                                                     |                                                                                   | -    | 70   | -         |                       |
| Fall time                                 | $t_f$               |                                                                                                                                     |                                                                                   | -    | 62   | -         |                       |
| Internal drain inductance                 | $L_D$               | Between lead,<br>6 mm (0.25") from<br>package and center of<br>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<br>showing the<br>integral reverse<br>p - n junction diode                                                            |                                                                                   | -    | -    | 30        | A                     |
| Pulsed diode forward current <sup>a</sup> | $I_{SM}$            |                                                                                                                                     |                                                                                   | -    | -    | 120       |                       |
| Body diode voltage                        | $V_{SD}$            | $T_J = 25\text{ }^{\circ}\text{C}$ , $I_S = 30\text{ A}$ , $V_{GS} = 0\text{ V}^b$                                                  |                                                                                   | -    | -    | 2.0       | V                     |
| Body diode reverse recovery time          | $t_{rr}$            | $T_J = 25\text{ }^{\circ}\text{C}$ , $I_F = 30\text{ A}$ , $dI/dt = 100\text{ A/ms}$                                                |                                                                                   | -    | 360  | 540       | ns                    |
| Body diode reverse recovery charge        | $Q_{rr}$            |                                                                                                                                     |                                                                                   | -    | 4.6  | 6.9       | $\mu\text{C}$         |
| Forward turn-on time                      | $t_{on}$            | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )                                                     |                                                                                   |      |      |           |                       |

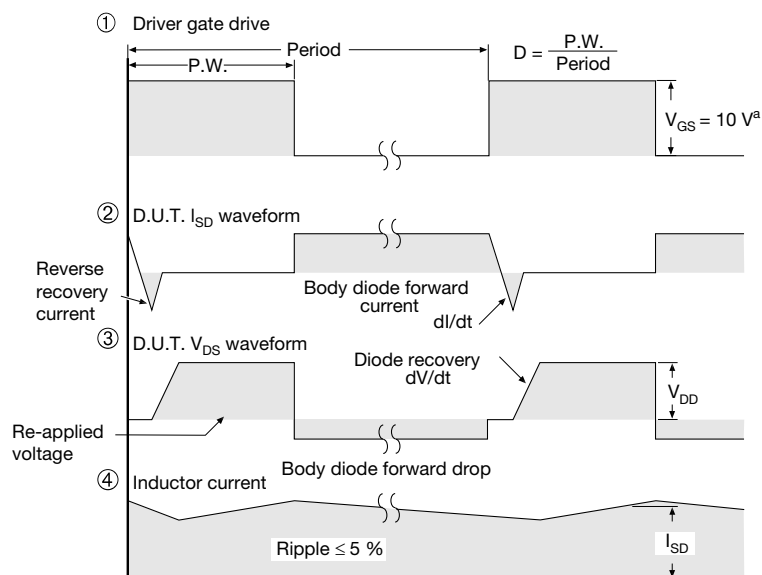
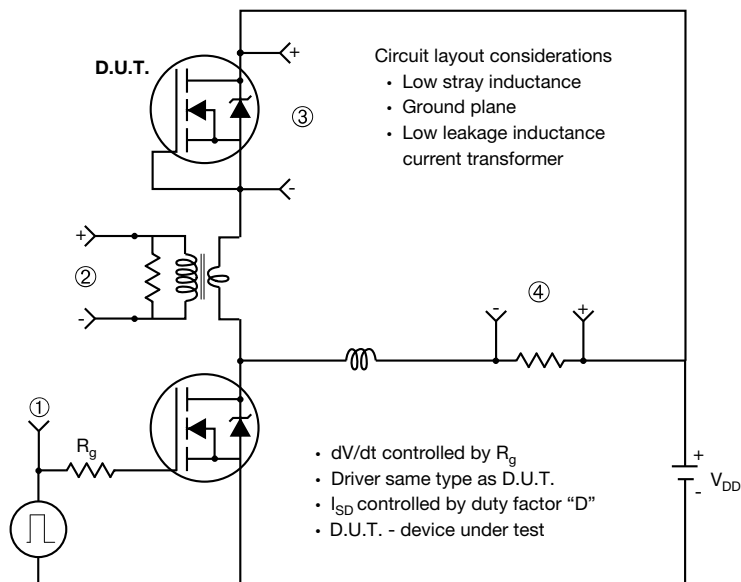
**Notes**

- 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,  $T_C = 25\text{ }^{\circ}\text{C}$** 

**Fig. 4 - Normalized On-Resistance vs. Temperature**

**Fig. 2 - Typical Output Characteristics,  $T_C = 150\text{ }^{\circ}\text{C}$** 

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

**Fig. 3 - Typical Transfer Characteristics**

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


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

**Fig. 9 - Maximum Drain Current vs. Case Temperature**

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

**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**

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

**Note**

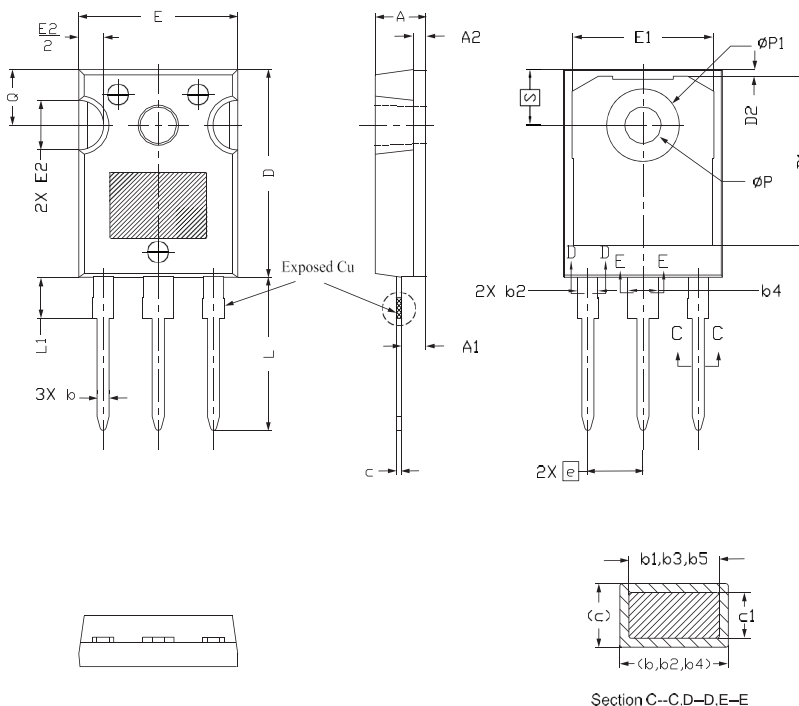
a.  $V_{GS} = 5\text{ V}$  for logic level devices

**Fig. 14 - For N-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?91212](http://www.vishay.com/ppg?91212).

## TO-247AC (High Voltage)

### VERSION 1: FACILITY CODE = 9



| MILLIMETERS |       |       |       |       |
|-------------|-------|-------|-------|-------|
| DIM.        | MIN.  | NOM.  | MAX.  | NOTES |
| 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     |

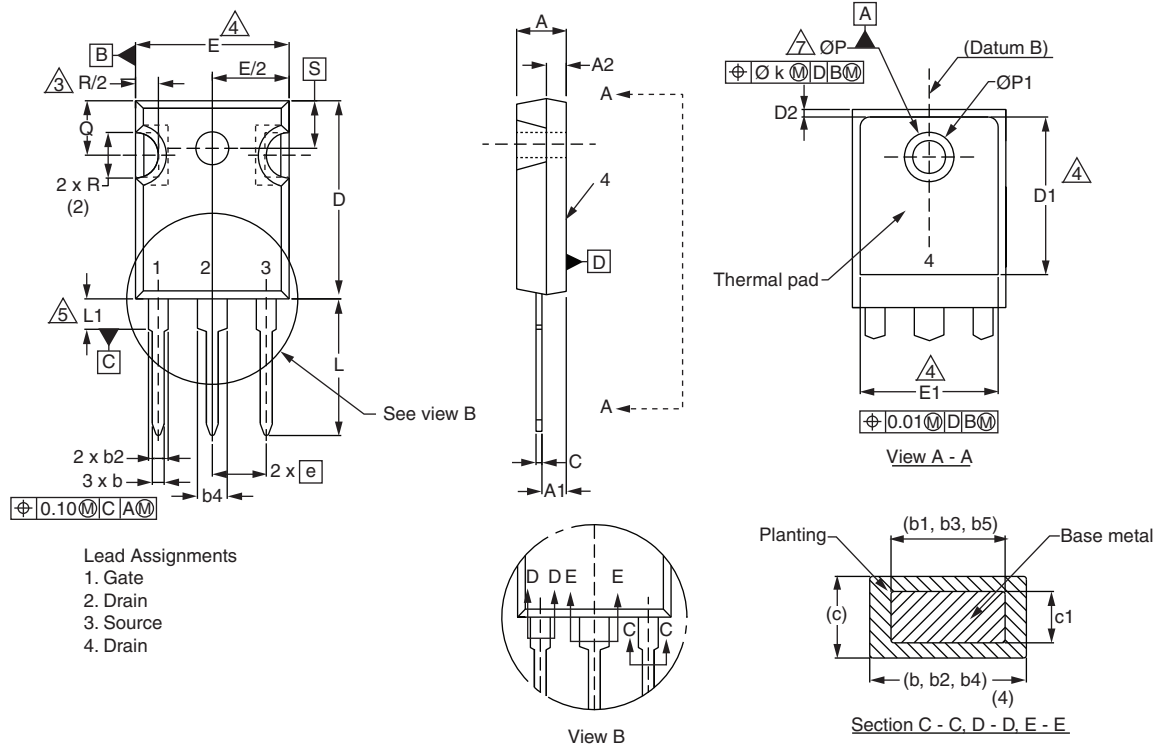
| MILLIMETERS |           |       |       |       |
|-------------|-----------|-------|-------|-------|
| DIM.        | MIN.      | NOM.  | MAX.  | NOTES |
| D1          | 16.46     | 16.76 | 17.06 | 5     |
| D2          | 0.56      | 0.66  | 0.76  |       |
| E           | 15.50     | 15.70 | 15.87 | 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

- Package reference: JEDEC® TO247, variation AC
- All dimensions are in mm
- Slot required, notch may be rounded
- 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
- Thermal pad contour optional with dimensions D1 and E1
- Lead finish uncontrolled in L1
- 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
- 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



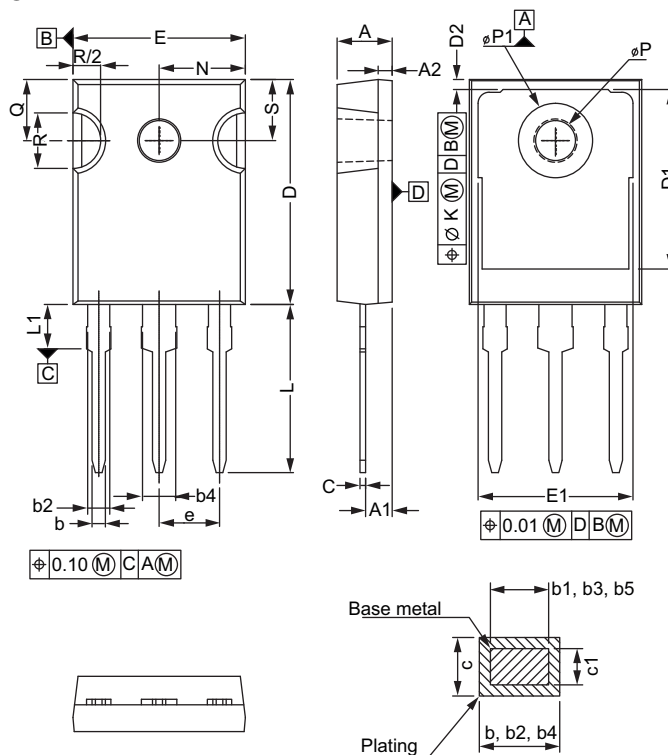
| DIM. | MILLIMETERS |       | NOTES |
|------|-------------|-------|-------|
|      | MIN.        | MAX.  |       |
| A    | 4.58        | 5.31  |       |
| A1   | 2.21        | 2.59  |       |
| A2   | 1.17        | 2.49  |       |
| b    | 0.99        | 1.40  |       |
| b1   | 0.99        | 1.35  |       |
| 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

- Dimensioning and tolerancing per ASME Y14.5M-1994
- Contour of slot optional
- 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
- Thermal pad contour optional with dimensions D1 and E1
- Lead finish uncontrolled in L1
- 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")
- 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")



## Disclaimer

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