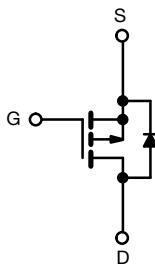
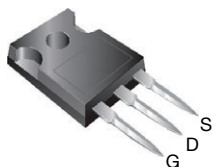


## Power MOSFET

**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                         | $I_D$            | $T_C = 25$ °C    | A     |
|                                                  |                  | $T_C = 100$ °C   |       |
| 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                        | $P_D$            | 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               |       |
|                                                  |                  | 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

**THERMAL RESISTANCE RATINGS**

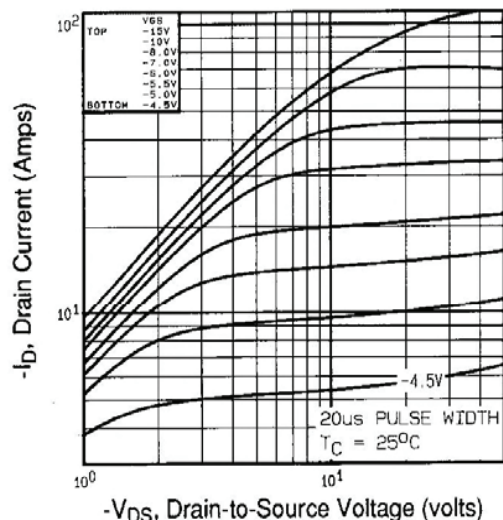
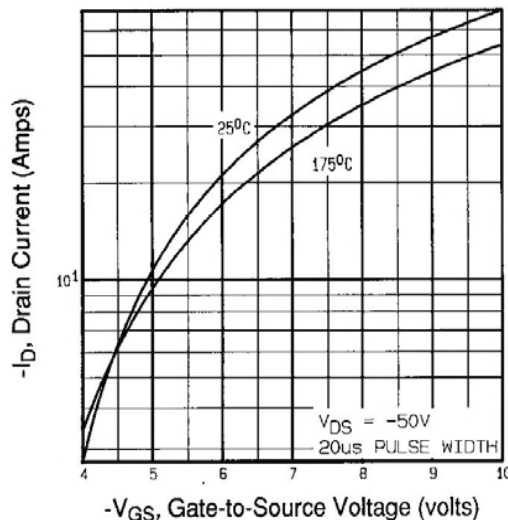
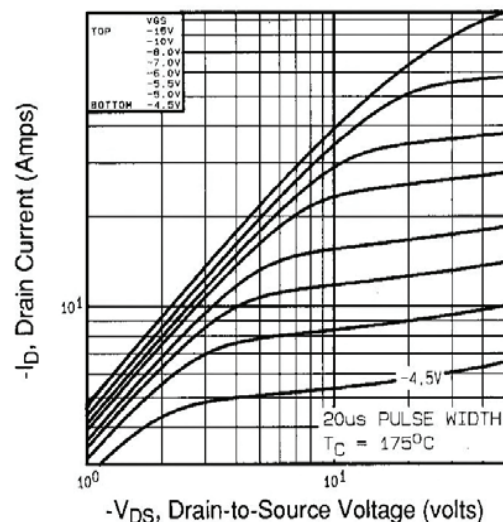
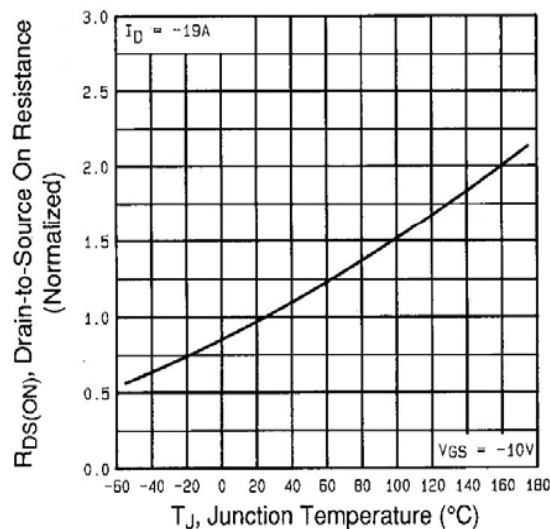
| PARAMETER                           | SYMBOL     | TYP. | MAX. | UNIT |
|-------------------------------------|------------|------|------|------|
| Maximum junction-to-ambient         | $R_{thJA}$ | -    | 40   | °C/W |
| Case-to-sink, flat, greased surface | $R_{thCS}$ | 0.24 | -    |      |
| Maximum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

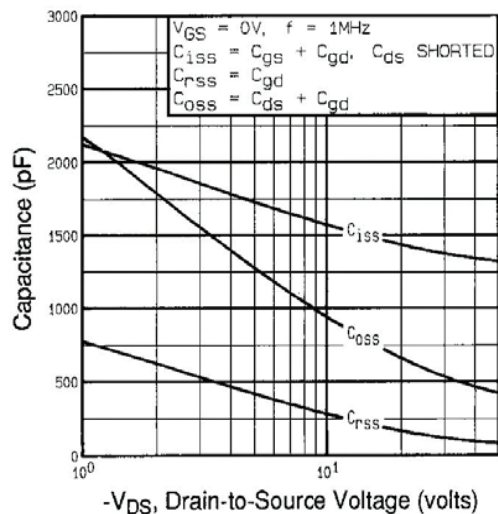
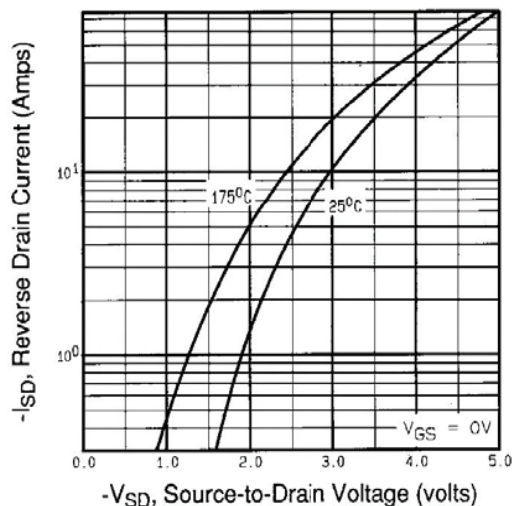
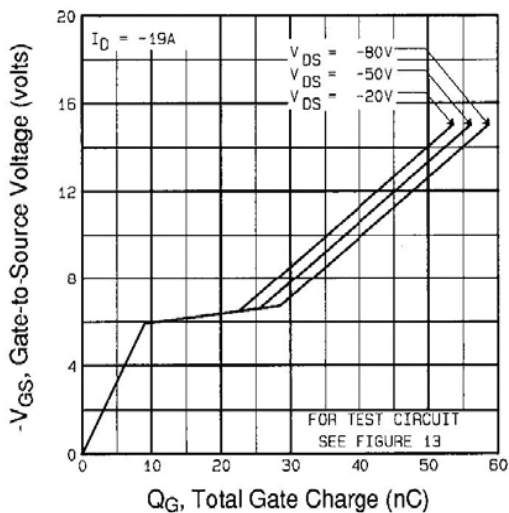
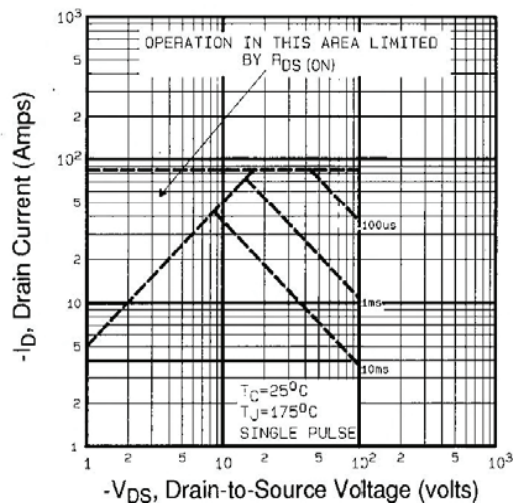
**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

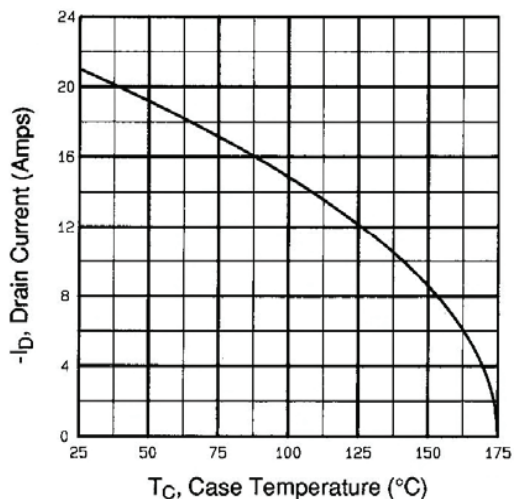
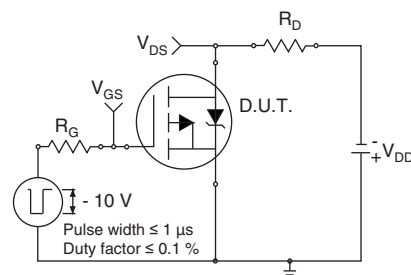
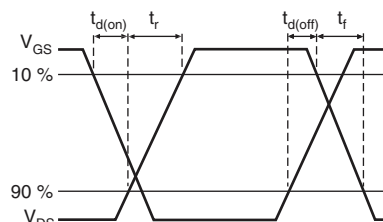
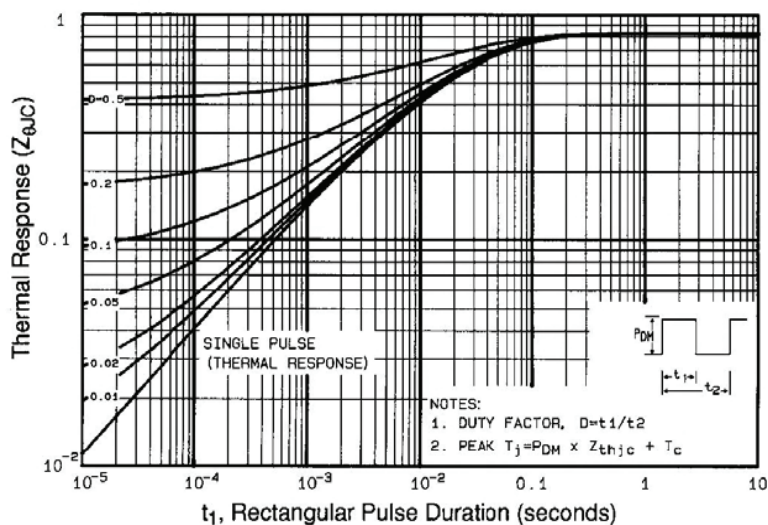
| PARAMETER                                 | SYMBOL                           | TEST CONDITIONS                                                                                                               |                                                                                     | MIN. | TYP.   | MAX.  | UNIT |
|-------------------------------------------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------|--------|-------|------|
| Static                                    |                                  |                                                                                                                               |                                                                                     |      |        |       |      |
| Drain-source breakdown voltage            | V <sub>DS</sub>                  | V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA                                                                               |                                                                                     | -100 | -      | -     | V    |
| V <sub>DS</sub> temperature coefficient   | ΔV <sub>DS</sub> /T <sub>J</sub> | Reference to 25 °C, I <sub>D</sub> = -1 mA                                                                                    |                                                                                     | -    | -0.087 | -     | V/°C |
| Gate-source threshold voltage             | V <sub>GS(th)</sub>              | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA                                                                  |                                                                                     | -2.0 | -      | -4.0  | V    |
| Gate-source leakage                       | I <sub>GSS</sub>                 | V <sub>GS</sub> = ± 20 V                                                                                                      |                                                                                     | -    | -      | ± 100 | nA   |
| Zero gate voltage drain current           | I <sub>DSS</sub>                 | V <sub>DS</sub> = -100 V, V <sub>GS</sub> = 0 V                                                                               |                                                                                     | -    | -      | -100  | μA   |
|                                           |                                  | V <sub>DS</sub> = -80 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150 °C                                                       |                                                                                     | -    | -      | -500  |      |
| Drain-source on-state resistance          | R <sub>DS(on)</sub>              | V <sub>GS</sub> = -10 V                                                                                                       | I <sub>D</sub> = - 13 A <sup>b</sup>                                                | -    | -      | 0.20  | Ω    |
| Forward transconductance                  | g <sub>fs</sub>                  | V <sub>DS</sub> = -50 V, I <sub>D</sub> = - 13 A <sup>b</sup>                                                                 |                                                                                     | 6.2  | -      | -     | S    |
| Dynamic                                   |                                  |                                                                                                                               |                                                                                     |      |        |       |      |
| Input capacitance                         | C <sub>iss</sub>                 | V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = - 25 V,<br>f = 1.0 MHz, see fig. 5                                                |                                                                                     | -    | 1400   | -     | pF   |
| Output capacitance                        | C <sub>oss</sub>                 |                                                                                                                               |                                                                                     | -    | 590    | -     |      |
| Reverse transfer capacitance              | C <sub>rss</sub>                 |                                                                                                                               |                                                                                     | -    | 140    | -     |      |
| Total gate charge                         | Q <sub>g</sub>                   | V <sub>GS</sub> = -10 V                                                                                                       | I <sub>D</sub> = - 19 A, V <sub>DS</sub> = -80 V,<br>see fig. 6 and 13 <sup>b</sup> | -    | -      | 61    | nC   |
| Gate-source charge                        | Q <sub>gs</sub>                  |                                                                                                                               |                                                                                     | -    | -      | 14    |      |
| Gate-drain charge                         | Q <sub>gd</sub>                  |                                                                                                                               |                                                                                     | -    | -      | 29    |      |
| Turn-on delay time                        | t <sub>d(on)</sub>               | V <sub>DD</sub> = - 50 V, I <sub>D</sub> = -19 A,<br>R <sub>g</sub> = 9.1 Ω, R <sub>D</sub> = 2.4 Ω, see fig. 10 <sup>b</sup> |                                                                                     | -    | 16     | -     | ns   |
| Rise time                                 | t <sub>r</sub>                   |                                                                                                                               |                                                                                     | -    | 73     | -     |      |
| Turn-off delay time                       | t <sub>d(off)</sub>              |                                                                                                                               |                                                                                     | -    | 34     | -     |      |
| Fall time                                 | t <sub>f</sub>                   |                                                                                                                               |                                                                                     | -    | 57     | -     |      |
| Internal drain inductance                 | L <sub>D</sub>                   | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact                                                    |                                                                                     | -    | 5.0    | -     | nH   |
| Internal source inductance                | L <sub>S</sub>                   |                                                                                                                               |                                                                                     | -    | 13     | -     |      |
| Drain-Source Body Diode Characteristics   |                                  |                                                                                                                               |                                                                                     |      |        |       |      |
| Continuous source-drain diode current     | I <sub>S</sub>                   | MOSFET symbol<br>showing the<br>integral reverse<br>p - n junction diode                                                      |                                                                                     | -    | -      | - 21  | A    |
| Pulsed diode forward current <sup>a</sup> | I <sub>SM</sub>                  |                                                                                                                               |                                                                                     | -    | -      | - 84  |      |
| Body diode voltage                        | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = - 21 A, V <sub>GS</sub> = 0 V <sup>b</sup>                                           |                                                                                     | -    | -      | - 5.0 | V    |
| Body diode reverse recovery time          | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = - 19 A, dI/dt = 100 A/μs <sup>b</sup>                                                |                                                                                     | -    | 130    | 260   | ns   |
| Body diode reverse recovery charge        | Q <sub>rr</sub>                  |                                                                                                                               |                                                                                     | -    | 0.35   | 0.70  | μC   |
| Forward turn-on time                      | t <sub>on</sub>                  | Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> and L <sub>D</sub> )                             |                                                                                     |      |        |       |      |

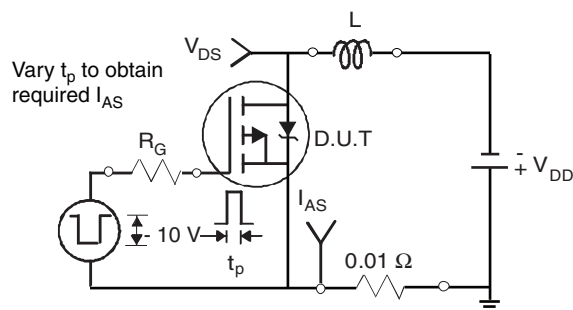
**Notes**

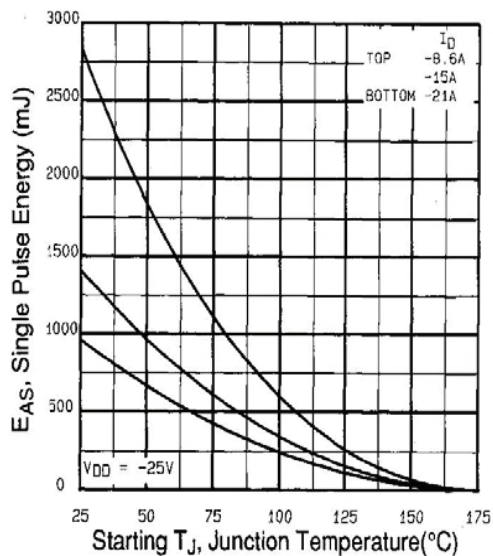
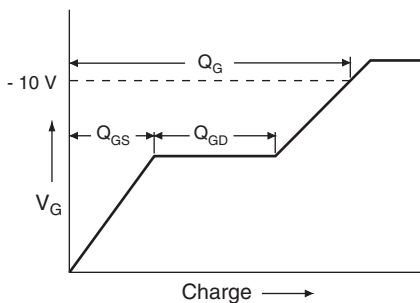
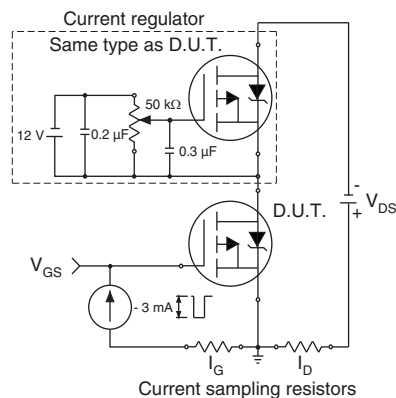
- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).  
b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\text{ }\%$ .

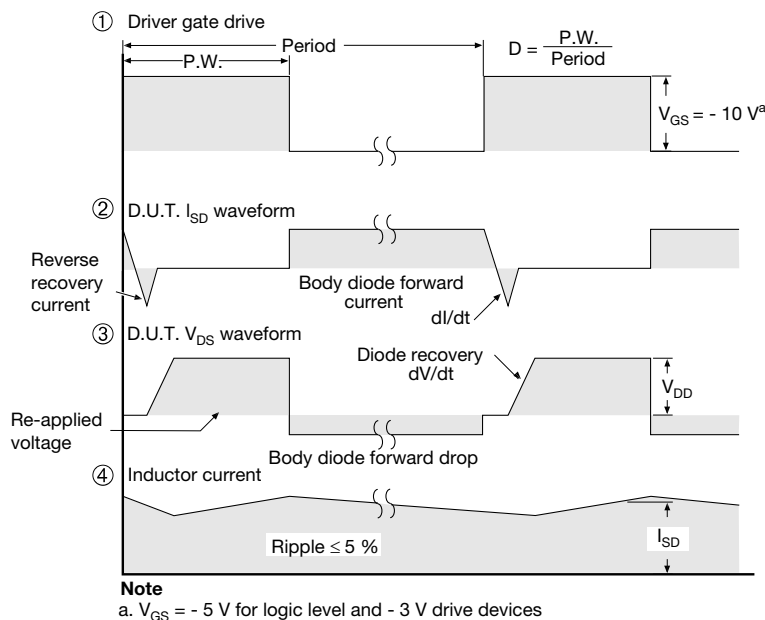
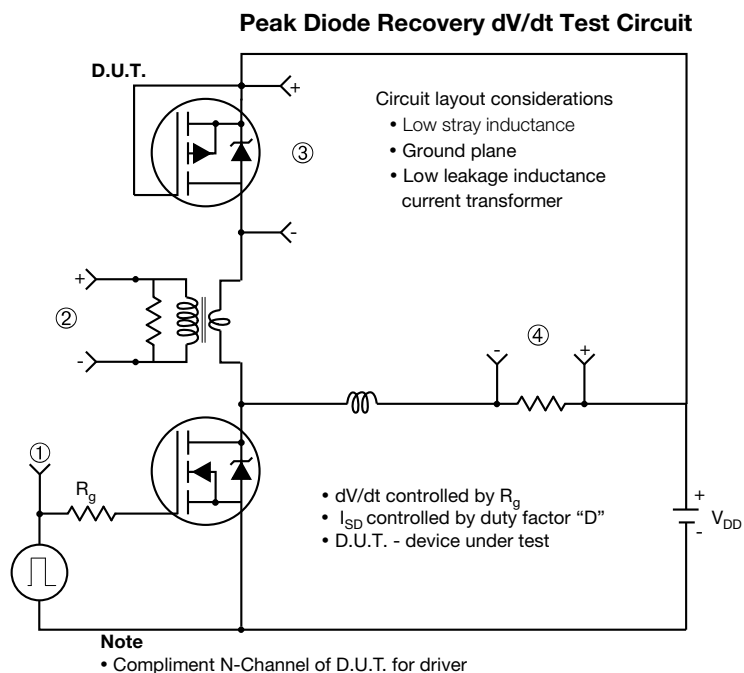
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**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. 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**



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

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## TO-247AC (High Voltage)

**VERSION 1: FACILITY CODE = 9**


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

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

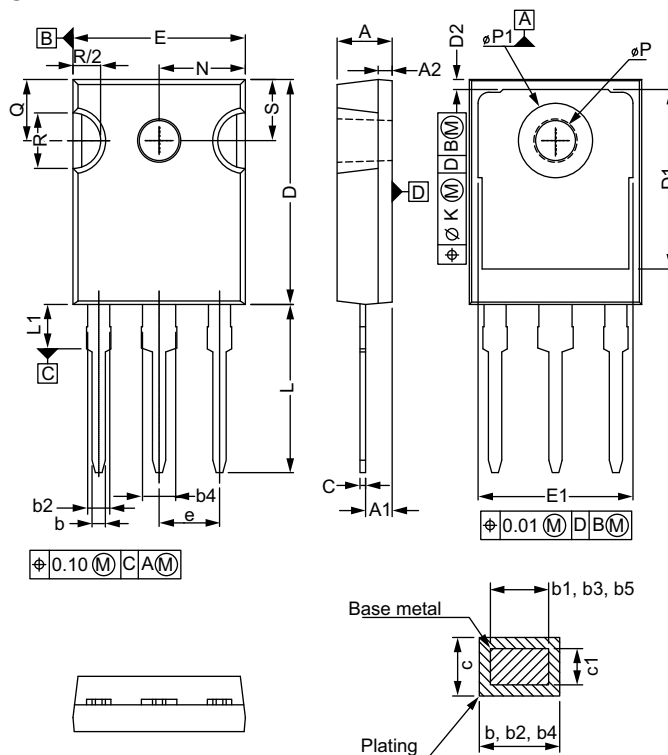
| DIM. | MILLIMETERS |       | NOTES |
|------|-------------|-------|-------|
|      | MIN.        | MAX.  |       |
| D2   | 0.51        | 1.30  |       |
| E    | 15.29       | 15.87 |       |
| E1   | 13.72       | -     |       |
| e    | 5.46 BSC    |       |       |
| Ø k  | 0.254       |       |       |
| 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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