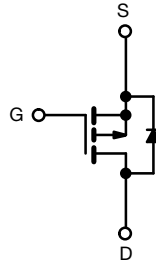
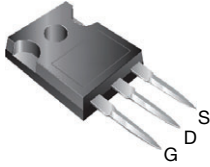


Power MOSFET

TO-247AC


P-Channel MOSFET

FEATURES

- Dynamic dV/dt rating
- Repetitive avalanche rated
- P-channel
- 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


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) | -200 V | |
| $R_{DS(on)}$ (max.) (Ω) | $V_{GS} = -10$ V | 0.50 |
| Q_g (max.) (nC) | 44 | |
| Q_{gs} (nC) | 7.1 | |
| Q_{gd} (nC) | 27 | |
| Configuration | Single | |

ORDERING INFORMATION

| | |
|----------------|-------------|
| Package | TO-247AC |
| Lead (Pb)-free | IRFP9240PbF |

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 | -12 | A |
| | | $T_C = 100$ °C | -7.5 | |
| Pulsed drain current ^a | I_{DM} | -48 | | |
| Linear derating factor | | 1.2 | W/°C | |
| Single pulse avalanche energy ^b | E_{AS} | 790 | mJ | |
| Repetitive avalanche current ^a | I_{AR} | -12 | 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

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- $V_{DD} = -50$ V, starting $T_J = 25$ °C, $L = 8.2$ mH, $R_g = 25$ Ω , $I_{AS} = -12$ A (see fig. 12)
- $I_{SD} \leq -12$ A, $dI/dt \leq 150$ A/ μ s, $V_{DD} \leq V_{DS}$, $T_J \leq 150$ °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_{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 $25\text{ }^\circ\text{C}$, $I_D = -1\text{ mA}$ | - | -0.20 | - | 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} | $V_{GS} = \pm 20\text{ V}$ | - | - | ± 100 | nA |
| Zero gate voltage drain current | I_{DSS} | $V_{DS} = -200\text{ V}$, $V_{GS} = 0\text{ V}$ | - | - | -100 | μA |
| | | $V_{DS} = -160\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ | - | - | -500 | |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS} = -10\text{ V}$, $I_D = -7.2\text{ A}^b$ | - | - | 0.50 | Ω |
| Forward transconductance | g_{fs} | $V_{DS} = -50\text{ V}$, $I_D = -7.2\text{ A}$ | 4.2 | - | - | S |
| Dynamic | | | | | | |
| Input capacitance | C_{iss} | $V_{GS} = 0\text{ V}$, $V_{DS} = -25\text{ V}$, $f = 1.0\text{ MHz}$, see fig. 5 | - | 1200 | - | pF |
| Output capacitance | C_{oss} | | - | 370 | - | |
| Reverse transfer capacitance | C_{rss} | | - | 81 | - | |
| Total gate charge | Q_g | $V_{GS} = -10\text{ V}$, $I_D = -11\text{ A}$, $V_{DS} = -160\text{ V}$ see fig. 6 and 13 ^b | - | - | 44 | nC |
| Gate-source charge | Q_{gs} | | - | - | 7.1 | |
| Gate-drain charge | Q_{gd} | | - | - | 27 | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD} = -100\text{ V}$, $I_D = -11\text{ A}$ $R_G = 9.1\text{ }\Omega$, $R_D = 8.6\text{ }\Omega$, see fig. 10 ^b | - | 14 | - | ns |
| Rise time | t_r | | - | 43 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 39 | - | |
| Fall time | t_f | | - | 38 | - | |
| 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 | - | - | -12 | A |
| Pulsed diode forward current ^a | I_{SM} | | - | - | -48 | |
| Body diode voltage | V_{SD} | $T_J = 25\text{ }^\circ\text{C}$, $I_S = -12\text{ A}$, $V_{GS} = 0\text{ V}^b$ | - | - | -5.0 | V |
| Body diode reverse recovery time | t_{rr} | $T_J = 25\text{ }^\circ\text{C}$, $I_F = -11\text{ A}$, $dI/dt = 100\text{ A}/\mu\text{s}^b$ | - | 250 | 300 | ns |
| Body diode reverse recovery charge | Q_{rr} | | - | 2.9 | 3.6 | 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 $\leq 300\text{ }\mu\text{s}$; duty cycle $\leq 2\text{ }\%$

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

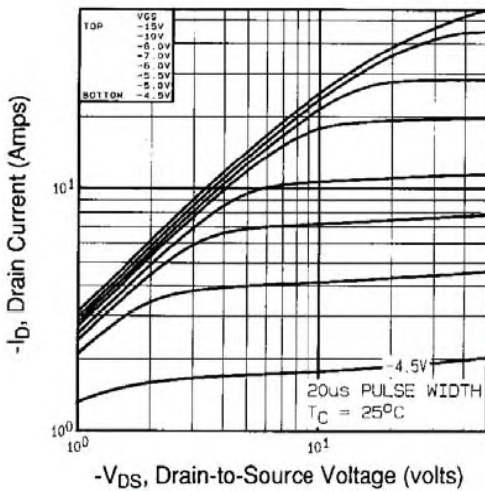


Fig. 1 - Typical Output Characteristics, $T_C = 25\text{ }^\circ\text{C}$

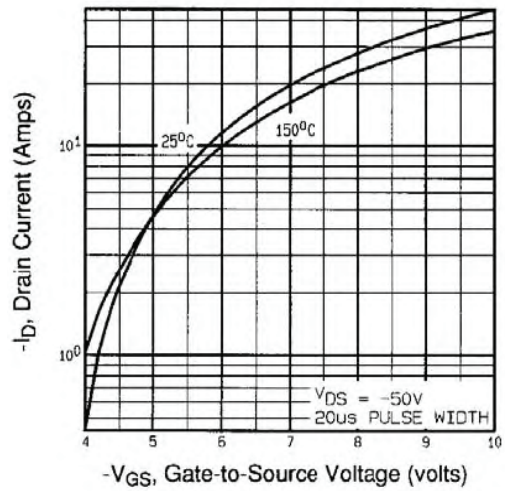


Fig. 3 - Typical Transfer Characteristics

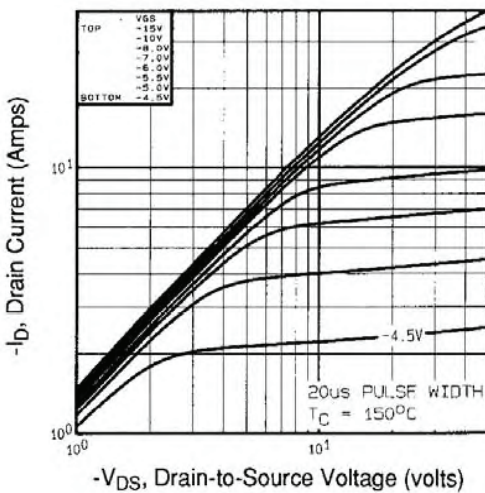


Fig. 2 - Typical Output Characteristics, $T_C = 150\text{ }^\circ\text{C}$

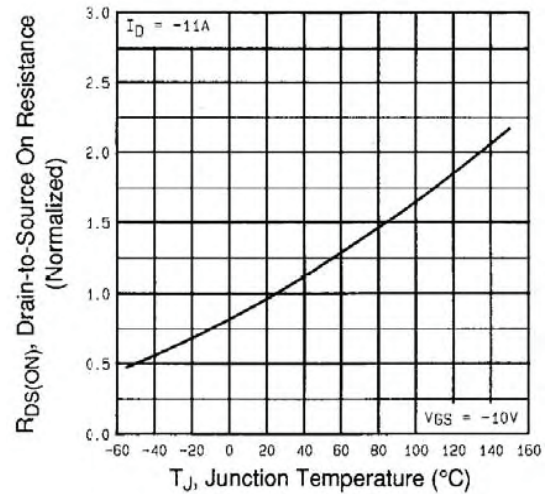


Fig. 4 - Normalized On-Resistance vs. Temperature

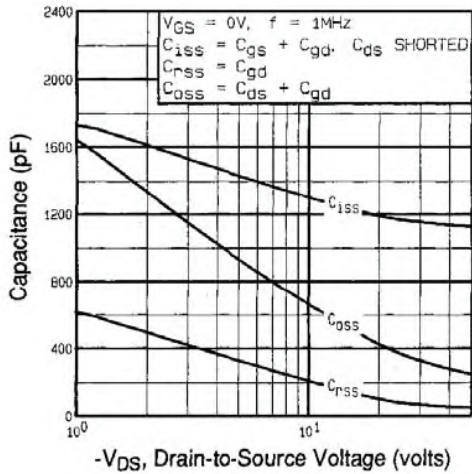


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

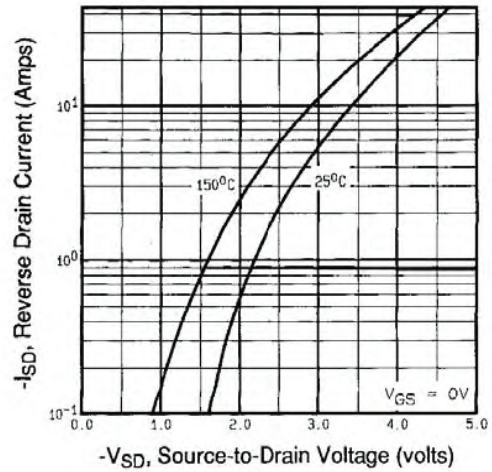


Fig. 7 - Typical Source-Drain Diode Forward Voltage

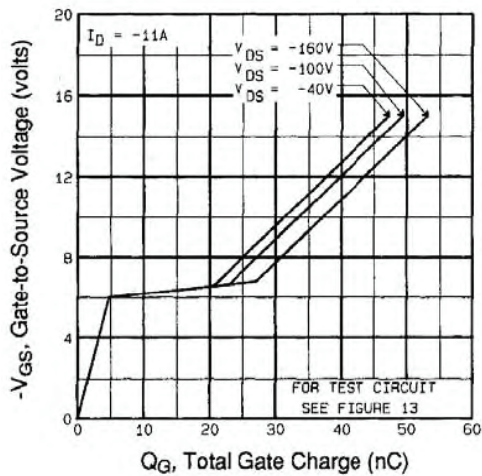


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

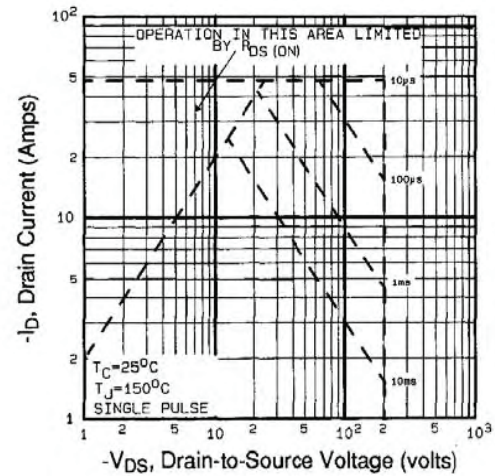


Fig. 8 - Maximum Safe Operating Area

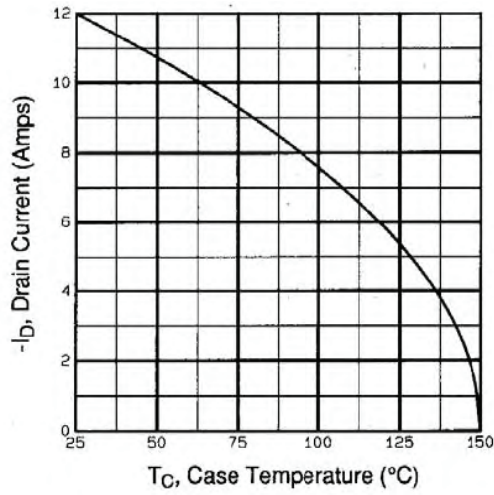


Fig. 9 - Maximum Drain Current vs. Case Temperature

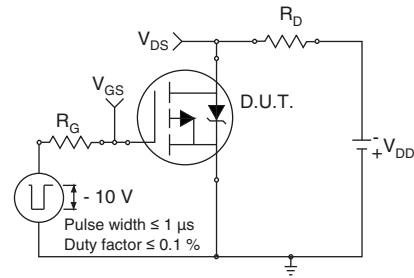


Fig. 10 - Switching Time Test Circuit

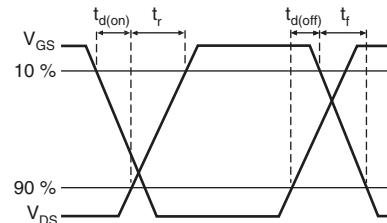


Fig. 11 - Switching Time Waveforms

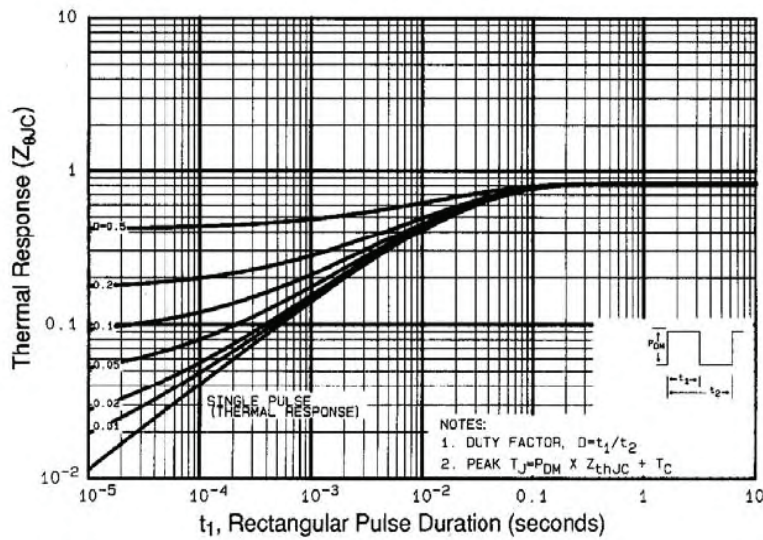


Fig. 12 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

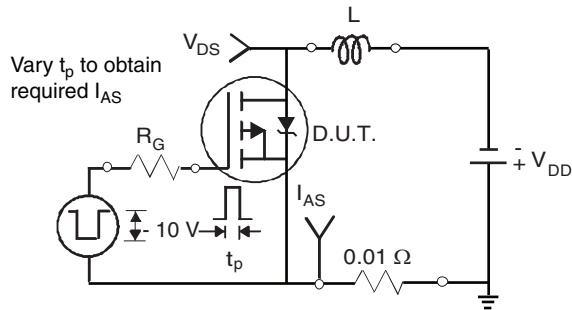


Fig. 13 - Unclamped Inductive Test Circuit

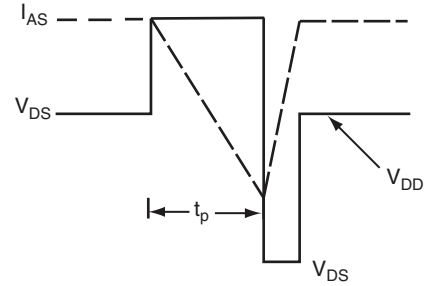


Fig. 14 - Unclamped Inductive Waveforms

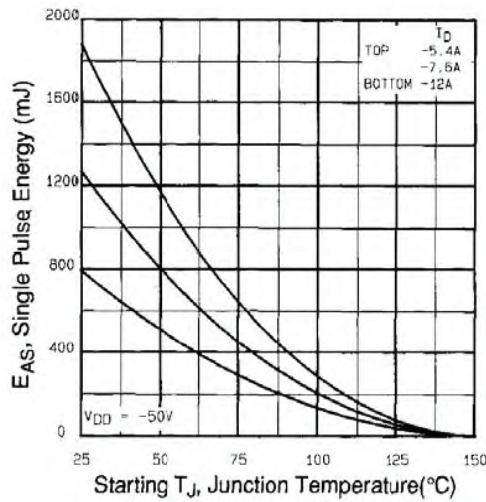


Fig. 15 - Maximum Avalanche Energy vs. Drain Current

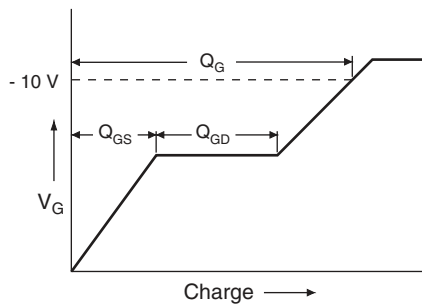


Fig. 16 - Basic Gate Charge Waveform

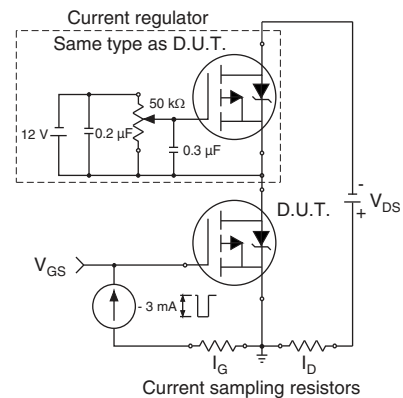
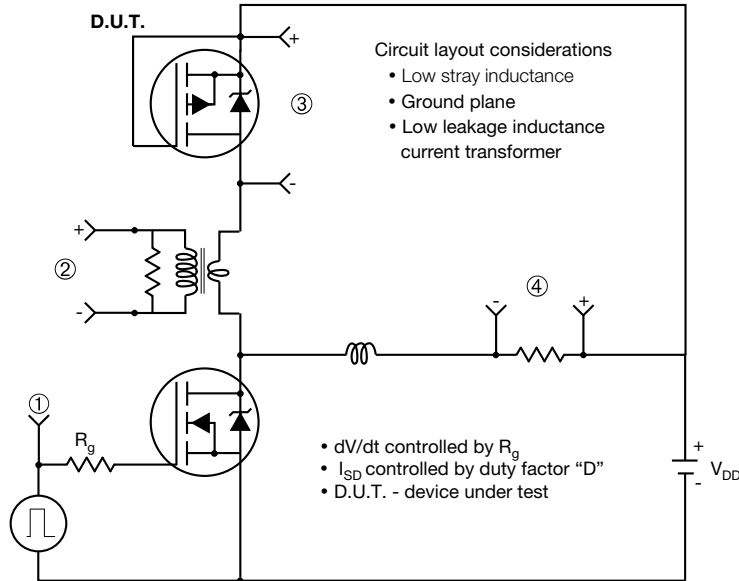


Fig. 17 - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



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

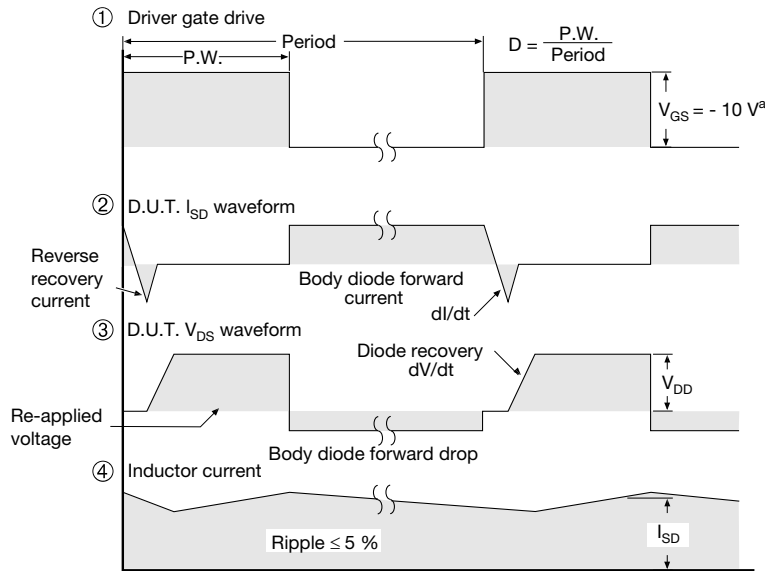


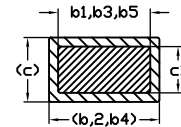
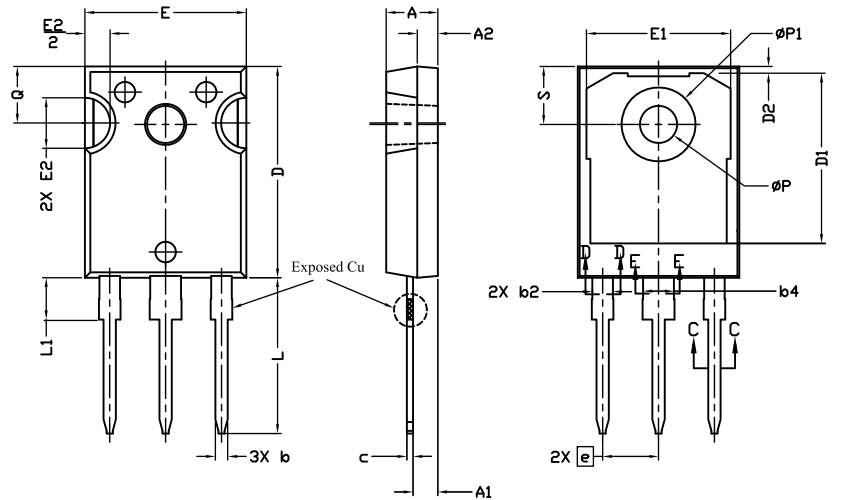
Fig. 18 - For P-Channel

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?91239.



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 |

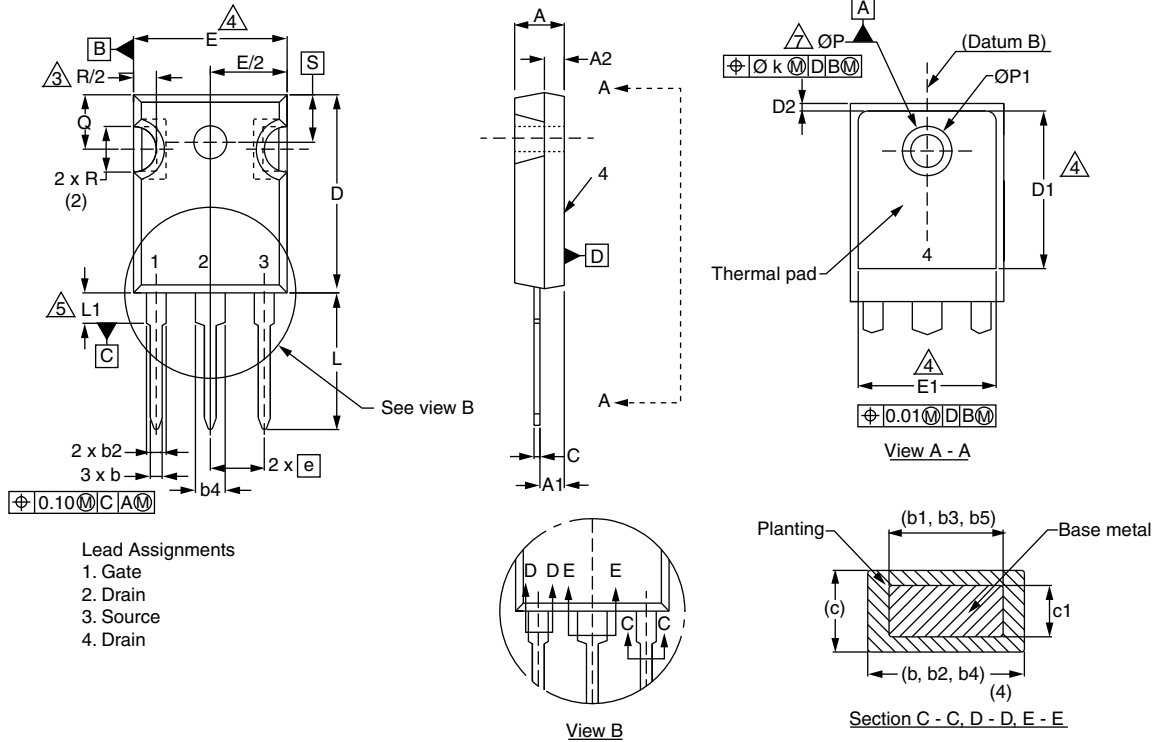
| DIM. | MILLIMETERS | | NOTES |
|------|-------------|-------|-------|
| | MIN. | MAX. | |
| D1 | 16.25 | 16.85 | 5 |
| D2 | 0.56 | 0.76 | |
| E | 15.50 | 15.87 | 4 |
| E1 | 13.46 | 14.16 | 5 |
| E2 | 4.52 | 5.49 | 3 |
| e | 5.44 BSC | | |
| L | 14.90 | 15.40 | |
| L1 | 3.96 | 4.16 | 6 |
| Ø P | 3.56 | 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 | - | |

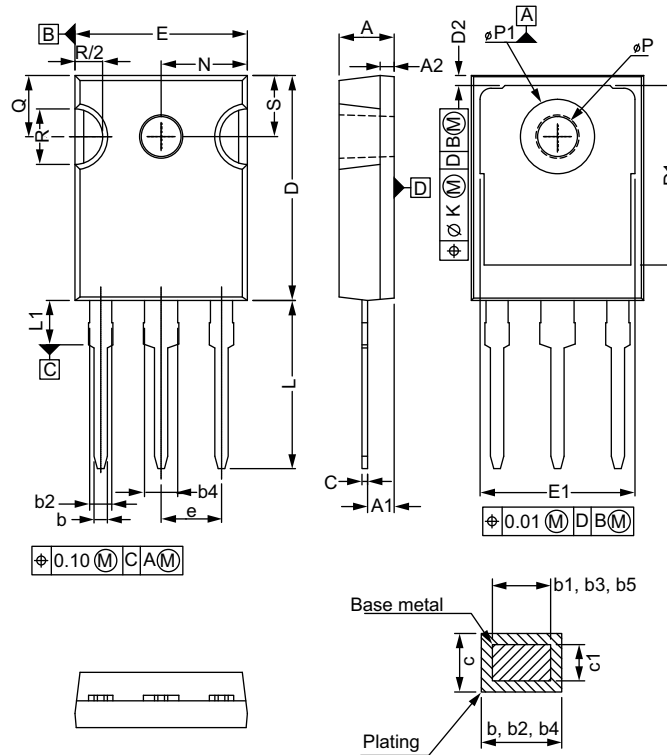
| DIM. | MILLIMETERS | | NOTES |
|------|-------------|-------|-------|
| | MIN. | MAX. | |
| D2 | 0.51 | 1.30 | |
| E | 15.29 | 15.87 | |
| E1 | 13.72 | - | |
| e | 5.46 BSC | | |
| Ø k | 0.254 | | |
| L | 14.20 | 16.25 | |
| L1 | 3.71 | 4.29 | |
| Ø P | 3.51 | 3.66 | |
| Ø P1 | - | 7.39 | |
| Q | 5.31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