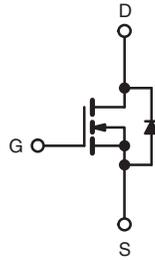
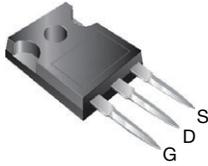


Power MOSFET

TO-247AC


N-Channel MOSFET

| PRODUCT SUMMARY | |
|---------------------------|-----------------------------|
| V_{DS} (V) | 500 |
| $R_{DS(on)}$ (Ω) | $V_{GS} = 10\text{ V}$ 0.23 |
| Q_g (max.) (nC) | 120 |
| Q_{gs} (nC) | 32 |
| Q_{gd} (nC) | 52 |
| Configuration | Single |

FEATURES

- Low gate charge Q_g results in simple drive requirement
- Improved gate, avalanche and dynamic dV/dt ruggedness
- Fully characterized capacitance and avalanche voltage and current
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


 Available
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

APPLICATIONS

- Switch mode power supply (SMPS)
- Uninterruptable power supply
- High speed power switching

TYPICAL SMPS TOPOLOGIES

- Full bridge converters
- Power factor correction boost

| ORDERING INFORMATION | |
|----------------------|---------------|
| Package | TO-247AC |
| Lead (Pb)-free | IRFP22N50APbF |

| ABSOLUTE MAXIMUM RATINGS ($T_C = 25\text{ }^\circ\text{C}$, unless otherwise noted) | | | | |
|---|----------------------------------|-----------------------------------|---------------------|----------|
| PARAMETER | SYMBOL | LIMIT | UNIT | |
| Drain-source voltage | V_{DS} | 500 | V | |
| Gate-source voltage | V_{GS} | ± 30 | | |
| Continuous drain current | V_{GS} at 10 V | $T_C = 25\text{ }^\circ\text{C}$ | A | |
| | | $T_C = 100\text{ }^\circ\text{C}$ | | |
| Pulsed drain current ^a | I_{DM} | 88 | | |
| Linear derating factor | | 2.2 | W/ $^\circ\text{C}$ | |
| Single pulse avalanche energy ^b | E_{AS} | 1180 | mJ | |
| Repetitive avalanche current ^a | I_{AR} | 22 | A | |
| Repetitive avalanche energy ^a | E_{AR} | 28 | mJ | |
| Maximum power dissipation | $T_C = 25\text{ }^\circ\text{C}$ | P_D | 277 | W |
| Peak diode recovery dV/dt ^c | | dV/dt | 4.8 | V/ns |
| Operating junction and storage temperature range | T_J, T_{stg} | -55 to +150 | $^\circ\text{C}$ | |
| Soldering recommendations (peak temperature) ^d | 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)
- Starting $T_J = 25\text{ }^\circ\text{C}$, $L = 4.87\text{ mH}$, $R_g = 25\text{ }\Omega$, $I_{AS} = 22\text{ A}$ (see fig. 12)
- $I_{SD} \leq 22\text{ A}$, $dI/dt \leq 190\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 150\text{ }^\circ\text{C}$
- 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} | - | 0.45 | |

| 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} | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | 500 | - | - | V | |
| V_{DS} temperature coefficient | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}, I_D = 1\text{ mA}$ | - | 0.55 | - | 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} | $V_{GS} = \pm 30\text{ V}$ | - | - | ± 100 | nA | |
| Zero gate voltage drain current | I_{DSS} | $V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$ | - | - | 25 | μA | |
| | | $V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$ | - | - | 250 | | |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}, I_D = 13\text{ A}^b$ | - | - | 0.23 | Ω | |
| Forward transconductance | g_{fs} | $V_{DS} = 50\text{ V}, I_D = 13\text{ A}^b$ | 12 | - | - | S | |
| Dynamic | | | | | | | |
| Input capacitance | C_{iss} | $V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz},$ see fig. 5 | - | 3450 | - | pF | |
| Output capacitance | C_{oss} | | - | 513 | - | | |
| Reverse transfer capacitance | C_{rss} | | - | 27 | - | | |
| Output capacitance | C_{oss} | $V_{GS} = 0\text{ V}$ | $V_{DS} = 1.0\text{ V}, f = 1.0\text{ MHz}$ | 4935 | | pF | |
| | | | $V_{DS} = 400\text{ V}, f = 1.0\text{ MHz}$ | | 137 | | |
| | | | $V_{DS} = 0\text{ V to } 400\text{ V}^c$ | | 264 | | |
| Effective output capacitance | $C_{oss\text{ eff.}}$ | | | | | | |
| Total gate charge | Q_g | $V_{GS} = 10\text{ V}, I_D = 22\text{ A}, V_{DS} = 400\text{ V},$ see fig. 6 and 13 ^b | - | - | 120 | nC | |
| Gate-source charge | Q_{gs} | | - | - | 32 | | |
| Gate-drain charge | Q_{gd} | | - | - | 52 | | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD} = 250\text{ V}, I_D = 22\text{ A}, R_G = 4.3\text{ }\Omega, R_D = 11\text{ }\Omega,$ see fig. 10 ^b | - | 26 | - | ns | |
| Rise time | t_r | | - | 94 | - | | |
| Turn-off delay time | $t_{d(off)}$ | | - | 47 | - | | |
| Fall time | t_f | | - | 47 | - | | |
| Drain-Source Body Diode Characteristics | | | | | | | |
| Continuous source-drain diode current | I_S | MOSFET symbol showing the integral reverse p - n junction diode  | - | - | 22 | A | |
| Pulsed diode forward current ^a | I_{SM} | | - | - | 88 | | |
| Body diode voltage | V_{SD} | $T_J = 25\text{ }^\circ\text{C}, I_S = 22\text{ A}, V_{GS} = 0\text{ V}^b$ | - | - | 1.5 | V | |
| Body diode reverse recovery time | t_{rr} | $T_J = 25\text{ }^\circ\text{C}, I_F = 22\text{ A}, dl/dt = 100\text{ A}/\mu\text{s}^b$ | - | 570 | 850 | ns | |
| Body diode reverse recovery charge | Q_{rr} | | - | 6.1 | 9.2 | 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 $\leq 2\text{ }\%$
- c. $C_{oss\text{ eff.}}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DS}

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

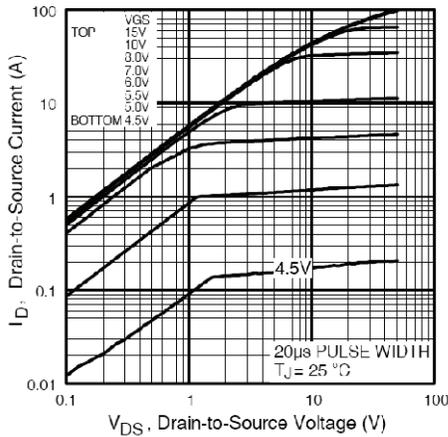


Fig. 1 - Typical Output Characteristics

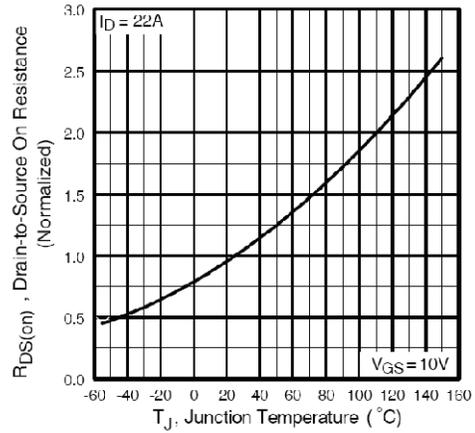


Fig. 4 - Normalized On-Resistance vs. Temperature

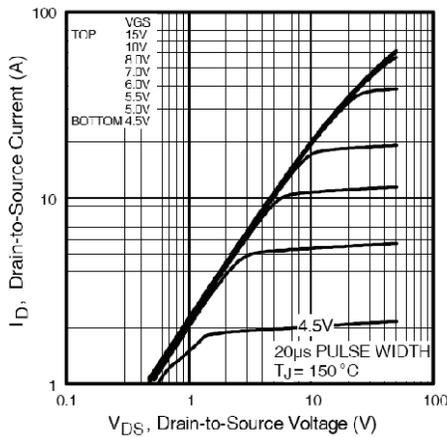


Fig. 2 - Typical Output Characteristics

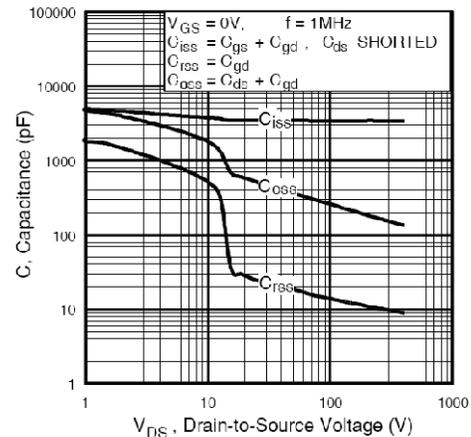


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

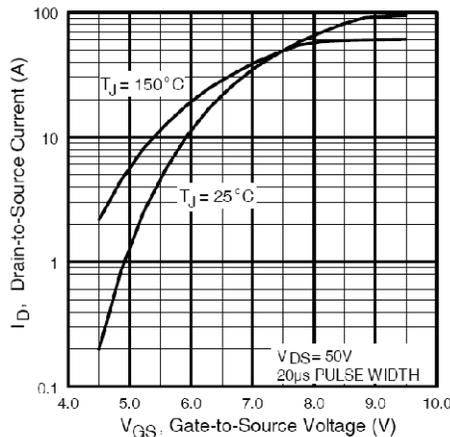


Fig. 3 - Typical Transfer Characteristics

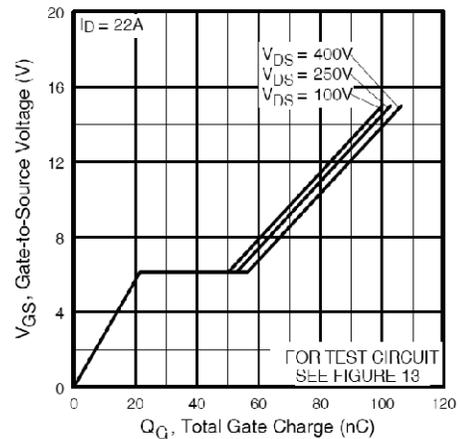


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

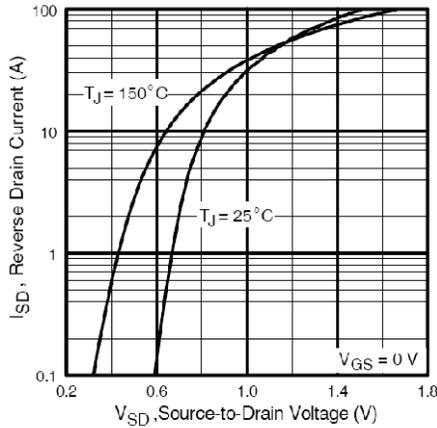


Fig. 7 - Typical Source-Drain Diode Forward Voltage

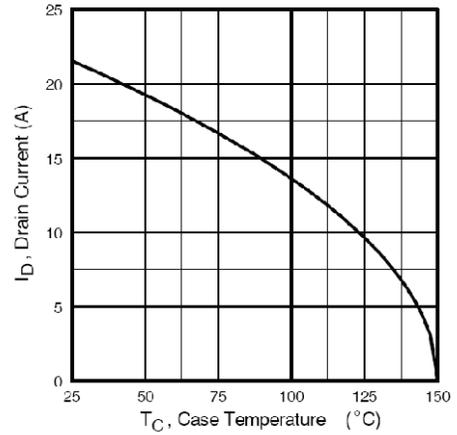


Fig. 9 - Maximum Drain Current vs. Case Temperature

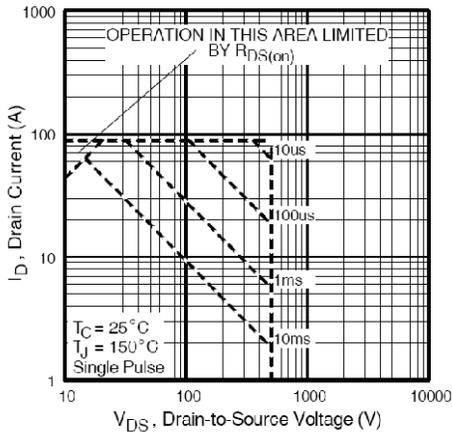


Fig. 8 - Maximum Safe Operating Area

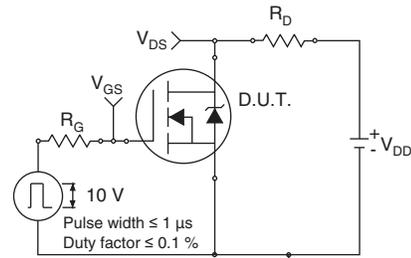


Fig. 10a - Switching Time Test Circuit

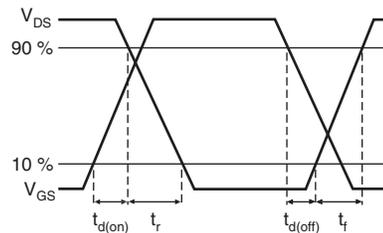


Fig. 10b - Switching Time Waveforms

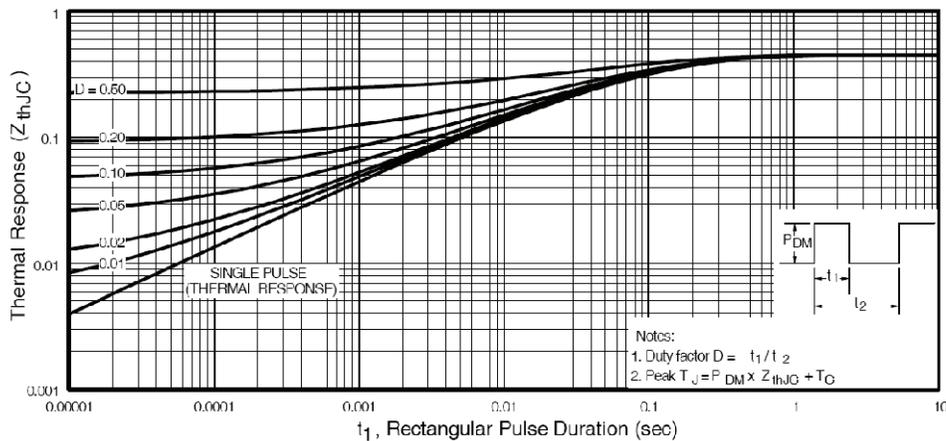


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

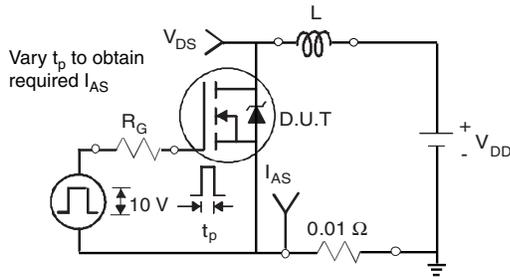


Fig. 12a - Unclamped Inductive Test Circuit

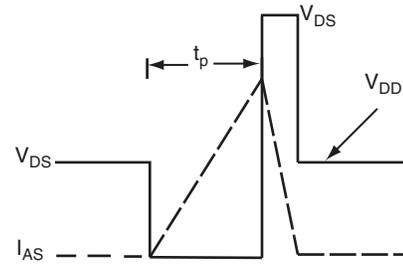


Fig. 12b - Unclamped Inductive Waveforms

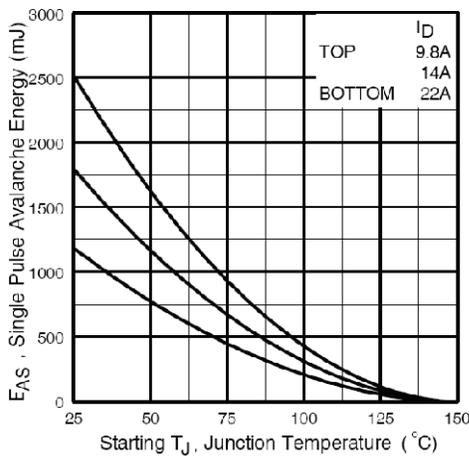


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

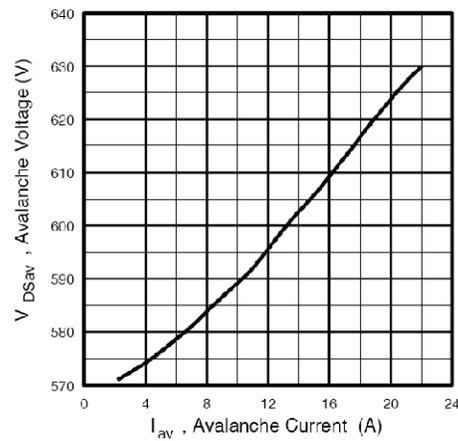


Fig. 12d - Typical Drain-to-Source Voltage vs. Avalanche Current

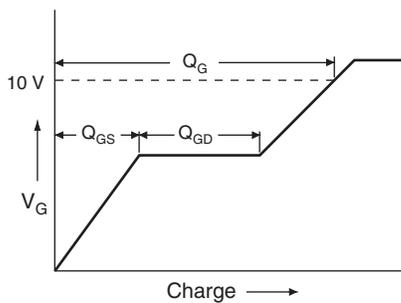


Fig. 13a - Basic Gate Charge Waveform

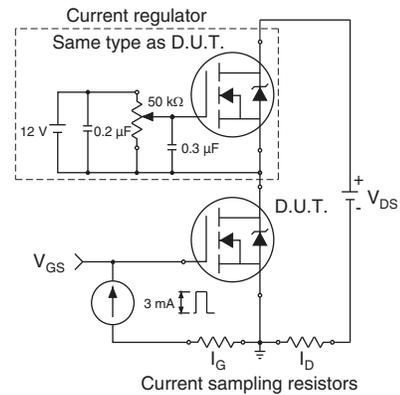
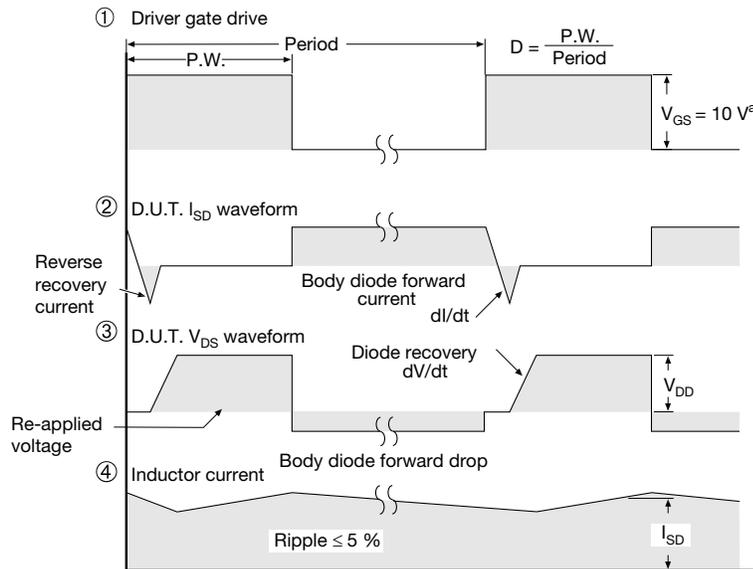
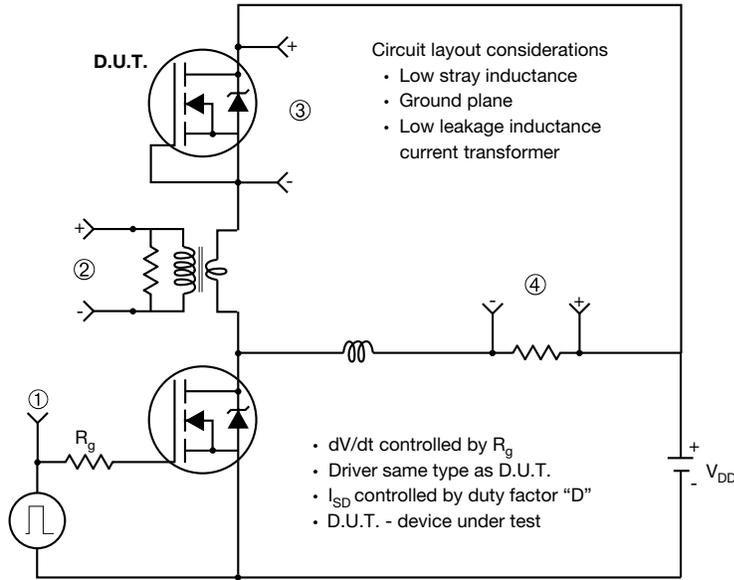


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



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

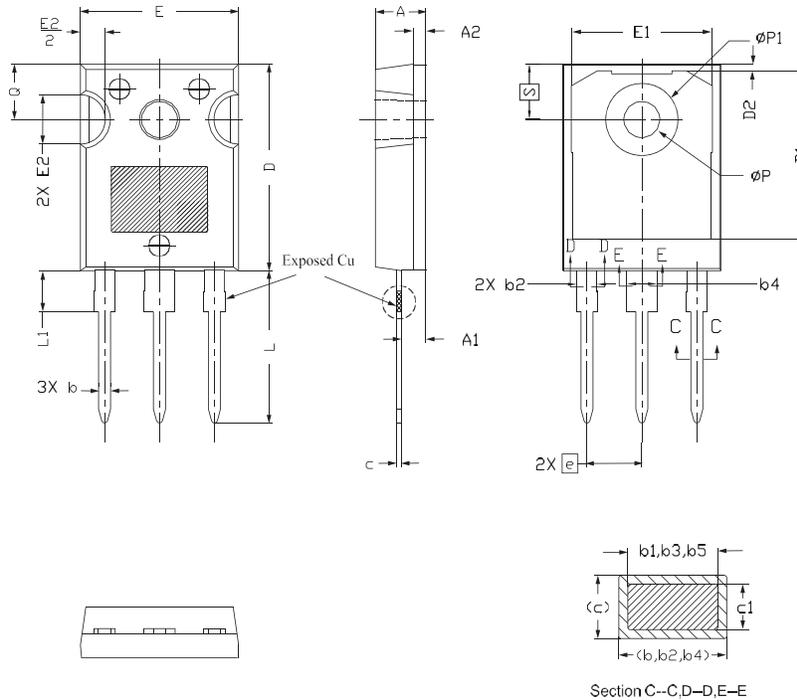
Fig. 14 - For N-Channel

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TO-247AC (High Voltage)

VERSION 1: FACILITY CODE = 9



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

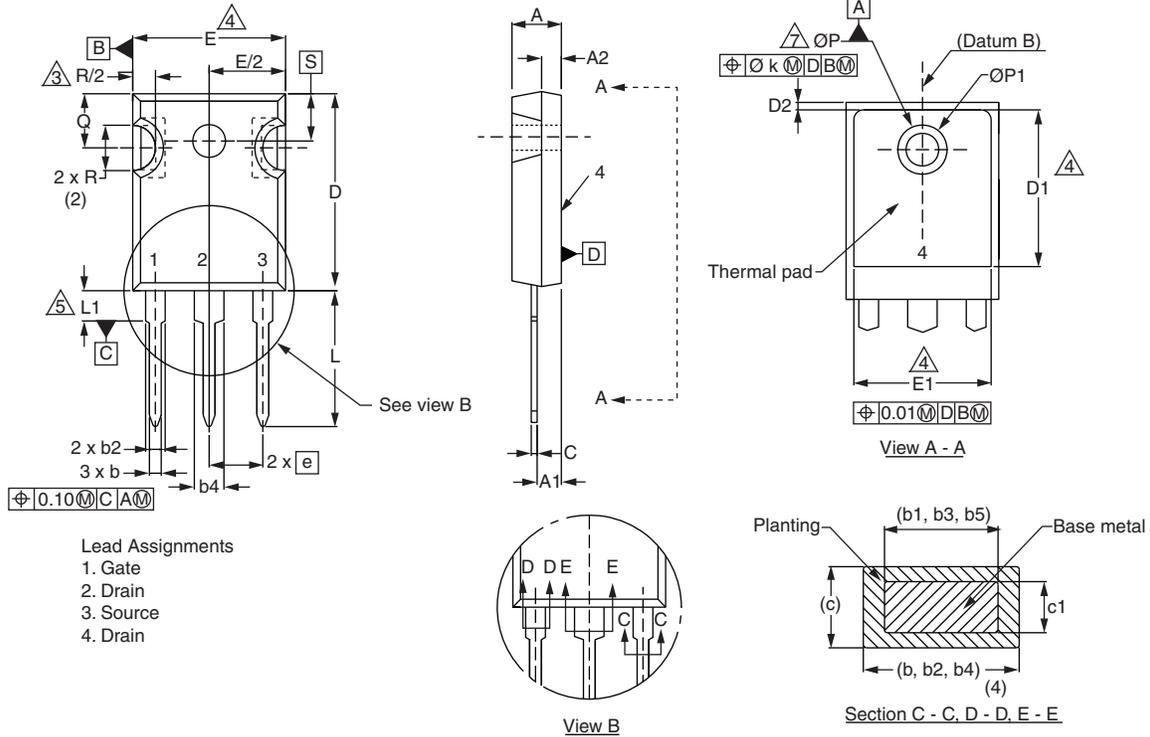
| DIM. | MILLIMETERS | | | NOTES |
|------|-------------|-------|-------|-------|
| | MIN. | NOM. | MAX. | |
| D1 | 16.46 | 16.76 | 17.06 | 5 |
| D2 | 0.56 | 0.66 | 0.76 | |
| E | 15.50 | 15.70 | 15.87 | 4 |
| E1 | 13.46 | 14.02 | 14.16 | 5 |
| E2 | 4.52 | 4.91 | 5.49 | 3 |
| e | 5.46 BSC | | | |
| L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

Notes

- (1) Package reference: JEDEC® TO247, variation AC
- (2) All dimensions are in mm
- (3) Slot required, notch may be rounded
- (4) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm per side. These dimensions are measured at the outermost extremes of the plastic body
- (5) Thermal pad contour optional with dimensions D1 and E1
- (6) Lead finish uncontrolled in L1
- (7) Ø P to have a maximum draft angle of 1.5° to the top of the part with a maximum hole diameter of 3.91 mm
- (8) Dimension b2 and b4 does not include dambar protrusion. Allowable dambar protrusion shall be 0.1 mm total in excess of b2 and b4 dimension at maximum material condition



VERSION 2: FACILITY CODE = Y



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

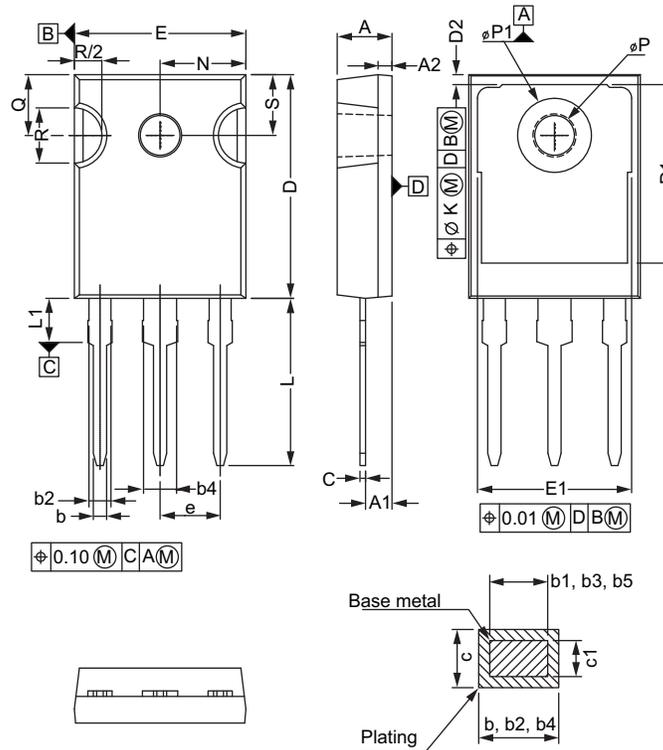
| DIM. | MILLIMETERS | | NOTES |
|------|-------------|-------|-------|
| | MIN. | MAX. | |
| D2 | 0.51 | 1.30 | |
| E | 15.29 | 15.87 | |
| E1 | 13.72 | - | |
| e | 5.46 BSC | | |
| Ø k | 0.254 | | |
| L | 14.20 | 16.25 | |
| L1 | 3.71 | 4.29 | |
| Ø P | 3.51 | 3.66 | |
| Ø P1 | - | 7.39 | |
| Q | 5.31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

Notes

- (1) Dimensioning and tolerancing per ASME Y14.5M-1994
- (2) Contour of slot optional
- (3) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outermost extremes of the plastic body
- (4) Thermal pad contour optional with dimensions D1 and E1
- (5) Lead finish uncontrolled in L1
- (6) Ø P to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")
- (7) Outline conforms to JEDEC outline TO-247 with exception of dimension c



VERSION 3: FACILITY CODE = N



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

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

ECN: E22-0452-Rev. G, 31-Oct-2022
 DWG: 5971

- Notes**
- (1) Dimensioning and tolerancing per ASME Y14.5M-1994
 - (2) Contour of slot optional
 - (3) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outermost extremes of the plastic body
 - (4) Thermal pad contour optional with dimensions D1 and E1
 - (5) Lead finish uncontrolled in L1
 - (6) Ø P to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")



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