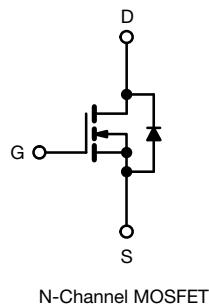
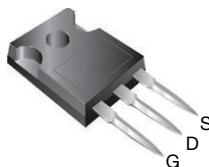


EF Series Power MOSFET with Fast Body Diode

| PRODUCT SUMMARY | | |
|--------------------------------|-----------------|-------|
| V_{DS} (V) at T_J max. | 650 | |
| $R_{DS(on)}$ typ. at 25 °C (Ω) | $V_{GS} = 10$ V | 0.033 |
| Q_g (Max.) (nC) | 380 | |
| Q_{gs} (nC) | 62 | |
| Q_{gd} (nC) | 102 | |
| Configuration | Single | |

TO-247AC



FEATURES

- Fast body diode MOSFET using E series technology
- Reduced t_{rr} , Q_{rr} , and I_{RRM}
- Low figure-of-merit (FOM): $R_{on} \times Q_g$
- Low input capacitance (C_{iss})
- Increased robustness due to low Q_{rr}
- Ultra low gate charge (Q_g)
- Avalanche energy rated (UIS)
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- Telecommunications
 - Server and telecom power supplies
- Lighting
 - High intensity discharge (HID)
 - Light emitting diodes (LEDs)
- Consumer and computing
 - ATX power supplies
- Industrial
 - Welding
 - Battery chargers
- Renewable energy
 - Solar (PV inverters)
- Switch mode power suppliers (SMPS)
- Applications using the following topologies
 - LLC
 - Phase shifted bridge (ZVS)
 - 3-level inverter
 - AC/DC bridge

ORDERING INFORMATION

| | |
|---------------------------------|-----------------|
| Package | TO-247AC |
| Lead (Pb)-free and Halogen-free | SiHG70N60EF-GE3 |

ABSOLUTE MAXIMUM RATINGS ($T_C = 25$ °C, unless otherwise noted)

| PARAMETER | SYMBOL | LIMIT | UNIT |
|---|-------------------|-------------|------|
| Drain-Source Voltage | V_{DS} | 600 | V |
| Gate-Source Voltage | V_{GS} | ± 30 | |
| Continuous Drain Current ($T_J = 150$ °C) | I_D | 70 | A |
| | | 45 | |
| Pulsed Drain Current ^a | I_{DM} | 229 | |
| Linear Derating Factor | | 4.2 | W/°C |
| Single Pulse Avalanche Energy ^b | E_{AS} | 1706 | mJ |
| Maximum Power Dissipation | P_D | 520 | W |
| Operating Junction and Storage Temperature Range | T_J , T_{stg} | -55 to +150 | °C |
| Drain-Source Voltage Slope | dV/dt | 70 | V/ns |
| Reverse Diode dV/dt ^d | | 50 | |
| Soldering Recommendations (Peak Temperature) ^c | for 10 s | 300 | °C |

Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature
- b. $V_{DD} = 50$ V, starting $T_J = 25$ °C, $L = 28.2$ mH, $R_g = 25$ Ω, $I_{AS} = 11$ A
- c. 1.6 mm from case
- d. $I_{SD} = 35$ A, $dl/dt = 750$ A/μs, $V_{DS} = 400$ V

THERMAL RESISTANCE RATINGS

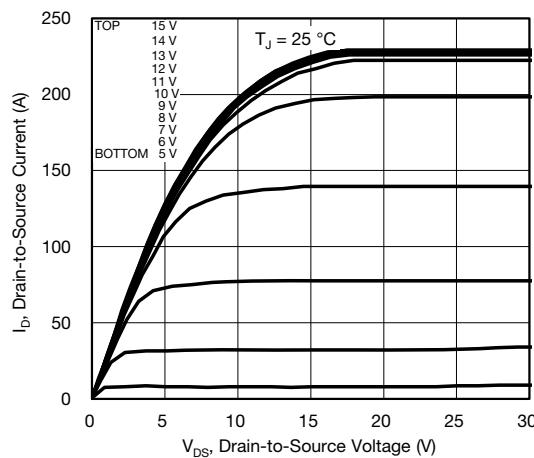
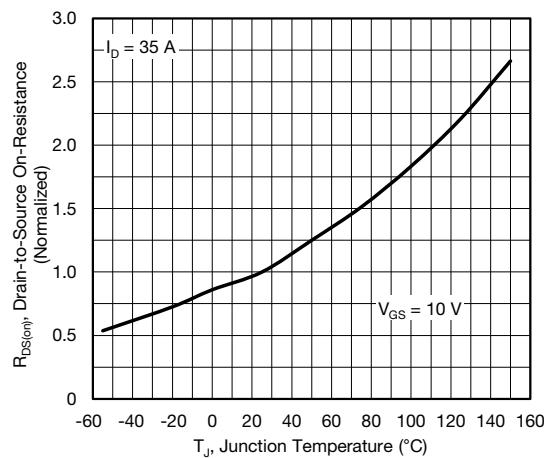
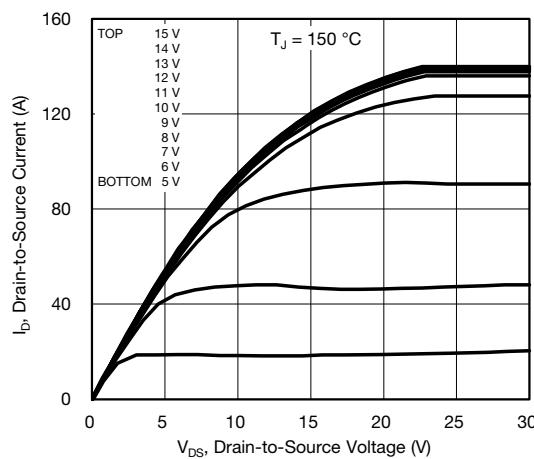
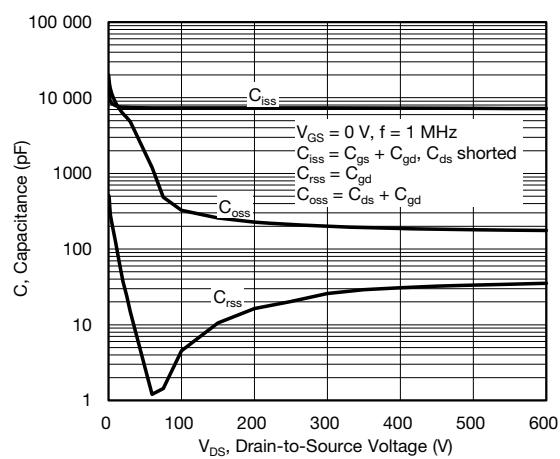
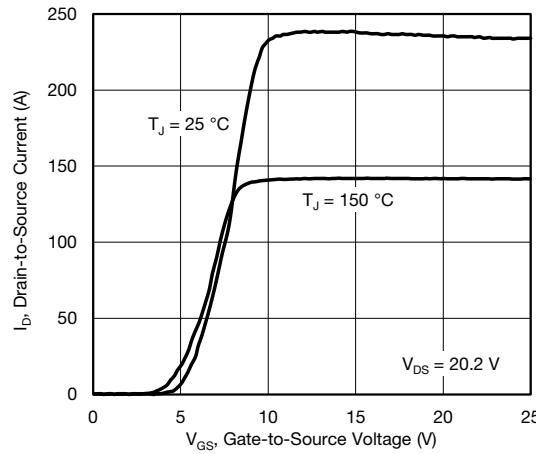
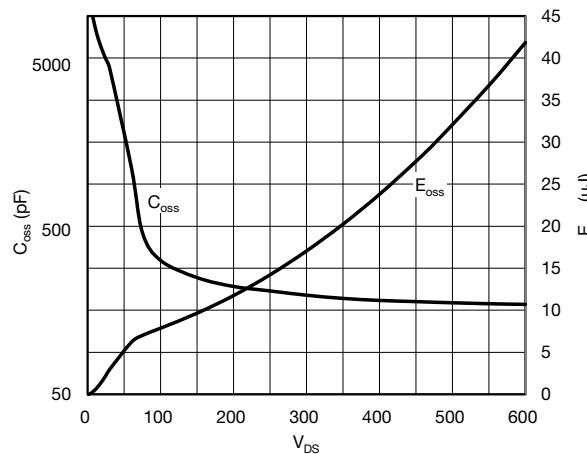
| PARAMETER | SYMBOL | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient | R_{thJA} | - | 40 | °C/W |
| Maximum Junction-to-Case (Drain) | R_{thJC} | - | 0.24 | |

SPECIFICATIONS ($T_J = 25$ °C, unless otherwise noted)

| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNIT |
|---|---------------------|--|---|------|-------|-------|----------|
| Static | | | | | | | |
| Drain-Source Breakdown Voltage | V_{DS} | $V_{GS} = 0$ V, $I_D = 250$ μ A | | 600 | - | - | V |
| V_{DS} Temperature Coefficient | $\Delta V_{DS}/T_J$ | Reference to 25 °C, $I_D = 1$ mA | | - | 0.69 | - | V/°C |
| Gate-Source Threshold Voltage (N) | $V_{GS(th)}$ | $V_{DS} = V_{GS}$, $I_D = 250$ μ A | | 2.0 | - | 4.0 | V |
| Gate-Source Leakage | I_{GSS} | $V_{GS} = \pm 20$ V | | - | - | ± 100 | nA |
| | | $V_{GS} = \pm 30$ V | | - | - | ± 1 | μ A |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = 480$ V, $V_{GS} = 0$ V | | - | - | 1 | μ A |
| | | $V_{DS} = 480$ V, $V_{GS} = 0$ V, $T_J = 125$ °C | | - | - | 2 | mA |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS} = 10$ V | $I_D = 35$ A | - | 0.033 | 0.038 | Ω |
| Forward Transconductance | g_{fs} | $V_{DS} = 30$ V, $I_D = 35$ A | | - | 25 | - | S |
| Dynamic | | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0$ V, $V_{DS} = 100$ V, $f = 1$ MHz | | - | 7500 | - | pF |
| Output Capacitance | C_{oss} | | | - | 378 | - | |
| Reverse Transfer Capacitance | C_{rss} | | | - | 5 | - | |
| Effective output capacitance, energy related ^a | $C_{o(er)}$ | $V_{GS} = 0$ V, V_{DS} = 0 V to 480 V | | - | 263 | - | |
| Effective output capacitance, time related ^b | $C_{o(tr)}$ | | | - | 926 | - | |
| Total Gate Charge | Q_g | $V_{GS} = 10$ V | $I_D = 35$ A, $V_{DS} = 480$ V | - | 253 | 380 | nC |
| Gate-Source Charge | Q_{gs} | | | - | 62 | - | |
| Gate-Drain Charge | Q_{gd} | | | - | 102 | - | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = 480$ V, $I_D = 35$ A $R_g = 9.1$ Ω , $V_{GS} = 10$ V | | - | 56 | 84 | ns |
| Rise Time | t_r | | | - | 107 | 161 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | - | 257 | 386 | |
| Fall Time | t_f | | | - | 123 | 185 | |
| Gate Input Resistance | R_g | $f = 1$ MHz, open drain | | 0.5 | 1.1 | 2.2 | Ω |
| Drain-Source Body Diode Characteristics | | | | | | | |
| Continuous Source-Drain Diode Current | I_S | MOSFET symbol showing the integral reverse p - n junction diode |  | - | - | 70 | A |
| Pulsed Diode Forward Current | I_{SM} | | | - | - | 229 | |
| Diode Forward Voltage | V_{SD} | $T_J = 25$ °C, $I_S = 35$ A, $V_{GS} = 0$ V | | - | 0.9 | 1.2 | V |
| Reverse Recovery Time | t_{rr} | $T_J = 25$ °C, $I_F = I_S = 35$ A, $dl/dt = 100$ A/ μ s, $V_R = 400$ V | | - | 213 | 426 | ns |
| Reverse Recovery Charge | Q_{rr} | | | - | 1.6 | 3.2 | μ C |
| Reverse Recovery Current | I_{RRM} | | | - | 16 | - | A |

Notes

a. $C_{oss(er)}$ is a fixed capacitance that gives the same energy as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DS}
b. $C_{oss(tr)}$ is a fixed capacitance that gives the 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 - C_{oss} and E_{oss} vs. V_{DS}

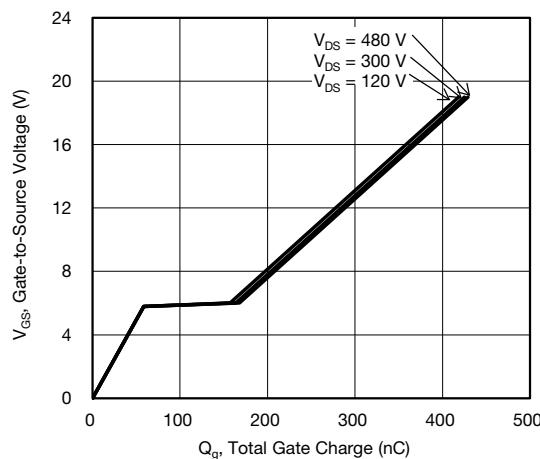


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

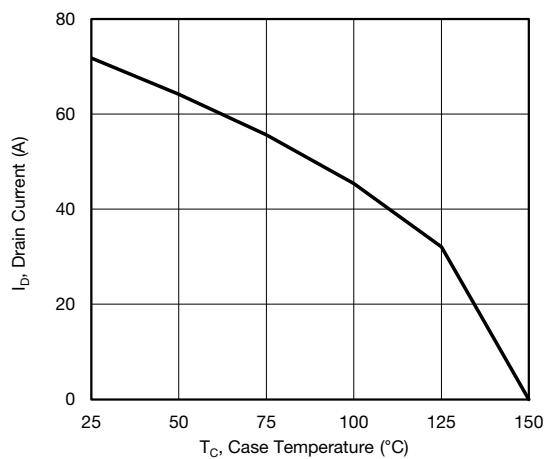


Fig. 10 - Maximum Drain Current vs. Case Temperature

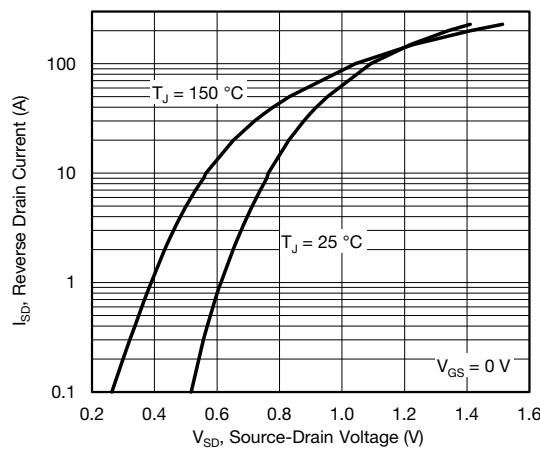


Fig. 8 - Typical Source-Drain Diode Forward Voltage

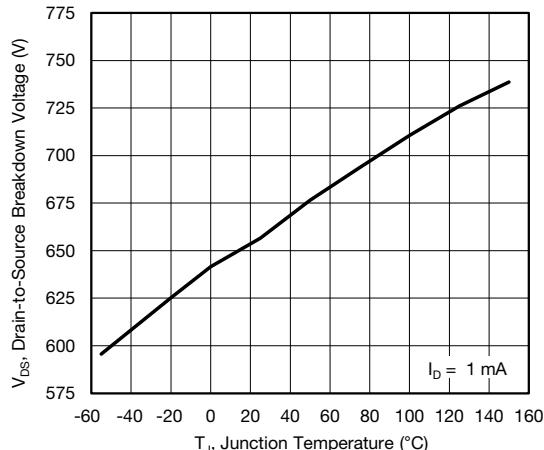


Fig. 11 - Typical Drain-to-Source Voltage vs. Temperature

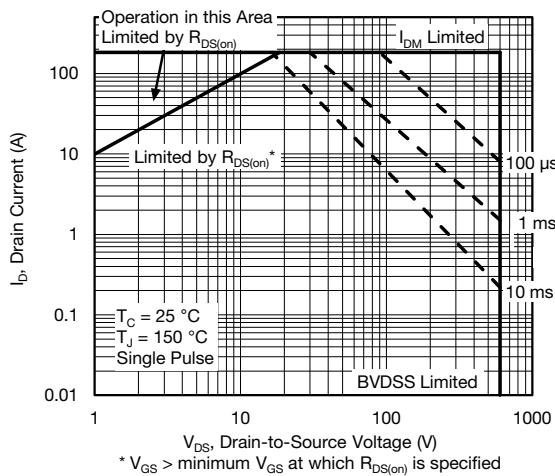


Fig. 9 - Maximum Safe Operating Area

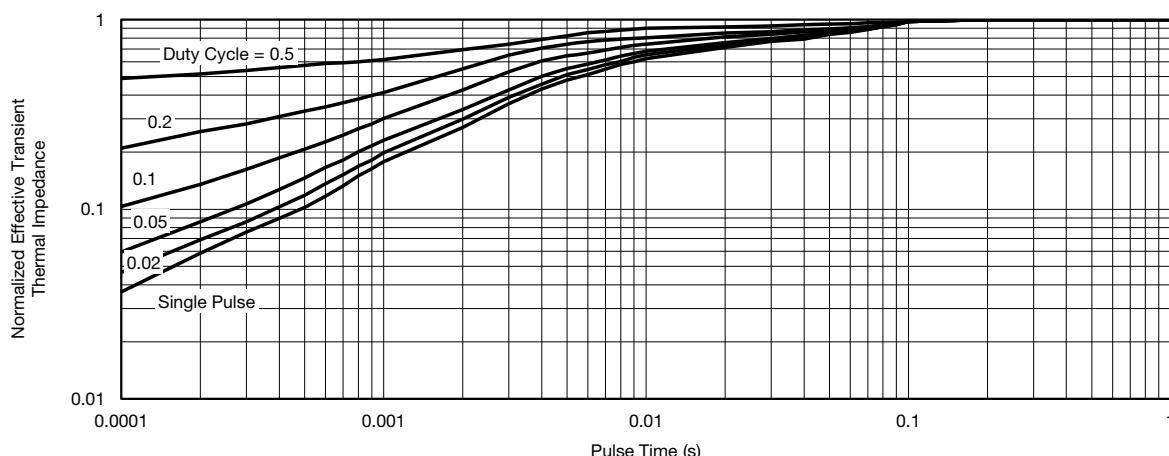


Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case

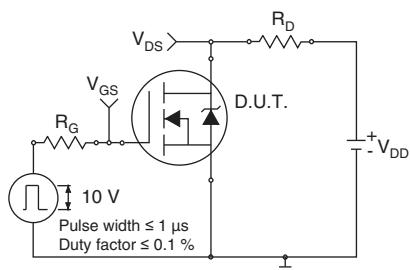


Fig. 13 - Switching Time Test Circuit

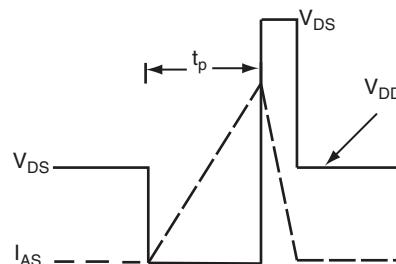


Fig. 16 - Unclamped Inductive Waveforms

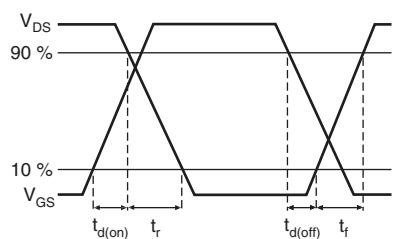


Fig. 14 - Switching Time Waveforms

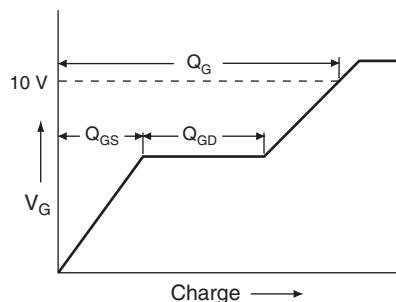


Fig. 17 - Basic Gate Charge Waveform

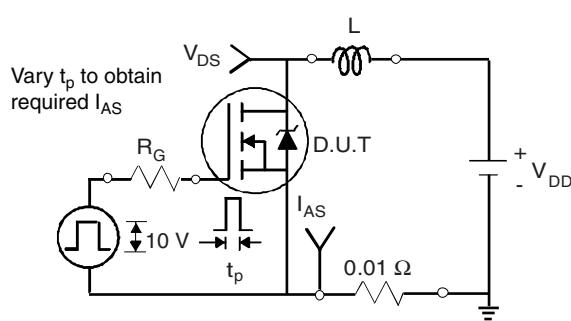


Fig. 15 - Unclamped Inductive Test Circuit

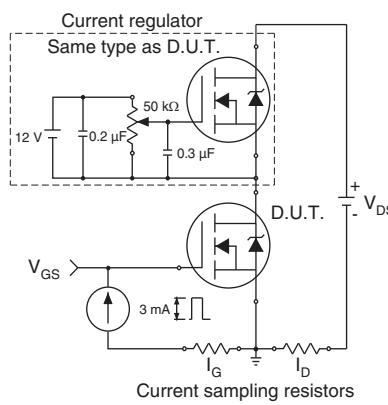
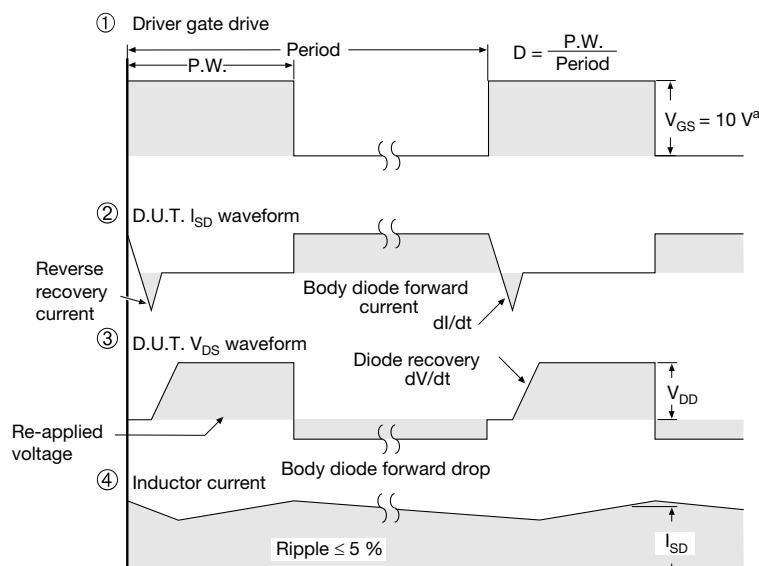
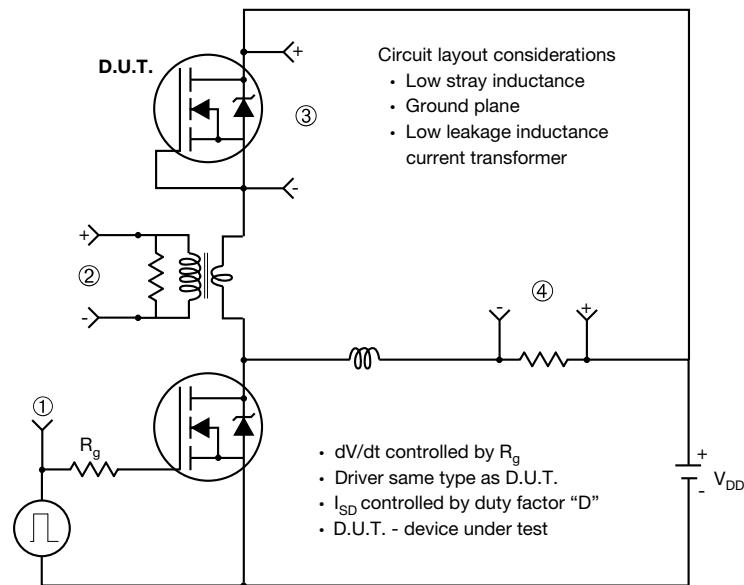


Fig. 18 - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit

Note

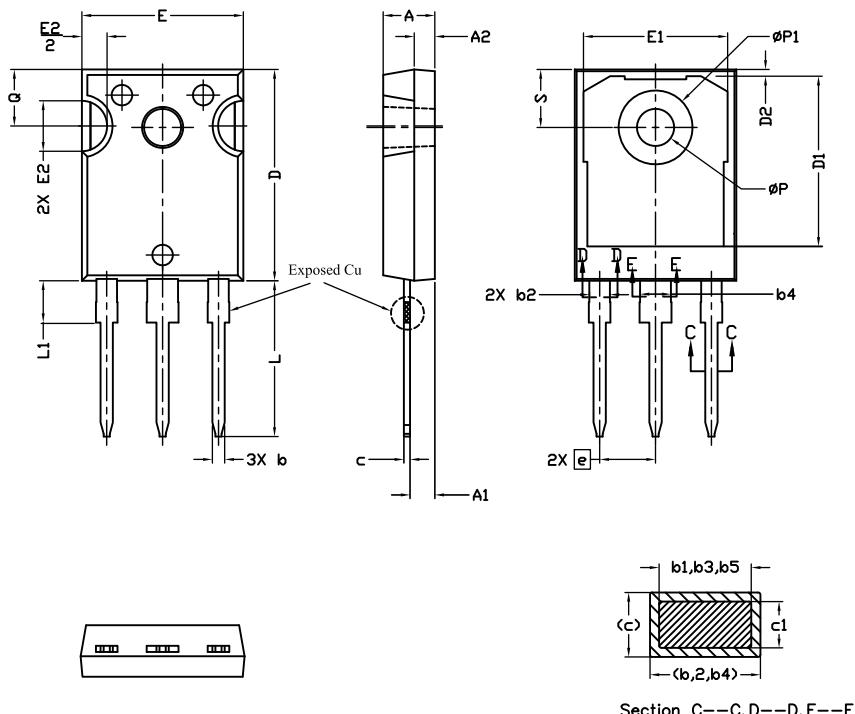
a. $V_{GS} = 5 \text{ V}$ for logic level devices

Fig. 19 - For N-Channel

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TO-247AC (High Voltage)

VERSION 1: FACILITY CODE = 9



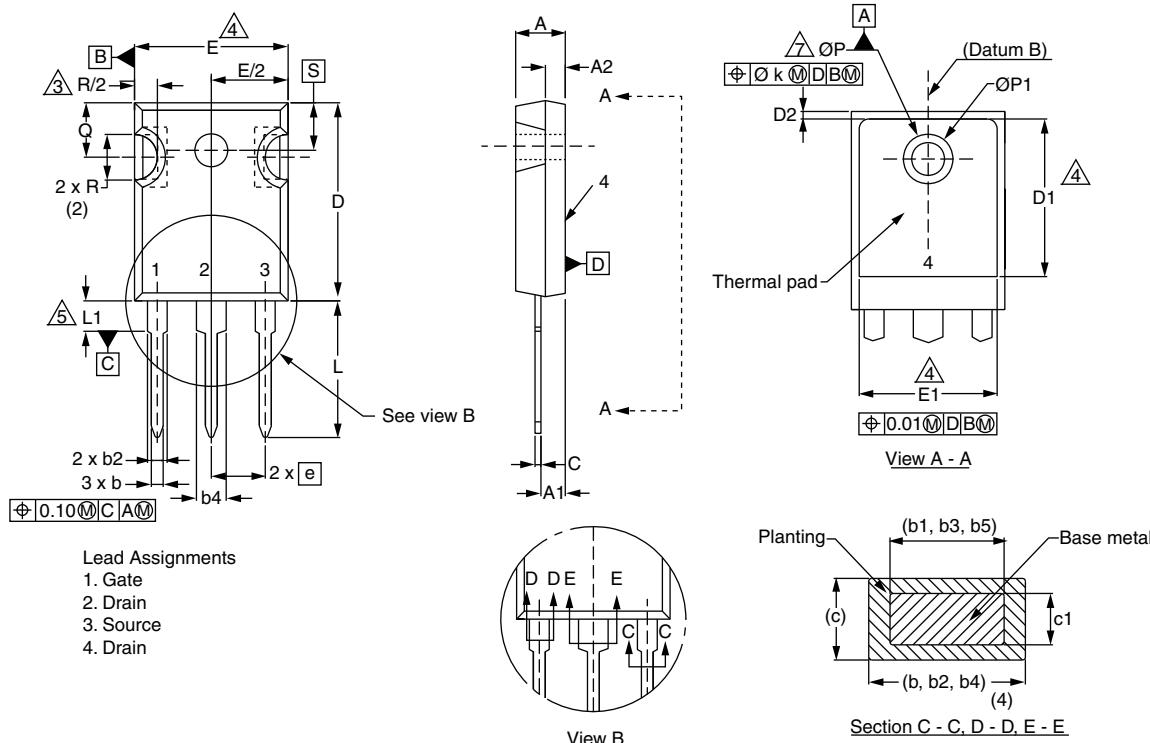
| MILLIMETERS | | | |
|-------------|-------|-------|-------|
| DIM. | MIN. | MAX. | NOTES |
| A | 4.83 | 5.21 | |
| A1 | 2.29 | 2.55 | |
| A2 | 1.50 | 2.49 | |
| b | 1.12 | 1.33 | |
| b1 | 1.12 | 1.28 | |
| b2 | 1.91 | 2.39 | 6 |
| b3 | 1.91 | 2.34 | |
| b4 | 2.87 | 3.22 | 6, 8 |
| b5 | 2.87 | 3.18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

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

| 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 | |

VERSION 2: FACILITY CODE = Y



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

ECN: E19-0614-Rev. E, 08-Jan-2020

DWG: 5971

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

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