# E Series Power MOSFET

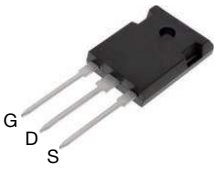
| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{DS}$ (V) at $T_J$ max. | 650 | |
| $R_{DS(on)}$ max. at 25 °C (Ω) | $V_{GS}$ = 10 V | 0.064 |
| $Q_g$ max. (nC) | 220 | |
| $Q_{gs}$ (nC) | 36 | |
| $Q_{gd}$ (nC) | 60 | |
| Configuration | Single | |

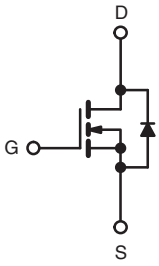
## FEATURES

- Low Figure-of-Merit (FOM) $R_{on}$ x $Q_g$
- Low Input Capacitance ($C_{iss}$)
- Reduced Switching and Conduction Losses
- 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

TO-247AD




N-Channel MOSFET

## APPLICATIONS

- Switch Mode Power Supplies (SMPS)
- Power Factor Correction Power Supplies (PFC)
- Lighting
  - High-Intensity Discharge (HID)
  - Fluorescent Ballast Lighting
- Industrial
  - Welding
  - Induction Heating
  - Motor Drives
  - Battery Chargers
  - Renewable Energy
  - Solar (PV Inverters)

| ORDERING INFORMATION | |
|---|---|
| Package | TO-247AD |
| Lead (Pb)-free and Halogen-free | SiHW47N60E-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 | | | $V_{GS}$ | ± 20 | |
| Gate-Source Voltage AC (f > 1 Hz) | | | | 30 | |
| Continuous Drain Current ($T_J$ = 150 °C) | $V_{GS}$ at 10 V | $T_C$ = 25 °C | $I_D$ | 47 | A |
| | | $T_C$ = 100 °C | | 30 | |
| Pulsed Drain Current[a] | | | $I_{DM}$ | 145 | |
| Linear Derating Factor | | | | 3 | W/°C |
| Single Pulse Avalanche Energy[b] | | | $E_{AS}$ | 1800 | mJ |
| Maximum Power Dissipation | | | $P_D$ | 357 | W |
| Operating Junction and Storage Temperature Range | | | $T_J$, $T_{stg}$ | -55 to +150 | °C |
| Drain-Source Voltage Slope | $T_J$ = 125 °C | | dV/dt | 37 | V/ns |
| Reverse Diode dV/dt[d] | | | | 11 | |
| 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 = 73.5 mH, $R_g$ = 25 Ω, $I_{AS}$ = 7 A.
c. 1.6 mm from case.
d. $I_{SD} \leq I_D$, dI/dt = 100 A/µs, starting $T_J$ = 25 °C.

| THERMAL RESISTANCE RATINGS | | | | |
|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TYP.** | **MAX.** | **UNIT** |
| Maximum Junction-to-Ambient | $R_{thJA}$ | - | 40 | °C/W |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | - | 0.33 | |

| **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 µA | 600 | - | - | V |
| $V_{DS}$ Temperature Coefficient | $\Delta V_{DS}/T_J$ | Reference to 25 °C, $I_D$ = 250 µA | - | 0.66 | - | V/°C |
| Gate-Source Threshold Voltage (N) | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 2.5 | - | 3.5 | V |
| Gate-Source Leakage | $I_{GSS}$ | $V_{GS}$ = ± 20 V | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 600 V, $V_{GS}$ = 0 V | - | - | 1 | µA |
| | | $V_{DS}$ = 480 V, $V_{GS}$ = 0 V, $T_J$ = 150 °C | - | - | 10 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 24 A | - | 0.053 | 0.064 | Ω |
| Forward Transconductance | $g_{fs}$ | $V_{DS}$ = 8 V, $I_D$ = 3 A | - | 6.8 | - | S |
| **Dynamic** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 100 V, f = 1 MHz | - | 4810 | - | pF |
| Output Capacitance | $C_{oss}$ | | - | 230 | - | |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 5 | - | |
| Total Gate Charge | $Q_g$ | $V_{GS}$ = 10 V, $I_D$ = 24 A, $V_{DS}$ = 480 V | - | 147 | 220 | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 36 | - | |
| Gate-Drain Charge | $Q_{gd}$ | | - | 60 | - | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = 480 V, $I_D$ = 24 A, $V_{GS}$ = 10 V, $R_g$ = 4.4 Ω | - | 24 | 50 | ns |
| Rise Time | $t_r$ | | - | 11 | 25 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 94 | 140 | |
| Fall Time | $t_f$ | | - | 13 | 26 | |
| Gate Input Resistance | $R_g$ | f = 1 MHz, open drain | - | 0.65 | - | Ω |
| **Drain-Source Body Diode Characteristics** | | | | | | |
| Continuous Source-Drain Diode Current | $I_S$ | MOSFET symbol showing the integral reverse p - n junction diode  | - | - | 47 | A |
| Pulsed Diode Forward Current | $I_{SM}$ | | - | - | 140 | |
| Diode Forward Voltage | $V_{SD}$ | $T_J$ = 25 °C, $I_S$ = 24 A, $V_{GS}$ = 0 V | - | - | 1.2 | V |
| Body Diode Reverse Recovery Time | $t_{rr}$ | $T_J$ = 25 °C, $I_F$ = $I_{S\ =\ 24\ A}$, dI/dt = 100 A/µs, $V_R$ = 25 V | - | 696 | - | ns |
| Body Diode Reverse Recovery Charge | $Q_{rr}$ | | - | 16 | - | µC |
| Reverse Recovery Current | $I_{RRM}$ | | - | 39 | - | A |

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

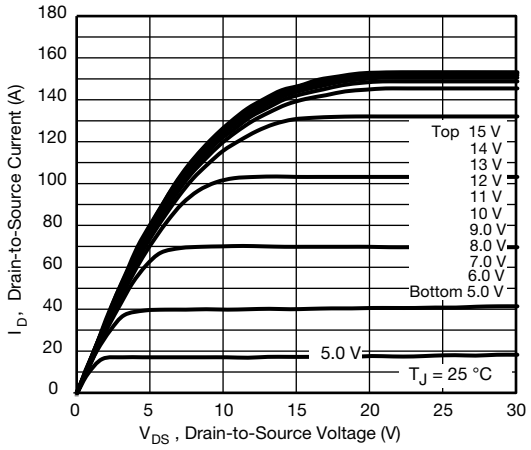



**Fig. 1 - Typical Output Characteristics, $T_C$ = 25 °C**

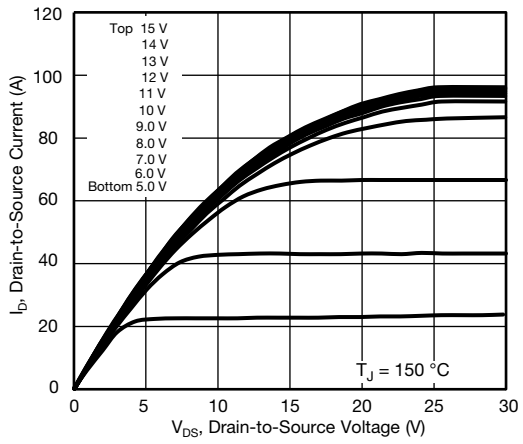



**Fig. 2 - Typical Output Characteristics, $T_C$ = 150 °C**

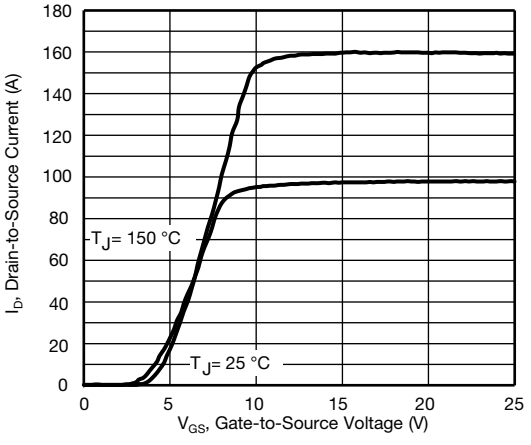



**Fig. 3 - Typical Transfer Characteristics**

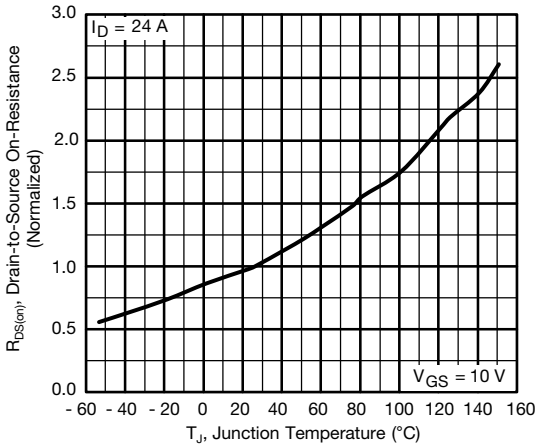



**Fig. 4 - Normalized On-Resistance vs. Temperature**

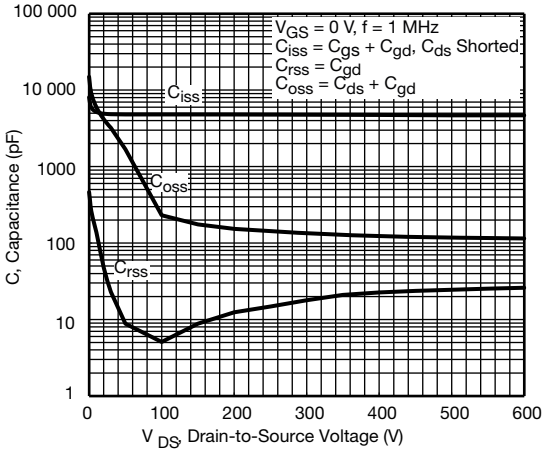



**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

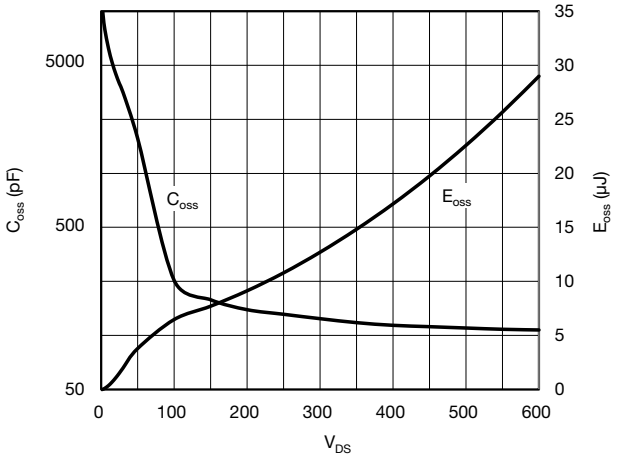



**Fig. 6 - $C_{oss}$ and $E_{oss}$ vs. $V_{DS}$**

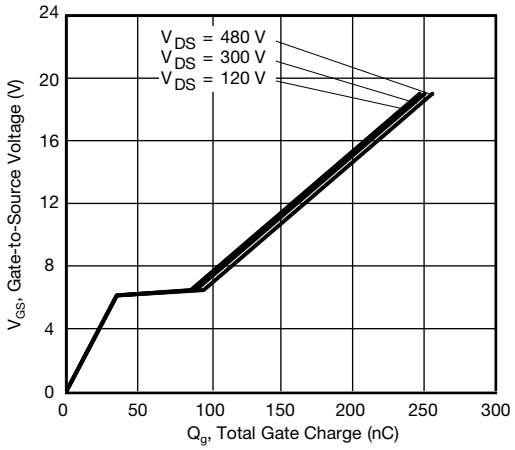



**Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage**

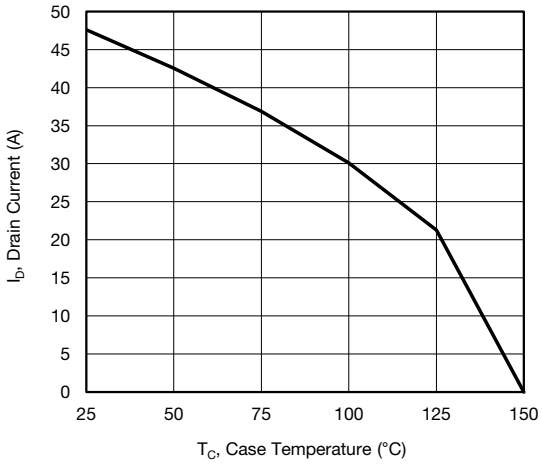



**Fig. 10 - Maximum Drain Current vs. Case Temperature**

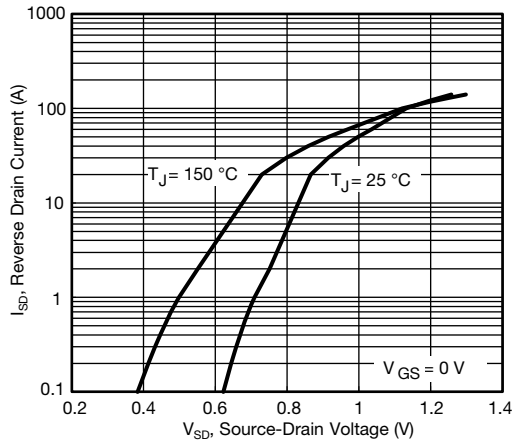



**Fig. 8 - Typical Source-Drain Diode Forward Voltage**

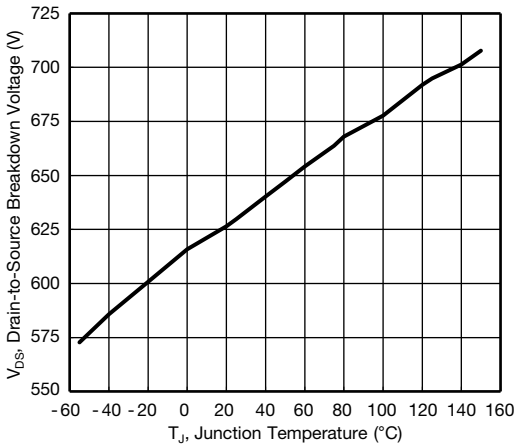



**Fig. 11 - Temperature vs. Drain-to-Source Voltage**

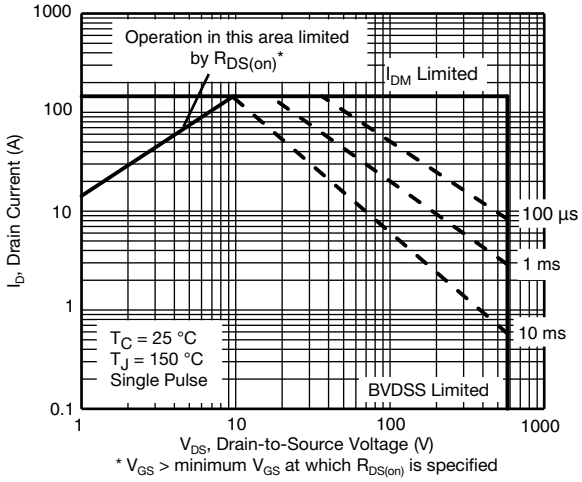



**Fig. 9 - Maximum Safe Operating Area**

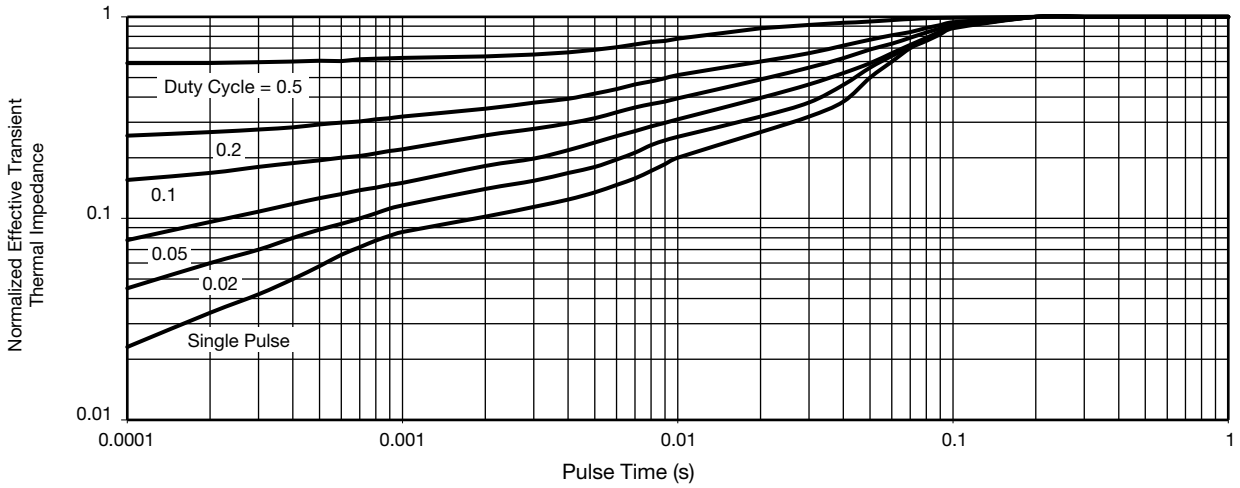



**Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case**

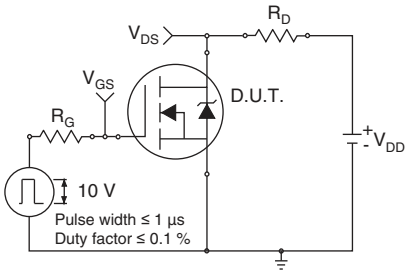



**Fig. 13 - Switching Time Test Circuit**

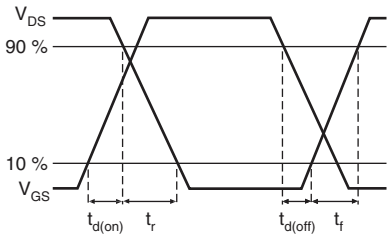



**Fig. 14 - Switching Time Waveforms**

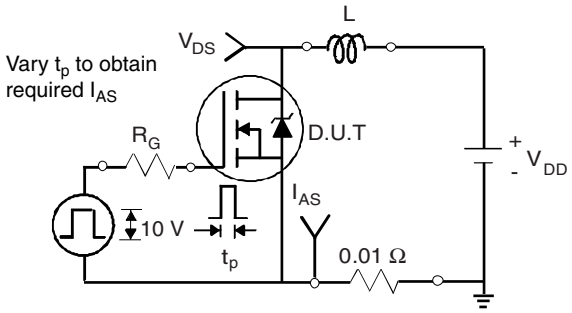



**Fig. 15 - Unclamped Inductive Test Circuit**

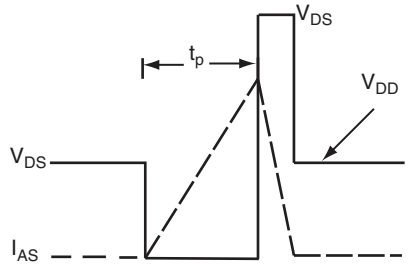



**Fig. 16 - Unclamped Inductive Waveforms**

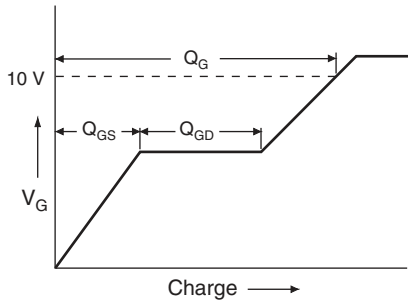



**Fig. 17 - Basic Gate Charge Waveform**

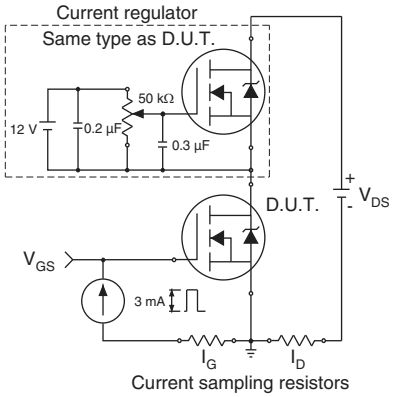
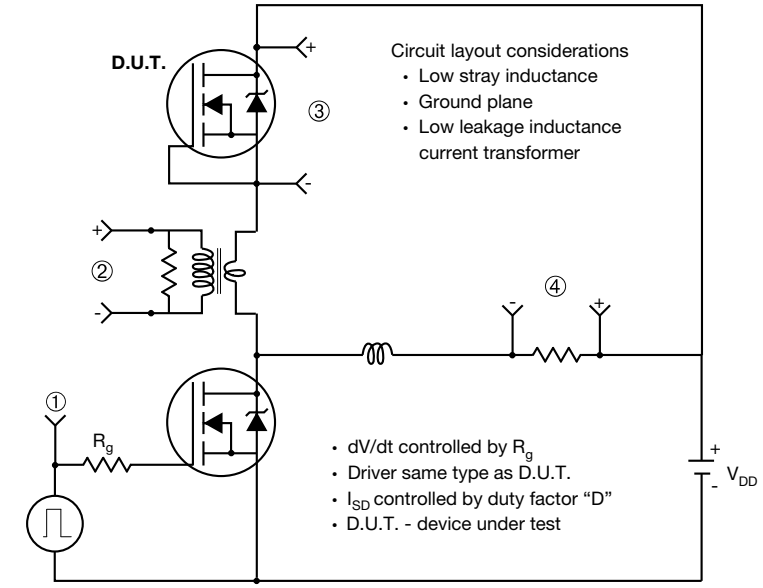
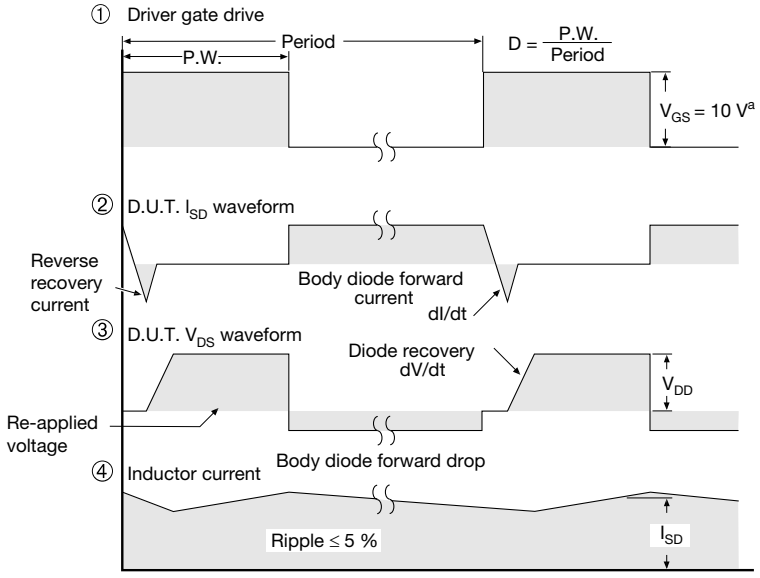



**Fig. 18 - Gate Charge Test Circuit**

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



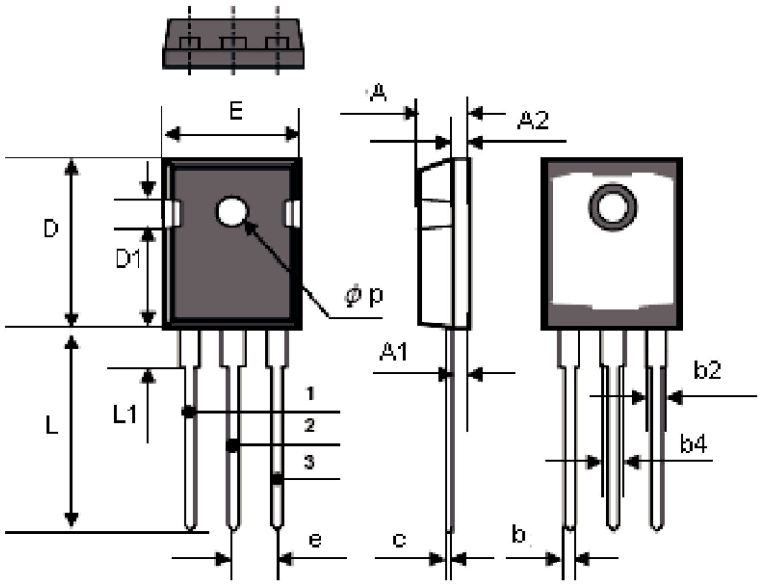

**Note**

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

**Fig. 19 - 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?91517.*

## TO-247AD (HIGH VOLTAGE)





| DIM. | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. |
| A | 4.90 | 5.10 | 0.193 | 0.200 |
| A1 | 2.30 | 2.40 | 0.090 | 0.094 |
| A2 | 1.92 | 2.08 | 0.076 | 0.082 |
| b | 1.15 | 1.25 | 0.045 | 0.049 |
| b2 | 1.95 | 2.05 | 0.077 | 0.081 |
| b4 | 2.85 | 3.11 | 0.112 | 0.122 |
| c | 0.6 BSC | | 0.024 BSC | |
| D | 20.80 | 21.46 | 0.819 | 0.845 |
| D1 | 4.37 | 4.63 | 0.172 | 0.182 |
| e | 5.32 | 5.58 | 0.209 | 0.220 |
| E | 15.77 | 16.03 | 0.621 | 0.631 |
| L | 19.85 | 20.11 | 0.781 | 0.792 |
| L1 | 4.07 | 4.33 | 0.160 | 0.170 |
| Ø p | 3.56 | 3.66 | 0.140 | 0.144 |
| ECN: X12-0191-Rev. A, 22-Oct-12<br>DWG: 6010 | | | | |

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