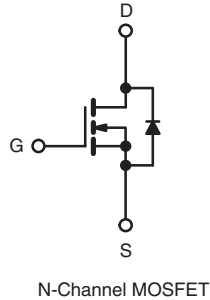
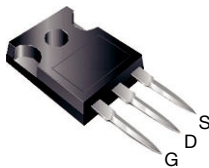


## D Series Power MOSFET

| PRODUCT SUMMARY                         |                 |      |
|---|-----------------|------|
| $V_{DS}$ (V) at $T_J$ max.              | 550             |      |
| $R_{DS(on)}$ max. at 25 °C ( $\Omega$ ) | $V_{GS} = 10$ V | 0.25 |
| $Q_g$ max. (nC)                         | 170             |      |
| $Q_{gs}$ (nC)                           | 14              |      |
| $Q_{gd}$ (nC)                           | 28              |      |
| Configuration                           | Single          |      |

**TO-247AC**


### FEATURES

- Optimal Design
  - Low Area Specific On-Resistance
  - Low Input Capacitance ( $C_{iss}$ )
  - Reduced Capacitive Switching Losses
  - High Body Diode Ruggedness
  - Avalanche Energy Rated (UIS)
- Optimal Efficiency and Operation
  - Low Cost
  - Simple Gate Drive Circuitry
  - Low Figure-of-Merit (FOM):  $R_{on} \times Q_g$
  - Fast Switching
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

### Note

\* Lead (Pb)-containing terminations are not RoHS-compliant. Exemptions may apply.

### APPLICATIONS

- Consumer Electronics
  - Displays (LCD or Plasma TV)
- Server and Telecom Power Supplies
  - SMPS
- Industrial
  - Welding
  - Induction Heating
  - Motor Drives
- Battery Chargers
- SMPS
  - Power Factor Correction (PFC)



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**  
Available

| ORDERING INFORMATION            |              |
|---------------------------------|--------------|
| Package                         | TO-247AC     |
| Lead (Pb)-free                  | IRFP460BPbF  |
| Lead (Pb)-free and Halogen-free | SiHG460B-GE3 |

| ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted) |                  |                |      |
|---|------------------|----------------|------|
| PARAMETER   | SYMBOL           | LIMIT          | UNIT |
| Drain-Source Voltage  | $V_{DS}$         | 500            | V    |
| Gate-Source Voltage   | $V_{GS}$         | $\pm 20$       |      |
| Gate-Source Voltage AC ( $f > 1$ Hz)                              |                  | 30             |      |
| Continuous Drain Current ( $T_J = 150$ °C)                        | $V_{GS}$ at 10 V | $T_C = 25$ °C  | A    |
|   |                  | $T_C = 100$ °C |      |
| Pulsed Drain Current <sup>a</sup>                                 | $I_{DM}$         | 62             |      |
| Linear Derating Factor  |                  | 2.2            | W/°C |
| Single Pulse Avalanche Energy <sup>b</sup>                        | $E_{AS}$         | 281            | mJ   |
| Maximum Power Dissipation   | $P_D$            | 278            | W    |
| Operating Junction and Storage Temperature Range                  | $T_J, T_{stg}$   | - 55 to + 150  | °C   |
| Drain-Source Voltage Slope  | $dV/dt$          | $T_J = 125$ °C | V/ns |
| Reverse Diode $dV/dt^d$   |                  | 24             |      |
| Soldering Recommendations (Peak Temperature)                      |                  | 0.36           |      |
|   | for 10 s         | 300°           | °C   |

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 50$  V, starting  $T_J = 25$  °C,  $L = 10$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 7.5$  A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$ , 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) | $R_{thJC}$ | -    | 0.45 |      |

| SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted) |                     |   |  |      |      |           |               |
|---|---------------------|---|--|------|------|-----------|---------------|
| PARAMETER   | SYMBOL              | TEST CONDITIONS   |  | MIN. | TYP. | MAX.      | UNIT          |
| <b>Static</b>   |                     |   |  |      |      |           |               |
| 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 $25\text{ }^\circ\text{C}, I_D = 250\text{ }\mu\text{A}$   |  | -    | 0.56 | -         | V/°C          |
| Gate-Source Threshold Voltage (N)   | $V_{GS(th)}$        | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$   |  | 2    | -    | 4         | V             |
| Gate-Source Leakage   | $I_{GSS}$           | $V_{GS} = \pm 20\text{ V}$  |  | -    | -    | $\pm 100$ | nA            |
| Zero Gate Voltage Drain Current   | $I_{DSS}$           | $V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$  |  | -    | -    | 1         | $\mu\text{A}$ |
|   |                     | $V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$   |  | -    | -    | 10        |               |
| Drain-Source On-State Resistance  | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$  | $I_D = 10\text{ A}$                        | -    | 0.2  | 0.25      | $\Omega$      |
| Forward Transconductance  | $g_{fs}$            | $V_{DS} = 50\text{ V}, I_D = 10\text{ A}$   |  | -    | 12   | -         | S             |
| <b>Dynamic</b>  |                     |   |  |      |      |           |               |
| Input Capacitance   | $C_{iss}$           | $V_{GS} = 0\text{ V},$<br>$V_{DS} = 100\text{ V},$<br>$f = 1\text{ MHz}$  |  | -    | 3094 | -         | pF            |
| Output Capacitance  | $C_{oss}$           |   |  | -    | 152  | -         |               |
| Reverse Transfer Capacitance  | $C_{rss}$           |   |  | -    | 13   | -         |               |
| Effective output capacitance, energy related <sup>a</sup>                   | $C_{o(er)}$         | $V_{GS} = 0\text{ V},$<br>$V_{DS} = 0\text{ V to } 400\text{ V}$  |  | -    | 131  | -         |               |
| Effective output capacitance, time related <sup>b</sup>                     | $C_{o(tr)}$         |   |  | -    | 189  | -         |               |
| Total Gate Charge   | $Q_g$               | $V_{GS} = 10\text{ V}$  | $I_D = 10\text{ A}, V_{DS} = 400\text{ V}$ | -    | 85   | 170       | nC            |
| Gate-Source Charge  | $Q_{gs}$            |   |  | -    | 14   | -         |               |
| Gate-Drain Charge   | $Q_{gd}$            |   |  | -    | 28   | -         |               |
| Turn-On Delay Time  | $t_{d(on)}$         | $V_{DD} = 400\text{ V}, I_D = 10\text{ A},$<br>$V_{GS} = 10\text{ V}, R_g = 9.1\text{ }\Omega$  |  | -    | 24   | 50        | ns            |
| Rise Time   | $t_r$               |   |  | -    | 31   | 62        |               |
| Turn-Off Delay Time   | $t_{d(off)}$        |   |  | -    | 117  | 176       |               |
| Fall Time   | $t_f$               |   |  | -    | 56   | 112       |               |
| Gate Input Resistance   | $R_g$               | $f = 1\text{ MHz}, \text{ open drain}$  |  | -    | 1.8  | -         | $\Omega$      |
| <b>Drain-Source Body Diode Characteristics</b>                              |                     |   |  |      |      |           |               |
| Continuous Source-Drain Diode Current                                       | $I_S$               | MOSFET symbol showing the integral reverse p - n junction diode  |  | -    | -    | 20        | A             |
| Pulsed Diode Forward Current  | $I_{SM}$            |   |  | -    | -    | 80        |               |
| Diode Forward Voltage   | $V_{SD}$            | $T_J = 25\text{ }^\circ\text{C}, I_S = 10\text{ A}, V_{GS} = 0\text{ V}$  |  | -    | -    | 1.2       | V             |
| Reverse Recovery Time   | $t_{rr}$            | $T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 10\text{ A},$<br>$di/dt = 100\text{ A}/\mu\text{s}, V_R = 20\text{ V}$                                   |  | -    | 437  | -         | ns            |
| Reverse Recovery Charge   | $Q_{rr}$            |   |  | -    | 5.9  | -         | $\mu\text{C}$ |
| Reverse Recovery Current  | $I_{RRM}$           |   |  | -    | 25   | -         | 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 same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DS}$ .



TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

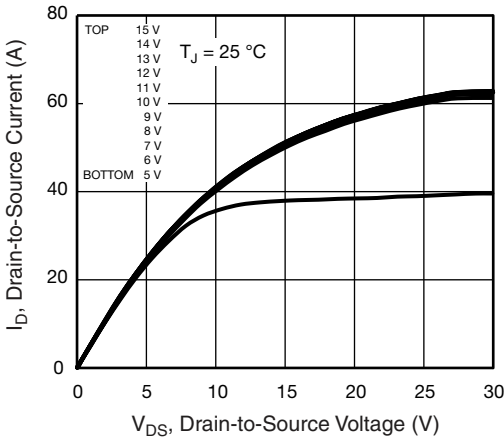


Fig. 1 - Typical Output Characteristics

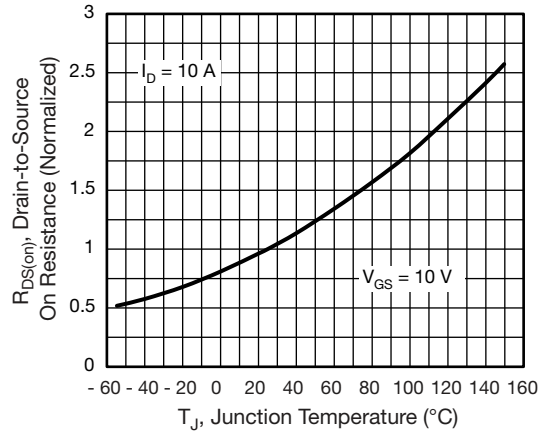


Fig. 4 - Normalized On-Resistance vs. Temperature

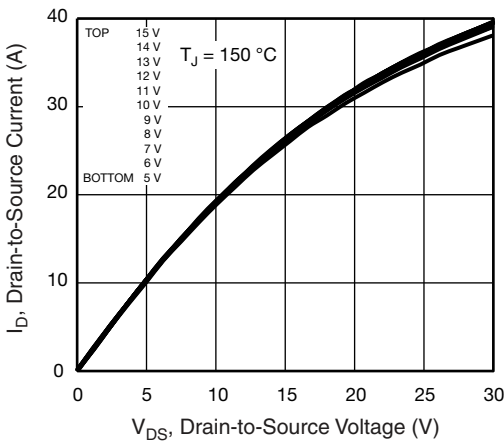


Fig. 2 - Typical Output Characteristics

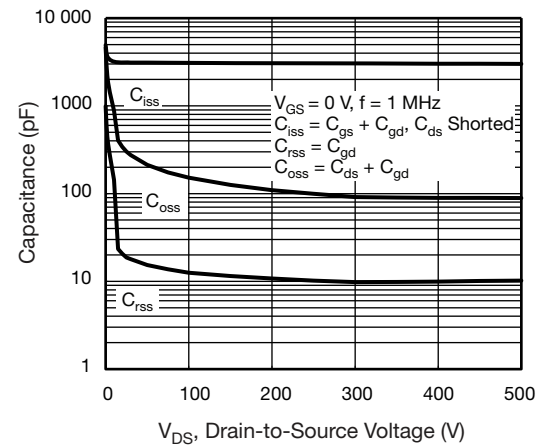


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

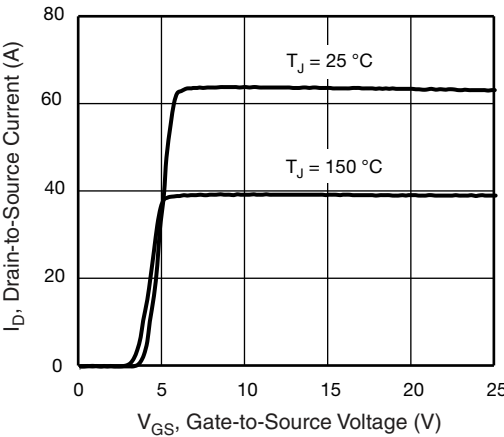


Fig. 3 - Typical Transfer Characteristics

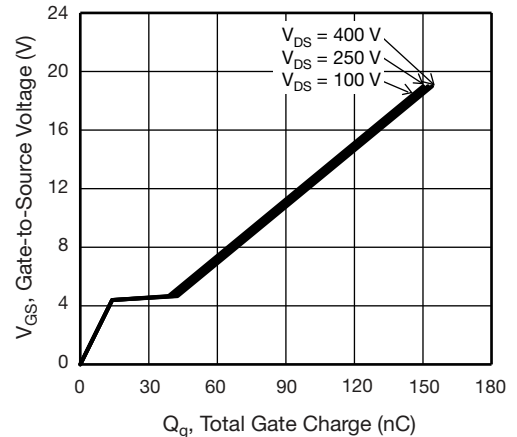


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

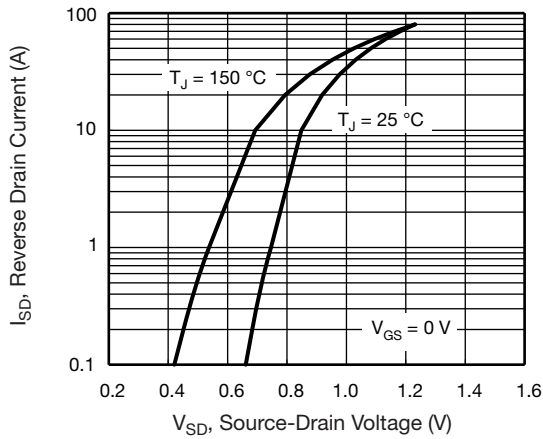


Fig. 7 - Typical Source-Drain Diode Forward Voltage

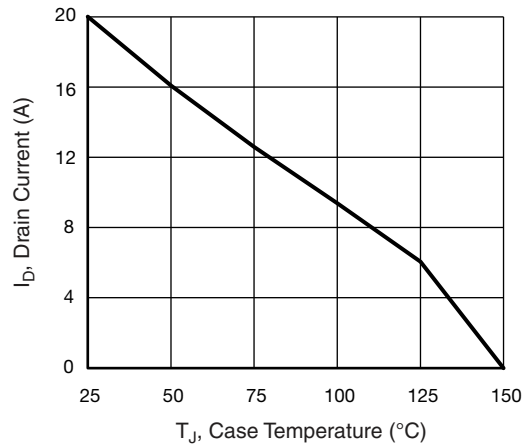


Fig. 9 - Maximum Drain Current vs. Case Temperature

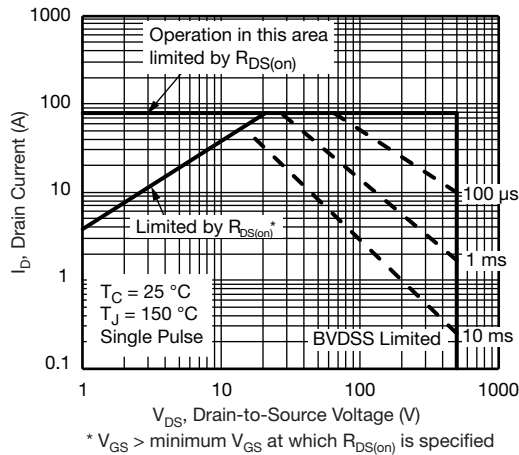


Fig. 8 - Maximum Safe Operating Area

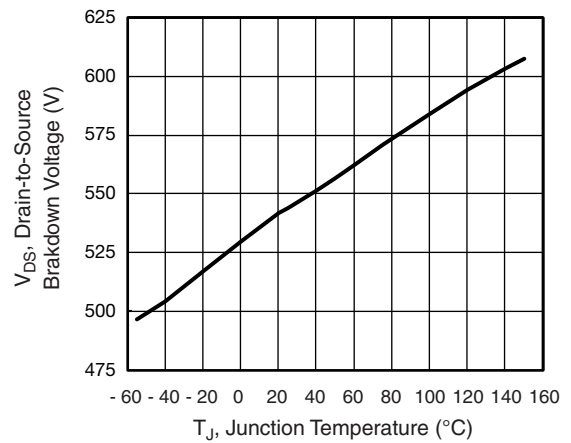


Fig. 10 - Temperature vs. Drain-to-Source Voltage

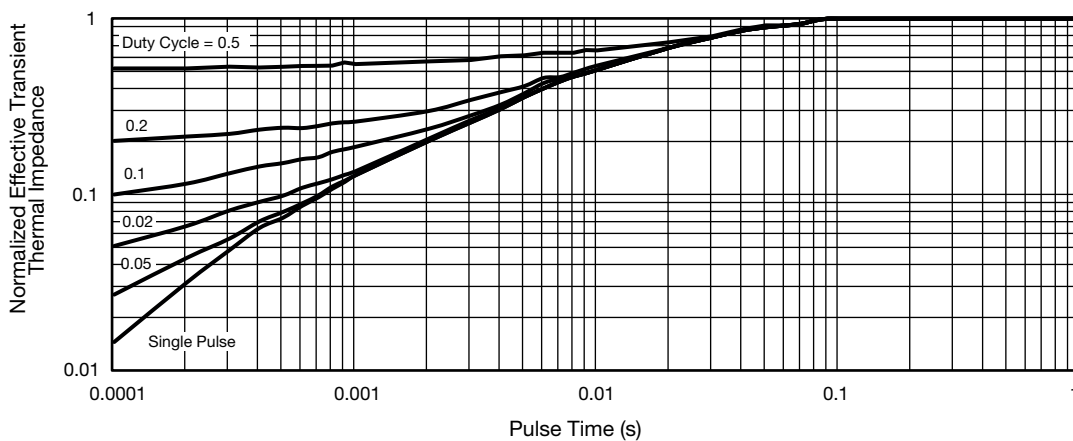


Fig. 11 - Normalized Thermal Transient Impedance, Junction-to-Case



**Fig. 12 - Switching Time Test Circuit**



**Fig. 16 - Basic Gate Charge Waveform**



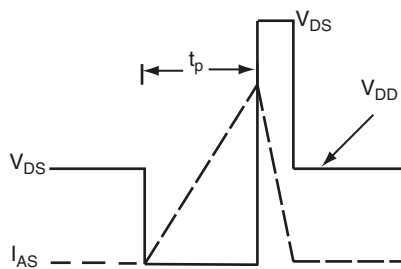
**Fig. 13 - Switching Time Waveforms**



**Fig. 17 - Gate Charge Test Circuit**



**Fig. 14 - Unclamped Inductive Test Circuit**



**Fig. 15 - Unclamped Inductive Waveforms**



**Note**

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

**Fig. 18 - For N-Channel**

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# TO-247AC (High Voltage)



| DIM. | MILLIMETERS |       | INCHES |       |
|------|-------------|-------|--------|-------|
|      | MIN.        | MAX.  | MIN.   | MAX.  |
| A    | 4.58        | 5.31  | 0.180  | 0.209 |
| A1   | 2.21        | 2.59  | 0.087  | 0.102 |
| A2   | 1.17        | 2.49  | 0.046  | 0.098 |
| b    | 0.99        | 1.40  | 0.039  | 0.055 |
| b1   | 0.99        | 1.35  | 0.039  | 0.053 |
| b2   | 1.53        | 2.39  | 0.060  | 0.094 |
| b3   | 1.65        | 2.37  | 0.065  | 0.093 |
| b4   | 2.42        | 3.43  | 0.095  | 0.135 |
| b5   | 2.59        | 3.38  | 0.102  | 0.133 |
| c    | 0.38        | 0.86  | 0.015  | 0.034 |
| c1   | 0.38        | 0.76  | 0.015  | 0.030 |
| D    | 19.71       | 20.82 | 0.776  | 0.820 |
| D1   | 13.08       | -     | 0.515  | -     |

| DIM. | MILLIMETERS |       | INCHES    |       |
|------|-------------|-------|-----------|-------|
|      | MIN.        | MAX.  | MIN.      | MAX.  |
| D2   | 0.51        | 1.30  | 0.020     | 0.051 |
| E    | 15.29       | 15.87 | 0.602     | 0.625 |
| E1   | 13.72       | -     | 0.540     | -     |
| e    | 5.46 BSC    |       | 0.215 BSC |       |
| Ø k  | 0.254       |       | 0.010     |       |
| L    | 14.20       | 16.25 | 0.559     | 0.640 |
| L1   | 3.71        | 4.29  | 0.146     | 0.169 |
| N    | 7.62 BSC    |       | 0.300 BSC |       |
| Ø P  | 3.51        | 3.66  | 0.138     | 0.144 |
| Ø P1 | -           | 7.39  | -         | 0.291 |
| Q    | 5.31        | 5.69  | 0.209     | 0.224 |
| R    | 4.52        | 5.49  | 0.178     | 0.216 |
| S    | 5.51 BSC    |       | 0.217 BSC |       |

ECN: X13-0103-Rev. D, 01-Jul-13  
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").
7. Outline conforms to JEDEC outline TO-247 with exception of dimension c.
8. Xian and Mingxin actually photo.





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