

## E 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 | 0.184 |
| $Q_g$ max. (nC)                         | 92              |       |
| $Q_{gs}$ (nC)                           | 10              |       |
| $Q_{gd}$ (nC)                           | 19              |       |
| Configuration                           | Single          |       |

### FEATURES

- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low input capacitance ( $C_{iss}$ )
- Reduced switching and conduction losses
- Low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

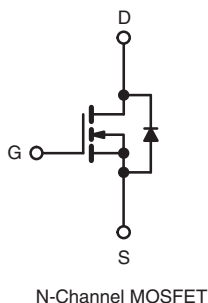
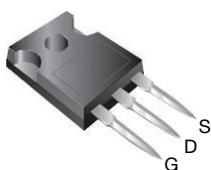


**RoHS**  
COMPLIANT  
HALOGEN  
FREE

### APPLICATIONS

- Computing
  - PC silver box / ATX power supplies
- Lighting
  - Two stage LED lighting
- Consumer electronics
- Applications using hard switched topologies
  - Power factor correction (PFC)
  - Two switch forward converter
  - Flyback converter
- Switch mode power supplies (SMPS)

TO-247AC



### ORDERING INFORMATION

|                                 |                |
|---------------------------------|----------------|
| Package                         | TO-247AC       |
| Lead (Pb)-free and Halogen-free | SiHG20N50E-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                                       | $V_{GS}$         | $\pm 30$       |      |
| 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>                         | $I_{DM}$         | 42             |      |
| Linear Derating Factor                                    |                  | 1.4            | W/°C |
| Single Pulse Avalanche Energy <sup>b</sup>                | $E_{AS}$         | 204            | mJ   |
| Maximum Power Dissipation                                 | $P_D$            | 179            | 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 $dV/dt$ <sup>d</sup>                        |                  | 32             |      |
| Soldering Recommendations (Peak Temperature) <sup>c</sup> | for 10 s         | 300            | °C   |

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 50$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 3.8$  A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C.

### THERMAL RESISTANCE RATINGS

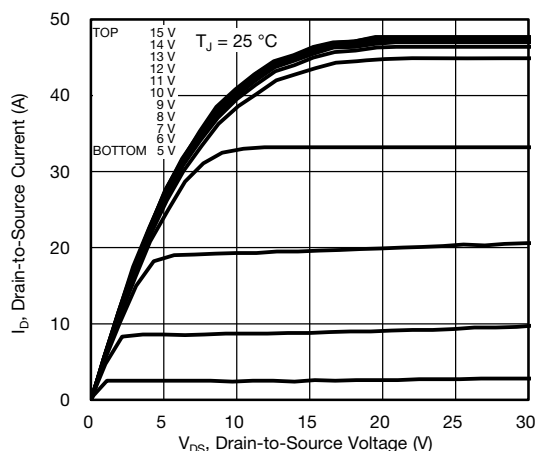
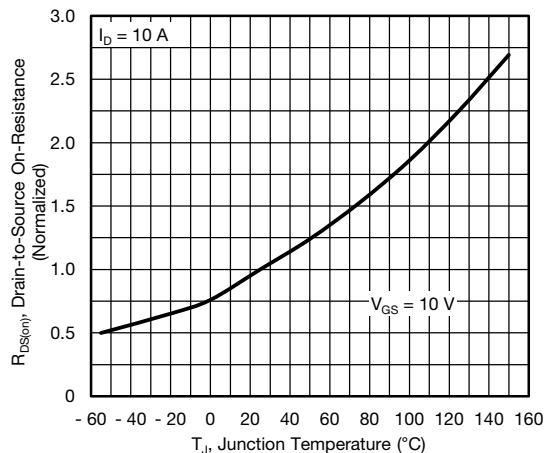
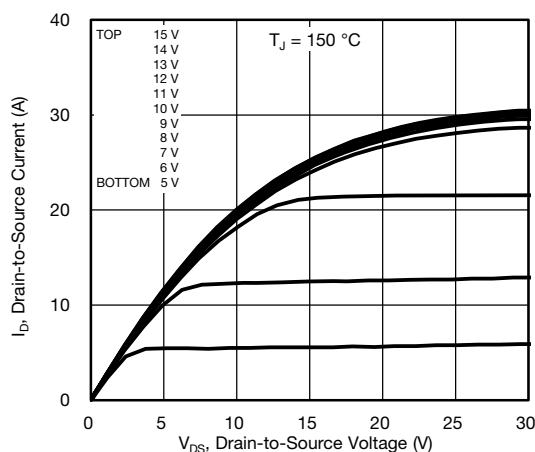
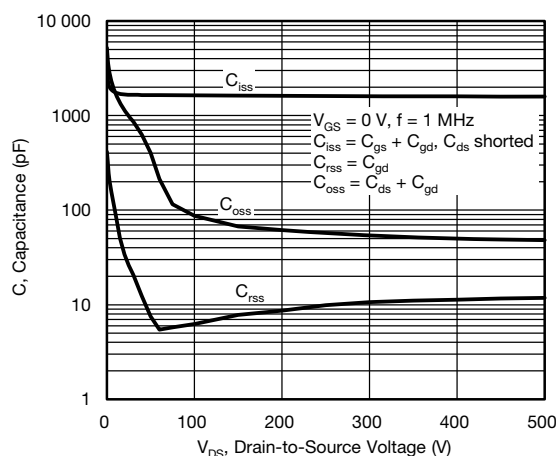
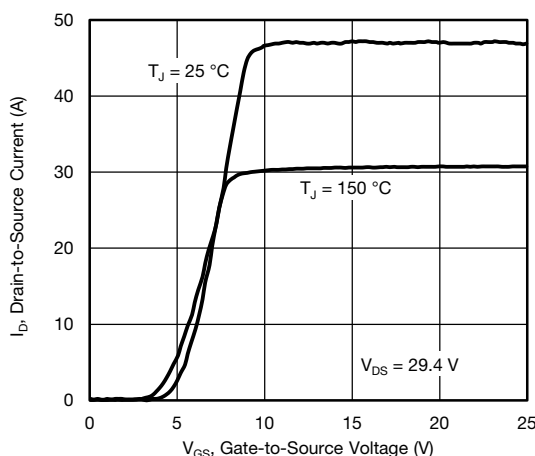
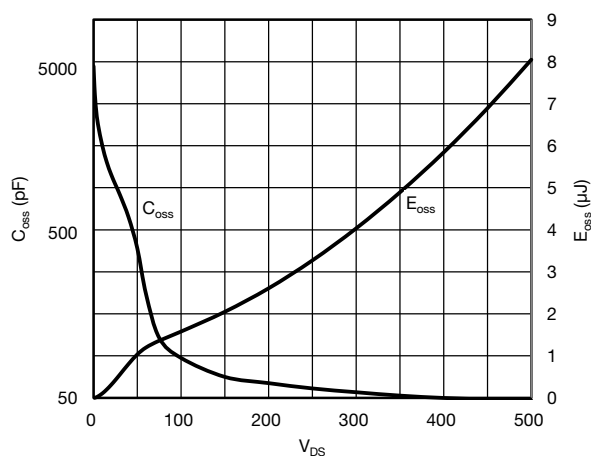
| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient      | $R_{thJA}$ | -    | 62   | °C/W |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | -    | 0.7  |      |

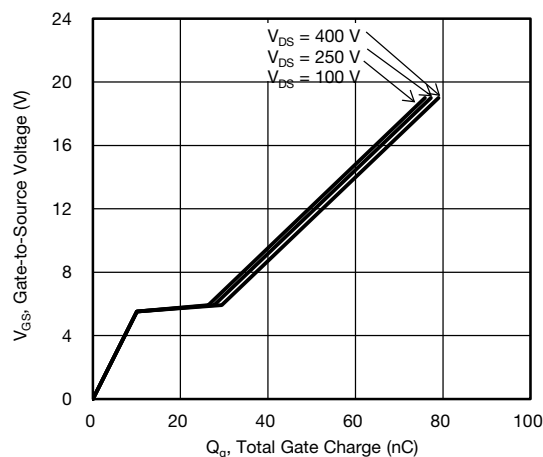
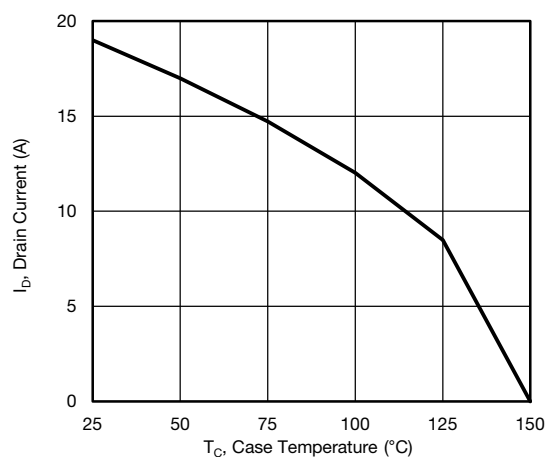
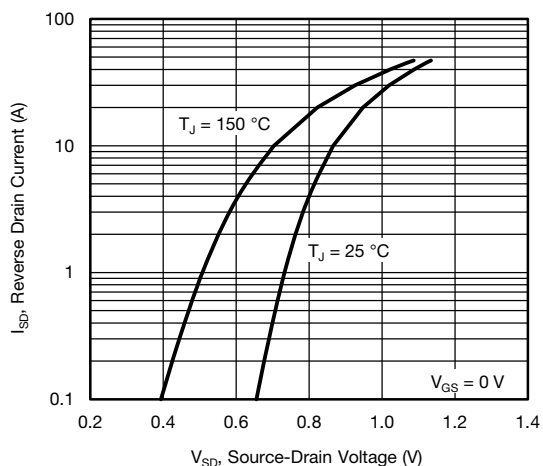
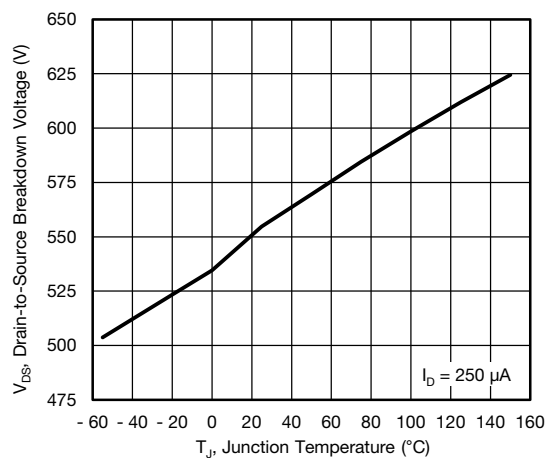
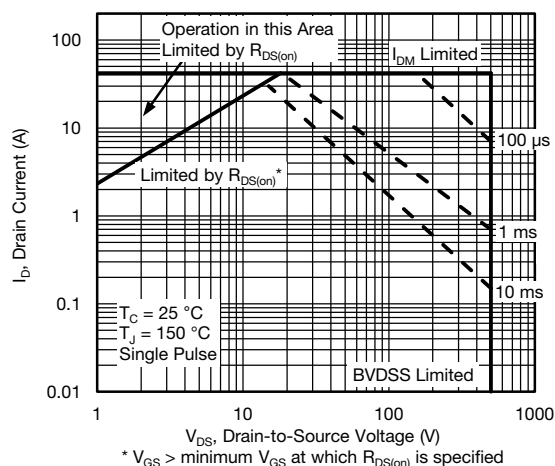


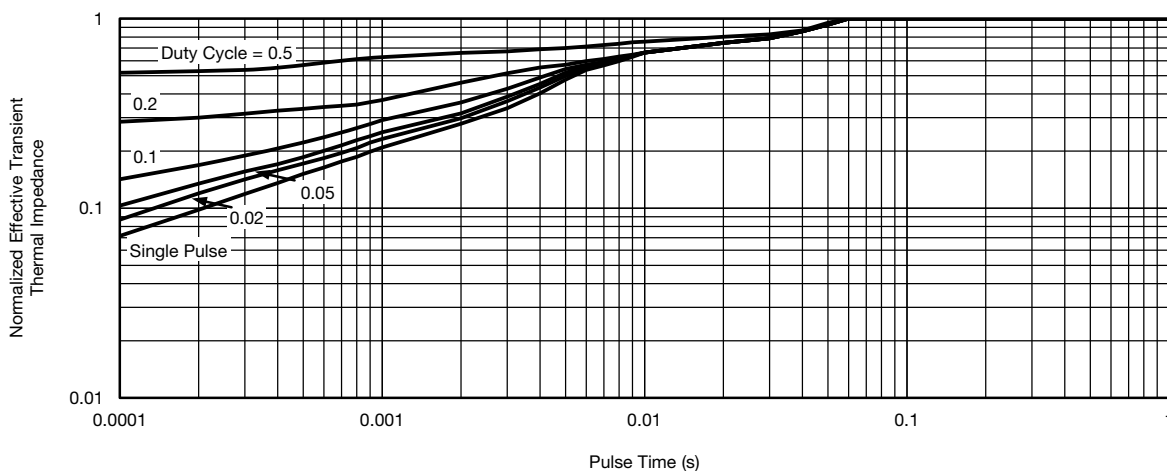
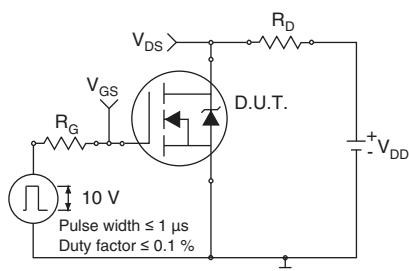
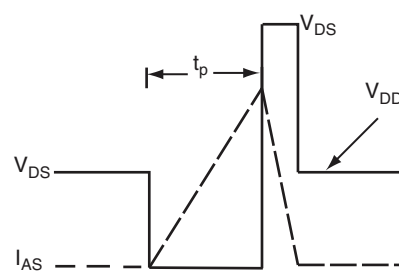
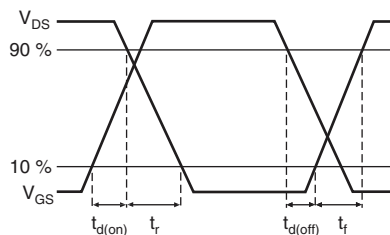
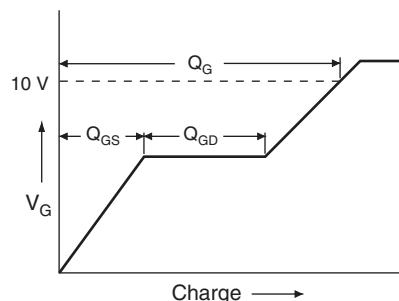
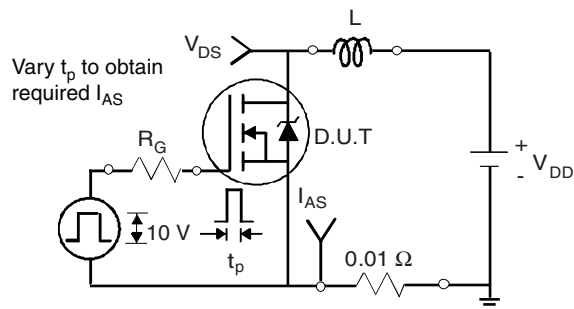
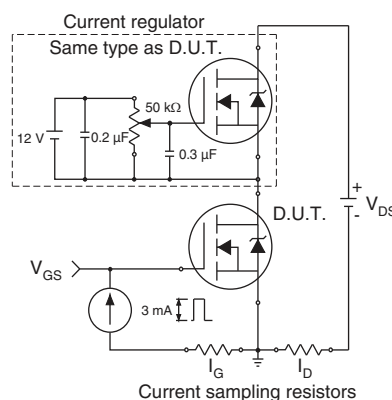
| SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted) |                                  |                                                                                                                                                       |                                                |      |       |       |      |
|-----------------------------------------------------------------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|------|-------|-------|------|
| PARAMETER                                                       | SYMBOL                           | TEST CONDITIONS                                                                                                                                       |                                                | MIN. | TYP.  | MAX.  | UNIT |
| Static                                                          |                                  |                                                                                                                                                       |                                                |      |       |       |      |
| Drain-Source Breakdown Voltage                                  | V <sub>DS</sub>                  | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                                                                                                        |                                                | 500  | -     | -     | V    |
| V <sub>DS</sub> Temperature Coefficient                         | ΔV <sub>DS</sub> /T <sub>J</sub> | Reference to 25 °C, I <sub>D</sub> = 1 mA                                                                                                             |                                                | -    | 0.59  | -     | V/°C |
| Gate-Source Threshold Voltage (N)                               | V <sub>GS(th)</sub>              | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                                                                                           |                                                | 2.0  | -     | 4.0   | V    |
| Gate-Source Leakage                                             | I <sub>GSS</sub>                 | V <sub>GS</sub> = ± 20 V                                                                                                                              |                                                | -    | -     | ± 100 | nA   |
|                                                                 |                                  | V <sub>GS</sub> = ± 30 V                                                                                                                              |                                                | -    | -     | ± 1   | μA   |
| Zero Gate Voltage Drain Current                                 | I <sub>DSS</sub>                 | V <sub>DS</sub> = 500 V, V <sub>GS</sub> = 0 V                                                                                                        |                                                | -    | -     | 1     | μA   |
|                                                                 |                                  | V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C                                                                               |                                                | -    | -     | 10    |      |
| Drain-Source On-State Resistance                                | R <sub>DS(on)</sub>              | V <sub>GS</sub> = 10 V                                                                                                                                | I <sub>D</sub> = 10 A                          | -    | 0.160 | 0.184 | Ω    |
| Forward Transconductance                                        | g <sub>fs</sub>                  | V <sub>DS</sub> = 30 V, I <sub>D</sub> = 10 A                                                                                                         |                                                | -    | 4.4   | -     | S    |
| Dynamic                                                         |                                  |                                                                                                                                                       |                                                |      |       |       |      |
| Input Capacitance                                               | C <sub>iss</sub>                 | V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = 100 V,<br>f = 1 MHz                                                                                       |                                                | -    | 1640  | -     | pF   |
| Output Capacitance                                              | C <sub>oss</sub>                 |                                                                                                                                                       |                                                | -    | 87    | -     |      |
| Reverse Transfer Capacitance                                    | C <sub>rss</sub>                 |                                                                                                                                                       |                                                | -    | 6     | -     |      |
| Effective Output Capacitance, Energy Related <sup>a</sup>       | C <sub>O(er)</sub>               | V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V                                                                                                 |                                                | -    | 73    | -     | pF   |
| Effective Output Capacitance, Time Related <sup>b</sup>         | C <sub>O(tr)</sub>               |                                                                                                                                                       |                                                | -    | 222   | -     |      |
| Total Gate Charge                                               | Q <sub>g</sub>                   | V <sub>GS</sub> = 10 V                                                                                                                                | I <sub>D</sub> = 10 A, V <sub>DS</sub> = 400 V | -    | 46    | 92    | nC   |
| Gate-Source Charge                                              | Q <sub>gs</sub>                  |                                                                                                                                                       |                                                | -    | 10    | -     |      |
| Gate-Drain Charge                                               | Q <sub>gd</sub>                  |                                                                                                                                                       |                                                | -    | 19    | -     |      |
| Turn-On Delay Time                                              | t <sub>d(on)</sub>               | V <sub>DD</sub> = 400 V, I <sub>D</sub> = 10 A,<br>V <sub>GS</sub> = 10 V, R <sub>g</sub> = 9.1 Ω                                                     |                                                | -    | 17    | 34    | ns   |
| Rise Time                                                       | t <sub>r</sub>                   |                                                                                                                                                       |                                                | -    | 27    | 54    |      |
| Turn-Off Delay Time                                             | t <sub>d(off)</sub>              |                                                                                                                                                       |                                                | -    | 48    | 96    |      |
| Fall Time                                                       | t <sub>f</sub>                   |                                                                                                                                                       |                                                | -    | 25    | 50    |      |
| Gate Input Resistance                                           | R <sub>g</sub>                   | f = 1 MHz, open drain                                                                                                                                 |                                                | -    | 0.83  | -     | Ω    |
| Drain-Source Body Diode Characteristics                         |                                  |                                                                                                                                                       |                                                |      |       |       |      |
| Continuous Source-Drain Diode Current                           | I <sub>S</sub>                   | MOSFET symbol showing the integral reverse p - n junction diode  |                                                | -    | -     | 19    | A    |
| Pulsed Diode Forward Current                                    | I <sub>SM</sub>                  |                                                                                                                                                       |                                                | -    | -     | 42    |      |
| Diode Forward Voltage                                           | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 10 A, V <sub>GS</sub> = 0 V                                                                                  |                                                | -    | -     | 1.2   | V    |
| Reverse Recovery Time                                           | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = I <sub>S</sub> = 10 A,<br>dI/dt = 100 A/μs, V <sub>R</sub> = 25 V                                            |                                                | -    | 293   | -     | ns   |
| Reverse Recovery Charge                                         | Q <sub>rr</sub>                  |                                                                                                                                                       |                                                | -    | 4.0   | -     | μC   |
| Reverse Recovery Current                                        | I <sub>RRM</sub>                 |                                                                                                                                                       |                                                | -    | 26    | -     | A    |

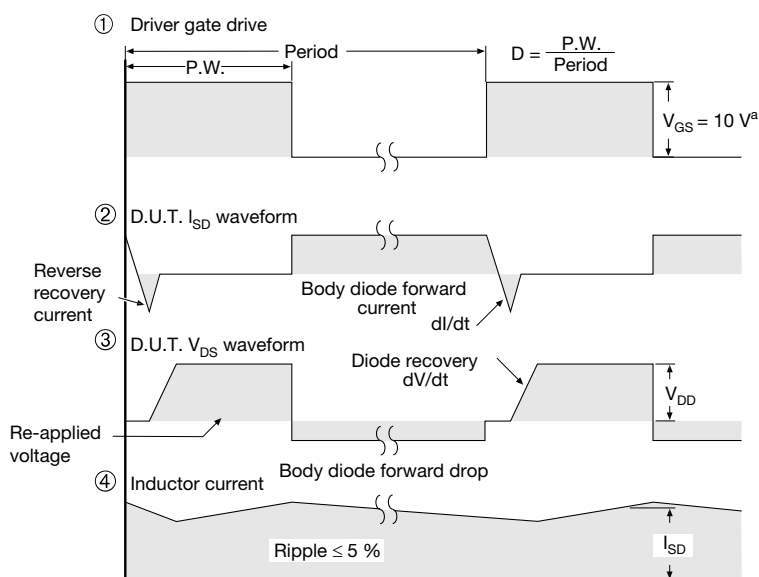
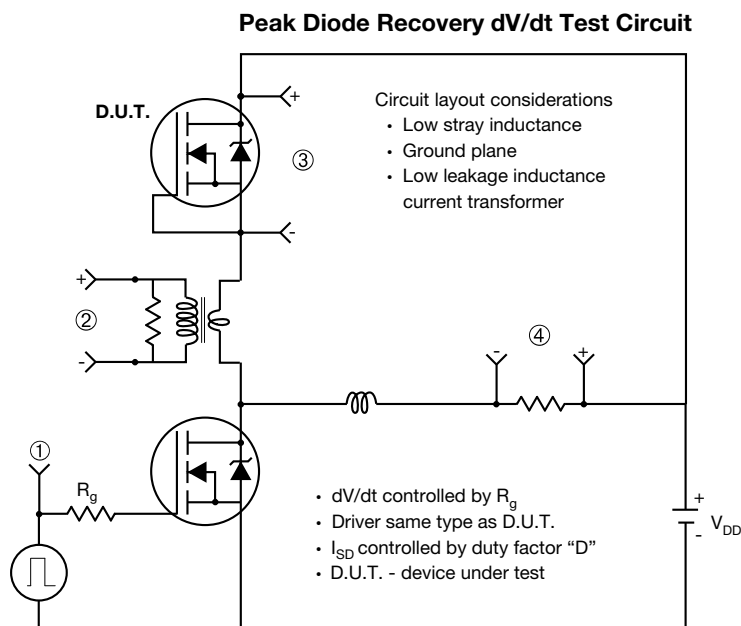
**Notes**

- a. C<sub>oss(er)</sub> is a fixed capacitance that gives the same energy as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 % to 80 % V<sub>DSS</sub>.  
b. C<sub>oss(tr)</sub> is a fixed capacitance that gives the same charging time as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 % to 80 % V<sub>DSS</sub>.

**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 - 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. 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**



**Note**

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

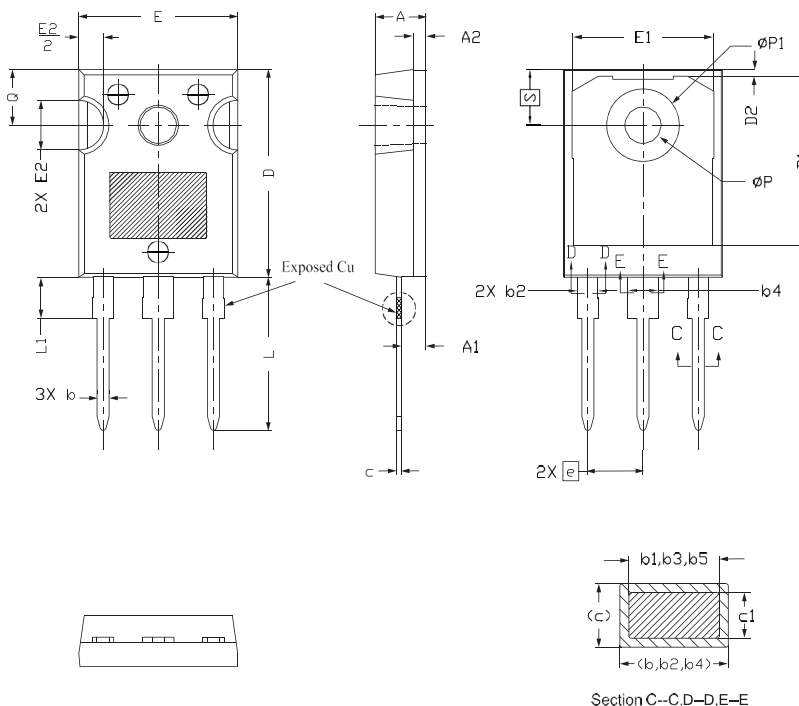
**Fig. 19 - For N-Channel**

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## TO-247AC (High Voltage)

## VERSION 1: FACILITY CODE = 9



Section C--C,D--D,E--E

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

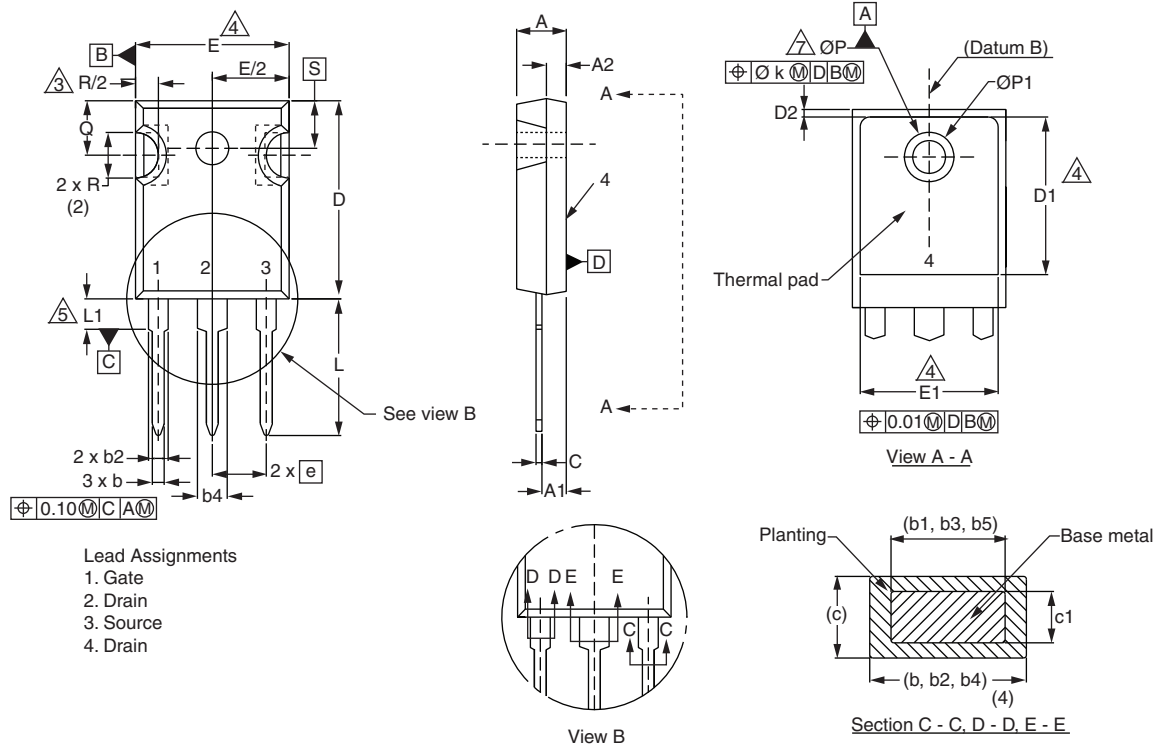
| MILLIMETERS |           |       |       |       |
|-------------|-----------|-------|-------|-------|
| DIM.        | MIN.      | NOM.  | MAX.  | NOTES |
| D1          | 16.46     | 16.76 | 17.06 | 5     |
| D2          | 0.56      | 0.66  | 0.76  |       |
| E           | 15.50     | 15.70 | 15.87 | 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



|      | 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       | -     |       |

|      | MILLIMETERS |       |       |
|------|-------------|-------|-------|
| 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    |       |       |

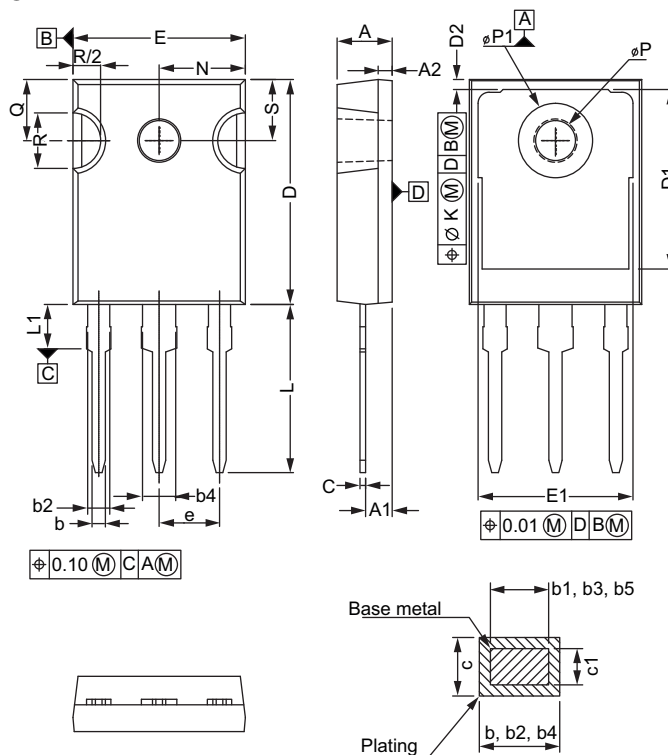
#### Notes

- (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





## 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")



## Disclaimer

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