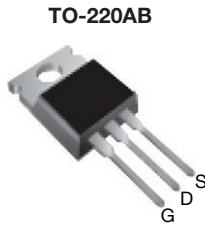


## E Series Power MOSFET



N-Channel MOSFET

### FEATURES

- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- 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](http://www.vishay.com/doc?99912)



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

### APPLICATIONS

- Server and telecom power supplies
- 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)

### PRODUCT SUMMARY

|   |                 |       |
|---|-----------------|-------|
| $V_{DS}$ (V) at $T_J$ max.              | 650             |       |
| $R_{DS(on)}$ typ. ( $\Omega$ ) at 25 °C | $V_{GS} = 10$ V | 0.269 |
| $Q_g$ max. (nC)                         | 64              |       |
| $Q_{gs}$ (nC)                           | 8               |       |
| $Q_{gd}$ (nC)                           | 13              |       |
| Configuration                           | Single          |       |

### ORDERING INFORMATION

|                                 |                             |
|---------------------------------|-----------------------------|
| Package                         | TO-220AB                    |
| Lead (Pb)-free and halogen-free | SiHP14N60E-BE3 <sup>a</sup> |
|                                 | SiHP14N60E-GE3              |

#### Note

a. "-BE3" denotes alternate manufacturing location


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

| PARAMETER   | SYMBOL           | LIMIT          | UNIT |
|---|------------------|----------------|------|
| Drain-source voltage                                      | $V_{DS}$         | 600            | V    |
| Gate-source voltage                                       | $V_{GS}$         | $\pm 30$       |      |
| Continuous drain current ( $T_J = 150$ °C)                | $V_{GS}$ at 10 V | $T_C = 25$ °C  | 13   |
|   |                  | $T_C = 100$ °C | 8    |
| Pulsed drain current <sup>a</sup>                         | $I_{DM}$         | 32             | A    |
| Linear derating factor                                    |                  | 1.2            |      |
| Single pulse avalanche energy <sup>b</sup>                | $E_{AS}$         | 136            | mJ   |
| Maximum power dissipation                                 | $P_D$            | 147            | 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 | 70   |
| Reverse diode $dV/dt$ <sup>d</sup>                        |                  | 32             |      |
| Soldering recommendations (peak temperature) <sup>c</sup> |                  | For 10 s       | 300  |

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DD} = 140$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 3.1$  A
- 1.6 mm from case
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C

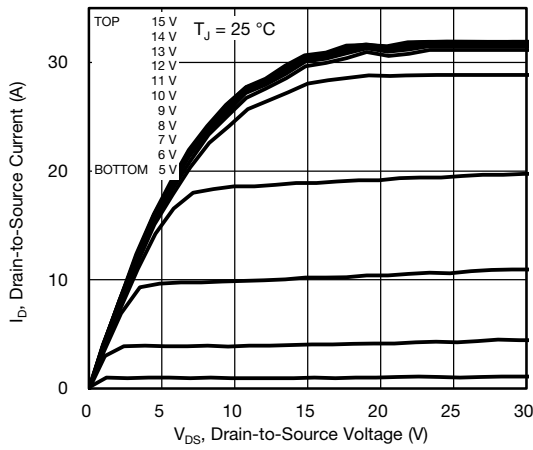
| THERMAL RESISTANCE RATINGS       |            |      |      |      |
|----------------------------------|------------|------|------|------|
| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
| Maximum junction-to-ambient      | $R_{thJA}$ | -    | 62   | °C/W |
| Maximum junction-to-case (drain) | $R_{thJC}$ | -    | 0.85 |      |

| 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  | $V_{DS}$            | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$   |   | 600  | -     | -         | V             |
| $V_{DS}$ temperature coefficient  | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$   |   | -    | 0.73  | -         | V/°C          |
| Gate-source threshold Voltage (N)   | $V_{GS(th)}$        | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$   |   | 2.0  | -     | 4.0       | V             |
| Gate-source leakage   | $I_{GSS}$           | $V_{GS} = \pm 20\text{ V}$  |   | -    | -     | $\pm 100$ | nA            |
|   |                     | $V_{GS} = \pm 30\text{ V}$  |   | -    | -     | $\pm 1$   | $\mu\text{A}$ |
| Zero gate voltage drain current   | $I_{DSS}$           | $V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$  |   | -    | -     | 1         | $\mu\text{A}$ |
|   |                     | $V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$   |   | -    | -     | 10        |               |
| Drain-source on-state resistance  | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$  | $I_D = 7\text{ A}$                        | -    | 0.269 | 0.309     | $\Omega$      |
| Forward transconductance  | $g_{fs}$            | $V_{DS} = 30\text{ V}, I_D = 7\text{ A}$  |   | -    | 3.8   | -         | S             |
| <b>Dynamic</b>  |                     |   |   |      |       |           |               |
| Input capacitance   | $C_{iss}$           | $V_{GS} = 0\text{ V},$<br>$V_{DS} = 100\text{ V},$<br>$f = 1\text{ MHz}$  |   | -    | 1205  | -         | pF            |
| Output capacitance  | $C_{oss}$           |   |   | -    | 62    | -         |               |
| Reverse transfer capacitance  | $C_{rss}$           |   |   | -    | 5     | -         |               |
| Effective output capacitance, energy related <sup>a</sup>                   | $C_{o(er)}$         | $V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$   |   | -    | 52    | -         | pF            |
| Effective output capacitance, time related <sup>b</sup>                     | $C_{o(tr)}$         |   |   | -    | 177   | -         |               |
| Total gate charge   | $Q_g$               | $V_{GS} = 10\text{ V}$  | $I_D = 7\text{ A}, V_{DS} = 480\text{ V}$ | -    | 32    | 64        | nC            |
| Gate-source charge  | $Q_{gs}$            |   |   | -    | 8     | -         |               |
| Gate-drain charge   | $Q_{gd}$            |   |   | -    | 13    | -         |               |
| Turn-on delay time  | $t_{d(on)}$         | $V_{DD} = 480\text{ V}, I_D = 7\text{ A},$<br>$V_{GS} = 10\text{ V}, R_g = 9.1\text{ }\Omega$   |   | -    | 15    | 30        | ns            |
| Rise time   | $t_r$               |   |   | -    | 19    | 38        |               |
| Turn-off delay time   | $t_{d(off)}$        |   |   | -    | 35    | 70        |               |
| Fall time   | $t_f$               |   |   | -    | 15    | 30        |               |
| Gate input resistance   | $R_g$               | $f = 1\text{ MHz}, \text{ open drain}$  |   | 0.38 | 0.75  | 1.5       | $\Omega$      |
| <b>Drain-Source Body Diode Characteristics</b>                              |                     |   |   |      |       |           |               |
| Continuous source-drain diode current                                       | $I_S$               | MOSFET symbol showing the integral reverse p - n junction diode  |   | -    | -     | 13        | A             |
| Pulsed diode forward current  | $I_{SM}$            |   |   | -    | -     | 32        |               |
| Diode forward voltage   | $V_{SD}$            | $T_J = 25\text{ }^\circ\text{C}, I_S = 7\text{ A}, V_{GS} = 0\text{ V}$   |   | -    | -     | 1.2       | V             |
| Reverse recovery time   | $t_{rr}$            | $T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 7\text{ A},$<br>$di/dt = 100\text{ A}/\mu\text{s}, V_R = 25\text{ V}$                                    |   | -    | 281   | -         | ns            |
| Reverse recovery charge   | $Q_{rr}$            |   |   | -    | 3.4   | -         | $\mu\text{C}$ |
| Reverse recovery current  | $I_{RRM}$           |   |   | -    | 22    | -         | A             |

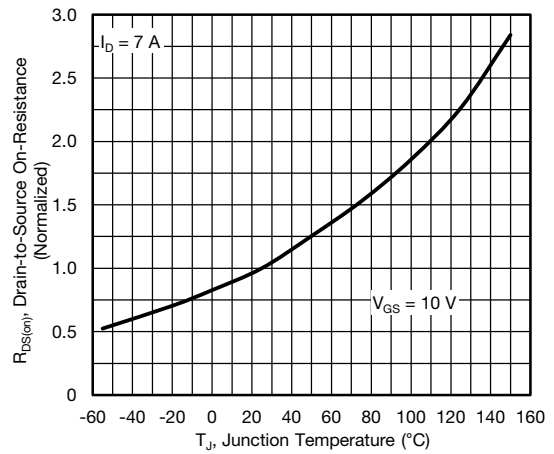
**Notes**

- 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 %  $V_{DSS}$   
 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 %  $V_{DSS}$

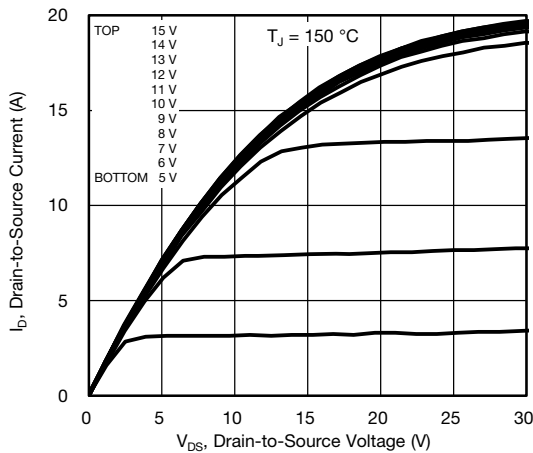
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



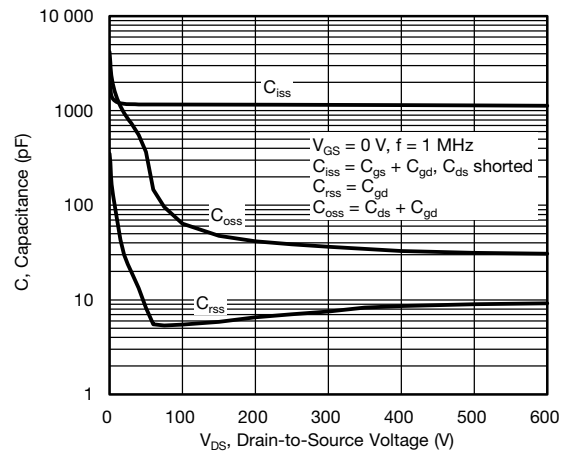
**Fig. 1 - Typical Output Characteristics**



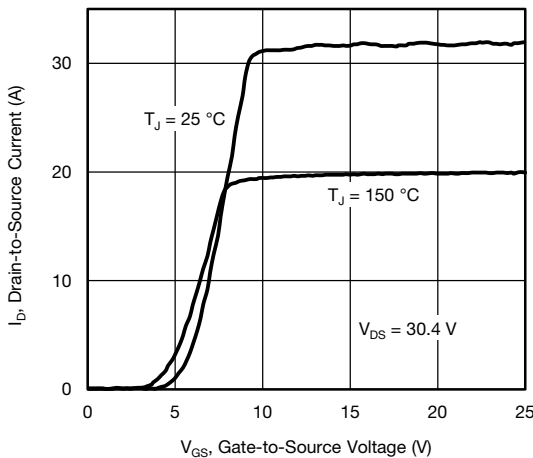
**Fig. 4 - Normalized On-Resistance vs. Temperature**



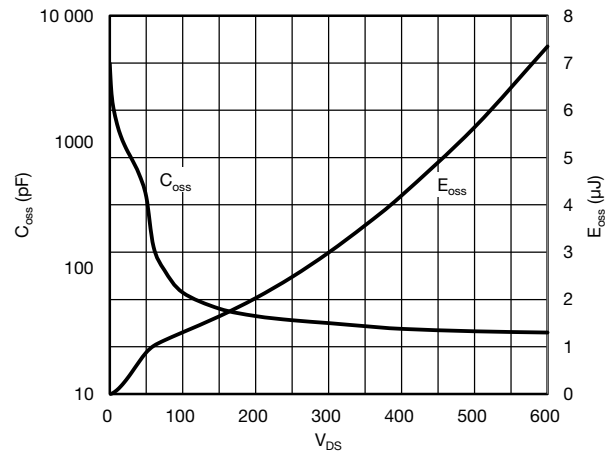
**Fig. 2 - Typical Output Characteristics**



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



**Fig. 3 - Typical Transfer Characteristics**



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

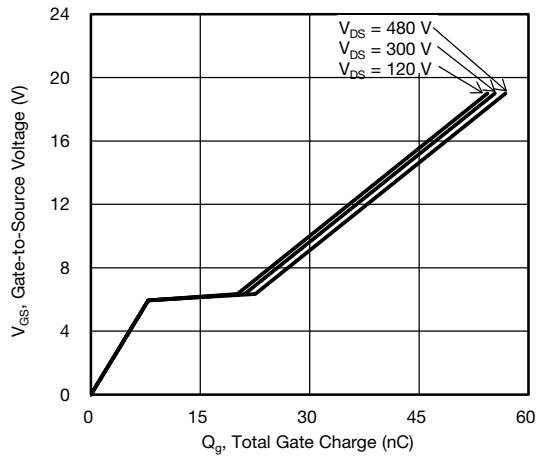


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

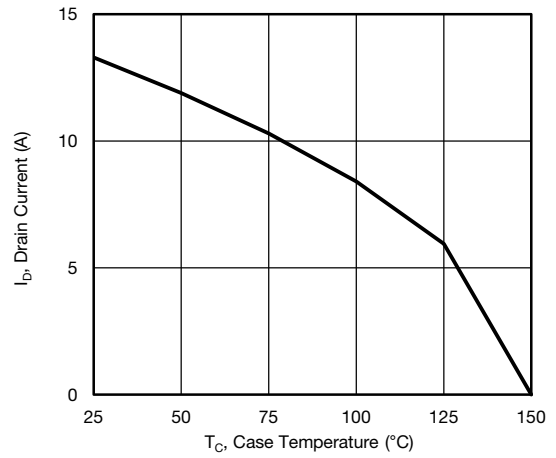


Fig. 10 - Maximum Drain Current vs. Case Temperature

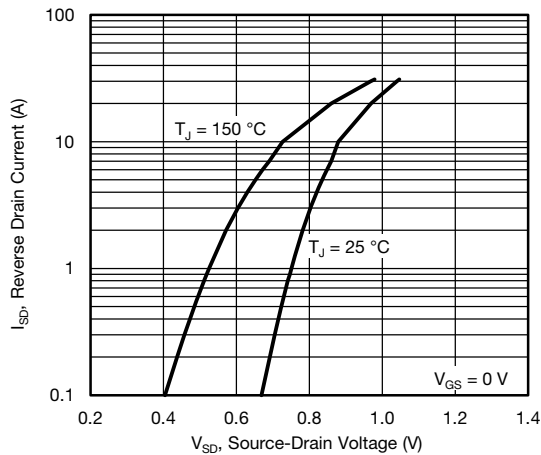


Fig. 8 - Typical Source-Drain Diode Forward Voltage

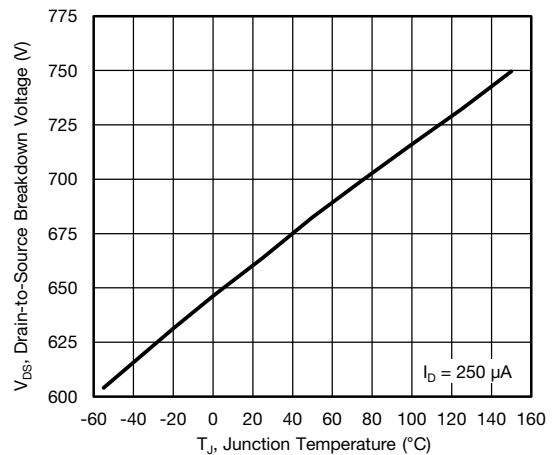


Fig. 11 - Temperature vs. Drain-to-Source Voltage

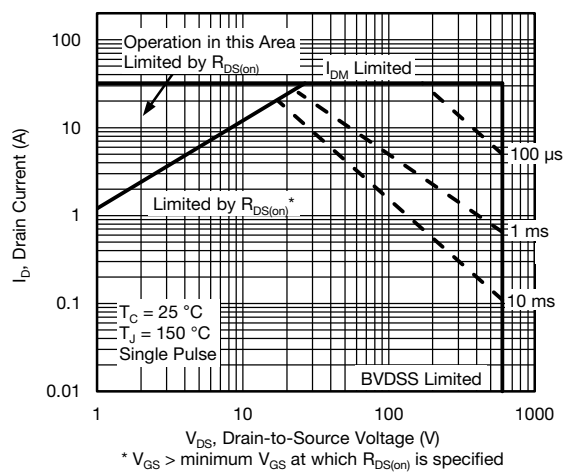


Fig. 9 - Maximum Safe Operating Area

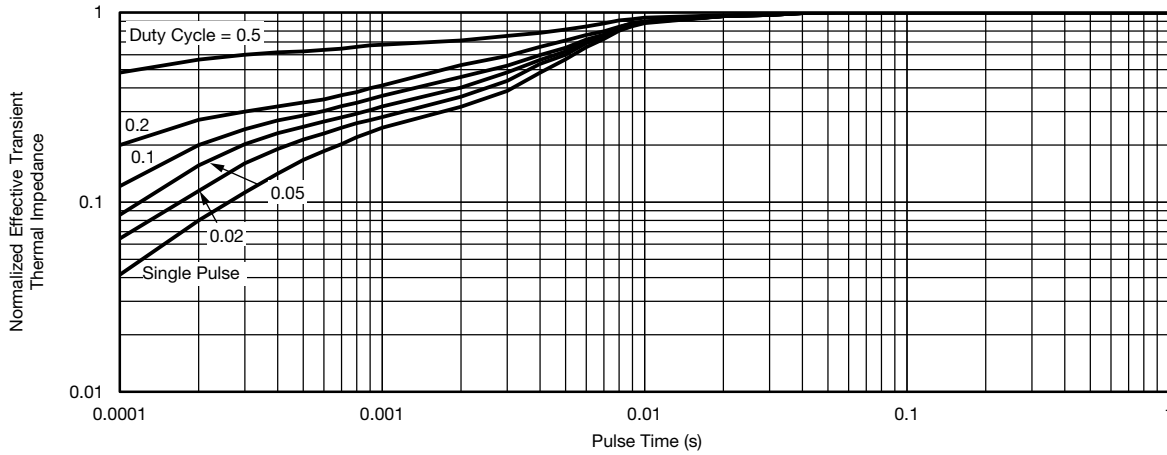


Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case

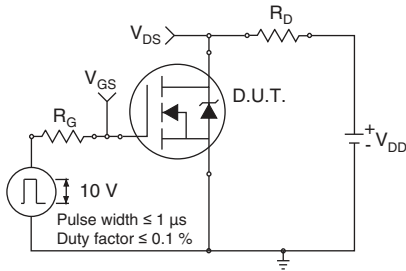


Fig. 13 - Switching Time Test Circuit

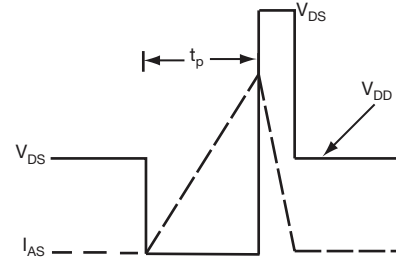


Fig. 16 - Unclamped Inductive Waveforms

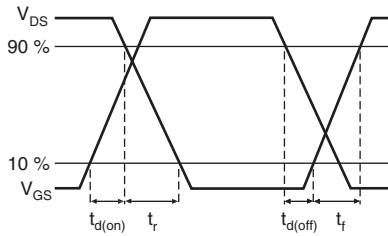


Fig. 14 - Switching Time Waveforms

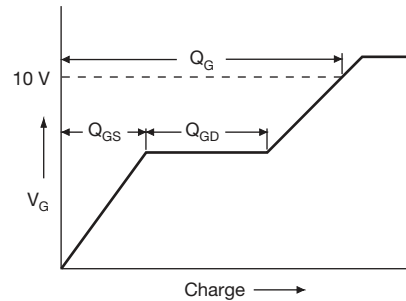


Fig. 17 - Basic Gate Charge Waveform

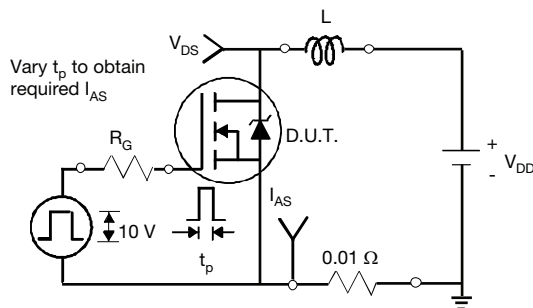


Fig. 15 - Unclamped Inductive Test Circuit

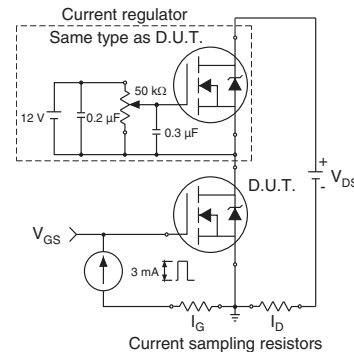


Fig. 18 - Gate Charge Test Circuit

### 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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