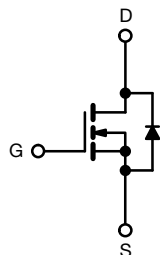
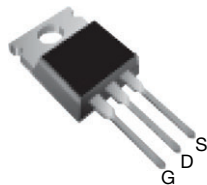


## EF Series Power MOSFET With Fast Body Diode

**TO-220AB**

**N-Channel MOSFET**

### PRODUCT SUMMARY

|   |                 |       |
|---|-----------------|-------|
| $V_{DS}$ (V) at $T_J$ max.              | 850             |       |
| $R_{DS(on)}$ typ. ( $\Omega$ ) at 25 °C | $V_{GS} = 10$ V | 0.220 |
| $Q_g$ max. (nC)                         | 71              |       |
| $Q_{gs}$ (nC)                           | 10              |       |
| $Q_{gd}$ (nC)                           | 21              |       |
| Configuration                           | Single          |       |

### FEATURES

- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low effective capacitance ( $C_{o(er)}$ )
- Reduced switching and conduction losses
- 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

- 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
  - Solar (PV inverters)

### ORDERING INFORMATION

|                                 |                  |
|---------------------------------|------------------|
| Package                         | TO-220AB         |
| Lead (Pb)-free and halogen-free | SIHP21N80AEF-GE3 |

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

| PARAMETER   | SYMBOL           | LIMIT          | UNIT           |
|---|------------------|----------------|----------------|
| Drain-source voltage                                      | $V_{DS}$         | 800            | 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>                         | $I_{DM}$         | 37             | W/°C           |
| Linear derating factor                                    |                  | 1.4            |                |
| Single pulse avalanche energy <sup>b</sup>                | $E_{AS}$         | 127            | 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                                | $dv/dt$          | $T_J = 125$ °C | V/ns           |
| Reverse diode $dv/dt$ <sup>d</sup>                        |                  |                |                |
| Soldering recommendations (peak temperature) <sup>c</sup> | For 10 s         | 260            | °C             |


#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DS} = 140$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 3.0$  A
- 1.6 mm from case
- $I_{SD} \leq I_D$ ,  $di/dt = 170$  A/ $\mu$ s, starting  $T_J = 25$  °C

**THERMAL RESISTANCE RATINGS**

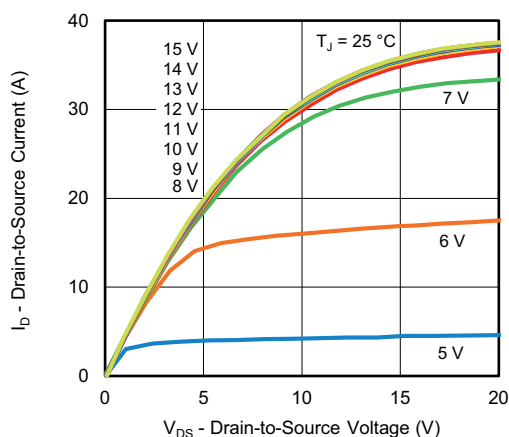
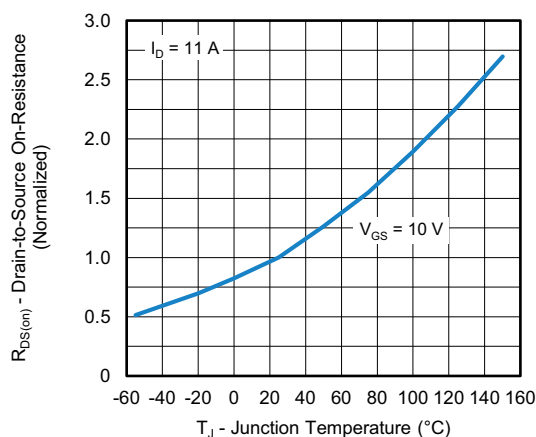
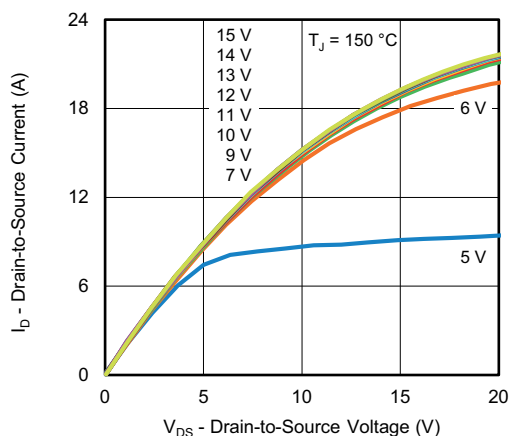
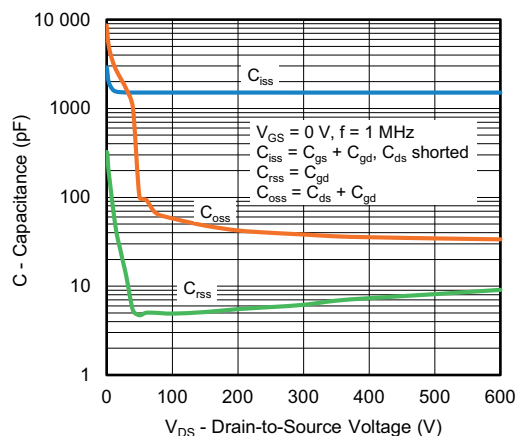
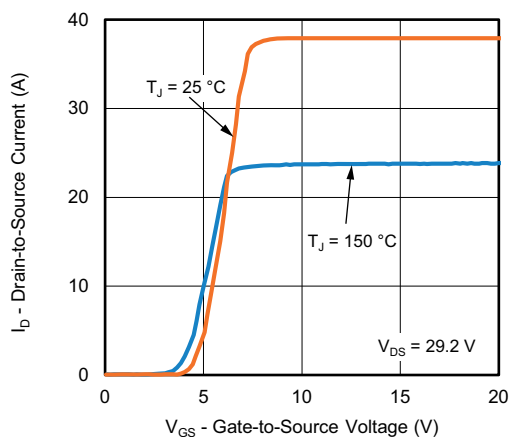
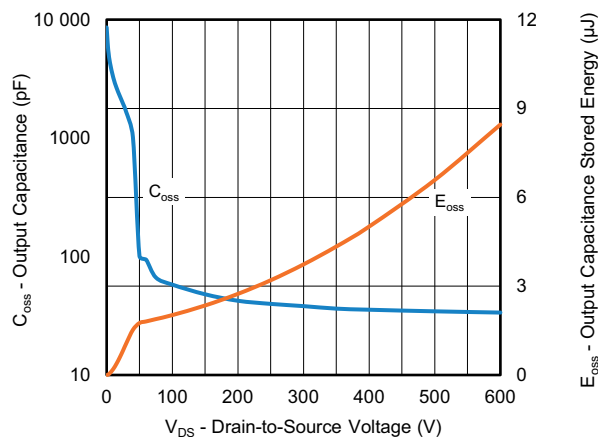
| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum junction-to-ambient      | $R_{thJA}$ | -    | 62   | °C/W |
| Maximum junction-to-case (drain) | $R_{thJC}$ | -    | 0.7  |      |

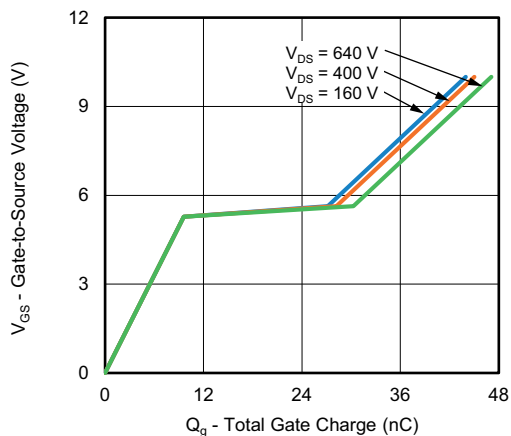
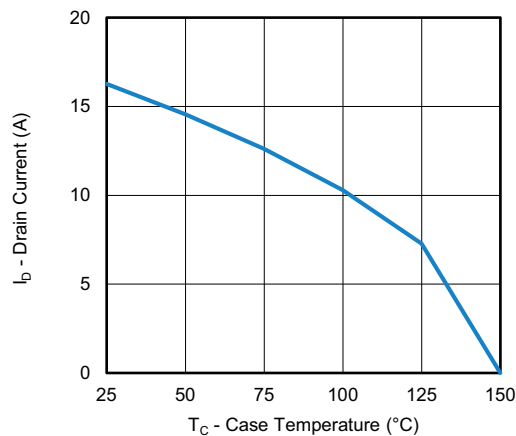
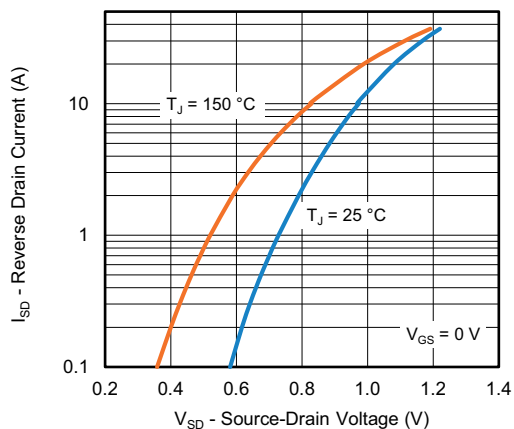
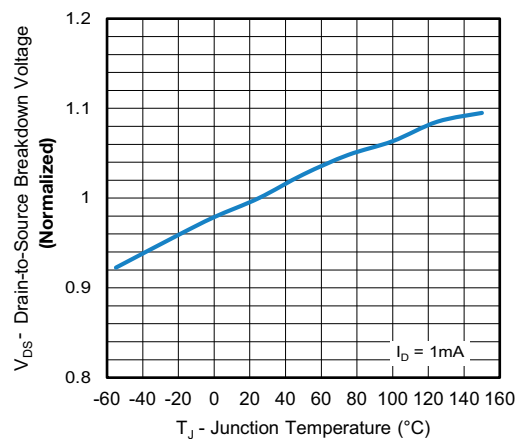
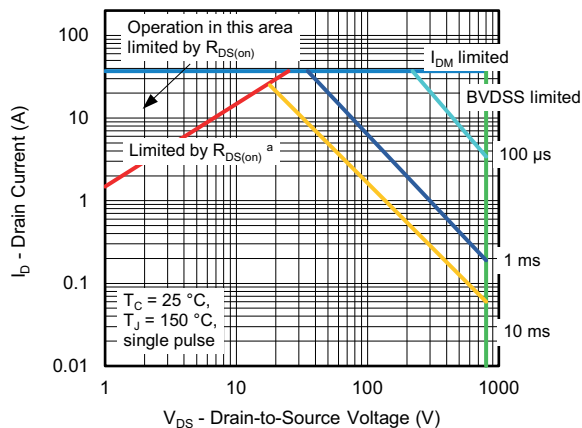
**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

| PARAMETER   | SYMBOL              | TEST CONDITIONS  |   | MIN. | TYP.  | MAX.      | UNIT                  |
|---|---------------------|--|---|------|-------|-----------|-----------------------|
| Static  |                     |  |   |      |       |           |                       |
| Drain-source breakdown voltage                            | $V_{DS}$            | $V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$   |   | 800  | -     | -         | V                     |
| $V_{DS}$ temperature coefficient                          | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^{\circ}\text{C}$ , $I_D = 1\text{ mA}$  |   | -    | 0.8   | -         | V/ $^{\circ}\text{C}$ |
| 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                           | $I_{DSS}$           | $V_{DS} = 640\text{ V}$ , $V_{GS} = 0\text{ V}$  |   | -    | -     | 1         | $\mu\text{A}$         |
|   |                     | $V_{DS} = 640\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^{\circ}\text{C}$  |   | -    | -     | 2         | mA                    |
| Drain-source on-state resistance                          | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$   | $I_D = 8.5\text{ A}$                          | -    | 0.220 | 0.250     | $\Omega$              |
| Forward transconductance <sup>a</sup>                     | $g_{fs}$            | $V_{DS} = 30\text{ V}$ , $I_D = 11\text{ A}$   |   | -    | 8.7   | -         | S                     |
| Dynamic   |                     |  |   |      |       |           |                       |
| Input capacitance   | $C_{iss}$           | $V_{GS} = 0\text{ V}$ ,<br>$V_{DS} = 100\text{ V}$ ,<br>$f = 1\text{ MHz}$   |   | -    | 1511  | -         | pF                    |
| Output capacitance  | $C_{oss}$           |  |   | -    | 58    | -         |                       |
| Reverse transfer capacitance                              | $C_{rss}$           |  |   | -    | 5     | -         |                       |
| Effective output capacitance, energy related <sup>a</sup> | $C_{o(er)}$         | $V_{DS} = 0\text{ V to } 480\text{ V}$ , $V_{GS} = 0\text{ V}$   |   | -    | 44    | -         | pF                    |
| Effective output capacitance, time related <sup>b</sup>   | $C_{o(tr)}$         |  |   | -    | 271   | -         |                       |
| Total gate charge   | $Q_g$               | $V_{GS} = 10\text{ V}$   | $I_D = 11\text{ A}$ , $V_{DS} = 640\text{ V}$ | -    | 47    | 71        | nC                    |
| Gate-source charge  | $Q_{gs}$            |  |   | -    | 10    | -         |                       |
| Gate-drain charge   | $Q_{gd}$            |  |   | -    | 21    | -         |                       |
| Turn-on delay time  | $t_{d(on)}$         | $V_{DD} = 640\text{ V}$ , $I_D = 11\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ , $R_g = 9.1\text{ }\Omega$  |   | -    | 18    | 36        | ns                    |
| Rise time   | $t_r$               |  |   | -    | 28    | 56        |                       |
| Turn-off delay time                                       | $t_{d(off)}$        |  |   | -    | 44    | 88        |                       |
| Fall time   | $t_f$               |  |   | -    | 43    | 86        |                       |
| Gate input resistance                                     | $R_g$               | $f = 1\text{ MHz}$ , open drain  |   | 0.2  | 0.5   | 1.0       | $\Omega$              |
| Drain-Source Body Diode Characteristics                   |                     |  |   |      |       |           |                       |
| Continuous source-drain diode current                     | $I_S$               | MOSFET symbol showing the integral reverse p - n junction diode<br> |   | -    | -     | 16.3      | A                     |
| Pulsed diode forward current                              | $I_{SM}$            |  |   | -    | -     | 37        |                       |
| Diode forward voltage                                     | $V_{SD}$            | $T_J = 25\text{ }^{\circ}\text{C}$ , $I_S = 11\text{ A}$ , $V_{GS} = 0\text{ V}$   |   | -    | -     | 1.2       | V                     |
| Reverse recovery time                                     | $t_{rr}$            | $T_J = 25\text{ }^{\circ}\text{C}$ , $I_F = I_S = 11\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 400\text{ V}$                            |   | -    | 128   | 256       | ns                    |
| Reverse recovery charge                                   | $Q_{rr}$            |  |   | -    | 0.8   | 1.6       | $\mu\text{C}$         |
| Reverse recovery current                                  | $I_{RRM}$           |  |   | -    | 12    | -         | A                     |

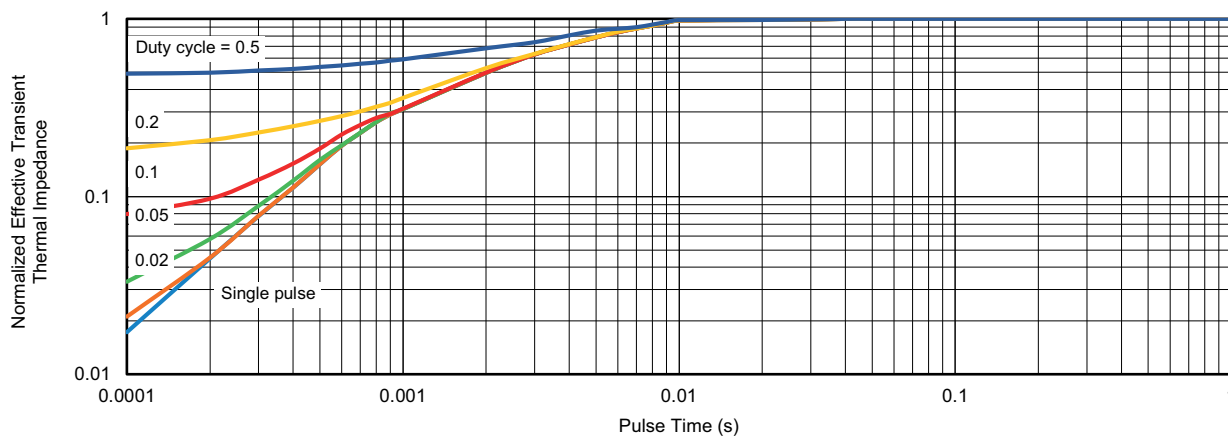
**Notes**

- e.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 V to 480 V  
f.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 V to 480 V

**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**
**Note**

a.  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

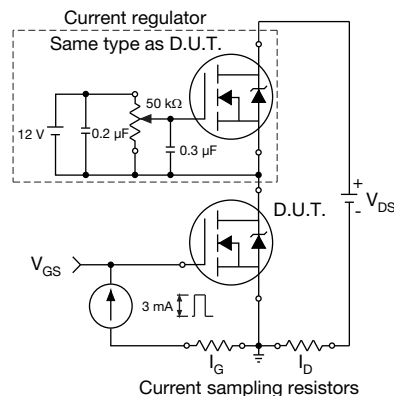

**Fig. 12 - Normalized Transient Thermal Impedance, Junction-to-Case**

**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**


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



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